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IMPACT ASSESSMENT REPORT

Accompanying the documents

Proposal for a

**DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
amending Directive 2003/87/EC and Decision (EU) 2015/1814 as regards driving
competitiveness and cost-effective decarbonisation**

**REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
amending Directive 2003/87/EC as regards revised benchmark values for the heat and
fuel benchmarks for the period from 2026 to 2030**

**REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
amending Regulations (EU) 2015/757 and (EU) 2023/1805 to simplify and streamline
monitoring, reporting and verification and to align with revisions of the EU Emissions
Trading System**

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GLOSSARY

Term or acronym	Meaning or definition
BECCS	Bioenergy with carbon capture and storage
CCfD	Carbon contract for difference
CCS	Carbon Capture and Storage: a set of technologies aimed at capturing, transporting, and permanently storing CO ₂
CCUS	Carbon capture, utilisation, and storage
CBAM	Carbon Border Adjustment Mechanism
CDR	Carbon Dioxide Removal
CHP	Combined Heat and Power: a combined heat and power unit is an installation producing both electrical energy and heat
CO ₂ -eq	Carbon dioxide-equivalent: a measure used to compare quantities of different greenhouse gases in a common unit based on their global warming potential over a given period
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
CRCF	Carbon Removals and Carbon Farming framework, established under Regulation (EU/2024/3012)
CSCF	Cross-sectoral correction factor: a factor by which free allocation of emission allowances is reduced uniformly across all industry sectors, if the demand for free allocation exceeds the total amount of available free allowances
DACCS	Direct Air Capture with Carbon Storage
E-fuels	Liquid fuels produced based on hydrogen obtained from electricity via electrolysis.

EEA	European Economic Area
EIB	European Investment Bank
ESR	Effort Sharing Regulation
EU ETS	European Union Emissions Trading System covering stationary installations, aviation, and maritime transport
ETS2	Emissions Trading System covering Buildings, Road Transport and Additional Sectors in accordance with Chapter IVa of the ETS Directive
EUA	European Union Allowance: the tradable unit under the EU ETS, giving the holder the right to emit one tonne of CO ₂ -eq
GDP	Gross Domestic Product
GEM-E3	General Equilibrium Model for Energy-Economy-Environment interactions
GHG	Greenhouse gas
GT	Gross Tonnage
HWI	Hazardous waste incineration
ICC	Indirect carbon cost
IDB	Industrial Decarbonisation Bank
IF	Innovation Fund
IMO	International Maritime Organization
JRC	Joint Research Centre of the European Commission
LDC	Least developed countries

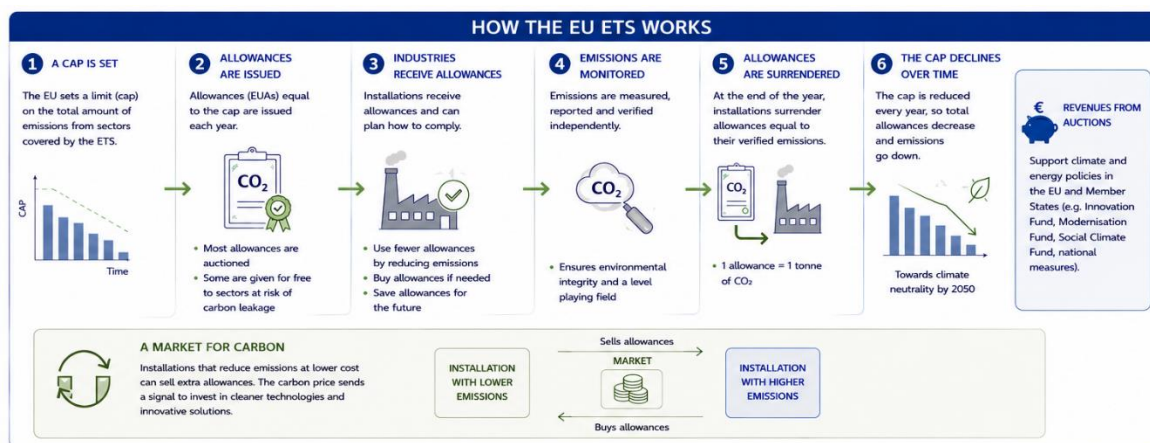
LRF	Linear Reduction Factor: a factor by which the ETS cap is reduced yearly
MF	Modernisation Fund
MSR	Market Stability Reserve
MtCO ₂	Million tonnes of CO ₂
MW	Megawatt
MWI	Municipal waste incineration
NECP	National Energy and Climate Plan
NIMs	National implementation measures under Article 11 ETS Directive
OPC	Open Public Consultation
PRIMES	Price-Induced Market Equilibrium System model
PRIMES-TREMOVE	Integrated transport component of PRIMES model
SAF	Sustainable Aviation Fuel
SME	Small and medium-sized enterprise
SIDS	Small island developing states
SWD	Staff working document
TNAC	Total number of allowances in circulation
UNFCCC	United Nations Framework Convention on Climate Change

1. INTRODUCTION: POLITICAL AND LEGAL CONTEXT

The European Commission 2025 Foresight¹ report points out that climate change is a risk multiplier that should be addressed, and that the green transition for many countries can result in more independence and growth. Particularly for Europe, a successful transition to sustainable growth provides the opportunity to simultaneously enhance the Union's strategic autonomy. In the same vein, the Draghi Report² points out that *“if Europe's ambitious climate targets are matched by a coherent plan to achieve them, decarbonisation will be an opportunity for Europe. But if we fail to coordinate our policies, there is a risk that decarbonisation could run contrary to competitiveness and growth.”*

The EU Emissions Trading System (EU ETS) is the cornerstone of EU climate policy. Directive 2003/87/EC (the 'ETS Directive') lays down the rules for greenhouse gas emission allowance trading within the European Union. The Market Stability Reserve (MSR) for the EU Emissions Trading System (EU ETS) was established by Decision (EU) 2015/1814 (the 'MSR Decision').

Figure 1: How the EU ETS works



Regulation (EU) 2021/1119 of the European Parliament and of the Council ('the European Climate Law')³ sets a legally binding economy-wide target of net zero greenhouse gas emissions at the latest by 2050, and an intermediate target of reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels. The 'Fit for 55' package of legislation under the European Green Deal makes all sectors of the EU's economy fit to meet

¹ European Commission, *Foresight Report 2025: Resilience 2.0: Empowering the EU to thrive amid turbulence and uncertainty*, 2025, Publications Office of the European Union, https://commission.europa.eu/strategy-and-policy/strategic-foresight/2025-strategic-foresight-report_en.

² European Commission, *The Future of European Competitiveness: Part A: A competitiveness strategy for Europe*, 2024, https://commission.europa.eu/document/download/97e481fd-2dc3-412d-be4c-f152a8232961_en?filename=The%20future%20of%20European%20competitiveness%20_%20A%20comp%20etitiveness%20strategy%20for%20Europe.pdf.

³ Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law') (OJ L 243, 9.7.2021, p. 1).

this target. The ETS Directive and the MSR Decision were revised by Directive (EU) 2023/958 and (EU) 2023/959⁴ and amended in 2023 as part of that package.

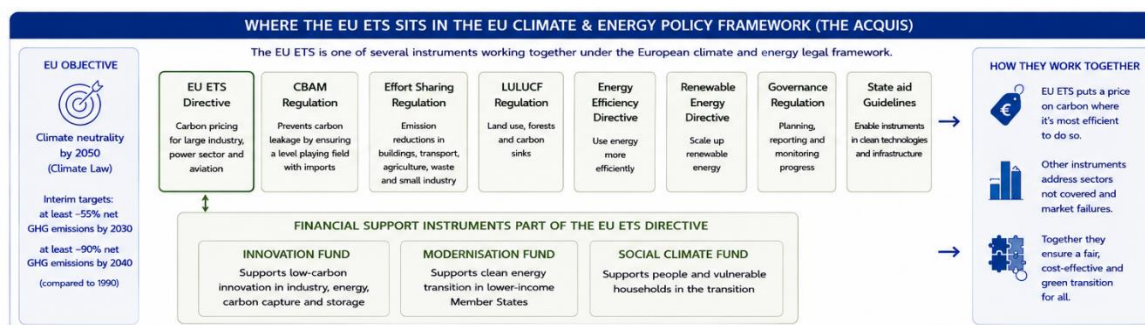
Most changes introduced by these amendments took effect from January 2024 or take effect from 2026. However, some have applied since the entry into force of Directive (EU) 2023/959 in June 2023.

The ETS Directive sets an emission reduction target of 62% for stationary installations, aviation and maritime (EU ETS) by 2030 compared to 2005. Stability and full implementation of the legislative framework in place for meeting the 2030 climate and energy targets is a precondition for the EU to stay on course to reach climate neutrality in 2050.

The evaluation of the EU ETS (see Annex 15) concludes that the EU ETS continues to be well aligned to the broader EU climate policies.

The ETS covered sectors delivered more economically efficient emissions reductions compared to non-ETS sectors. The EU ETS has effectively met its objectives, achieving over 50% emissions reductions by 2025, compared to the 43% target initially set in 2018 to be achieved by 2030, prior to the amendment in 2023. The EU ETS remains not only relevant for the future, but the key policy instrument to achieve the EU's climate goals for the next decade. The evaluation and recent report by the European Securities and Markets Authority (ESMA)⁵ showed that the ETS functions in line with market trends and underlying fundamentals and ESMA did not identify any issue in the integrity or transparency of EU carbon markets.

Figure 2: EU ETS in the context of the EU's climate and energy policy framework



The EU has adopted a legally binding climate target of 90% reduction in net greenhouse gas (GHG) emissions for 2040. The 2040 climate target takes full account of the current economic, security and geopolitical landscape in alignment with the EU Competitiveness Compass⁶,

⁴ Directive (EU) 2023/958 of the European Parliament and of the Council of 10 May 2023 amending Directive 2003/87/EC as regards aviation's contribution to the Union's economy-wide emission reduction target and the appropriate implementation of a global market-based measure (OJ L 130, 16.5.2023) and Directive (EU) 2023/959 of the European Parliament and of the Council of 10 May 2023 amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union and Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading system (OJ L 130, 16.5.2023).

⁵ European Securities and Markets Authority, *ESMA Market Report: EU carbon markets 2025*, 2025, https://www.esma.europa.eu/sites/default/files/2025-10/ESMA50-481369926-30552_Carbon_Markets_Report_2025.pdf.

⁶ Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions: A Competitiveness Compass for the EU, COM(2025) 30 final, 29.1.2025, <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52025DC0030>.

Clean Industrial Deal⁷, and Affordable Energy Action Plan⁸. It provides the necessary predictability and stability for investments in the EU's clean energy transition and for driving industrial competitiveness.

The initiative seeks to ensure achievement of the climate targets in the European Climate Law. Therefore, this impact assessment includes the Commission's assessment of the consistency of the initiative with the European Climate Law's objectives, as required by Article 6(4) of the European Climate Law.

The 2040 target includes a possibility to use a limited quantity of high-quality international credits to make an 'adequate contribution' towards the 2040 target, starting in 2036. This amount can be up to 5% of 1990 EU net GHG emissions, corresponding to a domestic reduction of net GHG emissions of at least by 85% compared to 1990 levels by 2040. A pilot period in 2031-2035 may be considered.

International credits should be integrated to the future climate legislation in a way which ensures reaching the climate target cost-efficiently using high-quality and integrity credits. High credit integrity must be ensured taking the rules developed under Article 6.4 of the Paris Agreement as a baseline. The specific role and deployment of international credits will be based on a thorough impact assessment and subject to the development of Union law setting robust and high integrity criteria and other safeguards.

Nevertheless, this impact assessment concludes that a direct integration of international credits in the ETS is not appropriate. The EU has had experience of direct integration of Certified Emission Reductions (CERs) from the Clean Development Mechanism (CDM) into the EU ETS and discontinued this approach due to negative impacts on the effectiveness and integrity of the EU ETS. Repeating these results should be avoided. By contrast, adjusting the ETS cap equivalent to the amount of international credits that would be centrally purchased from mitigation outside of the EU under strict criteria and oversight, is a simpler, straightforward approach that aligns with the fundamental principles of the system, ensuring a clearly defined cap and environmental integrity, while still granting additional emission space to the EU ETS. Revenues associated with the additional allowances that can be auctioned could be earmarked to finance the international credits that justify the additional emissions space in the EU ETS.

This impact assessment therefore uses (modelled) scenarios aiming at an economy-wide reduction of net greenhouse gas emissions by 85% in 2040 as indicative of the domestic impacts of the Climate Law, in particular on EU ETS sectors. It could be decided later that less than 5% of international credits are used, which would enable more investment in domestic action. Consequently, the domestic reduction of net GHG emissions could be higher than 85%. However, this target was chosen as the basis for the impact assessment to consider the maximum potential use of the international credit flexibility allowed in the European Climate Law. The costs and full impacts of purchases of international credits are not included in this impact assessment. Allowing direct use of international credits for operators for their ETS

⁷ Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions: The Clean Industrial Deal: A Joint Roadmap for Competitiveness and Decarbonisation, COM(2025) 85 final, 26.2.2025, <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52025DC0085>.

⁸ Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions: Action Plan for Affordable Energy: Unlocking the True Value of Our Energy Union to Secure Affordable, Efficient and Clean Energy for All Europeans, COM(2025) 79 final, 26.2.2025, <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52025DC0079>.

compliance obligations as means to create additional emissions space is an option which cannot be implemented simultaneously with the adjustment of the ETS cap to the EU-wide 85% domestic ambition target.

The 2023 review under the Fit for 55 package introduced several review clauses relating to the EU ETS, under Article 3gg, Article 28b and Article 30 to assess potential adjustments to the system on aviation, maritime and stationary installations in 2026. In addition, Article 3 of the MSR Decision sets a legal obligation for a review of this instrument, with the next review due in 2026.

Following the ‘evaluate first’ principle, the ETS Directive and the MSR Decision should be evaluated before undergoing revision. A new emissions trading system covering CO₂ emissions from fuel combustion in buildings, road transport and small industry (ETS2) was created in the 2023 revision of the ETS Directive. As the ETS2 becomes fully operational in 2028, it is excluded from the scope of this impact assessment. Furthermore, the application of the ETS2 is due to be reviewed by 2028 and any assessment of the feasibility of integrating the sectors under ETS2 into the EU ETS is subject to a review clause due in 2031, as set out in Article 30i of Directive 2003/87/EC.

Based on the Climate Law and the Paris Agreement, all sectors of the economy must contribute to reducing emissions, including all the sectors covered by the EU ETS. This contribution risks being hampered by potential residual emissions from sectors where there is currently a lack of business case for decarbonisation technologies, notably in the energy intensive industries (EIIs) where many processes are ‘hard-to-abate’⁹; from sectors with low incentives to shift to clean solutions due to incomplete internalisation of the climate cost; and from sectors where alternative low-carbon technologies remain constrained.

Aviation accounts for 2-3% of global CO₂ emissions¹⁰ and is a source of non-CO₂ climate impacts at least as significant as those of CO₂. Aviation’s share of EU transport emissions today is 13.9%, or around 4% of the EU’s total CO₂ emissions. By 2050, aviation’s share is expected to grow to around 90%¹¹. Long-haul flights fuel this growth. Globally, the International Civil Aviation Organization (ICAO) projects that international aviation emissions will continue to grow, although Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) aims to offset most of that growth¹². Aviation, like shipping, has important decarbonisation

⁹ European Commission, *The Future of European Competitiveness: Part B: In-depth analysis and recommendations*, 2024, https://commission.europa.eu/document/download/97e481fd-2dc3-412d-be4c-f152a8232961_en?filename=The%20future%20of%20European%20competitiveness%20%20A%20competitive%20strategy%20for%20Europe.pdf.

¹⁰ European Union Aviation Safety Agency, *European Aviation Environmental Report 2025*, 2025, <https://www.easa.europa.eu/en/domains/environment/eaer/downloads#download-2025>.

¹¹ Source: Figure 76, Direct CO₂ emissions from the EU transport sector by mode, Annex 8, and Section 1.5.5, page 97, in: European Commission, Commission Staff Working Document: Impact Assessment Report: Part 3: Accompanying the document: Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Securing our future: Europe’s 2040 climate target and path to climate neutrality by 2050 building a sustainable, just and prosperous society, SWD(2024) 63 final, 6.2.2024, https://eur-lex.europa.eu/resource.html?uri=cellar:6c154426-c5a6-11ee-95d9-01aa75ed71a1.0001.02/DOC_3&format=PDF.

¹² ICAO notes that due to partial participation in CORSIA, international aviation emissions will continue to grow above the CORSIA baseline level (~500 MtCO₂ per year). Source: ICAO, *A42-WP/28 Report – Technical Assessments in Support of the 2025 CORSIA Periodic Review*, 2025, https://www.icao.int/sites/default/files/Meetings/a42/Documents/WP/wp_028_en.pdf.

challenges as a hard-to-abate sector, marked by long asset lifetimes, significant capital intensity, and a current scarcity of immediate alternatives to fossil fuels.

Maritime transport represents around 14% of the total EU transport emissions, or around 4% of the EU's total CO₂ emissions. Its green transition will require the mobilisation of the whole EU maritime value chain and will require substantial investment in enhancing vessel efficiency, developing new sustainable propulsion technologies, and scaling up the production and distribution of sustainable renewable and low-carbon fuels, including the upgrade of port and energy infrastructures.

For aviation and maritime, complementary policies such as FuelEU Maritime and ReFuelEU Aviation work in synergy with the ETS's multiple incentives supporting the uptake of more sustainable fuels¹³.

Over the coming decade and to achieve climate neutrality by 2050, industry has to go through a significant transformation to decarbonise and switch to cleaner and more energy efficient technologies, such as electrification, the use hydrogen from renewable sources, or deploying CCUS, as well as generating carbon removals. At the same time, it needs to remain competitive in a global market and ensure quality jobs consistent with the objectives of the Clean Industrial Deal. This transformation requires stepping up investments substantially. Scenario S2 in the 2040 Climate Target Impact Assessment, reaching -88% GHG reductions by 2040 compared to 1990, estimates the investment needs to transform the iron and steel sector at around EUR 80 billion between 2031 and 2040; at around EUR 330 billion for the five largest EIIs together (chemicals, basic metals, non-metallic minerals, and pulp and paper industry) for the same period¹⁴.

The carbon price signal, together with the phase-in of the Carbon Border Adjustment Mechanism (CBAM) already provides an incentive for industrial decarbonisation, while protecting against carbon leakage. In addition, carbon pricing works hand in hand with regulatory measures such as targets and requirements on energy efficiency, renewable energy or decarbonised mobility and industry. In many sectors (e.g. steel, cement or chemicals), however, the price signal (together with regulatory framework) has not been strong enough to drive the transformational change and in the near future, investments will still be lacking a business case at prevailing and anticipated carbon prices and as the regulatory measures still need time to be fully implemented. This is why the Clean Industrial Deal Communication announced the Industrial Decarbonisation Bank (IDB) to address the scale-up and roll-out of more mature industrial decarbonisation projects, notably in EIIs across all Member States to be funded mostly by a dedicated part of ETS revenues¹⁵. With the IDB focussing on scale-up

¹³ For aviation, ReFuelEU aviation sets targets for fuel producers to supply an increasing share of sustainable aviation fuels, starting with 2% of certain biofuels in 2025, 6% in 2030 (of which 0.7% synthetic fuels). For the maritime sector, FuelEU Maritime sets maximum limits for the yearly average greenhouse gas (GHG) intensity of the energy used by ships above 5 000 gross tonnage calling at European ports, regardless of their flag.

¹⁴ European Commission, Commission Staff Working Document: Impact Assessment Report, Europe's 2040 climate target and path to climate neutrality by 2050 building a sustainable, just and prosperous society, Part 3, pp.164-167, https://eur-lex.europa.eu/resource.html?uri=cellar:6c154426-c5a6-11ee-95d9-01aa75ed71a1.0001.02/DOC_3&format=PDF.

¹⁵ The IDB will be placed within the governance of the future European Competitiveness Fund to ensure that both funding instruments are complementary. European Competitiveness Fund will also support decarbonisation of the EIIs. Considering the high investment needs of these sectors both instruments are

and roll-out, there is also need for continuation of the Innovation Fund (also funded by ETS resources) to continue supporting innovative and first of a kind technology that can address the sectors that currently do not yet have technically viable decarbonisation solutions. Importantly, the rollout of decarbonisation technologies in EIIIs will lead to a significant increase in electricity demand so expansion of the power generation capacities will be needed.

The EU ETS thus supports the objectives of the Clean Industrial Deal by providing a clear and predictable carbon price, incentivising investment in decarbonisation solutions and funding the investments which still lack the business case or where decarbonisation solutions have yet to be demonstrated, while continuing to provide carbon-leakage protection and financial support from the auction revenues with more than EUR 260 billion generated since the start of the system. In the same way, the ETS will complement other initiatives in support of the Clean Industrial Deal objectives. Examples include: action to speed up permitting for industrial decarbonisation investments, build lead markets for European clean technologies and industrial products through the Industrial Accelerator Act; action to lower industrial energy costs through the Affordable Energy Action Plan, including the European Grids Package that will accelerate electrification and integration of cheaper renewables by enabling energy to flow efficiently across all Member States; and action to stimulate supply and demand for secondary raw materials, most notably through the Circular Economy Act.

GHG emissions from waste treatment are not subject to carbon pricing in most Member States. Waste accounts for about 3% of the EU's total greenhouse gas (GHG) emissions – excluding waste incineration with energy recovery (waste-to-energy), which is estimated to account for a further 2-3% of the EU's GHG emissions. In addition to losing valuable resources, waste can have significant negative impacts on human health and the environment. For example, incinerating waste can contribute to air pollution, while landfills might contaminate water and land. Waste sector emissions could decrease further once all current EU waste policies are fully implemented. However, new policy instruments, including the sector's inclusion in the ETS, could support GHG emissions reductions from the sector.

In addition, the EU ETS's contribution to the necessary emissions reductions may be hampered by market inefficiencies resulting from a decreasing market size, which is intrinsic to the system design. The MSR rules under the ETS aim to tackle structural supply-demand imbalances between the available allowances to emit CO₂ and the emissions of the compliance entities covered. The impact assessment therefore analyses whether the rules governing the operation of the MSR remain appropriate in the context of a declining supply of allowances. And more precisely, this involves: (i) ensuring that the market remains efficient and creates an incentive to invest in decarbonisation in the global context; and (ii) addressing specific challenges faced by covered sectors to facilitate the uptake of available solutions. This assessment is carried out in consideration of other legislative acts that facilitate the clean transition and the competitiveness of EU industry. The impact assessment also examines how to optimise the use of ETS revenues in support of decarbonisation investments.

In consequence, the impact assessment explores a broad variety of options compared to the baseline (in general terms, the continuation of the current EU ETS framework) for the following aspects. These aspects were selected because they correspond to the topics established in the review clauses introduced with the Fit for 55 package (Article 3gg, Article

needed but should be designed as complementary in the support of technologies development, types of instruments offered and role in the project's investment journey. This will be also facilitated by the common governance framework.

28b and Article 30 of the ETS Directive) and the regular review of the MSR Decision (Article 3), and more broadly because they need to be reviewed to ensure that the EU ETS continues to contribute in the most cost-effective and economically efficient manner to the overall goal of reaching economy-wide carbon neutrality by 2050 and to the 2040 target, taking into account the broader policy framework and the need for all sectors to contribute to the EU climate efforts, while growing our economy and preserving competitiveness:

- **Carbon removals:** this covers the possible inclusion of domestic permanent carbon removals in the EU ETS. More specifically, it looks at (i) how the EU ETS could account for negative emissions resulting from GHGs that are removed from the atmosphere and safely and permanently stored (such as biogenic emissions with carbon capture and storage or direct air capture with carbon storage); (ii) how those negative emissions, if appropriate, could be covered by ‘emissions trading’, setting a clear scope and strict criteria; (iii) putting in place of safeguards to ensure that such removals do not deter necessary emissions reductions.
- **Market Stability Reserve:** the review considers the parameters of the reserve (intake and release rates, thresholds, and their potential alignment with a declining market) and analyses if the MSR is adequately designed for the ETS of the next decade, which will be characterized by a shrinking market.
- **Industrial Decarbonisation Bank:** the Clean Industrial Deal announced the Industrial Decarbonisation Bank, aiming for the budget of EUR 100 billion drawing on the ETS auction revenues and the revision of InvestEU so that a sizable impact can be made on the industrial decarbonisation in the EU. The policy options assessed concern: possible ways to allocate the support by the Bank; different forms that the support could take and measures to ensure the geographical balance in allocating the support. The IDB will operate alongside the Innovation Fund (IF) and the European Competitiveness Fund (ECF). This assessment also considers the role the IDB can play in addressing residual risks of carbon leakage for CBAM sectors. For the IF, the Fund’s evaluation recommends the continuation of the programme with improvements, notably in terms of simplification without, however fundamental change to its operation and objectives (i.e. support for innovative, First-of-a-Kind projects).
- **Modernisation Fund:** the evaluation indicates that it is succeeding in supporting relevant investments to decarbonise the energy systems of Member States with high needs and low-income. The distinction between priority area and non-priority area and the rules attached to each category have proved effective to foster those investments most closely aligned with EU climate and energy targets, while allowing room for some investments in transitional technologies. The impact assessment considers the possibility to increase the scope of priority investment to more decarbonation technologies; to discontinue financing investments related to fossil fuels and waste-to-energy, the respective shares of priority/non-priority investments and the governance related to the confirmation of priority investments.
- **Aviation emissions:** While legally the ETS covers emissions from January 2027 from flights landing in (unless exempted) and departing from the European Economic Area (EEA), the EU has temporarily limited the scope to intra-EEA flights and departing flights to the UK and Switzerland. This is to encourage the development of an effective global carbon pricing scheme by ICAO. This impact assessment examines CORSIA in line with the ETS Directive assessment criteria and indications on geographical scope.

- **Maritime emissions¹⁶:** the impact assessment examines the possibility of a dedicated EU mechanism to directly support shipping companies with ETS allowances in their efforts to use sustainable fuels and clean propulsion technologies. Furthermore, it considers legislative improvements to ensure the effective implementation of ETS application to maritime transport, notably in relation to the possible risk of evasion/circumvention. It also examines opportunities for simplification and other measures to enhance the robustness and effectiveness of the system's implementation, including in terms of alignment with other EU legislation and the need for derogations to maintain territorial continuity and connectivity. The impact assessment further examines design options to ensure coherence between the EU ETS and any global measure at the International Maritime Organization (IMO) implementing the 2023 IMO GHG Strategy, notably in order to avoid double payment of the same emissions. It also examines the feasibility and possible impacts of including emissions from small ships (i.e. below 5 000 gross tonnage but not below 400 gross tonnage).
- **Risk of carbon leakage:** this involves the assessment of measures that aim to protect industrial installations exposed to a risk of transfer of production or investments to other countries with laxer emission constraints as a result of having to pay for their greenhouse gas emissions (directly or indirectly), while ensuring the necessary incentives for emissions reductions. Carbon leakage can occur due to the cost of both direct emissions (ETS costs paid by installations) and indirect emissions (carbon costs in the power sector that are passed onto electro-intensive industries). The impact assessment will consider primarily carbon leakage protection options for emissions not covered by CBAM. For CBAM sectors CBAM's full but gradual implementation from 2026 and the corresponding gradual phase-out of free allocation to CBAM sectors provide for a change of mechanism to address carbon leakage risks. Nevertheless, this assessment will also consider the impacts of a slowdown of the phase-out of free allocation for CBAM sectors, addressing residual risks of carbon leakage. For indirect emissions, the impact assessment will consider how to address carbon leakage risk post-2030, in particular whether to continue to encourage Member States to provide indirect carbon cost compensation (ICC) through State aid, and/or whether to harmonise the provision of compensation through an EU instrument.
- **Thermal input thresholds:** this examines the feasibility of lowering the 20 MW total rated thermal input thresholds for the activities listed in Annex I from 2031 onwards (minimum threshold for inclusion in the ETS for several activities), considering ETS2.
- **Municipal waste incineration:** this considers the feasibility of including emissions from municipal waste incineration in the EU ETS from 2028 (with possible opt-outs until 2030). The Commission must also assess the possibility of including in the EU ETS other waste management processes, in particular landfilling, which creates significant methane and nitrous oxide emissions. The analysis on the possible scope expansion of the EU ETS to waste management processes must take into account the alignment with the waste hierarchy.
- **Non-permanent carbon capture and use (CCU):** the impact assessment examines whether, in view of providing incentives for emission reductions, all GHG emissions covered by the ETS are effectively accounted for and whether double counting is

¹⁶ Further detail in the Ricardo/WSP (forthcoming), *Support for the 2026 review of the ETS maritime study*

avoided, in particular regarding emissions considered to have been captured and utilised in a product that does not permanently chemically bind CO₂.

- **Linking with other carbon markets:** a standalone annex considers how effective links can be established between the revised EU ETS and other carbon market to realise the benefits of a reduced cost of emission abatement, an increased market liquidity, an effective mitigation of the risk of carbon leakage, without impeding achievement of the climate-neutrality objective and EU climate targets.

Overall, the impact assessment assesses the consistency with other EU legislative acts and possible simplification options, including evaluation of the administrative costs linked to ETS implementation and the risk of additional burden resulting from monitoring and reporting obligations. Impacts on third countries are catered for in current policies, such as the CBAM application based on effective EU ETS price, or assessed as part of separate dedicated processes, such as linking or EU enlargement frameworks.

2. PROBLEM DEFINITION

2.1. What are the problems?

Problem 1: Risk of not contributing cost-effectively (i) to the EU emissions reduction target in line with climate neutrality and the 2040 target, and (ii) to addressing the EU ETS's fair share of international emissions

The overarching objective of the EU ETS is to contribute to reduce GHG emissions cost-effectively through-out the EU economy, including its fair share of international emissions, in a way that is in line with the climate neutrality objective by 2050 and the intermediate 2040 climate target. However, there is a risk that the EU ETS is not contributing to these emissions reductions cost-effectively for several reasons:

- The current legislative framework was designed in view of the 2030 climate target, so the EU ETS cap trajectory is not aligned with the overall climate policy framework that ensures a balanced and cost-effective contribution of all sectors to greenhouse gas emission reductions and carbon removals towards the 2040 target.
- As the cap is reduced towards climate neutrality, the carbon price is expected to rise. In a market which functions perfectly otherwise, this expectation would be sufficient to guarantee long term investment. However, there are other market failures, such as insufficient incentive for investing in R&D&I as a public good, or the more myopic perspective of investors. Therefore, other risks remain:
 - Insufficient long-term investments will be made to decarbonise certain sectors, among other things, due to lack of sufficiently strong carbon price signal as perceived by investors. This risk is confirmed by the findings of the evaluation (see Annex 15). While the EU ETS has delivered significant emissions reductions in the power sector, the relatively low carbon prices, and high share of free allocation to industry reduced the incentives to invest in decarbonisation technologies.
 - Lack of funding mechanisms of sufficient duration and magnitude to support the business case for industrial decarbonisations and thus investments¹⁷. In this case, ETS risks leading to GHG emissions reductions mainly through a decrease

¹⁷ In scenarios for reaching the 2040 climate target, investment needs are estimated at approximately EUR 30-50 billion annually between 2031 and 2040 for industry (around EUR 25-40 billion for energy-intensive industries).

in production levels rather than by a decrease in carbon emissions intensity of industrial activities.

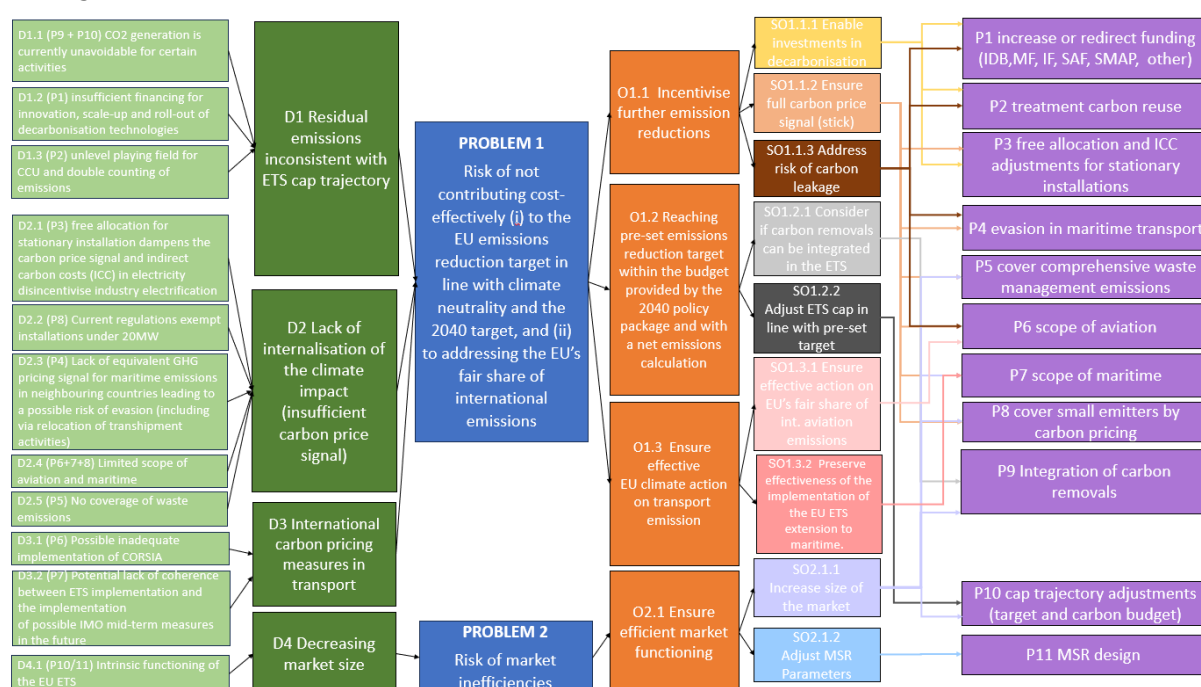
These issues are particularly acute for climate solutions which are not yet¹⁸ market ready, or which require infrastructure to be built, such as carbon or hydrogen transport networks.

- The EU ETS risks not contributing cost-effectively to the reduction of the EU's fair share of international emissions, if there is a lack of implementation of or coherence between the ETS and global measures, for example in case transport is subject to double carbon pricing.

Problem 2: Risk of market inefficiencies

The EU ETS is designed as a cap-and-trade system, with the cap limiting the total amount of GHG that can be emitted by installations and operators covered under the scope of the system. As the price of allowances is determined by the market at the intersection of demand and a pre-determined supply, the European carbon market can be exposed to a certain risk of market inefficiencies (e.g. trading frictions, price volatility) as it becomes smaller.

Figure 3: Problem tree



2.2. What are the problem drivers?

Associated with Problem 1:

- **D1: Residual emissions inconsistent with EU ETS cap trajectory.** The climate neutrality objective is at the heart of the European Green Deal, and is a legally binding objective set out in the European Climate Law (ECL). The 2040 climate target is the EU's intermediate step after 2030 on the path to climate neutrality. In December 2025,

¹⁸ For the bulk of technologies needed to reach the 2040 targets, the Technology Readiness Level already amounts to at least 8 (out of 9), meaning that they are in an advanced deployment stage. Examples include capture in cement production (TRL 9), low temperature industrial heat pump at TRL 9, while medium and high temperature industrial heat pumps are at lower TRL levels, as is some hydrogen-based direct iron ore reduction to produce steel (TRL 6-8).

the European Parliament and the Council reached agreement on amending the European Climate Law, introducing a binding intermediate climate target for 2040 of a 90% reduction in net greenhouse gas (GHG) emissions compared to 1990 levels. The agreement also sets out certain areas of flexibility to support the achievement of the 2040 target including on the contribution of high-quality international carbon credits to the target. However, there will still be residual emissions in industry, aviation and maritime that need to be abated in order to align to the carbon budget and target that are given by the cap trajectory.

The following sub-drivers have been identified:

- D1.1 (P9+10) CO₂ generation is currently unavoidable for certain activities, which needs to be recognised in the cap setting and/or role of removals.
- D1.2 (P1) Insufficient financing for innovation, scale-up and roll-out of decarbonisation technologies and clean fuels to address the lack of business case and high investment needs in carbon-intensive, in particular in low-income Member States.
- D1.3 (P2) Unlevel playing field for CCU and double counting of emissions.
- **D2: Lack of internalisation of the climate impact (insufficient carbon price signal).**
The reason for setting a cap and letting the market put a price on carbon emissions is to trigger a behavioural and investment change that should result in reduced emissions in line with the climate change mitigation pathway. The price signal of the EU ETS adds to the cost of activities that generate greenhouse gases, 'internalising' the harmful effect on the environment, known as 'negative externalities', in accordance with the 'polluter pays' principle. When the EU ETS does not cover certain activities, it does not play a role in the internalisation of their carbon cost. As a result, they may lack the incentive to reduce their emissions, unless other regulatory measures achieve the reductions fully (e.g. targets or prohibitions). Lack of internalisation of carbon cost concerns for instance the emissions of small ships. It is estimated that all categories of small ships (below 5000 gross tonnage, but not below 400 gross tonnage) could add a total of 14.6 MtCO₂ in the ETS scope. Similarly, measures to address carbon leakage (assigning allowances free of charge and allowing compensation for indirect emission costs) can also dampen the carbon price signal and reduce incentives to decarbonise. This is confirmed by the findings of the evaluation, which indicates, based on literature review, that the effect of the EU ETS prices on carbon efficiency and emissions reduction is more pronounced for sectors transitioning away from free allocation and into auctioning (see Annex 15, Section 4).

The following sub-drivers have been identified:

- D2.1 (P3) Free allocation dampens the carbon price signal. Indirect carbon cost (ICC) passed through in electricity disincentivises industry electrification.
- D2.2 (P8) Current regulations exempt small installations under 20MW
- D2.3 (P4) Lack of equivalent GHG pricing signal for maritime emissions in neighbouring non-EU countries leading to a possible risk of evasion (including via relocation of transshipment activities).
- D2.4 (P6/7/8) Limited scope of aviation and maritime
- D2.4 (P5) No comprehensive coverage of waste emissions

- **D3: International carbon pricing measures in transport.** In terms of interaction between the implementation of the EU ETS and the implementation of global measures to reduce emissions from aviation and shipping, the following sub-drivers have been identified:
 - D3.1 (P6) Possible non-implementation of CORSIA by third countries: A wide range of quantification scenarios would be possible, as the impact of the driver depends on which countries outside the EEA implement CORSIA, and how and to what extent (if any) it is strengthened. Table 5 compares emissions coverage in two key participation scenarios (PO1 and PO2/3, where assumed participation is the same), and Annex 10 Section 5 provides further context, including Table 19 which examines six participation scenarios.
 - D3.2 (P7) Potential lack of coherence between ETS implementation and the implementation of possible IMO mid-term measures in the future

Associated with Problem 2:

- **D4: Decreasing market size.** The decreasing market size can have a negative impact on trading. This is because a low market size entails the risk of thin or illiquid trading¹⁹, which would in turn cause price volatility and uncertainty.

The following sub-driver has been identified:

- D4.1 (P10/11) Intrinsic functioning of the EU ETS (as the cap reduces over time so will the size of the market), which, under certain circumstances, can lead to market failure.

The individual sub-drivers are further developed in Annex 7.

2.3. How likely is the problem to persist?

The risk that the EU ETS does not contribute cost-effectively to the EU emissions reduction target in line with 2050 economy-wide climate neutrality and the 2040 target and fails to address the EU's fair share of international emissions, is likely to persist because the current legislative framework was designed to achieve the 2030 climate target for the sectors covered. The continuation of the current provisions post-2030, in particular the cap trajectory, without adjustments risk market inefficiencies (e.g. trading frictions, price volatility) and excessive costs. These effects can be seen in the analysis of the baseline in Section 5.1.

3. WHY SHOULD THE EU ACT?

3.1. Legal basis

Articles 191, 192 and 193 of the Treaty on the Functioning of the European Union empower the EU to act to preserve, protect, and improve the quality of the environment; protect human health; and promote measures at the international level to deal with regional or worldwide environmental problems. The legal basis of this impact assessment is in Article 192(1), as this impact assessment is action being taken to combat climate change and to serve the other environmental objectives specified in Article 191. The ETS has been operating on this legal basis since 2003. The European Parliament and Council adopted all amendments to the ETS Directive on this legal basis.

¹⁹ Note that the concept of liquidity of the market, referring to the amount of allowances available for trading, should be differentiated from the concept of market tightness, which can occur regardless of the market size if the supply of allowances is very tight in relation to the demand of allowances (i.e. actual emissions).

3.2. Subsidiarity: Necessity of EU action

Climate change is a trans-boundary problem and both international and EU action can effectively complement and reinforce regional, national and local action. Adjusting the ETS to the 2040 target for EU GHG reductions will affect many sectors across the EU economy and coordinated action at the EU level is therefore indispensable and has a much bigger chance of leading to the necessary transformation, acting as a strong driver for cost-effective change and upward convergence. Furthermore, many of the policy elements assessed in this impact assessment have an important internal market dimension, in particular the options related to the carbon leakage protection and the low-carbon funding mechanisms. EU action can also inspire and promote the development of other market-based measures, including at global level.

3.3. Subsidiarity: Added value of EU action

As a carbon market, the ETS incentivises emission reductions made by cost-effective solutions first across the activities it covers, achieving greater efficiency by virtue of its scale. Implementing a similar measure nationally would result in smaller, fragmented carbon markets, risking distortions of competition and likely lead to higher overall abatement costs. The same logic holds for the extension of carbon pricing to new sectors.

4. OBJECTIVES: WHAT IS TO BE ACHIEVED?

To address the problems identified, the revision of the ETS Directive and the MSR Decision has a number of general objectives.

As regards the **risk of not contributing cost-effectively to the EU emissions reduction target in line with climate neutrality and the 2040 climate target including addressing the EU's fair share of emissions (problem 1)**, the impact assessment aims to:

- O1.1 Incentivise further emission reductions: to ensure the EU ETS contributes cost-effectively to economy-wide efforts (including transport) of achieving emission reductions of the EU in line with climate neutrality and to contribute cost-effectively to the EU's fair share of economy-wide emissions reductions. The following specific objectives have been identified for O1.1:
 - SO1.1.1 Enable investments in decarbonisation technologies (both innovative ones and those ready for scale-up/roll-out) that currently do not yet have the business cases.
 - SO1.1.2 Ensure full carbon price signal is applied to emissions sources which are currently not in the scope of the EU ETS but would be well suited for its coverage, and to sectors where currently dampened.
 - SO1.1.3 Address risk of carbon leakage.
- O1.2 Reach a pre-set emissions reduction target provided by the 2040 policy package and with a net emissions calculation: exploring if the EU ETS gross emissions could be increased without compromising the sectors' contribution to economy-wide net emission reductions in line with climate neutrality, including exploring if the emission reduction efforts could be complemented with carbon removals. The following specific objectives have been identified for O1.2:
 - SO1.2.1 Consider how carbon removals can be integrated in the EU ETS with sufficient environmental safeguards while preserving cost efficiency in achieving the ETS/EU climate objectives before 2040.

- SO1.2.2 Adjust EU ETS cap in line with pre-set climate target for 2040.
- O1.3 Ensure effective EU climate action on transport emissions.

To ensure effective EU climate action means to ensure that there is a meaningful carbon price on the EU's fair share of international transport emissions.

- For aviation, the objective is to ensure a meaningful carbon price on the EU's fair share of international aviation emissions, which can be a complement to CORSIA.
- For maritime, the objective is to ensure coherence between any IMO mid-term measures and the EU ETS while addressing possible risk of significant double burden when (and if) payments are made due to IMO regulations in relation to emissions already priced under the EU ETS maritime, in a way that prevents environmental backsliding.

The following specific objectives have been identified for O1.3:

- SO1.3.1 Ensure effective action on EU's fair share of aviation emissions in the period 2031-2040
- SO1.3.2 Preserve the effectiveness of the implementation of the EU ETS extension to maritime.

As regards the **risk of market inefficiencies (problem 2)**, the impact assessment aims to:

- O2.1 Ensure efficient market functioning: this means ensuring that, in spite of a decreasing market, there is sufficient liquidity in the market so as to prevent trading frictions and excessive price volatility. The following specific objectives have been identified for O2.1:
 - SO2.1.1 Increase size of the market until 2040.
 - SO2.1.2 Adjust MSR parameters to ensure a healthy supply-demand balance until 2040.

The specific objectives are further developed in Annex 7.

5. WHAT ARE THE AVAILABLE POLICY OPTIONS?

5.1. What is the baseline from which options are assessed?

The baseline of this impact assessment assumes the continuation of the ETS Directive as currently in legislation, and the continuation of all other relevant legislation, most notably Renewable Energy Directive²⁰, the Effort Sharing Regulation²¹ (until 2030), the Waste

²⁰ Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (recast) (OJ L 328, 21.12.2018, ELI: <http://data.europa.eu/eli/dir/2018/2001/2024-07-16>).

²¹ Regulation (EU) 2024/1028 of the European Parliament and of the Council of 11 April 2024 on data collection and sharing relating to short-term accommodation rental services and amending Regulation (EU) 2018/1724 (OJ L, 2024/1028, 29.4.2024, ELI: <http://data.europa.eu/eli/reg/2024/1028/oj>)

Framework Directive²², the Landfill Directive²³, ReFuelEU Aviation²⁴, FuelEU Maritime²⁵ Regulations.

This means, most notably, a continuation of the legislated linear reduction factor of 4.4 % from 2028 onwards, leading to a 2040 cap of 69 Mt; the continuation of the current MSR parameters; application of EU ETS to departing and arriving flights from the EEA from the start of 2027 and ending of ETS SAF support in 2030; the Modernisation Fund runs up to 2030, and Member States receive all the allowances that are not issued for free, placed in the MSR or established as own resources; the maritime scope remains as legislated²⁶ with temporary derogations ending in 2030, while taking into account the effect of global policies and strategies at IMO; accounting of emissions that are captured in the EU ETS installations for utilisation in products (CCU) takes place upstream; the 20 MW threshold continues to apply; the incineration of municipal or hazardous waste are generally excluded from the full scope of the EU ETS (with co-incineration, however, fully covered).

As an exception, the baseline for **free allocation** for sectors not covered by CBAM results from the continuation of the current rules post-2030, based on the provisions set out in Article 10a of the ETS Directive. This does not correspond to the legal default, as the provisions of Article 10a of the ETS Directive apply only until 2030. However, assuming a baseline of continued free allocation post-2030 allows for a more meaningful analysis of the proposed measures based on comparable scenarios. For the sectors covered by CBAM, free allocation is phased out up to 2034 in parallel with the gradual phase-on of CBAM. The quantity of allowances available for free allocation is based on 43% share of the baseline cap trajectory, resulting from the provision in Article 10 of the ETS Directive that 57% will be allocated via auctioning.

Equally, the baseline on **instruments to support investments** assumes continuation of the Innovation Fund (IF) as defined in the ETS Directive using existing instruments ('regular' grants and, to lesser extent, auctions and financial instruments) to address technology and early commercialisation risks across innovative decarbonisation technologies in the ETS covered sectors. The baseline also assumes the establishment of the Industrial Decarbonisation Bank (IDB) with a EUR 100 billion envelope as announced under the Clean Industrial Deal to focus addressing market risks for scale-up and roll-out of decarbonisation technologies in Energy Intensive Industries. The current ETS Directive foresees the ETS revenues to be set aside for the IF for the period 2031-40 that are sufficient serve both the IDB endowment and the IF continuation. In line with necessary specialisations of the two instruments – with the IF serving as the 'innovation pillar' and the IDB becoming the 'roll-out pillar' - and reflecting the

²² Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (OJ L 312, 22.11.2008, ELI: <http://data.europa.eu/eli/dir/2008/98/oj>).

²³ Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste (OJ L 182, 16.7.1999, ELI: <http://data.europa.eu/eli/dir/1999/31/oj>).

²⁴ Regulation (EU) 2023/2405 of the European Parliament and of the Council of 18 October 2023 on ensuring a level playing field for sustainable air transport (ReFuelEU Aviation) (OJ L, 2023/2405, ELI: <http://data.europa.eu/eli/reg/2023/2405/oj>)

²⁵ Regulation (EU) 2023/1805 of the European Parliament and of the Council of 13 September 2023 on the use of renewable and low-carbon fuels in maritime transport (OJ L 234, 22.9.2023, ELI: <http://data.europa.eu/eli/reg/2023/1805/oj>).

²⁶ For maritime, the ETS Directive applies to ships of or above 5 000 gross tonnage. All emissions of voyages between EU ports, as well as emissions within EU ports are covered but only 50% of emissions of voyages between EU and non-EU ports. Methane and nitrous oxide emissions from maritime transport are covered under the ETS1 as from 2026 and emissions from large offshore vessels will be covered as from 2027.

expected technology deployment needs after 2030, the ETS revenues will be allocated between the two instruments.

The Baseline described above needs to be distinguished from modelled 85% target scenarios which will be used in the quantitative sections of the impact assessment focused on economic impacts. These are model-based scenarios which optimise the technological investments required to hit an 85% net emissions reduction target by 2040 compared to 1990, and climate neutrality in 2050. However, this economy-wide optimisation does not provide sufficient information about detailed policies to achieve the necessary technology deployments. The reason to use these scenarios for further analysis is that they allow us to abstract out the economic impact of the change in the LRF, which would otherwise dominate all other policy measures. Furthermore, the key purpose of this impact assessment is not to assess the overall economy-wide ambition level, but to assess the policy measures through which the EU ETS could best contribute to attaining it. The ambition level as a whole was assessed in the impact assessment of the 2040 Climate Target²⁷.

5.2. Policy options

Three policy options have been developed that ensure that the ETS contributes cost-effectively to the EU emissions reduction target in line with climate neutrality and the 2040 target and to addressing the EU's fair share of international emissions. The options differ in the degree of change that they entail to the current system. *Policy option 1 Aligning ambition and improving incentives* includes the measures that, overall, lead to least change compared to policies in place in 2026. *Policy option 2 Aligning ambition and extending scope and corresponding incentives* includes measures that introduce moderate innovations or changes to the system. *Policy option 3 Aligning ambition and extending scope and incentives comprehensively* alters most substantially how the system works. Annex 7 explains why each measure was included in the relevant policy option. In addition, the concluding sections of Annexes 8 to 13 summarise the assessment of each measure. Not all the measures analysed for each topic in the annexes were included in the policy options.

The most impactful measures in the policy options are those related to scope (aviation and waste), ambition (cap, removals and MSR), and use of allowances (in particular, for the IDB and free allocation), impacting for example costs of production or the business case for investments in emissions reductions. Regarding the scope, the combined extension of the system to departing flights and all waste incineration installations and landfills of non-hazardous waste (PO3 – largest scope extension) could increase the size of the ETS by around 30% compared to PO1 in terms of cumulative budget over 2031-2040.

Regarding the ambition, all policy options include the same measure for the cap, meaning that the impact is driven by the integration of carbon removals and the MSR. This choice has been made for the pragmatic reason that the other measures, not related to the cap, need to be assessed without this assessment being affected by changes in overall ambition level. The cap section of Annex 8 and chapter 6 of this impact assessment will nevertheless show environmental and economic impacts of comparing CAP2 and CAP4 to CAP3. Various other caps and targets are also illustrated in the Annex. The *relative* impacts of the other measures, such as those on removals, carbon leakage or CCU, will not be affected by changes in cap trajectory: if a policy measure performs better under certain criteria than an alternative measure under CAP1, it can be expected to perform better under CAP3 as well. By keeping the same

²⁷ COM(2024) 63 final

CAP measure under all POs, such relative performance can be isolated, without being dominated by the environmental and economic impacts of changing the cap.

For removals, the differences in the degree of change among the policy options are not based on the level of the increase of the emissions space (all POs count on the same amount of removals being eligible for integration) but rather on the certainty on the net and gross emissions²⁸. For the MSR, the differences between the policy options stem from changing from static parameters (PO1) to dynamic parameters (PO2-PO3), in which MSR parameters decline at a fixed proportional rate from 2028 onwards. This ensures a MSR design that dynamically accompanies the overall decreasing market of allowances. Regarding the use of allowances, the most impactful changes relate to the deployment of the 100 billion of the IDB (already in the baseline), and the changes to rules on free allowances – ranging from targeted improvements (PO1), to introducing their conditional use (PO2) and their phase-out (PO3). More in-depth analysis of options is provided in Annex 9.

The policy options all address the main risk that the ETS does not contribute cost-effectively to the EU emissions reduction target – this is because all options align the cap trajectory with the 2040 climate ambition of the EU. In all cap options, the reduction rate can continue at a slower pace than the currently legislated LRF. This means more allowances can be issued each year and new allowances will continue to be issued well beyond 2040. The integration of removals and adjustments to the MSR can also improve the cost-effectiveness of the ETS contribution to the EU’s climate ambition, by increasing the emissions space in the system through removals and adjusting the MSR so it can maintain a healthy supply and demand balance. The stability of the system and its environmental integrity act as constraints to any changes on either topic. Beyond that, differences in achieving a cost-effective contribution depend mainly on the scope extensions and use of allowances. Broader scope extensions allow the system to contribute to more emissions reductions and increase market efficiency by making it larger, but this needs to be measured against the efficiency of the extension (emission reduction potential and implementation costs). Introduction conditions on free allocation or reducing free allowances can improve incentives to decarbonise and lead to greater emissions reductions, as long as it does not lead to carbon leakage. This carbon leakage risk is in turn mitigated in part by the financing support provided through the IDB. Regarding the risk of not contributing cost-effectively on the EU’s fair share of international emissions, it is assessed whether the international scheme CORSIA is providing this contribution, or whether a complement through application of the ETS carbon price is required. Cost effectiveness is preserved through a deduction of CORSIA offsetting costs in case a complementary ETS price is applied, and additional financial support for aviation decarbonisation is provided.

Table 1: Overview of policy measures and policy options

Topic	Policy measure	PO1	PO2	PO3
Cap	CAP1: “Linear” measure - it follows a linear trajectory from 2030 to 2040 towards and 85% consistent target in 2040			

²⁸ PO1 providing relative certainty in both, under the condition that the public authority receives sufficient financing; PO2 providing certainty on net emissions; and PO3 providing certainty on gross emissions.

Topic	Policy measure	PO1	PO2	PO3
	CAP2: Default modelled trajectory to 85%: it follows the 2031-2040 trajectory of GHGs currently under ETS towards the estimated cost-effective contribution of the EU ETS to a reduction of economy-wide net GHGs by 85% in 2040. This option is illustrated by the scenario “85%”.	X	X	X
	CAP3: Until 2035 it follows the trajectory of GHGs currently under ETS towards the estimated cost-effective contribution of the EU ETS to a reduction pathway for economy-wide net GHGs moving linearly towards 90% in 2040, but in the second half of the decade the trajectory flattens to move towards the estimated cost-effective contribution of the EU ETS to a reduction of economy-wide net GHGs by 85% in 2040. This option is illustrated by the scenarios labelled “9085”.			
	CAP4: An accelerated version of CAP3, comparable to a non-linear pathway towards the 90% target in the first five years, then flattening to be compatible with an 85% target in 2040.			
	CAP5: “90% extended legal default”, extending the legal default LRF until 2035, followed by a lower LRF to be compatible with the 90% target in 2040			
Removals ^{29, 30}	CR1: Limited operator integration on top of the cap		X	
	CR3: Limited operator integration under the cap (one-in-one-out)			X
	CR4: Public authority integration through regular auctions under the cap	X		
MSR	MSR1: Static parameters, new thresholds (Adjust current parameter values based on updated assessments of market conditions and hedging needs (e.g. reduced upper and lower threshold, buffer also for lower threshold))	X		

²⁹ As explained in Annex 8 – Part II, all measures consider only the inclusion of CCS-based permanent carbon removals certified under the CRCF (BioCCS and DACCS) generated inside or outside the ETS.

³⁰ On top of the cap, refers to when gross emissions are limited by the cap plus the number of allowable removal units; under the cap, to where the cap determined the gross emissions level and removal units do not generate additional emissions space. For further explanations see Section 2.1. of Annex 8 – Part II.

Topic	Policy measure	PO1	PO2	PO3
	MSR2: Dynamic parameters (MSR 1 + rates changing over time by the LRF)			
	MSR3: Dynamic parameters (Adjusted release rate, upper and lower at declining fixed rate)		X	X
IDB - allocation mechanism	AM 1: Multi-criteria call for proposals	X		
	AM 2: Auctions			X
	AM 3: First-in, first served administrative schemes		X	
IDB - form of support	FS 1: 'Regular' grants covering the funding gap	X		
	FS 2: Carbon Fixed Premium		X	
	FS 3: Carbon Contracts for Difference			X
IDB - ensuring geographical balance	GB 1: EU-level competition, no geographical balance measures	X		
	GB 2: balance between EU-level competition and national allocations for the overall IDB spending		X	
	GB 3: strong national allocations			X
Modernisation Fund - Eligibility of gas/Waste- to-energy	GAS/WtE1: PI: Exclusion. NPI: Status quo	X		
	GAS/WtE2: PI: Exclusion. NPI: Allowed under conditions.		X	
	GAS/WtE3: PI/NPI: Exclusion			X
Modernisation Fund - Respective shares of Priority (PI)/Non-Priority investments (NPI)	PI/NPI0: NPI share = 10%	X		
	PI/NPI1: NPI share = 5%		X	
	PI/NPI2: No NPI			X
Modernisation Fund - confirmation process of priority investments	GOV0: on rolling basis	X		
	GOV1: Status quo (as in current MF)		X	
	GOV2: vetting by Investment Committee			X
Aviation - Geographic Scope	AS1: clean cut – intra-EEA flights and departing flights to Switzerland and the UK	X		
	AS2: departing flights		X	X

Topic	Policy measure	PO1	PO2	PO3
Aviation - SAF support	SAF0: status quo	X		
	SAF1: medium extension		X	
	SAF2: larger extension			X
Maritime -Support for emissions reduction in the shipping sector	LCF0: No dedicated ETS support mechanism	X		
	LCF1: EU ETS support mechanism for Sustainable Maritime Alternative Propulsion (SMAP)		X	X
Maritime -Evasion Risk	RE0: Current measures on evasion	X		
	RE1: Revise the list of neighbouring container transshipment ports		X	X
	RE2: Ensure that offshore activities by ships operating in EU waters are covered, independently from their port of origin		X	X
Maritime - Simplification	SI1: Simplification, and targeted enhancement measures	X	X	X
Maritime - Derogations	DE0: no extension of derogations	X		
	DE1: Extension of derogations for limited time		X	X
Maritime – IMO adjustments	IMO0: No adjustment	X		
	IMO1: Deduction from the ETS surrendering obligations of emissions subject to pricing by IMO.		X	X
Maritime - Smaller Ships	MSS0: The existing scope in terms of ship categories and sizes remains unchanged	X		
	MSS1: Targeted extension of the scope of the EU ETS to emissions from smaller ships, by including ship categories emitting the most among small ship categories		X	
	MSS2: Extension of the scope of the EU ETS to all smaller vessels (from categories non-exempt from MRV, plus fishing vessels and non-commercial yachts)			X
Stationary installations - Carbon Leakage	CL1: Improved current approach	X		
	CL2: Conditional Free allocation for investments		X	

Topic	Policy measure	PO1	PO2	PO3
	CL3: No free allocation and partial surrender of allowances until 2034			X
Stationary installations - Indirect Cost Compensation	ICC1: Continue state aid encouragement	X	X	
	ICC2: Harmonised ICC			X
Stationary Installations - Waste	W0: No inclusion of additional waste management processes in the EU ETS.	X		
	W1: Inclusion of municipal waste incineration installations in the EU ETS		X	
	W3: Inclusion of all waste incineration installations and landfills of non-hazardous waste in the EU ETS			X
Stationary installations - CCU	CCU0: 'Upstream accounting' with current waste scope	X		
	CCU1: 'Upstream accounting' with MWI inclusion			
	CCU3 'Hybrid Downstream & Midstream accounting'		X	X

5.3. Options discarded at an early stage

Several measures were discarded to address the specific problems, as set out in the description of the policy options with reference to Annexes 8 to 13. In addition, alternative options that could address the problem as a whole by replacing the ETS for another instrument, either harmonised at EU-level or for Member State implementation, instead of adjusting the EU ETS through the measures examined in the Annexes 8 to 13, were discarded at an early stage.

Beyond the theoretical advantages of the EU ETS over its alternative policies (e.g. carbon taxes or command-and-control measures), the discontinuation or narrowing of the EU ETS would lead to economic losses, weaken low carbon investments signals, penalise early movers, reduce investor confidence, distort competition, reduce revenues, reduce employment in affected firms, and jeopardise climate-related jobs in sectors. These sectors include clean tech, renewable energy, energy efficiency, and also monitoring and verification, consulting, and innovation support. At an international level, dismantling the EU ETS would undermine the EU's credibility in international climate diplomacy and weaken the EU's position on shaping global carbon pricing mechanisms and border adjustment instruments (see Evaluation Report in Annex 15, Section 6.3). Final impacts on the economy and on the credibility of the EU would depend on whether the EU ETS is replaced by another policy, by which, and the transition period for the new system to function. Feedback from the stakeholder consultation broadly confirms the findings. Respondents most frequently emphasised the EU's added value in harmonising implementation across Member States, avoiding a fragmented patchwork of

national schemes³¹ and ensuring a common price signal. Similarly for maritime, discontinuation of EU ETS maritime would put at risk the fair contribution of the maritime sector to the EU's climate objectives and undermine the shipping companies that have already invested in cleaner vessels and fuels.

Beyond alternatives to the EU ETS as a whole, in relation to specific measures to modify the system, the implications of lowering the 20 MW threshold (the thermal capacity below which stationary installations are exempt from EU ETS) is considered in detail in Annex 12 of this Impact Assessment. Based on that assessment, the option of lowering the threshold is not taken further. Most emissions from small installations will be covered under EU ETS2, which will become fully operational in 2028 and is outside the scope of this impact assessment. Therefore, the environmental gains from lowering the threshold would be very small compared to the substantial increase in administrative effort.

As regards the Market Stability Reserve, the evaluation and impact assessment demonstrate that the MSR should remain a rule-based and transparent framework for supply adjustments in the EU ETS, able to respond to external shocks without discretionary and price-based interventions or political interference. Alternative far-reaching reforms such as a carbon central bank are therefore discarded as they represent departures from the MSR's established operational principles, would require multi-year preparatory timelines and hence are not feasible for implementation by 2028.

6. WHAT ARE THE IMPACTS OF THE POLICY OPTIONS?

6.1. Environmental impacts

This section assesses the main environmental impacts associated with the measures under each topic in Table 1. The focus of this assessment is on both the impact of the policy options on GHG emission reductions both within the EU (in terms of annual and cumulative emissions) and other environmental impacts. Additional details on the environmental impacts for each of the measures considered can be found in the thematic Annexes 8-13.

Based on the assessed environmental impacts for the individual policy measures, a summary is provided with an overview of the impacts per policy options scenarios.

6.1.1. Climate

6.1.1.1. Cap

All measures considered for the cap in Annex 8 reach the same ETS contribution to the 2040 objectives for gross and net emissions, as they are modelled on the basis of the same EU domestic climate target. In addition, all policy options use deliberately the same cap measure ('CAP2' the modelled cost-efficient trajectory to 85%), so they will follow a similar budget trajectory, differing as a result of the changes in scope. Nevertheless the 9085 and other pathways will also be illustrated here.

The below table shows the range of outcomes in the PRIMES and POTEnCIA models, rounded to five, in order to represent the uncertainty range resulting from using the different models:

³¹ For an overview of carbon pricing instruments, see Annex B of World Bank, *State and Trends of Carbon Pricing 2025*, <https://www.worldbank.org/en/publication/state-and-trends-of-carbon-pricing>.

Table 2: Table showing approximate cap trajectories, when including extra EEA aviation in the target

EEA Caps (Mt), LRF (%) and Carbon Budget (Mt)	CAP1: Linear trajectory	CAP2: cost effective trajectory	CAP3: 90-85 pathway
2030	911	911	911
2035	620-645	580-670	560-605
2040	330-375	330-375	330-375
LRF 2030-2035	2.7-2.5%	3.1-2.3%	3.3-2.9%
LRF 2035-2040	2.7-2.5%	2.3-2.7%	2.1-2.1%
Carbon Budget 2031-2040	5915-6175	5705-6295	5605-5965

The table above shows that, for a given model, the two-step trajectory would have smaller total emissions (i.e. carbon budget) over the 2031-2040 period than either the linear or modelled trajectories unconstrained in 2035. However, we see that there is overlap in the ranges, due to the different models used.

Here it should be noted that this modelling has been performed under the assumption that (one-way) international extra EU aviation has been included in the EU target. See Annex 8 on a qualitative economy-wide assessment and modelling results on the caps if international extra EU aviation is not regarded as part of the target scope. The above numbers include the current scope of EU ETS, including international extra EEA aviation, and maritime non-CO₂. They exclude waste and are set at gross emissions.

In terms of the inclusion of municipal waste incineration in PO2 and landfills and hazardous waste incineration in PO3, the environmental impact will depend on how the additions to the cap compare to hypothetical policies to reduce waste emissions outside the EU ETS (see Section 6.1.1.8.). Inclusion in the EU ETS would increase the (long term) certainty and investment signal that the sector contributes its share in emissions reductions by reducing emissions or paying for reductions elsewhere. The increases in the cap in the scenarios PO2 and PO3 are relatively generous compared to reductions by 2040 expected from other sectors.

In PO1, EU ETS includes intra-EU flights but not international extra EU flights, and the cap is therefore lower. Implicitly, other policies will apply to international aviation. In PO2 and PO3, outgoing international aviation is included in the EU ETS, as well as emissions from smaller ships.

However, there are other possible ways to design the cap measure, as described in Annex 8. If international aviation were to be excluded from the target, total emissions under the EU target would be lower. As international aviation is a hard-to-abate sector with lower reduction potential by 2040 than other sectors, this would nevertheless create additional emissions space of ca. 45 Mt for other sectors of the economy.

In addition, if the EU ETS is assumed to benefit from the total amount of industrial removals in the models, the cap can be decomposed into a more ambitious cap set at the level of net emissions plus an amount of removals-linked allowances, which together add up to a total

gross emissions carbon budget; this is in particular relevant to PO1. The result of both excluding international extra EU aviation from the cap, as well as the decomposition in net trajectory and removals-linked allowances is estimated below for the POTEnCIA model:

Table 3: Net caps trajectories for POTEnCIA, excluding international extra EEA aviation and with added removals linked allowances

EEA Caps (Mt), LRF (%) and Carbon Budget (Mt)	CAP1: 85 linear trajectory	CAP2: 85 trajectory	CAP3: 90linear-85 pathway	CAP4: accelerated 90-85 pathway
2030	847	847	847	847
2035	570	600	555	485
2040	290	290	285	285
LRF 2030-2035	-2.7%	-2.4%	-2.8%	-3.5%
LRF 2036-2040	-2.7%	-3.0%	-2.6%	-1.9%
Added removals-linked allowances	320	320	320	320
Carbon Budget 2031-2040	5720	5885	5640	5290

In PRIMES the emissions space would be lower for CAP1, CAP2 and CAP3: as an example, the gross emissions carbon budget for the modelled 85% trajectory would be 5205 Mt including 170 Mt of removals linked allowances. CAP4 is comparable to a non-linear pathway towards the 90% target in the first five years, then flattens to be compatible with an 85% target for the second five years. From all the net cap options in Table 3, CAP4 shows the lowest carbon budget over the period, contributing with the highest emissions reductions.

6.1.1.2. Removals

- **Net and gross emissions**

The policy options in this impact assessment integrate removals as a way to provide additional emissions space. The policy options should ensure the generation of all the removals that are taken into account in the design of the cap:

1. for ETS to achieve its **net objective** and
2. for the ETS sectors to benefit from the emissions space that is represented by the relevant removals (i.e. the **gross objective**).

The net objective for each policy option is the gross emissions limit in that option minus an amount of eligible removals³² modelled for the 85% scenario³³ of between 175 and 330 Mt.

³² Eligible for inclusion based on the assessment carried out in Annex 8: removals from DACCS, and for BECCS stored underground and removals from biomass processing and stored underground (jointly called 'BioCCS').

³³ See Table 3 in Annex 8 – Part II.

This section assesses the likelihood that each policy option would reach the net and gross objectives.

PO1 includes measure CR4 (*‘Public authority integration through regular auctions under the cap’*). As shown in Annex 8, the purchase of removal units and corresponding issuance of additional (removal-backed) allowances by the regulator would allow gross emissions in the ETS to increase, while maintaining the same level of net emissions, conditional on the purchase by the public authority of the relevant removals. The public authority would commit to the purchase of between 170 and 330 Mt of removals from BECCS and DACCS, pre-increasing the cap by that amount, and guaranteeing the gross emissions for the ETS sectors. Assuming the purchasing programme is endowed with sufficient budget and the expected supply materialises, there is thus, in principle, certainty on the achievement of both the net and gross emissions objectives³⁴. Therefore, PO1 integration of removals should not generate uncertainty on reaching climate targets in comparison to the baseline scenario of an ETS without the integration of removals and reduces the risk of carbon leakage by increasing the gross emissions space. Moreover, modelling results in an overachievement of the removals objective, generating 222 Mt instead of 175 Mt as per the design of the measure, due to the certainty provided by the public commitment to purchase removals which in the model is represented by a lower discount rate. However, the modelling results are subject to significant uncertainty given the wide range of possible future technology costs and deployment constraints. In addition, if the public authority had a limited budget and/or carbon removal prices were higher than projected, there would be a risk of not attaining the net emissions target.

Meanwhile PO2, implementing CR1 (*‘Limited operator integration on top of the cap’*), provides certainty in reaching net emissions, as the cap is set at the level of the targeted net emissions. However, in the absence of support measures, CR1 creates uncertainty on gross emissions (within bounds). Removals will only be used, providing additional emissions space on top of the net cap, when they become cost competitive. This could lead to lower investment in removals (due to uncertainty of the size of the market) and higher investment in mitigation (due to the uncertainty that removals will materialise and enable hitting the net target). Under these assumptions, represented by an increase in discount rates for removals (due to uncertainty), modelling shows 110 Mt tonnes of eligible removals come into the EU ETS on top of the cap). However, perceptions are hard to predict: an equilibrium in which there is underinvestment in mitigation (due to optimism about removals) and high investment in removals as a result thereof cannot be ruled out.

In PO3, implementing CR3 (*‘Limited operator integration under the cap (one-in-one-out)’*), introduces an uncertainty that does not exist in the baseline, regarding the net contribution of the ETS – there is a maximum level of net emissions (how low net emissions can go) but not a minimum that would be reached. PO3 operates as PO1, with a pre-increase of the cap, but in PO3 the central regulator is not responsible for procuring removals, and their realization depends on market dynamics. Removals are remunerated at the prevailing EU ETS price, meaning that their volume remains uncertain and not guaranteed, introducing potential variability in both net emissions outcomes and investment behaviour. Modelling shows all the eligible carbon removals are generated as the model is constrained to hit the economy-wide 2040 and 2050 climate target. However, in reality, as long as removals are not cost competitive, there is a risk of insufficient removal being incentivised, causing the EU ETS to miss its net

³⁴ As shown in Annex 8 – Part II, by 2040 removals can cover 10-13% of the gross emissions of the ETS by 2040.

objective. This should be kept in mind when interpreting the results for PO3. The risk in PO3 is that the modelled assumptions would simply not be met.

Considering the price difference, the removals entering EU ETS in PO3 should be closer in quantity to those in PO2, or less, as the pre-increase of the cap should lower EU ETS prices, increasing the cost-differential. In the 85% scenario, removal units from BECCS are expected to become cost competitive vis à vis the allowance price in 2038, whereas DACCS removal units would not reach cost competitiveness within the period³⁵. As with PO2 regarding gross emissions, the uncertainty on net emission in PO3 can be reduced if financing is provided to support removals, e.g. through contracts for difference³⁶.

Finally, from a broader perspective, it should be noted that funding from ETS revenues provided to support the integration of removals – in particular in PO1 which is designed with the funding as essential element - necessarily reallocates scarce fiscal resources away from other uses. An alternative use of ETS revenues can be mitigation and enabling investments, e.g. via the Innovation Fund or of Member State's climate spending. It raises a question of whether the subsidization of removals leads to crowding out cheaper emission reductions in the short term and potentially increasing the overall cost of achieving EU targets, while supporting the long-term objective of scaling up removals to make them cost-competitive.

- **Abatement deterrence**

We must distinguish the abatement deterrence (when carbon removals substitute otherwise expected emissions reductions) linked to expectations on carbon removals, from that happening immediately due to the introduction of carbon removals in EU ETS as a means to increase in the cap. PO1 and PO3 see an upfront increase of the cap. As a result, abatement efforts are reduced in both cases.

Meanwhile, abatement deterrence³⁷, can also result from the risk that the overoptimistic expectations of market participants on removals supply or prices in the future will lead them to excessively *reduce* or *delay* current abatement measures³⁸. This is particularly relevant for the

³⁵ Based on technology costs from European Commission: Directorate-General for Climate Action, Ramboll Management Consulting, Witteveen, E., Marton, C., Bert, N. et al., *Carbon removals in the EU – Review of current carbon removal projects and early-stage financing*, Publications Office of the European Union, 2025, <https://data.europa.eu/doi/10.2834/0004994>.

³⁶ PO2 and PO3 are designed without support measures because the private integration option allows for it, while the public authority integration, per definition does not. These differences in design allow testing the range of results. See Section 4.6.3 in Annex 8 – Part II for more details on how the support would operate.

³⁷ Abatement deterrence lies at the heart of the Commission consideration of the possible inclusion of removals in the EU ETS. Article 30 paragraph 5(a) requires the Commission to consider “safeguards to ensure that such removals do not offset necessary emission reductions in accordance with Union climate targets laid down in Regulation (EU) 2021/1119”. The effect by which removals could displace emission reductions is often referred to as ‘mitigation deterrence’. However, ‘mitigation deterrence’ can be a misleading term, as CDR is also a type of mitigation action (Honegger et al., *Is carbon dioxide removal ‘mitigation of climate change’?*, 2021, <https://doi.org/10.1111/reel.12401>). Therefore, the term abatement deterrence is used.

³⁸ Abatement deterrence is not inherently a problem, provided that CDR delivers similar outcomes as compared to emission reductions with regards to climate and other societal objectives. The effect could also be desirable if, all things considered, removals are used to offset emissions that are prohibitively expensive to abate. However, several factors impact if removals deliver outcomes (climate and societal) that are similar or better than those of abatement: (1) risk of failure that would make it impossible to retroactively reduce emissions if these technologies do not materialise as expected; (2) delaying near-term emissions reductions in favour of future removals temporarily increases GHG concentrations; (3) carbon removal efforts may deliver fewer

ETS, where abatement in the short term is mostly only possible through a lowering of production volumes (which is undesirable). Abatement in the long run requires investment decisions that only lead to abatement after several years. As a result, long-run abatement and the ETS-price are highly dependent on future expectations. Integrating removals exposes the abatement investment decisions of ETS sectors to the long-term uncertainty of permanent carbon removals (e.g. limited/incomplete information on future costs and availability of BioCCS, DACCS). As the ETS is capped, the realisation of this risk (i.e., that the expected supply or lower prices of removals do not materialise as expected) would not translate in higher gross emissions but in an increase in prices and/or a lowering of production volumes, resulting in an avoidable lowering of economic output.

PO1 is shielded from this effect because the ETS market does not have direct access to removals. Thus, the expectation on removals supply or prices should not impact the abatement actions of ETS market participants, which are just determined by the cap. This is valid as long as the market trusts that the increase in the cap due to the integration of removals is done tightly linked to a realistic budget for the purchase of the removals. Alternatively, the market may expect that the cap will be further increased in the future, if that increase does not really depend on the availability of a budget to purchase removals.

Meanwhile, PO2 and PO3 are exposed to abatement deterrence due to the direct substitutability between abatement and carbon dioxide removals (CDR). This risk is moderated by limits, meaning that the CDR cost would not act as the price ceiling for the ETS once CDR becomes cost-competitive in the ETS.

In PO2, the volume of removals is not guaranteed by the regulator. This means EU ETS sectors could be incentivised to maintain sufficient abatement efforts in line with the net emissions target (the cap), because removal volumes would be uncertain. In economic terms, this is represented in the model by higher discount rates for investing in removals. As shown in Section 6.2.1.2, the modelling, higher removals costs lead to higher ETS prices in PO2 and higher abatement (translating in lower gross emissions). However, if the market would expect a high availability of cheap removals, some abatement, moderated by the limit, could be deterred.

PO3 should lead to a lower abatement deterrence risk, beyond the initial cap increase, because any removal used would lead to the cancellation of an allowance. Therefore, wrong expectations on removals volumes should not impact the expectations on gross emissions in the ETS, which would be similar as in PO1. However, the expectation that removals would become very cheap could potentially impact market dynamics if participants delay abatement in the overoptimistic expectation of purchasing (or creating) removals in the future, leading to a price spike later on. In addition, the absence of support measures to generate the additional removals space could lead to reduced political credibility by market participants of the

climate benefits than anticipated due to rebound effects; (4) substituting removals for emissions reductions in sectors with viable mitigation alternatives may deplete the removal potential needed for achieving future net-negative emissions targets; and (6) despite potential for some positive externalities, the large-scale deployment of some removal options in climate pathways may create significant negative externalities. In this regard, the European Scientific Advisory Board on Climate Change (ESABCC) notes that removals need to contribute to EU climate neutrality in a dynamically cost-effective way while avoiding the risk of mitigation deterrence. To this end, there is a need to support the early deployment of a portfolio of removal options, to consider the wider social costs and benefits of reduction and removal methods, and to avoid overreliance on future removal methods with uncertain costs and potential (ESABCC 2024, p. 83).

willingness of the regulator to increase the cap only under the condition that the removals are purchased, reducing credibility on the long-term stringency of the cap.

- **CDR support**

All options **support CDR development** to a greater extent than the baseline, which is a positive impact for the climate objective of net-zero in 2050³⁹. The modelling generates 110 Mt of removals, but these are generated within the EU economy due to the model and not necessarily incentivised by the ETS.

Among the options, PO1 is much more likely to be effective in supporting CDR development and deployment than PO2 and PO3. The effective support in PO1 was the most frequently cited reason by stakeholders supporting this option. The modelling also shows the earlier deployment of removals during the period 2031–2040 in PO1 and (over-) achievement of the removals objective. The regulator can make strategic long-term investments in procuring initially expensive but promising engineered CDR to stimulate innovation and cost reductions, which could enhance overall economic efficiency in achieving deeper decarbonization goals in the future even if initially more expensive.

In PO2 and PO3, the operator integration of CDR in the EU ETS would expose CDR suppliers to the ETS price risk as well as to a lack of predictability in the timing of demand. These options lead to lack of early incentives from EU ETS demand towards development and deployment of CDR technologies, as can be seen in the modelling of the volumes of removals generated in PO2, as referred to above. PO2 and PO3 likely result in higher removal costs and a greater risk of under-delivery of removals during the 2031–2040 period, compared to PO1 that includes guaranteed removals volumes. Support for removals e.g. through contracts for difference could complement PO2 and PO3 to counter this effect.

6.1.1.3. MSR

Changes to the MSR alter the allowance supply over the assessment window via releases, providing more liquidity to the market and putting downward pressure on the carbon price. Depending on how this affects the timing of surrendering of allowances, this may in turn affect cumulative emissions. However, since any MSR release remains within the cap, the system's overall ambition is unchanged. The MSR measures are compared with a baseline that assumes no further changes to either EU ETS or the MSR.

Policy option PO1 is based on the MSR1 measure as described in Annex 8. Under this measure, parameters of the MSR design are then kept constant over the time until 2040.

Policy options PO2 and PO3 on the other hand, are based on the MSR3 measure, which assumes parameters decline at a fixed proportional rate from 2028 onwards. This ensures that all parameters under PO2 and PO3 are adapted on an annual basis to take account of the overall decreasing market of allowances.

Results for cumulative emissions between 2026–2040 exclude waste, landfills and extra-EU aviation to ensure comparability across all the policy options. Overall, all policy options achieve similar emissions reductions over the period. However, PO2 and PO3 appear to deliver

³⁹ As a caveat, CDR stakeholders have noted that integration of removals so that ETS ambition is increased, rather than the space to emit, would allow CDR developers to leverage private financing on top of ETS prices that could support CDR development. However, precise impacts would depend on that private financing realising and forgone public support that may only be leverage if linked to an integration that increases the emissions space in the ETS.

slightly lower cumulative emissions than PO1. On this basis, PO2 and PO3 are considered the preferred option as they achieve comparable emissions reductions than PO1 whilst maintaining better economic performance, further explained in Section 6.2.1.2.

Table 4: PO environmental impact summary

	Baseline	PO1	PO2	PO3
Cumulative emissions over 2026-2040 (MtCO ₂) – excl. waste, landfills and extra-EU aviation for comparability	9,687	10,690	10,598	10,598

6.1.1.4. Instruments to support investments

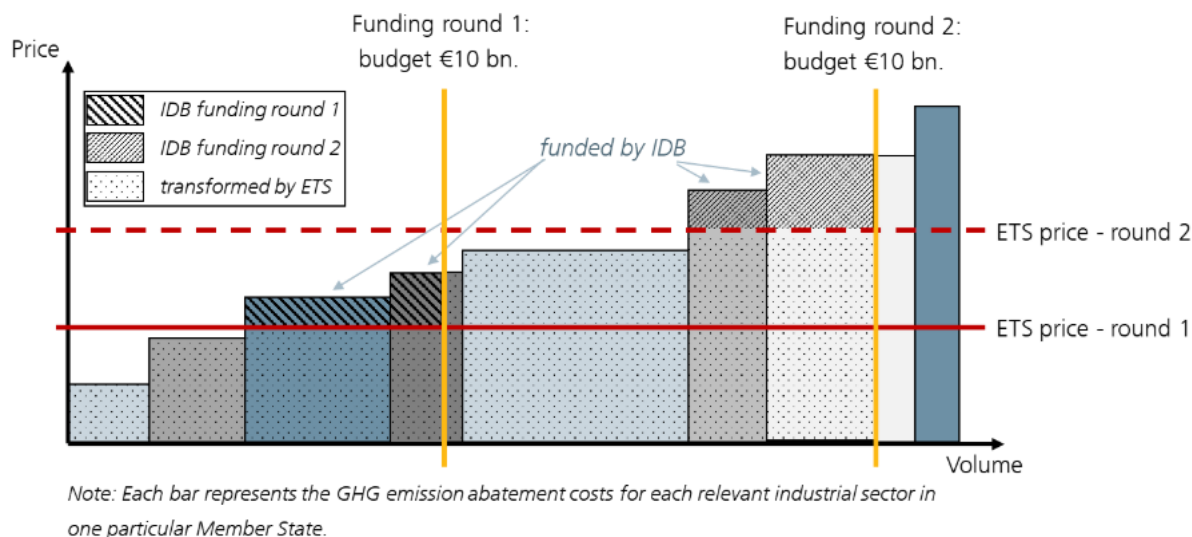
For the IDB, the assessment in terms of environmental and other impacts to be achieved is based on assessment of the Baseline size of the IDB (EUR 100 billion) which is defined in the Clean Industrial Deal. The differences among IDB options in terms of allocation method, support formats and geographical balance would only have marginal bearing on the impacts and such assessment would also require more granularity in terms of funding mechanism features ⁽⁴⁰⁾. As a general rule, the allocation method options like auctions and variable premiums should be more cost-efficient, thus resulting in higher emissions savings, stronger private capital mobilisation and larger spillover benefits, although results will critically depend on the detailed implementation of the funding rounds and competitive dynamics achieved in all of them. In addition, the trade-off has to be considered between cost-efficiency (delivered by very competitive calls for proposals, auction and variable premia) and effectiveness (better delivered by administrative schemes with fixed premia that could allow a more robust financial model for projects, increase likelihood of projects materialising and better diversification of portfolio). In general, the mechanisms that bring high level of competition are better suited to more mature technologies that operate on deep and liquid markets, which should progressively become the case for many decarbonisation technologies. Administrative schemes should be needed in the early years of the IDB operation when uncertainties are the highest and the business case the most difficult.

The analysis performed for this Impact Assessment is a simulation of the impact of the IDB once it operates through competitive calls for proposals/auctions and using as inputs the main results of 2040 climate target modelling (e.g. electricity or carbon prices). This analysis indicates a cumulative GHG emission abatement of 1630 MtCO₂ over a ten-year period, based on a total budget of EUR 100 billion allocated across ten yearly auction rounds, each of EUR 10 billion funding volume. The support would target, among others, process heat electrification both for medium and high temperature applications. It will also support low-carbon primary steel production via hydrogen-based direct reduction, as well as carbon capture and storage solutions in energy-intensive sectors such as cement and lime. Over the assumed support period of ten years, the resulting weighted average awarded support amounts to EUR 60/tCO₂ abated. In the early years when the administrative schemes are applied, the impact would likely be lower. This analysis is illustrative because the actual impact of the IDB will depend on the final IDB design, the specific design of funding rounds as well as necessary infrastructure availability, demand for low-carbon products and project delivery risks.

⁴⁰ Typically, the Commission conducts an internal assessment of the project pipeline and likely impacts of the IF auctions, but this can only be done when the specific auction's Terms & Conditions are nearly finalised.

The calculation of impacts is based on the assumption that the IDB support bridges the remaining cost gap (covering both CAPEX and OPEX) of the low-emission technologies deployed in IDB-funded projects compared to their fossil fuels-based incumbent technologies. The IDB support accounts for the average ETS price⁴¹ faced by the incumbent fossil-based alternative (conventional technology).

Figure 4: Illustration of support logic for two consecutive funding rounds of the IDB



Source: Fraunhofer

In the absence of the IDB, the ETS revenues are set aside solely for the IF, which would imply broader eligibility (beyond the EIIs) and focus on innovation with continuation of the existing allocation mechanism and support formats of the IF. The needs of the decarbonisation technologies roll-out for EIIs would not be fulfilled, there could be also a diminishing attractiveness of the IF calls for proposals considering that large share of the decarbonisation technologies would be entering the roll-out phase post-2030.

For the Modernisation Fund, all considered Policy Options, which maintain the **Modernisation Fund** after 2030, would have positive impacts on the reduction of GHG emissions. Those impacts are expected to be comparable to the benefits reported in the MF evaluation, which found that the MF will deliver an annual average reduction of about 84.8 MtCO₂eq, corresponding to roughly 32% of 2020 emissions from the electricity, gas, steam and air-conditioning sector in beneficiary Member States (265 MtCO₂eq). In the absence of Modernisation Fund, the additional auctioning allowances received by beneficiary Member States⁴² would be spent by all Member States under the broader scope of uses that applies to the general pool of auctioning revenues. However, MF investments are concentrated in low-income countries where the challenges to decarbonise are higher and in sectors where the resulting GHG reductions are economy-wide and structural.

Through allocating revenues for investments in energy efficiency (including in buildings, transport, etc), renewables deployment and modernisation of the energy grids, the Fund would continue its contribution to lowering greenhouse gas emissions in Member States with high carbon intensity under both the ETS and the non-ETS sectors. The fund would also contribute

⁴¹ ETS prices are an assumption in this calculation and are derived from 2040 climate target modelling.

⁴² The number of EU ETS allowances received by MF beneficiary Member States due to the MF is increased by 11% compared to the situation without the MF.

to modernising the power sector. Energy efficiency measures in ETS2 sectors would address the investment needs that lower income Member States still face to continue their industrial decarbonisation efforts (including buildings and all types of transport), as compared to the Social Climate Fund which only covers very small businesses and most vulnerable households. The deployment of renewable energy still needs support in certain Member States, either through grid reinforcement or energy storage deployment, and it did not reach its full potential. The MF evaluation shows that although the progress in the deployment of renewables differs across Member States, there is an overall deployment gap for many of them to reach the 2030 renewable energy target of 42.5% and that their energy mix still largely relying on fossil fuels⁴³. Decarbonising heating and cooling is still a major challenge for the 13 beneficiary Member States.

EU ETS allowances spent in the context of the Modernisation Fund are subject to ex-ante verification at EU level through both state aid compliance check and a review by the EIB as an outcome of which the EIB confirms that the investments proposed by beneficiary Member States are in line with the objectives of the ETS Directive. For priority investments, this includes falling into the priority areas defined by the Directive. For non-priority area, this includes a due diligence and assessment of planned GHG emissions reductions.

Furthermore, all policy options considered increase the level of climate ambition in terms of reducing GHG emissions insofar as they all exclude support to investments involving natural gas and waste-to-energy as priority investments. Expanding the scope of the Fund to CCS and direct electrification for industry across all policy options is expected to reinforce the positive impact on GHG reductions. PO3 brings the highest climate benefits in terms of potential GHG emissions reduction insofar as it excludes all types of investments involving gas and waste-to-energy, including as non-priority investments, while bringing the share of priority investment to 100%. PO2 also brings high climate benefits as it importantly restricts the share of non-priority investments (to 5%) while excluding any support to gas infrastructure or any support to waste-to-energy which would not be in the conditions of high efficiency combined heat and power.

Finally, PO1 brings more limited benefits in terms of GHG emissions reduction potential compared to the current MF set up – but still important ones compared to the baseline where the MF is absent – as it still allows for 10% of non-priority investments and the possibility to fund investments supporting gas and waste-to-energy with these 10%.

6.1.1.5. Aviation

If SAF is counted as zero emissions⁴⁴, we expect aviation's global international CO₂ emissions to reduce by 14% between 2024 and 2040. Without accounting for the use of SAF, these aviation emissions are projected to grow around 12% in the same timeframe. EASA reports⁴⁵ confirm this upward trend, which is in place since the 1990s. In particular, emissions from international aviation are expected to increase through 2040, 2050 and beyond⁴⁶. Alongside

⁴³ European Environment Agency, *Share of energy consumption from renewable sources in Europe*, 2025, <https://www.eea.europa.eu/en/analysis/indicators/share-of-energy-consumption-from>.

⁴⁴ Most SAF has residual emissions, but in line with the ETS Directive it is counted as zero emissions, supporting the price incentive in favour of SAF use.

⁴⁵ For departing flights: 147 Mt CO₂ in 2019, 228 Mt CO₂ in 2050. Source: EASA, *European Aviation Environmental Report* 2025, 2025, <https://www.easa.europa.eu/en/domains/environment/eaer/downloads#download-2025>, p.14.

⁴⁶ ICAO, *Environmental Trends in Aviation to 2070*, https://www.icao.int/sites/default/files/sp-files/environmental-protection/Documents/EnvironmentReport-2010/2025/Envreport2025_9.pdf, p. 28.

carbon pricing, deployment of clean aircraft and innovative operations, SAF use at global scale is key to reduce emissions. This section examines the effects of carbon pricing and SAF use.

- **Carbon pricing**

The policy options assessed differ on the extent to which the effect of aviation CO₂ emissions on the environment is internalised. Airlines can directly reduce their emissions or use market-based measures outside the aviation sector⁴⁷. The options have different coverage of emissions by CORSIA and the EU ETS⁴⁸, resulting in different price signals, and different levels of support for the uptake of eligible SAF. This environmental impact of the policy options is considered for CO₂ emissions of global international aviation⁴⁹. What amount of CO₂ emissions would remain unaddressed by carbon pricing (ETS, CORSIA) under each option is also shown. Not considered are aviation's non-CO₂ emissions: in-depth analysis considers that aviation's non-CO₂ emissions have at least double climate effect of aviation CO₂ emissions alone (so CO₂ emissions figures would need to be multiplied by three to obtain the full climate impact).

In the baseline and all options, global international aviation CO₂ emissions decrease between 2024 and 2040 by 13-15%, both for extra-EEA departing flights and global international aviation when discounting the impact of projected SAF uptake in Europe and globally⁵⁰. In the baseline most flights are covered by the EU ETS carbon price, and emissions are lowest. Emissions are highest under PO1, where the ETS geographic scope of 2026 continues to apply, and no extra support for the uplift of SAF is set aside.

Global international aviation emissions have the biggest climate impact and the highest level of CO₂ emissions⁵¹. They are defined as: CO₂ emissions from flights inside Europe, and from international flights outside Europe. Flights inside Europe include departing flights to Switzerland and the UK. Examples include flights from Berlin to Munich, Sofia to Brussels and Madrid to London. International flights outside Europe include flights from Paris to Toronto, or from Beijing to Dubai (but they exclude domestic flights outside Europe, such as Toronto to Vancouver). **Currently, the ETS carbon price applies within Europe and to departing flights to Switzerland and the UK, but not to other third countries. Policy options differ in how they address CO₂ emissions from flights to other third countries.** In PO1, the ETS carbon price does not apply to international emissions, but CORSIA applies to a part of these emissions⁵². In PO2 and PO3, the ETS carbon price addresses emissions from flights that depart from Europe (Paris to Toronto, but not Toronto to Paris, and neither Beijing to Dubai). In PO2 and PO3, the ETS scope is the same as the ReFuelEU Regulation⁵³, which mandates increasing production of SAF and requires airlines to uptake fuel at Union airports.

⁴⁷ ETS: airlines can buy, trade and surrender allowances; CORSIA: they can buy and cancel eligible offsets.

⁴⁸ On the differences, see Annex 10, in particular Sections 1 and 5.

⁴⁹ The scope considered is intra-EEA emissions (domestic and non-domestic, including departing flights to Switzerland and the UK) and international aviation emissions, i.e. between Europe and other third countries and between two third countries, but not the emissions within third countries.

⁵⁰ ReFuelEU Aviation for flights departing from Union airports. For arriving flights, SAF uptake increases in line with the global fuel scenario F1 presented in the Long-Term Aspirational Goal report of ICAO.

⁵¹ Eurocontrol, *Think Paper #22: Decarbonising long-haul flights by 2050: Is there a pathway through sustainable aviation fuel use, fleet renewal and green energy upscaling?*, 2024, <https://www.eurocontrol.int/publication/eurocontrol-think-paper-22-decarbonising-long-haul-flights-2050>.

⁵² CORSIA exempts ~500 Mt CO₂ each year, CO₂ emissions above that level should be offset. See Annex 10, Section 5.1.

⁵³ Nearly identical but ReFuel covers departing flights from Union airports (a subset of EEA airports defined in ReFuelEU), whereas in PO2/3 the ETS would cover departing flights from any EEA airport, but not to all destinations (exempt are flights to Least Developed Countries and Small Island Developing States).

Use of SAF reduces emissions significantly, but industry have claimed they may fail to meet ReFuelEU mandates, unless they receive additional financial support⁵⁴. ReFuelEU is a separate regulation, not part of the ETS Directive, and therefore outside the scope of this review. Our modelling assumes ReFuelEU mandates are met, with the resulting emissions reductions having a larger impact than the carbon price alone.

A larger scope of application of the ETS carbon price slightly reduces **global international aviation emissions**. Most emissions growth is projected to occur outside Europe⁵⁵, i.e. for flights that neither take off nor land in an EEA country and is therefore not affected by the ETS price signal or ReFuelEU.

The Commission review focuses on flights that are connected to the European territory, i.e. take off in Europe, and can be directly affected by our policies. It is therefore interesting to single out CO₂ emissions of **extra-EEA departing flights**, because that is a key difference between policy options. Impacts of policy options follow the same pattern as for global international emissions but are more pronounced. In the baseline, ETS scope is broadest, and CO₂ emissions decrease most. Under PO1, ETS scope is smallest (it does not apply at all to departing flights), resulting in the smallest reduction. Table 5 below presents the policy options and modelled CO₂ emissions rounded to the nearest 5Mt.

Table 5: Policy options and global international aviation emissions (inside Europe: domestic and international; outside Europe: international only)

2024 emissions 690 Mt CO ₂	Emissions 2030 in Mt CO ₂	Emissions 2035 in Mt CO ₂	Emissions 2040 in Mt CO ₂
Baseline	590	600	590
<i>Return to full legal scope</i> , where the EU ETS applies to flights within Member States, between Member States and extra-EEA flights to and from Member States. Flights to-, from and between Outermost Regions are included from January 2031.			
PO1	605	605	600
<i>Continuation of clean-cut subject to CORSIA implementation</i> : Existing EU policy implementation: the EU ETS applies to flights within Member States and between Member States, as well as to departing flights to the UK and Switzerland. Flights to-, from and between Outermost Regions are included from January 2031. CORSIA is implemented by others under high participation assumption (all those who should implement CORSIA from 2027 do so, and all those who voluntarily participate in 2025 do also implement CORSIA).			
PO2	600	605	595

⁵⁴ Reuters, *European Airlines will miss green jet fuel targets, CEOs warn*, 2025, <https://www.reuters.com/sustainability/climate-energy/european-aviation-falling-behind-risks-missing-green-fuel-targets-ceos-say-2025-03-27/>.

⁵⁵ See ICAO, *Initial assessments in support of the 2025 CORSIA periodic review*, 2024, https://www.icao.int/sites/default/files/environmental-protection/CORSIA/Documents/CORSIA%20Periodic%20Review/CAEP_Inputs-to-2025-CORSIA-periodic-review-C232.pdf, p. 23: CO₂ emissions growth rates of 1.8%-2.3% for Middle East, Asia Pacific, Africa and Latin America & Caribbean, vs 0.4% for Europe for the period 2019-35.

<i>Departing flights & SAF support extension by a medium amount:</i> The EU ETS applies to flights within Europe, and to departing international flights. Flights to-, from and between Outermost Regions are included from January 2031. CORSIA is implemented by others, and offsetting costs can be deducted on relevant routes. ETS-financed SAF support is extended by a medium amount.			
PO3	600	605	595
<i>Departing flights & SAF support extension by a larger amount:</i> The EU ETS applies to flights within Europe, and to departing international flights. Flights to-, from and between Outermost Regions are included from January 2031. CORSIA is implemented by others, and offsetting costs can be deducted on relevant routes. ETS-financed SAF support is extended by a larger amount.			
International impact • <i>Least Developed Countries and Small Island Developing States</i> No impact: No carbon pricing applies to flights to-, from- or between those countries, unless they voluntarily apply it. They are exempt from CORSIA and the ETS in all policy options. • <i>Switzerland and the UK</i> No change: Flights from Europe (meaning EEA countries) to Switzerland and the UK are currently covered by the ETS carbon price and remain so in all options. • <i>Other third countries</i> The options differ in the choice of carbon pricing tool(s) that apply to CO₂ emissions from flights departing from Europe to these countries. In any case, an effective carbon price should apply to those emissions, either if CORSIA satisfies the requirements of Article 28b ETS Directive (Policy Option 1), or through a combination of ETS and CORSIA (Policy Options 2 and 3). See detail in Annex 10. In Policy Options 2 and 3, some third country reactions can be expected, because due to equal treatment on routes, the ETS carbon price would apply in the same manner to all departing flights, independent from the nationality of the airline. This equal treatment on routes maintains a level playing field. All policy options take CORSIA into account – demonstrating continued EU support for CORSIA. ETS-financed SAF support would continue to be available to any airline covered by ETS carbon pricing: airlines are treated equally regardless of their home country.			

Environmental effectiveness of carbon pricing tools: CORSIA has global reach, but analysis finds several limitations (see detail in Annex 10, Section 5).

- **Structural limitation:** CORSIA addresses emissions growth and exempts around 500 Mt CO₂ emissions each year. Table 6 below shows that in PO1, CORSIA covers more emissions than the EU ETS. However, in PO2 and PO3, it covers less despite its broader geographic scope. In PO1, high participation is assumed⁵⁶, which is needed to meet the

⁵⁶ *PO1:* All countries that should apply CORSIA from 2027, plus all countries who volunteer now continue to do so. Dominica and Viet Nam in from 2026, Mauritius out. Brazil, China, India, Russia in from 2027. *Baseline/ PO2/ PO3:* All countries who volunteer now continue to do so. Viet Nam in from 2026; Brazil, China, India, Russia out. Participation also influences the amount of emissions that CORSIA does not address: Both the baseline and the emissions taken into account in the offsetting calculation are determined annually by the collective emissions in that year. The growth in emissions above the baseline level determines the offsetting required for each operator under in CORSIA:

emissions coverage test in Article 28b of the ETS Directive. As CORSIA is set to end in 2035, its emissions coverage is assumed as zero thereafter.

- **Quality of offset credits:** Environmental effectiveness depends also on the quality of units (offsets) used, i.e. a tonne purchased is a tonne reduced, and this reduction is permanent and counted only once. However, as of March 2026, analyses find significant challenges with CORSIA-eligible offsets. For example, emissions reductions may be overestimated (airlines would pay for a reduction of 1 tonne CO₂ but, in reality, no reduction or a much smaller reduction takes place). See Annex 10, Section 5.1.
- **Enforceability:** The 2021 IA gives a legal analysis of why CORSIA is not binding unless implemented in national law. Analysis in Annex 10, Section 5.2 demonstrates that national implementation in ICAO member states varies widely and does not include major emitters like China, Russia or India, based on most recently available implementation data. According to this analysis, 21 countries have penalties for CORSIA non-compliance in place in 2025 (apart from EEA countries). This means that the certainty of the environmental impact is greater under options where EU ETS emissions coverage is greater (PO2 and PO3). It is the greatest in the baseline.
- **Fuels:** Instead of relying on offsets, airlines can use SAF to meet CORSIA offsetting requirements. However, it is far cheaper for airlines to rely on offsets⁵⁷.

Table 6: Global international aviation CO₂ emissions

Global international aviation CO ₂ emissions					
Policy Option <i>All emissions per year in MtCO₂</i>	Year	Global emissions	ETS coverage	CORSIA coverage	Non- priced emissions
Baseline (full scope)	2035	600	170	60	365
	2040 (87%)	590	155	0	435
PO1 (clean cut)	2035	605	50	140	415

1. Participation determines the overall amount of emissions taken into account in the offsetting calculation, leaving all other international emissions below or above the floating baseline uncovered. More participation means more emissions are taken into account in the offsetting calculation, and therefore less emissions fully excluded.
 2. Participation determines the level of the baseline (the amount of CO₂ emissions not offset) within the amount of emissions taken into account in the calculation.
Participation also determines the amount of socialisation of the growth above the baseline. A decision by a large, emerging economy with a faster growing aviation sector than in Europe to implement and continue to participate in CORSIA would for example lead to Europe offsetting a larger share of emissions. The extent of implementation and continued participation in CORSIA and its enforcement by participating states has a larger impact than oil or carbon price on the outcomes of the options. More detail in Annex 10, Section 5.1.
- ⁵⁷ ICAO estimates: The cost of abatement (CORSIA eligible fuel premium compared to kerosene/tCO₂ abated) around \$600-800 per tCO₂. The cost of abatement for using offsets at around \$10-40 per tCO₂. This means it is 15-80 times cheaper for airlines to buy CORSIA eligible offsets than to use CORSIA eligible SAF. There are a number of uncertainties around prices and also in CORSIA one tonne of eligible SAF is not counted as one tonne of emissions reduced, decreasing the incentive to use fuels. See ICAO, *Assembly Working Paper 28*, August 2025, https://www.icao.int/sites/default/files/Meetings/a42/Documents/WP/wp_028_en.pdf.

	2040 (87%)	600	45	0	555
PO2 (departing flights, medium SAF support)	2035	605	110	75	420
	2040 (87%)	595	95	0	500
PO3 (departing flights, larger SAF support)	2035	605	110	75	420
	2040 (87%)	595	95	0	500

Global international aviation emissions cover inside Europe: domestic and non-domestic; outside Europe: non-domestic only. The far-right column shows emissions that remain without a carbon price. Numbers rounded to the nearest 5Mt.

- **SAF use**

On **support for the uptake of eligible fuels**, between 2028 and 2035, around 40 Mt of sustainable aviation fuel (including 6 Mt of synthetic fuels) compliant with ReFuelEU Aviation Regulation would be used. This SAF use decreases the emissions covered by EU ETS allowances by 130 Mt⁵⁸. All options assume uptake and use of SAF on flights departing the EEA in line with the ReFuelEU Aviation mandates. While ETS-financed SAF support may incentivise higher uptake of SAF, this is not modelled given large uncertainties in this nascent market, high price differentials with fossil kerosene, and to avoid overestimating available supply. However, under PO2 and PO3, the extension of SAF support offers an additional incentive over PO1, making PO3 with a larger amount of SAF support the option with the highest potential for impact on emission reductions. In the modelling, this impact is offset by an overall increase in traffic, so when comparing PO2 and PO3, overall PO3 leads to higher emissions. This is because SAF is mixed with Jet-A (kerosene), and the kerosene emissions are greater than savings from the use of SAF at least until 2040.

6.1.1.6. Maritime

For maritime, the environmental impacts of the baseline and of **PO1** are the same. In both cases, GHG emissions from the maritime sector follow a decreasing trajectory driven by regulatory measures at EU level (as currently legislated) along with future mid-term measures at IMO (once adopted), in line with the IMO 2023 GHG Strategy. By 2050, policy option PO1, which does not cover emissions from smaller vessels, results in residual emissions estimated at 20 MtCO₂e, the majority of which come from small vessels (14 out of 20 MtCO₂e).

The recycling of part of the ETS revenues in shipping in PO2 is expected to accelerate the uptake of GHG mitigation measures in the sector. The establishment of a Sustainable Maritime Alternative Propulsion mechanism (SMAP) would directly support the use and production of renewable and low-carbon maritime fuels by reducing the price gap compared to fossil fuels and support the uptake of clean propulsion technologies, which are both key to unlock the decarbonisation of the sector. This may however come with trade-offs between investment in

⁵⁸ Due to the zero-rating of SAF under EU ETS, the fuel is considered to emit 0 CO₂/tonne of fuel. However, in reality, these fuels still have upstream emissions.

a hard-to-abate sector and possible other revenue uses for more cost-efficient emission reductions in the short-term.

As regards **anti-evasion** measures, the lowering of the container transshipment incidence threshold to 50% contemplated in PO2 would marginally increase the ETS maritime scope in the short-term (+0.2% compared to current situation). The other anti-evasion measure regarding **offshore ships**, is expected to lead to an overall small net reduction in ETS scope emissions.

The extension in PO2 of the current maritime **derogations** beyond 2030 for ice-class vessels, small islands, outermost regions and transnational public service contract or public service obligation, would lead to 5 MtCO_{2e} per year being excluded from the ETS scope (corresponding to around 5% of all ETS scope maritime emissions in 2024).

The **IMO deduction measure** included in PO2 to address the risk of double payment in case payments for emissions are made at IMO level is not expected to alter the environmental integrity of the ETS system as the measure comes together with an obligation to cancel a similar amount of ETS allowances. The IMO deduction measure is applicable to all ships without discrimination, which are subject to EU ETS and whose emissions would be priced under a future IMO global measure. The deduction is expected to have positive environmental impacts at international level as it ensures that the EU ETS is adjusted in coherence with the IMO decisions. At the same time, the application of the EU cap-and-trade system to the EU maritime emissions not priced by a future IMO measure allows the EU to deliver on its climate targets and on international climate contributions in the UNFCCC context, including the EU submission of an updated Nationally Determined Contribution (NDC) for 2035.

The **extension of the ETS to most emitting categories of smaller vessels** in option **PO2** would increase the ETS scope by 11.3 MtCO_{2e} (13%). Overall, PO2 would result in much lower residual emissions by 2050 (-41.3% in comparison to PO1) and it would lead to a cumulative reduction in GHG emissions of around 5% over the period 2030-2050 in comparison to PO1 and the baseline (considering all vessels above 400 GT). It would also lead to an increase in the uptake of renewable fuels in the sector, by around 2% by 2040 and 5% by 2050.

The environmental impact of option PO3 for maritime is relatively comparable to the outcomes of PO2. The main difference is driven by the extension of EU ETS to more smaller vessels (including fishing vessels and non-commercial yachts), which would increase the ETS scope by 14.6 MtCO_{2e} (+17%). Overall, PO3 would lead to a cumulative reduction in GHG emissions of 6.2% over the period 2030-2050 compared to the baseline.

In **sum**, the extension of the ETS to smaller vessels in PO2 and PO3 would increase the scope of emissions under ETS whereas the IMO deduction measure would diminish it (depending on the scope of emissions priced under a future IMO measure). Extending derogations (the same for PO2 and PO3) would diminish the emissions under ETS further by some 5 MtCO_{2e} per year.

6.1.1.7. Carbon leakage prevention

The impact of the policy options on carbon leakage is assessed via the GEM-E3 model. The GEM-E3 model only partially considers the increased scope of the EU ETS envisaged under PO2 or PO3, via the inclusion of waste emissions under the EU ETS, but it is not able to consider the particular effects of other measures in the policy options. Given that each of the policy options include different free allocation distributions across industry, the model run from GEM-E3 provides insights into how each policy option results in different impacts in terms of carbon

leakage. Additionally, the extension of EU ETS sectoral coverage is examined to include also waste emissions in PO2 and PO3. PO2 includes only municipal waste incineration (MWI) in EU ETS while PO3 includes all waste emissions under EU ETS.

The evaluation findings confirmed that in the previous period there was little evidence of carbon leakage due to the relatively low carbon price and the high share of free allocation compared to emissions. However, this also has the effect of reducing the incentives to reduce emissions and invest in the decarbonisation. The revision of free allocation rules for Phase IV already moved in that direction to balance the need for carbon leakage protection and the need to encourage the reduction in emissions by developing a more targeted carbon leakage list, more ambitious benchmarks, and the introduction of adjustments to allocation to better consider changes in activity levels. The reforms to free allocation considered in this assessment continues in this direction, aiming to ensure a fair balance between safeguarding current competitiveness of European industry and encouraging emissions reductions and investments to promote long term competitiveness. The following reforms to free allocation are reflected in the policy options:

- In PO1, free allocation is reformed in accordance with the CL1 measure, which assumes a continuation of free allocation for non-CBAM sectors based on the existing rules, but with some streamlining and simplification.
- In PO2, free allocation is reformed in accordance with the CL2 measure, which assumes that a progressive share of free allocation is conditional on investments with two variants of compliance modelled (i.e. 90% compliance and 50 % compliance). This policy options also includes a revision of the CBAM phase-out factor.
- In PO3, free allocation is reformed in accordance with the CL3 measure, which assumes that free allowances are phased out for non-CBAM sectors at the same rate as for CBAM sectors so that from 2034 onwards no further free allocation is provided to industry.

In addition, scenario variants for PO1 and PO3 marked with R include revised revenue recycling assumptions where analysed, while scenario variants marked with C for PO2 refer to variants with a slow-down of the phase-out of free allocation for the sectors under the scope of CBAM. A more detailed description of the scenarios used in the GEM-E3 analysis can be found in Annex 12, Section 1.4.1.

These reforms to the provision of free allocation that are included within the policy options are compared to the baseline scenario, which considers a phase out of free allocation until 2040.

The conventional approach for carbon leakage assessment considers the emissions that increase in one (not regulated) region whilst decreasing in another regulated region and can be expressed by the following simple formula: *Carbon leakage rate = increase in foreign emissions / decrease in domestic emissions*. However, EU27 EU ETS GHG emissions increase from baseline levels in all policy options, as the ambition level is reduced. Within the limitations of the GEM-E3 model, the results show that as these emissions increase, the ETS sectors covered are not threatened by carbon leakage risks. Instead, the impacts on EU, non-EU and global GHG emissions are presented to discuss environmental implications both at the EU level and beyond.

Emissions are influenced both by the number of free allowances allocated and by the carbon price required to meet the EU ETS cap. In PO2—and especially in PO3—the inclusion of waste emissions in EU ETS results in an increase of the cap, which leads to higher emissions across all EU ETS sectors. In addition, the increase of the cap for PO1 and PO2 result in higher

allocation of free allowances compared to the baseline, thus providing additional protection against carbon leakage. Overall, EU27 emissions increase across most scenarios, driven by three main factors: 1) the number of free allowances allocated in EU ETS sectors; 2) the carbon price required to meet the EU ETS cap and 3) the increase in economic activity observed in all scenarios. At the level of the total economy, EU27 emissions increase because of higher overall activity across all scenarios. The economy wide increase of EU27 emissions ranges between an additional 7 MtCO₂eq in 2040 under PO2, 50 and 46 MtCO₂eq under PO3, compared to the baseline. In terms of sectoral results, the most significant increase of emissions is recorded for the non-metallic sector, with up to 10 MtCO₂eq in 2040 under PO3. Additional details, including figures and insight for selected sectors can be found in Annex 12, Section 1.4.4.1.

Indirect carbon cost (ICC) compensation can provide substantial environmental benefits, since electrified technologies have the potential to provide up to 90% of Europe's industrial heat demand by 2035. Electrification, combined with decarbonisation of electricity supply, therefore delivers a climate benefit. The extent of the benefit depends on the mixture of fossil-based industrial processes that are replaced, as well as the emissions from increased electricity demand. ICC compensation supports the business case for electro-intensive industrial processes by reducing their carbon costs. It is particularly relevant for electrified industrial processes that face an indirect carbon cost and compete with non-electrified processes that emit CO₂ directly and benefit from free allocation. Conceptually, the environmental benefit of ICC compensation is therefore a combination of:

- *Carbon leakage protection:* addressing the risk of electro-intensive industries relocating, due to indirect carbon costs, to areas with less strict climate governance.
- *Incentivising electrification:* supporting the business case for electrification relative to direct emissions, for industries that could electrify their processes.

Under continuation of current policies, the ETS Directive would continue to encourage Member States to provide ICC compensation. Article 10a(6) would continue to apply, outlining the key features of Member States' compensation measures (e.g. they should be based on indirect emission benchmarks corresponding to the most efficient available technologies and emissions of the relevant European electricity production mix). Future State aid rules (which are not the subject of this Impact Assessment) would determine more detailed parameters such as sectoral eligibility and any other conditions that beneficiaries would have to meet.

Policy option ICC1 would continue the State-aid-based approach and propose limited amendments to the ETS Directive's ICC provisions.

In policy option ICC2, an ICC Fund would be established to provide compensation at an EU-level on a harmonised basis in order to reduce distortion of the single market and provide a level playing field for industry. Due to competing claims on ETS auction revenues (see Section 6.1.1.4) the proposed scale of the fund (e.g. 5% of the average revenue for 2031-2040) would be smaller than the potential scale of ICC compensation if all Member States were to provide State aid post-2030 using schemes similar to those currently in place post-2030 (at least 11%, see Annex 12 for analysis of ICC drivers). As a result, Member States would retain the option to provide ICC compensation as State aid, up to the level permitted in the guidelines.

The options' potential environmental benefits would be similar. However, the benefit of ICC2 could be slightly larger since some beneficiaries from an EU fund may not otherwise have received State aid under ICC1.

6.1.1.8. Waste

All sectors in the economy need to decarbonise to achieve climate neutrality in 2050. Under the baseline, emissions from waste incineration and landfills would continue to be mainly covered by the Effort Sharing Regulation until 2030 and are not driven by a carbon price, with post-2030 coverage subject to future review. Emissions from municipal waste incineration are expected to continue increasing at least into the early 2030s in line with recent trends, planned capacity increases and absent additional abatement incentives, while emissions from landfilling are projected to continue to gradually decrease, albeit slower than stipulated due to lagging implementation of the current regulatory framework and remaining responsible for the largest share of waste sector emissions.

Extending the scope of the EU ETS to activities in the waste management sector would increase accountability for emissions in this sector – representing up to 3% of EU GHG emissions depending on the scope of the policy options considered – and provide for increased certainty in delivering GHG emissions reductions, since the cap sets a limit on the emissions that economic operators can account for by surrendering allowances. Such certainty is not possible through other types of measures.

Compared to the continuation of current policies, policy option PO1 would not substantially improve the environmental outcome, only implementing legal clarifications to improve certainty on the current scope.

Policy option PO2 would extend carbon pricing to municipal waste incineration (MWI), driving the largest decrease in cumulative emissions from waste incineration, of -53 MtCO₂eq or -22% over the period 2031-2040 compared to the baseline, with most of the decrease projected to occur in the second half of the decade. The carbon price would provide an economic incentive to reduce emissions cost-effectively at different stages of the waste value chain, through a combination of improved waste prevention, reduction and pre-collection sorting at source and improved post-collection mixed-waste sorting and recycling in the shorter-term, and carbon capture for residual emissions in the medium- to longer-term (as of mid-decade). Both increased recycling and carbon capture provide dual climate benefits in the waste management sector. Increased recycling reduces GHG emissions from waste disposal and generates recycled materials displacing more carbon-intensive virgin materials, while carbon capture reduces fossil emissions in combination with generating biogenic carbon removals. Similar to other hard-to-abate sectors, targeted policy and investment support can advance the business case for carbon capture and strengthen planning and investment predictability. Complementary waste policies under the future Circular Economy Act will contribute to ensure a comprehensive approach by stimulating the single market and demand for secondary materials and circular products, supporting investment in recycling capacity, reducing the landfilling and incineration of used raw materials, and rolling-out upstream producer-oriented policies such as eco-design requirements and strengthened Extended Producer Responsibility (see Annex 13, Section 1.3 for a detailed assessment of how the carbon price can drive behavioural changes, costs and opportunities contributing to emissions reductions). The inclusion of municipal waste incineration installations under PO2 and PO3 will also support the efforts to promote a more circular economy via the use of captured CO₂ as a feedstock through a hybrid downstream accounting for non-permanent CCU products (see Section 6.1.1.9.) by accounting for the downstream emissions associated with non-permanent CCU products.

In policy option PO3, the scope of the EU ETS would also be extended to CO₂-emissions from hazardous waste incineration (HWI) and to methane emissions from non-hazardous landfilling,

leading to a higher amount of overall GHG emissions reductions but a lower amount of municipal waste incineration emissions reductions compared to PO2. How much higher ultimately depends on when, how, and which GHG emissions from landfilling would be included within the scope, i.e. only from future disposal in active landfills or also from historical deposits. Cumulative emissions from waste incineration (MWI and HWI) would decrease compared to the baseline, by -29 MtCO₂eq or -11% over the period 2031-2040, but substantially less compared to PO2. This is mainly due to landfills being the primary driver of overall emissions reductions in this policy option because of the regulatory waste policy framework already in place and a comparatively higher cost-effective abatement potential (see Annex 13, Section 1.3). The Landfill Directive, if fully implemented and enforced, is projected to lead to significant emissions reductions from landfills in the order of -45% by 2040 compared to 2030 and of -55% compared to 2025 (GAINS)⁵⁹, with limited further technical abatement potential for additional emissions reductions. The primary benefit of inclusion of landfills in EU ETS would be to deliver increased certainty and complementary financial incentives supporting the achievement of these emissions reductions⁶⁰. Uncertainty in the quantification of emissions from HWI and landfills under PO3 remains high, including due to the diffuse, long-term and site-specific nature of methane emissions in the latter case. Harmonised monitoring and reporting frameworks to collect standardised, robust and verified emissions data prior to inclusion would be important to ensure a high degree of integrity in the system.

The waste-specific risk of emissions leakage (distinct from the risk of carbon leakage for industry in general discussed in other sections and assessed separately from the environmental risk of waste diversion in Section 6.1.2.5.) associated to waste diversion to other waste disposal processes or third countries is considered limited under all policy options. Under PO2, the risk of emissions leakage to landfills is contained by the zero-rating of biogenic emissions in incineration, limiting the incentive to divert organic waste to landfills – the main source of methane emissions – to circumvent the carbon cost. PO3, by including methane emissions reductions in landfills, would address any residual risks of organic waste diversion from incineration to landfills. Emissions leakage risks to hazardous waste incineration are limited by technical and operational constraints, higher costs, and strict regulatory requirements under PO2 and would be absent under PO3. Finally, the risk of emissions leakage to third countries is limited by the strict regulatory framework on waste exports in place (Waste Shipment Regulation – see Annex 13, Section 1.5).

6.1.1.9. Carbon Capture and Utilisation

The policy options that include an extension of the scope of EU ETS to include the waste sector (i.e. PO2 and PO3) are also accompanied by new accounting measures related to the storage and utilisation of captured CO₂ as a feedstock in non-permanent CCU products. In comparison to the baseline, PO2 and PO3 both include the implementation of the policy measure CCU3 providing a hybrid downstream accounting for non-permanent CCU products other than e-fuels and midstream accounting for e-fuels, as explained in Section 6.2.7.

⁵⁹ Emissions from landfilling could not be modelled in the PRIMES model as the scope covers CO₂ emissions only, whereas landfill emissions are mainly driven by CH₄. Landfill emissions have been separately modelled in GAINS.

⁶⁰ GAINS does not allow to separately model the disaggregated contribution of the carbon price to emissions reductions from non-hazardous landfilling under PO3.

The inclusion of such accounting options under PO2 and PO3 will support the efforts to promote a more circular economy via the more efficient use of materials that will also have a downward impact on GHG emissions. Numerous sectors and services rely on carbon, so they cannot be “decarbonised.” The use of captured CO₂ as a feedstock can provide a source of carbon for producing fuels, chemical and materials and ensure that these sectors can eventually be de-fossilised. The transition to alternative source of carbon is, therefore, an important part of reaching the EU’s climate targets⁶¹.

However, the accounting approach included PO2 and PO3 also leads to the possibility of creating loopholes risking the ETS integrity. In case the downstream emissions associated with non-permanent CCU products take place outside of the ETS scope, then those emissions are not accounted and priced within the scope of the ETS system, creating a potential loophole to the EU ETS.

A detailed analysis on the potential risk of loopholes is presented in Section 2 of Annex 13. The results of the analysis found that most potential non-permanent CCU products, such as synthetic polymers or plastics, are not likely to lead to any significant loopholes as regards the integrity of the EU ETS. Under PO2 and PO3, the downstream emissions from these non-permanent CCU products that are combusted in waste incinerators or other ETS installations will fall within the scope of EU ETS. If these non-permanent CCU products receive a different end-of-life treatment, such as recycling or landfilling, they would not be altered chemically and the CO₂ embedded in them is likely not to be released throughout the waste management process.

CO₂ used to produce e-fuels will also not represent a loophole risk, as their combustion will mostly occur within the scope of the EU ETS, in sectors such as maritime and aviation. E-fuels are also subject to specific certification requirements and are easily tracked across the value chain. However, to avoid undercounting of emissions used to produce e-fuels would necessarily mean that it is not possible anymore to zero-rate the emissions from the combustion of these fuels.

When specific loopholes are identified and are associated with clearly identifiable CCU products or applications, the risk can be best addressed by applying the upstream accounting as a derogation to a general rule or setting additional requirements or limitations to the use of such products to minimise the risks. Nevertheless, addressing all possible loopholes risks is not feasible in practice without severely restricting the use of non-permanent CCU applications, and therefore limiting their development and foregoing the benefits they bring. Given the low volumes of CCU products currently being produced, these risks are only hypothetical. Therefore, it is preferable to adopt an approach that regularly assesses the effective risk posed by non-permanent CCU to the integrity of the ETS and introduces corrective mechanisms if and when such risks start having a material impact. For a more detailed analysis of the risks of undercounting emissions, see Annex 13.

⁶¹ Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Towards an ambitious Industrial Carbon Management for the EU, COM/2024/62 final, 6.2.2024, <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52024DC0062>.

6.1.2. *Other environmental impacts (e.g. biodiversity and pollution)*

6.1.2.1. Removals

Broadly speaking, the more effective a measure is at incentivizing CDR deployment (see Section 6.1.1.2), the higher the effect of additional biomass use is expected to be. In PO2 and PO3, the operator integration routes would likely see little effect on additional biomass use during the 2031-2040 period, except if further CDR policy support is put in place. PO3 would have the additional effect of the reduced scarcity in the system by setting a gross cap with 1-in-1-out approach, making technologies such as BioCCS even less competitive. In the presence of CDR support outside the ETS however, these measures would see an increase in biomass demand in line with biomass eligibility criteria and the relative cost competitiveness across CDR technologies, bounded by the CDR limit. PO1 would provide more predictable support through the public purchasing programme, and thus affect biomass use accordingly. However, the primary levers in addressing risks from biomass over-reliance lie not in measure selection, but primarily on the establishment of strict sustainability criteria, accounting for indirect land-use change, and effectively internalizing externalities from biomass use, which are under different regulatory frameworks. Under the CRCF operators generating carbon removals need to comply with the do no significant harm principle and additional specific requirements related to the type of carbon removal activity they are operating (see Annex 8 – Part II, Section 3.1.2.4). Additional sustainability criteria beyond the CRCF methodologies are not considered for the removal units to be included in the ETS. However, in a wider context, the incentive structure for biomass should be reviewed. NGO's OPC responses highlighted this as a general concern regarding the integration of carbon removals in the EU ETS.

6.1.2.2. Instruments to support investments

The IDB is expected to generate broader environmental co-benefits beyond greenhouse gas emission reductions, including lower air pollutant emissions (such as NO_x, SO_x and particulate matter), reduced resource and water use, and less waste generation. It can also improve the environmental performance of industrial sites and support more circular production models, while potential local trade-offs are managed through existing environmental safeguards and permitting. However, the differences among IDB options in terms of allocation method, support formats and geographical balance would only have marginal differences.

Under the current ETS Directive, the Modernisation Fund is instrumental in phasing out solid and liquid fossil fuels in Member States which are heavily reliant on them for the provision of electricity and heating. Under the baseline scenario (discontinuation of the MF in 2030), investments available to such activities can be expected to diminish.

Under all considered policy options, the Modernisation Fund would continue to support beneficiary Member States in reducing their dependency on fossil fuels, with an even greater impact on the reduction of liquid fossil fuels, which would be either fully excluded or strictly limited. All options also reduce support to waste-to-energy.

Phasing out fossil fuels and support to waste-to-energy has positive co-benefits for health and the environment through increased air quality and reduced air pollution control costs.

6.1.2.3. Aviation

The baseline has the lowest NO_x, PM_{2.5} and overall climate costs, calculated in line with PRIMES external costs for non-road transport and the carbon values of the Commission handbook of external costs of transport (2019) see Table 7 for details. Costs from CO₂ in 2040 are 4% above the baseline for PO1, and 2% above the baseline for PO2/3.

Table 7: Total estimated externality costs

Total estimated EEA externality costs (PM and NO_x include all non-road transport), cumulative costs for 2024-2040				
Policy option	Costs in EUR bn (2023)			
	Local NO _x	PM _{2.5}	CO ₂	Total
Baseline (full scope)	12,720	79	674	13,472
PO1 (clean cut)	12,871	79	699	13,650
PO2 (departing flights, medium SAF support)	12,864	79	687	13,630
PO3 (departing flights, larger SAF support)	12,880	80	689	13,649

6.1.2.4. Maritime

As regards **air quality** and related emissions of PM_{2.5}/PM₁₀, NO_x and SO_x, from maritime transport, PO2 and PO3 have a marginally lower air pollution impact of -0.06% and -0.05% respectively, in comparison to option PO1 and Baseline, in terms of monetised air pollution impact over the period 2030-2050. The drivers for the air pollutant emission reduction are the switching to fuels with lower local emissions (e.g. LNG, renewable and low-carbon fuels, or electricity), as well as the energy efficiency improvements of the ships within the smaller vessels segment. The very small differences between PO1, PO2 and PO3 are consistent with the nature of the proposed measures, considering that the focus is on ETS coverage, compliance rules and governance aspects.

6.1.2.5. Waste

Action is needed at different levels to move waste up the waste hierarchy. Many Member States are currently not on track to achieve their 2025 and 2030 recycling and recovery targets under the EU's environmental policy framework.

Extending carbon pricing to GHG emissions from municipal waste incineration (PO2) can provide an important complementary financial incentive supporting the circular economy by making waste prevention, recycling and reuse more financially competitive through the application of a carbon price on waste management processes further down the waste hierarchy. PO2 is additionally projected to lead to improved air quality for citizens, as increased waste reduction, prevention and recycling incentivised by the carbon price signal reduces harmful emissions by reducing or diverting materials like plastics and organics from incineration, thereby lowering the formation of air pollutants and toxic compounds. Member States with high recycling rates are overall found to have lower environmental life cycle costs than those with high disposal rates. In isolation, PO2 carries a risk of waste, in particular fossil waste streams, being diverted from incineration to landfills where no effective regulatory or fiscal policies (reduction targets, taxation, bans on organic and combustible waste streams sent to landfilling) to discourage landfilling are in place. In those cases, higher compliance and operational costs for municipal waste incineration may further increase the cost differential with landfilling, incentivising some operators or waste producers to look for cheaper treatment or disposal routes, which would run counter to the waste hierarchy. This was also consistently raised in the public consultation, with a majority of respondents stressing the need to address potential risks of diversion to landfills.

The EU has a comprehensive framework to reduce landfilling in place. However, implementation varies significantly across Member States and national regulatory and fiscal measures differ widely in scope, enforcement and impact. In addition to PO2, the harmonised

price signal on biodegradable organic fractions under PO3 can contribute to reduce landfilling and land and groundwater contamination from leachate. However, PO3 does not substantially address the risk that waste with high fossil waste fractions or fossil fractions separated from mixed municipal waste could be diverted to landfills to circumvent the carbon price on incineration. The simultaneous implementation and enforcement of effective complementary waste policies to discourage landfilling therefore remains crucial under all policy scenarios. In terms of incentivising waste treatment higher up the waste hierarchy, the additional impact of the application of the carbon price to hazardous waste incineration is expected to be more limited, especially for highly hazardous substances required to be disposed at high temperatures, as there is generally lower technical and regulatory flexibility in treatment options for materials that cannot be safely recycled, recovered, or treated by other means. The risk of waste diversion to exports to third countries under both PO2 and PO3 is considered to be limited as a result of legal restrictions under the Waste Shipment Regulation, with stricter rules and enforcement upcoming from 2027.

6.2. Economic impacts

This section assesses the economic impacts associated with the different policy measures that make up the three policy options. It is not an assessment of the economic impact of the climate ambition itself, which was analysed as part of the 2040 Climate Target Impact Assessment. The focus of this assessment is on whether the policy options will impose additional costs (i.e. ETS price or administrative) on business and, if so, how might this impact upon their competitiveness. These impacts will also be considered specifically for SMEs and the impact of the policy options more broadly on the functioning of the internal market and the impact on public authorities will also be carefully assessed.

6.2.1. Cost of compliance

The cost of compliance refers to the impact of the policy measures on the carbon price and the cost for installations to comply based on their exposure to the ETS price.

6.2.1.1. Carbon removals

The integration of removals is expected to help with cost containment, especially for hard to abate sectors by putting downward pressure on the allowance price over time. Compared to the baseline⁶², all of the policy options will provide greater flexibility for the cost of compliance, but the impact is likely to vary depending upon how removals are integrated into the EU ETS. The net effect on compliance costs would depend among others on marginal abatement costs, on the removal supply curve and on complementary CDR support instruments.

Under PO1, a net cap with integration of removals through a public authority, it is expected that the allowance price goes down as compared to the baseline in line with the increased availability of allowances as removal-backed allowances via auctions. Indeed, it is associated

⁶² The baseline is a net cap (adjusted to the relevant ambition level and all other changes in the policy options), as no additional emissions space would be provided through the integration. The ETS could eventually progress to absolute zero, unless removals would be generated elsewhere to compensate for the ETS having a positive cap, or it would be replaced by another system. For options on the future of the ETS in case of no integration of removals, see Stephanie La Hoz Theuer, Victor Ortiz Rivera, Katja Biedenkopf, *ETS, Reloaded? Designing Emissions Trading for Net-Zero and Net-Negative Societies*, Secretariat of the International Carbon Action Partnership, March 2025. Berlin, Germany, https://icapcarbonaction.com/system/files/document/ets-reloaded-paper_final.pdf.

with potentially lower ETS prices, as shown below, as it introduces two positive effects of regulatory intervention:

- (i) a reduction in capital risk premiums for removal operators, due to the guaranteed purchase of removals, and
- (ii) for industry emitters, a guarantee of removals availability that provides greater compliance certainty.

Overall, public intervention is expected to provide a mutual benefit to both emitters and removal operators through greater predictability and reduced market risk.

Under PO2, a net cap with direct integration of removals and a limit, it is expected that removal units increase compliance unit supply and affect allowance prices primarily if and when marginal abatement costs equal or exceed marginal removal costs, although expectations of future CDR cost declines and availability can lower EUA prices before parity is reached.

Under PO3, a gross cap with direct integration of removals, the regulator would increase the number of conventional allowances in circulation through an increase in allowance auction volumes distributed throughout the period. The increase in conventional allowances would not be conditional on removal units coming in. This would reduce scarcity in the EU ETS and exert downward pressure on the price – thereby reducing compliance costs compared to the baseline. Conversely, the use of removal units would trigger the cancellation of a conventional allowance from future auctions, potentially creating an upward price pressure⁶³.

The effects of the different integration options can be shown through either higher or lower discount rates, representing higher and lower risks for removals operators, which impact the removals price and therefore the ETS price in PO2 and PO3. In the modelling results, PO1 actually operates with a higher number of removals than those considered in the design of the policy option, due to removals becoming more attractive: more certainty leads to lower interest rates for investments, and thus to lower removals prices, and higher removals amounts. Thus, PO1 prices are affected indirectly through the increased of supply.

6.2.1.2. MSR

The MSR reform impacts compliance costs because MSR rules and parameters interact with all other elements in a given policy option (in particular as regards cap trajectory, removals integration and sectoral scope), to alter the allowance supply and demand, and therefore EUA prices. These will result in different compliance costs that will impact the standing of businesses across the economy. Three main indicators can be considered in the analysis of economic impacts of the MSR: future prices, price volatility and the TNAC-to-emissions ratio as a measure of market balance / liquidity. As explained above, the MSR1 design was chosen for PO1 and the MSR3 design for PO2 and PO3 and were tested for an EU ETS contribution to the 90-85% economy-wide emissions reduction target. The results for PO2 and PO3 are identical given certain MSR modelling limitations as regards the integration of removals and

⁶³ The year a removal unit is used instead of a normal allowance, the total emissions space in that year is higher. As an allowance is cancelled in a later year, the total volume doesn't change, but the distribution of those allowances. This creates temporal arbitrage opportunities. If arbitrage is perfect, frictionless, and without cost, this has no effect on prices in any years. If instead it is fully sticky, then the allowance price would be lower in the year the removal unit is used, and higher in the later year where fewer allowances are auctioned. Reality will lie between these two extremes, meaning a higher price volatility under PO3 than the other policy options.

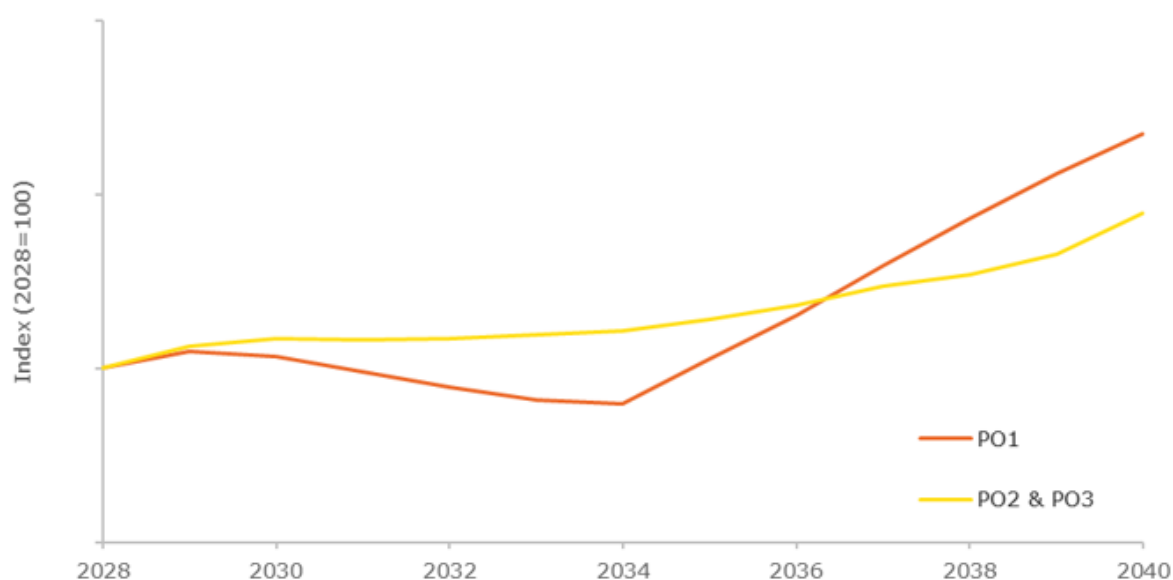
the different sector scope in the two policy options (see more detailed explanations in Annex 8).

The modelling provides estimates of the TNAC trajectory and corresponding MSR operations (intakes and releases) for each policy option, which impact the indexed carbon price trajectories. The EUA price evolution was simulated using the POLES-Enerdata model, based on a supply-demand equilibrium. In Annex 8, indexed price curves are presented to illustrate overall annual price trends compared to 2028. Such illustrations require careful interpretation as modelling relies on uncertain assumptions and may not capture actual short term price movements, which can be driven by other factors outside the scope of this assessment. The indexes are therefore used to illustrate trends - such as relative annual price increases and directional movements - and to serve as a comparison framework across policy options, rather than to deliver precise price forecasts. This approach applies to all measures modelled in Annex 8.

For PO1, the MSR1 design leads to an EUA indexed price that gradually increases until 2029, but then declines until 2034, which could potentially send mixed signals to actors investing in decarbonization. Then, the price increase after 2034 is steep and steady, as faster decarbonisation needs to be triggered to reach the 2040 target. However, this could prove challenging for regulated entities facing rapidly rising carbon costs and having limited time to adjust and decarbonize their activities. The indexed price curve in this policy option therefore depicts a lack of continuity in market tightness across the studied horizon.

For PO2 and PO3, the MSR3 design allows for a monotonic and steady increase in the price throughout the period, indicative of a healthy supply-demand balance on the market. More generally, the MSR3 design used for PO2 and PO3 brings a form of stability to the EU ETS price signal, with a progressively increasing price signal, providing a well-balanced environment for actors to invest in decarbonization activities while leaving them time to undertake the necessary transformations (i.e. not exposing them to rapid price increases).

Figure 5: MSR Policy options results – indexed EUA price evolution



Source: Own visualisation derived from POLES-Enerdata model

It is important to note that within-year price volatility cannot be assessed quantitatively with the modelling approach employed in this analysis. In addition, all the policy options assessed share the same Article 29a release mechanism, whose objective is to address high price movements, so cannot be distinguished in this regard. More generally, high price volatility, whether within-year or inter-annual, tends to occur in markets characterised by low liquidity.

Nonetheless, the inter-annual variability of the price paths shown reveals information about the comparative stability offered by the different policy options. As explained above, PO1 exhibits a notable price dip around 2030-2034, followed by a rapid and steep increase through to 2040, which would prove challenging for regulated entities facing such a price trajectory. In contrast, PO2 and PO3 demonstrates first a stabilisation of prices in the period of 2030-2034, followed by a progressive, monotonic price trajectory until 2040, offering a credible and steady price signal that facilitates long-term investment planning.

Market liquidity

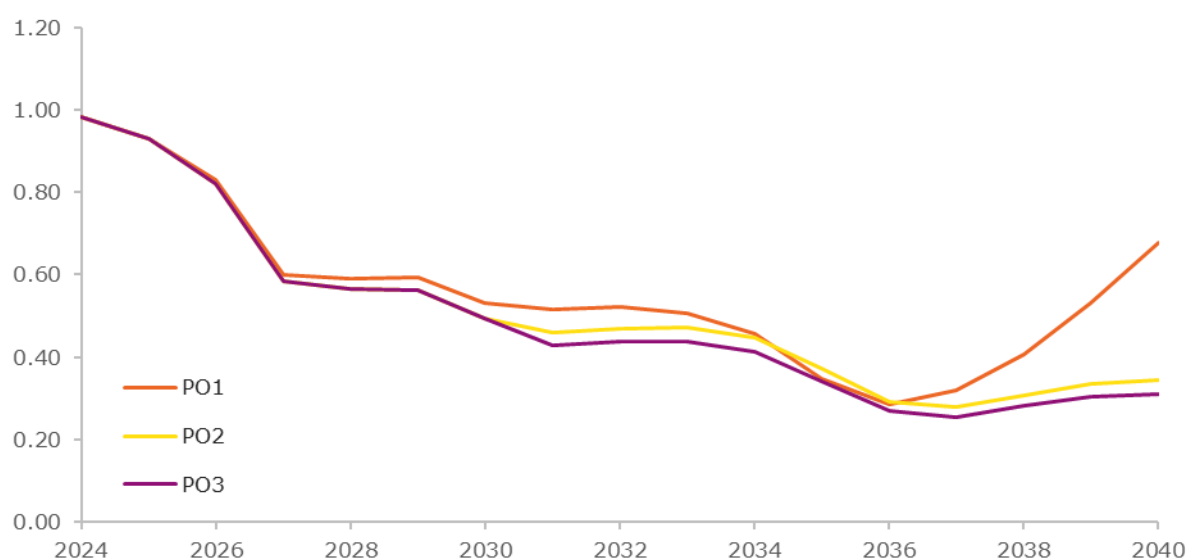
The TNAC-to-emissions ratio is used as an approximate measure of market liquidity. In all policy options, the ratio decreases from its high historical values to about 0.6 for the 2027 TNAC, given the downward TNAC technical adjustment for the historic net aviation demand in 2012-2023 of approximately 173 million EUAs. The ratio then slightly decreases by 2030, after which it diverges in the different policy options.

In PO1, the decrease continues slowly until 2036 to 0.29, a year after the first MSR release takes place. After that, due to the continued annual releases, the ratio rises again and reaches its maximum value of 0.68 in 2040, exhibiting a u-shaped pattern.

Starting in 2027, the PO2 & PO3 options include extra-EU aviation one-way emissions, not included in PO1, explaining the slight translation between their respective trajectories after 2027 (before other factors make them diverge further). Likewise, the inclusion of hazardous waste and landfills emissions from 2031 in PO3, not covered in PO2, creates the translation between their respective curves, otherwise comparable in evolution.

For PO2 & PO3, the ratio starts to increase again in 2038, due to the first MSR releases, and then oscillates in a narrow band, maintained by ongoing releases by the MSR, suggesting a steady state for this indicator. The spread of the ratio for the 2027-2040 period is slightly lower for PO2 (0.28-0.59) than for PO3 (0.25-0.59), although both are within an acceptable range. The PO1 spread is wider (0.29-0.68), and features values on the relatively high range in the last years of the period (above 0.6).

Figure 6: Policy options results - TNAC-to-Emissions ratio



Source: Own visualisation derived from POLES-Enerdata model

6.2.1.3. Instruments to support investments

The IDB by providing the support to investments will help the industry to stay on the net-zero trajectory. It thus helps to avoid higher compliance costs for industry stemming from further increases in the ETS carbon price that would have happened in case investments do not materialise or are delayed.

Considering the role of the IDB to contribute to ensuring that the investments foreseen in the 2040 climate target modelling materialises, there should be a limited/no impact on the ETS carbon price that was modelled. In the modelling exercise investments happen due to the carbon price trajectory and regulatory framework, fully implemented and perfectly integrated in the decision-making of all economic actors. In reality, however, there will still be shortcomings compared to model-based exercise and those shortcomings need to be addressed by the support mechanisms.

The IDB has no compliance costs for the ETS installation, instead it will turn the ETS resources into the investment support for the industry so that the industry can follow the net-zero trajectory. The magnitude of this support will vary across the IDB options primarily due to type of support (fixed or variable premium) and even more granular support features than those analysed in this Impact Assessment, e.g. the size of fixed premium.

6.2.1.4. Aviation

Compliance costs for aviation are made up by ETS compliance costs (minus benefits from ETS-financed SAF support) and CORSIA compliance costs, as applicable in the different policy options. Costs for compliance with ReFuelEU Aviation are out of the scope of this Impact Assessment. Administrative costs are limited and covered in Section 6.2.2.3. In the baseline, **ETS compliance costs** are highest, because the ETS scope is largest. When looking at 2035, ETS compliance costs are lowest in PO3, where ETS-financed SAF support is highest. ETS compliance costs are highest in the baseline, and second highest in PO2, where the ETS scope is the same as in PO3, but ETS-financed SAF support is modelled to have run out. ETS compliance costs are mostly channelled back towards climate action: either through revenues

for Member States, which they must use towards climate purposes (in the sector of their choosing), and/ or for allowances for the support of uplift of eligible SAF which are set aside before the revenues reach Member States. Most revenues are set aside for ETS-financed SAF support in PO3, and least (none) in PO1 and the baseline. The baseline and PO2 result in the highest revenues for Member States, as the ETS scope of application is larger (largest in the baseline) and SAF support is smaller (none in the baseline). See Annex 10, Section 3.1, tables 13 and 14.

CORSIA compliance costs depend on the level of participation of third countries (see Annex 10). CORSIA compliance costs are highest in PO1, since it assumes highest implementation of CORSIA by third countries. CORSIA is currently implemented in EU law until the end of 2026, therefore CORSIA costs are zero in the baseline. For all policy options, CORSIA costs are zero after 2035, as this is when CORSIA is set to end. In PO2/3, CORSIA costs are lower than in PO1, because it is assumed that fewer third countries implement the scheme. An important characteristic of this Impact Assessment and the Commission approach is that it **avoids double pricing emissions** – for each tonne of CO₂ emissions, airlines either pay the ETS carbon price, CORSIA offsetting, or no carbon price (if an exemption applies): airlines pay at most once per tonne of CO₂ emissions, never more than once, because PO2/3 allow for the deduction of CORSIA offsetting costs from ETS costs. This is taken into account in all modelling. CORSIA compliance costs are expected to nearly exclusively go towards the purchase of offset credits which are located in third countries outside Europe, for example Guyana (for detail, see Annex 10, Section 5.1).

6.2.1.5. Maritime

For maritime, the Baseline and PO1 have similar economic impacts in terms of compliance cost.

The increased **recycling of EU ETS revenues** to support the decarbonisation of the maritime sector would reduce costs across all vessel sizes. PO2 assumes that 50% of the ETS revenues generated by the maritime sector are going back to the sector, through national support programmes or the implementation of an EU ETS support mechanism for sustainable maritime propulsion, that would notably help bridging the price gap between renewable and low-carbon fuels and the use of fossil fuels. If designed in a way similar to the present SAF in aviation, the establishment of such a mechanism to support sustainable maritime propulsion would lead to 46 million EUAs being attributed to bridge the price gap between sustainable propulsion and fossil fuels over 2031-2040.

The extension of **existing derogations** in PO2 would reduce compliance costs for shipping companies compared to the baseline, corresponding to the none-surrendering of around 5 million EUAs.

The **application of the IMO deduction in PO2** would lead to lower compliance costs for vessels subject to both the EU ETS and the IMO mid-term measure (once adopted), compared to PO1 and the Baseline. It would prevent double regulation and double payment for the same emissions, while ensuring that emissions are always priced at a level at least equivalent to that of the ETS. The economic impact of the IMO deduction depends notably on the stringency of the IMO measure once adopted and the respective decisions of each ship regarding the use of fuels.

The **extension of the EU ETS scope to emissions from smaller vessels** contributes to a modest increase in total shipping costs in **PO2** compared to PO1 in 2030 and an increase of 1.6% in 2040 and 1.5% in 2050. In comparison to PO1 and Baseline, in PO2 it is expected that

companies responsible for smaller vessels will face a total shipping costs increase of EUR 1.2 billion in 2030, EUR 1.8 billion in 2040 and EUR 0.7 billion in 2050. These additional costs correspond to ETS payments but also to fuel costs and capital expenditure associated with decarbonisation measures within the segment. It should further be noted that smaller vessels are also eligible to benefit from existing maritime derogations under ETS (i.e. for outermost regions, public service contracts/obligations and ice-class ships), which would partially offset any compliance cost.

While the application of the cancellation mechanism accompanying the IMO deduction measure in PO2 would lead to reduced **ETS revenues**, the extension of the ETS scope to small vessels will increase ETS revenues. Depending on the stringency of the global measure, the fuel used by shipping companies and the scope of the priced emissions, the combined impact of these two factors will result in a net gain or net loss of the ETS revenues over the period 2030-2040 in PO2.

Similar to PO2, **the competitive and economic impacts of option PO3 for maritime**, are mostly driven by the extension of EU ETS to smaller vessels. Inclusion of all smaller vessel categories instead of only the most emitting ones (as in PO2) incurs only marginally higher compliance costs when considering the entire fleet.

Since **PO3** does not differ to PO2 as regards the application of the IMO deduction, derogations, the recycling of ETS revenues into decarbonisation measures within maritime sector as well as additional anti-evasion measures, the impacts in PO3 are only impacted by wider extension of ETS to all small ships. In comparison to PO1 and Baseline, in PO3 companies responsible for smaller vessels will face a total shipping costs increase of EUR 1.5 billion in 2030, EUR 1.9 billion in 2040 and EUR 0.5 billion in 2050. As for PO2, changes in ETS revenues depends on the amount of allowances to be cancelled under the IMO deduction measure, which would in turn largely depend on the level of ambition of the global measure.

In sum, the recycling of EU ETS revenues back to maritime sector is expected to incentivise the use of sustainable propulsion fuels and clean technologies and reduce costs of energy transition in shipping. The IMO deduction measure in PO2 and PO3 also ensures that emissions priced under IMO global measure (once adopted) are not priced for the second time under EU ETS, avoiding therefore double payment. The concrete economic impact on each shipping company will depend on the stringency of the global measure and the fuels used on board each ship. The prolongation of derogations contemplated in PO2 and PO3 leads to avoided costs for shipping companies, which could help support the connectivity of islands and outermost regions but delay at the same time investments for decarbonisation. The economic impacts linked to the inclusion of smaller vessels in PO2 and PO3 are relatively modest when considering the costs for the whole fleet. It also brings some positive effects in terms of level playing field with the larger vessels that are already subject to EU ETS.

6.2.1.6. Carbon leakage prevention

The different carbon leakage protection measures described in Annexes 7 and 12 will result in varying free allocation levels for non-CBAM sectors. This in turn will result in different levels of exposure to the carbon price in each of the policy scenario, impacting the carbon compliance costs faced by businesses.

The reforms to the provision of free allocation that are included within the policy options are compared to the baseline, which simply assumes a continuation of free allocation with updated benchmarks (same as CL1), but with a lower free allocation budget as the baseline is set in

accordance with the legal default that sets a more stringent EU ETS cap than assumed in the policy options.

In the baseline, the free allocation is expected to be 778 M EUAs. For the policy options, based on the available free allocation budget (see Table 4 in Annex 12) and the policy measure, the resulting free allocation will range between 487 and 990 million EUAs over the period 2031-2040. The equivalent financial volume of this free allocation amounts to over 110 billion EUR for the baseline and between approximately 70 – 170 billion EUR for the policy scenarios (see Table 12 in Annex 12 for additional details).

In terms of the adjustment cost of each policy option compared to the baseline, it would have a positive impact in PO1 and PO2 on the conduct of business as the provision of free allocation would increase compared to the baseline. This primarily reflects the less stringent ETS cap set for the policy options than the baseline, but the extended scope of the EU ETS into waste activities also has an upward effect on the number of free allowances available under PO2 and PO3. However, in the case of PO3 the increase in allowances due to the extension of the scope is offset completely by the rapid phase out of free allocation envisaged under CL3 for non-CBAM sectors and the total number of allowances available is lower than the baseline.

In addition, under PO2, part of the free allocation is made conditional to making investment of equivalent value to that of the free allocation given. This results in an expected level of investment due to conditionalities between approximately 50 and 90 billion EUR, depending on the assumed level of compliance. ICC compensation can prevent carbon leakage and encourage industrial electrification by compensating for some of the ICC cost that electro-intensive industries incur.

Analysis in Annex 12 suggests that the cost of such compensation could be equivalent to 11% of ETS revenues in 2031-40 on average, if all Member States were to provide State aid post-2030 using schemes similar to those currently in place⁶⁴. Among other drivers, this estimate assumes that indirect carbon costs are dampened by the increasing role of non-fossil generation in setting electricity prices post-2030 (meaning that indirect carbon cost accounts for a smaller share of electricity bills). Without the estimated price-setting effect of non-fossil generation, demand for ICC compensation could reach even higher levels (up to 22% of revenues).

Under both ICC1 and ICC2, actual expenditure could be lower than the range given above due to budget constraints and priorities of Member States. However, under ICC2 a minimum compensation level of 5% of the total revenue generated from 2031-2040 would be guaranteed, provided this level of eligible indirect carbon cost can be demonstrated.

6.2.1.7. Waste

Under PO1 (no inclusion of additional waste management processes), no additional cost of compliance is expected compared to the baseline.

Under PO2 (inclusion of municipal waste incineration installations) and PO3 (inclusion of all waste incineration installations and landfills of non-hazardous waste), the effective carbon cost for operators depends on the volumes of waste treated, the share of fossil versus biogenic emissions, the carbon price, the ability of operators to pass on carbon costs to other actors and

⁶⁴ Note that this figure does not take into account i) the forthcoming possibility for some indirect costs to be compensated by free allocation rather than State aid (which would reduce the figure); and ii) the expanded number of sectors eligible for ICC compensation since the December 2025 amendment to the State aid rules (which would increase the figure). See Annex 12 for further details.

the availability and cost-effectiveness of abatement solutions across the waste value chain. Complementary policies and targeted support mechanisms can be essential enabling conditions to provide investment and planning predictability for local authorities and operators, investment support to help manage the impact and implement key decarbonisation pathways, and synergies with circular economy policies to strengthen the market for recycled materials, address upstream producer responsibility and discourage landfilling (see Annex 13, Sections 1.3.1. and 1.3.2.). The extension of the carbon price to waste management operations will generate significant revenues which can be used for targeted investments for these purposes.

Under PO2, the effective carbon cost is substantially reduced due to the zero-rated biogenic share of emissions (roughly half). Compared to the baseline, ETS inclusion can financially incentivise and support investments in carbon capture technology, which is a key decarbonisation pathway for the waste incineration sector to reduce hard-to-abate emissions and contribute towards the economy-wide 2050 climate neutrality target. The integration of permanent carbon removals into the EU ETS can further provide opportunities to mitigate or offset the cost of carbon capture implementation mitigated or compensated through the generation of biogenic carbon removals. The carbon price cost passthrough can also incentivise circular economy policies, such as improved waste prevention, reduction, collection, sorting and recycling, to be more successful, if channelled to targeted and proven waste measures and policies with a positive steering effect, such as Pay-As-You-Throw or weight-based disposal fees (see Annex 13, Section 1.3.1.), reducing emissions and costs at source. While operating costs are expected to vary depending on installation type, size and location, evidence from the national application of the EU ETS to municipal waste incinerators in Sweden and Denmark indicates the carbon cost (2025) represented $\geq 10\%$ of total operating costs prior to the implementation of abatement solutions or cost passthrough.

Under PO3 the cost of compliance differs per type of waste treatment. Costs are expected to be comparatively higher for hazardous waste incineration compared to municipal waste incineration due to a higher fossil content of the waste treated, also leading to a more limited potential for biogenic carbon removal generation. For non-hazardous landfilling, the average effective carbon cost per tonne of waste is projected to be higher than for municipal waste incineration in both absolute and relative terms. At the same time, the assessment indicates a higher cost-effective abatement potential for emissions under PO3 (coming from landfills), with biogas production from landfill gas capture providing a substantial economic benefit potential for operators. The specific associated costs of compliance for the sector would further depend on the scope of PO3 covering only emissions from future landfilling or also emissions from historical deposits before the application of the carbon price. While positive in terms of environmental integrity, the latter scope would pose additional monitoring, economic and operational constraints while not being influenced by pre-treatment or alternative waste management higher up the waste hierarchy.

6.2.1.8. CCU

Compared to the baseline, PO1 represents no change to the current upstream accounting, which continues to reward only the capture of emissions for permanent storage (CCU0). As CCS is not an economically feasible option for all installations that could benefit from carbon capture, upstream accounting effectively restricts the development of alternative technologies that make use of the capture carbon instead of storing it. Therefore, under PO1, the upstream accounting negatively affects the efficiency and effectiveness of the EU ETS in achieving its objectives.

The measure CCU3, hybrid downstream and midstream accounting, included in PO2 and PO3 effectively addresses the issues outlined in the previous paragraph and it enables investments

in carbon capture and non-permanent CCU. This in turn contributes to reduction in costs of CO₂ feedstock and it improves the business case for CCU products. The midstream accounting encompassed in measure CCU3 also best addresses the specificities of e-fuels, for which there is a well-developed regulatory framework already in place.

The hybrid accounting under PO2 and PO3 would incentivise the capture of CO₂ and provide flexibility for operators to decide whether the CO₂ should be stored or utilised in different types of products or applications depending on their particular circumstances (location, access to CO₂ infrastructure and storage, access to green H₂, etc.) and the comparative costs and benefits between storing emissions, or producing different synthetic chemicals, plastics or e-fuels. However, it would also increase ETS compliance costs for e-fuel for e-fuel producers or distributors, responsible for surrendering ETS allowances for the fossil CO₂ used in e-fuels.

6.2.2. Administrative effort for the private sector

The ETS Evaluation Report (see Annex 15, in particular Section 10.4.4.2), based on a survey of ETS installations and the feedback from a reality check workshop, identifies a number of simplification options for the Monitoring, Reporting, Verification and Accreditation (MRVA) system. This includes for example increased use of existing common reporting tool, increased use of default values, and streamlining and harmonising of procedure for competent authorities, which will benefit all ETS compliance entities.

6.2.2.1. Carbon removals

The administrative cost associated with integration of removals is expected to be influenced by the channel through which operators procure compliance units, contract standardisation and market infrastructure, and risk management needs.

Under PO1, a net cap with integration or removals through a public authority, the transaction costs related to CDR purchases for operators under this measure would be lower than under measures where operators would acquire all allowances (including removal-backed ones) through regular ETS auctions or the secondary market. There would be no need to engage in separate procurement of CDR units – from this perspective, the option is the same as the baseline.

Meanwhile, PO2, a net cap with direct integration of removals and a limit, the inclusion of another compliance unit would mean that operators could face higher portfolio management complexity – optimising between allowances, CDR types, and timing, including risk management costs. Nevertheless, for PO2 direct market access through e.g. standardised contracts could minimise intermediary fees.

Under PO3, a gross cap with direct integration of removals, the administrative cost would be similar to PO1 but with additional cost for operators to understand how best to respond to the extra operational complexity from tracking the one-in-one-out mechanics.

6.2.2.2. Instruments to support investments

For the IDB, the measures assessed have different levels of complexity. In terms of allocation mechanism, the ‘regular’ multicriteria calls for proposals as well as the types of support employing ‘regular’ grants and CCfDs, particularly when aligned with dynamic energy vectors prices) require more complex multi-stage evaluations. These processes involve, sophisticated financial modelling, extensive documentation, regular calibration of parameters such as energy price indices, due diligence, grant negotiations and thorough monitoring of emissions reductions and performance milestones. Therefore, these approaches result in higher administrative costs for both the programme and applicants, particularly impacting small and

medium sized enterprises that may lack the necessary resources. In addition, Member State-driven processes can lead to additional administrative burden due to divergences in priorities, sequential consecutive stages of project selection, State aid compliance issues, and fragmented project pipeline.

On the other hand, auctions and administrative schemes as allocation mechanisms and fixed premium grants offer lower transaction costs through standardised terms, price/output-based selection, and simpler compliance (though monitoring remains necessary),

Such simplified mechanisms with performance requirements distilled to key aspects (i.e. GHG abatement) ensure good coverage of all industrial sectors and countries while containing administrative costs across the support lifecycle.

6.2.2.3. Aviation

Administrative effort relating to the EU ETS and CORSIA is shared between the aircraft operators, national competent authorities, and the European Commission⁶⁵. Aviation has been included in the EU ETS since 2012, and aircraft operators have established processes to comply. Therefore, compared to the baseline, none of the policy options increase the administrative effort: the amount of climate action varies, but the tools remain unchanged. In principle the same pool of aircraft operators must comply with the EU ETS and CORSIA as the threshold for inclusion in the EU ETS is always based on the geographic scope of the baseline. Moreover, individual flights are reported either under the EU ETS or CORSIA in any case, resulting in no to very low differences in administrative effort required. For the inclusion of private and business jets in the EU ETS, the Commission proposes considerable administrative simplification for any newly covered aircraft operators as well as further simplification for low activity operators already covered. This includes simplified monitoring and reporting, a waiver of verification as well as exclusion for aircraft operators with very low EU ETS surrender obligation (see Annex 10, Section 7). This assessment applies equally to all policy options.

Administrative efforts for the deduction of CORSIA costs do not apply in the baseline or in PO1. Some administrative costs apply in PO2 and PO3: Operators are already required to report the most important information. National competent authorities handle this information already, whereas the additional effort would concern the deduction of costs and relate to aircraft operators, national competent authorities and the Commission. This would apply until 2035, when CORSIA is set to end (unless a decision is taken to prolong it).

ETS-financed SAF support is prolonged under PO2 and PO3, with conditionalities to further support decarbonisation. All key characteristics of the existing support would be maintained, meaning it would continue to work with minimal administrative effort. This was welcomed by stakeholders in the open public consultation. Additional conditionalities are examined in the context of incentivising decarbonisation and limiting administrative effort (see Annex 10, Section 8).

⁶⁵ Operators need to monitor, report and verify emissions, and comply (i.e. buy and surrender/ cancel EU ETS allowances and CORSIA eligible credits). National authorities manage the system for reporting emissions, control free allocation, administer Union Registry accounts, follow up and enforce compliance and are in direct contact with aircraft operators. The Commission provides the Union Registry, approves free allocation, publishes the list of aircraft operators and administering Member States, publishes annual prices of SAF, publishes all data under transparency provisions, proposes/adopts legislation and guidance documents for harmonised implementation of the system.

6.2.2.4. Maritime

The **simplification measures** in **PO1, PO2 and PO3** aimed at aligning requirements across different regulatory frameworks. They would directly benefit shipping companies and translate, according to conservative estimates, into potential annual savings between 10% and 20% of current annual MRV compliance costs, i.e. up to EUR 9.4 million per year for the entire MRV fleet. These savings would originate from streamlined compliance processes and reduction of existing duplications reducing man-hours and staff costs for companies through the different steps of the compliance process.

The **administrative costs** for smaller ships will increase in **PO2** due to their partial inclusion in the EU ETS and MRV scope. However, the annual additional administrative costs need to be compared to the revenues that ships would be eligible to receive from the support to decarbonise shipping (see economic impacts). Recurrent MRV compliance costs for smaller vessels are estimated on average at EUR 3 690 per year and per vessel (plus one-off costs estimated at EUR 3 193 per vessel). Staff limitations and increased frequency of voyages of smaller vessels have been quoted by some shipping companies as the main reasons for slightly higher monitoring costs in comparison to similar costs for larger vessels. In addition, those shipping companies not previously active under ETS scope, would incur additional administrative costs to familiarise themselves with the ETS rules and set up and manage their Union Registry account. When considering together the MRV and ETS total administrative costs, PO2 would result in additional recurrent administrative costs for smaller ships estimated at EUR 15 million EUR per year. For **PO3**, which covers more smaller vessels, the total additional administrative costs would amount to EUR 30 million EUR per year.

6.2.2.5. Carbon leakage prevention

All the carbon leakage prevention measures include design options that will reduce administrative burden. The main simplification measures introduced in PO1 and PO2 are linked to simplifying or eliminating the need to update the carbon leakage and streamlining the process for applying for free allocation. This simplification will eliminate administrative obligations for EU ETS operators in all the policy measures, with considerable time spent on administration expected to be saved.

However, the extension of conditionalities for free allocation under PO2 would introduce new administrative requirements. The additional administrative cost has been estimated based on the information provided by industrial stakeholders on the person/time spent for different administrative tasks and estimated as one-off administrative tasks for complying with the conditionalities. Considering an average cost of labour across Member States of EUR 40, the average administrative cost for free allocation related tasks amounts to EUR 0.02 per tonne of CO₂. This represents a very small share (approximately 0.026%) of the carbon price (assumed to be EUR 64.74, which was the average price of a EUA in 2024) and it is insignificant in relation to the estimated value of free allocation. Nevertheless, to avoid a disproportionate burden on small installations of the new measures, simplified requirements or even exclusion of small installations can be applied.

The stakeholder consultation involved a series of interviews with industrial associations⁶⁶ and strong views were expressed opposing the expansion of conditionality requirements for free allocation and that any expansion of conditionality would add significant administrative

⁶⁶ Stakeholder interviews were conducted with eleven industrial associations from CBAM and non-CBAM sectors.

burdens to EU ETS operators. However, results from the OPC also showed support for conditionality, mainly among companies and business associations from the energy sector and NGOs.

PO3 will result in the most significant reduction of administrative burden, given that free allocation would be replaced by a partial surrender obligation. Therefore, there would be no administrative costs associated with the application of free allocation (i.e. provision of a baseline data report, monitoring methodology plan and verification plan, etc.). It is important to note that whilst indeed the administrative costs would be lower if PO3 was adopted, this would lead to higher compliance costs.

For additional details on the impact on administrative costs of the carbon leakage protection, see Section 1.4.2.2 of Annex 12.

6.2.2.6.Waste

Extending the scope of the EU ETS to the waste disposal sector under PO2 and PO3 overall relies on the existing system under the EU ETS. For both options PO2 and PO3, one-time administrative costs, regularly occurring administrative costs and costs for disclosure and sanctioning can be identified for competent authorities and for the operators. For PO2, the existing system, processes and infrastructure (such as the Registry) can be used, limiting costs. For PO3, the existing system and processes need to be modulated to a new sector and GHG emissions (diffuse methane emissions from a large number of landfill sites) different to the current system.

PO2 builds on the already implemented MRV requirements for MWI, including the developed monitoring plans, data collection and reporting and verification infrastructure. Additional monitoring and reporting costs under PO2 may result from changes when further detailing tailored harmonised monitoring and reporting standards and protocols for the sector. The administrative burden for a specific operator will vary according to plant size, complexity and the MRV methodology adopted. There are a range of methods available for monitoring emissions from waste incinerators, which have different associated costs. The sector-wide annual MRV costs (assuming 395 installations as reported under the 2024 MRV data) has been estimated in Annex 13, Section 1.4. to range from EUR 7.8 million to EUR 78 million per year, depending on plant size, methodology and specific monitoring requirements (e.g. frequency). Overall, the technical implementation and cost related to MRV have been manageable in light of other reporting obligations and experience already in place, for example under the Industrial Emissions Directive (IED), and the tiered system that incorporates both measurement-based and calculation-based methodologies, along with simplified provisions for smaller emitters, to provide a scalable and proportionate MRV system minimising administrative costs.

Under PO3, the monitoring and reporting framework for hazardous waste incineration would largely build on the framework under PO2, while additional costs may be associated to the development and implementation of tailored approaches due to regulatory and operational restrictions. For landfilling, additional administrative costs for competent authorities and operators are expected to be associated to the development and implementation of dedicated monitoring, reporting and verification rules, standards and protocols under the ETS framework in view of the current lack of established, harmonised MRV approaches to monitor and report methane emissions from landfills. The administrative and operational cost of MRV would be dependent on the methodological approach followed (calculation- vs measurement-based), as well as on the choice of the scope of emissions covered (emissions from future disposal only

or also emissions from historical disposal) (see Sections 1.4.3. and 1.5.1.2.3. of Annex 13 for a detailed analysis).

6.2.2.7. CCU

In terms of administrative costs, the hybrid downstream and midstream accounting (PO2 and PO3) will result in a simplification in the rules applicable for the reporting of emissions in case of the capture of CO₂, compared to the upstream accounting (baseline and CCU0/PO1). Emitters that capture CO₂ will be able to report it as captured (and deduct it from their overall emissions) the amount of CO₂ that has been captured and transferred to another ETS installation, regardless of the purpose, be it for CCS, permanent CCU or non-permanent CCU. This contrasts with the current situation where CO₂ captured for different purposes has different regulatory treatments.

The downstream accounting for non-permanent CCU products other than e-fuels relies on the integration of waste incineration in the EU ETS. However, once included in the EU ETS, there is no difference between the administrative costs for waste incinerators in the upstream accounting (CCU1) or the hybrid downstream and midstream accounting scenario (CCU3/PO2 and PO3). Waste incinerators would continue to monitor and report emissions in the same manner in both accounting approaches.

6.2.3. Sectoral competitiveness, trade and investment flows

6.2.3.1. Cap

The different POs examined in the impact assessment regarding the cap do not change in substantial terms the efforts required by the regulated sectors to decarbonise, and with it their competitiveness, as they have all been chosen to lead to the same emissions reduction objective compatible with the European Climate Law and follow the same cost-efficient 85% trajectory (all POs include measure ‘CAP2’). An analysis of the impact of the ambition level itself was carried out in the 2040 Climate Target Impact Assessment⁶⁷. Of the scenarios assessed at the time, scenario S2 resulted in a -88% net reduction of domestic economy-wide greenhouse gas emissions by 2040 compared to 1990, i.e. equivalent to a use of 2% international credits compared to a 90% target.

In particular, in the 2040 Climate Target Impact Assessment, Tables 17 in Section 6.4.2 of Part 1 and 18 in 6.4.3. show the increase in investment needs in the decade 2031-2040 compared to the previous decade 2011-2020, per major sector of the economy. In the same Impact Assessment, Tables 14 and 15 in section 6.4.1. show the macro-economic impacts on sectoral output and the EU share in global exports respectively, with Table 15 illustrating the difference between a world with globally coordinated climate action and more fragmented action. More details are provided in Part 3 of the 2040 Climate Target Impact Assessment, in particular in Section 2.3.2. on energy system costs and prices for industry, as well as 2.3.6 on sectoral output and international trade. In terms of the measures taken, Section 1.4 of Part 3 shows energy efficiency, fuel switches and carbon capture as applied across different industrial sectors. Below some examples of the modelling of technological change in different industrial sectors towards the 2040 target. For *steel* modelling shows a large reduction in pre-capture emissions

⁶⁷ Commission Staff Working Document: Impact Assessment Report: Part 1: Accompanying the document Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Securing our future Europe's 2040 climate target and path to climate neutrality by 2050 building a sustainable, just and prosperous society, SWD(2024) 63 final, 6.2.2024, <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52024SC0063>.

by more than half due to a strong decrease in blast furnace use, substituted by hydrogen direct reduction technologies. Between 20-40% of the remaining emissions would be covered by carbon capture; residual emissions would be around 35 Mt.

For *non-metallic minerals* cement is the most important source of emissions. Here there is a strong need for carbon capture (70-100 Mt) with residual emissions of around 35-40 Mt. The modelling shows some deployment of low-carbon cement, where limestone is substituted by other, less emitting minerals.

The *chemicals* sector is highly complex, and a combination of electrification, biomass and hydrogen shows around 50% reduction of pre-capture emissions. Around a third of remaining emissions would be captured.

In *other industry sectors* modelling shows large emissions reduction (60-70%), mostly through electrification; there is some limited ability to also apply CCUS.

All policy options support the demand for permanent removals, although at different scales. Those measures that support removals in a more guaranteed manner (PO1) will support the competitiveness of EU both in carbon removals and broadly industrial competitiveness by allowing more space for emissions in the EU. The ultimate impact on the removals industry, however, will depend on support measures that may complement each policy option. E.g. PO2 with carbon contracts for difference (CCfDs) can have a greater incentivisation of carbon removals as it leads to an initial scarcity and higher ETS price. PO3 complemented with CCfD at the level required to incentivise the same level of removals as included by the public authority in PO1, could lead to similar results. Conversely, the options with highest guaranteed of removals can also lead to most abatement deterrence, having a detrimental effect on the competitiveness of decarbonised technologies in the EU ETS sectors (see Section 6.1.1.2 on abatement deterrence and CDR support).

The following table gives an illustration of investment needs and energy system costs in CAP 3 “9085” scenario. The numbers shown are a range of results from PRIMES and POTEnCIA models, illustrating the intrinsic uncertainties involved.

Table 8: Annual investment expenditure, energy related excluding transport in CAP 3 “9085” scenario

Annual Investment expenditure (energy related excl. transport)	EUR bn'25		%GDP	
	2021-2030	2031-2040	2021-2030	2031-2040
Industry	40;45	30;40	0.2%	0.2%
Supply side*	110;120	140;175	0.6%;0.7%	0.7%;0.8%

*includes power generation and production of new fuels.

Note: rounded to closest 5. Source: range over PRIMES and POTEnCIA models.

While the 2040 Climate Target Impact Assessment is the primary source for the impacts of the overarching ambition level, the impacts of CAP2 “85” cap trajectory are shown below relative to the CAP3 “9085%” cap trajectory. As shown in 6.1.1.1, there is more decarbonisation by 2035 and over the decade 2031-2040 in CAP3 compared to CAP2.

The steeper cap reduction under CAP3 up to 2035 incentivises a higher level of investment in decarbonisation technologies in the first half of the decade (2031-2035) than under CAP2 (see table 8). This is the case on the supply side (power generation and new fuels) as well as for industrial sectors on the demand side: the modelling analysis projects the anticipation of investment plans, with somewhat different degrees depending on the model, particularly on the supply side. Within industry, the anticipation of decarbonisation investment is stronger for energy-intensive industries than for non-energy intensive industries.

Given that both cap trajectories converge by 2040, the anticipation of investment needs under CAP3 translates into a flipside effect in the second part of the decade (2036-2040), where investment needs in the energy system are generally higher under the CAP2 than under CAP3, both on the supply side and for industry.

On average over the whole decade, both models find that average annual investment needs in ETS1 sectors are not significantly affected by the cap trajectory, with relative changes within a narrow -2%/+2% range for supply side and very small for investment in industry.

For the CAP4 “accelerated 9085” scenario, investments are estimated to be significantly higher in the first half of the decade than under the CAP 3 “9085” scenario, but lower in the second half of the decade. Over the whole decade (2031-2040), average annual investment needs on the supply side and in industry are slightly higher in the CAP4 “accelerated 9085” scenario.

Table 9: Investment needs in ETS sectors, deviation of the CAP4 “accelerated 9085” scenario and CAP2 “85%” scenario relative to CAP 3 “9085” scenario

		2031-2035	2036-2040	2031-2040
CAP4 “accelerated 9085” scenario relative to CAP 3 “9085” scenario	Supply*	+17%	-8%	+4%
	Industry	+12%	-7%	+2%
	Energy-intensive	+16%	-10%	+2%
	Non energy-intensive	+4%	-1%	+2%
CAP 2 “85%” scenario relative to CAP3 “9085” scenario	Supply*	-9%	+5%	-2%
	Industry	-6%	+5%	-0%
	Energy-intensive	-8%	+8%	+1%
	Non energy-intensive	-4%	+0%	-2%

**includes power generation and production of new fuels. Source: POTEnCIA model.*

A similar pattern is observed in terms of energy system costs for industry.

The following table shows energy system costs (system costs are annual costs incurred for energy services of end-users including annualised capital costs, variable costs, and fuel costs) as a percentage of GDP for the CAP 3 “9085” scenario. Energy system costs take into account both the capital costs of investments and potential economic savings in (fossil) energy expenditures, as experienced by the economic actors in a given year, over their foresight period. The numbers shown are a range of results of PRIMES and POTEnCIA models, illustrating the intrinsic uncertainties involved.

Table 10: Energy system costs as % of GDP in the CAP 3 “9085” scenario

Energy system costs as % GDP (including auction payments)	2030	2035	2040
Industry	2.0%; 2.3%	2.1%; 2.4%	2.2%; 2.3%

Source: PRIMES and POTEnCIA models.

The overall energy-related costs in the first half of the decade in the CAP4 “accelerated 9085” scenario are around 5.7% higher than under the CAP 3 “9085” scenario for energy intensive industries and 2.6% higher for non-energy intensive industries. This is driven essentially by fuel costs, but also capital costs to some extent, due to the anticipation of some level of investment in the first half of the decade. Fuel costs over that period are higher in the CAP4 “accelerated 9085” scenario than in the CAP 3 “9085” scenario due to a more rapid uptake of new fuels and to higher ETS carbon values. However, the redistribution of ETS revenues to decarbonisation of the sector could be used to mitigate this effect (ETS allowances purchasing represents around 60% of the total increase in fuel costs between scenarios over 2031-2035 and around 25% over the entire decade).

The relative difference in energy system costs in the period 2036-2040 between both scenarios is limited to less than 2% for industry as a whole. This translates into an energy-related cost for the sector over the entire decade (2031-2040) being 3.4% higher in the CAP4 “accelerated 9085” scenario compared to the CAP 3 “9085” scenario. This includes about 0.8 pp related to ETS allowance expenditure by the sector itself, which could be recycled, as could, potentially, other ETS revenues.

Table 11: Energy system costs in ETS sectors, deviation of the CAP2 ‘85’ and CAP4 “accelerated 9085” scenario relative to CAP 3 “9085” scenario

		2031-2035	2036-2040	2031-2040
CAP4 “accelerated 9085” scenario relative to CAP 3 “9085” scenario	Industry	+5.1%	+1.8%	+3.4%
	Energy intensive	+5.7%	+2.4%	+3.9%
	Non-energy intensive	+2.6%	+0.1%	+1.4%
CAP 2 “85% trajectory”	Industry	-2.6%	-0.9%	-1.7%
	Energy intensive	-3.0%	-1.2%	-2.0%

scenario relative to CAP3 “9085”	Non-energy intensive	-1.2%	-0.3%	-0.8%

Source: POTEnCIA model.

Energy system costs are lower in the CAP2 “85 trajectory” compared to CAP 3 “9085 scenario, -2% for energy-intensive industries and -1.7% for industry as a whole.

However, it should be noted the modelled impacts do not represent all the impacts, nor their potential mitigation through complementary policies.

System cost impacts could be mitigated through distribution of ETS auctioning revenues and supporting policies. Investments, when frontloaded in the decade, are lower in the last five years. The frontloading of investments would increase the probability of faster technological developments through scaling up and learning by doing. It would allow a fast electrification of the energy system and increase Europe’s energy independence. As pointed out in the 2040 Climate Target IA, this will also depend on Europe’s ability to secure supply chains for new technologies.

6.2.3.2. Instruments to support investments

All IDB options effectively create the business case for private investment in industrial decarbonisation technologies by covering sufficient share of the funding gap, though the outcomes will depend on further, more granular features of funding mechanisms like eligible technologies, eligible project stages or compensation structures (not analysed in this Impact Assessment).

Administrative schemes and fixed premia offer clear, simple mechanisms that integrate easily into corporate planning, while auctions with variable premia are more cost-efficient driving the high level of competition but eliciting also projects willing to take on more risks. There are risks of non-delivery (i.e. projects not materialising) inherent to all options and they would need to be analysed on more granular level (e.g. setting penalties on non-delivery or overly strict criteria triggering underbidding). Those risks are more prominent in IDB option packages that put projects under higher level of competition (PO1 and PO3), while on the other hand the approach of administrative schemes (in PO2) mitigates those risks, especially if favouring projects that are first to deliver on the market.

In general, the mechanism that bring high level of competition (PO1 and PO3) are better suited to more mature technologies that operate on deep and liquid markets, which should progressively become the case for many decarbonisation technologies. Administrative schemes (PO2) should be needed in the early years of the IDB operation when uncertainties are the highest and the business case the most difficult.

Through the IDB, industrial sectors in particular stand to benefit from accelerated deployment of decarbonisation solutions, which can mitigate the competitiveness pressures associated with rising carbon prices and reduce the transition risks (i.e. investments delayed or not materialising).

In addition to the direct investments provided by the IDB, the EC analysis indicates that a direct investment leverage effect of IDB support could be expected between 5% and 75%, depending on the sector and technology, with a weighted average of 45% across all modelled projects.

It must be emphasised that the industrial decarbonisation requires substantial upfront capital investments (CAPEX) in plants with long lifetimes (typically 15-25 years), but it is operating costs, particularly energy-related that dominate total production costs, a trend amplified for

low-emission technologies. The energy-related OPEX (notably electricity, hydrogen) were included in the assessment of the environmental impacts of the IDB but fall outside the direct leverage calculation presented above for simplicity of analysis. It is clear that IDB support is bound to generate stable demand signals that would drive additional indirect investment at the energy supply side and macro-economic levels (quantification of this effect was, however, beyond the scope of the analysis performed).

In the baseline the ETS revenues are set aside for the IF, which would imply broader eligibility (beyond the EIIs) and focus on innovation with continuation of the allocation mechanism and support formats of the IF. The needs of the decarbonisation technologies roll-out would not be then fulfilled, there could be also a diminishing attractiveness of the IF calls for proposals considering that decarbonisation technologies in their majority would be entering the roll-out phase post-2030. The Modernisation Fund, through continuing the support for investments in modernising energy systems and energy efficiency, indirectly supports the beneficiary Member States' competitiveness across many industrial sectors. Against the backdrop of high investment needs in lower-income EU Member States to reach the 2030 climate and energy targets as well as higher carbon prices, the MF financial support has been essential for these countries to close the investment gap for the decarbonisation. Furthermore, by expanding the support to CCS and electrification in industry, these economies will become more competitive and maintain their industrial base while ensuring alignment with climate objectives.

In the context of the 2040 climate and energy targets, the current MF beneficiary Member States are estimated to have an annual average investment need of around EUR 90 billion⁶⁸ in sectors relevant for the Modernisation Fund (power generation and distribution, industry, residential etc.) in the 2030-2040 decade.

6.2.3.3. Aviation

When looking at economic impacts, it is important to assess the policy options' implications on operating costs, ticket prices and demand, as well as aviation auction revenues. These are then used to assess whether there is potential for options to distort competition, between airlines, airports, and tourist destinations.

The options vary in their coverage of CO₂ emissions from aviation and in the policy tools used to cover different segments of emissions. The two policy tools, the EU ETS and CORSIA, lead to different prices for each tonne of CO₂ emissions covered. The scale of SAF support influences the effective price airlines pay for SAF which may in turn influence the amount of SAF they use (and therefore CO₂ and non-CO₂ emissions). As a result, the different measures have different impacts on the **operating costs** of airlines. Fuel costs currently account for about 30% of airlines' operating costs⁶⁹, and carbon costs depend on the amount and sustainability of fuel used. Regarding economic impacts and passenger demand, it is most interesting to compare over time two market segments: economy class demand and low-cost carrier demand. The most noticeable differences can be found in departing flights, as this is where policy changes on scope would apply, and where most fuel is consumed and therefore also the impact

⁶⁸ Model-based estimates with risk of changing due to finetuning of PRIMES model (4); Figures in EUR are rounded to the nearest EUR 5 billion.

⁶⁹ IATA, *Airfare, jet fuel price, and inflation*, 2024, <https://www.iata.org/en/iata-repository/publications/economic-reports/airfare-jet-fuel-price-and-inflation/>.

of the SAF support is biggest. Under all policy options, the aviation support study⁷⁰ finds an increase in demand and a decrease in prices compared to the baseline for **extra-EEA departing flights**. Low-cost demand is modelled to grow less than the other travel classes, whereas first/ business demand is expected to grow most. Passenger demand is relatively price inelastic for first/ business class travel. Ticket prices behave similarly for business and economy, but the latter is more affected by prices: first/ business demand is almost the same: +1.6pp in PO1 versus the baseline, whereas for economy it is +5.1pp higher in PO1 than in the baseline - see Table 7 in Annex 10.

Fuel use for departing flights increases under the baseline and all policy options: By 2040, fuel use for departing flights increases least under the baseline (11% compared to 2023), and most under PO1 (20% compared to 2023). Fuel use increases by 15% under both PO2/3.

SAF costs for airlines mainly depend on demand: higher traffic leads to higher SAF use, in line with ReFuelEU mandates, and results in higher costs. For departing flights in 2035, SAF cost would be lowest in the baseline, which has lower traffic than the policy options. Among the policy options, SAF costs would be lowest in PO2 (because traffic in PO2 lower than in PO3), and highest in PO1 (because there is no SAF support and traffic is higher than in PO2/3) - see Table 9 in Annex 10.

Table 12 below summarises **carbon costs as a percentage of total operating costs**. In PO1, the share of the carbon costs generally peaks in 2035, because after 2035 CORSIA would not apply anymore for extra-EEA flights (and in PO1 the EU ETS would not apply either on those flights). In PO2 and PO3, the carbon cost share increases over time because CORSIA's application until 2035 is accompanied by the EU ETS scope extension to departing flights (until but also beyond 2035). For those options, the SAF support is also reflected in the figures: in 2030 for PO2 as it is modelled to run out before 2035, and in PO3 in 2030 and 2035. **In all cases, carbon cost shares are lower in all policy options than in the baseline.** This is due to lower SAF and ETS costs, for example in 2035 PO3 carbon costs as percentage of fuel costs are about half of those in PO2. This is because SAF support is still available in PO3 but projected to have been fully used in PO2. See Table 11 in Annex 10 for further analysis.

Extra-EEA flights generally show lower carbon cost as a share of operating costs, compared to all (total) EEA flights. This is because in the policy options, extra-EEA flights are on average subject to a lower share of carbon pricing.

Table 12: Carbon costs as percentage of total operating costs

Extra-EEA flights (departing + incoming)				
Policy option	Carbon costs as % of total operating costs			
	2024	2030	2035	2040 (87%)
Baseline (full scope)	0%	7.7%	8.0%	10.8%
PO1 (clean cut)		0.4%	1.6%	0.0%

⁷⁰ Ricardo/WSP (forthcoming), *Support for the review by the Commission concerning the implementation of ICAO's CORSIA, and for Commission reports on certain types of flights, social impacts, and air connectivity of islands, remote territories and Iceland*, Referred to as "aviation support study".

PO2 (departing flights, medium SAF support)		3.4%	4.7%	5.4%
PO3 (departing flights, larger SAF support)		3.4%	2.2%	5.4%

In the freight sector, we also focus on the segment where the impact of policy options is greatest, extra-EEA departing flights. Demand is projected to increase by 2040 compared to 2024 in all cases: 37pp in the baseline (lowest increase) and 45pp in PO1 (highest increase). Again demand growth is greatest where prices are lowest: demand grows most where the ETS scope is smallest, and SAF support also has a positive effect on demand (see Table 7 in Annex 10).

For outermost regions, compared to the baseline, all options are expected to have a very limited impact on ticket prices for flights between outermost regions and their domestic mainland. In PO1, ticket prices remain unchanged compared to the baseline. PO2 shows that a potential slight (<1%) decrease in fares could be experienced in 2030 by most ticket types thanks to the prolonged ETS support for SAF uptake, with varying magnitude of impacts depending on the flight distance. Up to 0.8% reduction in the ticket price could be experienced by a passenger flying on a low-cost carrier between Paris and Guadeloupe. Through a further extension of the ETS-financed SAF support, PO3 shows that cheaper tickets could potentially be bought by passengers flying business, economy, and low-cost carriers beyond 2030, although differences remain small (less than 3% price difference compared to the baseline through to 2040). The maximum reduction in ticket prices (2.5%) is experienced by low-cost carrier passengers on a flight between Paris and Guadeloupe in 2035. Overall, while all options maintain or slightly enhance affordability, PO3 has the most favourable outcome, followed by PO2. Outermost regions and small islands benefit from 100% support for uptake of eligible SAF.

Competitive distortions for airlines may arise when policies do not apply equally on routes and where they are not enforced equally, for any policy option. Enforcement has been crucial for the success of the EU ETS to date⁷¹. Previous assessments⁷² found no evidence of carbon leakage for airlines, because they are equally treated on routes covered by the ETS. All options apply uniformly per route to all airlines so do not create distortions. For airlines with a higher proportion of flights on routes covered by the ETS, there is a risk that they are less able to cross-subsidise them from other routes. Several studies nevertheless argue that such cross-subsidisation is minimal⁷³. Also, the fact that SAF support is available for routes covered by the ETS channels more revenues back to the relevant airlines. This is consistent with the 2021 Aviation ETS Impact Assessment. For PO2 and PO3 where the EU ETS applies to departing flights, airlines are able to deduct any CORSIA offsetting costs.

⁷¹ Following some airlines paying fines for non-compliance for their flights within the EU, all major airlines have maintained compliance with the system.

⁷² European Commission, Commission Staff Working Document: Impact Assessment Report: Accompanying the document: Proposal for a Directive of the European Parliament and of the Council amending Directive 2003/87/EC as regards aviation's contribution to the Union's economy-wide emission reduction target and appropriately implementing a global market-based measure, SWD(2021) 603 final, 14.7.2021, <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021SC0603>.

⁷³ CE Delft, *Giving wings to emissions trading: inclusion of aviation under the European emissions trading scheme (ETS): design and impacts*, 2005, <https://cedelft.eu/publications/giving-wings-to-emission-trading/>; CE Delft and MVA, *Implications of EU emissions trading scheme for competition between EU and non-EU airlines*, 2007, <https://ce.nl/publicaties/implications-of-eu-emission-trading-scheme-for-competition-between-eu-and-non-eu-airlines/>.

Passenger behaviour and airport hubs: Modelling shows that across the policy options and the baseline, in most case studies there are some passenger shifts from EEA to non-EEA hubs. All policy options reduce these shifts compared to the baseline, with PO1 having the most significant effect, followed by PO3 and then PO2, see Annex 10, Table 18. EEA **airport** hubs with large shares of transfer passengers may face an unlevel playing field compared to other hubs subject to laxer rules, causing differences in operating costs, ticket prices, itinerary choice, etc. For EEA hubs, relatively higher costs induced by local policies⁷⁴ could risk shifting air transport activity to non-EEA hubs. If **passenger shift** occurs, it may lead to **hub carbon leakage**⁷⁵ – or it may reduce emissions, if the overall route is shorter for example. To address problem drivers D2 (Lack of internalisation of the climate impact) and D3 (International carbon pricing measures in transport), it is important to limit the risk of carbon leakage. Five case studies were carried out to assess the risk of hub carbon leakage (see Section 4 in Annex 10). As shown in Table 13 below, minor hub carbon leakage is observed in one case study in PO1 in 2040 (and two in the baseline). Overall, hub carbon leakage is minimal and emissions slightly decrease across all options and the baseline⁷⁶. **In PO1**, there is a risk of passenger shift of 3.5% in passenger-kilometres from the original route to the alternative route in 2040 on average across all case studies for economy and first classes. **In PO2 and PO3**, average risk of passenger shift is 1pp higher than in PO1 (4.5% on average in 2040).

Table 13: Case study averages for risk of passenger shift and emissions change compared to the original EEA-route

	Average passenger shift risk		Average emissions change		Specific risk of hub carbon leakage
	2035	2040	2035	2040	
PO1	3%	3.5%	-0.5%	-0.2%	CS 4 (0.25% in 2040)
PO2	3.7%	4.5%	-0.9%	-0.7%	n/a
PO3	3.4%	4.5%	-0.8%	-0.7%	n/a
Baseline	4.6%	6%	-1%	-0.5%	CS1 (0.72% in 2040) and CS5 (0.25% in 2040)

The impact assessment for the revision of the EU ETS for aviation⁷⁷ found that carbon leakage risks for **tourist destination** switching were low, due to the nature of air travel (passengers

⁷⁴ These could be related to climate policy, but equally to other policies such as labour laws, passenger rights and subsidies. The latter are out of the scope of this Impact Assessment. It should also be noted that itinerary choice is a function of journey time, cost, number of flight segments, available flight frequency and characteristics of the origin and destination airports.

⁷⁵ In the [European Commission's 2025 Carbon Market Report](#), carbon leakage is defined as a situation that could occur if ETS-regulated activities were moved to non-EU countries with less ambitious climate policies, leading to an increase in overall greenhouse gas emissions. Hub carbon leakage therefore occurs when such emissions displacement and increase take place due to hub switching, i.e. passengers switch from a direct flight or a connecting flight via an EEA hub to a connecting flight via a non-EEA hub.

⁷⁶ Emissions may still be displaced from within Europe to outside Europe.

⁷⁷ SWD(2021) 603 final.

usually know where they want to go and choose the best flight options to get there⁷⁸. This was confirmed by external studies⁷⁹, also showing that tourists prefer direct flights⁸⁰ and that demand has historically been relatively inelastic to cost changes⁸¹. A study of Green Deal policies for aviation (ETS, ReFuelEU) found that they achieve emissions reductions without carbon leakage (scope of the study: global aviation). It mostly identified carbon leakage to other sectors in case aviation fuel demand reduction leads to overall fuel price reductions⁸². Qualitative analysis therefore suggests that ticket prices are one among several decision-making factors for tourists, not necessarily the decisive factor. Ticket prices for tourist flights are impacted in the same way as any other flight, so analysis above on ticket prices etc. applies.

On **SAF support and ETS revenues**, PO2 sets aside 140 million allowances for SAF support, whereas PO3 sets aside 280 million. The allowances set aside lower the volume of allowances auctioned and thus decrease the ETS revenues available to Member States for other climate mitigation purposes and the Innovation Fund. In 2035, the medium amount of SAF support in PO2 is projected to be used up, while there is still support in PO3. See Section 8 in Annex 10 for analysis on the SAF support mechanism.

As a complement to the ETS price signal, ETS auctioning revenues are used to support the transition towards climate neutrality. **The highest revenues come from PO2, where ETS coverage is widest and a medium amount of allowances is set aside for direct SAF uptake support.** See Annex 10, Table 10 for more detail.

6.2.3.4. Maritime

In the policy scenario PO1, the **uptake of renewable fuels** would still be limited in 2030, but increase significantly in the period 2040 and 2050, reaching 87% of total energy demand in 2050. The fuel mix in 2050 is dominated by biofuels (58%), renewable fuels of non-biological origin (RFNBOs) (27%), electricity (2%) and a residual use of fossil fuels (13%). In policy options PO2 and PO3, the uptake of renewable fuels slightly increases by around 2-3 percentage points in 2040 and 5-6 percentage points in 2050. This is mainly due to the expansion of EU ETS to smaller vessels and the further uptake of renewable fuels in this segment. The allowances set aside for the SMAP mechanism would also contribute to such an uptake, although they also decrease the ETS revenues available to Member States for other sectoral uses.

In relation to **competitiveness impacts**, the lowering of the container transshipment incidence threshold from 65 % to 50% should lead to the identification of additional “neighbouring container transshipment ports” under the ETS Directive. In the short-term, it would concern, based on current data at the time of preparing this impact assessment, the ports

⁷⁸ Top determinants for overseas travellers to Europe are safety, famous landmarks, quality of infrastructures, weather conditions and direct routes. Source: European Travel Commission, *Long-Haul Travel Barometer 2026*, 2026, <https://etc-corporate.org/news/long-haul-travellers-grow-more-cautious-in-2026-while-safety-and-flexibility-shape-demand-for-europe/>.

⁷⁹ For example: SEO & NLR, *Aviation Fit For 55 – Ticket Prices, Demand and Carbon Leakage*, 2022, <https://www.seo.nl/wp-content/uploads/2022/03/2022-16-Aviation-fit-for-55.pdf>.

⁸⁰ Verma, Rebelo, and Araújo, *Impact of Inter-Country Distances on International Tourism*, 2019, <https://arxiv.org/abs/1902.04944?>.

⁸¹ ICF et al., Assessment of ICAO’s global market-based measure (CORSA) pursuant to Article 28b and for studying cost pass through pursuant to Article 3d of the ETS Directive, 2020, p. 236, <https://data.europa.eu/doi/10.2834/714858>.

⁸² Wei & Kallbekken, *Carbon leakage from aviation under the European Union Fit for 55 policies*, 2024, <https://www.sciencedirect.com/science/article/pii/S1361920924002268>.

of Abu Qir and Damietta in Egypt and the port of Tekirdağ in Türkiye, which represent a yearly transshipment volume of more than 2 million TEU. If these three additional ports were included, the anti-evasion measure would apply to more than 80% of the transshipment activities taking place in non-EU Mediterranean countries.

This measure could also help better address the risk of evasion linked to future transshipment hubs, such as the port of Cherchell in Algeria, the Port of Dakhla or Nador West Med in Morocco. In general, this measure should contribute to protect the competitiveness of EU ports and help avoid the negative impacts that may occur if relocation of container transshipment activities is taking place.

Amendments to relevant EU MRV and ETS elements to address the specific nature of offshore activities would ensure that all ships involved in offshore activities within EU Member States' territorial waters or Exclusive Economic Zones are subject to emissions regulation, regardless of their flag or port of origin. Consequently, it would promote a fairer and more level playing field for EU offshore shipping companies. However, it could slightly increase the administrative burden for both shipowners and regulators, due to the need for more detailed reporting and verification.

Additional compliance costs for smaller vessels are expected to be passed on to shippers and voyagers, which may have indirect impacts on **trade patterns and macroeconomic indicators**. Modelling of impacts of maritime policy options in GEM-E3 found that, for EU27 countries, GDP would drop by 0.001% in 2040 under both PO2 and PO3, which means that macroeconomic impacts are expected to be marginal on average. These effects are expected to be slightly more significant in FI, EL, SE, DK, due to higher dependency on transport provided by smaller vessels. Impacts on third countries are expected to be negligible, on average, with a drop in GDP estimated at 0.0003% in 2040.

6.2.3.5. Carbon leakage prevention

GEM-E3 model results provide insights into how alternative ETS design choices translate into heterogeneous sectoral and macroeconomic impacts, relative to the baseline scenario by taking into consideration key drivers within scenario assumptions such as the different free allocation distributions across industry, as well as the different ETS coverage and cap stringency and alternative revenue recycling. The policy scenarios assessed by the GEM-E3 model are described in Section 6.1.1.7 and in Annex 12, Section 1.4.1.

Changes in the unit cost of production are driven by specific scenario assumptions namely: (i) different shares of free allocation, with highest shares in PO2_90, (ii) changes in carbon prices, notably in PO2 and PO3 where carbon prices are lower than the reference case due to the expansion of EU ETS coverage to waste emissions, (iii) other scenario implications of waste inclusion in EU ETS, such as the increase in the price of electricity and (iv) the impact arising from revenue recycling. The dominant driver of the sectoral effects varies between these four mechanisms across sectors.

Among the policy measures, PO3 shows the highest reduction in production costs relative to the baseline, despite the full phase-out of free allowances after 2034. This improvement in competitiveness is driven by the inclusion of waste emissions in EU ETS, which leads on to a decline in the carbon price. By contrast, policy options with alternative revenue recycling (PO3R and PO1R) exhibit lower competitiveness, as redirecting revenues away from power-sector investment towards households increases domestic demand, which in turn raises both capital and labour costs.

Production and exports respond heterogeneously across policy options relative to the baseline scenario, reflecting differences in free allocation, sectoral coverage, and revenue recycling. By contrast, policy options with alternative recycling (PO3R and PO1R) show lower production and export level due to reduced competitiveness.

In all policy options, GDP in 2040 increases relative to the reference scenario, reflecting positive macroeconomic effects driven by higher exports and/or increased private consumption, depending on the scenario. The GDP increase ranges from 0.00% under PO2_50 to 0.08% under PO3R, with the latter achieving the highest GDP level due to the combined effect of a lower carbon price and stronger household demand stimulated by lump-sum recycling of EU ETS revenues.

In all scenarios except those with alternative recycling schemes, an improvement in EU27 competitiveness is observed, reflected in higher exports. This outcome is driven by a higher allocation of free allowances to EU ETS sectors (e.g. PO1), and/or lower carbon prices required to meet the EU ETS cap because of including waste emissions in EU ETS (e.g. PO3). In the recycling scenarios, private consumption is the main driver of GDP growth, reflecting the lump-sum transfer of EU ETS revenues to households. In these cases, exports decline due to higher labour and capital costs, which arise from increased household demand and upward pressure on factor prices. In PO2 scenarios, private consumption drops marginally as increasing electricity prices stemming from higher waste incineration, put a pressure to the remaining disposable income.

Additional details on the competitiveness impacts of carbon leakage measures, including figures and insight for selected sectors can be found in Annex 12, Section 1.4.2.

It was outside the scope of the impact assessment to consider the impact of the CBAM in preventing carbon leakage up until 2040, but it is important to note that the policy instrument will be progressively phased in as free allocation is phased out and it is expected that by equalising the carbon price paid at the border that the risk of carbon leakage in the sectors currently covered should be significantly, if not entirely, reduced.

Free allocation was always intended to be transitory in nature so its continuation into Phase V (2031-2040) in all of the policy measures under consideration shows an acknowledgement by the Commission that the non-CBAM sectors will require further support to decarbonise in what is a very challenging operating environment. However, the trajectory of the ETS cap means that the extent to which free allocation continues to be distributed based on the existing free allocation rules, will increasingly become less relevant if the annual amount of preliminary free allocation calculated exceeds the annual free allocation budget and the cross sectoral correction factor is applied in most years – ranging between 0.92 to 0.36 depending on the policy scenario⁸³.

An important topic in this regard is the use of allowance revenue to solely be used to support industry, which was a frequent position advocated by industrial associations during the stakeholder interviews. Ultimately it will require the state and private sector to work together to ensure the enabling conditions (i.e. availability of green hydrogen, infrastructure for CCUS,

⁸³ The cross-sectorial correction factor (CSCF) functions as an adjustment factor in case the preliminary free allocation (calculated based on benchmark, activity levels, etc.) is above the total free allocation budget. A CSCF of 1 means that final free allocation equals the preliminary free allocation. A CSCF of 0.7 means that the final free allocation is 30% lower than the calculated preliminary free allocation. N.B. the CSCF is applied before the CBAM phase-out factor.

availability of low cost and low carbon electricity, market demand for low carbon products) are available so that the ambitious trajectories already outlined by industrial sectors for their decarbonisation are achieved. The instruments to support decarbonisation via the IDB and the IF are assessed separately. In addition, other measures and initiatives announced by the European Commission, such as the Industrial Accelerator Act, the European Grids Package, or the CO₂ Infrastructure Package, as well as the revision of the Renewable Energy Directive will further complement EU ETS and drive the process of industrial decarbonisation

For **ICC** compensation, estimates indicate that indirect carbon cost accounts for between 8%-11% of the retail electricity price paid by large industrial consumers in the EU on average in 2025, smaller than the share of taxes, network charges, or fuel costs.

The upper end of this range is based on the *marginal emissions factor*, which takes account of the fact that ICC can be passed on through electricity prices even when the grid is largely decarbonised. This means that: i) carbon cost is passed through to consumers whenever fossil fuels are the price-setting marginal generator; but ii) carbon cost is not passed through whenever the price is set by non-fossil generation. The lower end of this range is based on the *average emissions factor* of the EU power mix and represents the share of carbon cost in total electricity system costs.

The main effect of continuing to provide compensation would be to alleviate the risk of carbon leakage and incentivise electrification by compensating for some of this cost. ICC compensation is therefore also an important contributor to the competitiveness of electro-intensive processes within sectors. This is particularly important for as long as direct emitting processes continue to receive free allocation, and as long as fossil fuels continue to act as the marginal generator, thereby exerting a greater influence on electricity prices than their generation share would suggest.

The provision of some ICC through an EU-level instrument would provide greater certainty over the availability of compensation compared to a purely State-aid-based approach, as well as diminish distortion of competition. Therefore, option ICC2 would have additional competitiveness benefits to some installations (those who would not have received aid under ICC1). On the other hand, it would bring additional administrative burden as noted in Section 6.2.2.5.

As explained in Section 6.2.1.6 above (and in Annex 12), the extent of this compensation is estimated as being equivalent to 11% - 22% of overall ETS revenues in the 2031-40 period if all Member States were to provide State aid post-2030 using schemes similar to those currently in place⁸⁴. The higher end of the range assumes that post-2030 compensation continues to be based on the carbon intensity of fossil-based electricity generation.

6.2.3.6. Waste

Extending carbon pricing to greenhouse gas emissions from municipal waste incineration (PO2) and hazardous waste incineration and landfilling of non-hazardous waste (PO3) can provide an important complementary financial incentive to foster sectoral innovation, support the economy-wide uptake of carbon removals and CCU, and contribute to the circular economy, reinforcing recycling, more efficient material flows, and EU competitiveness. These were also the most frequently cited reasons by stakeholders in the public consultation in support of MWI inclusion.

⁸⁴ See Section 6.2.1.6.

First, as explained in the preceding and following sections, the inclusion of municipal waste incineration in the scope of the EU ETS under PO2 and PO3 offers considerable opportunities for biogenic carbon removal generation and enables the consideration of alternatives for how to account the emissions that are captured and used in non-permanent products, such as e-fuels and synthetic chemicals.

Second, by internalising the carbon footprint of waste disposal and financially incentivising the business case for separate waste collection, sorting, material and carbon recovery and recycling, PO2 and PO3 contribute to the ambition set out in the Competitiveness Compass and the Clean Industrial Deal to make the EU the world leader on the circular economy by 2030, to double the amount of circular materials by 2030, and to establish a clear link between incentives for decarbonisation and circularity efforts by industry. Circular economy activities already represent around 1-2% of EU GDP⁸⁵ and generated almost EUR 300 billion in gross value added, alongside EUR 122 billion in private investment, in 2021⁸⁶. The European remanufacturing market's circular potential is projected to grow from its current value of EUR 31 billion to EUR 100 billion by 2030, creating 500,000 new jobs⁸⁷, with PO2 and PO3 projected to foster the growth of the EU circular economy and recycling sector. The impact is expected to be significant for PO2, and comparatively highest for PO3, while no change compared to the baseline is expected under PO1. Accelerating the joint transition to more circularity and decarbonisation of waste increases the EU's economic security, resilience and competitiveness by reducing global dependencies on imported virgin materials and price volatility, improving resource productivity, job creation and strengthening innovation.

Finally, while the situation substantially differs between Member States, in view of the EUs increasing recycling and circular economy targets, the carbon price can also provide a complementary incentive over time to aggregate infrastructure and make waste disposal more efficient from an environmental and recycling point of view.

6.2.3.7.CCU

Under the baseline scenario, upstream accounting would make non-permanent CCU products uncompetitive as it would require the surrender of allowances for the carbon embedded in CCU chemicals, plastics, which does not apply to traditional virgin fossil equivalent products (for which only direct, scope 1 emissions are covered by the ETS). Furthermore, in the baseline, the limited incentive to invest in carbon capture results in CO₂ feedstock being scarce and expensive, which negatively affects the business case for non-permanent CCU products.

The hybrid downstream and midstream accounting approach (PO2 and PO3), enabled by the integration of waste incineration in the ETS, ensures that there is a level playing field in terms of emissions accounting for non-permanent CCU products and their fossil fuel equivalent. Only the combustion and process emissions from their production are reported and priced in the ETS for both type of products, while the emissions embedded in the product will be reported and paid for downstream when those emissions are realised, i.e. at the point of incineration. This

⁸⁵ OECD, *The Circular Economy in Cities and Regions of the European Union*, 2025, https://www.oecd.org/en/publications/the-circular-economy-in-cities-and-regions-of-the-european-union_e09c21e2-en.html.

⁸⁶ Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions on a revised monitoring framework for the circular economy, SWD(2023) 306 final, 15.5.2023, <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52023DC0306>.

⁸⁷ World Bank, 2022

accounting approach also provides flexibility for operators to decide whether the CO₂ should be stored or utilised in different types of products or applications depending on their circumstances (location, access to CO₂ infrastructure and storage, access to green H₂, etc.) and the comparative costs and benefits between storing emissions, or producing different synthetic chemicals, plastics or e-fuels. For e-fuel producers this option gives more clarity on the costs and trade-offs available for sourcing different CO₂ feedstock for their production process. Fossil CO₂ may be more available and cheaper to capture, but it requires the surrendering of emissions allowances, while biogenic or atmospheric CO₂ may be more expensive to source, but do not require an ETS payment.

6.2.4. SMEs

6.2.4.1. Aviation

There are more than 370 active aircraft operators in the EU ETS, and 187 of these are registered in EU countries and therefore included in this report's analysis.

In most EU member states, large enterprises own a majority of aircraft operators. In 15 member states, large enterprises own all aircraft operators. In seven member states, 60 to 95% of aircraft operators are owned by large enterprises: Bulgaria (60%), Poland (67%), Greece (75%), France (86%), Belgium (86%), Italy (88%), and Germany (93%). In Romania, two thirds of aircraft operators are owned by medium-sized enterprises. Hungary and Slovenia each have a single aircraft operator, owned respectively by a medium-sized and a small enterprise. For more detail, see Annex 6.

6.2.4.2. Maritime

The extension of the ETS to smaller vessels under PO2 is expected to **primarily affect SMEs**, since companies managing smaller vessels tend to be on average smaller (i.e. 1.6 vessels per company) than those already reporting under the EU maritime MRV (2.6 vessels per company). In addition, most companies managing smaller vessels would be new to the MRV and ETS system and would need to set up and familiarise themselves with MRV and ETS processes. A key disadvantage for SMEs is their more limited capacity to absorb additional administrative costs. While some administrative costs borne by shipping companies are dependent on fleet size, other costs are fixed. As such, the proportionate administrative burden is likely to be higher for smaller businesses who do not benefit from significant economies of scale. SMEs in the maritime sector are expected to sell or buy allowances via intermediary traders mainly from the financial sector instead of participating directly in the primary or secondary markets. Another key disadvantage for SMEs is their limited ability to access financing for capital investments in low-carbon technologies (e.g., alternative propulsion systems or onboard carbon capture). This constraint may reduce the range of greenhouse gas abatement options available to them, potentially increasing their exposure to ETS-related costs in the short term.

6.2.4.3. Carbon leakage prevention

Businesses most likely to be affected by the policy measures were identified by using the preliminary NIMs dataset to categorise sub-installation information for selected non-CBAM sectors into different tCO₂ emission ranges. However, SMEs cannot be directly identified from the ETS data available and therefore proxy measures based on low direct emissions or low electricity consumption (for indirect emissions) are adopted for the SME test. Annex 6 contains further analysis, using non-ETS data, of the potential presence of SMEs among ETS-regulated installations.

For the non-CBAM sectors, the lime and refined oil sectors have the lowest shares of their total sub-installations that emit under 5,000 tCO₂ (under 20% and around 20% respectively), while the ceramics and paper and paperboard sectors have the highest shares accounting for over 60% and 50% of their total sub-installations respectively. The chemical sectors both organic and inorganic are within this range with a 34% and 36% share of their total sub-installations that emit under 5,000 tCO₂ respectively.

SME stakeholders were represented by their sector associations in the stakeholder interviews as well as having the opportunity to submit their views within the OPC itself. In terms of the impact of the policy measures on SMEs within the non-CBAM sectors, the consultation exercise collected evidence that the concerns raised (i.e. increased direct carbon costs and a loss of international competitiveness) are very similar in nature to larger emitters but that the magnitude of the impact may be greater. It is to be expected that CL1 (PO1) will have a smaller impact on SMEs than CL2 (PO2) or CL3 (PO3) given that the non-CBAM sectors receive more free allowances under the current approach without imposing additional requirements under CL2 (PO2) to comply with conditionalities or receiving less allowances under the more rapid phase out of free allocation envisaged under CL3 (PO3) to align with CBAM sectors. Indeed, interviews with industrial stakeholders advanced the position that the introduction of further conditionalities as envisaged in CL2 (PO2) would impose additional administrative costs on operators and that these would have a higher impact SMEs. Given the strong insistence by industrial associations regarding the importance of continued free allocation, CL3(PO3) would increase the risk of carbon leakage, and this risk would be even greater for SMEs.

Small installations in the NIMs dataset were also identified in sectors eligible for ICC compensation and categorised according to their annual electricity consumption. The smallest installations (under 5,000 MWh) accounted for 20%-35% of the total number in manufacture of other inorganic basic chemicals, aluminium production, the manufacture of basic iron and steel, and ferro-alloys and copper production (see Annex 12 for details). This suggests that changes to ICC compensation would have the greatest effect in these sectors, and that they would be most affected by the potentially larger administration effort of Option ICC2 (see Section 6.2.2.5).

6.2.4.4. Waste

PO1 is not expected to have an additional impact on SMEs as the scope of the EU ETS is not further expanded to waste activities. Under PO2 and PO3, the waste disposal sector integrated in the EU ETS is characterised by a relatively higher share of medium-sized enterprises compared to most other sectors currently under the EU ETS. Both the scope of PO2 and PO3 would be modulated by the applied activity threshold. Under the ETS Directive, combustion installations are normally included in the scope of the system if they are above the threshold of 20 MW rated thermal input. As assessed in Annex 13, an inclusion of the waste disposal sector under PO2 or PO3 must consider the appropriateness of this thermal capacity threshold in view of the specific nature of waste as a feedstock, regulatory consistency with the Industrial Emissions Directive, avoiding threshold effects and risks of circumvention, and avoidance of disproportionate impacts on small operators. Regardless of the threshold level, the impact on SMEs can be addressed through several provisions. First, administrative and financial burdens resulting from MRV compliance requirements are addressed through simplified MRV provisions for smaller installations, providing a scalable and proportionate approach, avoiding excessive burdens on low-emitting sites while still ensuring a basic level of emissions accountability. Second, regardless of the threshold level, smaller installations would be eligible

for the opt-out clauses under the existing small- and ultra-small emitter provisions in the ETS Directive.

6.2.4.5. CCU

While carbon capture requires expensive investments that make sense only for large installations, many technology providers in the field of CCU that look to commercialize recently developed technology are small, start-up businesses. Therefore, measures CCU2 and CCU3 seek to level the playing field for these new entrants to allow new CCU products to compete with CCS.

Furthermore, these measures have been designed to be implementable based on the established MRVA system that can ensure the accounting integrity of the EU ETS, while not imposing excessive administrative burdens on operators. For this reason, the measure based on LCA accounting has been discarded as overly complex and costly to implement.

Stakeholders consulted as a part of the OPC questionnaire emphasize the importance of ‘administrative proportionality’ for non-permanent CCU policy measures. Especially amongst business associations, emphasis was placed on implementing an accounting approach that prioritizes simplicity and continuity for SMEs to effectively implement non-permanent CCU measures.

6.2.5. *Public authorities*

A major benefit to public authorities is represented by the auction revenue derived from the auctioning of the EU ETS allowances. The auctioning volumes are derived from the estimates for the allowances distributed for free to industry, and it does not take into account any split between auction revenue that is accrued to EU level funds or to national treasures. This represents the total maximum auction revenue, excluding only what is allocated for free to industry from the annual cap of allowances. By deducting the estimated volumes of free allocation from the ETS cap for each year, the cumulative the value of auction revenue will range between approximately EUR 600 to over 800= billion, depending on the policy options – see Table 22 in Annex 12 for additional details.

In terms of the use of auction revenues, the quantitative assessment of macro-economic impacts done based on GEM-E3 assume that the revenue generated by EU ETS is recycled with 50% financing power dedicated to sector investments and 50% dedicated to improving energy efficiency in EU ETS industries. A variant to this assumption (marked R in the respective scenarios) considers a revised recycling structure where the 50% allocation to the power sector is instead transferred as a lump sum payment to households.

The spending of Member States revenues is analysed yearly in the Climate Action Progress Report and the Carbon Market Report⁸⁷. The Member States reported only 5% of the ETS revenues is used to support decarbonisation of energy intensive industries in 2024, while the most support received by industry is for indirect cost compensation. While the Member States could allocate a higher share of this revenue for the decarbonisation of industry, national approaches will remain inherently fragmented, lacking the ability to exploit the economies of scale and efficient allocation of resources the single EU market can provide.

⁸⁷ Report from the Commission to the European Parliament and the Council on the functioning of the European carbon market in 2024, COM(2025) 735 final, 3.12.2025, https://climate.ec.europa.eu/document/download/ddc1b1de-652b-49ed-8f15-d9fa8badd39f_en?filename=com_2025_735_en.pdf.

Therefore, EU level instruments, such as the IDB and the IF, will play a key role in the funding of decarbonisation investments in the next period (see Annex 9 for more details).

Impacts on public authorities also relate to the operation Union Registry, which resulted from the centralisation of 30 separate national registries under a single system. As indicated in the ETS Evaluation (see Annex 15, Section 10.6.4), the Union Registry plays a crucial role in ensuring the transparency, integrity, and security of the EU ETS. The changes analysed in this impact assessment, in particular as regards PO2 and PO3, increase the scope and complexity of the EU ETS, which in turn increase the risks for and demands on the Union Registry and the underlying IT infrastructure. In addition, the growth of the European carbon market and the value of the ETS allowances over the last decade⁸⁹, expected to continue with the measures analysed in this impact assessment, and the evolution of the regulatory environment⁹⁰ require a new setup for the financing of the Union registry, leaning of financial market standards and proportionate to the growing value of the assets.

Nevertheless, measures exist to address these growing risks to ensure a reliable service to its users, through adequate financing for the operation for the operation of the Union Registry. The central administrator of the Union Registry could be given the legal prerogative to raise fees from the users of the system (compliance accounts and traders) or use part of the auction revenue to finance the services it renders to these entities. These costs would cover the development, maintenance, and operation of the Registry, IT infrastructure, users' support, as well as IT security, audit capacity, oversight, and other functions required to achieve better compliance with financial market frameworks. These costs could also cover further tasks of the Central Administrator and related non-regulatory implementation tasks in the area of ETS.

6.2.5.1. Carbon removals

The fundamental, overall cost of achieving EU climate targets in terms of gross and net emissions objectives is not expected to change materially across the five CDR measures considered here. Similarly, the investment needed to support the development and deployment of CDR technologies does not a priori change materially across the measures assessed. Public disbursement can occur through the EU ETS as in PO1 and/or through other support policies (e.g. CCfDs or a public purchasing programme) that would complement PO2 or PO3.

In either case, total expenditure should be similar if the regulator has a clear commitment towards procuring enough CDR that guarantees the extra gross emissions headroom for operators (CR1) or to deliver the net emissions outcome (CR3), as the public purchasing programme guarantees in PO1. In PO1, the public authority would pay the full price of each CDR credit upfront but then recover the price difference with EUAs when the removal-backed EUAs are auctioned, covering only the price difference in the end, comparable to CCfD support in PO2 and PO3 (⁹¹). That said, the measures do vary considerably in terms of risk distribution and upfront finance for CDR development and deployment.

PO1 would see the regulator purchase removal units even if they are not cost competitive vis à vis the allowance price. Thus, CR4 would likely entail significant administrative costs for the regulator in e.g. the procurement of removal units, although it seems possible that procurement

⁸⁹ The last decade has brought a steep increase in the asset value, moving from an allowance price of EUR 5-10 to the current level of EUR 60-80.

⁹⁰ Since the entry into force of the review of the Directive on Markets in Financial Instruments in 2018, the emission allowances are categorised as financial instruments.

⁹¹ The exact amounts will depend on the timing of the purchase of the removals and the sale of allowances.

methods such as reverse auctions could yield lower overall transaction costs than if purchases were done by individual regulated entities in the primary CDR market, and would need to be compared with the administrative cost of complementary support measures needed under the other policy options (e.g. CCfDs). Annex 8 provides an illustrative assessment of the investment needs in CR4, the measure included in PO1. It estimates the total investment requirements for achieving net emissions reduction target of 85% with the ETS integration of 173 Mt of BioCCS and DACCS (PRIMES modelling result) by 2040 at EUR 35.7 billion based on the mid-point technology costs⁹². Considering different technological costs, between EUR 29 billion and EUR 43 billion (lower to upper bounds) are required as upfront investment. However, the purchasing programme would have a final fiscal cost of EUR 3 billion (based on the mid-point technology costs), when the revenues generated from the removal-backed allowances is deducted from the upfront costs^{93,94}. These are illustrative results, as investment requirements and final fiscal cost for a potential removal integration as per CR4, strongly depend on the final ambition level set out, the corresponding ETS prices, total volume of removals to be purchased, the ratio of BioCCS to DACCS in the portfolio, and timing of the purchase of the removals compared to the sale of the allowances. They nevertheless suggest that the sale of removals into the EU ETS could potentially be close to covering the full cost of the purchasing programme, if the timing of the purchase of the removals compared to the sale of the allowances could be fully optimised (e.g. delay in the sale of allowances to a time when ETS prices are highest and purchase of removals when the removal prices have decreased). However, as this is unlikely due to the need to kick start the market, budgetary rules requiring the availability of revenues at the start of a procurement process and the uncertainty in ETS and removal prices, a conservative approach to the calculation of the fiscal cost would be advisable, potentially considering average ETS prices during the phase.

PO2, in theory, would entail lower direct EU ETS costs for the regulator as compared to PO1. There would not be an upfront increase in the cap that would lower ETS prices and with it, it would also lower auction revenues for Member States, and no public purchasing would be needed. However, in the absence of public investments in CDR through other policies, PO2 risks that the CDR development and deployment does not take place in time for the CDR scale-up required and that the extra ‘space’ for residual emissions inside the ETS therefore not materialize, leading to higher costs for the regulator later on.

PO3, which applies a gross cap, would see a similar effect in apparent cost savings due to lower direct EU ETS costs for the regulator, again with the need for further support policies to ensure that CDR development and deployment take place in time for the CDR scale-up required. This is aggravated by the initial reduction in scarcity, which could reduce incentives for abatement and investment in removal by regulated entities – thus potentially requiring further investments in abatement and removal by the regulator outside the ETS. Effects are also expected on auction revenues. Under CR3, Member States would see an increase in the number of allowances for auction, but it is unclear whether this would entail higher revenues as the increase in the allowance volume may be offset by a price drop due to the reduced scarcity. Moreover, the

⁹² European Commission: Directorate-General for Climate Action, Ramboll Management Consulting, Witteveen, E., Marton, C., Bert, N. et al., *Carbon removals in the EU – Review of current carbon removal projects and early-stage financing*, Publications Office of the European Union, 2025, <https://data.europa.eu/doi/10.2834/0004994>.

⁹³ The public authority would pay the full price of each CDR credit upfront but then recover the price difference with EUAs when the removal-backed EUAs are auctioned, covering only the price difference in the end.

⁹⁴ See caveats to these results at the end of Section 2.3.1.2 in Annex 8, notably the high uncertainty on the development of technology costs and deployment capacity can greatly influence final costs.

one-in-one out mechanics would entail a reduction in auction volumes later in the phase, when prices are expected to be higher.

Beyond direct costs, it should be noted that funding from ETS revenues provided to support the integration of removals - in particular in PO1 which is designed with the funding as essential element - necessarily reallocates scarce fiscal resources away from other uses, which could potentially lead to crowding out cheaper emission reductions today and potentially increasing the overall cost of achieving EU targets.

Finally, any the integration of CDR into the EU ETS would require regulation and oversight on CDR eligibility and market surveillance, thus resulting in administrative costs.

6.2.5.2. Instruments to support investments

The IDB will be centrally managed on the EU-level except the option of the Member States proposing the short-list of projects (in terms of allocation mechanism), not included in the main policy options 1-3. Member States proposing shortlist would be a single case that would generate administrative costs for Member States. The size of the cost was not estimated but would likely be similar to estimation done for the Modernisation Fund, see below. Otherwise, all IDB policy options are centrally managed clearly offering to MS the management of complete project cycle from the allocation mechanism to monitoring.

For the Modernisation Fund, as shown in the evaluation, Member States are primarily responsible for implementation. Consequently, there are some administrative costs attached to it which have been estimated at 0.13% of the total MF envelope under the current version of the ETS Directive.

PO3 has the largest impact on administrative costs for public authorities, most notably through introducing a vetting of all priority investments by the Investment Committee. This would imply that all beneficiary Member States and the three non-beneficiary Member States sitting at the Committee review all investments submitted under the Fund and decide on their approval. At the same time, with the exclusion of gas and waste-to-energy from the scope of the MF as well as the exclusion of non-priority investments also entailed by this Policy Option, investments to be discussed at the Committee would be likely to be consensual. All investments submitted would indeed have to fall under the pre-defined list of activities supported as priority investments, with the European Investment Bank conducting a first screening. The reduction of the share of non-priority investments to 0 would also decrease administrative efforts related to applying to the Fund, as applications for these investments are more time-consuming.

PO1 and PO2 would reduce the administrative costs related to applying to the Fund, as they both reduce the share of MF envelope that beneficiary Member States can dedicate to non-priority investments, which bring a notable higher burden.

6.2.5.3. Aviation

The continuation of the SAF mechanism would lead to fiscal costs for Member States if they were to use national budgets to replace the reduced ETS revenues allocated to them, or in any case would reduce Member State revenues. See Annex 10, Table 27, for figures on the amount of allowances set aside for ETS-financed SAF support.

Other economic impacts on public authorities are covered in the section on administrative effort in section 6.2.2 above, since there are no significant changes specifically for public authorities.

6.2.5.4. Maritime

The SMAP mechanism would lead to fiscal costs for Member States if they would use national budgets to replace the reduced ETS revenues allocated to them.

The extension of the EU ETS to smaller vessels under PO2 and PO3 is expected to increase the workload for public authorities responsible for MRV and ETS administration. This may require additional resources and staff training, to ensure accurate reporting, effective compliance monitoring, and timely implementation of the system. Total additional recurrent administrative costs are estimated at EUR 0.74 million per year for PO2 and EUR 1.46 million per year for PO3.

6.2.5.5. Carbon leakage prevention

The simplification measures included in all the policy measures on carbon leakage protection will reduce administrative burden also for public authorities, in particular for ETS Competent Authorities.

For ICC compensation, in Option ICC1 each Member State would continue to have the option to use some of its share of auction revenues to fund an ICC State aid scheme, retaining the option to balance the importance of providing this aid against other revenue uses.

Option ICC1 would also ask Member States to provide additional information on how their ICC compensation measures contribute to decarbonisation. The additional burden from these requirements is expected to be modest since it would amend an existing reporting requirement in the ETS Directive rather than create a completely new one. Article 10a(6) already requires Member States to make information on ICC compensation publicly available.

Option ICC2 would create an additional administrative burden for public authorities at both national and EU levels due to the need to establish and administer an additional fund.

6.2.5.6. Waste

Under both PO2 and PO3, the carbon price is expected to be at least partially passed through up the waste value chain, extending the price signal to local waste collection and disposal authorities and contributing to incentivise improved waste prevention, reduction, collection and sorting at source. Around one fifth of stakeholders in the public consultation expressed concerns on the need to balance potential price impacts for households through waste collection fees or local taxation. Evidence from Member States already applying carbon pricing on municipal waste incineration indicates the impact on households is manageable, with average household waste management fees increases in the order of EUR 10-15 on annual basis⁹⁵. A substantial share of the impact can further be mitigated through improved waste prevention, reduction, collection and sorting measures by local waste disposal authorities. For this, it is essential that local authorities channel the incentive through targeted and proven waste measures and policies with a positive steering effect offering households a choice to avoid the additional cost of mixed waste disposal (see Annex 13, Section 1.3.1.). Complementary circular economy policies and financial instruments can support local authorities to implement those circular economy measures steering waste disposal in line with the waste hierarchy and helping households to manage impacts.

⁹⁵ EUR 10 in Sweden based on average 2025 EU ETS price; EUR 13 in Germany based on average 2025 German ETS price; EUR 15 in Norway based on average 2025 EU ETS price as mirrored by the Norwegian carbon tax.

ETS revenues from inclusion of waste disposal activities are projected to be significant and in the range of EUR 4.75 billion annually on average over 2031-2040 in case of an extension of the cap to municipal waste incineration and double to triple this amount in case of a full extension to all waste incineration and landfilling. Existing, proven measures and policies such as improved separate, weight-based and Pay-As-You-Throw collection schemes and strengthened Extended Producer Responsibility schemes can support cost-effective mitigation of emissions and carbon costs throughout the waste value chain and play an important role to manage the impacts on local waste collection and disposal authorities and ensure a smooth transition for the waste sector, balancing environmental benefits and circularity with the social impacts of waste management as a public service, as explored in detail in Annex 13, Section 1.3.

6.2.6. Impacts on the functioning of the internal market

6.2.6.1. Instruments to support investments

For the IDB, the options on ensuring geographical balance would be those that also have the most tangible impact on the internal market. Most likely and at least in the short term, the best efficiency and the best outcome for the internal market from the IDB would be achieved through the pure EU-level competitions that favours the most mature projects, with the best locations, benefiting from the most favourable natural endowment (in terms of renewables potentials), industrial structures, infrastructure and ecosystems and supportive national policies.

In the long term, however, this option can lead to missing some opportunities in countries/regions that are hampered by lack of administrative capacity/lack of innovation ecosystem or infrastructure rather than structural factors of their industry/economy. This option would also mean that the leverage and spillover effects due to the IDB is concentrated in some of the regions.

To sum up, strict national allocations (that can also take the form of ‘as a service’ or right of the first use – see Annex 9) can be perceived as the least efficient option because they limit the benefits of the EU-level competition. In the longer term, however, such approach might help to address some structural problems in certain regions (e.g. if funded activities create sufficient demand for new infrastructure or lead to creation of new industrial structures).

The best balance would be most likely achieved by a mix between the EU level competition and national allocations as it draws to large extent the benefits of the EU-level competitions and yet safeguards part of funding for national projects with all positive leverage and spillover effects that it will bring. This approach would avoid, in the longer-term, missing opportunities in terms of unlocking the potential of all EU Member States in terms of industrial decarbonisation.

Continuation of the Modernisation Fund will further support lower-income Member States’ catching-up process relative to higher income ones in terms of modernisation of energy systems and carbon intensity of the economy. Thanks to investments supported by the Fund, beneficiary Member States can develop the needed infrastructure for the clean energy transition (e.g. stable and modern grids, storage capacity, sizeable renewable energy capacity, EV charging infrastructure) and attract more private investments. This is therefore conducive to creating a level-playing field among Member States and alleviating some barriers to the single market.

6.2.6.2. Carbon leakage prevention

For direct emissions, continuation of free allocation is compatible with the internal market, since eligibility for free allocation is harmonised at EU-level in all options considered. For ICC, Option ICC1 would continue the current policy, which allows Member States to decide whether to offer ICC compensation or not. This system results in a somewhat fragmented system where 15 Member States currently offer compensation via separate national schemes⁹⁶.

The partial harmonisation of ICC compensation under option ICC2 would reduce this fragmentation by offering some compensation on a harmonised basis at EU-level. This would reduce internal market fragmentation to a limited extent by compensating a fraction of the potential indirect cost through a harmonised fund. Funding equivalent to 5% of 2030-2040 auction revenues is level is suggested based on striking a balance between the benefits of ICC harmonisation, compared to other uses of ETS revenues.

The issue of indirect carbon costs was often raised by industry stakeholders as this is often a cost that they have no direct control over. It is addressed to some extent by national decisions on whether to offer ICC compensation. However, the question of how to reduce industrial electricity prices is broader and depends on national and European efforts to decarbonise electricity supply and modernise the electricity grid in a way that also ensures the price of electricity does not become excessively high in comparison to industrial competitors.

The continuation of indirect cost compensation was consistently supported (with 74% of respondents in favour) by industrial stakeholders during the open public consultation. Overall, harmonisation was supported by 39% of stakeholders who responded to the question of whether indirect cost compensation will remain necessary after 2030 to address the risk of carbon leakage from indirect carbon costs not covered by other measures (such as CBAM). Several respondents in favour of harmonisation, indicated the need to re-visit different sectors' eligibility for ICC compensation, which is outside the scope of this review.

6.2.6.3. Waste

PO1 does not increase the scope of the EU ETS compared to the baseline, consequently no change from the baseline is expected in terms of the functioning of the internal market. The current situation is characterised by the heterogeneous application of carbon pricing to waste disposal. This unlevel playing field contributes to competitive distortions within the waste management sector, between Member States, and between sectors. First, the co-incineration of municipal waste in industrial installations is subject to the ETS carbon price, while municipal waste incineration is generally not – except in selected Member States, at different levels. Second, under the current climate framework (Effort Sharing Regulation), Member States apply different price signals and instruments, while a majority apply no dedicated carbon price signal or instrument for the sector, leading to competitive distortion on the internal market for waste. Third, while power generation installations are covered by the EU ETS, waste-to-energy installations are generally not, contributing to an unlevel playing field with renewable energy production. Extending the EU ETS to municipal waste incineration installations under PO2 would contribute to harmonise coverage of waste incineration under the EU ETS, ensuring a level playing field and addressing competitive distortions within the waste sector, between

⁹⁶ Report from the Commission to the European Parliament and the Council on the functioning of the European carbon market in 2024, COM(2025) 735 final, 3.12.2025, https://climate.ec.europa.eu/document/download/ddc1b1de-652b-49ed-8f15-d9fa8badd39f_en?filename=com_2025_735_en.pdf.

sectors and between Member States. First, extending the EU ETS to all non-hazardous waste incineration installations would harmonise the application of the polluter-pays principle within the waste incineration sector, addressing the current heterogeneous coverage of emissions from waste incineration depending on the waste type and Member States' classification of installations. Second, an extension would harmonise the application of the polluter-pays principle between waste incineration and the co-incineration of waste in industrial installations, such as cement kilns, and between energy produced from different sources, ensuring a level playing field between waste-to-energy and power generation installations that are connected to a common grid or district heating system. Third, an extension would also harmonise the application of the polluter-pays principle between Member States, addressing competitive distortions resulting from the current differentiated coverage of waste-to-energy installations in the EU ETS in selected Member States.

The additional extension of carbon pricing to hazardous waste incineration and landfilling under PO3 would further contribute to harmonising the application of the polluter-pays principle within the waste disposal sector, in addition to addressing potential competitive distortions between waste incineration and landfilling for residual waste resulting from different price signals, where dedicated fiscal and regulatory policies on landfilling (including bans on landfilling of specific residual waste streams and taxes) are not already sufficiently prohibitive to avoid such competitive disadvantages. However, depending on how the EU ETS price is translated to gate fees for landfilling, the price gap closing effect could vary per waste stream, as PO3 would predominantly price methane emissions from biogenic waste rather than emissions from fossil waste streams such as plastics.

6.3. Social impacts

6.3.1. Impacts on employment and skills

6.3.1.1. Cap

The employment impacts of the ambition level and cap scenarios are explained below in the section on carbon leakage. They were assessed with the GEM-E3 model.

6.3.1.2. Carbon removals

Removal integration into the EU ETS can influence employment mainly through its impact on the pace and predictability of domestic removal deployment and associated supply chains. Measures that provide predictable demand and bankable revenue streams for removals (PO1) are more likely to catalyse near-term investment and job creation in the European removal industry. Operator-integration measures (PO2-3) can deliver similar employment benefits if complemented by removal policy support outside the ETS. If such support is absent however, the weaker visibility of demand may delay investment decisions and temper job growth. Some jobs in the removal industry may represent a shift rather than net-increase (e.g., if cheaper removals displace abatement action in certain sectors).

Estimates from Boston Consulting Group conclude that the development of the CDR industry could not only bring substantial economic growth but also significant job creation. They conclude that by 2050, the CDR sector in Europe could support up to 670,000 jobs. This growth

trajectory indicates substantial employment opportunities across various sectors involved in CDR, including engineering & manufacturing, energy, and (digital) services⁹⁷.

Concretely, if CDR develops as modelled in the 1.5°C- and 2°C-compatible scenarios, the job potential in the CDR industry is expected to increase gradually, with a relatively modest growth in the next years. By 2035, however, the sector could already support 125,000-180,000 jobs in broader Europe. The job potential is estimated based on current sector ratios of jobs per EUR 1 million value added.

6.3.1.3. Instruments to support investments

IDB is proposed to be one of the key elements of the enabling framework that will be essential to achieve 2040 climate target. 2040 climate target as confirmed in the modelling exercise underpinning the 2040 climate target proposal is unlikely to be a major driver of GDP growth and employment levels in and of its own. The transition will nevertheless imply transformations in production and consumption patterns.

IDB can bring positive employment impacts in all sectors of economy. All economic sectors (not only industry) will be affected by the IDB because they all consume products of industry (e.g. fertilisers needed for agriculture are produced by chemical industry, services rely on electricity that together with industry is in the ETS).

More broadly, society as a whole will be affected (as all society actors will consume products of industry, some will work in the industry, some will have part of their pensions linked to performance of industrial stocks).

6.3.1.4. Aviation

The impact on **employment** of EEA aircraft operators is mainly dependent on demand. Demand is projected to grow in the baseline and all options, with greatest growth outside Europe (see 6.1.1.5) in areas which are mainly serviced by non-European airlines. Nevertheless, employment is also projected to grow for EEA airlines, with limited differences between the options (2.3% difference maximum from the baseline, in PO1 in 2040). By 2040, compared to 2024, employment is modelled to grow by 28% in PO1, and by 26% in PO2/3. This suggests that the ETS policy options do not lead to materially different employment trajectories.

The SAF industry offers a route for jobs in the refining sector to shift toward green economy, while simultaneously leveraging the industry's experience and existing infrastructure. In **PO1**, SAF support would expire at the end of 2030. This option does not allow for an increase in employment in SAF industry and related supply chain compared to the baseline. SAF production mandated by ReFuelEU⁹⁸ is already included in the baseline. Additional SAF support under **PO2** and **PO3** compared to the baseline could trigger more investment in the SAF sector and increase employment. This is not specifically modelled, because it is uncertain

⁹⁷ Patrick Herhold, Johanna Pütz, Karan Mistry, Robin Biergan, Phillip Spiekermann, Louisa Maier, German Association for Negative Emissions (DVNE) & Boston Consulting Group (BCG), *Europe and Germany's Role in Catalyzing a Trillion-Euro Industry*, 2024, https://pyreg.com/wp-content/uploads/240620_dvne_bcg_cdr_economic_potential_en.pdf.

⁹⁸ The study supporting the impact assessment of the ReFuelEU Aviation initiative (European Commission, 2021) estimated that it is expected to create more than 200,000 net additional jobs in the SAF production industry by 2050. European Commission: Directorate-General for Mobility and Transport, E3M, Ricardo, Oeko, Giannelos, G. et al., *Study supporting the impact assessment of the ReFuelEU Aviation initiative – Executive summary*, Publications Office, 2021, <https://data.europa.eu/doi/10.2832/680399>.

how much, if any, additional SAF will be available (beyond mandated levels) and where it will be produced (in Europe or elsewhere). For example, plants in Europe (FR⁹⁹, UK¹⁰⁰, DE¹⁰¹), are expected to create 0.2 to 1.8 jobs for 100 tonnes of SAF produced per year, depending on type of SAF, type of jobs (high/low skilled), inside/outside sector, and the pace of development of the SAF production.

Impact on households

Carbon pricing on air travel promotes fairness relative to other, taxed transport modes (such as road and rail). From the consumer perspective ticket price-to-income ratios remain broadly stable over time across all route types and passenger segments, and passenger travel demand continues to grow across all route types in all policy options. Highest and lowest income households are least likely to respond to carbon price incentives. Those who can afford the most expensive tickets are least sensitive to price increases (see 6.2.1.4 above). Those who cannot afford the cheapest tickets now, would continue to face similar barriers without carbon pricing. Economy- and low-cost passenger demand is more sensitive to price increases than business/ first class (see Annex 10, section 4.1).

In **PO1**, the impact on overall access to air travel across different income households is assessed to be minor and positive compared to the baseline. Demand is projected to increase across all travel classes, while average fares remain below the baseline levels (see Table 13 in Annex 10). Demand profiles differ between travel categories, where Business/ First class extra-EEA flights are on average 5900 km one way throughout 2035-2040, with less than 0.1% difference between the baseline and policy options. Economy class flights are shorter (~4900 km) and show a slight variation between baseline and policy options (0.3% or less difference in 2040 compared to the baseline). Low-cost flights are shorter at around 2900 km, with a maximum variation of 1.2% compared to the baseline in 2040. Similarly to PO1, **PO2 and PO3** would result in a very limited increase of demand for air travel, in comparison to the baseline, while average fares remain below baseline levels.

For **outermost regions, islands and remote territories** (including Iceland), no ETS-driven socio-economic impacts due to connectivity changes are expected under any policy option, compared to the baseline. In all cases, domestic flights to/from outermost regions are included in the EU ETS from 2031, with average ticket fares expected to remain the same for **PO1** and the baseline. Thanks to the prolonged ETS support for SAF uptake in **PO2** – and to a greater extent in **PO3**, the aviation support study expects average ticket fares for flights between outermost regions and their domestic mainland to be slightly lower relative to the baseline, depending on ticket type and destination in 2035 (e.g. 1.6% reduction in the ticket price for an economy class fare between Paris and Guadeloupe or for a low-cost carrier flight between Madrid and Gran Canaria in PO3). Similarly to the baseline, PO2 and PO3 would most likely

⁹⁹ In France, 4 projects will produce 270 kilotons of SAF per year by 2030 and 510 jobs, which amounts to 1.8 jobs per 100 tons. French Government, *France 2030 : Le Gouvernement dévoile les 4 lauréats de l'appel à projets Carb Aéro, en faveur de la décarbonation du transport aérien*, 2025, <https://www.info.gouv.fr/upload/media/content/0001/13/31506bf1bb147a6ca091685004ce8deb1303c3bf.pdf>

¹⁰⁰ In the UK, it is estimated that 0.6 MT of SAF will be produced in 2030, and 10,350 jobs created, which amounts to 1.7 jobs per 100 tons. ICF, *Roadmap for the development of the UK SAF industry*, 2023, <https://www.sustainableaviation.co.uk/wp-content/uploads/2023/04/Sustainable-Aviation-SAF-Roadmap-Final.pdf>.

¹⁰¹ In Germany, a new plant will produce 30,000 t of eSAF annually, for 65 jobs created, which amounts to 0.2 jobs per 100 tons.

only impact flights between Ireland and North America, and Iceland and North America. However, the aviation support study determined the risk of carbon leakage, thus of social and economic impacts, at the Irish and Icelandic airports to be low.

6.3.1.5. Maritime

Effects on employment, compared to PO1, are expected to be marginal for most EU27, similar to the macroeconomic effects. For countries most dependent on transport from smaller vessels, employment effects could be up to -0.025% (Finland). In third countries, employment effects are also expected to be negligible.

Due to the possibility to further **mitigate the transshipment relocation risks** in PO2 and PO3, the wider social impacts of possible transshipment relocation for EU ports and their hinterlands are likely to be reduced.

The **expansion of the EU ETS to smaller vessels under PO2 and even more PO3** could affect the connectivity of essential shipping services, particularly those serving islands and remote coastal areas, by increasing shipping costs. These services, often provided by ferries, are vital for social and economic integration, and cost pressures may lead to reduced service frequency, route consolidation, or fare increases.

Around 58% of ferries calling at EU ports were estimated to be between 400 and 5000 GT, which means that a large proportion of ferry services are likely to be affected by the extension of EU ETS to smaller vessels. Tourism-based economies could feel this impact.

However, public service obligations and contracts (PSO/PSC), which regulate pricing and service levels, already help protect these routes, and EU ETS derogations for PSO/PSC-covered services, small islands and outermost regions could further mitigate negative impacts.

The outermost regions and small islands require a special attention in this regard. The carbon price would represent a proportion of total voyage cost, though in most cases not exceeding the cost impact of regular fuel price volatility. Still, removing **derogations** would mean that sudden increases in fuel or carbon prices could pose a risk to stable, predictable maritime connectivity for these EU regions. Since ensuring connections is essential for small islands and outermost regions, some of the transport services are conducted under public service obligations. In these cases, ending derogations would not induce increased ticket prices but require larger budgets from public funding.

In the particular case of ice class ships (ICS) discontinuing of ICS derogations could be a challenge for maintaining critical logistics and regular services when ice conditions would otherwise prevent conventional vessels from reaching these locations¹⁰².

6.3.1.6. Carbon leakage prevention

The GEM-E3 model was used to estimate the impact of the implementation of policy measures on employment levels. The largest employment gains occur in chemicals and non-metallic minerals sector, which also records the highest production increase by 2040. Across sectors and policy measures, the overall employment impact ranges from -0.56% to 1.76%. Among the scenarios, PO1R shows the highest employment increase, driven by the volume of free allowances provided along with the alternate revenue recycling option, whereas PO3 records

¹⁰² However, Heikkilä et al. (2024) concluded that not all of the assessed ICS ship types have higher fuel consumption and thus emissions.

the lowest due to the complete phase-out of free allowances after 2034 and due to the lower production in market services.

The issue of employment is also directly linked to the long-term viability of industrial production in Europe. During the stakeholder engagement (and further supported by OPC inputs), industrial associations and businesses consistently argued that the competitiveness of EU producers would be undermined without the continuation of free allocation and if not ensuring that the necessary enabling conditions are in place for decarbonisation rather than deindustrialisation was frequently cited by stakeholders.

Continuation of **ICC** compensation (whether State aid or harmonised) is expected to have a positive impact on employment by protecting against carbon leakage and supporting the business case for electrification of industrial processes. In particular, it strengthens the business case for electrification investments by ensuring beneficiaries will not be disadvantaged by indirect carbon costs.

6.3.1.7. Waste

The application of the carbon price signal to waste management activities (PO2 and PO3) is projected to contribute to employment creation in the circular economy by further incentivising sorting and recycling. Circular economy activities already represent around 1-2% of EU GDP and 2.2% of employment, with the potential to create up to 2.5 million additional jobs by 2030¹⁰³. As recycling activities are more labour-intensive than incineration of waste or landfilling, the integration of waste disposal activities in EU ETS is projected to result in additional employment.

6.3.2. *Impacts on fundamental rights*

In accordance with the Better Regulation Guidelines, the policy options were assessed to understand if there is impact on the fundamental rights endorsed by the EU Charter of Fundamental Rights. Following a screening of the fundamental rights, the judgement was taken that the policy measures do not have a negative impact and are likely to have a positive impact on the fundamental right with regards to environmental protection under Article 37.

7. HOW DO THE OPTIONS COMPARE?

Following the assessment of the economic, social, and environmental impacts, as well as their distribution across stakeholders, the following section compares the different policy options with regard to their effectiveness, efficiency, and coherence.

7.1. Effectiveness

To compare the effectiveness of each of the policy options it is necessary to assess the extent to which each policy option addresses the general and specific objectives that were originally set in the problem tree diagram.

The matrix is colour-coded as follows

Strongly negative	Weakly negative	Neutral	Weakly positive	Strongly positive

¹⁰³ OECD, *The Circular Economy in Cities and Regions of the European Union*, 2025, https://www.oecd.org/en/publications/the-circular-economy-in-cities-and-regions-of-the-european-union_e09c21e2-en.html.

Table 14: Overview on the effectiveness of the measures

	PO1	PO2	PO3
General objective 1.1: Incentivise further emission reductions			
Enable investments (SO.1.1.1)	Neutral as the continued carbon leakage protection, while providing additional space for companies, provides no additional incentives for investment Neutral as limited additional incentives to invest in carbon capture and the lack of level playing for CCU restricts investments. Weakly positive impact of IDB PO1 that addresses well the funding gap of industrial decarbonisation projects but represents operational complexity, risk of projects' dropouts, administrative burden and geographical imbalances. Weakly positive impact as PO1 maintains MF with slightly increased level of environmental ambition Neutral, limited additional incentives for maritime sector to decarbonise.	Strongly positive impact under PO2 as the inclusion of conditional free allocation and hybrid downstream and midstream accounting for CCU may prompt additional investments. Strongly positive of IDB PO2 that addresses well the funding gap of industrial decarbonisation projects and offers simplification, attractive financial model as well as clear rewards for 'front-runner' projects. The risk of unspent resources is minimised. There is a strong alignment of funding with the scale and type of the decarbonisation challenges and proposal strikes a balance between the EU-level competition as well as geographical balance. Strongly positive impact as PO2 maintains the MF with an importantly increased level of environmental ambition, fully aligned with 2040 policy package Strongly positive impact to narrow the price gap between fossil fuels and the alternative fuels and propulsion technologies for maritime	Weakly positive impact under PO3 as the inclusion of hybrid midstream accounting incentivises additional investments in carbon capture and CCU. However, the phase out of free allocation under PO3 significantly increases the exposure of companies to carbon costs, which may affect their ability to invest. Moderate impact of IDB PO3 that addresses well the funding gap of industrial decarbonisation projects but with some design complexity and incentives for more risky projects. There is a risk of projects' dropouts and administrative burden. Strongly positive impact as PO3 maintains the MF with an importantly increased level of environmental ambition, fully aligned with 2040 policy package Strongly positive impact to narrow the price gap between fossil fuels and the alternative fuels and propulsion technologies for maritime
Ensure full carbon price signal (SO.1.1.2)	Weakly positive effect as under PO1 the current approach for free allocation is maintained for non-CBAM sectors. However, the gradually reducing free allocation due to the benchmark updates and operation of the CSCF will increase exposure to the carbon price signal.	Weakly positive effect as under PO2 free allocation is more conditional so depending on levels of compliance the exposure to the carbon price will vary but will be more than PO1 but less than PO3. Weakly positive impact due to inclusion of municipal waste incineration.	Strongly positive effect as under PO3 free allocation for non-CBAM sectors is phased out. Positive impact due to inclusion of landfills as well as municipal and hazardous waste incineration.

	PO1	PO2	PO3
	Neutral on waste management, as no scope extension is introduced in PO1. Weakly positive effect as smaller ships between 400GT-5000GT remain outside of the scope.	Positive effect as the ship categories emitting the most among smaller ships are included.	Strongly positive impact as all smaller vessels from vessel types non-exempted from MRV, plus fishing vessels and non-commercial yachts are in the scope.
Address carbon leakage risk ¹⁰⁴ (SO.1.1.3)	Strongly positive effect as impact of the less stringent cap reduces carbon leakage list and free allocation continues under current approach for PO1 without further conditionalities applied to free allocation. Strongly positive effect on the mobilisation of private investment for industry decarbonisation via IDB. Neutral, no effect in diminishing maritime evasion risk in comparison to baseline	Strongly positive effect as impact of the less stringent cap reduces carbon leakage list but support is conditional on investments so the level of free allocation available under PO2 is less certain than under PO1 but still better than under PO3. Strongly positive impact due to faster mobilisation of investments for industry decarbonisation. Positive effect in diminishing evasion risk in maritime due to the revision of the list of neighbouring container transshipment ports and revised rules for offshore ships.	Weakly positive effect as impact of the less stringent cap reduces carbon leakage risk in PO3 but by less than in PO2 and PO1 due to the accelerated phase out of free allocation for non-CBAM sectors. Positive effect in diminishing evasion risk in maritime due to the revision of the list of neighbouring container transshipment ports and revised rules for offshore ships.
General objective 1.2: Reaching a pre-set emissions reduction target within the budget provided by the 2040 policy package and with a net emissions calculation			
Removals integration (SO.1.2.1)	Strongly positive effect as PO1 offers more support for removals suppliers, guarantees inflows of units into the EU ETS, providing guaranteed emissions space without compromising the net target (unless public authority is not endowed with the budget calculated to procure sufficient removals, or the budget is insufficient). Medium mitigation	Weak positive effect as PO2 exposes the removals to the EUA prices which is good for cost effectiveness and economic efficiency, but entry is not guaranteed if EUA prices < removal supply costs. Lowest to medium mitigation deterrence compared to the baseline. Medium CDR support.	Strongly negative effect as PO3 provides added flexibility to reach the EU ETS target but 'one in one out' approach is expected to lead to missing pre-set net reduction target unless support measures are introduced to cover the price differential. Highest mitigation deterrence compared to the baseline. Lowest

¹⁰⁴ For non-stationary (i.e. aviation, maritime) this effectiveness in the achievement of this sub-objective is addressed in the specific sections.

	PO1	PO2	PO3
	deterrence compared to the baseline. Highest CDR support.		CDR support, absent complementary measures.
Adjust EU ETS cap in line with pre-set target (SO.1.2.2)	Cap is adjusted according to ambition level in 2040. All POs would be based on same trajectory / budget.	Cap is adjusted according to ambition level in 2040. All POs would be based on same trajectory / budget. Higher certainty about contribution from municipal waste incineration.	Cap is adjusted according to ambition level in 2040. All POs would be based on same trajectory /budget. Higher certainty about contribution from municipal and hazardous waste incineration and landfilling.
General objective 1.3: Ensure effectiveness of EU climate action on international transport while avoiding double effort			
Ensure effective action on EU's fair share of int. aviation emissions (SO.1.3.1)	Depending on the outcome of the CORSIA assessment, weak negative effect: if the assessment is positive there is an effective carbon price on the EU's fair share of international aviation emissions, without a change to the ETS scope. However, PO1 results in the highest global international aviation emissions (600 MtCO ₂ in 2040, compared to 590 MtCO ₂ in the baseline).	Strong positive effect by ensuring effective carbon pricing on the EU's fair share of international aviation emissions (departing flights), while allowing for the deduction of any CORSIA offsetting costs. Global international aviation emissions are projected at 595 MtCO ₂ in 2040.	Weakly positive effect by ensuring effective carbon pricing on the EU's fair share of international aviation emissions (departing flights), while allowing for the deduction of any CORSIA offsetting costs. However, PO3 results in higher global international aviation emissions than PO2 (same as PO2 in 2040, but higher emissions in 2035 due to higher SAF support, causing higher traffic).
Preserve effective action on EU's fair share of maritime emissions and maximise	Comparable to the baseline in terms of maritime emissions, with cumulative GHG emissions over 2030-2050 of 1,985 MtCO ₂ e and residual GHG emissions of 20 MtCO ₂ e in 2050. Derogations are running out after 2030 in PO1 (representing 5% of maritime GHG emissions under the ETS cope).	Positive impact on emissions with cumulative GHG maritime emissions over 2030-2050 of 1,890 MtCO ₂ e (5.0% reduction compared to PO1) and residual GHG emissions of 12 MtCO ₂ e in 2050. Positive effects in terms of regulatory efficiency as the deduction avoids the double pricing under the IMO measure (once adopted) and EU ETS.	Positive impact on emissions with cumulative GHG maritime emission over 2030-2050 of 1,865 MtCO ₂ e (6.2% reduction compared to PO1) and residual GHG emissions of 11 MtCO ₂ e in 2050. Positive effects in terms of regulatory efficiency as the deduction avoids the double pricing under the IMO measure (once adopted) and EU ETS.

	PO1	PO2	PO3
regulatory efficiency (SO.1.3.2)	Weakly positive impact of costs savings due to simplification and process enhancement measures (up to EUR 9 million /year)	Recycling of ETS revenues is expected to improve the economic case for complying with ETS and the IMO measure. Additional weak positive impacts of cost savings due to simplification and enhancement measures (up to 9 million EU/year). Positive impact by inclusion of smaller ships from the categories emitting the most, representing 13% of ETS emissions in 2023. Weakly negative impact as derogations will diminish the emissions subject to ETS by 5%. More than half (50.8%) of them benefit outermost regions and around a third benefit small island.	Recycling of ETS revenues is expected to improve the economic case for complying with the IMO measure. Additional weak positive impacts of costs savings due to simplification and enhancement measures (up to 9 million EU/year) Positive impact by inclusion of all small ships (17% of ETS emissions in 2023). Weakly negative impact as derogations will diminish the emissions subject to ETS by 5%. More than half of them benefit outermost regions and around a third benefit small island.
General objective 2.1: Ensure efficient market functioning			
Increase size of the market (SO.2.1.1)	No impact on the increase in the size of the market in relation to waste management and aviation as no further extension of the scope occurs in PO1. Integration of removals in PO1 is a net cap integration, but the public authority commits to purchasing the removals, resulting in the emissions space of the gross cap as in PO3. The risk of removals generation falls on the public authority, with a positive impact for the size of the market.	Positive effect on the increase in the size of the market but PO2 is less ambitious than PO3 as scope is only extended to all municipal waste incinerator installations. For aviation, positive effect compared to PO1 as the size of the market is increased to departing flights. Integration of removals in PO2 allows the market to increase with the integration of removals by operators. The cap is set at the net level, and the gross depends on the cost competitiveness of removals and support policies.	Positive effect on the increase in the size of the market with PO3 extending the scope of the EU ETS to all municipal and hazardous waste incinerator installations and landfilling of non-hazardous waste. For aviation, positive effect as the size of the market is increased to departing flights. Integration of removals in PO3 results in the cap being set at the gross level. The uncertainty in the removals generation falls on the climate ambition, as the attainment of the net objective

	PO1	PO2	PO3
		Positive effect as the ship categories emitting the most among smaller ships are included	is uncertain, with a positive impact for the size of the market. Strong positive impact as all vessel types non-exempted from MRV, plus fishing vessels and non-commercial yachts are in the scope
Adjust MSR parameters (SO.2.1.2)	Weakly positive as PO1 broadly achieves the two primary objectives of the MSR. First, the MSR contributes to reducing the historical surplus of allowances by removing supply of allowances and preventing a drop in carbon prices and weakened investment signals for low-carbon technologies. Under PO1 the MSR starts releasing allowances to keep the market balanced. However, while in the short-term prices are evolving relatively stable until 2034, as from 2035 PO1 observe a relative steeper increase of ETS prices as compared to PO2 and PO3. Second, PO1 enhances the resilience of the EU ETS and performs well in response to future demand shocks.	Strongly positive as PO2 and fully achieves the two primary objectives of the MSR. First, the MSR contributes to reducing the historical surplus of allowances by removing supply of allowances and preventing a drop in carbon prices and weakened investment signals for low-carbon technologies. Under PO2 the MSR starts releasing allowances to keep the market balanced. Second, PO2 enhances the resilience of the EU ETS and performs well in response to future demand shocks.	Strongly positive as PO3 as it entails the same design features for the MSR as PO2. Therefore, PO3 fully achieves the two primary objectives of MSR as it employs the same MSR parameters. First, the PO3 contributes to reducing the historical surplus and provides for the most stable and steady price evolution until 2040. Second, PO3 also enhances the resilience of the EU ETS and performs well in response to future demand shocks.

7.2. Efficiency

The efficiency of each policy option can be assessed by comparing the expected benefits (i.e., reduction of direct costs or externalities) against the respective expected costs incurred for the delivery of each the policy options. Therefore, efficiency concerns the extent to which objectives can be achieved for a given level of resource/at least cost.

The combined measures under the different POs have economic, social, and environmental impacts. The major costs of the policy options come in the form of an increase in the adjustment costs, administrative and indirect costs for the private sector to implement the requirements of the policy options. Additionally, EU Member State authorities are expected to benefit from an increase in revenues from higher volumes of auctioned allowances and this will offset costs associated with the implementation of the reforms.

Given that all policy options envisage a less stringent ETS cap, the costs and investments are expected to be less compared to the baseline. These lower system costs (excluding auction payments) in PO1 and PO2 are mainly driven by changes in the cumulative annual expenses borne by final energy users, which include operating and capital expenditures as well as taxes.

In PO1 providing certainty and thus lower capital costs for removals will benefit both removals producers and consumers. However, it does result in a burden placed on the public authority to either deliver on the removals or face non-attainment of the environmental objective. If a limit is applied to the removals that can be purchased the full theoretical economic benefits would also be limited to a maximum, although the guaranteed availability of removals would allow higher gross emissions, as well as lower prices for the removals.

In PO2, the higher uncertainty for removals producers leads to higher discount rates and lower volumes. As a result, abatement efforts expected to be higher, particularly in industry (as reflected in higher capital costs relative to the baseline), but the total costs of removals are lower, as a result of smaller removal volumes. The higher EU ETS price in such a scenario increases auction revenues, which could be recycled into the economy, also to support or expand removal activities. This feedback could partially offset the higher EU ETS price, though the net effect remains uncertain due to efficiency and transaction cost considerations. When including auction payments, system costs would be higher.

In PO3 modelling results for removals would be driven by the constraint of attaining the targets for 2040 and 2050. However, the higher uncertainty for removals and the lack of incentive for reducing below the gross emissions cap might well lead to an underachievement of the removal objective and therefore an underachievement of the 2040 target. As this consideration is not modellable, it should be acknowledged qualitatively.

In sum, the most efficient option for removals would be PO1, as this option gives highest certainty to the removals sector allowing it to scale and learn, and as it gives gross emissions space to EU ETS operators.

In addition to the costs and benefits from the cap, waste management integration and carbon removals, results have been integrated in this impact assessment through GEM-E3 modelling that focuses on the macro-economic costs and benefits that focuses on a comparison of PO1 to the 85% PRIMES scenario. The impact of changes to free allocation envisaged under PO2 and PO3 are reflected and the modelling output does take into account the potential change of scope (i.e. inclusion of waste management activities), but not of other measures included in policy measures PO1-3.

Table 15: Summary of costs and benefits per policy option compared to the 85% PRIMES scenario based on GEM-E3

		Difference to the baseline		
	Unit	PO1	PO2	PO3
Operators				
Adjustment cost				
Unit cost of production	%	0.02	-0.04, -0.02	-0.12
Public authorities				
GDP change	%	0.01	-0.01, 0.00	0.02
Sectoral Employment - ETS sectors (% change from baseline)	%	0.01	-0.05, -0.03	-0.06
Households				
Total private consumption (% change from baseline)	%	0.02	-0.08, -0.05	-0.10

To supplement the modelling outputs, further quantitative analysis has been undertaken to understand further the costs and benefits associated with the policy options. In terms of the administrative costs, it is envisaged that PO2 will result in some increase in administrative costs compared with the baseline as it will involve changes to free allocation with further conditionality requirements included, as well as additional MRV costs for waste incineration installations (the later would also be an additional cost for PO3). These estimates for administrative cost have been transparently calculated based on existing literature and stakeholder input (i.e. survey and interview processes). Importantly it is expected that the potential maximum revenues that will be generated from each of the policy options are likely to offset these additional administrative costs.

Table 16: Summary of costs and benefits per policy option compared to the baseline based on further quantitative estimates

		Difference to the baseline		
	Unit	PO1	PO2	PO3
Operators				
Adjustment cost				
Cost of phasing out free allocation	Bn EUR	-55	-67	49
Administrative costs				
Applying for free allocation cost	M EUR	0	8	0
MRV costs for inclusion of waste activities	M EUR	0	7.8 - 78	<7.8 - 78

Public authorities				
Benefits				
Revenues	Bn EUR	315	335	540

Overall, all policy options result in **net benefits** relative to the baseline, on these elements. This is evident from the output from the modelling runs from PRIMES and GEM-E3 as well as the further quantitative estimates.

For aviation, PO2 is the most efficient policy option because (other than the baseline) it results in the highest emissions reductions and the highest revenues to be used for climate purposes. It also sets aside more allowances for ETS-financed SAF support than are currently available or would be available in the baseline/ PO1 (which do not allow for further ETS-financed SAF support). See Annex 10, Section 1.3, 1.5, 2.3, 2.4 and 3.1.

Regarding maritime transport, the efficiency of the different policy options is compared in terms of their social Net Present Value (NPV), which compares discounted benefits of emission savings from the maritime sector against discounted abatement costs and administrative costs. ETS or possible IMO payments are excluded from this analysis as they represent a transfer between agents from the perspective of the society. Results presented in Table 17 show that both PO2 and PO3 would lead to a positive social NPV, compared to PO1.

Table 17: Social Net Present Value (NPV) of policy options PO2 and PO3 compared to PO1 (million EUR)

	PO2	PO3
Monetised GHG emission benefits	22,075	27,790
Monetised air quality benefits	64	53
Additional costs excl. EU ETS revenues	-14,404	-16,171
Administrative costs	-436	-860
Administrative and enforcement costs for national authorities	-17	-33
Social NPV	7,283	10,778

All policy options can work in full synergy with the FuelEU maritime initiative as carbon pricing will reduce the price gap between sustainable low carbon alternative fuels and traditional fossil fuels, and it will trigger energy efficiency improvements that will make the switch to alternative fuels more affordable by reducing the overall fuel consumption. Simplification introduced in all options reduces administrative burden on shipping companies coherently with the requirements under FuelEU.

The ETS funded Sustainable Maritime Alternative Propulsion mechanism assessed in PO2 and PO3 could be used to advance innovation and accelerate the deployment of renewable and low-carbon fuels, and clean propulsion technologies beyond the proposals submitted under the Innovation Fund calls from 2023, 2024 and 2025. Such a dedicated support

mechanism would complement other policies (e.g. carbon pricing, fuel standards) and help create a predictable demand for these fuels and technologies. It would stimulate their selection and deployment, as well as the gradual technological improvement of yet immature solutions. In this context, it would complement the IMO measures (once adopted) by making sustainable maritime propulsion more economically viable.

For the Industrial Decarbonisation Bank, the efficiency is best achieved by the allocation mechanisms of auctions as well as variable premium in terms of form of support (both included in PO3). Still to be stressed that actual efficiency of any funding mechanism will rely on features much more granular than addressed in this IA (e.g. completion bonds, monitoring arrangements etc). Also, while PO3 is the most efficient, it inherently attracts more risky projects that in the end might not be implemented (if faced with adverse market conditions etc) so to the detriment of effectiveness.

For the Modernisation Fund, PO3 importantly increases administrative costs as subjecting all priority investments to Investment Committee governance would require a substantially heavier process, involving many more actors. PO2 has the lowest administrative costs since it gives more limited space to non-priority investments (5% max, compared to 10% max in PO1), the approval process of which is more burdensome and no additional role to the Investment Committee.

In terms of abatement costs, PO3 (through a total ban on gas infrastructure) can gear investments of beneficiary Member States more towards new renewable capacity which are becoming increasingly cheaper than investments in gas. PO2 and PO1 also but to a relatively lesser extent. However, the abatement costs will continue to be mostly determined by the nature of the investments that Member States decide to support, within the eligible activities permitted by the Fund.

Options PO2 and PO3 introduce a deduction from the surrendering obligations of emissions priced under IMO measures (once adopted). This deduction ensures that regional measures and global measures work efficiently together in terms of carbon pricing, preventing double payments and allowing at the same time the EU ETS maritime to continue contributing to the implementation of the 2040 EU targets and climate policy objectives.

7.3. Coherence

The ETS is a well-established cornerstone of the EU's policy to combat climate change and its key tool for reducing greenhouse gas emissions cost-effectively. With its focus on markets and economic emission reduction incentives, it is coherent with other EU policies which primarily address non-price barriers. The EU ETS evaluation (see Annex 15) highlighted the coherence of the instrument with complementary policies for energy sector, such as the Renewable Energy Directive and the Energy Efficiency Directive. Together, these instruments were responsible for significative emissions reductions in the energy sector.

Increasing the environmental contribution of the ETS with an enlarged scope, as in PO2 and more extensively in PO3, does not change its technology-neutral character, allowing it to continue to run alongside sector-specific policies. The Market Stability Reserve will continue to enhance policy synergies by mitigating supply/demand imbalances regardless of their origin, for instance by reducing the impact that complementary and overlapping policies in the area of renewables or energy efficiency can have on the carbon market. PO2 and PO3 are most coherent for the MSR as they allow to maintain narrower TNAC-to-emissions ratios through timely releases whilst preserving deeper post-2040 intervention capacity. Both options also demonstrate the lowest inter-annual price volatility with smooth

trajectories resilient to shocks and provide for the most optimal market conditions balancing responsiveness with transparency.

For aviation, including departing flights under PO2 and PO3 is coherent with the scope of application of ReFuelEU Aviation and automatically unlocks additional ETS-financed support for SAF. Both PO2 and PO3 are supportive of multilateral action, as they allow the deduction of CORSIA offsetting costs.

For maritime, all policy options are fully consistent with existing EU legislation such as the EU maritime transport MRV framework and FuelEU. The deduction mechanism in PO1 and PO2 would ensure coherence with future IMO measures (once adopted)

The integration of carbon removals in all POs and the recognition of non-permanent CCU in PO2 and PO3 are coherent with the policies being developed under the Industrial Carbon Management Strategy and the broader framework of the Clean Industrial Deal, fostering the competitiveness of the EU. PO1 would be most coherent as it provides the greatest support for removals while provide the greatest certainty to industry on the space available under the ETS and for the achievement of the net target, in coherence with the European Climate Law.

The inclusion of the waste management sector into the EU ETS in PO2 and PO3 is coherent with the objectives of Waste Framework Directive, fostering the transition to a circular economy, and the broader environmental policy framework of the EU.

There are no marked differences between the POs on Industrial Decarbonisation Bank in terms of coherence. The IDB as a whole, however, needs to ensure coherence with other climate policies. As climate action progresses and the hardest to abate emissions have to be reached, the use of ETS's revenues to support investment become more relevant to ensure the investments take place. The strengthened EU-level support provided by the continuation of the Innovation Fund and new Industrial Decarbonisation Bank are from an EU single market perspective coherent with the carbon price signal and regulatory framework (both also driving the investments but currently not fully sufficient). Coherence with other EU-wide funding mechanisms can be fostered by focusing on specific stages of the technology development or 'investment journey' (avoiding overlaps with other programmes) as well as by creating an aligned governance framework of ECF and IDB. The coherence with other ETS based support instruments and the national use of ETS revenues continues to be fostered, including via State aid rules that enable the funding on the national level. Additionally, the set-up of the 'as-a-service' feature could enable even better integration of the State aid and EU-level funding if applied to the IDB funding instruments.

Expanding eligibility of priority investments to CCS and direct electrification of industry in all POs is coherent with the policies being developed under the Industrial Carbon Management Strategy and the broader framework of the Clean Industrial Deal. After 2030, hard-to-abate sectors will still need deployment of solutions like CCS and direct electrification which are costly. The phase out of public support to investments involving natural gas and waste-to-energy is also consistent with the EU's 2040 decarbonation targets since lower-emitting alternatives exist. In that respect, PO3 is the most consistent with the EU's decarbonation targets, followed by PO2 and finally by PO1.

7.4. Summary

Table 18 below provides a summary of the comparison of the options against the baseline scenario in terms of effectiveness, efficiency, and proportionality. The following ranking symbols have been used: from '+' (more effective/efficient/coherent than the baseline) to '+++' (much more effective/efficient/coherent than the baseline).

Table 18: Summary of the comparison of the policy options against the baseline scenario

	PO1	PO2	PO3
Effectiveness	+	+++	++
Efficiency	++	++	+
Coherence	++	+++	++

8. PREFERRED OPTION

8.1. Identification of the preferred policy option

All policy options achieve the same ETS emissions reduction target, although for variable scope / share of the economy-wide emission with PO2 and PO3 each adding additional scope. The decision on the preferred policy option is informed by their relative effectiveness and efficiency. While each PO has been primarily modelled with CAP2, each PO could be implemented under CAP3, with the same relative impacts as in above comparison table of the policy options relative to the baseline scenario.

PO2 was considered to be the preferred policy option. Together, its measures strengthen the environmental effectiveness of the system while maintaining proportionality, regulatory stability, and fairness across sectors, and safeguarding competitiveness.

Whilst PO3 was in some regards more effective (i.e. in terms of extending the scope further and reducing the phase out of free allocation to enhance the price signal), the efficiency of this option was lower due to the additional costs in terms of adjustment and administrative effort compared to the other policy options.

PO1 was also deemed to not be the preferred policy option as it did not achieve all the objectives that were set for the assessment. For example, this option was not considered to be effective in addressing future concerns regarding the functioning of the market as it did not increase the size of the market to new activities such as in the waste sector, and it had the weakest improvements in terms of enabling investments. It also showed the weakest results towards ensuring effectiveness of EU climate action on international transport while avoiding double effort.

The proposed reforms brought by PO2 maintain the existing compliance framework of the EU ETS, while introducing new obligations and funding streams, mainly during the 2031-2040 period, that are considered the preferred options:

- From 2031, the revised cap (and from 2028 the reformed MSR parameters) would apply to all ETS sectors, reducing the decreasing rate of cap, lowering the carbon prices and improving market predictability.
- Free allocation is continued as a carbon leakage prevention mechanism, but part of the free allocation is gradually made conditional on decarbonisation investments. Additional free allocation is made available to CBAM sectors to address residual carbon leakage risks.
- Public authorities, both at the national and EU level, would extend ETS registries and oversight systems to cover new operator categories and activities, and verify conditionality compliance for free allocation. These new administrative tasks are expected to build on existing processes and to be operational by 2031.

- The ETS Directive would continue to encourage Member States to compensate indirect carbon costs via State aid, while calling for this aid to contribute to the sectors' decarbonisation.
- An effective carbon price would apply also to the EU's fair share of international aviation emissions, and the approach would be coherent with the ReFuelEU Aviation scope of application. ETS support for SAF uptake would be increased compared to today, while ensuring that Member States still receive ETS revenues to tackle decarbonisation further.
- The preferred approach for maritime would introduce an ETS-funded mechanism to support the uptake of sustainable fuels and clean propulsion technologies, combined with a partial ETS scope extension to smaller vessels, reflecting the needed balance between environmental benefits and implementation costs. Simplification and enhancement measures would be implemented to improve the effective implementation of the system, also in relation to the risk of evasion, and an IMO deduction mechanism would be introduced to ensure the coherence of the ETS with future IMO global measures.
- The inclusion of all municipal waste incinerators would enter into force from 2031, allowing to implement the hybrid downstream and mid-stream accounting for non-permanent CCU. New regulated operators, such as e-fuel distributors and waste incinerators must obtain ETS permits, prepare MRV plans, report verified emissions, and surrender allowances accordingly.
- The preferred approach for implementation of the IDB would offer a toolbox of funding instruments (in terms of allocation method and type of support to be provided), allowing policymakers to tailor support to evolving policy priorities and industrial needs. With many uncertainties for the industrial decarbonisation projects, there is an urgent need to provide support that creates solid business cases, administratively simple and with predictable cash flows for the projects. This is why, in the early years of the IDB operation (i.e. the 'Investment Booster' announced in March 2026¹⁰⁵), the Commission could start with administrative schemes awarding a fixed premium and striking the balance between the EU-level competition and national allocations (notably for solidarity purposes). As technologies mature, ETS prices increase and regulatory frameworks fully take effect, the Commission could move to auctions for a Carbon Contracts for Difference in order to maximise the efficiency of the support. This approach could be combined with stronger national allocations, in the form of 'as a service' contributions or by applying by the Commission 'right of the first use' to ensure that decarbonisation projects materialise in all countries and bring positive spillover effects to them.

As an exception, PO1 is preferred for carbon removals, as it is considered preferable to provide certainty to the ETS sectors on the gross emissions space available and the CDR industry on the demand for carbon removals, for the benefit of the EU's competitiveness.

For the cap no single option is preferred, and the decision on the cap can be analytically separated from the other issues discussed. However, a sufficiently ambitious cap in the first half of the decade would have significant advantages. From an environmental point of view carbon budgets would be lower. While energy system costs would to an extent be higher, system cost impacts could be mitigated through distribution of ETS auctioning revenues and supporting policies. Investments, when frontloaded in the decade, would be lower in the last

¹⁰⁵ https://ec.europa.eu/commission/presscorner/detail/en/statement_26_663

five years. The frontloading of investments would increase the probability of faster technological developments through scaling up and learning by doing. It would allow a fast electrification of the energy system and increase Europe's energy independence. As pointed out in the 2040 Climate Target IA, this will also depend on Europe's ability to secure supply chains for new technologies. For the final five years of the decade, there is a higher uncertainty regarding the necessary technologies, and a greater need to provide emissions space for industry. For the pathway towards 2040 it would thus be prudent to assume the use of international credits, in order to generate sufficient emissions space for ETS operators, while still keeping an ambitious overall carbon budget.

The assessment carried out in this impact assessment shows that the preferred option, including this exception, is consistent with the European Climate Law's objectives, as required by Article 6(4) of the European Climate Law. The climate impact of the measures and in general the alignment of the ETS towards that objective and the intermediate 2040 target are at the core of this assessment. Where the measures introduce a certain level of uncertainty towards reaching the net climate contribution of the EU ETS (removals integration with a pre-increase of the cap) or can potentially create loopholes in the accounting of emissions (downstream accounting of the CCU) the level of the risks are assessed and justified towards the achievement of the climate objectives more broadly, together with the introduction of mitigating tools (on removals: the measures are justified to achieve the scale-up of removals and avoid carbon leakage, and risks are mitigated with sufficient budget for the purchase of removals; for CCU, the risks are justified to incentivise CCU while introducing mitigation measures for loopholes).

8.2. REFIT (simplification and improved efficiency)

Since the revision of the ETS Directive in 2018, a number of simplifications have been introduced. Article 27a was added to the Directive, allowing Member States to exclude installations emitting less than 2,500 tCO₂e per year. In addition, a number of simplifications, and clarifications have been made through amendments to the Monitoring and Reporting Regulation (Commission Implementing Regulation 2018/2066), and standardised methodologies and tools have been developed to facilitate implementation. These measures are discussed further in the Evaluation Report accompanying this Impact Assessment, with a number of possible measures for additional streamlining and simplification being proposed (see Annex 15).

Several of the measures in this Impact Assessment covering emissions from stationary installations generally do not involve simplification, since they are considering expanding the scope of EU ETS. However, they entail a simplification from a broader perspective, as EU-wide climate action should prevent a piece-meal approach of national or subnational measures that add complexity to the internal market. In addition, the carbon leakage prevention measures assessed consider simplifying the provision of free allocation by not updating the carbon leakage list for Phase V (2031-2040), thereby eliminating administrative burden for operators. The option of expanding conditionality in free allocation would involve some increase in administrative effort, which has to be weighed against the environmental benefits of conditionality and the value of the free allocation (see Section 6.2.1.6). Annex 12 considers the case for including more small installations within EU ETS by lowering the 20 MW thermal capacity threshold. However, it concludes that such an expansion would not be proportionate since most of the relevant emissions will be covered by EU ETS2.

The evaluation carried out on the implementation of the MRV Maritime Regulation (see Annex 15) confirmed that the MRV system functions as a robust framework, which has

successfully handled the changes stemming from the 2023 revision without compromising overall data quality or usability. At the same time, the evaluation identified some divergences and duplications between the MRV system for maritime and other regulatory frameworks on shipping decarbonisation¹⁰⁶, which hold potential for undue burden on operators. The evaluation found that, rather than a structural overhaul of the MRV system, incremental improvements through simplification initiatives could enhance the harmonised and robust implementation of the system, minimise existing duplications and deliver efficiency gains.

Policy measure SII for maritime ‘Simplification, and targeted enhancement measures’ includes specific simplification elements for the MRV maritime system which would enable shipping companies to exploit untapped synergies, minimise undue burden, and ultimately reduce administrative compliance costs. Among other things, the measure would ensure that one entity is responsible for compliance in respect of the emissions of a given ship under the ETS/MRV maritime and the FuelEU Maritime systems and that the monitoring-and-reporting-only-once principle is implemented. The present impact assessment estimates that simplification elements for maritime could deliver to shipping companies’ annual savings between 10% and 20% of current annual MRV administrative compliance costs.

9. HOW WILL ACTUAL IMPACTS BE MONITORED AND EVALUATED?

The Commission will continue to monitor and evaluate the functioning of the ETS in its annual Carbon Market Report, as foreseen under Article 10(5) of the ETS Directive. This covers also the impacts of the current revision of the ETS.

Furthermore, evaluation of progress on the application of the ETS Directive is regulated in the current Article 21, which requires Member States to submit to report to the Commission on issues including the allocation of allowances, operation of the Registry, application of monitoring and reporting, verification and accreditation and issues relating to compliance.

The measures above (namely the Commission’s annual Carbon Market Report and Member States reporting) shall also apply to the sectors to which emissions trading is extended. The MRV data obtained through the regulation of the new sectors will be a key source for information for the Commission to evaluate progress in the sectors concerned.

With respect to maritime transport, the Commission will notably rely on data collected through the EU maritime transport MRV system and analysis from the annual report on CO₂ emissions from maritime transport, which provides aggregated and explained results. With respect to the possible extension to buildings and transport, the Commission will rely on data collected through the new MRV system for these sectors, while comparing them also with the corresponding GHG inventory data for these sectors.

The integrated governance and monitoring process under the Regulation on the Governance of the Energy Union and Climate action is also expected to make sure that climate and energy-related actions at European, as well as regional, national and local level, including the ETS, contribute to the EU climate neutrality and Energy Union's objectives.

Several market analysts regularly closely follow various aspects of the carbon market and its functioning, and the Commission will continue to monitor this work. Also, through regular contacts with stakeholders, the Commission is alert to their views and concerns about the functioning of the ETS. ETS-related matters are discussed in a dedicated forum, the

¹⁰⁶ Such as the FuelEU Maritime Regulation at the EU level and the International Maritime Organisation Data Collection System (IMO DCS) at the global level.

Climate Change Expert Group (CCEG) which brings together Member States Competent Authorities, stakeholders (industry associations and NGOs) and the Commission. In its different formations, the CCEG discusses the implementation of free allocation, auctioning and issues related to the functioning of the Union Registry. In addition, the ETS Compliance Forum provides the Competent Authorities of all ETS countries (the 27 Member States, Norway, Iceland and Liechtenstein) with a platform for sharing information, learning and experience, leading to effective implementation of the ETS. The forum executes targeted events, such as the Compliance Forum Conference, organized annually and aimed at sharing experiences and facilitating dialogue amongst Member States Competent Authorities, as well as Task Forces dedicated to specific topics and training events. National Accreditation Bodies and verifiers are sometimes invited to participate to the activities of the ETS Compliance Forum, where relevant. Furthermore, the Technical Working Group on ETS MRVA brings together representatives of Member States Competent Authorities to share experiences and suggestions concerning effective and efficient implementation of Commission Implementing Regulation (EU) No 2018/2066 (Monitoring and Reporting Regulation) and Commission Implementing Regulation (EU) No. 2018/2067 (Accreditation and Verification Regulation) to discuss potential updates and improvements of the ETS MRVA Regulations.

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PART 2/5

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT REPORT

Accompanying the documents

Proposal for a

**DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
amending Directive 2003/87/EC and Decision (EU) 2015/1814 as regards driving
competitiveness and cost-effective decarbonisation**

**REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
amending Directive 2003/87/EC as regards revised benchmark values for the heat and
fuel benchmarks for the period from 2026 to 2030**

**REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
amending Regulations (EU) 2015/757 and (EU) 2023/1805 to simplify and streamline
monitoring, reporting and verification and to align with revisions of the EU Emissions
Trading System**

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ANNEX 1: PROCEDURAL INFORMATION

1. LEAD DG, DECIDE PLANNING/CWP REFERENCES

The Directorate-General (DG) for Climate Action has led the preparation of this initiative and the work on the Impact Assessment in the European Commission. The planning entry was approved in Decide Planning under the reference PLAN/2024/2770. It is included in the 2026 Commission Work Programme¹ under the headline ambition A new plan for Europe's sustainable prosperity and competitiveness and the policy objective Climate.

2. ORGANISATION AND TIMING

The planned adoption date (Q3 2026) was included in the Commission Work Programme. The Open Public Consultation was online between 14 April 2025 and 08 July 2025.

An inter-service steering group (ISSG) was established in October 2024 to prepare this initiative. Its members were: SG, LS, AGRI, BUDG, COMM, COMP, CNECT, DEFIS, DGT, DIGIT, EAC, ECFIN, ECHO, EEAS, EMPL, ENER, ENV, ESTAT, FISMA, FPI, GROW, HOME, HR, IDEA, INTPA, JRC, JUST, MARE, MENA, MOVE, NEAR, OLAF, REFORM, REGIO, RTD, SANTE, TAXUD and TRADE. The ISSG met five times in the period from November 2024 until adoption. On 20 November 2024 it discussed the draft Call for Evidence, Stakeholder consultation strategy and questionnaires for the Open Public Consultations, on 10 March 2025 the aviation study inception report, on 3 July 2025 the measures assessed in the Impact Assessment draft, and on 28 January 2026 the policy options. The Interservice Consultation was launched on 19 June 2026 and closed on 1 July 2026.

3. CONSULTATION OF THE RSB

An upstream orientation meeting on the review of the EU ETS for maritime, aviation and stationary installations, and of the Market Stability Reserve was held in October 2025. A draft Evaluation and Impact Assessment were submitted to the Regulatory Scrutiny Board (RSB) on 23 March 2026. Following the RSB meeting on 15 April 2026, a positive opinion with comments was issued on 17 April 2026.

The RSB's recommendations for improvement have been addressed as presented below.

Evaluation:

1) What benefits and costs can be attributed to the EU ETS over the evaluation period? What is the cost pass-through and distribution of costs and benefits? With regards to energy intensive industries, how could the analysis, conclusions and lessons learned be strengthened regarding the carbon price signal to provide incentive(s) to decarbonise? What were marginal abatement costs and what carbon price levels were needed to incentivise decarbonisation in different sectors? How could the results of the evaluation be better used in the impact assessment, in particular for the design of the policy options?

- We have presented the findings on benefits and costs in more detail throughout the evaluation report, including insights for sectors in Appendix III, section 8.3.4.2., and downstream implications in terms of competitiveness and investment decisions in Appendix III, section 8.3.4.5.
- We have included an overview table of costs and benefits in Appendix IV.

¹ COM/2025/870 final

- The presentation of findings and conclusions in the Evaluation Report has been improved to enhance clarity.
- Section 4.1.1.1.2. has been improved with more detail on abatement costs of the main sectors, complementary support measures in place, and effects of exposure to the carbon price signal.
- The presentation and conclusions have been improved to strengthen clarity on the evaluation of carbon leakage prevention in Appendix III, section 8.3., and the analysis on suitability of coverage of sectors.
- The findings of the evaluation have been integrated in the problem definition (e.g. P1 and D2), measures and policy options in the impact assessment (e.g. on free allocation, Modernisation and Innovation Fund).

Impact assessment:

2) How could the definition of the problem[s] be strengthened and made clearer as regards the constraints stemming from the 2040 EU climate target? How can the specific objectives be formulated in SMART terms, better reflecting available evidence? How is cost-effectiveness defined and to which timeframe does it apply? How can the intervention logic and the causal link between the problems and policy options be improved? What is the most appropriate baseline scenario to assess the policy measures and options?

- We have strengthened the analysis on the marginal abatement costs for ETS1 sectors compared to the carbon price as a basis to quantify driver D1.
- We have included a general explanation of the Technological Readiness Levels of technologies assumed in the models, in addition to more information regarding the economic viability of needed technologies at current and expected price levels.
- The quantification of driver D1.2, D2 and D3 has been strengthened regarding the size of the financing gap, free allocation, the 20MW threshold, maritime and aviation.
- We have clarified that the impact assessment examines various trajectories reflecting a commensurate and cost-effective ETS-contribution to the overall 2040 target in the Climate Law, always starting from alignment between the EU ETS and the 2040 target.
- Annex 7 has been further developed to better reflect the assessment criteria in the definition of the objectives, with the objectives formulated as measurable to assess cost-effectiveness in the relevant period.
- We have clarified the causal link between the problems and policy options in the intervention logic and analysis throughout the report.
- We have clarified the explanations on the use of the baseline and the 85% scenario in the main report, as well as in Annex 4, section 2.2.
- We have clarified the choices made in deciding the appropriate baseline in section 5.1, including the justification for the exceptions to the legal default for free allocation provisions and IDB, as well as the MSR0 scenario in addition to the baseline for the MSR.

3) How can the report better present the rationale for packaging the measures into the policy options? How are the policy measures expected to interact with each other? How could the impacts of the policy options be modelled?

- We have clarified the approach to model the impacts of each policy measures and the effects of their interaction. A more detailed overview has been included in Section 7 of the main report to enhance the overview of the combined impact of the policy options.

- We have reinforced the qualitative and quantitative assessment of synergies and interactions between the IDB, free (conditional) allowances and indirect cost compensation.
- We have expanded on the interaction between the development of marginal abatement costs and complementary enabling conditions to clarify the development of overall investment needs, in addition to clarifying uncertainties in the Potencia model.

4) How to properly account for the costs and the benefits of the preferred option vis-à-vis the baseline? What are the administrative and the adjustment costs of the preferred option? What is the distribution of costs and benefits? How could the analyses of both competitiveness and affordability be improved? How could the report be clearer regarding the key assumptions, in particular related to technologies and investment behaviour? How do the analyses deal with the uncertainty of key assumptions?

- We have more clearly distinguished the costs and benefits stemming from the baseline from those incurred due to the policy options, for those topics where the baseline includes a continuation of the policy.
- Costs and benefits of the preferred option have been quantified in Annex 3 on an issue-by-issue basis to provide greater transparency in view of the preferred option being a collection of different components.
- Due to the heterogeneous nature and differences in the focus and level of detail of the quantitative analysis across different topics, as well as the dependence on future implementing measures (notably the design of future MRV requirements) in certain cases, it has not been possible to monetise the aggregated costs and benefits of the preferred option.
- For the analysis on competitiveness and affordability, we have included concrete references to the analysis of the 2040 climate target impact assessment and further developed the impact assessment of the IDB in these terms. In addition, the report further clarifies the complementary role of other policies which go beyond the remit of the EU ETS and will be assessed in more detail in those respective areas.
- Annex 4 has been updated with more information on key assumptions and preconditions (infrastructure, technology development) for the target to be reached.

5) How can the report become clearer and more accessible, considering that the main impact assessment report builds on the several sub-impact assessments provided in annexes? In this respect, how can the report improve the logic of building the different policy options for the ETS review?

- We have reviewed and improved the clarity of the overall narrative in the main report, in addition to including bracketed references to more detailed information in the annexes where relevant.
- We have included a visual representation of the functioning of the EU ETS and its role within the relevant climate and energy policy framework.
- A description of the logic behind the combination of measures into three policy options, the key trade-offs between the options and the measures that drive their overall impact has been included in section 5.2. of the main report.

4. EVIDENCE, SOURCES AND QUALITY

This initiative builds upon evidence gathered in the Impact Assessment for the previous ETS revision² concluded in 2023, the Impact Assessment accompanying the 2040 Climate Target Communication and Proposal³ and any relevant evidence compiled in other concurrent initiatives. It builds on emissions data and experiences from the implementation of the EU monitoring, reporting and verification systems. It makes use of modelling scenarios using PRIMES, GEM-E3 and POLES models, as described in Annex 4 on Modelling and analytical methods. In addition, it makes use of several support contracts. Concerning the maritime and aviation sectors, sector-specific studies were carried out by Ricardo⁴. Further information on evidence, scenarios and sources is provided in Annexes 2 and 4.

² SWD(2021) 601

³ SWD(2024) 63

⁴ Ricardo (forthcoming). Support for the 2026 review of the ETS directive for maritime, report prepared for DG CLIMA, (forthcoming);
Ricardo et al., (2024). Supporting study for the implementation of the ETS Directive and MRV requirements for maritime transport”, and more specifically “MRV maritime evaluation support” part (forthcoming);
Ricardo (forthcoming) Opportunities of the Green Transition for the EU Maritime Industry and Value Chain.
Ricardo (forthcoming). Support for the review by the Commission concerning the implementation of ICAO’s CORSIA, and for Commission reports on certain types of flights, social impacts, and air connectivity of islands, remote territories and Iceland, prepared for DG CLIMA.

ANNEX 2: STAKEHOLDER CONSULTATION (SYNOPSIS REPORT)

1. INTRODUCTION

As part of the back-to-back evaluation and impact assessment to support the revision of the EU ETS Directive and the Market Stability Reserve (MSR) Decision, the Commission carried out a series of consultation activities⁵. The scope of the consultation consisted of an evaluation of the current framework and an impact assessment on a wide range of options for provisions subject to review. In particular, the main objective of the consultation was to gather stakeholder views on the aviation and maritime sectors, carbon leakage, carbon removals, municipal waste incineration (MWI), non-permanent carbon capture and use (CCU), thermal input thresholds, linking with other carbon markets, and the Market Stability Reserve. The consultation further examined the use of revenues and low-carbon support mechanisms. The Commission also looked for inputs on possible simplification measures.

The Commission organised an open public consultation (OPC) via an online survey. The OPC was open for 12 weeks, in line with the Better Regulation Guidelines, from 15 April to 8 July 2025. The questionnaire contained 61 questions, mainly multiple-choice questions but with the possibility to elaborate on the given response.

During the open public consultation period, position papers and feedback to the Call for evidence could also be submitted. In addition, targeted interviews were conducted to gather more detailed information from specific stakeholder groups.

The Commission engaged a contractor⁶ to analyse the results of the online survey, feedback on the call for evidence and stakeholder interviews. The results are summarised below based on the report provided by the contractor.

The Commission also instructed contractors⁷ to collect views and inputs on the implementation of MRVA rules for stationary installations and maritime operators through detailed questionnaires. The outcome of the study will be reflected in the MRVA related sections of evaluation report.

In addition, the Commission participated in multiple (virtual) bilateral and multilateral stakeholder meetings to discuss the revision of the ETS, including with companies and business associations across different sectors, trade unions, non-governmental organisations (NGOs) and public authorities of Member States. The Commission also participated in several virtual conferences in order to present the upcoming revision of the ETS and to invite stakeholders to participate in the public consultation. Finally, a joint meeting of the European Sustainable Shipping Forum sub-group on the implementation of MRV and ETS maritime (ESSF) and Climate Change Expert Group (CCEG Maritime) was held to collect insights and input on maritime-related topics from Member States and stakeholders.

In parallel, as part of the reality check exercise, the Commission also organised a targeted workshop on the EU ETS with over 50 representatives from stationary installations across the EU on 29 January 2026, which focused on experiences with practical implementation and

⁵ The details of the public consultation can be found at: [EU emissions trading system for maritime, aviation and stationary installations, and market stability reserve – review](#).

⁶ Ricardo. Service contract 090203/2024/924074/SER/CLIMA.B.1

⁷ Ricardo Nederland B.V; Viegand Maagøe A/S and SQ Consult.

identification of areas for simplification and streamlining of compliance processes and requirements.

Finally, the Commission organised a high-level stakeholder roundtable on the review of the EU ETS on 12 May 2026, bringing together close to 60 EU association and company representatives from more than 20 sectors covered under the EU ETS, civil society organisations and other relevant stakeholders such as auction platforms and market analysts, from different geographical areas across the EU. The Roundtable complemented the public consultation on the evaluation and the review of the EU Emissions Trading System and the Market Stability Reserve conducted in 2025, in view of the interim developments on the evaluation and review process, geopolitical events and guidance from the March 2026 European Council and the 2040 target amendment to the European Climate Law. The Roundtable gathered additional input on the policy priorities to guide the upcoming review of the EU ETS and the Market Stability Reserve (MSR) for the 2031-2040 period and the complementary instruments needed to make decarbonisation a driver of EU competitiveness and resilience. The Roundtable was also publicly web-streamed, with online observers invited to share positions in writing after the event.

2. METHODOLOGY FOR DATA PROCESSING

The questionnaire mainly consisted of closed questions presented as multiple-choice or multiple-answer questions⁸. The questionnaire also included several open-ended questions, mostly to elaborate on responses to closed questions, as well as some stand-alone open-ended questions. The results of all questions have been analysed quantitatively. For open-ended questions, key views raised by respondents were identified and grouped by theme, allowing the frequency of each issue to be assessed quantitatively.

In accordance with the Better Regulation Guidelines and Toolbox, sets of coordinated responses have been identified and analysed separately as campaigns. Campaigns were identified horizontally where respondents with key shared characteristics⁹ submitted similar or identical answers across multiple questions in the questionnaire. A scoring method ($R \times Q = S$) was applied that considered the combination of the number of respondents (R)¹⁰ and the number of questions where similar or identical responses (Q) were submitted¹¹ with the

⁸ Results for questions allowing multiple answers indicate the number of responses, which may exceed the total number of respondents.

⁹ Same stakeholder type, same sector within a stakeholder type, or stakeholders within the same stakeholder type all located in the same Member State.

¹⁰ With the threshold for (R) set at 4 or higher.

¹¹ For open-ended questions, similarity was measured by exact, case-sensitive character overlap: a response was considered “repeated” if at least 30% of its characters matched another answer word-for-word. Groups were constructed iteratively, beginning with matching pairs and then expanding until stable clusters were formed. For closed questions, the assessment was merged with that of the open-ended questions as a correlation in coordinated responses was identified with most groups of respondents who coordinated responses to open-ended questions also having submitted coordinated responses to related closed question(s). For those closed questions, similarity was measured by a threshold of at least 80% of responses being identical.

threshold (S) defined as 50 or higher to ensure that strongly coordinated sets of responses throughout the questionnaire were transparently identified¹².

The analysis of the closed and open-ended responses identified 13 campaigns, mainly affecting the stationary installation section of the Impact Assessment. While these had a visible impact on the responses submitted to open-ended questions, they did not significantly affect the results of closed questions. In particular, the relative ranking of options was not altered.

Additional position papers or feedback on the Call for evidence could be submitted to the OPC. In total, 404 unique contributions were received (of which 377 as feedback to the Call for evidence and 27 directly submitted): each could include feedback, a position paper, or both. Altogether, these comprised 377 feedback responses and 323 papers. Based on a preliminary review and a selection, 372 papers and feedback were thoroughly analysed. These were processed via cataloguing, meaning data from each contribution was logged in a database to provide key themes, issues raised and author.

3. RESULTS OF THE OPEN PUBLIC CONSULTATION

3.1. Overview of participants

The online survey received a total of 540 responses. Respondents represented a wide geographic distribution: 478 responses originated from 23 Member States. The largest shares came from Belgium (113; 21%)¹³, Germany (93; 17%), and France (77; 14%). 59 responses were submitted from outside the EU¹⁴.

The majority of responses (411, 76%) were submitted by private sector stakeholders, including companies and businesses (233, 43%) and business associations (178; 33%), followed by NGOs (44; 8%), public authorities (37; 7%), EU citizens (10; 2%), environmental organisations (8; 1%), academic or research institutions (4; 1%) and trade unions (3; 1%)¹⁵. Within the company/business category, 84 out of 233 respondents (36%) were classified as SMEs.

In terms of the sectors represented, respondents most frequently identified with the waste management sector (133, 26%), followed by the energy sector (107; 21%) and other sectors not explicitly listed (103; 20%). Manufacturing industry sectors¹⁶ combined represented 104 (20%) of respondents, maritime 29 (5.7%), and aviation 15 (2.9%).

¹² This methodology allowed to identify stakeholders with coordinated responses ranging from large groups of respondents submitting similar responses to a targeted topic (f. ex. 25 local public authorities coordinating on questions on waste management), to smaller numbers of respondents submitting similar responses across multiple topics (f. ex 5 companies/businesses from the chemicals sector horizontally coordinating on different topics related to stationary installations in the impact assessment).

¹³ This result is influenced by the fact that many business associations and NGOs are based in Belgium.

¹⁴ In addition, 3 out of the 540 respondents did not specify the country of origin.

¹⁵ In the further analysis of OPC results, the analysis per stakeholder type is focused on the private sector (companies/businesses and business associations) and NGOs, given the large share of respondents from these groups. Results for other stakeholder groups have to be interpreted with caution. For instance, the number of replies from trade unions, academic/research institutions or EU citizens is too low to draw representative conclusions, while public authorities encompass a diverse spectrum from different levels and policy areas, including local, regional and federal authorities. These stakeholder groups will therefore only be mentioned explicitly where relevant.

¹⁶ Chemicals and fertilisers, other energy-intensive industry, steel, cement, glass and ceramics, non-ferrous metals.

3.2. Evaluation

3.2.1. Effectiveness

69% of respondents (216 out of 314) from a wide range of stakeholder groups (including the majority of companies/businesses, business associations and NGOs) considered the ETS Directive moderately (157; 50%) to very (59, 19%) effective in reducing GHG emissions. A further 23% (72) considered it slightly effective. Only 2% (7) believed it had not been effective at all, and 6% (19) indicated they did not know.

Current carbon leakage protection measures in non-CBAM sectors were considered moderately (138; 46%) to very (18; 6%) effective by more than half of respondents (154 out of 300), mainly from companies/businesses and business associations. Conversely, most NGO respondents as well as companies/businesses from non-eligible sectors considered current carbon leakage measures only slightly (60; 20%) or not (27; 9%) effective.

A broad majority from across stakeholder groups agreed that the MSR has so far been very (100 out of 282; 35%) to moderately (82; 29%) effective in addressing the surplus on the market, while only 10% (28) considered it slightly effective and 2% (5) not effective. However, looking at the future, mainly NGOs supported maintaining this role as a key feature to stabilise the carbon price signal. Companies/businesses and business associations on the other hand frequently questioned the future role of MSR intakes and the invalidation mechanism in view of expected future scarcity on the market and predominantly considered limiting excessive price volatility and ensuring liquidity on the market as the most important role for the MSR. Views were divided on the MSR's effectiveness so far in this regard. While 39% of respondents (110 out of 283), including most NGOs, considered the MSR moderately (88; 31%) to very (22; 8%) effective in improving the system's resilience to major shocks, 34% of respondents, mainly companies/businesses and business associations, considered it only slightly (55; 19%) or not (43; 15%) effective at all. Overall, the questions related to the MSR gathered high degrees of uncertainty (ranging from 24% to 32%), suggesting stakeholders were less familiar with the functioning of the MSR compared to the ETS.

3.2.2. Cost-efficiency

Overall, slightly more than half of respondents from a wide range of stakeholder groups view the ETS Directive as moderately (111 out of 291; 38%) to very (39; 13%) efficient in achieving its objectives in a cost-efficient manner. Conversely, 52 respondents (18%), including a majority of NGOs¹⁷, considered it not cost-efficient, while nearly a quarter of respondents considered it only slightly cost-efficient (67; 23%).

The largest share of respondents, including most NGOs, also considered the MSR Decision to be moderately (69 out of 276; 25%) to very efficient (38; 14%), compared to a smaller share, mainly companies/businesses and business associations, viewing it as slightly efficient (36; 13%) or not efficient (37; 13%). However, more than one third of respondents (35%) indicated they did not know. Similarly to previous questions on the MSR, these results indicate a higher degree of division between stakeholder types and a relatively lower degree of familiarity overall with the functioning of the MSR compared to the ETS.

¹⁷ While no specific open-field question was attached to this closed question, analysis of open-field responses throughout the OPC suggests this is mainly due to the perceived inefficiency of free allocation among the majority of NGO stakeholders.

3.2.3. Relevance and added value

Three quarters of respondents from a wide range of stakeholder groups considered that the needs/problems addressed by the ETS Directive continue to require action at EU level to a very large (138 out of 294, 47%) or large (81; 27%) extent, with a further 45 (15%) agreeing to some extent. Only small shares agreed to a small extent (11; 4%) or not at all (5; 2%), indicating strong support for ongoing EU-level action to reduce GHG emissions.

Similarly, a very broad majority of respondents from across all stakeholder groups perceived the EU ETS and MSR as having high (93 out of 298, 31%) or very high (86; 29%) added value in reducing GHG emissions in the EU, with a further 80 (27%) considering the added value moderate. Less than one tenth rated added value as low (11; 3%) or very low (17; 6%), suggesting strong support for the key role of the EU ETS and MSR in EU climate policy going forward.

3.2.4. Simplification and coherence

Several open-ended and closed questions in the evaluation invited stakeholders' views and suggestions on the coherence, administrative cost and simplification of the ETS Directive without negatively affecting the achievement of its objectives. The responses and suggestions provided were similar across these questions.

A majority of respondents across all stakeholder groups considered that improvements could be made to reduce the administrative burden and regulatory cost of the ETS Directive, with 84 out of 287 (29%) viewing it only slightly efficient and 77 (27%) not efficient in this respect, a view which was most strongly shared among SMEs. Conversely, one third of respondents (mainly from the energy and cleantech sectors) considered the administrative burden to be moderately (69; 24%) to very (17; 6%) efficient.

Respondents were encouraged to provide suggestions to improve administrative burden and support simplification without negatively affecting the achievement of its objectives. The most frequently raised suggestions (nearly half of responses), mainly from companies/businesses and business associations and specifically from SMEs, related to the simplification and harmonisation of MRV rules in combination with streamlined reporting practices and ensuring that guidance, tools and processes are timely in place before the implementation deadline. Concrete suggestions frequently raised included the use of standardized/harmonised digital tools, automated data collection and simplified compliance requirements for smaller emitters, a reduced frequency of submissions, harmonised templates, expanded and harmonised opt-out rules for smaller emitters, streamlining the audit cycles by only conducting a full on-site audit every three years with a simplified remote audit in the intervening years, simplifying reporting by providing pre-filled data based on past submissions where possible and simplifying the scope of emission data reporting. Specifically, several SMEs from the waste sector suggested to update MRV rules with regards to MWI installations.

In second place came the simplification and increased coherence of free allocation and benchmarking rules (around two fifths of responses). Concrete suggestions were however strongly divided between stakeholder groups, with companies/businesses and business associations mainly favouring simplified free allocation rules to reduce administrative burden and strengthen coherence with overall competitiveness aims, while NGOs favoured a replacement of free allocation by full auctioning as a means to reduce administrative burden, simplify the ETS Directive and strengthen coherence with the polluter pays principle.

The third frequently raised suggestion (around a quarter of responses), mainly by companies/businesses and business associations, related to improving coherence with other EU energy and climate legislation. This was confirmed by the results of a separate question on the perceived coherence of the ETS and MSR with other EU policies and international climate agreements, where views were divided with the largest share, including most companies/businesses and business associations, perceiving only some extent of coherence (110 out of 293; 38%), or no coherence at all (21; 7%), compared to large (63; 22%) or very large (21; 7%) extents of coherence (including most NGOs) . Suggestions for improving coherence focused on streamlining rules and reporting requirements with other EU energy and climate legislation (one third of responses), followed by stronger coherence with international frameworks for GHG emission reductions in the maritime and aviation sectors (a quarter of responses).

3.3. Impact assessment

3.3.1. Aviation

The consultation on the EU ETS highlighted that most respondents see the application of the EU to aviation as a necessary instrument for aligning the aviation sector with the EU's climate objectives, whereas a smaller share of respondents mostly comprised of industry stakeholders see it as a source of challenges. There is broad support for strengthening aviation's contribution to EU climate objectives. Stakeholders have diverging views on how best to reconcile environmental integrity with competitiveness, connectivity, and global coordination.

3.3.1.1. Perceived level of climate action by the aviation sector compared to climate commitments

Around half of respondents considered the aviation sector's current level of climate action insufficient to meet climate targets, with one quarter of respondents (48 out of 183, 26%) judging it not sufficient at all and another quarter (45, 25%) rating it as somewhat sufficient but unlikely to meet the Paris Agreement and European Climate Law targets. This perception was particularly strong among civil society organisations (NGOs and environmental organisations), but it was also widely shared by the majority of companies (80%), business associations (78%), and public authorities (80%) that responded to the question.

When asked about the main concerns regarding the sector's decarbonisation pace, these stakeholders pointed to the need for increased support for development and deployment of sustainable aviation fuels (SAF) (10 mentions) to address their current limited availability and high costs (14 mentions). Several of these stakeholders questioned the effectiveness of current policy instruments in tackling aviation emissions. In particular, they challenged the current EU ETS system for its low carbon prices and free allowances (8 mentions), as well as its limited scope to only intra-EEA flights (7 mentions). Additional concerns included the aviation sector being undertaxed relative to other sectors (5 mentions) and the current lack of commercial viability for zero-emission aircraft technologies such as hydrogen and electric planes (1 mention).

Only a small minority of stakeholders (16, 9%) considered current action sufficient, largely comprised of companies and business associations, namely airlines, aviation associations, one Original Equipment Manufacturer (OEM) and one SAF producer, citing the already established pledges and strategies to achieve net zero operations by 2050 as main argument against further action (4 mentions). For these stakeholders decarbonisation ambitions need to align with the industry's capacity to invest and compete globally (2 mentions).

3.3.1.2. Adequacy of the current EU ETS approach to international flights outside Europe

Nearly 40% of respondents considered that the current approach to international flights outside Europe does not adequately address emissions from these flights. This perception of inadequacy was unanimous among civil society organisations, and was also the majority view among companies, business associations, public authorities and respondents in the “Other” category, which criticised CORSIA for its voluntary participation, lack of emissions reduction targets, absence of an effective carbon price, and limited in-sector reductions (21 mentions). Due to CORSIA’s shortcomings, stakeholders underlined how the limited scope of the EU ETS may lead to carbon leakage (4 mentions) and called for stronger EU leadership (2 mentions). Many argued that the EU ETS should be extended to cover all departing flights (20 mentions).

Among respondents in disagreement with the current approach, NGOs criticised CORSIA’s lack of integrity because of the questionable quality of carbon offsets (10 mentions), and ICAO’s slow and ineffective progress on delivering meaningful climate action (2 mentions). Conversely, companies and business associations emphasised the importance of prioritising a global approach by strengthening CORSIA rather than relying solely on unilateral EU measures (16 mentions), and raised concerns about extending the EU ETS, due to potential competitive disadvantages for carriers operating outside Europe and not subject to equivalent obligations (2 mentions).

29 respondents (15%), mostly from companies and business associations, argued that the current approach to international flights outside Europe is appropriate, highlighting that CORSIA is a suitable global mechanism to address emissions (9 mentions). In addition, they claimed that this approach preserves competitiveness and prevents market distortions (9 mentions), as a global approach through ICAO should be prioritised over unilateral EU action (7 mentions).

3.3.1.3. Stakeholder priorities on additional issues

Beyond the central debate on climate action and ETS–CORSIA interaction, stakeholders identified several priority areas requiring policy attention, in particular: the ETS support for SAF uptake; connectivity, competitiveness, and carbon leakage risks; emissions from private and business aviation, short-haul flights; and socio-economic impacts on outermost regions. Prioritisation results reflect varying degrees of support across stakeholder groups.

Business associations, companies, and public authorities mostly highlighted the importance of the ETS support for eligible fuels (92 ratings as top priority or high importance). Duration extension (15 mentions) and increased number of SAF allowances (10 mentions) were the main suggestions to enhance the support scheme. Many also called for redirecting ETS revenues to scale up SAF production (9 mentions) and increasing allowances to better reflect price differences between SAF and jet fuel (8 mentions). In relation to the latter, several proposals were put forward to particularly incentivise eSAF production and uptake.

Private sector stakeholders strongly emphasised connectivity, competitiveness, and carbon leakage concerns (68 ratings as top priority or high importance) stating that the ETS may divert traffic to non-EU hubs to avoid compliance—specifically due to the low price of CORSIA relative to the ETS—thus contributing to only shifting emissions outside the EU and disadvantaging EU carriers. Stakeholders asked for targeted tools to address leakage risk on specific routes, as a way to balance climate ambition with competitiveness and connectivity needs.

Civil society, instead, mostly prioritised tackling emissions from private and business jets (55 ratings as top priority or high importance), in order to ensure social fairness against their disproportionately high per-passenger emissions (8 mentions). In particular, stakeholders proposed various solutions to regulate emissions from private and business jets within (9 mentions) and beyond (6 mentions) the EU ETS. Similarly, flights of less than 1000 km were particularly challenged by NGOs and environmental organisations (55 ratings as top priority or high importance), which demanded a modal shift to rail for such short flights (10 mentions). While most respondents agreed on the stronger drive to decarbonise short-haul flights, one public authority highlighted the need to consider the specific local context, as these may play a key role in safeguarding regional cohesion.

3.3.2. *Maritime*

The consultation on the EU ETS as applied to maritime confirmed broad support for its success in driving decarbonisation, while also identifying opportunities to improve interaction with international measures, enhance competitiveness, include smaller vessels, and simplify the rules.

3.3.2.1. Coherence of the EU ETS with IMO NZF and avoiding significant double burden

Many stakeholders emphasized the importance of ensuring smooth coordination between the EU ETS and the upcoming IMO NZF, with some prioritising a global approach, and some calling for reducing or adjusting the EU ETS scope once IMO rules are in force. The most cited view was the need to avoid duplication, double burdens, or administrative costs from running parallel systems (75 mentions out of 107 responses), followed closely by the potential harmonisation between EU and IMO measures (70 mentions). Some stakeholders supported the phase-out of the EU ETS in favour of IMO rules (45 mentions). Other views included the importance of maintaining high environmental ambition and retaining EU ETS (15 mentions), concerns about competitive risks such as flagging out, carbon leakage, or investment diversion (8 mentions), imposing mutual recognition between EU ETS and potential IMO measures (6 mentions), importance of early engagement and support during phase-out (3 mentions), with stakeholders calling for temporary exemptions, regulatory clarity, and administrative alignment to ensure a smooth transition; and calls for differentiated, simplified, or sector-specific rules (2 mentions) aimed at reducing administrative and financial burdens while maintaining emissions coverage.

3.3.2.2. Effectiveness of the current measures in reducing risk of evasion

A total of 29 out of 184 respondents rather agreed (11%) or strongly agreed (4%) that the current measures are effective in preventing shipping companies from evading the requirements of the EU ETS Directive. A further 23 respondents expressed a neutral view (13%). Smaller shares of respondents rather disagreed or strongly disagreed (24;13%). The largest group indicated do not know (108, 59%). Regarding specific suggestions, the most frequently mentioned view was the need for stronger monitoring and enforcement to prevent circumvention, including addressing rerouting, transshipment, and port call issues (11 mentions). Several stakeholders called for alignment with the IMO NZF and international harmonisation to maintain a level playing field (5 mentions), and enhanced coordination among authorities, including EU ports and third countries (5 mentions). Others highlighted the importance of stricter and proportionate penalties for non-compliance (4 mentions), use of digital tools and registries to improve tracking and transparency (3 mentions), and regular reviews and updates of ETS scope and measures (3 mentions). Additional suggestions included

clearer definitions of ports, transshipment, offshore, and exemptions to reduce loopholes (2 mentions) and exemptions or compensations for regions with unique logistical challenges (1 mention).

Extending the scope of the EU ETS maritime provisions to include smaller ships

When asked whether the scope of the EU ETS Maritime provisions should be extended to cover emissions from smaller ships (below 5,000 GT but not below 400 GT, including offshore ships), a total of 57 out of 189 respondents rather agreed (16%) or strongly agreed (14%). A further 30 respondents expressed a neutral view (16%). Smaller shares of respondents rather disagreed (23, 12%) or strongly disagreed (19, 10%). The largest group indicated do not know (60, 32%). As far as the proposed scope for the extension is concerned, the most frequently cited view was support for extending EU ETS Maritime to vessels between 400 and 5,000 GT (30 mentions). Several stakeholders proposed phased or targeted inclusion of smaller ships (6 mentions) and highlighted the importance of consistency in scope with FuelEU Maritime, IMO NZF, and MARPOL Annex VI (2 mentions). Respondents emphasised both the need to ensure that revenues from extending the EU ETS to smaller vessels are reinvested in maritime decarbonisation (4 mentions) and the importance of simplified administration and reporting for smaller ships (3 mentions). Others raised calls for fair competition with road transport (3 mentions), support for including specific ship categories such as cruise ships, yachts, or offshore vessels (1 mention), and concerns about negative regional impacts, particularly in outermost regions or outermost regions (1 mention).

3.3.2.3. Effectiveness of EU ETS in addressing shipping challenges for islands and outermost regions

When asked whether the EU ETS are effectively reflecting the challenges faced by islands and remote territories, including outermost regions, 15 out of 179 (8%) respondents strongly agreed or rather agreed. A further 19 respondents expressed a neutral view (11%). Smaller shares of respondents rather disagreed or strongly disagreed (35, 20%). The largest group indicated do not know (110, 61%). On open ended question on connectivity, the most frequently cited concern was that the EU ETS would increase costs for ports in outermost regions and reduce competitiveness (17 mentions). Several stakeholders emphasised the need for tailored mitigation and differentiated treatment for islands and remote territories (11 mentions) and permanent compensation for special operating conditions, such as ice navigation (6 mentions). Other views included exemptions being inadequate for major islands and longer-term needs (5 mentions), priority access to sustainable fuels and complementary measures (3 mentions), administrative and compliance burdens for lifeline or ferry services (2 mentions), and reinvestment of ETS revenues to offset island-specific impacts (1 mention). When asked whether the administrative costs linked to the implementation of the ETS maritime provisions are proportionate and reasonable, 30 out of 186 respondents strongly agreed (2%) or rather agreed (14%). A further 19 respondents expressed a neutral view (10%). Smaller shares of respondents rather disagreed (36, 19%) or strongly disagreed (11, 6%). The largest group indicated do not know (90, 48%).

3.3.2.4. Stakeholder views on additional issues

When asked whether the administrative costs linked to the implementation of the ETS extension to maritime transport are proportionate and reasonable, 4 respondents strongly agreed (2%) and 26 respondents rather agreed (14%). A further 19 respondents expressed a neutral view (10%). Smaller shares of respondents rather disagreed (36, 19%) or strongly disagreed (11, 6%). The largest group indicated do not know (90, 49%). On suggested

improvements, the most frequent view (20 mentions) called for alignment of EU ETS rules with IMO NZF and FuelEU Maritime to avoid double regulation. Standardising data collection and reporting across EU MRV and IMO DCS was emphasised by 17 stakeholders, while 15 supported a single EU-level digital system for easier compliance. 10 stressed the need for clear, harmonised EU guidance to reduce interpretation risks. Some respondents requested simplified compliance for SMEs and smaller emitters, simplification by reducing procedural burdens, and administrative fees and verification costs to be reduced and standardised across Member States (each with 4 mentions).

When asked whether the ETS should further incentivise the uptake of renewable and low-carbon maritime fuels based on Well-to-Wake emissions, 87 out of 191 respondents strongly agreed (23%) or rather agreed (23%). A further 9 respondents expressed a neutral view (5%). Smaller shares of respondents rather disagreed or strongly disagreed (24, 13%). Other respondents indicated do not know (71, 37%). On suggested improvements, the most frequent suggestion (17 mentions) called for incentives based on full well-to-wake lifecycle emissions, excluding unsustainable biofuels. 12 stakeholders emphasised cost support for renewable fuels to compete with conventional options, while 11 stressed technology-neutral fuel incentives and alignment of EU ETS with FuelEU Maritime, RED III, and IMO frameworks. 7 respondents recommended reinvesting ETS revenues to de-risk clean fuel deployment and infrastructure. Other views included standardising sustainability certification (6 mentions), simplifying reporting (4 mentions), phased regulatory timing (2 mentions), targeted support for remote regions (1 mention), and boosting domestic renewable fuel production (1 mention).

3.3.3. Measures to address the risk of carbon leakage for emissions not covered by CBAM sectors

3.3.3.1. Free allocation

Asked on what basis free allocation should be provided beyond 2030 for sectors not covered by CBAM¹⁸, an updated benchmark methodology (94 out of 437 responses; 22%) was the most frequently selected option, predominantly by companies/businesses and business associations from the energy, waste, cement and cleantech sectors. They argued for benchmarks better reflecting current performance levels versus outliers or projections, considering technological and economic constraints, EU-wide availability of enabling conditions, resources and technologies. This was followed by 83 responses (19%) supporting maintaining the current carbon leakage list as applied in Phase IV (2021–2030), mainly on the grounds that the carbon leakage risk of the sectors concerned has not substantially changed and in opposition to the possible introduction of conditionalities. This view was mainly supported by companies/businesses and business associations from manufacturing industry sectors. A further 72 responses (16%), mainly from companies/businesses and business associations from the energy, waste and cleantech sectors, supported an updated carbon leakage list. Very few provided details, with those who did mostly calling for trade intensity to be given more weight over emission intensity when calculating the carbon leakage indicator value. Finally, 59 responses (13%), mainly from companies/businesses and business associations in the energy sector as well as most NGOs, favoured making free allocation conditional on taking steps towards carbon neutrality. A further 83 (19%) clicked “other”, providing very diverse input from which no representative conclusions could be drawn. 46 responses (11%) were uncertain.

¹⁸ Respondents could indicate multiple responses.

In addition, several campaigns coordinated their responses on this question, showing a similar distribution of preferences which did not have a decisive impact on the overall results. Five campaigns by companies/businesses and business associations in different manufacturing industry sectors (29 respondents in total) advocated for keeping the current carbon leakage list, with two of those (9 respondents in total) also indicating that they support an update of the benchmark methodology, for similar reasons as indicated higher. Two campaigns, from the waste and cement sectors, (28 respondents in total) preferred both an updated carbon leakage list and an updated benchmark methodology. Three campaigns by NGOs and by companies/businesses from the waste-to-energy sector (20 respondents in total) advocated for conditionality in combination with an updated benchmark methodology, with the two NGO campaigns specifying a preference for phasing out free allocation. In terms of specific views provided, the waste sector campaigns all argued for a specific EU-wide waste-to-energy benchmark, separate from energy-sector benchmarks, to reflect the functional unit (tonnes) and prevent waste leakage.

3.3.3.2. Indirect cost compensation

Almost three quarters of respondents (175 out of 238, 74%) considered that indirect cost compensation will remain necessary after 2030 to address the risk of carbon leakage from carbon costs passed on in electricity prices (in sectors not covered by CBAM). Of these, 93 respondents (39%) supported harmonising the system at EU level, the main justification being to address competitive distortion among operators, and 26 respondents (11%) called for an extension to cover more sectors and sub-sectors, with some degree of overlap between the two¹⁹. These views were mainly shared by companies/businesses and business associations from sectors and sub-sectors currently not eligible for indirect cost compensation²⁰. While few respondents justified their choice for harmonisation, the available answers seem to indicate different interpretations of harmonisation, with some focusing on geographical harmonisation (to all Member States) while others focused on regulatory harmonisation (same rules). Conversely, 50 respondents (21%), mainly from manufacturing industry sectors, favoured maintaining the current approach based on State aid. Only 12 respondents (5%), almost exclusively NGOs and environmental organisations, opposed continuing indirect cost compensation.

Furthermore, three campaigns by companies/businesses and business associations from the glass and ceramics, steel, and waste-to-energy sectors (32 respondents in total) were identified calling for harmonisation, one of which also called for an extension to all sectors, in addition to one further campaign (5 respondents in total) by companies/businesses in the agriculture sector advocating an extension specifically to their sector. One campaign (5 respondents in total) by companies/businesses from the manufacturing sector (chemicals and fertilisers) supported maintaining the current approach. Conversely, two NGO campaigns (15 respondents in total) preferred to phase out indirect cost compensation. These campaign responses did not have a decisive impact on the overall conclusion that a majority of respondents support the

¹⁹ The overlap was due to respondents who selected 'other views' and specified multiple preferences in the related open-ended question. Out of the 57 respondents who selected 'other views', around 20 advocated for both harmonisation and sectoral extension.

²⁰ Including but not limited to the energy sector, subsets of the chemicals and fertilizers sector and cement sector, the glass and ceramics sector, the agriculture sector, and mining and building sectors.

continuation of indirect cost compensation, with most of those supporting harmonisation at EU-level.

3.3.4. Revenue use

Respondents clearly prioritised using future ETS1 auction revenues for industrial decarbonisation (ranked top 3 by more than 60% of respondents), followed by the development of renewable energy sources and clean energy systems, and the development and upscaling of clean technologies (each ranked top 3 by around 40% of respondents)²¹. Priorities however strongly diverged between stakeholder groups, with these responses mainly driven by companies/businesses and business association respondents, while most NGOs and environmental organisations prioritised energy efficiency, social support and just transition, as well as public transport, climate adaptation and international climate finance.

A broad majority of respondents from a wide range of stakeholder groups (except public authorities) agreed that transparency on how Member States use the ETS revenues is currently insufficient, with only 31 out of 288 (11%) respondents considering there is sufficient transparency, compared to 160 (55%) disagreeing and 97 (34%) neutral or uncertain. Respondents highlighted the need for better public access to data, including the use of digital platforms (40%), clearer and more frequent reporting by Member States on revenue use (26%), and improved accountability mechanisms to ensure revenues are used effectively (7%).

3.3.5. Industrial decarbonisation support

Respondents from across all stakeholder groups overwhelmingly supported the creation of an Industrial Decarbonisation Bank to assist industrial decarbonisation efforts (240 out of 288 respondents; 83%). Only a small minority (10 respondents, 4%) opposed the idea, while 38 respondents (13%) were uncertain. Furthermore, seven campaigns by companies/businesses and business associations from different sectors (61 responses in total) also supported the creation of an Industrial Decarbonisation Bank, further amplifying the outcome. Among the instruments considered most effective for supporting the business case for industrial decarbonisation, carbon contracts for difference were highlighted in almost half of responses, followed by grants (one out of five responses), tax credits (one out of ten responses) and fixed premia for specific products (one out of ten responses), with most respondents supporting a combination of such tools. Among campaign respondents, preferences were very similar, with most supporting a mix of tools including carbon contracts for difference, tax credits and/or grants.

The continuation of the Innovation Fund was also broadly supported, with almost three quarters of respondents from across all stakeholder groups strongly agreeing (132 out of 288 respondents; 46%) or rather agreeing (79; 27%). In contrast, only 6 respondents (2%) rather disagreed, and 2 respondents (1%) strongly disagreed, while 26 respondents (9%) were neutral, and 43 respondents (15%) did not know. In addition, four campaigns by companies/businesses and business associations from different sectors (39 respondents in total) also supported the continued need for the Innovation Fund, confirming the result of this question. The main arguments for the continued need for the Innovation Fund centred on its complementary role

²¹ Respondents were asked to rank a range of possible future uses for ETS1 auction revenues. The options were ranked using a weighted average method, where higher ranks received higher weights (12 for Rank 1 down to 1 for Rank 12). For each option, the rank frequencies were multiplied by their weights, summed, and divided by the total number of responses. The resulting weighted average score reflects the overall prioritisation, with higher scores indicating stronger preference.

to other instruments (such as a future Decarbonisation Bank) by supporting early-stage, high-risk, breakthrough innovation, and its critical role in supporting decarbonisation in hard-to-abate sectors such as aviation, maritime and heavy industry. Suggestions for improvements included reducing administrative complexity, speeding up disbursement, more flexible eligibility criteria, supporting a wider range of technologies (including mature and market-ready solutions) and introducing dedicated windows for priority areas. The identified campaigns shared similar views, in addition to arguing for the inclusion of the waste sector in the scope of the Fund (waste-to-energy companies' campaign) and supporting national allocations under the Fund to ensure geographic balance (group of energy companies located in one Member State).

The continuation of the Modernisation Fund was also supported by a clear majority of respondents from across all stakeholder groups, with 73 out of 272 respondents (27%) strongly agreeing and 65 respondents (24%) rather agreeing, while only a minority rather disagreed (16 respondents, 6%) or strongly disagreed (4 respondents, 1%). Support was particularly strong among respondents located in eligible Member States and from the energy sector. The remaining respondents were neutral (35 respondents, 13%) or uncertain (79 respondents, 29%), with those respondents mainly located in non-eligible Member States. In addition, one campaign by energy sector companies located in a Member State covered by the Fund (5 respondents in total) also strongly supported the continuation of the Modernisation Fund, which did not affect the result of this question. When asked about the scope of the Fund, most respondents did not share specific views. Of those who did, nearly two thirds called for an extension of the scope, mainly to also cover industrial decarbonisation beyond energy efficiency and renewables, while the remaining third considered the current scope sufficient to address the decarbonisation challenges in lower-income Member States. Some of those respondents, all NGOs and environmental organisations, on the contrary specified that they would like some investments to be excluded from the scope of Fund, mostly gas, but also waste incineration, nuclear and/or forest biomass.

3.3.6. Market Stability Reserve (MSR)

Looking ahead to what the MSR should achieve to ensure the proper functioning of the EU ETS in the future, strengthening the MSR to prevent excessive EU ETS price volatility (96 out of 256 responses; 38%) and increasing market liquidity (66; 26%) were clearly indicated as the top 2 priorities by most respondents, mainly by companies/businesses and business associations. Conversely, 46 responses (18%), mostly NGOs and environmental organisations, prioritised to continue tackling the surplus in the market. Roughly one fifth were uncertain (47; 18%). In addition, several campaigns were identified, submitting responses along largely similar lines which did not affect the overall balance of preferences. One NGO campaign (10 respondents in total) preferred continued tackling of the market surplus, while four business/company campaigns (20 respondents in total) prioritised increasing market liquidity, of which one also called for preventing excessive price volatility, possibly through a price corridor or cap. Finally, one campaign by companies/businesses in the agriculture sector (5 respondents in total) called for a phase-out of the MSR.

Given their expectation that the ETS cap will fall to zero towards the end of Phase V of the EU ETS, respondents from companies/businesses and business associations predominantly expressed concerns about the predictability and volatility of future allowance prices. The potential changes to the MSR most frequently raised, mainly by companies/businesses and business associations, were to make the intake and/or release thresholds dynamic to reflect prevailing market conditions (67 out of 451 responses; 15%), to adjust the invalidation rule for

holdings in the reserve above 400 million allowances (57; 13%), and to shorten the response time through more frequent adjustments (45; 10%). In addition, out of the “other” responses (87; 19%), almost half also called for the cancellation of the invalidation rule, making this the top priority among respondents. Conversely, NGOs predominantly supported keeping the intake rate at 24% beyond 2030 (34; 8%) to continue tackling the surplus. Finally, 34 responses (7%) from across various stakeholder types called for a downward adjustment of fixed thresholds for MSR intake and/or release, while 14 (3%), all companies/businesses, supported an upward adjustment. Additionally, 22 (5%) of responses called for a buffer to the lower threshold to address potential threshold effects. The aforementioned campaigns did not have a substantial impact on the outcome of this question.

3.3.7. *Carbon removals*

A very broad majority of respondents (259 out of 313 respondents; 83%), including the majority of companies/businesses and business associations, supported the integration of permanent CRCF removal units in the EU ETS, arguing that this is essential to expand operators’ options to achieve the long-term climate objective, to support the uptake of such technologies and to enhance liquidity in the market. Only a small minority of 38 respondents (12%), mainly NGOs and environmental organisations, opposed their integration, mainly on the grounds of the need to prioritise mitigation and due to associated environmental risks. In addition, seven campaigns by companies/businesses and business associations from various sectors (59 respondents in total) also strongly supported the integration of permanent removals, while two NGO campaigns (15 respondents in total) opposed their integration, reflecting the overall outcome on this question. A majority of respondents further indicated that complementary policies are needed (190 out of 285 respondents; 67%), while a smaller share, largely corresponding to the respondents not in favour of integrating CRCF removal units into the EU ETS, favoured alternative policies instead (44; 15%).

Conversely, integrating temporary CRCF removal units into the EU ETS proved very divisive, with a relative majority strongly or rather disagreeing (125 out of 308 respondents; 41%), including the strongest level of strong opposition (98; 32%) across all questions related to carbon removals, mainly citing unreliable quantification and risks to market stability, compared to those strongly or rather agreeing (117 out of 308 respondents, 38%), mainly citing lower costs and their ability to scale up more quickly, while many also acknowledged the need for strict criteria and a differentiated approach to quantification and use. Respondents on either side came from a very diverse range of sectors.

Looking more specifically into the modalities for integration of carbon removals into the EU ETS, support was strongest for allowing installations to deduct removals generated in their own activities from their compliance obligations (184 out of 300 respondents (61%) strongly or somewhat agreed, mainly companies/businesses and business associations from manufacturing industry sectors and the energy sector), closely followed by allowing operators to purchase CRCF removal units directly from removal suppliers to fulfil surrender obligations (172 out of 305 respondents (56%) strongly or somewhat agreed, mainly from the energy and waste management sectors, less frequently from the manufacturing industry). Support for acquiring and inserting CRCF removal units through a central agency was more limited, with a quarter of respondents, almost exclusively from companies/businesses and business associations engaged in carbon removal activities, strongly (19 out of 296; 6%) or somewhat (56; 19%) agreeing, while a larger share strongly (52; 18%) or somewhat (54; 18%) opposed, and the largest share was either neutral (62; 21%) or uncertain (53; 18%). This may indicate a substantial degree of uncertainty on this (rather technical) topic among stakeholders in general.

With regards to potential restrictions in relation to the integration of carbon removals into the EU ETS, a relative majority of respondents, from a diverse range of stakeholders, supported restrictions to the use of CRCF removal units (125 out of 299 respondents (42%) strongly or somewhat agreed, compared to 84 (28%) who strongly or somewhat disagreed). Asked about a slow phase in, the balance tipped in the other direction with a relative majority, from a diverse range of stakeholders, disagreeing (112 out of 300 respondents (37%) disagreed strongly or somewhat, mainly citing cost-effectiveness, compared to 88 (29%) who strongly or somewhat agreed, mainly citing the need to ensure market stability, environmental integrity, and a certain share of emission reductions before allowing offsets). The outcome was similar when asked whether there should be a limit on gross emissions by EU ETS installations, with 109 out of 297 respondents (37%) strongly or somewhat disagreeing compared to 86 (29%) strongly or somewhat agreeing. It is to be noted that for all three of these questions, around one third of respondents did not express strong views, selecting ‘neutral’ or ‘do not know’.

3.3.8. CO2 transport

There was broad support for the extension of CO2 transport coverage under the ETS Directive from transport with the objective of storage to transport for any purpose, although there was a clear division between different types of stakeholders. A clear majority of respondents (192 out of 227 respondents; 85%) considered it important to extend coverage to ensure a level playing field for CCS and CCU, incentivise CCU market development and reduce infrastructure and monitoring costs where infrastructure is shared for both CCS and CCU purposes. This view was supported by almost all companies/business and business associations. By contrast, only 35 respondents (15%) opposed such a change, mainly out of safety concerns or considering this out of scope of the ETS. This view was almost exclusively supported by NGOs and environmental organisations. The campaign responses identified on this question did not affect the outcome, showing a similar distribution with eight campaigns (69 respondents in total) from companies/businesses and business associations from various sectors supporting the extension, versus one NGO campaign (10 respondents in total) opposing the extension.

3.3.9. CCU

There was clear support for an adjustment of surrender obligations, with restrictions or conditions, where emissions are captured and used in products without permanent storage (CCU). Most respondents (57%), including a majority of companies/businesses and business associations (mainly from the energy sector and manufacturing industry), strongly (84 out of 244; 34%) or somewhat (55; 23%) support an adjustment of surrender obligations where emissions are captured and used in products without permanent storage. The main reasons provided were to incentivise the use of CCU and recognise the potential climate benefits of CCU products compared to products using virgin carbon. Conversely, most NGOs and environmental organisations (strongly) disagreed (48; 20%) with this option, with potential risks of double pricing raised by those opposing – as well as by some respondents in favour – in addition to the complexity of monitoring, reporting and verifying virgin versus captured carbon streams and the ensuing risks for environmental integrity. A further 25 respondents (10%) were neutral and 32 (13%) were uncertain. However, there was broad agreement across all stakeholder groups in favour of introducing restrictions or conditions when adjusting surrender obligations for the capture and use of non-permanent carbon (e.g.: minimum emission savings, displacement of fossil carbon, avoiding double counting/pricing of the same emissions), with more than half in favour (130 out of 245 respondents; 53%) versus only a minority against (31; 13%). The campaign responses identified in addition showed similar

distributions, not affecting the outcome. While five campaigns by companies/businesses and business associations from across various sectors (47 respondents in total) (strongly) supported an adjustment to surrendering obligations for CCU, three campaigns by NGOs and companies/businesses from the agricultural sector (20 respondents in total) strongly disagreed.

By contrast, there was overall no clear agreement and more division between different stakeholder groups on moving the surrender obligation downstream for non-permanent products produced with captured CO₂. Two fifths of respondents, predominantly from companies/businesses and business associations from the manufacturing industry, strongly (55 out of 246 respondents; 22%) or somewhat (41; 17%) agreed, due to the incentivising effect for both CCU in upstream installations and for the use of CCU-based carbon in downstream products, as well as the avoidance of double counting risks. However, this option attracted higher levels of disagreement compared to the ‘adjustment’ option and these views came from a broader range of stakeholders (including many companies/businesses from the energy and waste sectors and most NGOs), with nearly one third opposing strongly (49; 20%) or somewhat (26; 10%), and similar levels of uncertainty (50; 20%) and neutral (25; 10%) views. Concerns mainly centred on the risk of undercounting emissions and undermining environmental integrity, due to the complex traceability of carbon throughout the value chain, and a perceived unfairness for downstream operators (notably in the waste sector) and, especially for CCU-based fuels, ensuring regulatory stability. Furthermore, four campaigns (21 respondents in total) by companies/businesses and business associations from the manufacturing industry strongly supported downstream accounting, while three campaigns (32 respondents in total) from a broader range of stakeholders, including NGOs, energy sector companies/businesses and agriculture sector companies/businesses, disagreed. Overall, this confirms the conclusion that there is no clear agreement and that there are strong divisions between stakeholders on this topic.

3.3.10. Municipal waste incineration (MWI) and other waste management processes

3.3.10.1. Municipal waste incineration (MWI)

More than half of respondents to this question, including a relative majority of companies/businesses and business associations (mainly from the manufacturing industry) and most NGOs and environmental organisations, supported the inclusion of municipal waste incineration (MWI) installations in the EU ETS, with 87 out of 266 respondents (33%) strongly agreeing and 49 respondents (18%) rather agreeing. Conversely, nearly one third of respondents, mainly from companies/businesses and business associations, strongly disagreed (69; 26%) or rather disagreed (10; 4%). Smaller shares of respondents were neutral (25 respondents, 9%) or uncertain (26 respondents, 10%).

The main arguments in support of MWI inclusion in the EU ETS were to incentivise recycling in line with the waste hierarchy (over one third of responses), to ensure a level playing field between sectors and maximise cost-effectiveness of emission reductions (nearly one third of responses), to incentivise CCU uptake and prevent emission leakage from CCU products (nearly one fifth of responses) and to exploit potential to generate removal credits from biogenic CO₂ (nearly one tenth of responses).

At the same time, several respondents made their support conditional on addressing potential waste diversion to landfill. This was also one of the main arguments of respondents opposing the inclusion of MWI in the EU ETS, with two fifths in this group expressing concerns about the risk of landfill diversion. Further arguments opposing MWI inclusion were the expected impact and perceived lack of alternatives for customers, notably local authorities (one fifth of

responses), and operators' lack of control over waste generation (and composition), fixed price contracts and potential hindrance to investments in upgrading facilities (nearly one fifth of responses, combined).

While multiple campaigns were identified targeting the waste topic, those answers did not have a decisive impact on the outcome of this question that the majority of respondents supported including MWI installations in the EU ETS. Five campaigns by NGOs and companies/businesses and business associations from the manufacturing industry (30 respondents in total) (strongly) agreed with the inclusion of MWI in the EU ETS, while four campaigns by businesses/companies and business associations in the waste, energy and agriculture sectors, as well as by local public waste management authorities located in one Member State (57 respondents in total) (strongly) disagreed.

3.3.10.2. Installations for the incineration of hazardous waste

There was no clear agreement on the inclusion of installations for the incineration of hazardous waste in the EU ETS, with well over a third of respondents strongly (77 out of 249, 31%) or rather (16; 6%) disagreeing, compared to just over one third strongly (41 respondents, 17%) or rather (41; 17%) agreeing. The distribution of stakeholder groups also shifted compared to the question on the inclusion of MWI. While most NGOs and environmental organisations were also supportive of the inclusion of hazardous waste incineration, companies/businesses and business associations from the manufacturing industry tended more towards opposing the inclusion. Smaller shares were neutral (36 respondents, 14%) or uncertain (38 respondents, 15%).

The main arguments against the inclusion of hazardous waste incineration in the EU ETS were the public-service role in safely handling hazardous waste and potential risks to public health and safety, the lack of control over upstream waste generation and limited fuel-switch options due to the need for destruction at high temperatures. Arguments for the inclusion mainly focused on incentivising cleaner technologies and cleaner consumer choices, upholding the polluter pays principle by enhancing coherence and ensuring a level playing field between comparable incineration activities, as well as pointed out that many installations hold permits for both hazardous and municipal waste incineration.

Multiple campaigns coordinated responses to this question. Integrating these responses leads to a clearer outcome, with a majority opposing the inclusion of hazardous waste in the EU ETS (43% against versus 35% in favour, overall). Seven campaigns by companies/businesses and business associations mainly from the waste and waste-to-energy sectors, as well as local public waste management authorities (60 respondents in total) strongly opposed the inclusion, while three campaigns by NGOs and from the cement sector (21 respondents in total) strongly supported it. One campaign (22 respondents in total) by local waste-to-energy companies/businesses located in one Member State expressed conditional support for including installations with double hazardous and MWI activities, but not for installations exclusively incinerating hazardous waste.

3.3.10.3. Other waste management activities

Overall, relatively few stakeholders provided views on whether additional waste management activities should be included in the EU ETS if waste incineration was to be covered.

Stakeholders most frequently addressed the need for appropriate measures to avoid the diversion of waste to landfilling should municipal waste incineration be included in the EU ETS. Views were divided, however, on the preferred measures. Out of 161 respondents

addressing this concern, slightly more than half (83 responses; 51.5%) favoured stronger regulatory and fiscal policies, including strengthening the Landfill Directive, advancing landfill bans, or taxation, or generally called for an appropriate tool to be assessed in view of the complexities in terms of measurement and verification of methane emissions, while just below half (78 respondents; 48.5%) supported an inclusion of landfilling in the EU ETS. These responses include seven campaigns primarily by companies/businesses and business associations from the waste and waste-to-energy sectors (73 responses in total) advocating a holistic, sector-wide approach to EU ETS inclusion to ensure a level playing field, primarily for landfilling. Conversely, one campaign by local public waste management authorities located in one Member State (25 responses in total) strongly opposed the inclusion of landfills in the EU ETS on the grounds of already existing taxation.

Other waste management activities were mentioned much less frequently, with the majority of those responses opposing the inclusion of mechanical recycling, anaerobic digestion or composting on the grounds that these waste management processes should be incentivised in the waste hierarchy compared to either incineration or landfilling. Views on chemical recycling were more divided. Out of around 30 respondents, one third advocated for the inclusion of all chemical recycling processes in the EU ETS, one third only for the inclusion of recovery or conversion technologies such as pyrolysis and gasification on the grounds that those involve a substantial degree of fossil fuel use and emissions, and one third opposed any inclusion of chemical recycling processes on the grounds of supporting innovative recycling approaches in line with the waste hierarchy.

3.3.11. 20MW Threshold

A majority of respondents opposed lowering the installation capacity threshold to expand the pool of installations covered by the EU ETS. In total, 44% strongly (75 out of 245; 31%) or rather (33; 13%) disagreed, mainly companies/businesses and business associations. Conversely, 27% rather (37; 15%) or strongly (29; 12%) agreed, including most NGOs and environmental organisations. 15% (37 respondents) were neutral and 14% (34 respondents) were uncertain. In addition, four campaigns by companies/businesses and business associations in the manufacturing industry sector and one by local public waste management authorities (46 respondents in total) also opposed lowering the threshold, while two campaigns by NGOs in the waste sector and local waste-to-energy companies located in one Member State (27 respondents in total) supported it. These responses further amplify the results, leading to almost half of respondents (48%) opposing lowering the threshold.

3.3.12. Linking

A clear majority of respondents (221 out of 265; 83%), across all stakeholder groups, indicated that the EU should pursue further linking opportunities between the EU ETS and other emissions trading systems. Only a small share indicated that no further linking should be pursued (11 responses; 4%) or was uncertain (34 responses; 13%). The most frequently provided motivations²² were to reduce the risk of carbon leakage (24% of responses), followed by improving the cost-effectiveness of emissions reductions through price convergence (20% of responses) and supporting liquidity in the market (19% of responses), and reinforcing EU leadership on global carbon pricing and climate change mitigation (13% of responses, mainly from NGOs).

²² Multiple options could be selected.

3.4. Position papers

A total of 404 contributions were submitted in the form of position papers and/or feedback on the Call for evidence. More than two thirds came from business associations (156; 39%) or companies/businesses (127; 31%), while NGOs accounted for one tenth (42; 10%). Remaining papers included positions from public authorities, academia, environmental organisation, trade unions and others. Most contributions (258; 64%) addressed one or more topics related to stationary installations. 28 contributions (7%) focused exclusively on aviation emissions, 64 (16%) focused solely on maritime emissions, while another 8 contributions (2%) covered both maritime and aviation emissions. Finally, 42 contributions (10%) focused on topics across all sectors. 6 contributions (1%) did not address any of these topics. The majority opinions put forward in the group of stakeholders that submitted position papers were overall aligned with the majority opinions put forward by all stakeholders in the OPC questionnaire.

3.4.1. Aviation

A total of 56 position papers were identified as being relevant to aviation, with 26 papers solely targeting the sector. Submissions came from a broad spectrum of organisations including, among others: business associations (36%), private companies (29%), NGOs (18%), public authorities (7%), and environmental organisations (5%). “Overall scope and adequacy” of CORSIA and ETS (43 papers), “Sustainable aviation fuels” (33 papers) and “Competitiveness, market distortion, and carbon leakage” (31 papers) were the most frequently addressed themes. Business associations, environmental organisations, and public authorities all agreed that ETS revenues should be better utilised to support aviation decarbonisation, despite expressing different objectives and framing on the topic. Different contributions across highlighted themes reflected the stakeholders’ contrasting priorities. In particular, stakeholders were strongly divided on the suitability of ETS and CORSIA to contribute to the sector’s decarbonisation. Business association and companies expressed strong reservations to expand the ETS scope covering extra-EEA flights, while environmental organisations and NGOs criticised the ETS for its limited geographical coverage. Similarly, business association and companies supported CORSIA as the primary global mechanism to address the sector’s climate impact, while the latter questioned CORSIA’s environmental credibility, especially citing concerns with its reliance on offsetting. Public authorities maintained a more balanced stance, while urging to retain ETS policy ambition to ensure environmental integrity.

3.4.2. Maritime

A total of 88 position papers were identified as being relevant to maritime and were reviewed, checking for issues and proposed measures related to the maritime sector. Stakeholders emphasised the need for alignment of EU maritime measures with international frameworks, particularly harmonising the EU ETS, FuelEU Maritime, and IMO NZF. Several proposed legislative updates, international coordination, and potential phase-out of the EU ETS upon IMO NZF adoption. Others called for mechanisms to prevent overlapping regulation, while some supported maintaining a strengthened EU ETS to drive global decarbonisation. To address evasion risks, some stakeholders recommended monitoring measures and adjustments to scope and thresholds. On vessel coverage, many supported lowering the EU ETS threshold to 400 GT, with calls for proportional MRV and clearer ship type definitions. Regarding fuels, stakeholders advocated using EU ETS revenues to bridge clean fuel cost gaps, harmonise reporting, and recognise life-cycle emissions. There was broad support for extending derogations for outermost and peripheral routes and targeted exemptions for specific vessel types. Simplification was commonly highlighted, with strong support for harmonised MRV

systems and reduced administrative burden. Clarification of the "shipping company" definition was also sought to streamline compliance. On biofuels, some stakeholders recommended limiting zero-rating to advanced and sustainable fuels. Finally, many called for allocating EU ETS revenues to accelerate GHG mitigation through investments in clean fuels, technologies, and fleet upgrades.

3.4.3. Measures to address carbon leakage

Carbon leakage was a widespread concern among stakeholders. Out of the 47 respondents commenting specifically on this topic, roughly four out of five, mainly companies and business associations, advocated maintaining and improving free allocation, particularly for sectors not covered by the CBAM. A minority (one fifth), mainly NGOs, called for a complete phase-out of free allocation to fully implement the "polluter pays" principle and accelerate decarbonisation. Harmonising ICCC across Member States received support, by 25.5%. The CBAM is widely regarded as a crucial instrument, though a minority, mainly companies, suggest amendments such as simplification and scope extension.

3.4.4. Revenue use

Respondents commenting on revenue use (103) mostly urged to ensure that ETS revenues are reinvested in decarbonisation efforts and industry support (65%). A common suggestion was to increase funding and improve access to instruments such as the Innovation Fund and the Modernisation Fund. Some, from across various stakeholder types, called for strengthening the transparency and accountability of Member States in how ETS revenues are spent (10%).

3.4.5. Market Stability Reserve (MSR)

Overall, stakeholders consider the MSR to be effective in stabilising the carbon price. However, three quarters of respondents (81) who commented on the MSR, mainly companies and business associations, called for measures to improve predictability, enhance market liquidity, reduce price volatility, and adapt to the declining allowance supply after 2030. Two main proposals emerged to address these challenges: stopping the invalidation of allowances and using allowances held in the MSR to finance industrial decarbonisation efforts.

3.4.6. New technologies

Almost all of the stakeholders who commented on the integration of carbon removals into the EU ETS (94), mainly companies and business associations, support the integration of permanent CDR, particularly CDRF-certified methods such as BECCS and DACCS. They often recommended applying a "like-for-like" principle to ensure that permanent emissions are offset by permanent removals. A phased or cautious approach to integration is also frequently suggested, combined with measures such as the involvement of an intermediary agency or the introduction of volume limits to avoid undermining emission reduction incentives.

Only a small fraction of position papers (34) commented on integration of CCU applications into the ETS. A large share of those (82.4%, 28 stakeholders) supported the integration. Where stakeholders supported adjustments for CCU (roughly one fifth of the 28 stakeholders), they call for clear accounting rules and preferential incentives over fossil feedstocks.

3.4.7. Potential expansion of the scope of the Directive

Many respondents (118) commented on the potential inclusion of MWI in the EU ETS, with most (63 respondents, 53%), mainly companies, business associations and NGOs, supporting the inclusion to incentivise recycling and emission reductions. On the other hand, a smaller minority (55 respondents, 47%), composed of business associations, companies and public

authorities, opposed MWI inclusion on the grounds of potential cost increases for citizens and municipalities, as well as the risk of distorting the waste hierarchy through increased landfilling or waste exports. Both sides recommended including landfilling to prevent waste diversion. 7 stakeholders (business associations, companies and public authorities) also suggested exempting hazardous waste incineration from the ETS.

3.4.8. 20MW threshold

The issue of lowering the 20 MW thermal input threshold for stationary installations attracted few comments (29), of whom two thirds (19), mainly business associations and companies, opposed on the grounds of the disproportionate administrative burden on smaller emitters, whereas one third (10), mostly NGOs, argued that lowering the threshold could encourage wider adoption of clean technologies and ensure consistency between ETS1 and ETS2.

3.5. Interviews

In addition to the open public consultation, stakeholder interviews were conducted to collect further evidence for use in both the evaluation and the impact assessment. The interview process enabled a range of stakeholders to provide more detailed input complementing and expanding on the questions in the OPC. All input and conclusions from the interviews were taken into consideration to inform and complement the quantitative and qualitative research throughout the evaluation and impact assessment.

In preparation for each interview, semi-structured questions were sent in advance to each stakeholder to allow for written input to be submitted. Stakeholders engaged constructively in the process providing detailed information that allowed for the interview to focus on the key issues that were identified. Over 50 interviews were conducted by the research team, with considerable efforts made to ensure that there was a balanced representation across sectors when discussing issues related to carbon leakage, the Market Stability Reserve and the options for best accounting for CCU use. In addition, technical experts were also consulted to discuss the more detailed design questions related to the topic of integrating carbon removals into the EU ETS and, given the potential expansion of the ETS scope to include waste activities, a considerable effort was made to interview a range of stakeholders from the waste sector to discuss the potential impact.

ANNEX 3: WHO IS AFFECTED BY THE INITIATIVE AND HOW?

1. PRACTICAL IMPLICATIONS OF THE INITIATIVE

The EU ETS is the European Union's main instrument for cost-effective emissions reductions. The preferred policy option identified in Section 8 of the main Impact Assessment report for the period 2031-2040 builds on the existing ETS framework, while introducing targeted adjustments to ensure that the system remains aligned with the EU's 2040 climate target and the pathway towards climate neutrality by 2050. The preferred option combines a series of policy measures identified for each thematic area, aimed at strengthening the environmental effectiveness of the system while maintaining proportionality, regulatory stability, and fairness across sectors.

The proposed reforms maintain the existing compliance framework of the EU ETS, while introducing new obligations and compliance actions on specific groups of operators and administrations during the 2031-2040 period.

Therefore, the preferred option introduces measures that are expected to affect transversely different stakeholders, including industry, SMEs and micro-enterprises, public authorities, and citizens.

1.1. Effects on regulated entities

1.1.1. Stationary installations

Installations already covered by the EU ETS (in sectors such as electricity and heat generation, steel, cement, chemicals, refining, pulp and paper, and other energy-intensive industries) remain the main regulated entities. The measures contained in the preferred option affect them in a number of ways:

- Due to the more gradual reductions in the **cap on emissions**, in line with a fair contribution of the EU ETS to the economy-wide target for 2040, the preferred option exhibits carbon prices that are lower compared to the baseline. Exposure to carbon costs therefore increases more slowly. However, the preferred option is still expected to result in an increasing carbon price signal over time. See Annex 8 – Part I on the emissions cap.
- The preferred option on **carbon removals** (a public purchasing programme) is expected to help contain carbon costs by releasing a predictable amount of additional allowances onto the market (170-330Mt subject to funding and availability of removal units), thereby stimulating carbon removal technology while retaining certainty over the impact on gross and net emissions. See Annex 8 – Part II on carbon removal.
- The revised **Market Stability Reserve (MSR)** parameters should ensure that installations face a stable, progressively increasing, carbon price signal driven primarily by supply and demand fundamentals. See Annex 8 – Part III on the MSR.
- The creation of the **Industrial Decarbonisation Bank (IDB)** is expected to improve the business case for investment in the decarbonisation technologies for the stationary industrial installations in the ETS. In practice, the IDB will provide a tangible support (notably in the form of Carbon Fixed Premium and Carbon Contracts for Difference) for projects focused on more mature technologies than those covered by the Innovation Fund. By ensuring the energy intensive industries (EIIs) remain on the net-zero

pathway, IDB will also help to limit rising carbon prices. See Annex 9 – Industrial Decarbonisation Bank.

- In **carbon leakage prevention**, the increased availability of free allocation compared to the baseline is expected to have a positive impact on installations. This improves their competitiveness and ability to transition to adapt to a low carbon economy. At the same time, the increased use of conditionality in the preferred option, in both free allocation and indirect cost compensation, implies a moderate increase in the administrative effort needed from the beneficiaries (as they would need to demonstrate decarbonisation investment). See Annex 12 – stationary installations.
- In the **waste sector**, the preferred option implies increased compliance costs related to the allowance surrender obligation for municipal waste incinerators brought into the scope of EU ETS, while compliance costs related to the MRV-system are already in place. On the other hand, the preferred option for **Carbon Capture and Utilisation (CCU)** will strengthen the business case for this technology by enabling emitters and users of captured carbon to avoid double counting when making use of CO₂ that is captured and stored non-permanently. See Annex 13 – new sectors and technologies, waste and CCU.

Overall, industries face an increase in certain compliance costs but gain from a more gradual decarbonisation trajectory and free allocation phase-out relative to the baseline, greater policy certainty, targeted innovation support, and a more level playing field for low-carbon investment.

1.1.2. Aviation and maritime transport

In **aviation**, the aircraft operators affected by the preferred option are already included in the EU ETS and remain the main regulated entities. The preferred option proposes the appropriate inclusion of a larger share of emissions (from all outgoing flights). Therefore, administrative costs will not increase for operators, as the amount of action varies, but the tools remain unchanged. Furthermore, the same pool of aircraft operators must comply with EU ETS and CORSIA resulting in low differences of administrative efforts. At the same time, the EU ETS would be extended to include private and business jets. Newly covered aircraft operators will benefit from considerable administrative simplification, and low activity operators already covered from further simplification, which would result in mitigated increased administrative costs. Furthermore, compliance costs are lower in the preferred option compared to the baseline and are mostly channelled back towards climate action.

Maritime transport operators already covered by the EU ETS, in particular shipping companies operating large vessels, remain the main regulated entities. All shipping companies will receive the opportunity of support for their decarbonisation efforts (in terms of fuels and technologies) by recycling part of the allowances back to them. From a competitiveness perspective, the preferred options strengthen anti-evasion provisions related to container transshipment, reducing incentives to relocate activities outside the EU and supporting the competitiveness and connectivity of EU ports, support a level playing field for operators of vessels involved in offshore activities. The administrative cost for shipping companies will be reduced by the simplification measures included under the preferred options aiming at aligning requirements across regulatory frameworks, reducing duplications and streamlining compliance processes. Furthermore, the obligations of shipping companies under EU ETS will be reduced by deducting emissions effectively priced by a global measure under IMO, once in place. At the same time the EU ETS would be extended to a limited share of smaller vessels, broadening the

regulatory coverage of the maritime sector to smaller ships. This will lead to exposure of more shipping companies to a carbon price signal under EU ETS, providing predictability for investment and operational planning. The extension of the EU ETS to some categories of smaller vessels leads to higher administrative costs for companies operating those vessels, linked to compliance with the MRV and ETS requirements. However, some of the additional costs are expected to be passed on to users of maritime transport, with limited indirect effects on trade and transport demand. Overall, the preferred option entails proportionate compliance costs while providing greater regulatory coherence, a gradual decarbonisation pathway and safeguards against competitive distortion

1.2. Effects on other stakeholders

1.2.1. SMEs

SMEs within the EU ETS scope will be subject to the same requirements as large organisations, although the ETS covers predominantly larger installations (due to thermal capacity thresholds) and larger firms, as measured by the traditional SME metrics of turnover and number of employees (see Annex 6: SME Check). SMEs regulated by the EU ETS can benefit from simplified rules for small emitters, such as standardised and simplified monitoring rules. Moreover, provisions on carbon leakage will be conceived to offer proportional treatment to SMEs: simplified forms of conditionality for free allocation or potential derogations for eligible SMEs. In addition, low emitters continue to benefit from technical guidance and simplified monitoring, reporting and verification rules. Micro-enterprises remain largely outside the ETS coverage.

SMEs that are not directly covered by EU ETS might be affected indirectly by carbon cost pass through, though this effect is moderated by the measures such as the more gradual reduction of the emissions cap and reform of the Market Stability Reserve. Furthermore, predictable carbon pricing and available innovation funding limit the negative impact on competitiveness. Indirect cost effects of scope expansion, such as changes in waste management or energy prices, are expected to be minimal. In the aviation sector, in most EU member states, large enterprises own the majority of aircraft operators, resulting in a small number of SMEs affected by the preferred option.

Maritime SMEs, with small market power, may experience limited cost pass-through possibility, but the gradual carbon price trajectory and access to maritime-relevant innovation support are expected to limit the impacts on competitiveness. Very small maritime operators are expected to remain largely outside the ETS scope, as the preferred option does not foresee the inclusion of any type of vessel below 400 gross tonnage. Any indirect effects, such as price changes along the supply chain, are expected to be minimal. While the IDB will mostly target large-scale industrial decarbonisation projects, it could also provide support to smaller projects, especially via the operation of administrative schemes that would offer simplified funding for smaller projects. Building on the experience of the Innovation Fund and national support schemes, a dedicated support for the SMEs could be operationalised under the IDB.

1.2.2. Public authorities

Public authorities at the EU, national, and local levels play a key role in implementation and oversight.

- National competent authorities will expand ETS administrative systems to include new operators (waste, CCU), to administer additional shipping companies and aircraft operators following extension to cover smaller vessels and business and private jets,

update permitting and MRV procedures, and oversee verification of climate-neutral investment plans for conditional free allocation

- EU institutions will update or develop harmonised MRV methodologies for the waste sector and CCU and, where necessary, for carbon removal, update registry infrastructure, and adapt MSR parameters.
- EU institutions will establish a purchasing programme for carbon removal.
- EU institutions will modify the rules for prevention of carbon leakage (allocation of free allowances and indirect cost compensation). National competent authorities will implement these rules. Reduction in administrative burden is expected since the carbon leakage list will not be updated for Phase V and the formula for determining free allocation will no longer include the carbon leakage exposure factor. However, the extension of conditionalities for free allocation under PO2 would introduce new administrative requirements.
- For the main policy options analysed, the funding mechanisms of the IDB will be developed on the EU level, so there should not be an additional effort for national authorities. In addition, IDB could have ‘as-a-service’ feature that enables Member States to channel State aid through IDB and thus reduces administrative burden of developing national support schemes.
- The beneficiary Member States are responsible for the implementation of the Modernisation Fund, and the appropriate legal and procedural structure is already in place.
- Waste disposal authorities, including local and regional authorities, may need to adjust waste management contracts as ETS compliance costs are incurred by waste incineration operators and passed on to waste disposal authorities.

1.2.3. Citizens

Citizens are indirectly affected because environmental, health, and economic aspects are at stake. The inclusion of municipal waste incineration (MWI) contributes to the reduction of air-pollutant emissions, especially in urban areas. This improvement is accelerated, compared to the baseline, due to carbon price signal incentivising waste reduction and diversion to recycling at source. From an economic point of view, citizens should be positively affected due to more limited cost pass through in electricity and industrial prices associated with the more gradual trajectory and decarbonisation investments facilitated by the Industrial Decarbonisation Bank. They may be negatively affected by the pass-through of costs associated with waste incineration, however this impact is expected to remain manageable. Citizens may benefit from increased employment compared to the baseline as new workplaces in decarbonised industrial installations can offset the workplaces lost in fossil-fuels based industries. In the long-term, the issue of employment is directly linked to the viability of industrial production in Europe. With this in mind, the preferred option aims to contribute to achieving the EU’s climate neutrality objective, while striking the balance between maintaining carbon price exposure that increases gradually over time, and providing sufficient auction revenues for supporting industrial decarbonisation investments and mitigating distributional impacts.

In aviation, the effect of the preferred policy option on air travel and employment is expected to be limited but positive compared to the baseline. Without use of sustainable aviation fuels, aviation emissions in EEA countries are expected to increase. With support for the uptake of aviation fuels, citizens may benefit from improved air quality and creation of jobs.

In the maritime sector, the preferred policy option is expected to deliver a positive environmental and climate impact, primarily through the reduction of GHG and air pollutant emissions. These measures will contribute not only to climate mitigation objectives but also to improved air quality and thereby creating public health benefits for citizens particularly in coastal and port areas. Regarding economic impacts, further mitigating the transshipment relocation risks, the wider social impacts of possible transshipment relocation for EU ports and their hinterlands are likely to be reduced. The inclusion of some types of smaller vessels within the scope of the EU ETS may lead to limited indirect impacts on shipping costs and employment. However, these impacts are expected to remain negligible and are likely to be offset by efficiency gains and cost reductions stemming from the promotion of innovation and uptake of cleaned technologies including electrification.

2. SUMMARY OF COSTS AND BENEFITS

The preferred policy option consists of a combination of policy measures, identified in Section 8.1 of the main impact assessment report, which are considered to be the optimal choice, individually and collectively, for revising EU ETS.

Taken as a whole, the preferred option is designed to strengthen the environmental effectiveness of the system while maintaining proportionality, regulatory stability, and fairness across sectors, and safeguarding competitiveness.

A quantitative comparison of the costs and benefits of the policy options, per theme, is provided in Section 7.2 of the main report (on efficiency).

The tables below identify the key benefits and costs of the measures under the preferred option, and the affected stakeholders. They are presented at the level of individual measures in order to display the relationship between each measure and its cost/ benefit impacts transparently.

In line with the principle of proportionality and burden minimisation, the One in One out table is compiled, outlining the new administrative burden and the ones that have been removed. Finally, this section provides an overview of the key Sustainable Development Goals (SDGs) addressed by the proposed intervention.

2.1. Overview of benefits – preferred option

Overview of Benefits (total for all provisions) – Preferred Option		
Description	Amount	Comments
<i>Environmental benefits</i> (See Section 6.1 of impact assessment)		
GHG emissions reduction	Achieves 85% emission reduction by 2040 (~62% by 2030 compared to 2005 levels) (6.1.1.1). The preferred option for MSR is expected to deliver a slightly lower cumulative emissions comparatively with other options whilst maintaining better economic performance (6.1.1.3) Regarding carbon removal, the preferred option is expected to lead to 175-330 MtCO₂ removal through a public purchasing programme (6.1.1.2). Including emissions from municipal waste incineration in the ETS is expected to reduce cumulative emissions from municipal waste incineration by –53 MtCO₂ or - 22% over 2031-40 compared to the baseline (6.1.1.8). The Modernisation Fund is expected to continue delivering annual emission reductions of around 85 MtCO₂e (6.1.1.4). Actual GHG emissions reductions will depend on what sectors Member States decide to spend their envelope. The IDB can deliver over 1,630 Mt of CO₂ abatement (over 10 years of operation of the awarded projects) and thus address large share of the emissions in the EII sectors.	Main beneficiary: society at large. Driven by declining emissions in line with ETS contribution to economy-wide climate target.

	In aviation, greater uptake of sustainable aviation fuel is expected to reduce emissions covered by ETS allowances by 131 MtCO₂ (6.1.1.5). In maritime, extending the ETS scope to smaller vessels reduces cumulative emissions by around 5% over 2030-2050, compared to the baseline (6.1.1.6). Uptake of renewable fuels increases by 2-3% in 2040 and 5-6% in 2050 (6.2.3.5).	
Incentivising innovative forms of decarbonisation	The technologies of Carbon Removal (6.1.1.1) and Carbon Capture and Utilisation (6.1.1.9) are incentivised, thereby boosting the market for captured and/or stored CO₂, reducing both GHG emissions reliance on virgin fossil-based fuel and feedstock. Industrial decarbonisation supported through the IDB deploying EUR 100 bn over 10 years to decarbonise industry at scale and facilitate modernising the EU economy — in addition to continuation of the existing Innovation Fund and targeted improvements to the Modernisation Fund (6.1.1.4). Greater uptake of sustainable propulsion technologies in aviation (6.1.1.5) and maritime (6.2.3.5).	Main beneficiary: society at large. Expands options for meeting emission reduction target, improves cost efficiency of abatement options and reducing the cost of climate action. Other beneficiaries include developers of climate technologies and sectors with hard-to-abate emissions.
Improved air quality and public health	Reductions in PM, NO_x, SO₂ from industry and waste. Achieved from: phase-out of Modernisation Fund support to fossil fuels and waste-to-energy (6.1.2.2). lower air pollution in the maritime sector, with social net present value of EUR 22 million (6.2.1.5). waste reduction, prevention and recycling (6.2.1.7).	Main beneficiaries: citizens, urban communities, coastal communities, islands.
<i>Economic benefits</i>		

More gradual decarbonisation trajectory for industry	The ETS cap declines more gently compared to the baseline, reducing carbon costs for industry.	
Greater stability in carbon market and lower compliance costs	Achieved through MSR reform, the preferred design option leads to a gradual and more stable EUA price evolution and a more liquid market, resulting in stable signal for investment and business planning certainty (6.2.1.2).	Main beneficiaries: ETS operators, investors. Driven by MSR reform which ensures smoother price trajectory.
Support to deployment of carbon removals and innovative mitigation technologies and markets.	Due to carbon removal integration through the public purchasing programme (6.2.1.1). Fostering permanent carbon removals from biogenic emissions in municipal waste incineration, supporting economy-wide decarbonisation (6.1.1.8.). Increased investment due to support of the Industrial Decarbonisation Bank, EUR 100bn with average direct leverage effect estimated at 45%²³ (6.2.3.3). Investment estimated at EUR 50-90 billion over 2031-2040 due to conditional free allocation (6.2.1.6) Improved business case for carbon capture and utilisation due to accounting change and inclusion of waste incineration (6.2.1.8, 6.2.3.7 & 6.2.3.8)	Main beneficiaries: ETS operators, consumers, industrial operators, developers of relevant technologies (e.g. carbon removal, e-fuel producers).
Reduction in carbon leakage rates	Less carbon leakage compared to baseline (6.2.3, Annex 12 Section 1.4.4.1). Increased free allocation of 42%-47% over 2031-2040 (Annex 12, Table 12).	Main beneficiaries: industries exposed to the risk of carbon leakage. Driven by more gradual cap tightening than baseline combined with investments facilitated by ETS revenues and conditionality in free allocation.

²³ Direct leverage effect is defined as IDB support divided by private investment expenditures

Circular economy incentive	Inclusion of waste incineration incentivising circular economy for materials, reducing GHG emissions from waste disposal, and generating recycled materials displacing more carbon-intensive virgin materials (6.1.2.5.).	
Improved functioning of internal market for waste	Level playing field between sectors, within sector and between Member States through harmonised carbon price signal (6.2.6.3.).	
Lower compliance costs in aviation	Compliance costs are significantly lower compared to the baseline (36% lower in 2035) due to narrower ETS scope (Annex 10, Table 13).	Main beneficiaries: aircraft operators, passengers.
Overall net benefit (maritime)	Maritime policy options are expected to yield a net benefit of EUR 7bn in the preferred option (7.2)	Analysis combining discounted benefits of emission savings against discounted abatement costs and administrative costs
Avoiding double pricing of GHG emissions priced upon implementation of the global measure CORSIA	Depends on the participation to CORSIA by third countries (6.1.1.5).	Main beneficiaries: aircraft operators operating international flights.
Avoiding of double pricing of GHG emissions priced under a global measure, once adopted, at IMO	Depends on emissions of each ship 6.2.1.5	Main beneficiaries: shipping companies that face payments at IMO and under EU ETS for emissions of their ships.
Decarbonisation support in maritime	Due to support mechanism for Sustainable Maritime Alternative Propulsion (SMAP) (6.2.1.5).	Shipping companies using sustainable fuels and propulsion technologies like wind and electricity
Increased economic activity in some port areas	Due to addressing the risk of relocation of container transshipment activity from EU to non-EU ports and areas	Local economies in port areas.

	ensuring a level playing field for vessels performing offshore activities (6.2.3.5).	
Increased auction revenues to public authorities	Higher auction revenues (+137% - 146 %) compared to baseline (Table 16 of main Impact Assessment, Annex 12, Table 21).	
Lower administration costs for public authorities (free allocation)	Due to not updating carbon leakage list for ETS Phase V (6.2.2.5).	
Employment	Sectoral employment gains occur in chemicals and non-metallic minerals sector, which also records the highest production increase by 2040. Across sectors and policy measures, the overall employment impact ranges from - 0.56% to 1.76 (6.3.1.6) Creation of new employment opportunities in new removals market (6.3.1.2) and projects benefiting from the IDB support (6.3.1.3). Positive employment impact in aviation (6.3.1.4). Possible positive employment impact in ports and their hinterland and negligible employment impact concerning smaller vessels (6.3.1.5) Positive employment impact in waste due to increased recycling and circular economy activities (6.3.1.7)	Main beneficiaries: citizens, society at large Follows estimated increase in production
Distributional effects	Qualitative assessment	Compared to the baseline, lower income households are expected to benefit from a more gradual ramp-up of carbon prices and associated cost pass through, as well as positive economic and employment outcomes, but may on the other hand be affected by the new carbon price on waste disposal and associated cost pass through.

2.2. Overview of costs – preferred option

Separate cost overviews are provided for each topic.

ETS cap and Market Stability Reserve

- Measures regarding the ETS cap, its adjustment trajectory, and the adjustment of the Market Stability Reserve (MSR) are expected to reduce, not increase, costs compared to the baseline.
- The cap adjustment results in a gentler decarbonisation trajectory for stationary ETS installations and operators, which lowers costs (see tables below for aviation, maritime and waste sectors).
- The MSR adjustment is expected to ensure a steady increase in the price of ETS allowances, compared to other options that exhibit greater variability (6.2.1.2). It also maintains a greater reserve for potential activation during the 2030s and 2040s (Annex 8, Section 1.4.3). These attributes are expected to improve the functioning of the carbon market compared to continuing with Market Stability Reserve parameters closer to the baseline.

Carbon removal

- The preferred option (a public purchasing programme) has lower expected transaction costs for carbon removal operators compared to other options (direct integration of removals into the ETS) (6.2.2.1).
- By definition, the preferred option increases public costs related to carbon removal compared to the baseline (no carbon removal integration). However, these costs are necessary to deliver the measure's benefits, namely lower ETS allowance costs, additional mitigation options for the hardest emissions to abate and support to development of innovative technology.

II. Overview of costs – Preferred option							
		Citizens/Consumers		Businesses		Administrations	
		One-off	Recurrent	One-off	Recurrent	One-off	Recurrent
	Direct adjustment costs	N/A	N/A	N/A	N/A	N/A	
	Direct administrative costs	N/A	N/A	Cost of participating in public	Cost of participating in public purchasing	Cost of public purchasing programme: establishment (by public	The ultimate cost for stimulating CDR is the same among all options for integrating carbon removal.

				purchasing programme (6.2.2.1)	programme (6.2.2.1)	authorities) and participation (by operators) (6.2.2.1)	However, the preferred option requires public authorities finance the up-front cost of removals before recouping some of this through sale into the ETS market. The final fiscal cost of the purchasing programme is estimated to be EUR 3 bn (6.2.5.1).
	Direct regulatory fees and charges	N/A	N/A	N/A	N/A	N/A	N/A
	Direct enforcement costs	N/A	N/A	N/A	N/A	N/A	N/A
	Indirect costs	N/A	N/A	N/A	N/A	N/A	N/A

Instruments to support investment

- The Industrial Decarbonisation Bank (IDB) has no compliance costs for ETS installations but turns ETS resources into investment support for industry (6.2.1.3).

II. Overview of costs – Preferred option							
		Citizens/Consumers		Businesses		Administrations	
		One-off	Recurrent	One-off	Recurrent	One-off	Recurrent
	Direct adjustment costs	N/A	N/A	N/A	N/A	N/A	N/A
	Direct administrative costs	N/A	N/A	Participation costs (6.2.2.2)	Participation costs (6.2.2.2)	To public authorities, predominantly on the EU level, for organisation of calls (6.2.2.2).	

						Cost estimated to be similar to Modernisation Fund (0.13% of total envelope). For Modernisation Fund, the preferred option is expected to reduce administrative cost by reducing share of non-priority investments, which have higher administrative burden (6.2.5.2)	
Direct regulatory fees and charges	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Direct enforcement costs	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Indirect costs	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Aviation

II. Overview of costs – Preferred option						
	Citizens/Consumers		Businesses		Administrations	
	One-off	Recurrent	One-off	Recurrent	One-off	Recurrent
Direct adjustment costs	N/A	N/A	N/A	N/A	N/A	N/A
Direct administrative costs	N/A	N/A	N/A	Administrative effort associated with existing SAF support is prolonged (6.2.2.3).	N/A	Administrative effort is needed for deduction of CORSIA costs but can make use of existing reporting systems (6.2.2.3). Administrative effort associated with existing SAF support is prolonged (6.2.2.3).
Direct regulatory fees and charges	N/A	N/A	N/A	In the preferred option, ETS compliance costs are lower than in the baseline (6.2.1.4). Preferred option ensures no double pricing of ETS & CORSIA compliance costs (6.2.1.4).	N/A	Compared to baseline, administrative effort for operators, national and European authorities is lower (6.2.2.3). Member States may use national budgets to reduce SAF support once ETS support expires (6.2.5.3).
Direct enforcement costs	N/A	N/A	N/A	N/A	N/A	N/A
Indirect costs	N/A	N/A	N/A	N/A	N/A	N/A

Maritime

II. Overview of costs – Preferred option						
	Citizens/Consumers		Businesses		Administrations	
	One-off	Recurrent	One-off	Recurrent	One-off	Recurrent
Direct adjustment costs	N/A	N/A	N/A	N/A	N/A	N/A
Direct administrative costs	N/A	N/A	One-off MRV costs for smaller ships estimated at EUR 3 193 on average per vessel.	Potential MRV savings of 10%-20% of current MRV from simplification measures aimed at aligning requirements across different regulatory frameworks (6.2.2.4). Recurrent MRV costs for smaller ships estimated at EUR 3 690 on average, partly offset by eligibility for decarbonisation support.		ETS extension to smaller vessels estimated to increase public authority MRV and administrative cost by EUR 0.74m per year (6.2.5.4).
Direct regulatory fees and charges	N/A	N/A	N/A	Extension of ETS scope to smaller vessels increases shipping costs by EUR 1.2 bn in 2030, 1.8 billion in 2040 & 0.7 bn in 2050. (ETS costs, fuel costs, decarbonisation capex) (6.2.1.5). Extension of existing derogations reduces compliance costs compared to baseline by estimated EUR 546m in 2031 (6.2.1.5). Preferred option's IMO deduction lowers compliance costs compared to baseline.	N/A	Member States may face fiscal cost of sustainable maritime alternative propulsion (SMAP) following expiry of EU programme (6.2.5.4).

Direct enforcement costs	N/A	N/A	N/A	N/A	N/A	N/A
Indirect costs	N/A	N/A	N/A	N/A	N/A	N/A

Carbon leakage

II. Overview of costs – Preferred option							
		Citizens/Consumers		Businesses		Administrations	
		One-off	Recurrent	One-off	Recurrent	One-off	Recurrent
	Direct adjustment costs	N/A	N/A	Cost reduction due to avoiding carbon leakage list update (6.2.2.5).	Reduction in the cost of adjusting to free allocation phase-out compared to baseline (increased free allocation of 39% in 2031-2040) (Annex 12, Table 4).	N/A	Cost reduction due to simplification, including avoiding carbon leakage list update (6.2.5.5).
	Direct administrative costs	N/A	N/A	Costs related to the extension of free allocation conditionality. Estimated one-off cost of EUR 0.02 (<0.1%) per tonne CO2, or EUR 8m in total: derived using Standard Cost Model (Table 16 of main Impact Assessment, Annex 12, Section 1.4.2.2.1). Very little cost increase expected for conditionality related to indirect carbon cost (ICC) since existing State aid-based approach is maintained.			

Direct regulatory fees and charges	N/A	N/A		N/A	N/A	N/A
Direct enforcement costs	N/A	N/A	N/A	N/A	N/A	N/A
Indirect costs	N/A	N/A	N/A	N/A	N/A	N/A

Waste

II. Overview of costs – Preferred option							
	Citizens/Consumers			Businesses		Administrations	
	One-off	Recurrent		One-off	Recurrent	One-off	Recurrent
Direct adjustment costs	N/A	N/A		N/A	N/A	N/A	N/A
Direct administrative costs	N/A	N/A		MRV cost already applies since 2024. Annual MRV costs of EUR 7.8 – 78 million depending on plant size (6.2.2.6). Cost is minimised by building on existing ETS and Industrial Emissions Directive processes and practices (Table 16 of main Impact Assessment, Annex 13, Section 1.6.2.1.1).			
Direct regulatory fees and charges	N/A	N/A		N/A	Carbon cost for municipal waste estimated at EUR 39-66 per tonne in 2031 (Annex 13, Section 1.3).	N/A	N/A

Direct enforcement costs	N/A	N/A	N/A	N/A	N/A	N/A
Indirect costs	N/A	Average annual household waste management fee increases in the order of 4.5%-8.8% or EUR 10-15 on annual basis, based on current experience and depending on waste prevention and collection policies applied (6.2.5.6.)	N/A	Cost passthrough to competent authorities projected to add 39-66% to gate fee if fully passed through (Annex 13, Section 1.3). Projected to foster increase in cost-mitigating actions: waste reduction (+10%-20%) and recycling (+16%-23%). (Annex 13, Section 1.6.2.1).	N/A	N/A

Carbon Capture and Utilisation

- The main effect of the preferred option reduces overall costs by providing more flexibility to operators.
- The proposal is to adopt hybrid downstream and midstream accounting, enabling operators who capture their CO₂ emissions to pass the carbon cost down the supply chain to the eventual emitter, thereby adding flexibility compared to the baseline (upstream accounting with no opportunity to pass non-permanent carbon capture cost down the value chain).

II. Overview of costs – Preferred option						
	Citizens/Consumers		Businesses		Administrations	
	One-off	Recurrent	One-off	Recurrent	One-off	Recurrent
Direct adjustment costs	N/A	N/A	N/A	N/A	N/A	N/A
Direct administrative costs	N/A	N/A		Simplification for operators who capture CO ₂ . Operators will be able to report CO ₂ as captured and transferred to another ETS installation, regardless of the subsequent purpose (6.2.2.7).	N/A	N/A

Direct regulatory fees and charges	N/A	N/A	N/A	Opportunity to reduce carbon costs by replacing direct emissions with CCU. Increase in compliance costs for e-fuel producers, who become responsible for fossil CO2 used in their production (6.2.1.8).	N/A	N/A
Direct enforcement costs	N/A	N/A	N/A	N/A	N/A	N/A
Indirect costs	N/A	N/A	N/A	N/A	N/A	N/A

2.3. Application of the “one in, one out” approach – Preferred option

III. Application of the ‘one in, one out’ approach – Preferred option			
Type of burden	One off (annualised total net present value over the relevant period)	Recurrent (nominal values)	Comments
<i>Businesses</i>			
New administrative burdens (INs)	Moderate. Includes: EUR 8m EU-wide associated with free allocation conditionality. (Annex 12, Section 1.4.2.2.1) Waste incineration facility. (Annex 13, Section 1.7.2) Maritime: ETS extension to smaller vessels	Includes: Maritime: ETS extension to smaller vessels. Estimated at EUR 15m total cost (6.2.2.4)	Administrative effort associated with use of measures that are optional for operators: • New MRV requirements for CCU operators; • Reporting for removals certification
Removed administrative burdens (OUTs)	Simplification from discontinuing carbon-leakage risk updates – approx. EUR 27m savings based on 2015 cost calculations (SWD(2015)135) - (Annex 12, Section 1.3) Simplification and limited extension of derogations in maritime (6.2.2.4)	Simplification and limited extension of derogations in maritime (6.2.2.4) Lower administrative burden in aviation (6.2.2.3)	

Net administrative burdens*	Moderate	Moderate	Net increase mainly from new operator groups and conditionality requirement for free allocation
Adjustment costs **	Moderate	-	One-off system adjustments (permit updates, MRV digitalisation, registry onboarding)
<i>Public authorities</i>			
New administrative burdens (INs)	Moderate (registry updates, verification oversight)	Moderate (compliance monitoring, MRV verification)	Expansion of ETS coverage (MWIs, CCU, CDR); verification of free-allocation conditionality.
Removed administrative burdens (OUTs)	Minor	Minor	Fewer carbon leakage list review; harmonised verification guidance
Net administrative burdens*	Moderate	Moderate	Can be absorbed within existing ETS structures and systems
Total administrative burdens	Moderate overall increase	Moderate overall increase	New obligations offset partly by avoided costs for small emitters and simplifications

3. RELEVANT SUSTAINABLE DEVELOPMENT GOALS

IV. Overview of relevant Sustainable Development Goals – Preferred Option		
Relevant SDG	Expected progress towards the goal	Comments
SDG 13 – Climate Action	The revised ETS cap trajectory and inclusion of additional sectors (MWIs, CCU, removals) will contribute to the EU's economy-wide GHG reduction target for 2040, ensuring continued progress towards the EU's 2050 climate-neutrality target, which in turn contributes to SDG 13. The proposal also reduces the share of GHG emissions that are not subject to carbon pricing by expanding the EU ETS scope in shipping, maritime and waste. The extension of the scope of the EU ETS maritime sector with smaller ships and the new measures to better avoid the risk of carbon leakage incentivise shipowners and relevant operators to adopt cleaner technologies, alternative fuels, and energy-efficient practices. This supports Target 13.3 by strengthening institutional and industry capacity for mitigation and low-carbon transition. Similarly, the EU is appropriately bringing effective carbon pricing into a larger share of the hard to abate aviation sector, aligning with SDG 13).	Positive contribution is reinforced by improved market stability (MSR reform) and stronger investment incentives.
SDG 9 – Industry, Innovation and Infrastructure	Strengthened support instruments (notably Industrial Decarbonisation Bank), conditional free allocation (linked to verified climate-neutral investment plans), scope extension (to waste and removals), and account changes for CCU, drive large-scale deployment of low-carbon technologies and new infrastructure for CCU and CDR. Support mechanism for fuels and propulsion technologies in maritime helps companies to modernise their fleet and incentivises clean fuels and technology production in the EU. Similarly, support mechanism for sustainable aviation fuels incentivises clean fuels and technology production in the EU. Both support mechanisms are contributing directly to Target 9.4, which concerns the upgrading of infrastructure and industries to be sustainable and resource-efficient. The extension of the scope of maritime sector in the EU ETS to smaller ships incentivises the shipping industry to innovate and even upgrade its fleets to meet environmental and climate goals. Revenues generated through the ETS, alongside support from the EU Innovation Fund and other EU facilitating framework, enable Member States to finance research and deployment of breakthrough technologies, advancing	Strongly positive effect on industrial innovation. Transitional compliance costs may challenge some energy-intensive sectors, but these are mitigated by funding from auction revenues and innovation instruments.

	Target 9.b on supporting domestic technology development and industrial diversification. Together, these efforts help build a resilient and competitive sectors that foster sustainable industrialization, in full alignment with Target 9.2, which aims to promote inclusive and sustainable industrial growth.	
SDG 7 – Affordable and Clean Energy	Continued carbon pricing across energy and industrial sectors and extension to waste-to-energy strengthens the competitiveness of renewable and low-carbon energy sources. Expected increase in power-sector decarbonisation supports progress towards affordable, clean energy. The proposal also helps expand the market for cleaner fuels in aviation and shipping.	Carbon costs may temporarily raise electricity prices; revenues can be used to support vulnerable consumers, electro-intensive industries and energy-efficiency measures.
SDG 11 – Sustainable Cities and Communities	Inclusion of municipal waste incineration installations reduces local air-pollutant emissions and promotes cleaner urban waste management.	Positive benefits for public health and air quality; implementation costs for municipalities can be offset by improved sorting and recycling incentives.
SDG 12 – Responsible Consumption and Production	ETS coverage of waste incineration and CCU processes encourages circular resource use and waste prevention, supporting responsible production and consumption patterns. The extension of the EU ETS scope to private and business jets, used by a very limited group of citizens, will encourage more responsible consumption within aviation; It will also bring in additional ETS revenues, ensuring aviation contributes to the EU decarbonisation. Similarly, the extension of the scope of the EU ETS to smaller maritime vessels will encourage more responsible consumption and production patterns within shipping. Furthermore, the EU ETS fosters transparency and accountability by requiring detailed and simplified emissions reporting, aligning with Target 12.6, which calls for shipping companies to adopt sustainable practices and integrate sustainability information into reporting cycles.	Positive effect may be constrained by limited short-term recycling capacity; accompanying waste policy measures will mitigate this.
SDG 8 – Decent Work	The transition towards climate-neutral industry and investments spurred notably via the Industrial Decarbonisation Bank support is expected to create skilled jobs in green technology sectors in all ETS sectors and in circular economy sectors.	Short-term adjustment costs may occur in carbon-intensive regions; Just Transition and

and Economic Growth		Innovation Funds provide mitigation.
SDG 3 – Good Health and Well-being	Reduced industrial and waste sector emissions, and incentives to reduce aviation and maritime emissions lead to improved air quality and lower exposure to harmful pollutants, benefiting public health. By encouraging the shipping sector to switch to sustainable fuels and adopt more efficient and innovative technologies, the ETS, including SMaP, contributes to lowering air pollution levels in coastal and port communities, directly advancing Target 3.9, which aims to improve health conditions by reducing illnesses and deaths from hazardous chemicals and air and water pollution. Additionally, improved air quality benefits vulnerable populations, including children and the elderly citizens, supporting the broader goal of ensuring healthy lives and promoting well-being for all ages	Health co-benefits complement environmental gains
SDG 14 – LIFE below Water	EU ETS supports SDG 14 as one of the main EU instruments for reducing greenhouse gas emissions, damage marine ecosystems through both global warming and ocean acidification. The EU ETS for maritime plays significant role in protecting our oceans by encouraging the shipping sector to operate in a more sustainable way according to the SDGs. Beyond reducing GHGs, the policy promotes cleaner fuels, energy efficiency and better practices that help reduce emissions and pollutants affecting marine life. This supports the goal of maintaining healthy and productive seas by limiting factors such as acidification and chemical contamination, which directly impact biodiversity. Moreover, by promoting the innovation and better environmental monitoring, the EU ETS helps improve how the way the shipping sector manages its environmental footprint, contributing to stronger scientific understanding and responsible stewardship of ocean resources. In this way, the maritime ETS supports the long-term maintenance of the shipping industry while safeguarding marine ecosystems, aligning closely with the broader aims of SDG 14.	Marine biodiversity and ecosystems' co-benefits complement environmental gains

ANNEX 4: MODELLING

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1. ANALYSIS OF FUTURE GHG EMISSIONS

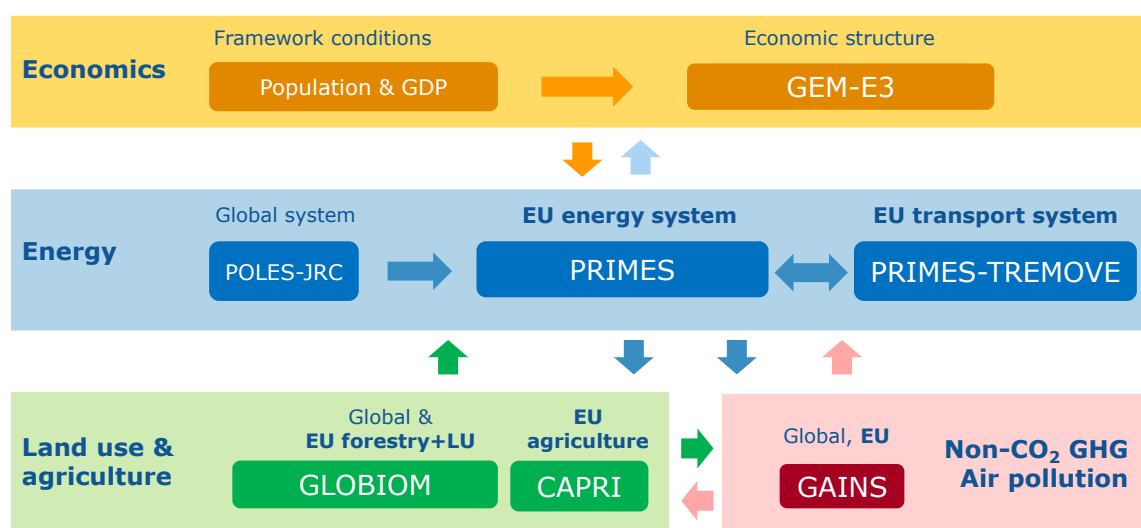
1.1. Models²⁴

The projections for this Impact Assessment are performed with the help of state-of-the-art, computational models for energy and GHG system analysis, which follow an approach based on micro-economics, solve a price-driven market equilibrium, and integrate engineering and economic representations for all sectors. The models use peer-reviewed assumptions and detailed and up-to-date databases to produce projections per sector and per country. Calibration ensures continuity between historical data and projections.

1.1.1. Main modelling suite for GHG emissions

The modelling suite used for overarching climate target modelling which is being used for this Impact Assessment, (Figure 1) is common to the one used for the Commission's proposal for Long Term Strategy²⁵, the 2030 Climate Target Plan²⁶, and the EU Reference Scenario 2020²⁷ as well as for the most recent modelling exercises supporting the Fit for 55²⁸, the REPowerEU²⁹ and the 2040 Climate Target Plan³⁰ policy frameworks.

Figure 1: Main modelling suite used for GHG projections.



The modelling capacity consists of a series of interlinked models well known to the modelling community³¹. These are continuously improved with cutting-edge features. The models combine technical and economic methodologies assessing GHG pathways and associated

²⁴ The model-based analysis is a technical exercise based on a number of assumptions that are shared across scenarios. Its results do not prejudice the future design of the post-2030 policy framework.

²⁵ In-depth analysis in support of the commission communication COM (2018) 773

²⁶ SWD (2020) 176 final

²⁷ European Commission, EU reference scenario 2020: energy, transport and GHG emissions: trends to 2050, Publications Office, 2021, DOI: 10.2833/3575

²⁸ COM (2021) 550 final

²⁹ SWD (2022) 230 final

³⁰ SWD (2024) 63 final

³¹ See for instance Ringkjøb, H. K., et al. (2018). A review of modelling tools for energy and electricity systems with large shares of variable renewables. *Renewable and Sustainable Energy Reviews*, 96, 440-459 and Angenendt, E., et al. (2018). Modelling and tools supporting the transition to a bioeconomy. *Bioeconomy: Shaping the Transition to a Sustainable, Biobased Economy*, 289-316.

system cost. It allows to project the evolution of all GHG net emissions from the EU economy up to 2050.

For the aviation sector specifically, the quantitative analysis of the impacts of each option and combinations relies on the values modelled under PRIMES and is based on modelling of the aviation sector using the AERO-MS model³². For this exercise, the latest updated version of the model has been used and aligned with fuel and carbon price projections from PRIMES. As a result, PRIMES (and consequently AERO-MS) outputs should be interpreted as internally consistent representations of possible energy system and aviation transport developments, with robustness assessed through comparison across scenarios.

Table 1: Overview of assumptions modelled using AERO-MS

Designation	87% decarbonisation context, 70% cost pass-through			
Scenario	Baseline (full scope)	PO1 (clean cut)	PO2 (departing flights, medium SAF support)	PO3 (departing flights, larger SAF support)
Decarbonisation context (whole EU economy)	87%			
PRIME S EU Reference scenario (used as basis and adjusted for aviation ETS policies)	87p_var3_y3			
Scope ETS for international aviation (extra-EEA flights)	All departing and arriving flight	Only departing flights	Only departing flights	None
ETS carbon price paid by airlines (extra EEA-flights)	ETS	ETS minus CORSIA	ETS minus CORSIA	n/a
ETS support mechanism - Duration	20min SAF allowances until they run out <2030	Extended to 2035 by a medium amount	Extended to 2035 by a larger amount	20min SAF allowances until they run out <2030
ETS support mechanism - Scope (flights covered by ETS)	All intra- & extra-EEA flights	All intra-EEA & only departing extra-EEA flights	All intra-EEA & only departing extra-EEA flights	Only intra-EEA flights
ETS support mechanism - Support level (% of price differential between SAF and conventional fuel)	non-Part A biofuels (HEFA)	50%	30% in 2028-2029, 0% from 2030 on	50%
	Advanced biofuels (part A)	70%	50% until including 2034	70%
	RFNBOs (P2X)	95%	50% until including 2034	95%
	New SAF (elec / H2)	70%	50% until including 2034	70%
SAF volumes supported	Based on the RefuelEU aviation mandate			
Carbon cost pass-through rates (modelling assumption)	≈70% (as in 2021 IA)			
Fuel prices used	From PRIMES			
Years for modelling runs in AEROMS	2030	Yes	Yes	Yes
	2035	Yes	Yes	Yes
	2040	Yes	Yes	Yes

With respect to the specific impacts relevant for this exercise, the impact on activity between scenarios have been delivered by the AERO-MS model. The main sources of results variation in the scenarios examined come from fuel-related costs, including taxes and carbon (ETS, CORSIA) prices derived from PRIMES. Consequently, although there remains uncertainty around future price developments, the model-driven variables are internally consistent. Overall, scenario results indicate that possible impacts on activities exist but are barely relevant at these price levels and are more strongly associated with general fuel price variations than with the ETS price signal itself.

1.1.2. Modelling used for the current Impact Assessment

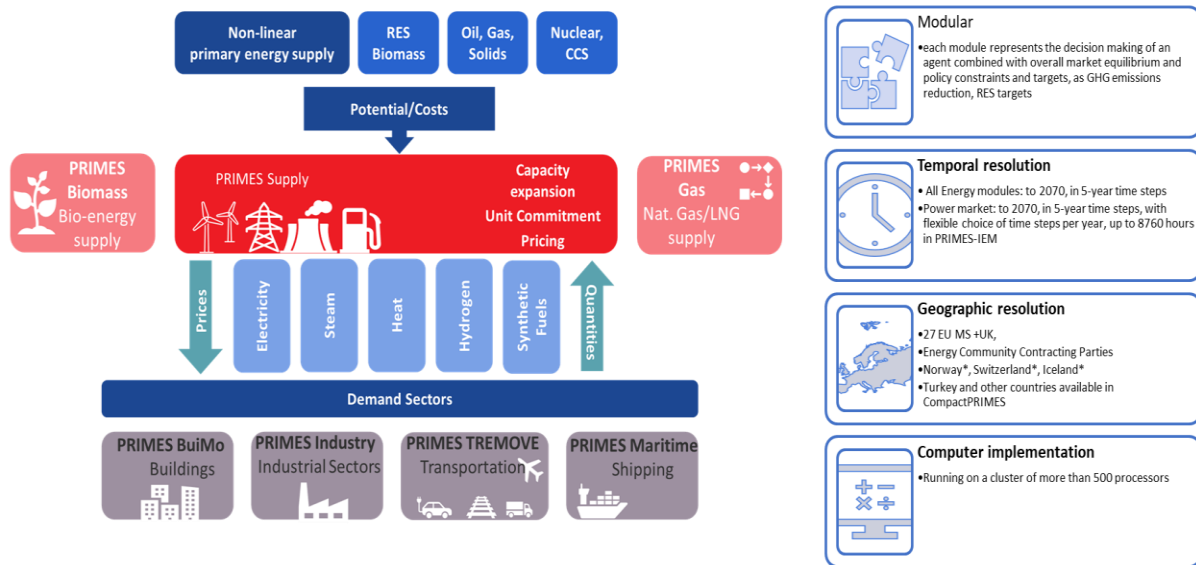
1.1.2.1. PRIMES

PRIMES supports detailed analysis of climate and energy policies, technology shifts, and the long-term economic effects of different policy and market pathways.

Analytical structure, assumptions, limitations.

³² AERO-MS Fact Sheet available at <https://web.jrc.ec.europa.eu/policy-model-inventory/explore/models/model-aero-ms-print/>

Figure 2: PRIMES model structure.



Source: PRIMES

A series of research programs funded by the European Commission led to the development of the PRIMES model. The PRIMES (Price-Induced Market Equilibrium System) is a large-scale applied energy system model that provides detailed projections of energy demand, supply, prices and investment to the future, covering the entire energy system including emissions. The distinctive feature of PRIMES is the combination of behavioural modelling (following a micro-economic foundation) with engineering aspects, covering all energy sectors and markets. The model has a detailed representation of policy instruments related to energy markets and climate, including market drivers, standards, and targets by sector or overall (over the entire system). It handles multiple policy objectives, such as GHG emission reductions, energy efficiency and renewable energy targets, and also provides a pan-European simulation of internal markets for electricity and gas.

The PRIMES model currently covers all 27 EU Member States, UK and all 9 Energy Community Contracting Parties, as well as Iceland, Norway Switzerland and Turkey. The full suite of PRIMES model comprises the following models:

- *PRIMES-TREMOVE* transport model: recently enhanced to include linkage to synthetic fuels and hydrogen and to detailed spatial projections of transport activity and route assignment
- *PRIMES BuiMo* residential and services model: model with high resolution representation of the housing and office building stock, embedded in an economic-engineering model of multi-agent choice of building renovation, heating system and equipment/appliances by energy use
- *PRIMES-Industry* model: recently enhanced version of the very detailed industrial model that includes a high-resolution split of industrial consumption by sector and type of industrial process and now includes the possibility of using hydrogen and synthetic fuels directly, as well as extended possibilities of electrification and the possible emergence of non-fossil hydrocarbon feedstock in the chemicals
- *PRIMES Biomass supply* model: biomass supply model that includes land use constraints, many types of biomass and waste feedstock, sustainability regulation, and endogenous learning and industrial maturity of a large number of potential biomass to

biofuels conversion technologies; the model is linked with the IIASA models that handle LULUCF and forestry, as well as to the agricultural model CAPRI

- *PRIMES Electricity and Heat/Steam supply and market model*: The electricity and heat/steam market model of PRIMES includes three elements: hourly unit commitment model - with a pan-European market simulation over the grid constraints and detailed technical operation restrictions - the long-term power system expansion model, the costing and pricing electricity and grid model, the integration of heat supply and industrial steam supply with synchronised hourly operation
- *PRIMES Gas Supply and Market model*: a stand-alone model representing in detail the gas supply and infrastructure in the Eurasian and Middle East area and the internal European market of gas within an oligopoly model embedding engineering gas flow modelling
- *PRIMES new Fuels and storage model* covering Hydrogen, Synthetic fuels, Power-to-X, CO₂ capture from the air and biogenic, CCS/CCU and process-emissions modelling to enhance and perform sectoral integration aiming at simulating a zero-CO₂ system.
- *PRIMES Maritime model*: a module of PRIMES and PRIMES-TREMOVE transport model, including the developments in maritime transport activity, energy use in the maritime sector, the greenhouse gas emissions and air pollution emissions, as well as the associated costs.

The PRIMES model offers the possibility of handling market distortions, barriers to rational decisions, behaviours, as well as and market coordination issues and includes a complete accounting of costs (CAPEX and OPEX) and investment expenditure on infrastructure needs. PRIMES is designed to analyse complex interactions within the energy system in multiple agents – multiple markets framework.

PRIMES is well-placed to simulate medium and long-term transformations of the energy system (rather than short-term ones) and includes non-linear formulation of potentials by type (resources, sites, acceptability etc.) and technology learning.

The PRIMES model, with its ETS tool combines two essential characteristics required for the purpose of the analysis in this impact assessment: It combines a rigorous simulation of the ETS market functioning under different circumstances with the energy system model which allows the simulation of the developments driven by policies other than ETS. Being a vintage-engineering based model it includes the inertia of the energy system and has sufficient detail to capture the effects of the other multiple policies (Energy efficiency policies, RES policies, etc.) in combination with the ETS system. As the model covers all sectors of the economy from an energy and emissions perspective, as well as multiple technologies (including negative emission technologies) almost any extension or changes in the ETS system can be captured. PRIMES can provide information on and verify the effect of the possible implications of all interventions.

- Demand for allowances under different emissions reduction targets
- Different trajectories of ambition (also for different sectors and emissions scope) can be verified
- The compliance of an ETS price trajectory with alternative MSR designs
- The ETS price tool (ex post) can mimic different actor anticipation and foresight

- The PRIMES model can mimic the effect of complementary policy packages for each sector individually (measures on transport, energy efficiency policies, etc).

The PRIMES model is regularly used in EU impact assessments and for developing the EU Reference Scenario. Recent applications include the *EU Reference Scenario 2020* (European Commission, 2021)³³, which projects trends in energy, transport, and GHG emissions through 2050, updating the 2016 version (European Commission, 2016)³⁴. PRIMES has been central to assessing key EU climate and energy policy packages, such as the *Fit-for-55* initiative, supporting the design of pathways to meet 2030 targets and achieve climate neutrality by 2050.

The model was also used in response to the recent energy crisis triggered by the Russian invasion of Ukraine, underpinning the *REPowerEU* plan to reduce dependence on Russian fossil fuels (European Commission, 2022)³⁵. Most recently, in 2024, PRIMES supported the analysis behind the EU's 2040 climate target plan (European Commission, 2024).³⁶

1.1.2.2. GEM-E3

GEM-E3 is a large-scale multi-sectoral hybrid CGE model designed to evaluate the effects of external shocks on the economy. The model provides a robust framework to capture the complex energy-economy-climate interactions and simulate the impact of climate damage or climate and energy policies on the performance of sectors, sectoral output, prices and bilateral trade, the competitiveness of regions and the welfare of communities. Results have a yearly time-steps up to 2030 and 5-year time steps until 2050/2100. The model has a global coverage, with 47 regions, where the G-20 countries, EU27 Member States, and major equipment manufacturing or energy exporting countries are represented individually, and countries are linked through bilateral trade. All countries are linked through endogenous bilateral trade transactions. The model explicitly represents 50 distinct economic activities, which are interlinked across the production and consumption value chain.

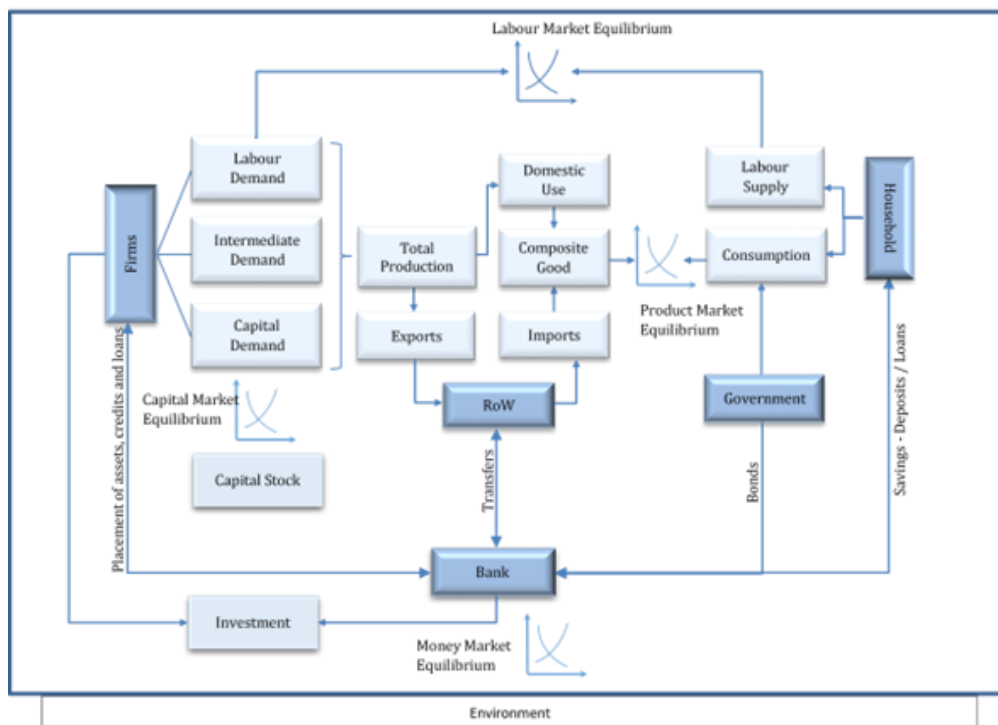
³³ European Commission 2021. European Commission, Directorate-General for Climate Action, Directorate-General for Energy, Directorate-General for Mobility and Transport, De Vita, A., Capros, P., Paroussos, L. et al. EU reference scenario 2020: energy, transport and GHG emissions: trends to 2050. Publications Office. <https://data.europa.eu/doi/10.2833/35750>

³⁴ European Commission 2016. European Commission, Directorate-General for Climate Action, Directorate-General for Energy, Directorate-General for Mobility and Transport, Zampara, M., Obersteiner, M., Evangelopoulou, S. et al. EU reference scenario 2016: energy, transport and GHG emissions: trends to 2050. Publications Office. <https://data.europa.eu/doi/10.2833/001137>

³⁵ European Commission 2022. Commission staff working document Implementing the RepowerEU action plan: Investment needs, hydrogen accelerator and achieving the bio-methane targets. Accompanying the document "Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions REPowerEU Plan" SWD/2022/230 final

³⁶ European Commission 2024. Impact Assessment Report Part 1 Accompanying the document "Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Securing our future Europe's 2040 climate target and path to climate neutrality by 2050, building a sustainable, just and prosperous society". SWD/2024/63 final

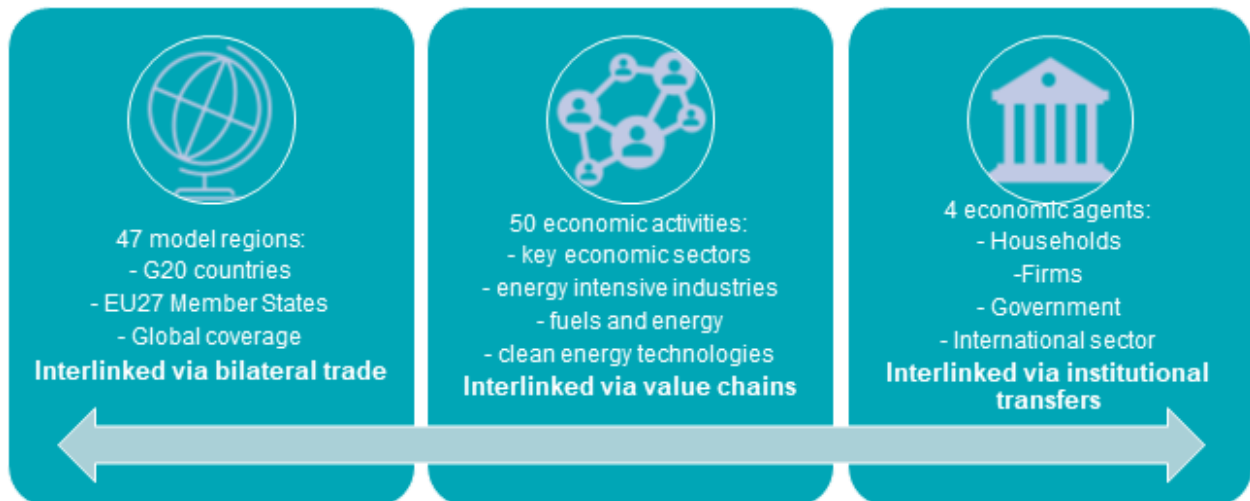
Figure 3: Schematic representation of the GEM-E3 model



Focus is placed on the representation of the energy system where specialised bottom-up modules for power generation, buildings and transport sectors have been developed. To this end, the model includes a detailed representation of the power generation system (12 power technologies) and a detailed transport module (private and public transport modes), while different technological options for energy use in buildings and industry are provided. The energy system representation includes an explicit representation of new technologies such as hydrogen, clean fuels, and bioenergy options. The GEM-E3 environment module covers all GHG emissions and a wide range of abatement options, as well as a thoroughly designed carbon market structure (e.g., grandfathering, auctioning, alternative recycling mechanisms). The model has been used extensively by the European Commission, governments and public institutions to assess the macroeconomic, distributional and employment implications of the transition to climate neutrality.

The model is based on advanced applied modelling techniques and has been further extended to allow the representation of semi-endogenous technical progress, endogenous formation of labour skills and human capital and a detailed bottom-up representation of the energy system (in particular transport and power generation), along with non-CO₂ emission abatement options and negative emissions technologies. It moves beyond the standard CGE framework as it is dynamic and features involuntary unemployment in the labour market and alternative macroeconomic closures supported by a detailed representation of the financial sector. The model is established on rigorous microeconomic theory; it is empirically estimated (substitution and trade elasticities) and is able to undertake long term analysis as opposed to econometric models that suffer from the Lucas critique. The model can be used both in a comparative and what if analysis frameworks and represents a closed and consistent accounting of resources.

Figure 4: GEM-E3 system dimensions



The model is calibrated to a wide range of datasets comprising of Input-Output tables, financial accounting matrices, institutional transactions, energy balances, GHG inventories, bilateral trade matrices, investment matrices and household budget surveys. The model has been calibrated to the latest statistics (GTAP 11, IEA, UN, ILO) while Eurostat statistics have been used for the EU. All countries in the model are linked through endogenous bilateral trade transactions identifying origin and destination. The substitution elasticities of the model are not derived from the general literature but are estimated according to its dimensions and functional forms using the latest available datasets. The model is recursive dynamic through the accumulation of capital via the decision for investments and through the accumulation of knowledge stocks via R&D and human capital development. Model regions are linked through endogenous bilateral trade following the Armington assumption of imperfect substitution across domestic and imported goods. The nested production functions are differentiated by sector and follow a CES structure. For the demand side, the model simulates consumer behaviour and maximises a Klein-Rubin utility function that results in a Linear Expenditure demand system subject to its disposable income not used for obliged consumption (subsistence minima consumption) and after allowing for the decision on savings. The representative household decides on the allocation of the income that is available for consumption over different consumption categories (COICOP), distinguishing between durable and non-durable goods. The model has been calibrated to the latest statistics (GTAP 11, IEA, UN, ILO) while Eurostat statistics have been used for the EU.

The key innovations of the model relate to the explicit representation of the financial sector, semi-endogenous dynamics based on R&D induced technical progress and knowledge spillovers, the representation of multiple households, unemployment in the labour market with a representation of five labour skill levels and endogenous formation of labour skills.

The model is written in structural form and can be used for the comparative analysis of alternative policy scenarios and the provision of insights on the distributional effects of long-term structural adjustments. In all simulation alternatives the model ensures that the economic system is always in general equilibrium. It extends beyond the static comparison of alternative policies.

The GEM-E3 model is written entirely in GAMS. The implementation of the model is split in two stages:

- I. Calibration: At this stage the calculation of the model parameters is carried out so that the model replicates a single year (base year) data.
- II. Scenario quantification: This stage entails model implementation that quantifies a reference and/or a counterfactual scenario.

GEM-E3 enables the analysis of the impacts of policy scenarios on key macro-economic variables. A wide range of policies and measures can be assessed under any given level of mitigation ambition, including those to support the deployment of renewable energy or industrial decarbonisation, e.g. via the recycling of carbon revenues, measures to support up-skilling and re-skilling of the labour force, or policies to avoid carbon leakage, such as the carbon border adjustment measure. The model can also be used to assess the impact of price shocks on the economy, e.g. fossil fuel price shocks.

They key variables represented in GEM-E3 include GDP and its components, employment by economic activity and by skill and unemployment rates, capital, interest rates and investment by country and sector, private and public consumption, bilateral trade flows, consumption matrices by product and investment matrix by ownership branch, GHG emissions by country, sector and fuel and detailed energy system projections (energy demand by sector and fuel, power generation mix, deployment of transport technologies, energy efficiency improvements).

GEM-E3 enables a thorough understanding and detailed identification of risks and opportunities of the low carbon transition and of the implementation of specific climate and energy policies by capturing:

- Direct impacts on each sector, e.g., how carbon prices and carbon border taxes will affect a sector's costs of production (considering carbon intensity) and thus its production levels (via domestic and international demand)
- Indirect impacts via value chain effects (e.g. changes in prices of intermediate products, of labour and capital inputs), technology costs, consumer preferences, material availability and costs
- Induced effects via economy feedback, prices, and income implications (e.g. overall drop of demand even for products not directly affected by carbon prices etc.)
- The impacts of financing requirements (capital-intensive process of mitigation) and different financing options
- Impacts on competitiveness
- Impacts on sectoral productivity, household incomes and prices due to climate damages

Table 2: Regional resolution of the GEM-E3 model

Country Code:	Description:		Country Code:	Description:
AUT	Austria		USA	USA
BEL	Belgium		JPN	Japan
BGR	Bulgaria		CAN	Canada
CYP	Cyprus		BRA	Brazil

CRO	Croatia		CHN	China
CZE	Czech Republic		IND	India
DEU	Germany		KOR	South Korea
DNK	Denmark		IDN	Indonesia
ESP	Spain		MEX	Mexico
EST	Estonia		ARG	Argentina
FIN	Finland		TUR	Turkey
FRA	France		SAR	Saudi Arabia
GBR	United Kingdom		OCE	Oceania
GRC	Greece		RUS	Russian federation
HUN	Hungary		ARE	United Arab Emirates
IRL	Ireland		REP	Rest of energy producing countries
ITA	Italy		SAF	South Africa
LTU	Lithuania		REU	Rest of Europe
LUX	Luxembourg		ROW	Rest of the World
MLT	Malta			
NLD	Netherlands			
POL	Poland			
PRT	Portugal			
SVK	Slovakia			
SVN	Slovenia			
SWE	Sweden			
ROU	Romania			

Table 3: Sectoral resolution of the GEM-E3 model

Code	Description	Code	Description	Code	Description
Industry		Industry (continued)		Agriculture	
IND01	Ferrous metals	IND19	Equipment for PV panels	AGR01	Agriculture
IND02	Non-ferrous metals	IND20	Equipment for CCS power technology	Services	
IND03	Fabricated Metal products	IND21	CO2 Capture	SRV01	Market Services
IND04	Chemical Products	Energy		SRV02	Non-Market Services
IND05	Basic pharmaceutical products	ENE01	Coal	SRV03	R&D
IND06	Rubber and plastic products	ENE02	Crude Oil	Power Generation	
IND07	Paper products, publishing	ENE03	Oil	PGT01	Coal fired
IND08	Non-metallic minerals	ENE04	Gas	PGT02	Oil fired
IND09	Computer, electronic and optical products	ENE05	Power Supply	PGT03	Gas fired
IND10	Other Equipment Goods	ENE06	Biomass Solid	PGT04	Nuclear
IND11	Transport equipment (excluding EV)	ENE07	Biofuels	PGT05	Biomass
IND12	Consumer Goods Industries	ENE08	Hydrogen	PGT06	Hydro electric
IND13	Construction	ENE09	Clean Gas	PGT07	Wind
IND14	Batteries	Transport		PGT08	PV
IND15	EV Transport Equipment	TRA01	Warehousing and support activities	PGT09	Geothermal
IND16	Advanced Electric Appliances	TRA02	Air transport	PGT10	CCS coal
IND17	Advanced Heating and Cooking Appliances	TRA03	Land transport	PGT11	CCS Gas
IND18	Equipment for wind power technology	TRA04	Water transport	PGT12	CCS Bio

Table 4: Data sources used in GEM-E3 model for the base year calibration

Data	Source
Economic activity (GDP/GRDP)	GTAP v11
Employment (per economic activity)	GTAP v11
GHG emissions (per GHG and economic activity)	GTAP v11
Energy consumption (per fuel and economic activity)	GTAP v11, IEA
Population	GTAP v11, ILO
Working age	GTAP v11, ILO
Labour force	GTAP v11, ILO
Unemployment rate	GTAP v11, ILO
Sectoral production per economic activity	GTAP v11
Bilateral trade	GTAP v11)
Input/Output tables	GTAP v11
Transport fleet (by mode, fuel, age, etc)	IEA
CAPEX for power generation technologies	IEA
Energy prices	IEA

1.1.2.3. POTEnCIA

POTEnCIA (the Policy Oriented Tool for Energy and Climate Change Impact Assessment) is an economic model designed to represent the supply of energy and all sectors of energy demand in the EU: industry, residential, services and agriculture, transport, and power and heat generation.

POTEnCIA has been used in the Annex on Cap setting as an alternative view to the PRIMES modelling underlying the Impact Assessment, distributing effort across sectors in a different way. It has also been used in the Annex on Removals to for different estimates of removals supply. It also provides estimates for economic estimates such as investment needs, allowing the impact assessment and Annex on the Cap to provide a range of such estimates.

We provide a short description here.

POTEnCIA represents each EU Member State individually with the option of addressing the EU27 energy system as a whole. It is designed to evaluate prospective or existing policies, generally by comparing scenarios that depict alternative energy and climate policy environments. To this end POTEnCIA:

- Realistically captures the adoption and use of new energy technologies under different policy conditions.

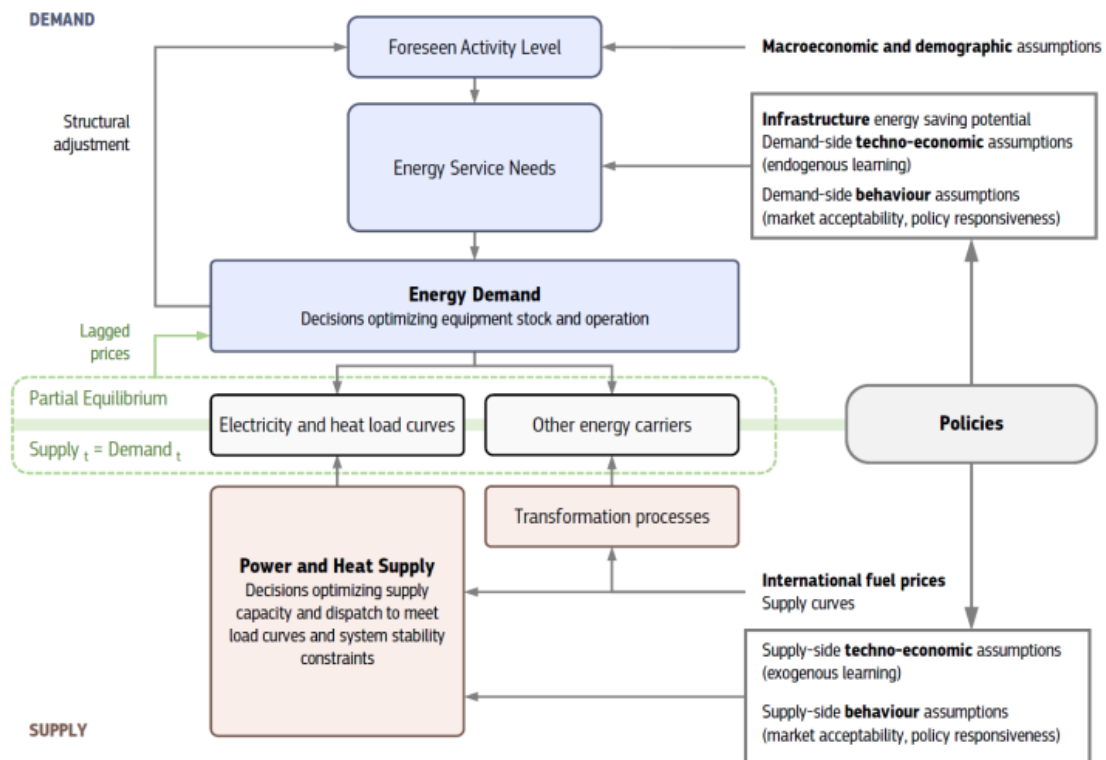
- How? By simulating decision-making under imperfect foresight at a high level of techno-economic detail.
- Provides high temporal detail to assess rapid structural changes in the EU's energy system.
 - How? By combining a yearly simulation of demand-side investment with hourly resolution for the power sector.
- Accurately represents the age and performance of installed energy equipment and enables the assessment of stranded asset risks and retrofitting or retirement strategies.
 - How? By tracking yearly equipment stock vintages for energy supply and demand.

These features enable the joint analysis of technology-focused policies as well as policies addressing the decision-making of energy users. Model outputs are provided in annual time steps for 2000-2050; historical conditions (2000-2021) are consistent with Eurostat and based on the Joint Research Centre's Integrated Database of the European Energy System (JRC-IDEES), which is publicly available and maintained in parallel to the POTEnCIA model.

The core modelling structure of POTEnCIA (detailed in a scientific article³⁷) follows a recursive dynamic partial equilibrium approach, which successively optimises demand and supply across energy carriers in each year. This approach assumes that each demand sector requires a certain energy service to meet foreseen activity levels in a given year (such as tonnes of steel produced or mobility needs). This energy service is then met by optimising both the stock and use of energy-related equipment in each sector of energy supply and demand.

³⁷ JRC 2017, "POTEnCIA: A new EU-wide energy sector model", <https://publications.jrc.ec.europa.eu/repository/handle/JRC106760>

Figure 5: POTEnCIA model structure



1.2. Key Assumptions

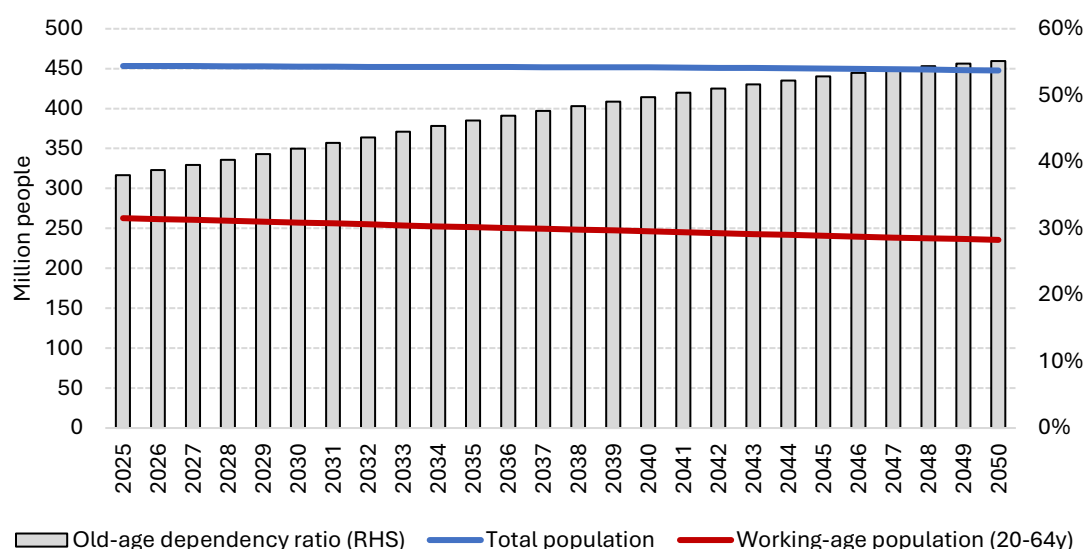
1.2.1. Economic Assumptions

The modelling work is based on socio-economic assumptions describing the expected evolution of the European society. Long-term projections on population dynamics and economic activity form part of the input to the model and are used to estimate transport activity, particularly relevant for this impact assessment.

Population projections rely on Eurostat's long-term projections (EUROPOP2023)³⁸. The EU population is projected to remain broadly stable over the projection period to 2050. However, there is a noticeable trend towards the ageing of the population, with a 10% decline in the working-age population aged 20 to 64 between 2025 and 2050 and an increase in the old-age dependency ratio from 38% to 55.2%.

³⁸ EUROPOP2023 (proj_23n).

Figure 6: Population assumptions



Source: Eurostat

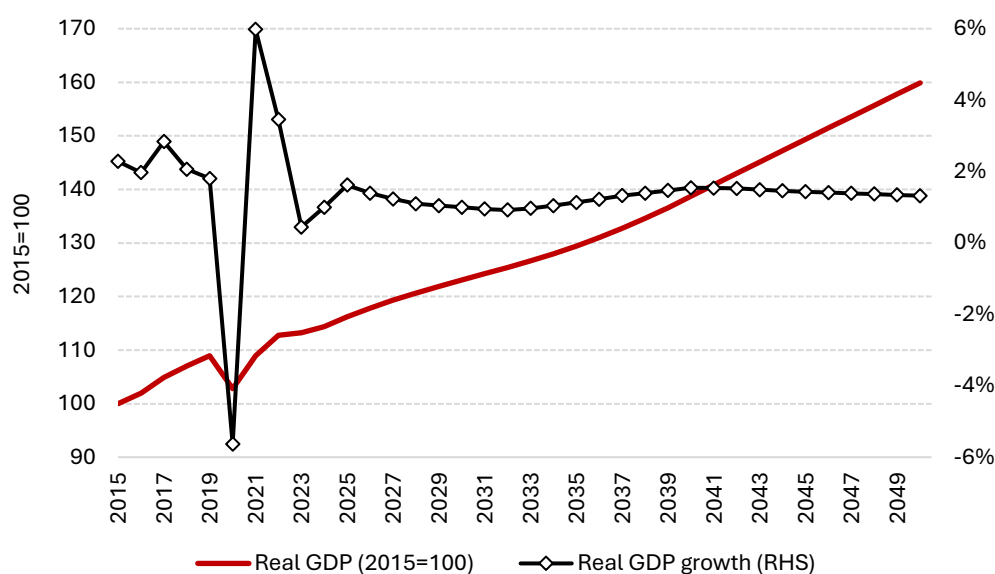
Economic projections have taken place in an unusually unstable context in the past few years, as the EU and world economies were hit first by the COVID pandemic and second by Russia's war of aggression against Ukraine, with the ensuing sharp increase in international energy prices. The GDP projections for 2025 rely on the Spring Forecast³⁹ of the Directorate General for Economic and Financial Affairs (DG ECFIN). From 2025 onwards, the GDP growth projections converge to those prepared by DG ECFIN for the 2024 Ageing Report⁴⁰. At EU level, real GDP is projected to be 23% higher in 2030 than in 2015, 39% higher in 2040, and 60% higher in 2050 compared to 2015.

Projections on the sectoral composition of GDP were prepared using the GEM-E3 computable general economic model. It is projected that the EU economy will continue to become increasingly services-oriented, with the sector's share rising from close to 74% of total gross value added (GVA) in 2016-2020 to around 75% in 2040 and 76% in 2050.

³⁹ DG ECFIN, https://ec.europa.eu/commission/presscorner/detail/en/ip_22_6782

⁴⁰ DG ECFIN, 2024 Ageing Report. Economic and budgetary projections for the EU Member States (2022-2070).

Figure 7: EU GDP (2015 = 100) and GDP growth (%)



Source: DG ECFIN

1.2.2. International energy prices assumptions

The assumptions for fuel prices trajectories take into account the market conditions for 2025 but there are large uncertainties for the long term. Main sources for post-2025 trajectories are the projections from the POLES model in the Global Energy and Climate Outlook 2023 and the World Energy Outlook from the International Energy Agency. The table below shows the oil prices assumptions of the baseline used in this impact assessment.

Table 5: Fossil fuel price assumptions

EUR2023	Oil price	Gas price (NCV)	Coal price
	EUR/boe	EUR/toe	EUR/toe
2025	76	394	172
2030	85	377	169
2035	94	344	161
2040	97	422	160
2045	105	412	165
2050	121	403	166

1.2.3. Technology assumptions

Modelling scenarios on the evolution of the energy system is highly dependent on the assumptions on the development of technologies - both in terms of performance and costs.

Continuing the approach adopted in the long-term strategy in 2018 and for the Reference Scenario 2020, the Commission consulted on the technology assumption with Member States and stakeholders in 2024. In particular, the technology database of the main model suite (PRIMES, PRIMES-TREMOVE, POTEnCIA, GAINS, GLOBIOM, and CAPRI) were discussed with Member State during a meeting of the Reference scenario expert group on 5 June 2024. They also benefited from a dedicated consultation workshop with stakeholders, held on 22 and 23 October 2024. The technology costs assumptions for energy technologies including for industry are published together with the impact assessment report for the ETS review.

The discount rates for investing in these technologies differ per sector and are published in the Reference Scenario 2020 report⁴¹ for the PRIMES model.

1.2.3.1. International aviation carbon pricing

Specific to the aviation sector, the offset price of CORSIA (expressed in EUR23/tCO₂) is projected to increase from 30 EUR/tCO₂ in 2030 to 83 EUR/tCO₂ in 2035. No projections are made for later years considering CORSIA's defined end date in 2035 (subject to the "special review" in 2032 determining if and how the scheme should be continued). It is equally worth noting that modelling includes flights operated by EU-based airline operators between two third countries outside the scope of application of the EU ETS and subject to CORSIA. In 2023, such flights represented approximately 5% of emissions covered by CORSIA. Based on available data, it is speculative to project the 2023 share to future years: beyond typical fluctuations in activity levels, network planning through aviation partnerships determines the dynamics of routes and slot allocation. For this reason, these flights were not taken into account when calculating CORSIA offsetting costs, which in turn would result in modelling presumably slightly underestimating such cost estimates.

International jet fuel prices expressed in (EUR23/boe) are projected to increase by 14% approximately from 85 EUR/boe in 2030 to 97 in 2040.

SAF options are used as computed in PRIMES⁴², resulting in slightly higher post-2035 ETS compliance prices compared to the PRIMES 85% (20 EUR/tCO₂). This slight difference is thus not relevant to the SAF support mechanism because dedicated allowances are projected to be used up by 2035 at the latest. It is equally worth noting that further breakdowns per feedstock category and production processes are used based on the underlying assumptions on fuel production within PRIMES. Such finer granularity results in SAF prices' projected evolution differing from PRIMES overall assumptions when assessing the options of an extended support mechanism for SAF uptake (cross-ref to relevant section, currently 8). SAF uptake being represented in the models consistently with ReFuelEU Aviation mandates results in synthetic fuels' use starting in 2030 with production costs used as a proxy to today's inexistent market price and held constant over the time period of relevance to this exercise. SAF produced from RED Annex IX Part A via advanced conversion processes (Alcohol-to-Jet, and Fischer-Tropsch) are conversely projected to lower production costs while still more costly than HEFA in the same period. Production costs are based on EASA's ReFuelEU Aviation Annual

⁴¹ [EU reference scenario 2020 - Publications Office of the EU](#)

⁴² PRIMES 87p_var3_v3

Technical Report²⁸⁹. This choice is justified out of precaution when considering fuel options not in commercial production today. Assumptions are aligned with PRIMES with respect to EU domestic production vs imported volumes of SAF.

2. SCENARIOS

The specific objectives of this initiative are to identify and assess pathways towards climate neutrality in 2050 and an intermediate target for 2040⁴³.

2.1. Baseline Scenario

The Baseline scenario in this Impact Assessment is used as a counterfactual scenario – with the EU ETS as currently legislated: meeting the emissions reduction target in 2030, and post-2030 gross emissions under the EU ETS will reduce yearly as defined by the linear reduction factor. The scenario will be used as the comparison basis to analyse and assess the impacts of the alternative policy options compared to the unchanged policy setup for the EU ETS and broader EU climate goals (overall GHG emission reduction target, renewable and energy efficiency objectives).

The Baseline scenario was reproduced with the PRIMES model for the EU level and at member state level. GEM-E3 and POLES-Enerdata models integrate elements of the Baseline scenario produced with the PRIMES model, by aligning assumptions and scenario narrative. However, it was not possible in the modelling to reproduce fully the linear reduction factor of 4.4% until 2040. A scenario, called PRIMES-MAX, utilizes the technical potentially available. While the scenario provided technical information, it is not the key scenario to which economic data is compared, as the change in ambition level would dominate the differences between all other aspects of the policy options.

Table 6: Overview of the development of the baseline at the non-EU level

	Baseline / PRIMES MAX
The energy and climate policies that we will consider in non-EU countries impact the carbon leakage	Options: 1. Current policies in non-EU countries (suggested option) – legislated up until 2023 – e.g., China NDC not included. 2. nationally determined contributions (NDC) until 2030 and frozen policies after 2030. 3. NDC until 2030 and long-term strategy (LTS) afterwards.

At the EU level and in the context of the EU ETS revision impact assessment, the Baseline scenario can be summarised with the following points:

- *GHG scope* : Domestic countries + intra-EU aviation + 100% international intra-EU maritime + 50% international extra-EU MRV maritime + 50% international extra-EU aviation (incoming and outgoing).
- *EU ETS cap*: follows the EU ETS emissions reduction trajectory *as currently legislated*.

⁴³ The model-based analysis is a technical exercise based on a number of assumptions that are shared across scenarios. Its results do not prejudice the future design of the post-2030 policy framework.

- *EU ETS scope*: follows the EU ETS scope *as currently legislated*, where the aviation scope from 2027 onwards is: domestic, intra-EEA flights and extra-EEA flights (outgoing and incoming).
- *Removals in EU ETS*: Carbon removals (from BECCS or DACCS) do not contribute to the yearly decrease of emissions under the EU ETS.
- *CCU in EU ETS*: Fossil CO₂ emissions captured from installation under ETS and used to produce synthetic fuels count as emissions under ETS.

The detailed overview of PRIMES Baseline scenario specifications is provided in Table 7.

Table 7: Overview of the development of the baseline at the EU level

	Baseline / PRIMES MAX
International fossil fuel prices (oil, gas, coal)	Assumptions as presented in section 1.2.2.
Technology assumptions, coal, nuclear, CCS capacities	Technology assumptions as presented in section 1.2.3. and capacities based on Member States' latest announced capacity developments, and information in final updated NECP ¹ , as well as information collected during bilateral meetings with Member States.
Population, GDP/ macroeconomics/ activity levels	Assumptions as presented in section 1.2.1.
2030	
EU ETS emissions reduction target / cap and scope	The cap follows the EU ETS emissions reduction trajectory as currently legislated. The EU ETS aviation scope includes extra-EEA aviation from January 2027 . CO ₂ emissions from installation under EU ETS and used to produce e-fuels are accounted for under the EU ETS at the point where they are captured.
EU RES share in final energy consumption	Can deviate from the legislated target in 2030, driven by the GHG emissions reduction target.
Total GHGs emissions	As currently legislated.
Reduction in final energy consumption relative to the projection in the EU 2020 Reference scenario	Can deviate from the legislated target in 2030, driven by the GHG emissions reduction target.
2040	
EU ETS emissions reduction target / cap and scope	As currently legislated
EU RES share in final energy consumption	Post 2030, the RES share as observed in the scenario, is the result of implemented policies and scenario specifications.

Total GHGs emissions	The scenario does not assume the overall net GHG objective post-2030, the GHG emissions reduction observed, is the result of policies implemented and scenario specifications.
Reduction in final energy consumption	Post 2030, the reduction in final energy consumption as observed in the scenario, is the result of implemented policies and scenario specifications.
2050	
Total GHGs emissions without LULUCF	Achieve climate neutrality by 2050.
EU ETS Impact Assessment thematic policy measures	
EU ETS cap trajectory	In line with existing legislation (as amended by ETS 2023/959)
ETS2 cap trajectory	In line with existing legislation (as amended by ETS 2023/959)
Carbon Leakage	
Policy measures	In line with existing legislation (as amended by ETS 2023/959)
MSR EU ETS	
Policy measures	In line with existing legislation (ETS 2023/959)
Potential inclusion of permanent carbon removals	
Policy measures	Permanent removals excluded from the ETS (existing legislation (ETS 2023/959))
Potential inclusion of municipal waste incineration (MWI) and other waste management processes	
Policy measures	Waste management activities not included (in line with existing legislation (ETS 2023/959))
Carbon Capture and Use (CCU):	
Policy measures	Upstream accounting - Emitter pays for the carbon molecule

2.2. 85% Policy Scenario

The PRIMES85 scenario serves as a basis for the assessment of EU ETS policy options. The scenario aims at achieving 85% reduction of net GHGs in 2040 and climate neutrality in 2050. Main changes compared to the Baseline scenario at the EU level can be summarised with the following points:

- *GHG scope*: Domestic countries + intra-EU aviation + 100% international intra-EU maritime + 50% international extra-EU MRV maritime + outgoing extra-EEA aviation.
- *GHG emissions reduction ambition*: achieving 85% reduction of net GHGs in 2040 and climate neutrality in 2050.

- *EU ETS cap*: the scenario does not aim at following the EU ETS trajectories as in the Baseline scenario.
- *EU ETS scope*: domestic flights within EU-27 countries (except to and from outermost regions), intra-EEA flights (including non-domestic flights to and from outermost regions) plus departing flights to UK and Switzerland, outgoing extra-EEA aviation.

Table 8: Overview of the development of the policy scenario at the EU level

	Policy scenario
2040	
EU ETS emissions reduction target	The reduction of EU ETS emissions as observed in the scenario, is the result of implemented policy options and scenario specifications. The cap trajectory will be the subject of the policy option design.
EU RES share in final energy consumption	Post 2030, the RES share as observed in the scenario, is the result of implemented policies and scenario specifications.
Total GHGs emissions	Aims at achieving 85% reduction of net GHGs in 2040 and climate neutrality in 2050, considering the following net GHG scope: domestic countries + intra-EU aviation + outgoing extra-EEA aviation + 100% international intra-EU maritime + 50% international extra-EU MRV maritime.
Reduction in final energy consumption	Post 2030, the reduction in final energy consumption as observed in the scenario, is the result of implemented policies and scenario specifications.
2050	
Total GHGs emissions without LULUCF	Achieve climate neutrality by 2050 (assuming LULUCF net sink of 250-275 Mt).
Impact Assessment thematic policy measures	
EU ETS cap trajectory	To be defined based on policy option.
Carbon Leakage	
Policy measures	To be defined based on policy option.
MSR EU ETS	
Policy measures	To be defined based on policy option.
Potential inclusion of permanent carbon removals	
Policy measures	To be defined based on policy option.
Potential inclusion of municipal waste incineration (MWI) and other waste management processes	

Policy measures	To be defined based on policy option.
Carbon Capture and Use (CCU):	
Policy measures	To be defined based on policy option.

Here, the elements which can be varied per policy option are not necessarily modelled in PRIMES but handled in different models like GEM-E3 for carbon leakage, POLES for MSR, and various post-hoc analysis for the other options, using PRIMES results.

A version of this scenario attaining in 2035 an economy-wide GHG emissions level consistent with a pathway towards a 90% target in 2040, but thereafter consistent with an 85% target in 2040, has also been used.

2.3. Integration of different models

The key analytical approach followed in the impact assessment has been to use the PRIMES 85 scenario and using its outputs and variants to analyse policy options.

Data about energy use, investments, technology deployment and other key drivers generated in the PRIMES 85 run have been provided to the GEM-E3 model for macro-economic analysis. The GEM-E3 model then provides macro-economic indicators showing the sectorial impact of the different policy options for dealing with carbon leakage prevention (see Annex 12, section 1.3). Similar data has been provided to the POLES model to provide analysis of MSR measures, calibrated to specific PRIMES scenarios, but providing broader insights.

Other measures have been analysed through analysis of PRIMES results, including by varying removals amounts and costs, to represent different measures.

3. MODELLING FOR THE MARKET STABILITY RESERVE (POLES-ENERDATA)

The objective of this section is to present the methodology used for the quantitative modelling work, using the POLES-Enerdata model, to support the analysis of the Market Stability Reserve (MSR). POLES was selected for the MSR modelling exercise instead of PRIMES, POTEnCIA, or GEM-E3 because it is a comparatively lightweight model, enabling faster simulations of scenarios and sensitivity analyses. By contrast, PRIMES and POTEnCIA are substantially more complex and require much more time and resources produce results for a single variant, making them less suited for exploring a large number of sensitivities and variants. To ensure consistency with across the different models, the cap trajectory implemented in POLES was aligned with the cap derived from the PRIMES. Although the outputs generated by PRIMES and POTEnCIA are generally more detailed and are considered more robust, POLES nonetheless provides useful insights, particularly with regard to the relative impacts observed across the measures and policy options for the MSR.

3.1. Approach for MSR analysis

The quantitative analysis of the MSR is based on two successive phases. First, a measure-level analysis is undertaken, with the aim to define possible MSR designs that best support the system's stability and resilience to shocks. This measure-level analysis is based on a standard situation, referred to as the MSR core working assumption scenario (or MSR0 measure), which aims to represent one possible base trajectory for the future evolution of the EU emission reductions and of the EU ETS cap, as opposed to the legal default configuration which would lead to an over-constrained system by 2040. The core working assumption scenario definition (presented below) had to be set before the final version of the Policy scenario was ready and

was defined to be close enough to the final versions tested in the next phase of policy option-level analysis. Indeed, the calibration of the POLES-Enerdata model for the CWAS was based on the PRIMES scenario for a 90% economy-wide target available on 30 May 2025. Despite these, PRIMES results having been updated subsequently, POLES-Enerdata used the intermediate results in order to be able to deliver the MSR results for the measure-level analysis within the deadline set by the contract. However, the MSR analysis at the policy options level was done using the most recent PRIMES results available for the 90-85% target, on 31 March 2026.

Then, the obtained robust MSR designs were indeed incorporated as part of policy options. This phase allowed to fine-tune and validate the parameters of the MSR configuration, in the actual context of the final considered scenario.

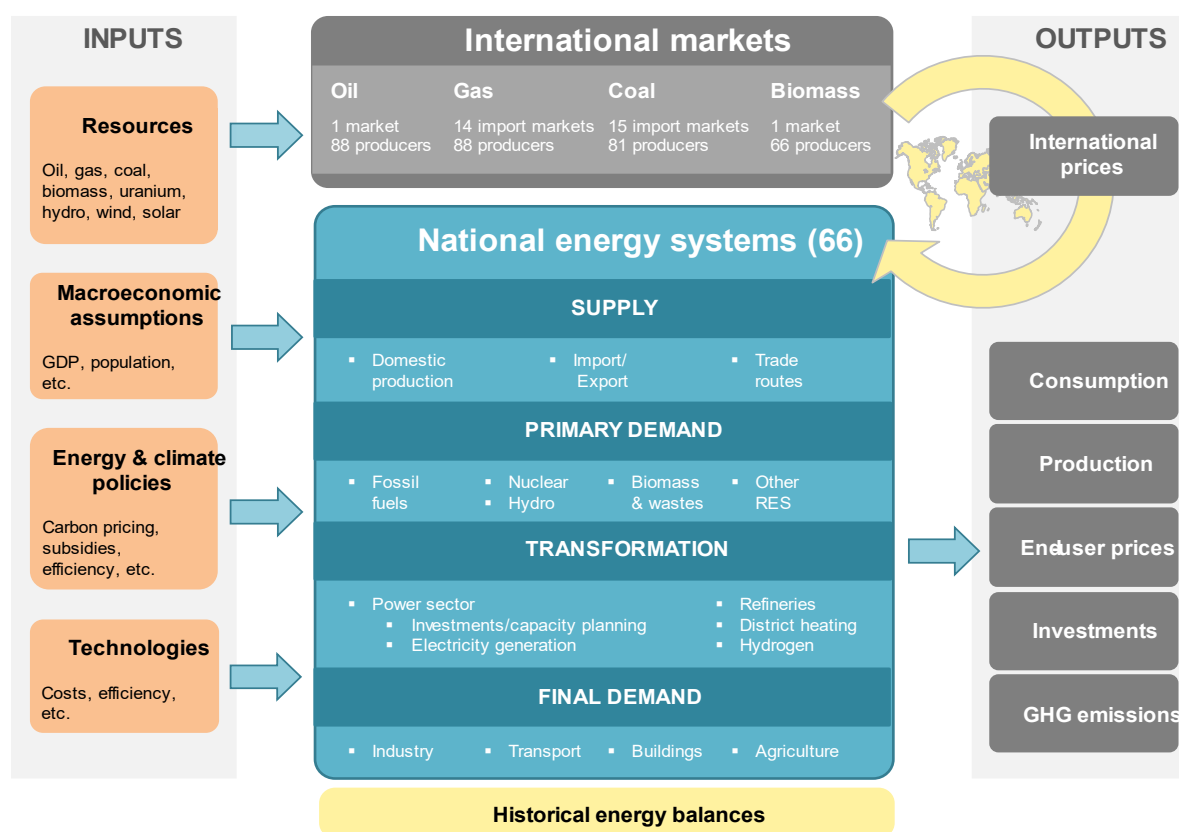
3.2. Presentation of the model

Enerdata used the POLES-Enerdata model to do this modelling task.

The POLES model has been initially (early 1990s) developed by IEPE (Institute for Economics and Energy Policy), now GAEL lab (Grenoble Applied Economics Lab). Today, it is co-developed by 3 entities: the GAEL lab, the Joint Research Centre of the European Commission in Sevilla, and Enerdata. Each entity has ownership of its own version of the model, which is not open-source. POLES-Enerdata is the version of the POLES model owned, maintained and operated by Enerdata. It is continuously updated, developed and used in the framework of numerous studies for public and private actors in the EU and globally.

The POLES-Enerdata (Prospective Outlook on Long-term Energy Systems) model is a recognised multi-issue energy model that relies on national energy balances combined with economic, policy and technological scenarios to withdraw energy production, consumption, and greenhouse gas (GHG) emission projections. The figure below shows the general structure of the model, with its main inputs, outputs and covered sectors.

Figure 8: POLES-Enerdata multi-issue energy model



Source: Enerdata

Enerdata co-develops and uses the internationally recognised POLES-Enerdata model to provide quantitative, scenario-based, empirical and objective analyses. Because the POLES-Enerdata model is used for many members of the energy sector (industry, governments, European Commission, etc.), it is very well adapted to forecast the effects of different energy-related engagements (demand-supply, GHG emissions limitations, promotion of renewables and energy efficiency, energy security issues, etc.). In addition, with its global coverage and the endogenous calculation of demand, supply and prices of numerous energies including oil, gas, and coal, the POLES-Enerdata model is very relevant to capture all the impacts of energy policies and climate change measures and to ensure that all the forecasts are coherent within the global environment.

The model is a world energy-economy partial equilibrium simulation model of the energy sector, with complete modelling from upstream production through to final user demand and greenhouse gas emissions. The simulation process uses dynamic year-by-year recursive modelling, with endogenous international energy prices and lagged adjustments of supply and demand by world region, which allows for describing full development pathways to 2050. The below figure presents the geographical coverage of the POLES-Enerdata model, with a global coverage including 66 countries or country aggregates. All EU Member States are covered individually.

Figure 9: POLES-Enerdata geographical coverage

66 countries/regions

Regions	Sub-regions	Countries	Country aggregates
North America		USA, Canada	
Europe	EU27	France, Italy, Germany, Austria, Belgium, Luxembourg, Denmark, Finland, Ireland, Netherlands, Sweden, Spain, Greece, Portugal, Hungary, Poland, Czechia, Slovakia, Slovenia, Malta, Cyprus, Croatia, Bulgaria, Romania	Baltic states
		United Kingdom, Iceland, Norway, Switzerland, Turkey	
			Rest of Europe
Japan - South Pacific		Japan, Australia, New Zealand	Rest of South Pacific
CIS		Russia, Ukraine	Rest of CIS
Latin America	Central America	Mexico	Rest of Central America
	South America	Brazil, Argentina, Chile	Rest of South America
Asia	South Asia	India	Rest of South Asia
	South-East Asia	China, South Korea, Indonesia, Malaysia, Thailand, Viet Nam	Rest South-East Asia
Africa / Middle East	North Africa	Egypt,	Rest of North Africa x2;
	Sub-Saharan Africa	South Africa	Rest of Sub-Saharan Africa;
	Middle-East	Saudi Arabia, Iran	Gulf countries; Rest of Middle East

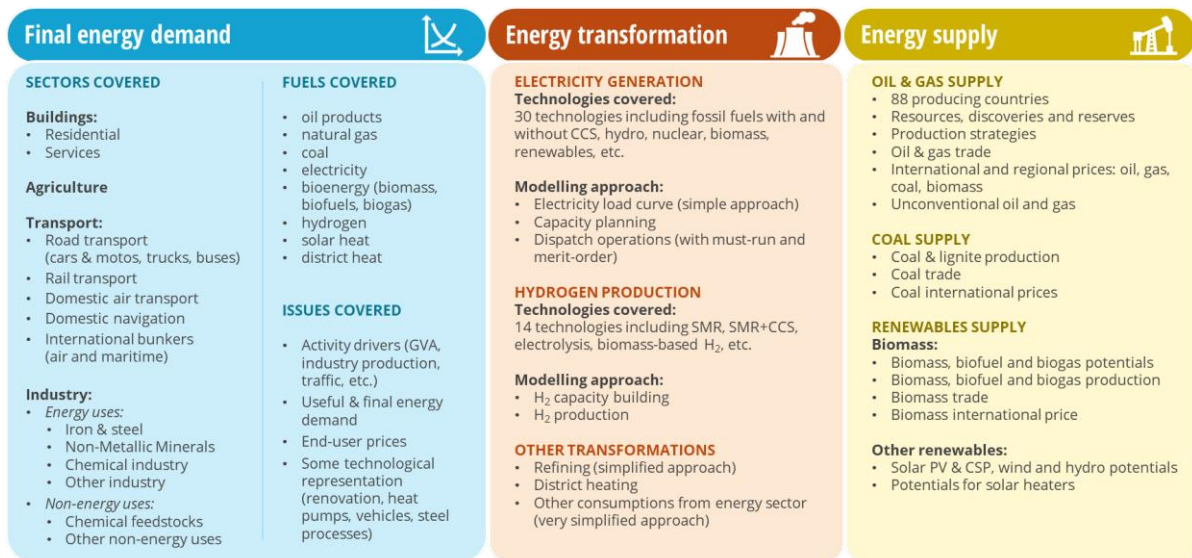
Source: Enerdata

The use of the POLES-Enerdata model combines a high degree of detail for key components of the energy system and a strong economic consistency, as all changes in these key components are influenced by relative price changes at the sectoral level. The model provides technological change through dynamic cumulative processes such as the incorporation of Two Factor Learning Curves, which combine the impacts of “learning by doing” and “learning by searching” on technologies’ development. As price induced diffusion mechanisms (such as feed-in tariffs) can also be included in the simulations, the model allows for consideration of key drivers to future development of new energy technologies. One key aspect of the analysis of energy technology development with the POLES-Enerdata model is indeed that it relies on a framework of permanent inter-technology competition, with dynamically changing attributes for each technology.

The model provides a complete endogenous calculation from upstream activities (supply, prices of several energies including oil, gas and coal) to final user demand. POLES-Enerdata offers a mixed approach based on:

- a “top-down” modelling for sectorial demand, which is directly related to activity, prices and technologies through econometric equations; for each key economic sector energy consumption is distinguished between substitutable fuels and electricity; and
- a “bottom-up” approach for the power sector (explicit representation of each type of technology as well as their costs).

Figure 10: POLES-Enerdata main issues and topics covered



Source: Enerdata

Key features of the POLES-Enerdata model are summarized in the following:

- Long-term (up to 2050) simulation of world energy scenarios/projections and international energy markets;
- World energy supply scenarios by main producing country/region with consideration of reserve development and resource constraints (88 producing countries/regions);
- Outlook for energy prices at international, national and sectoral level;
- Disaggregation into 15 energy demand sectors, with over 40 technologies (power generation, buildings, transport);
- Detailed national/regional energy balances, integrating final energy demand, new and renewable energy technologies diffusion, electricity, hydrogen and Carbon Capture and Sequestration systems, fossil fuel supply, and uranium (66 consuming countries/regions);
- Full power generation system (and feedback effect on other energies);
- Impacts of energy prices and tax policies on regional energy systems;
- National greenhouse gas emissions and abatement strategies; costs of national and international GHG abatement scenarios with different regional targets/endowments and flexibility systems;
- CO₂ emissions Marginal Abatement Cost Curves and Emission Trading System analyses by region and/or sector, under different market configurations and trading rules;
- Technology diffusion under conditions of sectoral demand and inter-technology competition based on relative costs and merit orders; and
- Endogenous developments in energy technology, with impacts of public and private investment in R&D and cumulative learning experience. Induced technological change of climate policies.

The POLES model benefits from numerous references, including public study reports, mentions in official publications from the European Commission, project references and academic references. In particular, it has recently been used as part of a study supporting the European Commission’s Impact Assessment on the 2040 Climate Target in 2024.

Furthermore, although the full documentation of Enerdata’s version is not publicly available, the one from the EC-JRC’s version is.⁴⁴ Both models are very similar in terms of core logic, and only a few recent developments on both sides have made them diverge on some aspects of the modelling.

3.3. Baseline scenario design

The Commission designed scenarios which were ran with the PRIMES model by Ricardo-E3M, which serve as bases for the present study.

These PRIMES-based scenarios include the baseline scenario, a “90% economy-wide scenario”, and a “85% economy-wide scenario”.

In the MSR measure-level analysis, the calibration of the POLES-Enerdata model for the core working assumption scenario was based on the “90% economy-wide scenario” available on 30 May 2025. In spite of these PRIMES results having been updated subsequently, intermediate results were used in order to be able to deliver the MSR results for the measure-level analysis within the deadline. For the policy option level analysis, the POLES-Enerdata baseline was based on the 90-85% var3 scenario sent by PRIMES on 15 December 2025.

The E3M team provided Enerdata with the GHG emissions for each consumption sectors and each EU ETS sector with a 5-year time step. Carbon prices trajectories were also provided for both the EU ETS and the ETS2 perimeters. The “90% economy-wide scenario” includes half of the emissions from extra-EU international aviation (“one way inclusion”).

Enerdata reproduced this scenario within the POLES-Enerdata model by targeting the same GHG emissions evolution for 2030 and 2050, looking at: total emissions, ETS-level emissions, and some specific sectors (notably: power generation). The aim of this approach is to align the emission reduction effort sharing between the EU ETS and other instruments, captured as part of the PRIMES model through the explicit inclusion of national policies.

3.4. Adaptation of the baseline with MSR modelling

3.4.1. MSR methodology applied to the core working scenario

Based on the core working assumption scenario, Enerdata would run the POLES-Enerdata model with its added ETS optimisation module, which explicitly represents MSR operations, and whose parameters are presented in detail below.

One of the results from the optimisation module is an indexed EUA price trajectory, as the specificities of the EU ETS market are represented and a limited foresight of the market from actors is considered (which inherently differs from PRIMES). The model calculates the EUA price evolution, based on a supply-demand equilibrium. These modelling outputs should not be considered as actual forecasts, as the model cannot perfectly capture the broader policy mix and relies on simplified assumptions for the regulated entities’ behaviors. The post-2040 period also has impacts on the output price trajectory due to a modelled actors’ anticipation horizon. The price results should therefore be considered with caution, however the main trends

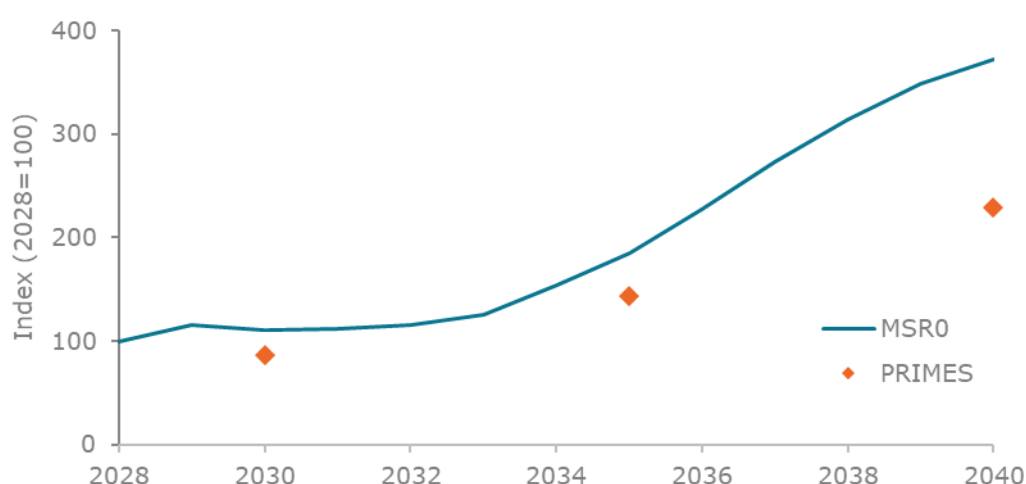
⁴⁴ Full documentation of the EC-JRC version of the POLES model can be found at: <https://ec.europa.eu/jrc/en/publication/poles-jrc-model-documentation>

observed, also validated with qualitative reasoning, are instructive and provide a very useful comparison framework for the different measures. All prices are provided as index considering 2028 as the base year.

As a result, a POLES-Enerdata core working assumption scenario is produced, consistent with the PRIMES 90% scenario (to which one-way extra-EU aviation is added to the ETS scope in 2027), and with the carbon price trajectory assessed with the MSR methodology. This scenario is taken as a basis for the different runs and sensitivities analysis envisioned as part of the quantitative measure-level assessment.

As shown on Figure 11, the indexed price outlook in POLES-Enerdata is not aligned with the initial 90% scenario from PRIMES to which the CWAS was aligned. This difference is explained by the differing methodologies used: in PRIMES, the carbon value is an input of the model, and the ETS and MSR operations are not directly endogenously represented. PRIMES also uses a benchmark approach with foresight up to 2050. In POLES-Enerdata, the price is the output from an optimization, which explicitly accounts for the ETS and MSR operations, and which works with a limited rolling anticipation horizon. These elements are the key factors explaining the differences observed.

Figure 11: EUA price comparison between POLES-Enerdata & PRIMES - Core Working Assumption Scenario



Source: POLES-Enerdata, PRIMES.

Note: Primes prices are indexed with 2028 POLES-Enerdata for model comparison.

3.4.2. Modelling the removals

In POLES-Enerdata, removals (both BECCS and DACCS) are modelled in the following way: it is agreed that the volume of CO₂ captured can be considered as an exogenous hypothesis. The level of captured CO₂ of BECCS and DACCS provided by PRIMES are considered as added in the gross cap. The development of these technologies is set exogenously in the model, bypassing its usual endogenous equations. This solution allows us to take into account the BECCS and DACCS contributions in the market by adding removals without having to assume any explicit mechanism for how they are integrated into the system. Also, the level of removals will not depend on the sensitivities ulteriorly run. In both cases, removals are excluded from the EU ETS emission perimeter.

3.4.3. Market parameters

This section presents the different scopes and parameters considered in the modelling of the EU ETS market and the MSR and provide the default values of these parameters, some of which are then modified in the different scenarios run for the analysis.

3.4.3.1. Geographical perimeter covered for the EU ETS market:

The geographical perimeter within the EU ETS is the EU27, Norway, Iceland and Liechtenstein. Emissions can be assessed for both this “EEA” perimeter and the EU27 perimeter allowing us to follow the PRIMES figures.

3.4.3.2. Sectoral perimeter accounted in the EU ETS market

Emissions from electricity generation are assumed fully accounted for in the EU ETS market

- Emissions from the industrial sector, in particular
 - Emissions from manufacturing industry sectors such as chemicals, non-metallic minerals, steel, and other industries
 - Non-CO₂ emissions from industry: PFC from aluminium production & N₂O from industry
 - Emissions from the hydrogen production sector
 - Emissions from the district heat production sector
- Emissions from the energy transformation sector.
 - Emissions from aviation (domestic & intra-EU since historically, extra-EU one-way starting 2027) and maritime (starting 2024) transport are considered exogenously in the modelling, with values based on the PRIMES 90% scenario. In the model, these aviation and maritime emissions are considered as an exogenous added demand for EU ETS allowances. The amount of allowances required for these sectors are therefore deducted from the EU ETS cap to reflect the contribution of these sectors in the EU ETS market.
 - This means that, for the purpose of MSR measure-level analyses, we assume that the aviation and maritime emissions will not be affected by the changes in the ETS price. In other words, we neglect the retroactions on aviation and maritime emissions through the price. This assumption enables to simplify the modelling work, also accounting for the fact that modelling price effects for mobility demand internationally is complex. Finally, some sensitivities to shocks will be studied as part of the measure analysis, some of which could simulate a different EUA demand from aviation and maritime.

3.4.3.3. Cap of emissions:

The cap taken into account is provided by the EU Commission for each year between 2023 and 2050. There is consideration of

- Industry EU ETS energy CO₂
- Industry EU ETS non energy CO₂
- Industry EU ETS non-CO₂
- Supply Side, that gather power, heat and hydrogen production sectors

- Intra EU international Aviation
- Domestic Aviation
- EU ETS Navigation
- 50% of international aviation outside the EU: “International aviation one way”

3.4.3.4. Banking from industrials:

A quantity of allowances is assumed historically banked by industrial actors. It is assumed that industrial actors will use these EUAs in the short term in a context of sustained ETS prices. In practice, it is assumed that 350 MtCO₂ is banked in end-2023 by industrials and they will release this quantity until 2030 with the same amount per year: 50MtCO₂/year. The model treats the “banked allowances” as a temporarily unavailable supply, to reproduce the reality of the market operations.

3.4.3.5. Hedging from the electricity sector:

Hedging behaviour from power actors is represented in the model. Hedging is a crucial strategy for electricity producers to manage and stabilise costs or revenues by locking in prices in advance. It is assumed that electricity producers apply this strategy within the EU ETS market.

In the modelling, the demand for EUA computed when representing compliance, i.e. the supply-demand equilibrium leading to the formation of the price, accounts for the hedging from power producers, assuming that the corresponding quantity of EUAs is not available for trade. Therefore, instead of calculating the EUA demand for a year N as [industry emissions (within the EU ETS scope) year N + Electricity production emissions year N + Aviation and maritime transport emissions], it is calculated as [industry emissions (within the EU ETS scope) year N + Electricity production emissions year N not already covered by past hedging + Electricity production emissions hedging need for future years + Aviation and maritime transport emissions]. It is assumed that the hedging needs are considered for the 3 years in advance (with partial coverage of future emissions). The aim for hedging at year N is to cover 80 % of emissions of year N+1, 50% of N+2 and 10% of N+3. These are default settings, adjusted with historical data, and are configurable.

Emissions projections of years N+1, N+2 and N+3 for calculating hedging are considered constant and equal to emissions in year N.

3.4.3.6. Actors’ foresight:

It is assumed that there is not a perfect but a limited foresight for actors assessing the constraint of the market. In this case, 8 years foresight is taken into account as it is a common hypothesis seen in the literature.

3.4.3.7. MSR specific parameters:

- Upper buffer: 1096 MtCO₂ until 2030; 947 MtCO₂ from 2031
- Upper threshold: 833 MtCO₂
- MSR intake:
 - If TNAC > Upper buffer: 24% of TNAC until 2030 and 12% of TNAC from 2031
 - If Upper buffer > TNAC > Upper threshold: TNAC – Upper threshold
- Lower threshold: 400 MtCO₂

- MSR release: 100 MtCO₂
- Maximum volume in MSR reserve: no limitation until 2023, then 400 MtCO₂ in 2024 and after because of the invalidation mechanism

3.5. Assessing the impact of the policy options on the functioning of the MSR

The policy options bring together sets of measures across all thematic areas of the project, and hence from a combined effort from all working groups. Three main scenarios are constructed in the PRIMES model to analyse results from the options on most thematic areas, although for the MSR aspects, the POLES-Enerdata is required.

The 3 policy options are indeed assessed quantitatively with the POLES-Enerdata model to quantify their impacts in terms of MSR. Similarly to the measure-level assessment, the model allows to simulate the EU energy systems, with an explicit representation of the EU ETS and its MSR design. The endogenous evolution of key indicators such as the ETS-covered emissions, the TNAC, the MSR operations and the EUA price evolution, for each considered policy option, are analysed in this section.

The 90-85% scenario from PRIMES, available on March 31st, 2026, is the starting point for the MSR option-level analysis. This scenario has been calibrated in the POLES-Enerdata model, to build upon the repartition of effort between ETS-covered emissions and other emissions calculated in PRIMES (exactly as the 90% scenario was used for the measures level assessment). In practice, the POLES-Enerdata scenario has been built by targeting the 90-85% scenario emissions provided by PRIMES for the ETS sectors (power generation and industry & other supply side) and non-ETS sectors as transports and buildings. Then, the different policy options are design incrementally to this reference case.

Using the 90-85% scenario for the policy option analysis was a compromise to ensure a timely delivery of results. Theoretically, it would have been needed to run the POLES-Enerdata model on the results of each PRIMES policy-option runs (incorporating the impacts from other thematic areas). However, given the delayed availability of results for policy option scenarios, it was decided to use only the 90% scenario for the MSR-focused analysis. The assumption is that the changes introduced in the other thematic areas have only a small impact on the MSR operations. In addition, the expected co-decision process to come at the EU level could lead to changes in the actual cap implemented. These changes are likely to have a magnitude as high (if not more) than what other thematic areas would induce in the model. Hence the choice to use a simple approach.

It should be noted that this 90-85% scenario differs somewhat from the 90% scenario, notably in that it assumes that non-carbon price efforts for electricity decarbonisation are greater in the 90-85% scenario. The impact on the POLES-Enerdata MSR optimisation is that prices are automatically lower for the same EU ETS market design. Therefore, the results of the level of measures analysis and the policy options analysis should not be compared in terms of carbon prices.

As with MSR assessment measures, the optimization of the EU ETS system price using MSR modelling is based on an equilibrium on stationary emissions that include the power, industry, and other supply-side sectors. Aviation, maritime transport, and removals are considered as an exogenous EUA demand in the POLES-Enerdata model.

The 3 main policy options studied here are defined below for the MSR part:

- Policy option 1 (PO1). For the MSR part, this policy option takes into account the MSR1 measure previously presented in the MSR annex Section 1.3.1.

- Policy option 2 (PO2). For the MSR part, this policy option takes into account the MSR3 measure previously presented in the MSR annex Section 1.3.1. The contribution from the waste sector to the EU ETS is considered as an exogenous demand in POLES-Enerdata.
- Policy option 3 (PO3). For the MSR part, this policy option takes into account the MSR3 measure previously presented in the MSR annex Section 1.3.1. The contribution from waste and landfills sectors to the EU ETS is considered as an exogenous demand in POLES-Enerdata.

PO2 envisages a net cap approach where removal credits must be purchased by market participants to offset their emissions, whereas the philosophy behind PO3 is a gross cap approach for participants, with an instrument (to be designed at a later stage by the European Commission) providing the market with the required amount of removals that develop in the 85% scenario.

The results of POLES-Enerdata are identical across these two scenarios, since the aviation and maritime transport sectors, BECCS and DACCS removals, and added waste and landfills are considered as additional exogenous demand on the market. Consequently, for POLES-Enerdata, the cap envisaged for optimising the MSR price on stationary installations (electricity + industry) is the same. This is why, in the section presenting the results, the TNAC, MSR and carbon price indicators are identical.

In theory, as removals could be modelled endogenously in the POLES-Enerdata model, a more in-depth analysis of PO2, considering endogenous development of BECCS and DACCS with their own production costs, would have been interesting and would have shown differences with PO3, as the marginal cost of the technology should have an impact on the EU ETS market price equilibrium.

ANNEX 5: COMPETITIVENESS CHECK

1. OVERVIEW OF IMPACTS ON COMPETITIVENESS

Competitiveness Check summary

Dimension of competitiveness	Impact of the initiative (++ / + / 0 / - / — / n.a.)	References to sub-sections of the main report or annexes
Cost and price competitiveness	+	Compared to baseline a combination of more gradual cap reduction, continued free allocation, carbon removal integration and reform of Market Stability Reserve promotes overall competitiveness and reduces the unit cost of production [6.2.3.1, 6.2.3.2, 6.2.3.6] Industrial Decarbonisation Bank supports investments in industrial decarbonisation and helps to limit the increase in the carbon price with positive impacts on costs and price competitiveness [6.2.3.3] Modernisation Fund supports lower income Member States improve their competitiveness through investments in modernising their energy systems and energy efficiency or electrification. [6.2.3.3] Moderate impact in aviation overall. Costs are passed through and incurred on the basis of equal treatment on routes. Avoidance of double-pricing of emissions through the deduction of CORSIA offsetting costs. Increased compliance costs for small operators of business jets. Enhanced market for sustainable aviation fuel due to extended support [6.1.1.5] Mixed impact in the maritime sector. Positive impact across the maritime sector, by supporting sustainable fuels and clean propulsion technologies, including for smaller vessels. Combined positive economic impact from action to address further the risk of evasion by containerships and offshore vessels as well as avoiding double payment in case emissions are priced under a future IMO mid-term measure. Increased compliance costs for smaller vessels [6.2.3.5] Inclusion of waste sector, combined with accounting change for carbon, capture and utilisation (CCU), can increase waste management costs in the short-term while promoting new opportunities for circular carbon products and biogenic carbon removals. [6.2.1.7, 6.2.1.8, 6.2.3.7] Modelling indicates higher sectoral employment compared to baseline for some industries. [6.3.1.6]
International competitiveness	+	Benefits to cost & price competitiveness above can be expected to improve international competitiveness. Economic modelling indicates higher exports and reduced imports in the preferred option compared to the baseline [Annex 12, Section 1.4.2.4].

Capacity to innovate	+	Positive impact expected due to a combination of financial support measures to specific innovations (e.g. Industrial Decarbonisation Bank calls, Sustainable Aviation and Marine Fuels and technologies) as well as market-based incentives promoting other innovations (e.g. CCU, carbon removal, waste) as well as enhanced energy-efficient solutions [6.2.3]
SME competitiveness	+	Entities affected by the preferred option are mainly larger enterprises. Fixed costs related to administrative effort affect SMEs disproportionately. Therefore, they will be particularly affected positively by simplification measures in aviation, maritime and waste [6.2.2.3, 6.2.2.4 & 6.2.4.4] and by the streamlining of free allocation [6.2.2.5]. On the other hand, they will be negatively affected by the expanded conditionality in free allocation [6.2.1.6], and extension of ETS maritime to smaller vessels [6.2.4.2]. Analysis in this impact assessment mostly assumes that operators with low emissions (e.g. small stationary installations, or small maritime vessels) are more likely to be SMEs than operators of larger installations, vessels or fleets. Annex 6 contains analysis using the standard definition of SME (related to corporate size).

2. SYNTHETIC ASSESSMENT

The preferred policy option is assessed as positive across all competitiveness dimensions. It strengthens the carbon-pricing framework while maintaining transitional safeguards for industry and providing clear incentives for investment in climate-neutral technologies.

2.1. Cost and price competitiveness

Macro-economic modelling (in Annex 12, Section 1.4.3.1) indicates that, compared to the baseline, the preferred option is expected to have a positive impact on GDP, industrial production and exports, as well as lowering unit costs of production.

The preferred option maintains cost stability for industrial operators by setting an emissions reduction trajectory that is more gradual compared to the the baseline, while still representing a fair contribution to the EU's economy-wide climate target for 2040. The resulting cap on emissions provides more emission space for industry, as well as it results in a higher free allocation budget available compared to the baseline. Through a reformed system of free allocation, firms in sectors exposed to international trade continue to receive transitional protection from carbon leakage, but part of the free allocation is made conditional on investments in decarbonisation. This approach keeps average compliance costs manageable, while improving the efficiency of support and supporting further investments in European industry. In addition, Industrial Decarbonisation Bank (IDB) will support the front-runner projects implementing industrial decarbonisation projects.

Modelling results indicates that unit production costs decrease relative to the baseline thanks to energy-efficiency gains and innovation uptake. Carbon-price predictability under the reformed MSR further limits volatility and allows operators to plan investments effectively.

In aviation, modelling results indicate a modest increase in demand and employment, and a decrease in prices compared to the baseline. There is no double-pricing of emissions, because airlines can deduct costs for CORSIA offsetting.

For maritime transport, positive effects are expected mainly from two measures; the support to shipping companies stemming from the recycling of part of the ETS revenues back to the maritime sector through the Sustainable Maritime Alternative Propulsion mechanism and from possible future cost savings for companies linked to the IMO deduction approach . Furthermore, lowering of the container transshipment incidence threshold is expected to further mitigate the risk of carbon leakage to non-EU ports and mitigate possible negative effects on e.g. employment and economic activity. Similar benefits apply when ensuring a level playing field for operators of offshore vessels active in EU waters, mitigating against evasive behaviour in this specialised sector. Limited economic impacts of expanding ETS scope to smaller vessels when considering the whole sector, though slightly more significant in some Member States.

2.2. International competitiveness

Model results show an increase in export volumes compared with the baseline, driven by productivity improvements and stronger technological positioning in low-carbon products. IDB support would help EU-based installations to apply decarbonisation technologies early on and secure technological leadership and position on the global markets. Continued free allocation for non-CBAM sectors preserves their global competitiveness during the transition and prevents any carbon leakage, while alignment with CBAM ensures coherence and fairness across sectors.

In aviation, the preferred option is expected to reduce passenger shift to non-EEA-based hubs, compared to the baseline. In addition, carbon leakage risks for tourism are expected to be low.

In maritime transport, the option to lower the container transshipment incidence threshold is expected to help further address the risk of evasion and the loss of container transshipment activity from EU ports to non-EU ports, where such loss might impact the surrounding EU economy. Addressing risk of evasion in the offshore maritime sector will not only ensure a level playing field between EU and non-EU offshore vessel operators but will also strengthen a sector that provides crucial support for the EU's energy and digital development. Similarly, the deduction of emissions priced under a possible future IMO mid-term measure from EU ETS will contribute towards level playing field for shipping companies operating to and from EU ports and non-EU ports.

2.3. Capacity to innovate

The preferred option maintains the capacity to innovate by supporting the business case for low-carbon innovation. This involves striking an appropriate balance between a strong price incentive (and therefore revenues to fund support measures), and a more gradual emissions reduction trajectory and measures to address the risk of carbon leakage.

For industry, linking free allocation to climate-neutral investment plans ensures that free allocation acts more effectively as an active driver of industrial transformation. This conditionality channels resources toward process innovation, electrification, and carbon-capture technologies, improving the EU's long-term productivity and technological leadership. Stable carbon-price expectations and expanded EU-level financing (IDB but also continuation of the Innovation Fund) reinforce these effects.

The preferred option also contains more specific measures that encourage innovation, including extended financial support for uptake of sustainable aviation fuel (SAF), and a dedicated decarbonisation support mechanism for maritime transport.

Furthermore, innovation capacity is also enhanced by the preferred option's proposed expansion of the EU ETS scope to include non-permanent CCU, waste incineration and carbon removal.

2.4. SME competitiveness

SMEs within scope face additional administrative requirements, notably on the preparation and period verification of proportionate investment plans to access free allocation, MRV reporting obligations, and possible supply chain implications of compliance. These burdens are administrative rather than cost-price in nature, and are mitigated by proportionality measures (maintained thresholds, simplified MRV), but do not amount to a net competitiveness loss or gain.

Annex 6 contains more detail summarising how this Impact Assessment has considered SMEs.

3. COMPETITIVE POSITION OF THE MOST AFFECTED SECTORS

3.1. Industry (stationary installations)

Overall, the industrial sector represented by large stationary installations represent the sectors most affected by the revision of the EU ETS.

Stakeholder consultations with industry highlighted the importance of continued free allocation and investment support to maintain their competitive position and support their decarbonisation efforts.

Quantitative analysis provided in Annex 12, section 1.4.2.4 provides insights into how alternative ETS design choices translate into heterogeneous sectoral and macroeconomic impacts, relative to the baseline scenario by taking into consideration key drivers within scenario assumptions such as the different free allocation distributions across industry, as well as the different ETS coverage and cap stringency and alternative revenue recycling. Changes in the unit cost of production for selected sectors are presented in Tables 14 and 15 of Annex 12a. For example, chemical products, which receive the largest share of additional free allocations (compared to the baseline), exhibit the steepest decline in unit production costs under the policy measures. It is noteworthy that when free allocation is extended to both CBAM and non-CBAM sectors, ferrous metals sector becomes more competitive compared to cases when only non-CBAM sectors received free allocation. Production and exports respond heterogeneously across policy options relative to the baseline scenario, reflecting differences in free allocation, sectoral coverage, and revenue recycling (see Tables 16 -19 in Annex 12). Chemical products and non-metallic minerals, which experience reductions in unit production costs relative to the baseline, face higher domestic and external demand and therefore record higher levels of both production and exports across the policy options. Non-ferrous metals, chemical products, and non-metallic minerals display higher production and export levels due to improved competitiveness under PO2 scenarios. On the contrary, ferrous metals become competitive leading to higher production and exports only when free allocation is extended to both CBAM and non-CBAM sectors. Overall, the impact on production and export across policy measures and sectors relative to the baseline ranges from -0.56% to 1.61% for production and -1.09% to 4.63% for exports.

In all scenarios except those with alternative recycling schemes, an improvement in EU27 competitiveness is observed, reflected in higher exports. This outcome is driven by a higher allocation of free allowances to EU ETS sectors (e.g. PO1), reductions in labour and capital costs (e.g. PO2_50), and/or lower carbon prices required to meet the cap because of including waste emissions in the EU ETS (e.g. PO3). In the recycling scenarios, private consumption is the main driver of GDP growth, reflecting the lump-sum transfer of EU ETS revenues to households. In these cases, exports decline due to higher labour and capital costs, which arise from increased household demand and upward pressure on factor prices. In PO2 scenarios,

private consumption drops marginally as increasing electricity prices stemming from higher waste incineration, put pressure to the remaining disposable income.

The competitive position of electro-intensive industries remains supported by the continuation of the framework for compensation of indirect carbon costs (ICC). European Commission analysis has indicated that carbon costs accounted for up to 11% of industrial energy prices in the EU on average in 2025, with fuel costs, network charges and taxes each accounting for a larger share. As shown in Annex 12 (Section 1.4.2.1.2) the impact of indirect cost could diminish over time if the energy and industry sectors decarbonise and broader energy market reforms reduce the influence of carbon cost on electricity prices. On the other hand, ICC compensation may be needed at least in the short-term, and while direct emitting processes can benefit from free allocation. In order to ensure that ICC aid contributes to decarbonisation or other measures to reduce indirect carbon costs, the preferred option would amend the ETS Directive to add conditionality and reporting provisions.

3.2. Waste

By internalising the carbon footprint of waste disposal and promoting separate waste collection, sorting and material and carbon recovery and recycling, inclusion of municipal waste incineration is projected to foster the economic growth of the EU circular economy and recycling sector, with circular economy activities already representing around 1-2% of EU GDP⁴⁵ and generating almost 300 billion EUR in gross value added alongside 121.6 billion EUR in private investment in 2021⁴⁶ (2021).

It also offers considerable opportunities for biogenic carbon removal generation and enables the consideration of alternatives for how to account the emissions that are captured and used in non-permanent products, such as e-fuels and synthetic chemicals. Strengthening the recycling sector also delivers increased economic security, added value, employment, and long-term competitiveness potential for the EU economy by reducing reliance on imported virgin materials and price volatility, improving resource productivity, and strengthening innovation.

3.3. Aviation

The proposed changes to EU ETS affect the aviation industry in a number of different ways.

Demand is expected to increase compared to the baseline in both passenger and freight sectors (see Section 4 of Annex 10).

In terms of **operating costs** for airlines, the proposal is expected to increase fuel use (including Sustainable Aviation Fuel – SAF in line with the ReFuelEU Aviation mandate) due to increased demand and decrease in prices. Fuel use is expected to be 15% higher compared to the baseline.

However, **carbon costs as a percentage of total operating costs** are substantially lower than in the baseline, though they are expected to increase over time due to the application of CORSIA combined with EU ETS scope extension to departing flights (rising to 5.4% of operating costs by 2030, compared to 10.8% in the baseline).

⁴⁵ OECD (2025). The Circular Economy in Cities and Regions of the European Union. Available at: https://www.oecd.org/en/publications/the-circular-economy-in-cities-and-regions-of-the-european-union_e09c21e2-en.html

⁴⁶ European Commission (2023) 306 final. Communication on a revised monitoring framework for the circular economy. Available at: https://www.europarl.europa.eu/RegData/docs_autres_institutions/commission_europeenne/com/2023/0306/COM_COM%282023%290306_EN.pdf

Regarding **competitive distortions**, for airlines with a higher proportion of flights on routes covered by the ETS, there is a risk that they are less able to cross-subsidise them from other routes. Several studies nevertheless argue that such cross-subsidisation is minimal. Also, the fact that SAF support is available for routes covered by the ETS channels more revenues back to the relevant airlines. Where the EU ETS applies to departing flights, airlines are also able to deduct any CORSIA offsetting costs.

3.4. Maritime

In relation to competitiveness impacts, the lowering of the container **transshipment** incidence threshold from 65 % to 50% should lead to the identification of additional “neighboring container transshipment ports”, protecting the competitiveness of EU ports and helping avoid the negative impacts of relocation of container transshipment activities.

Amendments to relevant EU MRV and ETS elements to address the specific nature of offshore activities would ensure that all ships involved in offshore activities within EU Member States’ territorial waters or Exclusive Economic Zones are subject to emissions regulation, regardless of their flag or port of origin. Consequently, it would promote a fairer and more level playing field for EU offshore shipping companies. However, it could slightly increase the administrative burden for both shipowners and regulators, due to the need for more detailed reporting and verification.

Additional compliance costs for smaller vessels are expected to be passed on to shippers and voyagers, which may have indirect impacts on **trade patterns and macroeconomic indicators**. Modelling of impacts of maritime policy options in GEM-E3 found that, for EU27 countries, GDP would drop by 0.001% in 2040 under both PO2 and PO3, which means that macroeconomic impacts are expected to be marginal on average. These effects are expected to be slightly more significant in FI, EL, SE, DK, due to higher dependency on transport provided by smaller vessels. Impacts on third countries are expected to be negligible, on average, with a drop in GDP estimated at 0.0003% in 2040.

4. OVERALL CONCLUSION

The competitiveness assessment finds that the preferred option delivers a balanced outcome.

Combined to the baseline, it delivers a generally positive economic outcome due to its more gradual pace of reduction (in line with the economy-wide 2040 target) and continuation of carbon leakage protection measures.

At the same time, it contains dedicated measures to enhance industrial competitiveness, encourage cost-effective decarbonisation, strengthen innovation capacity, and ensure that small operators are protected from disproportionate burdens.

ANNEX 6: THE SME TEST

1. OVERVIEW OF IMPACTS ON SMES

Relevance for SMEs

This initiative is relevant for SMEs, despite **most EU ETS installations belonging to large enterprises** (more than 250 employees and turnover larger than EUR 50 million, and/or balance sheet exceeding EUR 43 million)⁴⁷.

Based on corporate size (the standard definition of an SME) 88% of aviation operators covered by EU ETS belong to a large enterprise, and 74% of stationary installations. Since these are the largest firms, they represent an even larger share of employment and emissions.

Apart from the corporate size measure, the EU ETS Directive, and measures considered in this Impact Assessment, also consider a more flexible treatment of small stationary installations and waste installations (typically as measured by thermal capacity), smaller ships (by gross tonnage), and aircraft operators (lower emissions).

The maritime sector covered by EU ETS has a higher prevalence of SMEs with the previous impact assessment for the extension of the EU ETS to maritime transport finding that SMEs represents 95% of bulk carrier companies, 76% of oil tanker companies and 56% of containerships companies (European Commission, 2021), a share likely to be even higher for companies operating smaller vessels (between 400 and 5,000 GT). Using the number of vessels per company as a proxy of the company size, the recent report on the possible extension of the MRV Regulation to smaller vessels (European Commission, 2025) found that companies currently reporting under MRV are responsible for 2.6 vessels on average, compared to an average of 1.6 for companies managing smaller vessels.

(1) Identification of affected businesses and assessment of relevance

Are SMEs directly affected? (Yes/No) In which sectors?

As per Annex 3, Section 2.2.1, provisions are conceived to offer proportional treatment to smaller installations and operators.

Above these thresholds, SMEs will be subject to the same policy provisions as other firms. In other words, employee numbers and turnover are not typically used as differentiating elements in EU ETS. However, the ETS framework provides simplified monitoring, reporting and verification rules for small emitters.

Nevertheless, the potential impact on thousands of small installations is avoided through the proposal not to lower the 20 MW exemption threshold for stationary installations (see Annex 12, Section 2). Other ETS activities listed in Annex I of the Directive also include activity thresholds, preventing the inclusion in the ETS of the smallest installations. Furthermore, Member States have the possibility to request the opt-out of small emitters from the ETS under the provisions of Article 27 and 27a of the ETS Directive.

Considering the high share of SMEs in the maritime transport sector, the implementation of the EU ETS in the sector has a direct impact on SMEs. However, very small maritime operators are expected to remain largely outside the ETS scope, as all policy options do not foresee the inclusion of any type of vessel below 400 gross tonnage.

⁴⁷ Commission Recommendation of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises (Text with EEA relevance) (notified under document number C(2003) 1422)

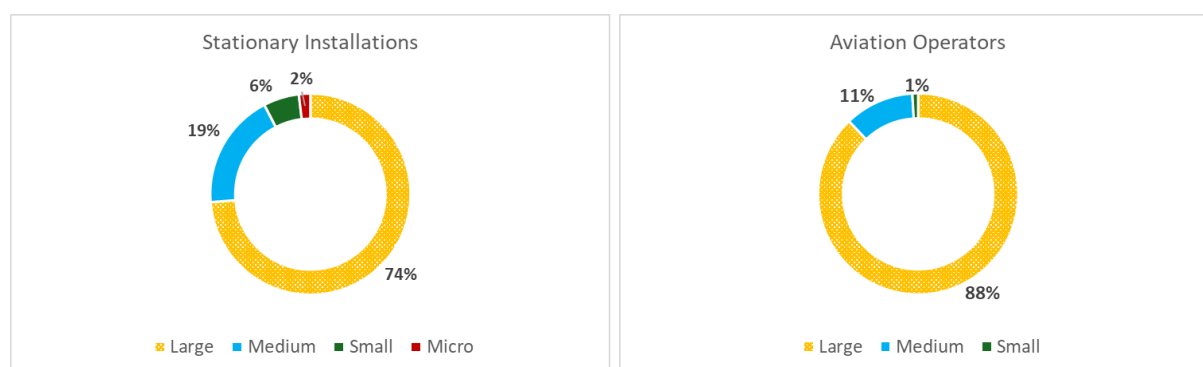
Estimated number of directly affected SMEs

The share of SMEs among firms covered by EU ETS was estimated using the Orbis database (a commercial database of corporate information). This was possible thanks to a dedicated mapping tool developed and maintained by the European Commission⁴⁸. For this purpose, SMEs were defined as firms with fewer than 250 employees, and a turnover not exceeding EUR 50 million or a balance sheet not exceeding EUR 43 million.

Due to data limitations, this analysis was only possible for stationary installations and aircraft operators. Even in these sectors, the results should be interpreted with caution due to known caveats concerning the Orbis database. In particular, the database, which itself relies on national statistics, tends to underrepresent small firms. Also, the level of coverage varies across countries.

The shares of medium, small and micro enterprises in ETS are shown in Figure 1 below. It is not possible to give an absolute figure since only a subset of firms were identifiable in the database. For comparison, in 2024 the EU ETS covered 8,704 stationary installations (noting that an installation is not equivalent to a firm), 393 aircraft operators and 3,313 shipping companies.

Figure 1: Share of SMEs in firms covered by EU ETS that are identified in the Orbis database



It was not possible to include maritime and waste sector emissions in the Orbis analysis due to data limitations. However, for maritime, it is assumed that most of the entities responsible for the implementation of the ETS are SMEs. According to the previous impact assessment on the extension of the EU ETS to maritime transport, 76% of freight companies and 86% of passenger transport companies having fewer than 10 employees.

Each thematic annex considers how small emitters should be treated but uses metrics other than the employment and turnover dimensions related to the official definition of SMEs. (Annex 10 for aviation, Annex 11 for maritime, Annex 12 for stationary installations, Annex 13 for waste).

Estimated number of employees in directly affected SMEs

Macroeconomic modelling was used to assess employment impacts of the policy options considered. See Section 6.3.1. This concluded that all policy options should increase employment relative to the baseline when it comes to carbon leakage and aviation. In the maritime transport sector, the modelling did not indicate a large effect. Small operators may be negatively affected by lowering of the tonnage threshold bringing them into the scope of EU ETS. On the other hand, the economy of EU ports should be positively affected by measures to address transshipment relocation risks. However, this analysis is not specific to SMEs. According to the Orbis analysis for stationary installations, out of the identified 7,685 operators of stationary ETS installations and found that 26% of these were SMEs. Most of these were medium-sized enterprises (19%) rather than small (6%) or micro (2%). It also found that the ceramics sector had the highest proportion of SMEs, in particular micro and small enterprises. Across all sectors, SMEs

⁴⁸ European Commission, DG GROW Chief Economist Team (2025): EUTL-Orbis matching dataset.

accounted for 2% of emissions, 1% of employment and less than 1% of turnover of the identified ETS installations.
Are SMEs indirectly affected? (Yes/No) In which sectors? What is the estimated number of indirectly affected SMEs and employees?
Indirect effects from EU ETS predominantly consist of the passthrough of the carbon price to consumers. This is expected to be highest for consumers that are closest in the value chain to the priced carbon. The clearest examples of this are the indirect carbon cost faced by electro-intensive industries (specific compensation for this is addressed in Annex 12) and the impact of carbon pricing in the aviation and shipping sectors.

(2) Consultation of SME stakeholders
How has the input from the SME community been taken into consideration?
As per 6.2.4.4 of the Impact Assessment, SME stakeholders were represented by their sector associations in the stakeholder interviews and had the opportunity to submit their views within the OPC (where 36% of respondents in the company/business category were SMEs).
Are SMEs' views different from those of large businesses? (Yes/No)
SMEs have stronger views on administrative burden and regulatory costs of the ETS Directive (see Annex 2, point 2.2.4) than large businesses, and thus request reduced procedural burdens and reduction and standardization of administrative fees and verification costs across Member States. SMEs are also advocates for simplification and harmonisation of MRV rules, with several SMEs from the waste sector suggesting updating MRV rules with regards to MWI installations.

(3) Assessment of impacts on SMEs
What are the estimated direct costs for SMEs of the preferred policy option? (Fill in only if step 1 flags direct impacts)
Qualitative assessment
A net increase administrative costs is expected due to: - Preparation and verification of climate-neutral investment plans to access conditional free allocation (among operators already participating in existing administration related to free allocation) - MRV related to expansion of ETS scope: waste, maritime, CCU, carbon removal. However, a number of mitigating factors exist including the proposal not to lower the thresholds for ETS inclusion, i.e. the 20 MW threshold. The possibility for opting out small emitters under Articles 27 and 27a of the ETS Directive will be streamlined. In addition, the MRVA evaluation (see Annex 15, section 8.4) makes a number of recommendations for simplification, which will be addressed in the revision of the relevant secondary legislation. The possible extension of the ETS to smaller vessels would be expected to primarily affect SMEs. Most of these SMEs managing smaller vessels would be new to the MRV and ETS system and would need to set up and familiarise themselves with MRV and ETS processes. A key disadvantage

for SMEs is their more limited capacity to absorb additional administrative costs. While some administrative costs borne by shipping companies are dependent on fleet size, other costs are fixed. As such, administrative burden is likely to be higher for smaller businesses who do not benefit from significant economies of scale. SMEs in the maritime sector are expected to sell or buy allowances via intermediary traders mainly from the financial sector instead of participating directly in the primary or secondary markets. Another key disadvantage for SMEs is their limited ability to access financing for capital investments in low-carbon technologies (e.g., alternative propulsion systems or onboard carbon capture). This constraint may reduce the range of greenhouse gas abatement options available to them, potentially increasing their exposure to ETS-related costs in the short term.
Quantitative assessment
N/A
What are the estimated direct benefits/cost savings for SMEs of the preferred policy option?
Qualitative assessment
The main benefit to SMEs is the positive economic impact of the policy options compared to the baseline. However, there are no direct monetary benefits specific to SMEs. The main indirect benefit is the continued exclusion of small combustion installations through the 20 MW threshold, which avoids new ETS obligations for thousands of small emitters. For covered SMEs, the design of simplified MRV templates and guidance reduces complexity and moderates administrative burden compared with large operators. For maritime, SMEs could benefit from the mechanism to support the uptake of sustainable renewable and low-carbon fuels and alternative propulsion technologies.
Quantitative assessment
N/A
What are the indirect impacts of this initiative on SMEs? (Fill in only if step 1 flags indirect impacts)
SMEs not directly covered by the ETS might be affected indirectly through changes in carbon cost passed through from suppliers of energy or emission-intensive products. Annex 12 analyses the macroeconomic impact of post-2030 options phaseout regarding carbon leakage prevention, including for small installations.

(4) Minimising negative impacts on SMEs
Are SMEs disproportionately affected compared to large companies? (Yes/No) If yes, are there any specific subgroups of SMEs more exposed than others?
SMEs are not disproportionately affected since they are generally less exposed to the scope of the ETS. SMEs covered by the EU ETS, operating in energy-intensive industrial sectors, face higher compliance effort relative to output, but these are not exacerbated by the options considered. Furthermore, the EU ETS contains a number of provisions aimed at small emitters which are retained in this initiative, such as the 20 MW exemption threshold, the possibility for Member States to exclude small installations subject to equivalent national measures, and simplified MRV templates and guidance.

Have mitigating measures been included in the preferred option/proposal? (Yes/No)
Yes. Key measures include: - Maintaining the 20MW threshold - Streamlined and simplified MRV requirements (benefitting mainly smaller operators), such as - o The implementation of digital tools, such as the Commission reporting tool ERT - o Streamline approval processes with national Competent Authorities, such as which type of modifications of the Monitoring Plan require approvals. - o Changes of requirements for site visits - o Relaxing monitoring accuracy requirements - o Further simplifications for small installations (or small source streams), such as increase of standard or default values - The simplification measures proposed in the maritime transport sector should help shipping companies exploit synergies across different regulatory frameworks, minimise undue burden, and ultimately reduce administrative compliance costs. According to conservative estimates, these measures have the potential to reduce current annual MRV compliance costs by 10% - 20%.

Contribution to the 35% burden reduction target for SMEs
Are there any administrative cost savings relevant for the 35% burden reduction target for SMEs?
N/A

ANNEX 7: PROBLEM DEFINITION, DETAILED BASELINE AND POLICY MEASURES

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1. PROBLEM DEFINITION

1.1. Problem drivers

Problem drivers associated with Problem 1:

- **D1 Residual emissions inconsistent with ETS cap trajectory:** The climate neutrality objective is at the heart of the European Green Deal and is a legally binding objective set out in the European Climate Law (ECL). The 2040 climate target is the EU's next intermediate step on the path to climate neutrality. In December 2025, the European Parliament and the Council reached agreement on amending the European Climate Law, introducing a binding intermediate climate target for 2040 of a 90% reduction in net greenhouse gas (GHG) emissions compared to 1990 levels. The agreement also sets out certain areas of flexibility to support the achievement of the 2040 target including on the contribution of high-quality international carbon credits to the target. However, there will still be residual emissions in industry, aviation and maritime that need to be abated in order to respect the carbon budget and target that are given by the cap trajectory.
- The following sub-driver has been identified:
 - D1.1 (P9+10) CO₂ generation is currently unavoidable for certain activities
Certain activities do not currently have technological viable alternatives allowing them to continue without generating CO₂ emissions⁴⁹.
 - D1.2 (P1) Lack of funding mechanisms of sufficient duration and magnitude to support the business case for industrial decarbonisations and thus investments⁵⁰.
In this case, ETS risks leading to GHG emissions reductions mainly through a decrease in production levels rather than by a decrease in carbon emissions intensity of industrial activities.

Today and in the near future, the carbon price signal and regulatory measures are perceived as not sufficient on their own to firmly enable the business case for investments in decarbonisation technologies for industries. In the absence of large (in terms of budget and duration) funding mechanism driven by the public sector, private investments alone will not deliver the industrial decarbonisation

⁴⁹ We can distinguish three main cases:

- Industrial process emissions where the chemical reactions of the process generate CO₂, such as in the calcination of limestone (a carbonate) to produce clinker, which is the basis of cement. Emissions will need to be captured either for reuse in products (CCU) or to be permanently stored (CCS).
- Production of organic chemicals, which cannot be decarbonised because they are carbon-based. Fossil-derived feedstocks will need to be replaced with alternative sources of carbon (from biomass, recycling or captured carbon) to produce these chemicals, both to reduce process emissions in their production and to avoid fossil emissions from the use or end-of-life treatment of such products.
- Processes where fossil energy cannot currently be replaced by electricity (e.g. long-haul aviation or certain high-heat industrial processes) and will therefore continue to rely on the combustion of fuels. Where no alternative modes of transport (e.g. train instead of flight) or replacement products are possible (e.g. wood construction materials instead concrete or steel), fossil fuel combustion will need to be replaced with alternative fuels, such as renewable fuels of non-biological origin (RFNBOs).
- Processes where fossil energy cannot currently be replaced by electricity (e.g. long-haul aviation or certain high-heat industrial processes) and will therefore continue to rely on the combustion of fuels. Where no alternative modes of transport (e.g. train instead of flight) or replacement products are possible (e.g. wood construction materials instead concrete or steel), fossil fuel combustion will need to be replaced with alternative fuels, such as renewable fuels of non-biological origin (RFNBOs).

⁵⁰ In scenarios for reaching the 2040 climate target, investment needs are estimated at approximately EUR 30-50 billion annually between 2031 and 2040 for industry (around EUR 25-40 bn for energy-intensive industries).

at the scale and within the time needed for achieving climate neutrality by 2050. Different State aid support mechanism are addressing this problem on the national level but not sufficiently. Ideally, the funding mechanism needs to operate on the EU level to avoid the risk of fragmented investments amongst the Member States.

Lack of or delayed investments in industrial decarbonisation would put the decarbonisation pathway in peril and lead to EU industry falling behind global competitors who can be faster in adopting cleaner technologies. Beyond losing the current market shares, a technological lag could result in European industries being less adaptable to future disruptions and demands and on macro-economic level and make the EU lose out on opportunities for growth and leadership in nascent markets and emerging sectors of the economy.

In addition, there is lack of funding for the roll-out of mature low-carbon technologies in low-income Member States. These are usually more carbon-intensive, with energy mixes still largely relying on fossil fuel.

- D1.3 (P2) For some ETS activities, such as the refining of fuels or the production of bulk organic chemicals, the ETS requires the surrender of allowances only for the energy and process (scope 1) emissions and not for the carbon content of the chemicals, plastics, or fuels produced. However, under the current rules, CCU requires the payment for the emissions captured and embedded in any product that does not meet the permanence criteria. This situation leads to a lack of level playing field between the traditional petrochemicals and alternative chemicals and materials based on captured carbon.

With the integration of waste incineration into the ETS, the embedded fossil feedstock in chemicals and materials would also be subject to carbon pricing at the point when that carbon is released from the product at the point incineration. However, without a change in the CCU rules, the emissions embedded in non-permanent products would be paid twice: once when captured (unless they meet the permanence requirement) and a second time at the end of life when incinerated. This leads to a double counting/pricing of emissions, which results in an inefficient reduction of emissions.

- **D2: Lack of internalisation of the climate impact (insufficient carbon price signal).**
The reason for putting a price on carbon emissions is to trigger a behavioural and investment change that should result in reduced emissions in line with the climate change mitigation pathway. The price signal of the EU ETS adds to the cost of activities that generate greenhouse gases, 'internalising' the harmful effect on the environment, known as 'negative externalities', in accordance with the 'polluter pays' principle. As shown in the Evaluation Report (see Annex 15, section 4.2.1.2), the ETS price has resulted in the internalisation of a significant share of the external climate costs, in particular for the power sector, reflecting the early phase out of free allocation the the cost pass-through to the electricity price. When the EU ETS does not cover certain activities, it does not play a role in the internalisation of their carbon cost. As a result, they may lack the incentive to reduce their emissions, unless other regulatory measures require the reductions (targets or prohibitions). In the case of municipal waste incineration, GHG emissions have continuously increased by approximately 300% since 1990. Despite being covered under the Effort Sharing Regulation since 2021, few Member States have implemented decarbonisation measures, and the sector is not on track to contribute to the Union's economy-wide decarbonisation targets in 2040 and 2050. Similarly, measures to address carbon leakage (assigning allowances free of

charge and allowing compensation for indirect emission costs) can also dampen the carbon price signal and reduce incentives to decarbonise, as approximately 80-90% of the verified emissions of industry have remained covered by free allocation during the first part of Phase IV of the EU ETS. This is confirmed by the findings of the evaluation, which indicates, based on literature review, that the effect of the EU ETS prices on carbon efficiency and emissions reduction is more pronounced for sectors transitioning away from free allocation and into auctioning. This suggests that when sectors bear the direct cost of their emissions, the incentives for them to reduce emissions is higher and that a 1% increase in ETS prices leads to an improvement of carbon efficiency by 0.04% and a decrease in emissions of 0.05% in regulated sectors⁵¹ (see Annex 15, section 4.1.1.1.2.).

The following sub-drivers have been identified:

- D2.1 (P3) Free allocation and compensation for indirect carbon costs (ICC) dampen the carbon price signal.

Free allocation to specific sectors is based on performance benchmarks and activity levels. Benchmarks are reduced incrementally to encourage companies in each sector to decarbonise and advance innovation. Installations that are below their benchmarks will receive more allowances than required for compliance, which can be monetised on the carbon market. Therefore, the use of benchmarks therefore incentivises innovation to lower emissions intensity production. Nevertheless, free allocation that covers a significant share of the emissions of the respective allocation dampens the carbon price signal to a degree. This factor, combined with high abatement costs for industrial sectors in the order hundreds of euro per tonne of abated CO₂ reduces the incentives for emission abatement in the respective sectors.

While ICC compensation also dampens the price signal, electro-intensive industries cannot necessarily influence the associated emissions cost themselves since it is passed on indirectly through electricity bills. The pass through of this price signal can also disincentivise industrial electrification, especially when free allocation is available to non-electrified processes.

- D2.2 (P8) Current regulations exempt small installations under 20MW

The thresholds for activities in Annex I, especially the 20 MW rated thermal input capacity for combustion of fuels, were established considering the relatively high compliance costs for smaller installations, such as monitoring, verification, registry fees, and administrative burden, which can outweigh the environmental benefits of participating in ETS.

In 2027, the ETS2 applies and small emitters that are not under the EU ETS will pay the carbon costs of their fuel use. However, process emissions of small industry will not be covered. It is therefore legitimate to consider the environmental impact of those exclusions, the case for maintaining simple rules, and the administrative burden for all parties involved in the compliance cycle; operators, Member States and Commission.

⁵¹ Jan Eric Hagendorn, Benjamin Hattemer, Fotios Kalantzis, EIB, 2024. "A positive trade-off: Emissions reduction and costs under Phase IV of the Emissions Trading System", https://www.eib.org/attachments/lucalli/20240297_economics_working_paper_2024_05_en.pdf

- D2.3 (P4) Lack of equivalent GHG pricing signal for maritime emissions in neighbouring non-EU countries leading to a possible risk of evasion (including via relocation of transshipment activities).

Evasive behaviours could undermine the overall environmental integrity of the ETS as shipping companies engaged in such circumvention strategies would surrender fewer allowances, while not actually reducing their emissions. In some cases, these operational adjustments could also reduce the traffic and connectivity of certain EU ports (e.g. container transshipment hubs, offshore operations) leading to possibly broader negative wider macroeconomic implications. Due to the end of the phase-in approach in 2026 and the absence of any global measure, the risk of evasion is expected to remain in the short-term.

- D2.4 (P6/7/8) Limited scope of aviation and maritime

For aviation, the EU ETS geographical scope is limited until January 2027 to only intra-EEA flights and departing flights to Switzerland and the UK. The internalisation of the climate impact is driven by the quality and implementation of international measures, or alternatively by applying an effective carbon price to the EU's fair share of these emissions.

The aviation EU ETS also currently exempts certain operators as defined in Annex 1, (h) and (k) of the Directive with low aviation activity, however these exemptions cover mostly private or business jets, meaning there is currently no carbon price signal for those flights. The reason for these provisions is the compliance cost for monitoring, verification, and registry fees, which can outweigh the environmental benefits of participating in ETS. In 2027, the ETS2 will apply essentially covering citizens by EU ETS, this underlines the need for inclusion of private and business aviation who should pay their fair share. The administrative burden for all parties involved in the compliance cycle would be minimized by simplification measures.

For maritime, small ships, including offshore vessels, with a gross tonnage between 400 and 4 999 gross tonnage, are not covered under the ETS and do not internalise the harmful effect of their EU-related emissions on the environment. As a result, they lack economic incentives to reduce their emissions.

- D2.4(P5) No coverage of waste emissions

Emissions from waste management are subject to the national emission reduction targets under the Effort Sharing Regulation, with incineration (with/without energy recovery and landfilling being the main sources). Measures to reduce emissions and promote circularity vary widely between Member States, which results in an uneven application of the polluter pays principle and a limited progress towards emission reductions but also circularity.

- **D3: International carbon pricing measures in transport.** In terms of interaction between the implementation of the ETS and the implementation of global measures to reduce emissions from aviation, the following sub-driver has been identified:

- D3.1 (P6) Possible non-implementation of CORSIA by third countries

To address carbon emissions from international aviation, the EU has supported the creation and implementation of CORSIA. A key aspect for CORSIA to work is that third countries have to implement the scheme in their national laws

and have to apply it effectively⁵², and whether the EU's fair share of aviation emissions is covered by an effective carbon price.

D3.2 (P7) Potential lack of coherence between the ETS implementation and the implementation of IMO mid-term measures in the future: In order to address GHG emissions from international maritime activities globally, the EU has actively supported the adoption of the revised IMO 2023 Strategy as well as of IMO mid-term measures, in particular the Net Zero Framework, which was agreed in April 2025 and for which the adoption decision has been adjourned until autumn 2026. This global measure would mark a significant step towards reducing the environmental impact of the shipping industry on a global scale and is a strong example of multilateralism at work. However the adoption of the IMO Net Zero Framework has been adjourned and there remains a number of uncertainties regarding its adoption and actual implementation. In the meantime, the EU ETS provides a stable and predictable regulatory framework to support the decarbonisation of shipping, e.g. by making renewable and low-carbon fuels or energy efficiency solutions more economically attractive, and ensures that maritime transport effectively contributes to EU's climate targets.

However, the combined implementation of a future IMO mid-term measure and EU ETS could also lead to some inefficiencies, including:

- Potential double pricing and double payment in case maritime emissions are subject to GHG pricing under both the ETS and a future IMO mid-term measure. The extent of the inefficiencies would depend on various factors such as the GHG price formation at global level, price scope, emissions covered, or timing.

Associated with Problem 2:

- **D4: Decreasing market size.** The decreasing market size can have a negative impact on trading. This is because a low market size entails the risk of thin or illiquid trading⁵³, which would in turn cause price volatility and uncertainty.

The following sub-driver has been identified:

- D4.1 (P10/11) Intrinsic functioning of the EU ETS: The design of the EU ETS as a cap-and-trade system to decrease EU emissions over time works on the principle that the cap is reduced annually in line with the EU's climate target. As the cap decreases, so does the supply of allowances to the EU carbon market. Therefore, as the cap approaches zero (or very low levels), the size of the market will also reduce over time. A smaller market size increases the risks of trading frictions.

1.2. Specific objectives

The general objectives set out above to address the identified problems can be broken down into a number of specific objectives.

⁵² The home country is responsible for ensuring that its airlines comply with CORSIA requirements. This is meant to be an obligation even if the country itself is not participating in CORSIA, as long as its airlines operate on routes covered by the scheme.

⁵³ Note that the concept of liquidity of the market, referring to the amount of allowances available for trading, should be differentiated from the concept of market tightness, which can occur regardless of the market size if the supply of allowances is very tight in relation to the demand of allowances (i.e. actual emissions).

For the **general objective O1.1 of incentivising emission reductions**, the following specific objectives have been identified:

- SO1.1.1 Enable investments in the decarbonisation technologies (both innovative ones and those ready for scale-up/roll-out) that currently do not yet have the business case (i.e. most of the technologies needed to address the emissions in the energy intensive industries, and in particular investments in mature decarbonisation technologies in carbon-intensive, low-income Member States). Those technologies need to address the ‘hard to abate’ emissions identified under D.1.1, for example, direct iron reduction for green steel, electrified steam and industrial heat production, electro-chemical processes, carbon capture in industry, renewable low-carbon marine and aviation fuels. To enable these investments the objective is to create the business case for private investment in the EU. with public funding instruments, or through recycling a part of ETS revenues in a simple and flexible way to provide appropriate investment certainty while minimising the administrative burden for the Commission, national competent authorities and private operators.
- SO1.1.2 Ensure full carbon price signal is applied to emissions sources which are currently not in the scope of the EU ETS but would be well suited for its coverage⁵⁴, and to sectors where currently dampened, to the degree possible while protecting against carbon leakage, maintaining territorial continuity and ensuring fulfilment of public service obligations;
- SO1.1.3 Address risk of carbon leakage: leakage is measured by estimating how much overall greenhouse gas emissions would be added to the atmosphere due to the shift of certain activities from the EU (region with stricter climate policies) to regions with weaker policies. To assess the risk of this leakage materialising, it is necessary to examine the role of free allocation for stationary installations in non-CBAM sectors as a continuation of measures to protect against carbon leakage due to carbon costs, as well as the case for making such support conditional on installations’ investments in emissions reductions. Industries’ exposure to carbon leakage is assessed based on two key criteria: trade and emissions intensity. For aviation, it is necessary to examine the risk of hub carbon leakage, i.e. carbon leakage which occurs through an airport hub, and if needed, ways to mitigate this risk. Annex 10 and the support study contain relevant case studies. For maritime, it is necessary to examine the risk evasion by containerships and the risk of relocation of container transshipment activities to neighbouring non-EU ports, as well as the risk of evasion in relation to offshore services provided by ships.

⁵⁴ A sector is generally well suited for ETS coverage when several conditions are present. The core idea is that emissions can be measured reliably reduced effectively by the influence of the carbon price. Key characteristics include:

1. Monitoring, reporting, and verification (MRV) can be done accurately and at reasonable cost.
2. There are relatively few large emitters: ETSs work best when emissions come from a manageable number of regulated entities as administrative costs stay lower.
3. There are viable technological or operational alternatives: Firms need realistic pathways to reduce emissions in response to carbon prices.
4. Demand is not perfectly inelastic: Carbon pricing can influence production, investment, or consumption decisions. If firms and consumers cannot respond at all, the ETS has weaker effects.
5. The sector is economically significant: high-emitting sectors provide larger emissions reductions per unit of regulatory effort.
6. Leakage and competitiveness risks are manageable

For the general objective O1.2 reach a pre-set emissions reduction target provided by the 2040 policy package and with a net emissions calculation, the following specific objectives have been identified:

- SO1.2.1 Consider if carbon removals can be integrated in the ETS with sufficient environmental safeguards while preserving cost efficiency in achieving the ETS/EU climate objectives before 2040: to integrate removals in such a way that they counterbalance a certain number of emissions remaining in the system toward the ETS's contribution to the 2040 climate target, while the market keeps functioning well and avoiding that companies postpone or defer crucial emission reductions.
- SO1.2.2 Adjust ETS cap in line with pre-set climate target for 2040: The EU ETS sectors will contribute to the economy-wide emissions reductions in line with the intermediate 2040-target. The cap trajectory of the EU ETS therefore should be aligned with this intermediate target.

For the general objective of O1.3 ensuring effectiveness of EU climate action on international transport while avoiding duplicative pricing, the following specific objective has been identified:

- SO1.3.1 Ensure effective action on EU's fair share of aviation emissions in the period 2031-2040 and adjust the scope of application of the EU ETS, if needed to ensure effective carbon pricing of the EU's fair share of aviation emissions, taking into account other existing carbon pricing measures for international aviation.
- SO1.3.2 Preserve the effectiveness of the implementation of the EU ETS extension to maritime transport and maximise the regulatory efficiency of the EU ETS and IMO mid-term measures once adopted, notably by avoiding duplicative pricing of emissions leading to any significant double burden for shipping companies, while preserving the environmental integrity of the EU ETS, the EU climate goals and its international commitments.

For the **general objective O2.1 of ensuring efficient market functioning**, the following specific objectives have been identified:

- SO2.1.1 Increase size of the market until 2040: to achieve a higher liquidity to directly reduce the risk of market inefficiencies stemming from a small market size (see Problem 2 description).
- SO2.1.2 Adjust MSR parameters to ensure a healthy supply-demand balance⁵⁵ until 2040: in particular by designing the market stability reserve in such a way that (i) the

⁵⁵ An MSR that ensures a healthy supply-demand balance out to 2040 would be one that:

- Ensures adequate liquidity (adequate allowance availability for compliance, hedging and banking) – Liquidity is assessed through several indicators: TNAC levels and trajectories in relation to the upper and lower thresholds and buffer zones; the evolution of the stock of allowances in the MSR indicating capacity for future interventions; the TNAC-to-emissions ratio spread which is a proxy for liquidity consistency relative to compliance needs; and the timing and volume of MSR releases.
- Maximises price predictability (stable signals for decarbonisation investment)– Rather than formal statistical volatility metrics, the assessment relies on graphical analysis of price trajectories and their evolution under baseline and shock scenarios.
- Enhances regulated entities' operational decision-making– assessed qualitatively based on market conditions that enable effective risk management, and mechanism predictability that supports credible price expectations.
- Strikes the right balance on cumulative emissions – assessed based on cumulative emissions, considering the trade-off between designs that release earlier and more forcefully raise cumulative emissions and designs that

rules for intakes and releases of allowances are adjusted to the cap trajectory (decreasing cap, but potentially at a different pace and with a wider scope), and (ii) the rule for invalidation of allowances is revised in view of the future market conditions, with the overall aim to ensure sufficient liquidity in the market; a secondary aim would be to ensure that liquidity is proportional to future demand, for a good balance of the market.

1.3. Baseline

The **ambition** of the system is determined by the continuation of the linear reduction factor established in Article 9 of the ETS Directive, of 4,4 % from 2028 onwards, which applies to all EU ETS sectors. In the current legislative framework, the system neither recognises the generation of carbon removals nor allows surrendering of carbon removals instead of allowances. The MSR continues to operate based on the surplus indicator defined as Total Number of Allowances in Circulation (TNAC) and its current parameters: intake rate of 24% (reverting to 12% as of 2031) of the TNAC when this is above 1096 million, intake rate of the difference between the TNAC and 833 million when the TNAC is between 833 million and 1 096 million; release of 100 million allowances when the TNAC falls below 400 million; the invalidation of allowances in the reserve above 400 million allowances.

The **cap trajectory** of the baseline is described in the below table:

Table 9: Baseline cap trajectory.

EEA	Cap 2030 (Mt)	Cap 2035 (Mt)	Cap 2040 (Mt)	LRF	Budget 2031-2040 (Mt)
Baseline	975	485	69	-4.4%	4436

The currently legislated cap trajectory and MSR design are the result of the latest revision of the ETS, which constituted an interim revision necessary to set the ETS in line with the increased 2030 ambition. While appropriate in the short term, continuing on this path is untenable in the long term and could lead to a vastly over-constrained system in the 2030s.

Strictly speaking, the baseline would reduce the cap to 69Mt by 2040 in its extended scope. However, taking all available technical options in the PRIMES modelling, the emissions would be some 147Mt in the EU scope and likely somewhat higher in the EEA scope, to reach some 150Mt (the ‘Modelling Baseline’ result).

This is significantly lower than the attained reductions and carbon budget in cost-effective scenario modelling which attains the 85% target for domestic economy-wide emissions reductions. As a result, economy-wide investments and costs will be higher in the baseline than the cost-effective case. In that sense, the baseline does not match the ETS trajectory appropriately to the cost-efficient domestic 2040 target. In addition, the technological risks that the reductions in the model will not be achieved are also higher, given the need to exhaust technical options, leaving little room for error.

The baseline scenario was also simulated for the **MSR** with the POLES-Enerdata model, using the legal default cap for the supply and the legal default emissions scenario from PRIMES for the demand. The modelling results show how the cap trajectory and MSR design could lead to a vastly over-constrained system in the 2030s. As a consequence, the ETS a price signal could

keep scarcity high reduce cumulative emissions but risk compromising market functioning if reserves become inaccessible.

- Performs best in a sensitivity analysis – measured based on (i) TNAC converging back to the no-shock trajectory; (ii) emissions converging back to the no-shock trajectory; (iii) TNAC-to-Emission ratio spread over 2027-2040; (iv) EUA price spread in 2040 (€2023/EUA).

have a steep increase in the period 2030-2032, after which prices stabilise until 2036 and then takes off again with steep increase until 2040. The analysis in Annex 8 further outlines that the legal default option the currently legislated is therefore not well suited to be used as a starting point in the MSR measure-level assessment. To that end an adjusted baseline is constructed that provides a more realistic evolution of market conditions.

In the baseline, in terms of **instruments to support investments** continuation of the Innovation Fund (IF) is assumed as already foreseen in the ETS Directive using existing instruments ('regular' grants and, to lesser extent, auctions and financial instruments) to address technology and early commercialisation risks across innovative decarbonisation technologies in ETS covered sectors, alongside the establishment of the Industrial Decarbonisation Bank (IDB) with a EUR 100 billion envelope as announced under the Clean Industrial Deal to address commercialisation risks for scale-up and roll-out of decarbonisation technologies in Energy Intensive Industries.

For **aviation**, the EU ETS would apply to departing and arriving flights from the EEA to around 90 countries from the start of 2027, if no amendment to the ETS Directive were adopted before surrender requirements for emissions released in 2027 are due. Currently, incoming flights from Switzerland and the UK are already exempted as those are covered by the Swiss and UK ETS respectively. Other incoming flights could also be exempted if this is considered optimal interaction. This is not assumed in the baseline, but it would reflect the EU's fair share of emissions while maintaining equal treatment of aircraft operators on routes, with the EU regulating departing flights, while other countries would be responsible for flights to the EEA. PO2 acts as such a variation. The ETS Directive reserves 20 million allowances from January 2024 until 31 December 2030 for covering up to 100% of the cost-difference for using eligible fuels on routes covered by the ETS carbon price (Article 3c(6)). Without action by the European Parliament and the Council, this support expires or runs out.

When accounting for the increasing use of SAF as mandated by ReFuelEU aviation and global SAF uptake projections by ICAO, in the baseline global⁵⁶ aviation CO₂ emissions should decrease to 590Mt CO₂ in 2040. Without accounting for the use of SAF, these emissions would increase from 690 Mt CO₂ in 2024 to 763Mt CO₂ in 2040. See table 2 in Annex 10. When looking at **out-of-sector abatement**, under the baseline in 2035, 28.5% of global international aviation emissions are covered by the EU ETS compliance obligation, and 10.4% by CORSIA offsets (see table 3 in the main body). In 2040, the baseline covers 26.1% of global international aviation emissions and CORSIA covers 0% (as it is set to end in 2035).

Regarding **economic impacts**, between 2023 and 2040, under the baseline demand increases across all market segments despite an increase in price for most segments (except cargo). Passenger demand for global international flights (those within Europe, as well as international flights outside Europe but not domestic flights outside Europe) increases: for first/ business class by 63%, for economy class by 49%, for low-cost by 30%, and for cargo by 43%. Average ticket prices are expected to increase between 2023 and 2040 under the baseline: for first/ business class by 20%, for economy class by 19%, for low-cost by 37%, and 0% (no change) for cargo. For other economic impacts of the baseline, including on the carbon cost as a share of the fuel cost or of total operating costs, risks of competitive distortions for airlines, risks of passenger shift and carbon leakage at airport hubs, or impacts on tourist destinations, please refer to the respective sections on the impacts of the policy options.

⁵⁶ Inside Europe: domestic and non-domestic and departing flights to Switzerland and the UK, outside Europe: non-domestic only.

Auction revenues from aviation in the baseline are estimated at EUR 24bn in 2035 and EUR 38bn in 2040⁵⁷. Under the baseline, there would be no CORSIA costs. It is important to note that the ETS mobilises significant support for decarbonisation, including for aviation. Additional support is available under the **Innovation Fund**. The Innovation Fund has supported 68 projects related to decarbonising the transport sector with EUR 3.89 billion. Between 2020-2024, the Innovation Fund has awarded more than EUR 286 million to three projects producing sustainable aviation fuels, one focusing on synthetic aviation fuel production. As part of the 2024 Innovation Fund Call implementation, the Commission is awarding EUR 153 million to four eSAF projects. In addition, 11 aviation projects that scored above the Innovation Fund evaluation thresholds are awarded the STEP Seal. In 2025, the Commission opened another European Hydrogen Bank auction with a dedicated budget of EUR 300 million for the production of renewable hydrogen with off-takers in the aviation and maritime sectors. The Innovation Fund is funded through ETS revenues. In 2025, the Commission opened another European Hydrogen Bank auction with a dedicated budget of EUR 300 million for the production of renewable hydrogen with off-takers in the aviation and maritime sectors. The Innovation Fund is funded through ETS revenues.

For **maritime**, the ETS Directive applies to ships of or above 5 000 gross tonnage and surrendering of allowances is phased in gradually (40% of 2024 emissions, 70% of 2025 emissions and 100% of 2026 emissions). All emissions of voyages between EU ports, as well as emissions within EU ports are covered but only 50% of emissions of voyages between EU and non-EU ports. Temporary derogations apply in some specific cases until end of 2030, such as for certain ice-class ships, voyages between ports in outermost regions and ports within the same Member State, certain small islands, and some routes for which a public service obligation or contract has been declared. Methane and nitrous oxide emissions from maritime transport are covered under the EU ETS as from 2026 and emissions from large offshore vessels will be covered as from 2027. The Baseline contains also full application of FuelEU Regulation and other relevant EU and international legislation adopted to date.

The baseline contemplates the fulfilment of the IMO GHG 2023 Strategy by reflecting the key design elements of the IMO mid-term measure as agreed in April 2025 (IMO Net Zero Framework)⁵⁸.

Under the Baseline, tank-to-wake (TTW) **GHG emissions** from all large ships under the ETS scope follow a decreasing trajectory driven by regulatory pressures coming from current EU legislations, including the EU ETS and FuelEU applied to the full extent and working together with IMO strategies and future policies. This trajectory leads to 20 MtCO₂e of residual emissions by 2050. Emissions from smaller vessels (between 400 and 4 999 gross tonnage) represent, in absence of regulation, the majority of these residual emissions of shipping. While not covered by current EU or global climate policies to reduce shipping emissions, GHG emissions from smaller vessels slightly decrease over the period 2030-2050, mostly driven by energy efficiency improvements.

Beyond in-sector GHG emission reductions, the participation of maritime transport in the EU ETS may also lead **to out-of-sector abatement**. This would occur in the event that maritime emissions (subject to EU ETS) decrease at a slower pace than the overall ETS cap reduction trajectory, leading to a scenario where shipping companies would need to acquire more

⁵⁷ Using carbon price projections as per PRIMES 87p_var3_v3

⁵⁸ Reduction of the GHG intensity of fuels (GFI) by at least a “Base target” of 8% in 2030, 30% in 2035 and 65% in 2040 and a more ambitious “Direct compliance target” of 21% GFI reduction in 2030 and 43% in 2035.

allowances from other ETS sectors. Under the Baseline, such a situation occurs from 2025 to 2040.

The non continuation of the derogations for outermost regions, small islands and ice-class ships under the EU ETS would also contribute to incentivise emissions reductions in the sector and avoid delaying green investments in vessels and port infrastructures.

International maritime shipping is an important contributor to poor **air quality** in the EU due to emissions of PM2.5/PM10, NOx, SOx, CO and NMVOC. It has particularly large impacts in port cities and coastal locations and due to long-range transport of pollutants it also deteriorates inland air quality. The major impact of air quality degradation is on human health, with smaller impacts to other areas such as crops, ocean acidification or degradation of buildings. The effects of air pollution under the Baseline are estimated for the period 2030-2050 at 112,997 MEUR of total external damage costs, which aggregate health effects, crop loss, biodiversity loss and material damage, as per the Handbook of the external costs of transport.

The assessment of impacts on compliance costs includes payments under EU ETS, fuel costs, operating costs and capital expenditures from shipping companies. Under the Baseline, total shipping costs are expected to grow over the period 2030-2050 from 105 billion EUR to 163 billion EUR. Total cost increases are largely driven by higher fuel costs following the gradual uptake of more expensive low carbon and renewable fuels (reaching 7% of the energy mix in 2030, 63% in 2040 and 87% in 2050) and, to a lower extent, by growing capital expenditure also linked to decarbonisation measures within the maritime sector.

In terms of social impacts for maritime, the non-continuation of the derogations for outermost regions and small islands under the EU ETS would increase the cost of maritime journeys to and from these areas. Considering that maritime transport is the main mode for freight transport in these territories and often key for connectivity, higher transport costs could reduce the affordability and frequency of maritime connections, which could potentially affect essential supply chains and access to goods, services, and economic opportunities. Furthermore, increased travel costs could possibly undermine the competitiveness of these regions as tourist destinations and reduce the economic benefits derived from tourism.

For **stationary installations**, the baseline for **free allocation** for sectors not covered by CBAM results from the continuation of the current rules post-2030, based on the provisions set out in Article 10a of the ETS Directive. This does not correspond to the legal default, as the provisions of Article 10a of the ETS Directive apply only until 2030. However, assuming a baseline of continued free allocation post-2030 allows for a more meaningful analysis of the proposed measures. For the sectors covered by CBAM, free allocation is phased out up to 2034 in parallel with the gradual phase-on of CBAM. The quantity of allowances available for free allocation is based on 43% share of the baseline cap trajectory, resulting from the provision in Article 10 of the ETS Directive that 57% will be allocated via auctioning.

For small stationary installations, the **20MW threshold** continues to apply, together with the provisions on the exclusion of small installations subject to equivalent national measures, and of very small installations (Article 27 and 27a respectively).

Accounting of emissions that are captured in the EU ETS installations for utilisation in products, or **for CCU, takes place upstream**. This means emissions can only be deducted by the installations when captured and transferred to another installation if they are captured for permanent storage in accordance with Article 12(3a) of the ETS Directive or for permanent use in a product in accordance with Article 12(3b) of the ETS Directive.

Finally, installations for the **incineration of municipal or hazardous waste** are generally excluded from the full scope of the EU ETS (with co-incineration in industrial installations

under the EU ETS, however, fully covered in line with Commission Guidance Document 0⁵⁹). Denmark, Sweden and Lithuania have installations for the incineration of municipal waste fully covered by the EU ETS⁶⁰. Since 1 January 2024, installations for the incineration of municipal waste monitor and report their emissions under the EU ETS.

2. OVERVIEW OF POLICY MEASURES

Three policy options have been developed that ensure that the ETS contributes cost-effectively to the EU emissions reduction target in line with climate neutrality and the 2040 target and to addressing the EU's fair share of international emissions. The options differ in the degree of change that they entail to the current system. *Policy option 1 Aligning ambition and improving incentives* includes the measures that, overall, lead to least change compared to policies in place in 2026. *Policy option 2 Aligning ambition and extending scope and corresponding incentives* includes measures that introduce moderate innovations or changes to the system. *Policy option 3 Aligning ambition and extending scope and incentives comprehensively* alters most substantially how the system works. The policy measures selected for each topic area are described individually in Annexes 8 to 13 to this report, to enable different approaches to building policy options. While those annexes include an in-depth assessment of a wider range of measures, the measures presented in the main body of the reports are those selected for the three policy options because they were assessed as addressing the relevant specific objectives with the best environmental, economic, and social impacts. Concretely, the following measures were considered in terms of each specific objective:

2.1. Ambition

The **ambition** of the EU ETS is primarily defined by the domestic EU-wide target considering international credits for net emissions reductions. However, the ambition of the ETS will depend on whether and how removals will be integrated. The cap itself can be set at the level of the gross emissions objective, or the net emissions objective. This differs per policy option and will be explained below.

2.1.1. Cap

Annex 8 describes the measures for different trajectories towards the 2040 point target in more detail:

- CAP1: In this “Linear” measure, the cap follows a linear trajectory from 2030 to 2040 towards an 85% consistent target in 2040.
- CAP2: In this “Modelled/cost-effective” measure, towards an 85% consistent target, the cap linearly follows modelled estimates from the 2030 legal cap estimate to the 2035 modelled emissions estimate, and from 2035 to the 2040 modelled estimate.
- CAP3: In this “90 – 85 pathway” measure, until 2035 the cap follows a trajectory towards the estimated cost-effective contribution of the EU ETS to the 90% target and then flattens to move towards the estimated cost-effective contribution of the EU ETS to an 85% consistent target in 2040. This reflects the fact that international credits will start contributing to the EU-target from 2036. A specific economy-wide modelling run was performed for the estimate of the EU ETS contribution to such a trajectory, hence it ends at a slightly different end point.

- CAP4: An accelerated version of CAP3, comparable to a non-linear pathway towards the 90% target in the first five years, then flattening to be compatible with an 85% target in 2040.
- CAP5: Maintains the 4.4% LRF from the legal default as an LRF for net emissions until 2035, then aims at a target compatible with 90% domestic reductions in 2040.

CAP2 was included in all the policy options. As a result, the further modelling-based analysis examined in the impact assessment is based on the cost-effective trajectory. PRIMES was used to model the variants PO1, PO2 and PO3, and the cost-effective trajectory is the most optimal economy wide to reach an 85% target in this model.

The conclusions drawn on the basis of this modelling about other measures should however be robust to changes in ambition level, if it were decided to follow a more stringent trajectory over this period, either CAP3, CAP4, or a scenario in which fewer international credits were purchased and domestic reductions were more limited, such as CAP5.

2.1.2. Carbon removals

Regarding the inclusion of **removals** (P9), the measures explored vary across three key dimensions explained below. Other elements were fixed as design elements for all measures, including the inclusion of CCS-based permanent carbon removals certified under the CRCF (BioCCS and DACCS) generated inside or outside the EU ETS. Detailed descriptions on the measures are available in Annex 8 - Part II.

The assessment carried out in Annex 8 - Part II, concluded that CR1, CR3, and CR4 provide the best balance in terms of increasing the size of the market (SO2.1.1.) to ensure efficient market functioning (O2.1), at the lowest cost, while providing most certainty in reaching the pre-set emissions reduction target (O1.2)⁶¹.

CR4 provides the lowest cost of compliance as it guarantees the gross emissions (matched only by CR3), thus is best at avoiding carbon leakage and increasing liquidity, with the smoothest market dynamics and without transaction cost for businesses, who operate in the ETS market as usual purchasing only conventional allowances. At the same time, net emissions are guaranteed (conditional on sufficient budget for the public authority), and abatement deterrence is only lower in CR5. While the most important downside of CR4 is the public cost, the apparent 'cost savings' for the regulator from CR1, CR2 and CR3 (notably from not having to invest into the purchase of removal units) entail risk transfers to the private sector that could materialize as higher costs for the regulator later on, e.g. if CDR technologies do not scale as required in time for target achievement, and especially if the regulator is left with little time to react to a CDR supply shortfall. And while CR4 would likely entail significant administrative costs for the regulator in e.g. the procurement of removal units, it seems possible that procurement methods such as reverse auctions could yield lower overall transaction costs than if purchases were done by individual regulated entities in the primary CDR market, and the administrative cost would need to be compared with the administrative cost of complementary support measures needed under CR1 and CR2 (e.g. CCfDs).

Compared to CR5, measure CR4 has the advantage of the predictability of the regulator in recouping some of the CDR purchase costs by auctioning allowances in the market. The higher fiscal cost of CR5 and higher carbon leakage risk resulting from the uncertainty in release of removal units seems, combined with the high fiscal cost, seems only acceptable if the priority is to pursue the option with lowest abatement deterrence. However, it should be considered if avoiding abatement deterrence will have, overall, a worse environmental impact than the loss

⁶¹ SO1.2.1 is linked to P9, to consider if carbon removals can be integrated in the ETS as sub-objective of O1.2.

in public budget and increased carbon leakage risk, or the over dependence on biomass as alternative abatement option. Both CR4 and CR5 have an equally positive impact in providing a certain source of demand for CDR.

Regarding the measures with private sector integration of removals, the main choice appears to be between prioritising (a) achieving EU targets at the price of putting the risk from CDR technologies (e.g. under-delivery, price risk) on operators (net cap options CR1-CR2) or (b) ensuring the extra ‘space’ for residual emissions in the EU ETS to enable cost-efficient abatement while mitigating carbon leakage, at the risk that the EU doesn’t ETS reaches its net contribution (gross cap option CR3). To avoid facing this choice and ensure both the environmental impact and protect the EU’s competitiveness, removals would need to be financially supported outside the ETS in measures CR1-CR3. Although the net target achievement is certain, the abatement deterrence risk is highest among all options assessed in CR2. The abatement deterrence is lower in CR1 and CR3 as a result of the limit, which in turn leads to a loss of cost-effectiveness when the limit becomes binding. However, the limit is expected to be binding if at all, late in the period. All three options incentivise CDR only when price competitive with the ETS, so early incentivisation will depend on public support outside the ETS. CR3 will have a slightly lower incentivisation as ETS prices would lower in view of the increased cap.

CR4 is included in policy option 1 ‘Aligning ambition and improving incentives’, as it allows the public authority to determine and manage the inflow of allowances in the system, leading to least changes for operators’ engagement in the system (operators will not need to trade in removals or depend for their emissions space on these units) and ensuring the achievement of the EU ETS net target (achieving both O2.1 and O1.2). CR1 is considered for policy option 2 ‘Aligning ambition and extending scope and corresponding incentives’, as it allows the use of removals within a limit on top of the cap, ensuring the net target is reached and abatement deterrence is lowest, while still allowing the increase of market size and liquidity (O2.1). Finally, CR3 is included in the ‘Aligning ambition and extending scope and incentives comprehensively’ option as it does not ensure the net target is reached, which is an essential objective of the system (O1.2) and it adds most complexity due to the cancellation of allowances for the removals used.

A very broad majority of respondents in the open public consultation (83%) supported the integration of permanent CRCF removal units in the EU ETS, arguing that this is essential to expand operators’ options to achieve the long-term climate ambition, to support the uptake of such technologies and to enhance liquidity in the market. This assessment was corroborated in stakeholder interviews and position papers. The complete assessment is set out in Annex 8.

Table 10: Policy measures for carbon removals

Policy measure	PO1	PO2	PO3
CR0: No integration			
CR1 ‘Limited operator integration on top of the cap’		X	
CR2 ‘Unlimited operator integration on top of the cap’			
CR3 ‘Limited operator integration under the cap (one-in-one-out)’			X
CR4 ‘Public authority integration through regular auctions under the cap’	X		

CR5 'Public authority integration through MSR on top of the cap'			

2.1.3. Market Stability Reserve (MSR)

For the policy options of the MSR a number of parameter changes have been determined based on the measure level analysis described in Annex 8. These parameters include the upper and lower threshold, the introduction of lower buffer, the intake and release rate, the invalidation mechanism as well some technical changes for the calculation of the TNAC.

For the policy options, a distinction is made between PO1 which applies the static parameter changes from the MSR1 level measure assessment while PO 2 and PO 3 applies dynamic parameters derived from MSR3 in the level measure assessment.

For PO1, the upper and lower threshold are respectively adjusted to 650 Mt and 310 Mt which remain static as from 2028. Furthermore, a lower buffer is introduced to address risk of a threshold effect close to the lower threshold. The intake rate is set at 24% constant over time and the release rate is maintained constant at 100 Mt and the invalidation mechanism is dropped after 2027 allowing more allowances to be held in the reserve. Some technical corrections are applied to the TNAC calculation.

For PO2 and PO2, the upper and lower thresholds are maintained at 833Mt and at 400 Mt in 2028 respectively. The options also include the introduction of the lower buffer, changing the intake rate at 12% from 2028 and dropping the invalidation mechanism from 2027 and the introduction of technical corrections for the TNAC calculation. Furthermore, the key parameters are adjusted and decrease with 4% as from 2028 to reflect the shrinking market of allowances.

For all PO regarding the MSR, it should be noted that greater number of allowances to remain in the MSR rather than invalidating them could provide an essential liquidity buffer to manage future market tightness in the mid-2030s and beyond. For this reason, the invalidation of allowances in the reserve should be stopped in the short term to allow for a larger number of allowances to remain in the reserve. This will increase the firepower of the Market Stability Reserve for future releases in the next decade to balance the market.

Table 11: Policy measures for MSR

	PO1	PO2/PO3
UB: upper buffer	Implied by UT and IR: $UB(y) = \frac{UT(y)}{1-IR(y)}$	
UT: upper threshold	650 Mt constant from 2028	833 Mt in 2028 Decreases at 4.0%/year after
IR: intake rate	24% constant	12% constant from 2028
LT: Lower threshold	310 Mt constant from 2028	400 Mt in 2028 Decreases at 4.0%/year after
LB: Lower buffer	Implied by LT and RR: $LB(y) = LT(y) - RR(y)$	
RR: Release rate	100 Mt constant	100 Mt in 2028 Decreases with 4.0%/ year after

	PO1	PO2/PO3
Invalidation mechanism	Dropped after 2027	
TNAC calculation	Technical correction for 2027 TNAC	

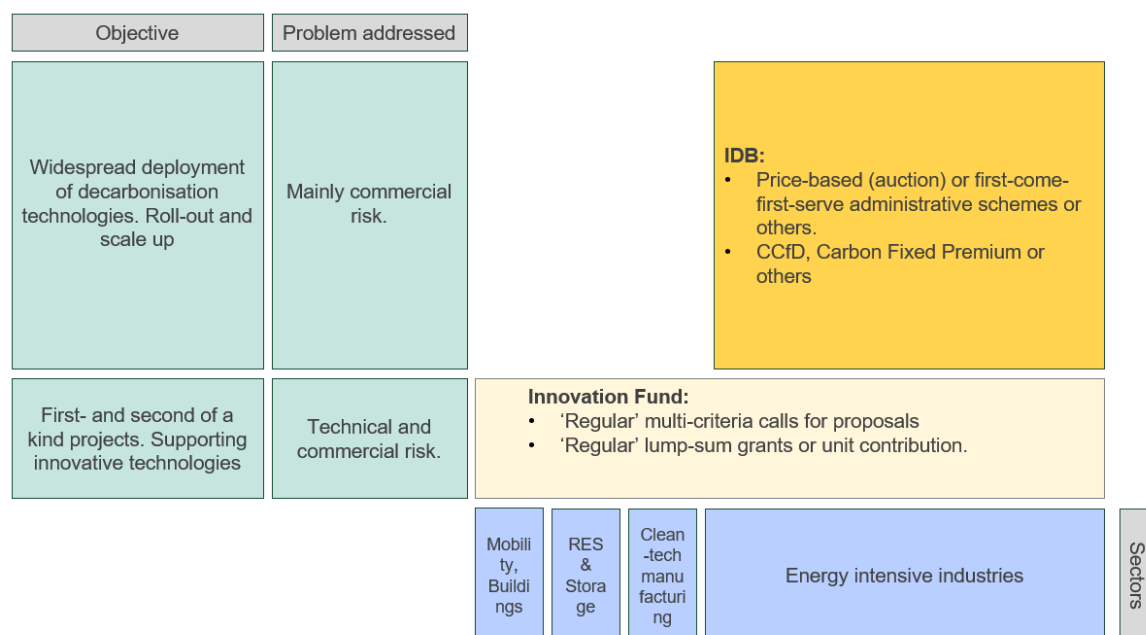
2.2. Instruments to support investments

2.2.1. Industrial Decarbonisation Bank

The Clean Industrial Deal announced the Industrial Decarbonisation Bank (IDB), with a budget of EUR 100 bn ‘based on funds in the Innovation Fund, additional revenues resulting from parts of the ETS as well as the revision of InvestEU.’ The objective of the IDB is to make a sizable impact on the industrial decarbonisation of the EIIs. Additionally, the Innovation Fund (IF) is set to be continued for the period 2031-40 using the existing instruments (‘regular’ grants and auctions⁶²) and providing existing type of support (‘classic grants’ with lump sum payments or fixed premium linked to the low-carbon product output and, to smaller extent, financial instruments) to a board range of innovative decarbonisation technologies in all sectors covered by the EU ETS, including ETS 2.

The IDB should focus on addressing the scale-up and roll-out of decarbonisation technologies in the EIIs while the IF would continue to focus on addressing technical and early commercial risks of innovative technologies. The Bank will be placed within the governance of the future Competitiveness Fund. The different scopes of the IDB and IF are proposed in the figure below.

Figure 2: Scope of the Industrial Decarbonisation Bank and Innovation Fund



The policy measures assessed in this Impact Assessment, examine the possible approaches for allocating support through the IDB, the different forms that such support could take, and the mechanisms available to ensure geographical balance in its distribution.

⁶² IF can provide support via (1) ‘regular’ grants based on the evaluation of multiple award criteria and in form of the lump sum payments linked to reaching project’s milestones as early as of Financial Close and (2) auctions based on the price-only competition and in the form of unit cost contribution as of Entry into Operation and (3) financial instruments.

Options on how the support should be allocated (allocation mechanism)

There is a number of allocation mechanisms that can be deployed, and in most of the cases these can be selected independently of type of support being provided. The options presented below reflect the most commonly used instruments, based on the experience from the Innovation Fund, and national support schemes for the industrial decarbonisation. These allocation mechanisms are not necessarily mutually exclusive, for example auctions may be designed as very similar to multicriteria processes (i.e. by including non-price criteria).

Table 12: Policy measures for IDB allocation mechanism

AM.1	Multi-criteria call for proposals
AM.2	Auctions
AM.3	First-in, first served administrative schemes

Measures on what form the support should take

Public support can take a number of forms and, in most cases, the choice of support can be made independently of the allocation mechanism. The options presented are not exhaustive but represent the most common types of support, reflecting the experience from the Innovation Fund and national support schemes for the industrial decarbonisation.

Table 13: Policy measures for IDB type of support

FS.1	Regular' grants covering the funding gap
FS.2	Carbon Fixed Premium (CFP)
FS.3	Carbon Contracts for Difference (CCfD)

Measures on ensuring geographical balance in IDB

The IDB design requires balancing between two partially conflicting objectives: directing EU-funding to the most cost-effective projects (typically low-risk, mature ones, located in the optimal locations of the EU); and, supporting industry decarbonisation across all Member States to ensure that all MS decarbonise their industrial base, benefit from spillover effects and, in the long-term no opportunities are missed (countries/regions that are not successful in the EU-level competition might be hampered by lack of administrative capacity/lack of innovation ecosystem rather than structural factors of their industry/economy). .

The Clean Industrial Deal highlights a fair geographical distribution of support needs to be ensured. Several options to achieve this balance:

Table 14: Policy measures for IDB geographical distribution

GB.1	EU-level competition, no geographical balance measures
GB.2	National allocations earmarked for MS
GB.3	Combining EU-level competition with national allocations

The measures are grouped into policy packages reflecting different degrees of change compared to the current ways to allocate the support provided under the Innovation Fund, with:

- PO1 replicating the current forms of support in the Innovation Fund,

- PO3 focusing primarily on novel forms of support that would work well with mature regulatory framework and strong carbon price signal and
- PO2 being a combination of the current and new ways of support.

Table 15: Policy measures for IDB in the policy options

Policy measure		PO1	PO2	PO3
How the support should be allocated (allocation mechanism)	AM1: Multi-criteria call for proposals	X		
	AM2: Auctions		X	X
	AM3: First-in, first served administrative schemes		X	
What form the support should take	FS1: Regular' grants covering the funding gap	X		
	FS2: Carbon Fixed Premium (CFP)		X	
	FS3: Carbon Contracts for Difference (CCfD)			X
Ensuring geographical balance in IDB	GB1: EU-level competition, no geographical balance measures	X		
	GB2: National allocations earmarked for MS	1.1.1.1		X
	GB3: Combining EU-level competition with national allocations	1.1.1.1	X	
Stable design elements across measures	• IDB budget of EUR 100 bn as announced in the Clean Industrial Deal • IDB scope on scale-up and roll-out of decarbonisation technologies in the EILs • IF to be continued using the existing instruments ('regular' calls for proposals and 'regular' grants)			

2.2.2. Modernisation Fund

As evidenced in the evaluation on its operating rules, the Fund demonstrates a degree of relevance, effectiveness, efficiency and EU added value which warrant its continuation after 2030, in volumes comparable with current situation so as to continue supporting lower income Member States in reaching EU climate and energy objectives. All policy measures presented below therefore maintain the Fund.

Coherence of the Fund with EU climate and energy objectives, and in particular the 2050 carbon neutrality objective can however be better addressed through increased climate ambition of the Fund, through better targeting of investments. In this context, all measures presented open the scope of priority investments (PI) to technologies relevant for industrial decarbonation such as CCS and direct electrification of industry, while making support to gas and waste-to-energy ineligible under PI.

In addition, three different measures are explored, related to 1) the eligibility of investments involving gas and waste-to-energy; 2) the share dedicated to priority investments and 3) governance of the priority investment confirmation process.

The **Policy Option (PO1)** maintains the status quo with regards to the eligibility of gas and waste-to-energy as non-priority investments. It also brings the share of non-priority investments to 10% across all three pots of money making up the Fund, down from the current 10% or 20% depending on the pot. This simplifies the current set-up while also recognizing the low resort to non-priority investments on the side of Member States (de facto less than 10% of supported investments currently). In terms of governance, this option opens up the possibility for confirmation of priority investments by the European Investment Bank on a rolling basis, without cut-off date (without any link to the timing of Investment Committee meetings). The actual disbursement of funds to the Member States would however remain limited to two disbursements decisions per year.

The **Policy Option (PO2)** limits the eligibility of non-priority investments of gas to energy efficiency-type investments (fuel switch from coal/lignite to gas) while excluding gas infrastructure. In a similar vein, non-priority investments may only support waste-to-energy in the conditions of high efficiency co-generation of heat and power and would concern only residual, non-recyclable waste. Concomitantly, the share of NPI would be brought down to 5% across all pots of Modernisation Fund allowances. Governance would maintain its status quo.

The **Policy Option (PO3)** excludes any support to gas or waste-to-energy, including as non-priority investment. The share of non-priority investment is brought down to 0. Approval process of priority investments becomes more stringent through the Investment Committee acquiring a vetting power over them.

Table 16: Policy measures for Modernisation Fund

Policy measure		PO1	PO2	PO3
Eligibility of Gas / Waste-to-energy	GAS/WtE1: PI: Exclusion. NPI: status quo	X		
	GAS/WtE2: PI: Exclusion. NPI: Allowed under conditions	X		
	GAS/WtE3: PI/NPI: Exclusion		X	
Respective shares of Priority / Non-Priority Investments	PI/NPI0: NPI share = 10%	X		
	PI/NPI1: NPI share = 5%		X	
	PI/NPI2: No NPI			X
Governance of the confirmation process of PI investments	GOV0: on rolling basis	X		
	GOV1: Status quo (as in current MF)		X	
	GOV2: vetting by Investment Committee			X

Stable design elements across policy options	• MF is maintained; • The scope of priority investments is enlarged to include CCS and direct electrification for industry; • Gas and waste-to-energy are ineligible as priority investments; • Two disbursement decisions per year.

2.3. Aviation

The measures for aviation addressing the above problems and drivers are set out in Table 8 below and in more detail in Annex 10. In addition, there are several elements which apply in a uniform manner across all options. On geographic scope of the EU ETS, the Directive as in force since 2023 permanently exempts flights to and from around **75 Least Developed Countries and Small Island Developing States**⁶³. This exemption is maintained across all measures. To ensure appropriate internalisation of the climate impacts (D2) of **private and business aviation**, all options include lowering the emissions threshold for all aircraft operators to 500t CO₂ to increase the reach of carbon pricing. This would bring the majority of **private and business aviation** into the ETS scope. All **private and business jet flights** departing EEA countries also come into the ETS. This element is accompanied by a **simplification** for monitoring, reporting and verification rules for all aviation small emitters limiting any increase in administrative effort for operators, Competent Authorities and the Commission (see Annex 10, section 7). In specific cases of **hub carbon leakage**, the ETS price would apply in both directions, on an equal-treatment-on-routes basis⁶⁴ to help level the playing field. In addition, the EU could provide “ETS-as-a-service” to interested third countries, which could receive a share of the revenues for climate purposes. However, this is not included in the modelling.

Policy Option 1 (PO1): The geographic scope of application of the EU ETS depends on the required assessment of CORSIA⁶⁵. PO1 assumes this assessment is positive and States continue to effectively apply CORSIA. This assessment would be in line with SO1.3.1, ensuring effective action on the EU’s fair share of international aviation emissions because departing flights would be covered by a meaningful carbon price. This means that the EU ETS carbon price would apply to flights within and between EEA States, as well as to departing flights to Switzerland and the UK. For countries that should be implementing CORSIA offsetting but are not doing so, the EU ETS would apply in both directions. CORSIA would apply to remaining flights between participating countries. Emissions between some countries would not be covered by a carbon price⁶⁶. States would continue to apply CORSIA so that airlines offset emissions above the negotiated baseline⁶⁷ until 2035 when CORSIA is set to end. In advance of CORSIA’s sunset clause, a new solution to ensure meaningful carbon pricing of international

⁶³ As defined by the United Nations, except for those States with a GDP per capita equal or exceeding Union average.

⁶⁴ The EU ETS carbon price would apply to any airline flying on that route.

⁶⁵ The Commission assessment checks whether CORSIA has been implemented in national law by third countries, and whether it has been strengthened. See detail in the Annex 10, section 5.

⁶⁶ Both CORSIA and the EU ETS exempt flights involving Least Developed Countries and Small Island Developing States. From January 2027, CORSIA should become mandatory for flights between 34 countries (resulting in offsetting above the baseline). Unless they voluntarily participate, flights involving other countries are not covered by CORSIA. As of 2025 and the latest list applicable for 2026, 130 countries voluntarily participate in CORSIA, accounting for 51% of 2024 emissions from international aviation.

⁶⁷ As of 2024, the CORSIA baseline is 85% of 2019 CO₂ emissions, amounting to at least 516 million tonnes CO₂ of international aviation emissions each year that are not addressed by CORSIA. Source: ICAO, *CORSIA Central Registry (CCR): Information and Data for Transparency, Part II: Total CO₂ emissions for 2019 Aggregated for all Aeroplane Operators on each State Pair*, 2022.

aviation emissions would need to be put into effect. The Commission would report on the application of CORSIA and changes in emissions coverage in its annual Carbon Market Report. On SAF support, in line with the unchanged ETS scope, support would expire at the end of 2030, and it would be allocated in the same manner as today (ETS Directive as in force since 2023). PO1 aviation measures require no adjustments to the ETS cap.

Policy Option 2 (PO2): Under PO2, the Commission assessment of CORSIA is negative: there would be exemption so that the EU ETS would not apply to flights arriving in the EEA from a country outside the EEA. The EU ETS would apply to departing flights from the EEA to less than about 90 destination countries⁶⁸. Where the ETS carbon price applies and the country participates in CORSIA, airlines can deduct CORSIA offsetting costs to avoid double charging. This approach is in line with SO1.3.1, ensuring effective action on the EU's fair share of international aviation emissions because it ensures that departing flights are covered by a meaningful carbon price. The geographic scope is expected to result in increased ETS revenues, part of which would be used to extend support for SAF uplift by an additional amount of allowances⁶⁹. In line with Objective SO1.1.1, enabling investments, this support is coupled with conditionalities such as having a longer term off-take contract agreement in place. PO2 would entail cap adjustments proportionate to the extension in scope of the ETS carbon price. To preserve the environmental integrity of the ETS, the deduction would be accompanied by the cancellation of an equivalent amount of EU ETS allowances.

Policy Option 3 (PO3): The geographic scope of application would be the same as under PO2, because larger geographic coverage would go beyond SO1.3.1 (ensuring effective action on the EU's fair share of international aviation emissions). The geographic scope is expected to result in increased ETS revenues, of which a larger part (compared to PO2) would be used to extend support for SAF uplift until the end of 2035, with the same conditionalities as in PO2. PO3 would entail the same cap adjustments as PO2.

Table 17: Policy measures for aviation

Review element	Policy measure	PO1	PO2	PO3
Geographic scope	AS1: clean cut	X		
	AS2: departing flights		X	X
Financial support for SAF uptake	SAF0: status quo	X		
	SAF1: medium extension		X	
	SAF2: larger extension			X
Design elements: stable across all options	Socially progressive: Private & business jets inclusion Automatic phase-in: Outermost Regions participation Automatic exemption: LDCs and SIDS exemption			

⁶⁸ The ETS would not apply if the destination is one of around 75 Least Developed Countries or Small Island Developing States (see footnote 15), countries where the ETS currently applies are not counted (EU27, EEA, flights to Switzerland).

⁶⁹ As foreseen by the ETS Directive Article 3c(6), penultimate paragraph.

2.4. Maritime

Regarding maritime, different measures are explored to address the various problems and drivers faced by the sector:

- LCF: support for emission reduction in the shipping sector and enable investments in line with the specific objective set in SO1.1.1.
- RE: Additional safeguards against the risk of evasion, linked to the specific objective defined in SO1.1.3:
- SI: Simplification, and targeted enhancement measures⁷⁰
- DE: Derogations and exemptions for outermost regions, ice-class ships, small islands and transnational public service contract or obligation.
- IMO: Deduction from the ETS surrendering obligations of emissions priced under IMO GHG mid-term measures, to ensure coherence between the EU ETS and the IMO measure once adopted and implemented, in line with the specific objective set in SO1.3.2;
- MSS: Extension of the EU ETS to cover emissions from smaller ships (i.e. ships below 5 000 gross tonnage but not below 400 gross tonnage) in line with the specific objective SO1.1.2;

Different variants and combination of these measures are considered across the three policy options.

The policy option PO1 focuses on the introduction of **simplification and targeted enhancement measures** with the objective to lessen administrative burden and enhance the effectiveness and robustness in the implementation of the system, both for shipping companies and the administering authorities of Member States. These measures are particularly important for small and medium-sized enterprises (SMEs), which often face higher administrative and compliance costs relative to larger operators. These are the only significant changes in comparison to the Baseline. However, **no changes to the anti-evasion** measure would be introduced and the existing **scope of the ETS in terms of ship categories and sizes** would remain unchanged. In addition, **no additional support mechanism** for maritime from ETS revenues would be introduced at EU level, beyond the support already provided through the Innovation Fund. In line with the current legislation, derogations would stop as from 2031.

For **maritime**, the **policy option PO2** includes a **dedicated support mechanism** (SMAP) that would be introduced for vessels to contribute to close the gap between the costs of mitigation solutions and the costs of fossil fuels, therefore accelerating the decarbonisation of the sector (assuming that in total 50% of ETS revenues generated by the ETS extension to maritime are recycled in the sector through EU mechanisms and national schemes).

Further, the option PO2 would strengthen the existing **anti-evasion measure** by including more ports in the list of neighbouring container transshipment ports (through lowering the annual average transshipment share threshold from 65% to 50%). Moreover, elements of the legislation that are also relevant to offshore activities would be adjusted to ensure that all ships providing relevant offshore services in EU waters are subject to the ETS, independently of their flag or from where they come from or where they go to after concluding the activity.

The existing derogations (islands, OMR, PSO/PSCs, and ice class ships) would be extended for limited time. **The Simplifications and targeted enhancement measures** for shipping

⁷⁰ Policy measure SI1 applies horizontally across the different policy options.

companies and administrative authorities foreseen under policy option PO1 would be maintained also under PO2 .

The option PO2 would introduce a deduction for emissions that are both covered by the ETS and subject to regulation and pricing under a future IMO mid-term measure, once adopted. This deduction would apply in full as long as the carbon price set by the IMO mid-term measure stays above ETS prices. In the opposite case, a correction factor would apply to reduce proportionally the amount of emissions to be deducted from the ETS obligations. This approach prevents double payment for the same emissions, while ensuring that emissions excluded from the ETS are priced at a level at least equivalent to that of the ETS. To preserve the environmental integrity of the ETS, the deduction would be accompanied by the cancellation of an equivalent amount of allowances.

This policy option would also extend the ETS scope to emissions from **small ships categories emitting the most** among small ships with gross tonnage bigger than 400 gross tonnage but below 5 000 gross tonnage.

Option PO3 includes the same approach as in option PO2 in relation to the dedicated support mechanism (SMAP), the IMO deduction, simplification and targeted enhancements for shipping companies and administrative authorities, derogations and measures to address evasion risks. However, compared to PO2, this option considers extending the scope of the ETS to a larger fleet of small vessels, namely **all categories of small vessels** already covered under the EU maritime MRV, non-commercial yachts, and fishing vessels.

Table 18: Policy measures for maritime

Topic	Policy measure	PO1	PO2	PO3
Maritime Support for emission reduction in the shipping sector	-LCF0: No dedicated ETS support mechanism	X		
	-LCF1: EU ETS support mechanism for Sustainable Maritime Alternative Propulsion (SMAP)		X	X
Maritime Evasion Risk	-RE0: Current measures on evasion	X		
	-RE1: Revise the list of neighbouring container transshipment ports		X	X
	-RE2: Ensure that offshore activities by ships operating in EU waters are covered, independently from their port of origin.		X	X
Simplification in Maritime	SI1: Simplification, and targeted enhancement measures	X	X	X
Maritime Derogations	-DE0: no extension of derogations	X		
	-DE1: Extension of derogations for limited time		X	X
	IMO0: No IMO deduction	X		

Maritime IMO deduction mechanism	IMO1: Deduction from the ETS surrendering obligations of emissions subject to pricing by IMO		X	X
Maritime Smaller Ships	MSS0: The existing scope in terms of ship categories and sizes remains unchanged	X		
	MSS1: Targeted extension of the scope of the EU ETS to smaller ships by including ship categories emitting the most among small ship categories		X	
	MSS2: Extension of the scope of the EU ETS to all smaller vessels (from categories non-exempt from MRV, plus fishing vessels and non-commercial yachts)			X

The possibility to offer EU ETS as a service to third countries (e.g. candidate countries) is also considered. It could promote the adoption of consistent carbon pricing mechanisms in non-EU countries and help drive global climate action in the maritime sector, especially in the event an IMO market-based measure is not applied. However, the possibility to support a future IMO Fund with payments from selling of ETS allowances could not be analysed considering that the IMO adjourned its decision regarding the adoption of the IMO Net Zero Framework. This issue will need to be re-assessed once (and if) a Fund is established at IMO.

2.5. Stationary installations

2.5.1. Carbon leakage prevention measures for direct emissions

Establishing a carbon pricing mechanism brings the risk of carbon leakage, which occurs if industrial production relocates from the EU to jurisdictions with less stringent environmental standards. For ETS sectors outside of the scope of the CBAM regulation, the provision of **free allocation** (P3) remains the main tool to address this risk. Some of the carbon leakage measures analysed are primarily developed as improvements and simplifications to the current free allocation rules (CL1) or as an expansion of the current limited application of conditionality to all installations (CL2). The other measure (CL3) provides an alternative approach for carbon leakage, under which installations do not receive allowances for free, but rather must surrender allowances only for part of the reported emissions, which is set to progressively increase to a full surrender.

CL1 is included in PO1 ‘Aligning ambition and improving incentives’, as it provides continuity with the current free allocation system in addressing the risk of carbon leakage (SO1.1.3), while providing some simplification to reduce administrative burden and making the implementation of the free allocation more efficient. CL2 is part of the ‘Aligning ambition and extending scope and corresponding incentives’ option PO2 and it builds on CL1 (including thus all the simplification and improvements therein). Under this measure, in order to ensure the better targeting of free allocation and to encourage investments in the decarbonisation of industry (addressing SO1.1.1), a gradually increasing share of free allocation is made conditional to installations demonstrating that the equivalent financial value of the received free allocation is invested in significant emissions reduction measures. For the purposes of the assessment of the impacts of this measure, two different scenarios are assumed for the rate of complying with the conditionalities under CL2 – 90% (CL2_90) and respectively 50% (CL2_50). Additional variants for CL2 include adjustments to the rate of the phase-out of free allocation for sectors falling under the scope of the scope of the CBAM regulation, addressing the risk of remaining carbon leakage for those sectors. CL3, which is part of the ‘Aligning ambition and extending

scope and incentives comprehensively’ option PO3, replaces free allocation with a partial non-surrender obligation that gradually increases to a full surrender obligation by 2034. This measure results a better carbon price signal (SO1.1.2) and it brings significant administrative simplification, as all the administrative processes related to applying and receiving free allocation are removed. However, this results in a less effective carbon leakage protection and does not provide incentives to reduce emissions.

Table 19: Policy measures for carbon leakage prevention

Policy measure	PO1	PO2	PO3
CL1: Improved current approach	X		
CL2: Conditional Free allocation for investments		X	
CL3: No free allocation and partial surrender of allowances until 2034			X

2.5.2. Carbon leakage prevention measures for indirect emissions

Compensation for indirect carbon costs (ICC) is encouraged under the ETS Directive as a way to address the risk of carbon leakage due to carbon costs passed on through electricity prices (SO1.1.3).

The Directive currently encourages provision of compensation to sectors at risk of carbon leakage due to ICC, as an alternative to free allocation (P3), which is justified due to the different nature of the risk. Carbon leakage risk from indirect emissions differs from the risk associated with direct emissions because: i) the carbon price is not paid directly by the industrial installations at risk but is passed on through their electricity bills; and ii) consumers of decarbonised electricity may face ICC due to the influence of fossil fuels on the marginal cost and wholesale price of electricity.

ICC compensation is currently provided voluntarily by Member States, subject to specific State aid rules⁷¹. This approach has several advantages. In particular, it gives Member States the flexibility to choose between ICC compensation and other uses of ETS revenues. However, an approach based purely on State aid can risk distorting the internal market, since an installation’s entitlement to compensation depends on whether the Member States where it is located decides to grant this type of aid. For this reason, the ‘Aligning ambition and extending scope and incentives comprehensively’ package PO3 considers augmenting State aid with an EU-wide component, whereby some ICC compensation is provided on a harmonised basis.

In this context, it is important to underline that the decarbonisation of the EU’s power sectors is advancing swiftly, which will have a dampening effect on carbon cost pass through even when electricity continues to be priced at the margin. The substantial growth of electricity production from renewable sources and the deployment of storage capacities will increasingly replace marginal generation by fossil fuel based power plants.

The policy options considered in this assessment are:

- ICC1 - a continuation of the current approach whereby the ETS Directive encourages Member States to provide ICC compensation, subject to rules elaborated in State aid

⁷¹ Guidelines on certain State aid measures in the context of the system for greenhouse gas emission allowance trading post-2021 (2020/C 317/04)

guidelines. This option includes enhancing the current regime by strengthening the direction given by the ETS Directive in three ways:

- i. making ICC compensation conditional on decarbonisation investment by beneficiaries. This is similar to option CL2 for free allocation and builds on conditionality requirements that are already in place in the current ICC State aid guidelines.
 - ii. enhancing verification and enforcement of the decarbonisation conditions.
 - iii. stating that the electricity production mix used for indirect emission benchmarks should take account of the role of fossil and non-fossil sources in the setting of electricity prices.
- ICC2 - harmonised ICC. In addition to the measures described in ICC1, this would consist of providing EU-level funding for ICC compensation by reserving 5% of auctioned allowances for this purpose. Member States would retain the right to provide a higher level of compensation up to the level permitted under State aid rules.

The extent to which each option exposes polluters to the full carbon price signal (SO1.1.2) or addresses the risk of carbon leakage (SO1.1.3) depends on the design of the compensation measures: such as aid intensity and sectoral eligibility. ICC1 would likely provide less support and greater exposure to the full carbon price than ICC2, simply because some Member States may not provide the maximum amount of State aid due to national budgetary priorities. Annex 12 assesses the implications of each option in greater detail.

Almost three quarters of respondents to the OPC, mainly companies/businesses and business associations, considered that indirect cost compensation will remain necessary after 2030 to address the risk of carbon leakage from carbon costs passed on in electricity prices (in sectors not covered by CBAM). Among this group, preferences differed, in order of frequency, between calls to harmonise the system at EU level, maintaining the current approach based on State aid and extending indirect cost compensation to cover more sectors and sub-sectors.

Table 20: Policy measures for indirect cost compensation

Policy measure	PO1	PO2	PO3
ICC1: Continue SA encouragement	X	X	
ICC2: Harmonised ICC (e.g. via IDB)			X

2.5.3. 20MW threshold

Regarding the possibility of lowering the **20 MW thermal input threshold** to cover smaller installations (P8), the measures under consideration reflect the review clause included in Article 30 (5)(b) of the ETS Directive, namely to consider the feasibility of lowering this threshold from 2031, thereby responding to problem driver D2 (specifically D2.2) related to insufficient carbon price signal. The measures considered were *T0: maintain the current 20 MW threshold* and *T1: lower the threshold* (e.g. by 5, 10, 15 or 20 MW).

A quantitative assessment was undertaken (see Annex 12) but should be considered tentative given the lack of sufficiently granular EU-level data collection relating to installations of this size⁷². The assessment found that approximately 227 MtCO₂e of emissions (2021-2023

⁷² The assessment used data collected in the context of the Medium Combustion Plant Directive, as discussed in Annex 12

average) from Annex I activities are not covered by EU ETS and could be brought into the EU ETS via lowering the threshold. However, 85% of these emissions will be covered by the introduction of ETS2 covering emissions from buildings, road transport and additional sectors. Of the remaining 33 MtCO₂e, around 5 MtCO₂e is excluded under Article 27 of the Directive (coverage by equivalent national measures), leaving 28 MtCO₂e of predominantly process emissions.

Since the majority of emissions below 20 MW will in any case be covered by ETS2, the environmental case for lowering the threshold is marginal when compared to the administrative cost. The Commission services' assessment is therefore that it would be a contribution to simplification and better regulation not to address these emissions through inclusion in the EU ETS due to the high administrative cost involved which is considered disproportionate. For example, lowering the threshold to 10 MW would bring approximately 10 MtCO₂e of annual emissions into the ETS, but would expand the EU ETS by more than 11,000 installations. This would more than double the number of stationary installations covered, in exchange for only marginal increase in emissions coverage.

This assessment was corroborated by the stakeholder consultation, where a majority of stakeholders across the OPC, position papers and interviews opposed lowering the threshold on the grounds that it would impose significant administrative and financial burdens on smaller operators, outweighing the potential climate benefits.

For these reasons, the option of lowering the threshold is discarded in all policy option packages, in favour of maintaining the existing threshold.

2.6. Waste

Regarding the EU ETS scope expansion to cover **waste management** emissions (P5), the measures under consideration mirror the review clause included in Article 30(7) of the ETS Directive. They correspond to progressing degrees of the possible expansion, in terms of waste management processes and their emissions so that the possibility of internalising the climate change impact of the waste management sector (D2.5) to advance further emissions reductions (O1.1) can be realised (cost-)effectively. The assessment of the measures addresses the environmental integrity, the alignment with the waste hierarchy, the feasibility of robust monitoring and reporting of emissions as well as internal market effects and potential distortions of competition— as prescribed in the review clause. Timewise, the expansion of the EU ETS to waste management regardless of the level was deemed not preferable prior to 2030 to ensure predictability and sufficient preparation time (considering the time for the co-decision process for the review and the time needed to implement its outcomes, particularly regarding monitoring and reporting rules).

The assessment found that W1 ('EU ETS expansion to municipal waste incineration installations') and W3 ('EU ETS expansion to all waste incineration installations and landfills of non-hazardous waste') would strike the right balance in terms of ensuring a full carbon price signal (SO1.1.2) in the waste management sector to incentivise further emission reductions (O1.1) and of increasing the size of the market (SO2.1.1) to ensure efficient market functioning (O2.1). PO1 'Aligning ambition and improving incentives' reflects the baseline with no inclusion of additional waste management processes in the EU ETS, instead mainly remaining under national emission reduction targets under the Effort Sharing Regulation. PO1 only implements some legal clarifications on the current scope. Co-incineration of waste would remain in the EU ETS and Member States would have the option to include their municipal waste-to-energy incineration installations in the scope of the system (cf. Denmark, Sweden and Lithuania already doing so).

PO2 'Aligning ambition and extending scope and corresponding incentives' reflects measure W1 as it expands the carbon price signal to a growing source of emissions – municipal waste incineration (MWI), both with and without energy recovery. Installations for incineration of municipal waste with energy recovery feed into the grid and district heating networks, where fossil fuel-based power installations are already subject to the EU ETS. To ensure the environmental integrity of this option and limit boundary and misclassification risks, emissions from all installations that predominantly incinerate municipal waste would be covered, consistent with the current MRV obligation for the sector. The cap estimate and GEM-E3 modelling integrates the cap increase by emissions estimates for the sector in PRIMES. In isolation, PO2 carries a risk of waste, in particular fossil waste streams, being diverted from incineration to landfills, depending on the effective enforcement and implementation of the waste policy framework, notably the Landfill Directive.

Finally, PO3 'Aligning ambition and extending scope and incentives comprehensively' reflects measure W3 as it expands the carbon price signal further to hazardous waste incineration (HWI) and to methane emissions associated with non-hazardous landfills. PO3 contributes to further overall emission reductions in the waste sector – primarily from methane – and addresses any residual risk of organic waste diversion from incineration to landfills. Conversely, PO3 has a more limited impact on fossil emission reductions and in isolation does not effectively address risks of diversion of fossil waste to landfills, which are ultimately subject to the enforcement and implementation of the waste policy framework. The cap estimate includes the emissions for the incineration sectors in the overall PRIMES modelling vis-a-vis the baseline. Emissions from landfilling could not be modelled in PRIMES as the model is constrained to CO2 emissions only, whereas landfill emissions are mainly driven by CH4. Landfill emissions have been separately modelled in GAINS. As a result, GAINS does not allow to separately model the disaggregated contribution of the carbon price to emissions reductions from non-hazardous landfilling under PO3.

The stakeholder consultation indicated broad support for the inclusion of municipal waste incineration installations in the EU ETS, with more than half of respondents to the OPC (51%), including companies/businesses and business associations as well as NGOs and environmental organisations, supporting an inclusion. Conversely, there was no agreement on a potential inclusion of hazardous waste incineration installations, with roughly equal shares in favour and against, although the latter was slightly larger. The consultation also highlighted that measures to address the risk of waste diversion to landfills would be important to ensure the robustness of the EU ETS expansion to waste incineration, whether through regulatory, fiscal or carbon pricing policies. The complete assessment is set out in Annex 13.

Table 21: Policy measures for waste

Policy measure	PO1	PO2	PO3
W0: No inclusion of additional waste management processes in the EU ETS.	X		
W1 Inclusion of the non-hazardous waste incineration installations in the EU ETS		X	
W2 Inclusion of all waste incineration installations in the EU ETS			
W3 Inclusion of all waste incineration installations and landfills of non-hazardous waste in the EU ETS			X
W4 Inclusion of all waste incineration installations, landfills of non-hazardous waste and chemical recycling processes in the EU ETS.			

W5 Inclusion of all waste incineration installations, landfills of non-hazardous waste and recycling processes in the EU ETS			
W6 Inclusion of all waste incineration installations, landfills of non-hazardous waste and recycling processes, as well as other waste management process (fermentation, composting and mechanical-biological treatment) in the EU ETS			

2.7. CCU

The recognition of non-permanent carbon reuse or **CCU (P2)** in ETS represents an accounting challenge, as emissions resulting from an ETS activity are captured and utilised in products that do not ensure their permanent storage to be then released in a different place and time. Therefore, the CCU measures are formulated around the different possible accounting options and assessed whether they ensure that emissions within the scope is effectively accounted, i.e. reported and the corresponding allowances surrendered, while avoiding the double counting or under-counting of emissions. In addition, the measures are assessed on whether they provide a level playing field or incentivise novel CCU products compared to their fossil-based equivalent.

As the carbon accounting in the EU ETS is dependent on the scope of the EU ETS coverage of waste incineration, the different policy measures need to reflect the inclusion or lack of it in the EU ETS. **CCU0** represents no change from the baseline, continuing the upstream accounting in the context of no inclusion of waste incineration in the EU ETS. Measure **CCU1** retains the current **upstream accounting system**, which means that the emitter pays for any captured emissions, unless they are permanently stored. However, unlike CCU0, CCU1 assumes that waste incineration has been included in the EU ETS. Measure **CCU2** moves the point of **accounting downstream**, which requires that the emissions contained in a CCU product are accounted at the point where they are finally emitted, which can be at the point of consumption for a product such as e-fuels or during the end-of-life treatment, such as when plastics or other materials are incinerated. Measure **CCU3** represents a hybrid accounting maintaining **the downstream accounting for most CCU products**, except for **e-fuels for which a midstream accounting** would be applied. This measure adapts the downstream accounting to the specificity of e-fuels, for which a developed regulatory framework and incentives⁷³ are already in place. Under CCU3, e-fuels producers or distributors would be required to account and pay for any fossil emissions embedded in the e-fuels, which allows to consider them as zero-rated fuels for the end user.

Table 22: Policy measures for CCU

Policy measure	PO1	PO2	PO3
CCU0: 'Upstream accounting' with current waste scope	X		
CCU1: 'Upstream accounting' with MWI inclusion			
CCU2 'Downstream accounting'			
CCU3 'Midstream accounting'		X	X

⁷³ The Renewable Energy Directive (2018/2001), the ReFuelEU Aviation Regulation (2023/2405)



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PART 3/5

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT REPORT

Accompanying the documents

Proposal for a

**DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
amending Directive 2003/87/EC and Decision (EU) 2015/1814 as regards driving
competitiveness and cost-effective decarbonisation**

**REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
amending Directive 2003/87/EC as regards revised benchmark values for the heat and
fuel benchmarks for the period from 2026 to 2030**

**REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
amending Regulations (EU) 2015/757 and (EU) 2023/1805 to simplify and streamline
monitoring, reporting and verification and to align with revisions of the EU Emissions
Trading System**

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1. INTRODUCTION TO CAP SETTING

This Annex provides more details on the impact each measure of scope expansion or removals inclusion would have on the cap setting, as presented in the Impact Assessment. It starts with a description of the legal default scenario, and a variant in which international aviation is only included for 50% of incoming and outgoing flights. Then, it explains different trajectories for reaching the target in 2040 cost-effectively. After explaining the scale of estimates for different scope extension and inclusion of removals, it summarises the way the caps for policy options have been estimated.

In general, the EU ETS cap is set with the geographical scope of the EEA. However, the modelling underlying the impact assessment is carried out with the geographical scope of the EU. This modelling is used to estimate the reduction rate of the EU ETS sectors and set the Linear Reduction Factor (LRF). The LRF is then applied to the EEA cap.

1.1. Legal default and Legal default with one-way aviation cap setting

1.1.1. Legal default

The legal default baseline is determined by the continuation of the linear reduction factor established in Article 9 of the ETS Directive, of 4.4 % from 2028 onwards, which applies to all EU ETS sectors. The current legislative framework does not yet recognise the generation of carbon removals.

It includes an estimated increase of 148 Mt in 2027 when including the emissions of incoming and outgoing international aviation in the EEA scope. This estimated increase of the linear trajectory to account for scope expansion is based on PRIMES EU near future emissions estimates for the EU scope. This estimate is uncertain¹, but it gives an indication. All international maritime navigation is included as per the current scope, but maritime non-CO₂ emissions are added to the scope. Current stationary sectors are in the scope.

Applying the Linear Reduction Factor (LRF) of 4.4% to the total cap in the relevant base years leads to the following estimates.

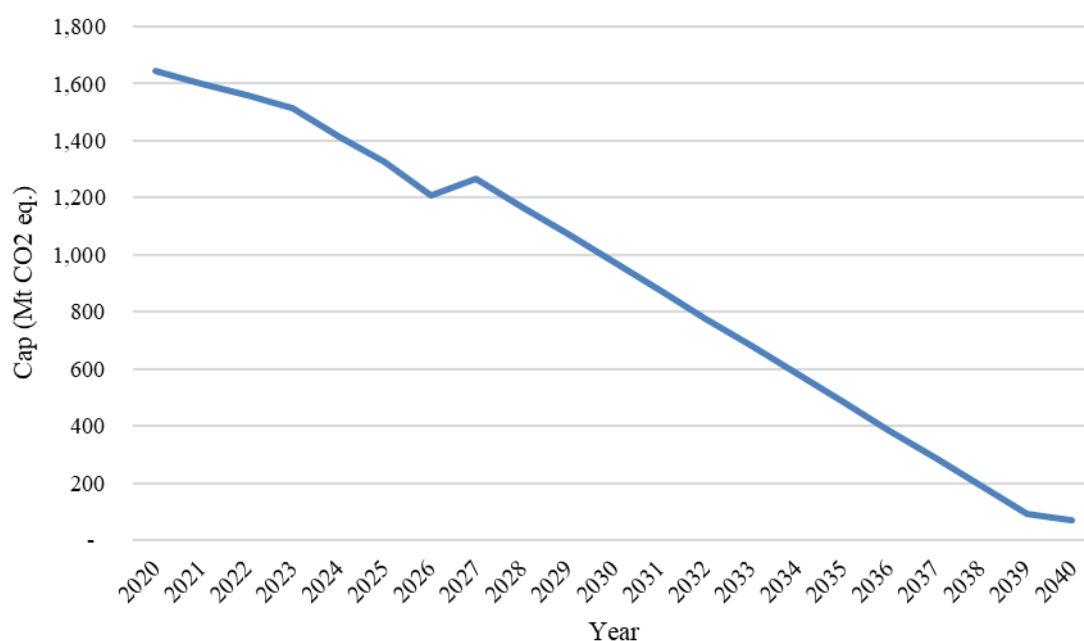
Table 1: Legal default baseline cap trajectory.

EEA	Cap 2030 (Mt)	Cap 2035 (Mt)	Cap 2040 (Mt)	LRF	Budget 2031-2040 (Mt)
Legal Default	975	485	69	-4.4%	4436

The graph below shows the rapid reduction pathway. The large kinks are due to the inclusion of international extra EEA aviation in 2027. The allowances due to the inclusion of aviation are still present under the cap in 2040.

¹ Smaller extensions for Maritime offshore vessels, at the scale of a few Mt in 2027, are ignored in below estimates, as they are not significant, and the precise amount is uncertain.

Figure 1: Trajectory Legal Default (incl. two-way aviation)



Source: Own visualisation

The following sections set out different options for cap trajectories reflecting varying levels of ambition and results for both PRIMES and POTenCIA models. Irrespective of the cap ultimately retained, a further point to be taken into account is described in section 5.5. of the MSR Annex. In particular, the section describes the use of the 3% free allocation buffer, which is expected to be fully used by industry operators between 2028-2030². This results in an earlier and more concentrated allocation of allowances than would otherwise have been in case of auctioning, as set out in the current ETS Directive³. As a result, liquidity and industrial emissions will be likely higher in the short term compared to modelled trajectories.

1.2. Different trajectories for the 85% scope scenario with current scope and 50% incoming and outgoing international aviation cap setting

In this section the cap in 2040 is estimated based on the cost-effective gross emissions for those sectors included in the legal default scenario, but where only half of incoming and outgoing aviation is included. International maritime navigation (including non-CO2 emissions but not offshore vessels) and stationary emissions are included as under the current scope.

To estimate the emissions in these sectors, we use the modelling results for the scenario which achieves an overall domestic reduction of economy-wide (including international extra EU aviation) net emissions of 85% compared to 1990. This represents a domestic ambition level coherent with buying 5% of high-quality international credits to add up to a -90% ambition. It could be decided later that less than 5% of international credits are used, which would enable more investment in domestic action. Consequently, the domestic reduction of net GHG emissions could be higher than 85%. However, this target was chosen as the basis for the impact assessment to consider the maximum potential use of the international credit flexibility

² Commission implementing regulation C(2026) 4372 final

³ Articles 10a (5a) and 10a (5b) of the ETS Directive

allowed in the European Climate Law. The costs and full impacts of purchases and use of international credits are not included in this impact assessment.

The modelling scenarios of the EU-wide 85% target are used to estimate emissions reductions for the ETS which are the basis of this impact assessment. The EU ETS should provide adequate funding for purchase of the high-quality international credits that it benefits from.

International credits integration into EU climate policy framework faces many similar questions and challenges as domestic permanent removal integration. These questions include detailed choice of policy integration, implementation, credit integrity, financing, quantification of credits. Integrating the international credits to future climate legislation should be done preserving the integrity and stability of the EU ETS (see section 1.2.2 on discarding the possibility of direct integration in the ETS in Annex 8 – Part II). The specific role and deployment of international credits outside the EU ETS will be based on a separate impact assessment and subject to the development of Union law further elaborating robust and high integrity criteria and safeguards. Important safeguards that complement those under Article 6.4 of the Paris Agreement must be ensured. There will be consideration of a pilot period in 2031-2035.

In any case, the point target for domestic emissions in 2040 itself does not fix the trajectory of the cap, and there could be at least three measures for the trajectory of the EU ETS cap from 2030 to 2040:

- CAP1: In this “Linear” measure, the cap follows a linear trajectory from 2030 to 2040.
- CAP2: In this “85 pathway” measure, the cap linearly follows modelled estimates from the 2030 legal cap estimate to the 2035 modelled emissions estimate, and from 2035 to the 2040 modelled estimate.
- CAP3: In this “90 – 85 pathway” measure, until 2035 the cap follows a trajectory towards the estimated cost-effective contribution of the EU ETS to the linear trajectory reaching a 90% target in 2040 and then flattens to move towards the estimated cost-effective contribution of the EU ETS to an 85% target in 2040. This reflects the fact that in this measure international credits will start contributing to the EU-target from 2036. A specific economy-wide modelling run was performed for the estimate of the EU ETS contribution to such a trajectory.

The sub-options all have the same end point in 2040, but they differ in terms of carbon budget over the period; they will differ as well in terms of incentives given to reduce emissions within a certain time horizon. The following tables illustrate the trajectories of the cap based on the 85 scenario. For these estimates we have assumed the inclusion of outgoing international aviation in the target. The caps presented are set at the level of gross emissions. The estimates translate EU modelling into an EEA estimate. The figure for 2030 is based on the legal cap extended for international aviation (one way). Note that the caps for policy options PO1, PO2 and PO3 below will differ as they refer to different scopes. The cap figures have been rounded to the nearest 5.

Table 2: Cap trajectories from the PRIMES model

EEA Caps (Mt), LRF (%) and Carbon Budget (Mt)	CAP1: Linear trajectory	CAP2: PRIMES 85 trajectory	CAP3: PRIMES 90-85 pathway
2030	911	911	911
2035	620	580	560
2040	330	330	330
LRF 2030-2035	-2.7%	-3.1%	-3.3%
LRF 2036-2040	-2.7%	-2.3%	-2.1%
Carbon Budget 2031-2040	5915	5705	5605

The following table shows the cap trajectories from the JRC POTEnCIA model.

Table 3: Cap trajectories for POTEnCIA

EEA Caps (Mt), LRF (%) and Carbon Budget (Mt)	CAP1: Linear trajectory	CAP2: POTENCIA 85 trajectory	CAP3: POTEnCIA 90-85 pathway
2030	911	911	911
2035	645	670	605
2040	375	375	375
LRF 2030-2035	-2.5%	-2.3%	-2.9%
LRF 2036-2040	-2.5%	-2.7%	-2.1%
Carbon Budget 2031-2040	6175	6295	5965

The table below shows the range of outcomes in the models, rounded to five, in order to represent the uncertainty range resulting from using the different models:

Table 4: Range of approximate cap trajectories

EEA Caps (Mt), LRF (%) and Carbon Budget (Mt)	CAP1: Linear trajectory	CAP2: 85 trajectory	CAP3: 90-85 trajectory
2030	911	911	911
2035	620-645	580-670	560-605
2040	330-375	330-375	330-375
LRF 2030-2035	2.7-2.5%	3.1-2.3%	3.3-2.9%

LRF 2036-2040	2.7-2.5%	2.3-2.7%	2.1-2.1%
Carbon Budget 2031-2040	5915-6175	5705-6295	5605-5965

The table above shows that, for a given model, the two-step trajectory would have smaller total emissions (i.e. carbon budget) over the 2031-2040 period than either the linear or modelled trajectories unconstrained in 2035. However, we see that there is overlap in the ranges, due to the different models used.

A two-step trajectory would stimulate innovation in the short term and could lead to a more balanced investment pathway. It is uncertain whether the benefits thereof would compensate the costs of a smaller carbon budget. The table also shows that the 85 trajectory as estimated in PRIMES is in between the linear trajectory and the 90-85 trajectory. In POTEnCIA the linear trajectory is very close to the 85 trajectory unconstrained in 2035.

For the further modelling-based analysis we have used the PRIMES 85 trajectory as PRIMES was used to assess the policy options, and this trajectory is the less constrained economy wide to reach an 85% target in this model.

This choice should not affect the relative impacts and rankings of the different policy options PO1, PO2, PO3 on most topics, such as removals, CCU, carbon leakage etc. The different behaviour of the two models provides an illustration of the intrinsic uncertainties involved in assessments on the longer-term technological future for different sectors. When, conversely, in this Annex, the two models show similar behaviour in response to changes to the cap, this provides evidence that a qualitative conclusion is robust.

The 90-85 pathway trajectory corresponds to including an extra emissions space that is created from buying international credits as of 2036. In comparison to the unconstrained 85 trajectory for a given model, it is a more ambitious trajectory.

1.3. Net cap trajectories excluding international aviation

All scenarios above assumed that (one-way) international extra EU aviation would be included in the EU target. If international aviation were to be excluded in the target, total emissions under the EU target would be lower. As international aviation is a hard to abate sector with lower reduction potential by 2040 than other sectors, this would nevertheless create additional emissions space of ca. 45 Mt for other sectors of the economy. Potentially, part of this emissions space could be assigned to ETS1, although it should be remembered that non-ETS1 sectors are expected to represent a larger share of emissions by 2040. In absolute terms the ETS1 cap would still be lower than in the numbers shown in this impact assessment; due to the absence of demand from international aviation the space for other sectors could still increase.

In addition, carbon removals could be introduced as a flexibility option to achieve the 2040 climate target in a more cost-effective way, since in some cases it may be cheaper to offset emissions through removals than to abate them directly. In particular, they can help compensate for residual hard-to-abate emissions in sectors covered by the EU ETS. If the EU ETS is assumed to benefit from the total amount of industrial removals in the models, the cap can be decomposed into a more ambitious cap set at the level of net emissions plus an amount of removals-linked allowances, which together add up to a total gross emissions carbon budget.

The precise result would depend on whether international aviation and removals are included in the EU target by co-legislators; and the way any additional emissions space due to its (partial) exclusion would be assigned across different sectors of the economy.

The table below shows the trajectory results for the different net cap options. It also includes an additional option in which the cap trajectory follows a 90-85 pathway as in CAP3 though with a higher ambition in the first half of the decade. In these options, the scope of the economy-wide target is limited to include intra-EU aviation (but not extra EU aviation) and current scope for maritime navigation.

Table 5: Net caps trajectories for POTEnCIA excluding international extra EEA aviation

EEA Caps (Mt), LRF (%) and Carbon Budget (Mt)	CAP1: 85 linear trajectory	CAP2: 85 trajectory	CAP3: 90linear-85 pathway	CAP4: accelerated 90-85 pathway
2030	847	847	847	847
2035	570	600	555	485
2040	290	290	285	285
LRF 2030-2035	-2.7%	-2.4%	-2.8%	-3.5%
LRF 2036-2040	-2.7%	-3.0%	-2.6%	-1.9%
Added removals-linked allowances	320	320	320	320
Carbon Budget 2031-2040	5720	5885	5640	5290

CAP4 is comparable to a non-linear pathway towards the 90% target in the first five years, then flattens to be compatible with an 85% target for the second five years. In PRIMES the emissions space would be lower: as an example, the gross emissions carbon budget for the modelled 85% trajectory would be 5205 Mt, including 170 Mt of removals linked allowances.

1.4. Caps for a trajectory towards 90% domestic reductions

The above trajectories have assumed the EU decision to use its full ability to buy international credits up to the 5% and for the ETS1 to claim its fair share of the additional domestic emissions space. To illustrate the opposite extreme, in which no international credits are used, below tables show the modelled cap trajectory for a target of 90% domestic emissions reductions.

The table below presents two cap trajectories achieving the 90% domestic emissions target. Both options exclude international aviation emissions from the EU target and linear reduction is calculated to achieve net emissions target. However, the last option is designed to maintain the -4.4% LRF legal default until 2035. This was suggested by several stakeholders and is presented as a fifth option in this Annex.

Table 6: POTEnCIA and PRIMES trajectory compatible with a 90% domestic EU target

EEA Caps (Mt), LRF (%) and Carbon Budget (Mt)	PRIMES-based estimation 90 excl. extra EU aviation	POTEnCIA 90% excl. extra EU aviation	CAP5: 90% extended legal default aiming at POTEnCIA in 2040
2030	847	847	847
2035	485	505	390

2040	155	185	185
LRF 2030-2035	-3.5%	-3.3%	-4.4%
LRF 2036-2040	-3.1%	-3.1%	-2.0%
Added removals linked allowances	210Mt	360Mt	360Mt
Carbon Budget 2031-2040	4785	5130	4560

The trajectory consistent with a 90% economy wide target extending the legal default LRF until 2035 has a significantly lower carbon budget than either the 90-85 or the 85% trajectory. This is because it requires a sharper reduction throughout the period in order to ensure that the EU ETS contributes its share to the attainment of the 90% target. A trajectory based on the accelerated 90-85 scenario would add an additional space of 730 Mt compared to the 90% trajectory extended legal default (compared to POTEnCIA).

1.5. Investment needs and system costs

The following table gives an illustration of investment needs and energy system costs in CAP 3 “9085” scenario. The numbers shown are a range of results from PRIMES and POTEnCIA models, illustrating the intrinsic uncertainties involved.

Table 7: Annual investment expenditure, energy related excluding transport in CAP 3 “9085” scenario

Annual Investment expenditure (energy related excl. transport)	EUR billion'25		%GDP	
	2021-2030	2031-2040	2021-2030	2031-2040
Industry	40; 45	30; 40	0.2%	0.2%
Supply side*	110;120	140;175	0.6%;0.7%	0.7%;0.8%

*includes power generation and production of new fuels.

Note: rounded to closest 5. Source: range over PRIMES and POTEnCIA models.

For the CAP4 “accelerated 9085” scenario, investments are estimated to be significantly higher in the first half of the decade than under the CAP 3 “9085” scenario, but lower in the second half of the decade. Over the whole decade (2031-2040), average annual investment needs on the supply side and in industry are slightly higher in the CAP4 “accelerated 9085” scenario.

Table 8: Investment needs in ETS sectors, deviation of the CAP4 “accelerated 9085” scenario and CAP2 “85%” scenario relative to CAP 3 “9085” scenario

		2031-2035	2036-2040	2031-2040
CAP4 “accelerated 9085” scenario relative	Supply*	+17%	-8%	+4%
	Industry	+12%	-7%	+2%
	Energy-intensive	+16%	-10%	+2%

to CAP 3 “9085” scenario	Non energy-intensive	+4%	-1%	+2%
CAP 2 “85%” scenario relative to CAP3 “9085” scenario	Supply*	-9%	+5%	-2%
	Industry	-6%	+5%	-0%
	Energy-intensive	-8%	+8%	+1%
	Non energy-intensive	-4%	+0%	-2%

*includes power generation and production of new fuels. Source: POTEnCIA model.

Under a CAP5 “90% extended legal default” scenario, much larger effects are expected: in the first half of the decade, investment needs are 50% higher for the supply side and 40% higher for energy-intensive industries (26% higher for industry on average). This level of investment would represent challenges regarding financing as well as from an industrial point of view. Over the 2031-2040 decade, this scenario would also require higher investment needs, as it achieves a more ambitious 90% GHG emissions reduction target compared to CAP3 and CAP4 which both achieve -85%. In CAP5, investment needs would be around 16% higher than in CAP 3 over the decade.

The steeper cap reduction under CAP3 up to 2035 incentivises a higher level of investment in decarbonisation technologies in the first half of the decade (2031-2035) than under CAP2. This is the case on the supply side (power generation and new fuels) as well as for industrial sectors on the demand side: the modelling analysis projects the anticipation of investment plans, with somewhat different degrees depending on the model, particularly on the supply side. Within industry, the anticipation of decarbonisation investment is stronger for energy-intensive industries than for non-energy intensive industries.

Given that both cap trajectories converge by 2040, the anticipation of investment needs under CAP3 translates into a flipside effect in the second part of the decade (2036-2040), where investment needs in the energy system are generally higher under the CAP2 than under [CAP3], both on the supply side and for industry.

On average over the whole decade, both models find that average annual investment needs in ETS1 sectors are not significantly affected by the cap trajectory, with relative changes within a narrow -2%/+2% range for supply side and very small for investment in industry as a whole.

The following table shows energy system costs (system costs are annual costs incurred for energy services of end-users including annualised capital costs, variable costs, and fuel costs) as a percentage of GDP for the CAP 3 “9085” scenario. Energy system costs take into account both the capital costs of investments and potential economic savings in (fossil) energy expenditures, as experienced by the economic actors in a given year, over their foresight period. The numbers shown are a range of results of PRIMES and POTEnCIA models, illustrating the intrinsic uncertainties involved.

Table 9: Energy system costs as % of GDP in the CAP 3 “9085” scenario

Energy system costs as % GDP (including auction payments)	2030	2035	2040
Industry	2.0%; 2.3%	2.1%; 2.4%	2.2%; 2.3%

Source: PRIMES and POTEnCIA models.

The overall energy-related costs in the first half of the decade in the CAP4 “accelerated 9085” scenario are around 5.7% higher than under the CAP 3 “9085” scenario for energy intensive industries and 2.6% higher for non-energy intensive industries. This is driven essentially by fuel costs, but also capital costs to some extent, due to the anticipation of some level of investment in the first half of the decade. Fuel costs over that period are higher in the CAP4 “accelerated 9085” scenario than in the CAP 3 “9085” scenario due to a more rapid uptake of new fuels and to higher ETS carbon values. However, the redistribution of ETS revenues to decarbonisation of the sector could be used to mitigate this effect (ETS allowances purchasing represents around 60% of the total increase in fuel costs between scenarios over 2031-2035 and around 25% over the entire decade).

The relative difference in energy system costs in the period 2036-2040 between both scenarios is limited to less than 2% for industry as a whole. This translates into an energy-related cost for the sector over the entire decade (2031-2040) being 3.4% higher in the CAP4 “accelerated 9085” scenario compared to the CAP 3 “9085” scenario. This includes about 0.8 pp related to ETS allowance expenditure by the sector itself, which could be recycled, as could, potentially, other ETS revenues.

Table 10: Energy system costs in ETS sectors, deviation of the CAP2 ‘85’ and CAP4 “accelerated 9085” scenario relative to CAP 3 “9085” scenario

		2031-2035	2036-2040	2031-2040
CAP4 “accelerated 9085” scenario relative to CAP 3 “9085” scenario	Industry	+5.1%	+1.8%	+3.4%
	Energy intensive	+5.7%	+2.4%	+3.9%
	Non-energy intensive	+2.6%	+0.1%	+1.4%
CAP 2 “85% trajectory” scenario relative to CAP3 “9085”	Industry	-2.6%	-0.9%	-1.7%
	Energy intensive	-3.0%	-1.2%	-2.0%
	Non-energy intensive	-1.2%	-0.3%	-0.8%

Source: POTEnCIA model.

A significantly larger impact can be expected for the CAP5 ‘90% extended legal default’ scenario, with increases in industry system costs scenario of 13% in 2031-2035 compared to the CAP 3 “9085”.

Energy system costs are lower in the CAP2 “85 trajectory” compared to CAP 3 “9085 scenario, -2% for energy-intensive industries and -1.7% for industry as a whole. The difference is notable in the first half of the decade (e.g. -3.0% for energy-intensive industry) and more limited in the 2036-2040 period (-1.2% for energy-intensive industry). This illustrates the higher costs related to energy purchases and higher ETS carbon values in a scenario which frontloads ambition and rely on more expensive new fuels.

The 2040 Climate Target Impact Assessment⁴ presented projections of electricity prices for industry in the context of electrification of the economy in different decarbonisation scenarios. Compared to the CAP 3 “9085” scenario, projections show that electricity prices for industry could be slightly higher in the CAP4 “accelerated 9085” scenario by around 1.5% in 2035 but

⁴ SWD(2024) 63 final

would be similar in 2040 in both scenarios. In the CAP5 ‘90% extended legal default’ scenario, electricity prices in 2035 are higher by around 2.5% compared to the CAP3 scenario.

However, it should be noted the modelled impacts do not represent all the impacts, nor their potential mitigation through complementary policies.

System cost impacts could be mitigated through distribution of ETS auctioning revenues and supporting policies. Investments, when frontloaded in the decade, are lower in the last five years. The frontloading of investments would increase the probability of faster technological developments through scaling up and learning by doing. It would allow a fast electrification of the energy system and increase Europe’s energy independence. As pointed out in the 2040 Climate Target IA, this will also depend on Europe’s ability to secure supply chains for new technologies.

A further impact on the estimated carbon budgets, as well as on economic impacts such as costs, can be expected from the announced Investment Booster, that will be allocated for 2027-2030 (but paid out over a longer period) and the separate proposal on benchmark updates for 2026-2030 that will result in distributing more and earlier free allowances from the buffer before 2030. These are explained in more detail in the Annex on the market stability reserve. The investment booster of 400 million allowances represents a significant volume of allowances that will be introduced gradually into the market, which are not represented in caps for phase V set on the basis of modelled emissions. To have the most beneficial effect on decarbonisation and carbon values in the next decade, investments should be boosted and scaled up as soon as possible. This will have the double effect of lowering medium to long term emissions through investment support and of increasing supply on the carbon market also resulting in a price dampening effect.

1.6. Components of the policy options - Inclusion measures:

1.6.1. Removals

For setting the net ambition objective for the EU ETS including removals, we estimate the total volume of removals stored underground in PRIMES and POTEnCIA (EU) estimates for the 85% scenario. These include removals from Biogenic Emissions Capture with Carbon Storage (BioCCS) and from Direct Air Capture with Carbon Storage (DACCS). See section Annex 8 - Removals on the choice of removals considered for ETS integration.

The total eligible removals in the EU are estimated to be:

Table 11: Total eligible removals in the EU, PRIMES and POTEnCIA

85% PRIMES scenario EU	2030 (Mt)	2035 (Mt)	2040 (Mt)	2031-2040 (Mt)
Removals stored underground	5	5	45	170

85% POTEnCIA scenario EU	2030 (Mt)	2035 (Mt)	2040 (Mt)	2031-2040 (Mt)
Removals stored underground	10	25	60	330

85% ranges in models EU	2030 (Mt)	2035 (Mt)	2040 (Mt)	2031-2040 (Mt)
Removals stored underground	5-10	5-25	45-60	170-330

Source: PRIMES and POTEnCIA models.

If removals are included in the EU ETS on top of the cap of allowances, then the cap of allowances would be set at the level of *net emissions* (i.e. the gross emissions estimate minus the estimate of removals). If removals are excluded from the ETS, or if they are included in a “one in, one out” system, then the cap of allowances will be set at the gross emissions level, unaffected by the estimated amount of removals (see the annex on Removals for a representation of the integration on top or under the cap).

Note that if all these removals are made available to the EU ETS to hit its target, they will no longer be available for other sectors. Conversely, if these are included in the net objective of the EU ETS, then the carbon price combined with complementary instruments for the support of removals will need to deliver on the implicit removals objective.

Finally, it should be clear that removals are a novel technology, just as the final abatement options for the hardest-to-abate sectors. The balance of reductions and removals in 2040 thus remains, to an extent, uncertain.

1.6.2. Waste

Emissions from waste management activities are complex to estimate. Based on the emissions reported by member states under the EU ETS MRV obligation, municipal waste incineration emissions in 2024 were around 38.0 Mt for the EU and 38.7 Mt at the EEA level. Taking these reporting data, taking into account a buffer for some missing reporting data and allowing for projected capacity growth (see Annex 13, section 1.2.1.) leads to an estimation of the increase in the cap “base level” due to the inclusion of municipal waste incineration by an amount of 41.5 Mt at EU level and 42.2 Mt at EEA level.

For hazardous waste incineration, comprehensive disaggregated data on emissions are not available. Based on the volume of hazardous waste incinerated and the standard emission factor, EU emissions have been estimated at around 9.5 Mt in 2022, with the cap increase modelled at 10.7 Mt taking into account a buffer for underestimation and new capacity.

For landfilling, the available EU-wide data on GHG emissions from non-hazardous landfills are mainly based on default emission factors, with limited availability of measurement-based data posing constraints on harmonised, robust and verified data. Based on UNFCCC GHG Inventory data, emissions from non-hazardous landfills were estimated to be around 73.9 Mt in 2023. Due to the policy framework in place policies to reduce landfilling and biogenic emissions from landfilling, the increase of the cap at EU “base level” is estimated to be around 65 Mt, and 67 Mt for the EEA, the reduction % compared to 73.9 Mt being estimated from the GAINS model.

1.7. Policy Options cap setting

This section explores the cap trajectories for the different policy options using the 85% scenario by PRIMES and POTEnCIA models. The 85% model was selected to enable comparability across the different policy option elements (e.g. removals, waste inclusion), while avoiding constraining the LRF in 2035.

1.7.1. Policy option 1

The cap for PO1 is based on the gross emissions estimate for currently included sectors (excluding extra- EU aviation). The LRFs are calculated and ranges for the caps are given. Note that the modelling is based on an assumption that extra EU aviation is included in the EU target, if not in the ETS cap.

Table 12: Table on PO1 in PRIMES and POTEnCIA, as well as approximate table

EEA cap (Mt), LRF(%) and carbon budget (Mt)	2030	2035	2040	LRF 2030-2035	LRF 2035-2040	Carbon Budget 2031-2040
PO1 PRIMES	847	520	280	-3.1%	-2.3%	5120

EEA cap (Mt), LRF(%) and carbon budget (Mt)	2030	2035	2040	LRF 2030-2035	LRF 2035-2040	Carbon Budget 2031-2040
PO1 POTEnCIA	847	615	335	-2.3%	-2.7%	5775

EEA cap (Mt), LRF(%) and carbon budget (Mt)	2030	2035	2040	LRF 2030-2035	LRF 2035-2040	Carbon Budget 2031-2040
PO1	847	520-615	280-335	3.1-2.3%	2.3-2.7%	5120-5775

To attain the net objective, an instrument outside the EU ETS, the public purchasing programme, would need to attain the removals objectives.

1.7.2. Policy option 2

For PO2, the cap is set at the level of estimated net emissions, including extra EEA aviation. Therefore, the estimated removals are added to the gross emissions trajectory for the EU as estimated by PRIMES as well as POTEnCIA, and the LRFs are recalculated, leading to a somewhat higher reduction rate. This new LRF is then applied to the increase of the base cap due to the inclusion of Municipal Waste Incineration. It should be noted that this leads to a far lower total reduction of MWI compared to other ETS sectors between 2031-2040. It can therefore be seen as a relatively generous cap adjustment.

The total caps therefore represent stationary sectors, international maritime navigation (including non-CO2 emissions), all international outgoing aviation and municipal waste incineration.

With regards to maritime, the possible extension of the system to smaller ships (below 5000 gross tonnage but not below 400 gross tonnage) would lead to a cap increase estimated at around 11.3 MtCO2 for PO2.

Table 13: Table calculating PO2 in PRIMES and POTEnCIA, as well as approximate table

Caps (Mt), LRF (%) and Carbon Budget (Mt) PRIMES	Net emissions trajectory EU	Net emissions trajectory EEA	MWI allocations	Total EEA cap
2030 legal cap	894	911	42	911
2035	565	575	36	610
2040	275	280	30	310
LRF 2030-2035	-3.1%	-3.1%	-3.1%	-3.1%

LRF 2036-2040	-2.7%	-2.7%	-2.7%	-2.7%
Carbon Budget 2031-2040				5890

Caps (Mt), LRF (%) and Carbon Budget (Mt) POTEnCIA	Net emissions trajectory EU	Net emissions trajectory EEA	MWI allocations	Total EEA cap
2030 legal cap	894	911	42	911
2035	630	645	37	680
2040	305	310	30	340
LRF 2030-2035	-2.5%	-2.5%	-2.5%	-2.5%
LRF 2036-2040	-3.1%	-3.1%	-3.1%	-3.1%
Carbon Budget 2031-2040				6330

Caps (Mt), LRF (%) and Carbon Budget (Mt) Ranges	Net emissions trajectory EU	Net emissions trajectory EEA	MWI allocations	Total EEA cap
2030 legal cap	894	911	42	911
2035	565-630	575-645	36-37	610-680
2040	275-305	280-310	30	310-340
LRF 2030-2035	3.1-2.5%	3.1-2.5%	3.1-2.5%	3.1-2.5%
LRF 2036-2040	2.7-3.1%	2.7-3.1%	2.7-3.1%	2.7-3.1%
Carbon Budget 2031-2040				5890-6330

1.7.3. Policy option 3

In this option, the cap is set at the level of gross emissions and includes MWI, hazardous waste and landfills. The approach for including the latter two sectors is similar, except that the lower reduction rates (LRFs) of the gross cap are applied, leading to the below result. The inclusion of MWI, HWI and landfill expands the scope by 120 Mt in 2030. From 2031 onwards, this additional sector is integrated into the cap. While the same LRF is being applied as for the other sectors of the ETS cap, the rate of decrease is comparatively slower, as its reference base is set at 120 Mt in 2030, whereas the remainder of the cap follow the reference base defined in Article 9 in the ETS Directive.

The total caps therefore represent stationary sectors, international maritime navigation (including non-CO₂ emissions), all international outgoing aviation and municipal and hazardous waste incineration, as well as landfills.

Table 14: Table showing the cap for PO3

Caps (Mt), LRF (%) and Carbon Budget (Mt) PRIMES	Gross emissions 85% trajectory	MWI allocations	HWI and Landfill allocations	MWI, HWI and Landfills	Total EEA cap
2030 legal cap	911	42	78	120	911
2035	580				680
2040	330				420
LRF 2030-2035	-3.1%				-3.1%
LRF 2036-2040	-2.3%				-2.3%
Carbon Budget 2031-2040					6715

Caps (Mt), LRF (%) and Carbon Budget (Mt) POTEnCIA	Gross emissions 85% trajectory	MWI allocations	HWI and Landfill allocations	MWI, HWI and Landfills	Total EEA cap
2030 legal cap	911	42	78	120	911
2035	670				775
2040	375				465
LRF 2030-2035	-2.3%				-2.3%
LRF 2036-2040	-2.7%				-2.7%
Carbon Budget 2031-2040					7335

Caps (Mt), LRF (%) and Carbon Budget (Mt) Ranges	Gross emissions cost-effective trajectory	MWI allocations	HWI and Landfill allocations	MWI, HWI and Landfills	Total EEA cap
2030 legal cap	911	42	78	120	911
2035	580-670				680-775
2040	330-375				420-465
LRF 2030-2035	3.1-2.3%				3.1-2.3%
LRF 2036-2040	2.3-2.7%				2.3-2.7%
Carbon Budget 2031-2040					6715-7335

For maritime, the possible extension of the system to smaller ships (below 5000 gross tonnage but not below 400 gross tonnage) would lead to a cap increase estimated at around 14,6 MtCO₂ for PO3 (inclusion of all categories of ships).

ANNEX 8: PART II – REMOVALS

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1. INTRODUCTION

1.1. Context of the assessment of the integration of domestic carbon removals in the EU ETS

Reaching the EU **economy-wide net-zero target** by 2050 will require significant GHG emission reduction efforts by all sectors. There will, however, be residual hard-to-abate emissions remaining in the EU economy. In accordance with the European Climate Law, these emissions will have to be balanced out with carbon removals in order to achieve climate neutrality at the latest by 2050, thus reducing emissions to net zero by that date, and negative emissions thereafter. This sequential role for removals is aligned with view of the European Advisory Board on Climate Change and the IPCC. They emphasise, that whereas removals cannot substitute deep emission reductions, they can fulfil different, complementary roles, at different points in time⁵.

Carbon removals are thus introduced as a **flexibility for the near-term in the European Climate Law** to allow the EU to reach its 2040 climate target in a more cost-efficient way, as some emissions will be more cost-efficient to offset through removals than to abate. In particular, they can contribute to compensate remaining hard-to-abate GHG in sectors covered by the EU ETS. In that context, the EU ETS should contribute to their uptake and financing, including because they can be generated by activities already under the EU ETS. Foregoing the flexibility provided by carbon removals would be at the cost of the EU's competitiveness and the environment, while the integration of removals can support competitiveness by keeping an EU ETS with a positive cap.

As the EU ETS cap reduces, **the system may face a number of challenges that the integration of removals can address**. The market for EUAs will be smaller, therefore possibly more volatile and with a lack of effective price discovery in the EU ETS, potentially undermining the effectiveness (and credibility) of the system (P2). As emissions across Europe are reduced, the remaining abatement potential of ETS covered entities naturally decreases and becomes more expensive. As the cap and abatement potential decreases, EUA prices could become very high, in turn undermining political support for the system (P1).

Removals could, together with other adjustments to the system such as on the cap and MSR, contribute to cost containment and improving liquidity in the EU ETS as its cap shrinks, in addition to providing an avenue to incentivise the development and deployment of nascent negative emissions technologies. From this perspective, removals contribute to the objectives of increasing additional gross emissions space without increasing overall net emissions (O1.2) and of avoiding carbon leakage (SO.1.1.3); and to the objective of increasing the size of the market (SO2.1.1.) to ensure efficient market functioning (O2.1). As a result, this impact assessment does not consider measures in which the ETS sets a cap at the level of the net target

⁵ IPCC, 2022e, 'Chapter 3: Mitigation Pathways Compatible with Long-term Goals', in: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, and "Scaling up carbon dioxide removals – Recommendations for navigating opportunities and risks in the EU" from the European Scientific Advisory Board on Climate Change.

In the near term, removals can further reduce net GHG emissions. This would accelerate the transition to net zero and reduce cumulative emissions before reaching, thereby reducing peak warming, the risk of tipping points and irreversible climate impacts. In the medium term, they are needed to counterbalance residual CO₂ emissions to halt CO₂-induced warming. Thereafter, achieving and sustaining net-negative CO₂ emissions to achieve overall net zero greenhouse GHG emissions would reverse warming in the medium-term. In the longer term, removals might be needed to sustain overall net-negative GHG emissions, to further reduce global temperatures.

and includes removals under the cap – often called ‘maintaining the cap’ – which would not provide additional emissions space and instead increase ambition’.

In the long-run, removals may become a cost-optimal solution for residual hard-to-abate emissions in the ETS. Nevertheless, the current **price-difference between removals and EUAs means that removals will need to be supported**, to ensure their generation in line with the additional emission space that is considered in the ETS. Therefore, from an ETS perspective, a central question is how much space is assigned to the ETS and how removals are paid for. If the Union aims to grant the ETS-sectors the additional space to emit (via a higher cap) but removals are not integrated in the EU ETS or financed from auction revenues, then other sectors or the public budget will need to finance the purchase of removals (for example through a separate purchasing programme or a ‘removals trading system’⁶). Those measures are discarded in 2.2. In a trajectory towards climate neutrality, it is considered fair that each policy instrument is **made responsible for its own emissions space** to the degree possible. This is also closest to the polluter pays principle.

Looking beyond 2040, alternative or complementary mechanisms to generate removals need to be developed to reach net-zero in 2050 and net-negative emissions afterwards (beyond the emissions still happening and that are offset by the emitting activities. See some examples in the section on measures which are discarded for this initiative, but which could be essential in the future in section 1.2.2.

This impact assessment assumes that:

- The EU ETS sectors are **benefitting from the additional emissions space provided by the removals that can be integrated in the system because they meet the minimum requirements** for such integration set out in section 3. These are all the BioCCS and DACCS removals that are modelled. As a result, these removals are assumed not to be available to contribute to other sectors’ ambition level. The minimum requirements for integration are developed from the basic idea that the surrendering of a removal unit replaces the surrendering of an emission allowance, which represents the payment of the price for having emitted a tonne of CO₂. Therefore, a removal unit needs to cancel out fully and permanently the effect of having emitted one tonne of CO₂, to replace having to pay for that tonne of CO₂.
- The **net target of the ETS is the equivalent of the gross emissions minus the removals that are subject to integration.**
- The **EU ETS must ensure that an amount of removals equivalent to those it counts on for extra space is generated through the integration:**
 - to ensure that ETS achieves its net contribution to the EU target⁷ and
 - to ensure that the ETS sectors have the emissions space that is represented by the relevant removals⁸, ultimately to avoid carbon leakage and protect the EU's competitiveness.

⁶ In this case ‘removals trading system’ refers to a system based on an obligation to remove carbon imposed on different entities, or partly different entities, from those in the ETS1, and where the obligation is not connected to the emissions produced under the ETS1.

⁷ In those integration models in which the emissions space is guaranteed (1-in-1-out/MSR/public authority- see section 2.1 for detailed description) financing removals will still be essential, in that case to ensure the removals are purchased to compensate for the additional emissions that are issued, so the ETS achieves its net target.

⁸ If not subsidised, in the integration options on top of the cap (see section 2.1 for full description) the ETS sectors will have the same emission space they would have without removals in the economy, as only few BECCS removals would be purchased in the late 2030s (see Table 3).

- Financing measures will need to be developed to that effect, taking into account the price differential between carbon removals and EUAs.

1.2. Considerations for the assessment of the integration

The inclusion of carbon removals is subject to several challenges, such as the risk that necessary abatement action be delayed or replaced by removals (also known as ‘abatement deterrence’). A second challenge concerns the need to ensure that carbon removals are permanent and appropriately quantified. Article 30(5) of the ETS Directive requires that the Commission report on how negative emissions resulting from GHG emissions that are removed from the atmosphere and safely and permanently stored (see section 1.3 on definitions different types of removal activities) could be accounted for and how those negative emissions could be covered, if appropriate, by emissions trading. This consideration needs to include (a) a clear scope, (b) strict criteria for any such trading, and (c) safeguards to ensure that carbon removals do not reduce the incentive to reduce emissions as required by the EU Climate Law.⁹

The Commission has developed the Carbon Removal and Carbon Farming (CRCF) Regulation (EU) 2024/3012, which entered into force in December 2024.¹⁰ The CRCF Regulation aims to create an EU-wide voluntary framework for certifying different types of carbon removal activities across Europe. Certified removal units will be issued for carbon removal activities that take place within the EU. The Commission has developed the methodologies to quantify and certify the carbon removals associated with three types of activities (BioCCS, DACCS and Biochar), adopted in a Delegated Act on 2 February 2026¹¹.

Units issued under the CRCF will be issued for permanent carbon removals, carbon storage in products, carbon farming sequestration and, in addition, for soil emission reductions (which do not represent removals but sit within the same framework). The CRCF is only a voluntary certification framework ensuring the quality of carbon removals and would require a clear source of demand for these certified units to help to incentivise and drive the development of carbon removal activities. The EU ETS could be that clear source of demand if CRCF-certified permanent carbon removals are integrated in the system.

In the open public consultation, 77% of respondents, mainly companies/businesses and business associations, disagreed or strongly disagreed with the statement “*Removals certified under the CRCF should NOT be allowed for use by ETS1 regulated entities towards their compliance obligations*”. There is thus very strong support among public consultation respondents to the integration of CDR in the EU ETS. In their answers, respondents in favour of CDR inclusion most frequently mentioned the need for CDR in order to achieve the EU’s long-term climate objective, in addition to the need to support the development and deployment of such technologies, enhancing liquidity under the EU ETS and flexibility for operators in how to best achieve compliance. Those against the inclusion of CDR in the EU ETS (12%) mentioned concerns over abatement deterrence as well as the environmental risks associated with CDR that could undermine the environmental integrity of the EU ETS. In addition, during the stakeholder interviews, one of the market observers supported the need to scale up CDR

⁹ DIRECTIVE (EU) 2023/959 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union and Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading system

¹⁰ CRCF Regulation 2024/3012 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L_202403012

¹¹ Brussels, 3.2.2026 C(2026) 553 final COMMISSION DELEGATED REGULATION (EU) 2024/3012 of 3.2.2026 supplementing Regulation (EU) 2024/3012 of the European Parliament and of the Council by establishing the certification methodologies for permanent carbon removals activities, OJ L, 2024/3012, 6.12.2024

while expressing concern that if integrated into the ETS, the impetus to develop other mechanisms to support the scale up of removals could be lost.

A first question considered in this chapter, thus, pertains to which types of carbon removals should be allowed into the EU ETS, so as to safeguard the environmental integrity of the system. The inclusion of removals into an ETS rests on the fundamental assumption that emissions and removals are, to some extent, fungible with (or equivalent to) each other. Yet this is subject to several challenges, foremost among them permanence and quantification, which create uncertainties in the carbon that is removed over time. It is necessary to clarify the relationship between the EU ETS and the CRCF, e.g., in terms of the types of units and methodologies (if any) that are deemed eligible, and of removal quantification, which includes the treatment of life cycle emissions in the CRCF methodologies versus the EU ETS MRV approach. The decision on which types of carbon removals should be allowed into the EU ETS is also impacted by the way in which carbon removals could be integrated into the EU ETS.

A second question pertains therefore to how carbon removals could be integrated into the EU ETS. Among several options, the EU ETS and the market for removals could be disconnected, connected through a public authority, or fully integrated. Several key considerations apply, including the challenge of balancing economic efficiency with the need to address abatement deterrence. This analysis considers the technical elements of the practical implementation of the options, such as the integration of removal units into the Union Registry, as well as the link with the planned EU-wide CRCF Registry. In terms of how CDR should be integrated, 56% of open consultation respondents (mainly from the energy and waste management sectors, with smaller shares from the manufacturing industry) agreed or strongly agreed with the statement “ETS1 regulated entities should be allowed to purchase CRCF removals directly from removal suppliers and use them to fulfil surrender obligations”, whereas only 15% disagreed or strongly disagreed with it. Asked whether “CRCF removals should be acquired by a central agency and inserted into the ETS1 under specific conditions”, 25% agreed or strongly agreed, with 36% disagreeing or strongly disagreeing. Respondents in favour of channelling removal units through a central authority mentioned that the body could act as a buyer, offering offtake agreements to help CDR developers secure predictable outcome. Respondents against the central agency cited concerns over competition distortion, unnecessary bureaucracy and reduced market predictability. The policy measures cover the mode of integration into the ETS and the relationship between removal inclusion and the ETS cap.

Setting quantitative limits on the amount of removals that are integrated in the ETS can be key in safeguarding the integrity of the system, especially in the early phases of removal integration. As part of the assessment on how to integrate removals, a question is whether there should be limits on the amount of carbon removals allowed into the EU ETS and how any limits could be implemented such as supply side versus demand side limits and the relationship between any limits and the overall ETS cap.

All these questions need to take into account that removals are a very young and innovative industry. Removals are not ready-made off-the-shelf-products, but rather products of an infant industry that still needs to scale-up and reduce the cost curve. Thus, some modes of integration may be more appropriate than others depending on the type of removals that could be integrated at each point in time, and some measures may be more suited for the short-run kick-off, others for the scale-up, and yet others for a longer-term framework towards net-negative. This impact assessment focuses mainly on those measures for the 2031-2040 period.

To address all of these questions:

- section 2 sets out the **different policy measures with an assessment of their impacts**.
- section 3 explores the question of **which types of carbon removal** could be considered for inclusion in the EU ETS, whilst ensuring the environmental integrity of the system.
- section 4 **cross-cutting design elements for the policy measures**, including the equivalence between the CRCF and the EU ETS accounting, and considerations on limits

2. POLICY MEASURES

2.1. Measures under consideration

This section assumes a baseline in which CDR is not integrated into the EU ETS. The cap (expressed in the number of conventional allowances issued by the regulator) would continue decreasing in line with the present-day linear reduction factor and reach zero in year 2044. This section outlines the measures considered in this impact assessment, beyond this baseline. The measures explored below vary across three key dimensions:

- Whether or not the flow of CDR into the EU ETS is subject to **limits**, exploring two possibilities: limited or unlimited. With the exception of CR2 ('Unlimited operator integration on top of the cap'), all measures below would see a limit on the flow of CDR into the EU ETS. Note that issues related to limits are further explored in section 4.4. Considerations on CDR limits.
- Mode of integration**, or how the EU ETS is connected with the market for removals. The measures below explore two possibilities: integration through the private sector ('operator integration') or integration through a public authority. Operator integration means that regulated emitters purchase removal units directly from CDR suppliers¹². By contrast, under public authority integration, it is a public authority that purchases the removal units and distributes or auctions them in the EU ETS¹³.
- The **relationship between removal units and the EU ETS cap**: on top of the cap or under the cap. The EU ETS cap is the total number of conventional allowances⁵⁴ issued by the regulator. The cap sets the maximum net emissions allowed by the system.¹⁴ When removal units are used 'on top of the cap', gross emissions¹⁵ are limited by the cap plus the allowed number of removal units. In the case of a private integration under the cap, as in CR3, removal units are integrated through a one-in-one-out approach, whereby an EUA is cancelled for each removal unit used in the EU ETS. This one-in-one-out mechanism implies that gross emissions in ETS regulated sectors are limited by the cap from the outset. In the case of a public

¹² The measures are designed assuming the private sector integration is carried out mainly by ETS regulated entities. However, the private sector integration can be envisaged more broadly, with a range of options that extend from the integration to certain financial market participants (credit institutions, investment firms, and commodity traders) when acting on behalf of clients; to those financial market participants when acting for their own accounts; to anyone with a Union Registry account; or also to suppliers. Section 4.3 examines the integration options for private entities.

¹³ Section 4.6 explores how the purchasing of removals could operate

¹⁴ 'Net emissions' refers to releases of GHG minus removals by anthropogenic sinks. In an ETS, since the use of conventional allowances enables unabated emissions to reach the atmosphere, the ETS cap (as the sum of conventional allowances) sets the limit on net emissions from ETS regulated entities. Contrast this with removal units, whose use in an ETS would lead to net zero emissions.

¹⁵ 'Gross emissions' refers to releases of GHG before accounting for removals by sinks. In an ETS, gross emissions are limited by the total volume of compliance units (e.g. conventional allowances and removal units) in circulation.

authority integration, removals are purchased by the public authority 1:1 for the allowances that are part to the gross cap that should be compensated by removals to reach the net target.

Table 1: Design of the measures

	CR1	CR2	CR3	CR4	CR5
Limits	Limited	Unlimited	Limited	Limited	Limited
Mode of integration	Operator	Operator	Operator	Public authority (regular auctions)	Public authority (MSR)
Relationship with the cap of conventional allowances	On top of the cap	On top of the cap	Under the cap	Under the cap ¹⁶	On top of the cap

- **CR1: ‘Limited operator integration on top of the cap’:** The regulator determines the total number of conventional allowances, which can be positive or zero. The number of conventional allowances determines net emissions from the system. There is a limit on the number of removal units that can be used towards EU ETS compliance obligations, which means that gross emissions from operators (that is, from regulated emitters in the EU ETS) are also subject to a limit. The limit on CDR supply applies to the entire phase (rather than, for example, a yearly limit). ETS operators buy removals directly from CDR providers and use them towards EU ETS compliance obligations. The CDR limit is assumed to be set at the range of the modelling expectation for CDR supply in the 85% scenario, between 175 and 330 Mt for the period 2031-2040 (see Table 3 further below).
- **CR2: ‘Unlimited operator integration on top of the cap’:** The regulator determines the total number of conventional allowances, which can be positive or zero. The number of conventional allowances determines net emissions from the system. There is no limit on the number of removal units that can be surrendered by operators, such that there is no limit on gross emissions from operators. Operators buy removal units directly from CDR providers and can use them towards EU ETS compliance obligations.
- **CR3: ‘Limited operator integration under the cap (one-in-one-out)’:** The regulator increases the number of conventional allowances by the same amount as the modelling expectation for CDR supply in the 85% scenario, between 175 and 330 Mt for the period 2031-2040, through an increase in allowance auction volumes distributed throughout the period. This increase is not conditional on removal units flowing in but does set the maximum number of removal units that can be used in the EU ETS for the period. The total number of allowances is adjusted following a ‘one-in-one-out’ approach whereby every removal unit used by an operator leads to the cancellation of an allowance by

¹⁶ This measure could be designed as ‘on top of the cap’ if the auctioning of removals-backed allowances was made conditional on the delivery of the removals and the removal-back allowances would be auctioned on top of the net cap. However, the measure is designed so the public authority bears the risk of being able to buy the right amount of removals, making it an ‘under the cap’ measure where the integration happens indirectly by the purchase by the authority of the removal units necessary to compensate the allowances previously added to the net cap.

withdrawing it from a future auction. The use of a removal unit, therefore, does not affect gross emissions, but reduces net emissions compared to the (increased) number of conventional allowances because the total number of allowances declines. As such under CR3 gross emissions are determined by the number of conventional allowances, and are not influenced by the use of CDR. The volume of net emissions depends on the number of removal units that actually makes it into the system, with its upper limit at the gross emissions limit. To ensure there are sufficient allowances to cancel for every removal used, the use of removal units would also be limited by the auction volume of the following year – such that the maximum number of removal units that can be used in year X is equal to the allowance auction volume of year X+1. The auction volume would, moreover, also act as a safeguard limit on the use of CDR in the EU ETS in case removal units drop radically in price and/or increase in supply.

- **CR4: ‘Public authority integration through regular auctions under the cap’¹⁷:** The regulator determines the total number of conventional allowances, which can be positive or zero. The number of conventional allowances determines net emissions from the system. Removal units flow indirectly into the ETS through regular auctions by a public authority, which adds “removal-backed allowances” (RBAs) to the cap based on the commitment of purchasing the equivalent pre-set amount of removal units from CDR suppliers. Funding will need to be made available for the public authority to purchase the removals. The cumulative amount of removal units purchased is assumed to be set at the modelling expectation for removal unit supply in the 85% scenario, between 175 and 330 Mt for the period 2031-2040 and an equivalent amount of removals-backed allowances will be auctioned in the EU ETS. The auction of “removal-backed allowances” (RBAs) helps increase the total amount of allowances that can be auctioned and thus the emissions space in the system. The use of removal units is limited to the pre-set purchases of removal units by the regulator, such that gross emissions by operators are also subject to a limit.
- **CR5: ‘Public authority integration through MSR on top of the cap’:** The regulator determines the total number of conventional allowances, which can be positive or zero. The number of conventional allowances determines net emissions from the system. The regulator purchases pre-set amounts of removal units, which are placed in the MSR in the form of removals-backed allowances added to the number of allowances already in the MSR. The amount of CDR purchased is assumed to be set at the modelling expectation for CDR supply in the 85% scenario, between 175 and 330 Mt for the period 2031-2040. When called into action, the MSR releases the units it holds in line with its parameters and rules at the time. When they are eventually released, the removal-backed allowances from the MSR allow for an increase in gross emissions while maintaining net emissions constant. The use of removal-backed allowances is limited to the pre-set purchases of removal units by the regulator, such that gross emissions by operators are also subject to a limit.

¹⁷ Although the main feature of this measure is the integration by the public authority with a prior increase of the cap based on the amount of removals that are planned to be purchased, it can be combined with the integration by the ETS regulated entities that generate removals. This option could be introduced to give these more flexibility, would these installations prefer to use the removals they generate themselves, instead of selling them to the public authority. The decision would be uneconomical in most cases, given the expected price differential. To respect the gross emissions limit that is determined by the pre-increased cap in CR4, any removals used by regulated entities would lead to the cancellation of a removal-backed allowance, as in the CR3 one-in-one-out approach.

This graph represents the relationship between each measure and the cap. The red line represents the total number of allowances of the system (the ‘cap’ of allowances). Together with any removal units used **on top** of the cap, they provide the total emission space allowed in the EU ETS.

Figure 1: Relationship of CDR with the cap in the measures

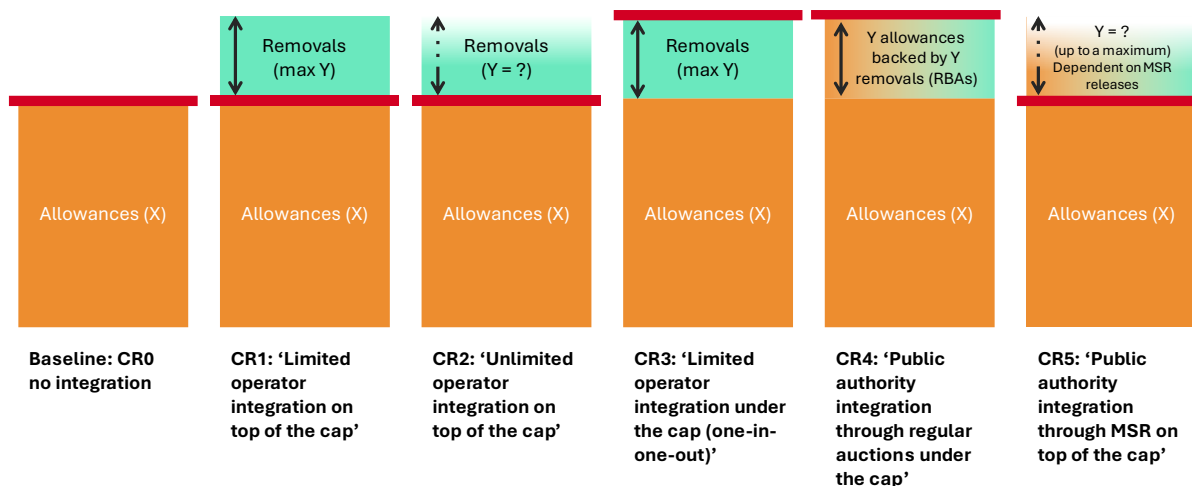


Table 2: Summary of the net and gross emissions certainty in the measures:

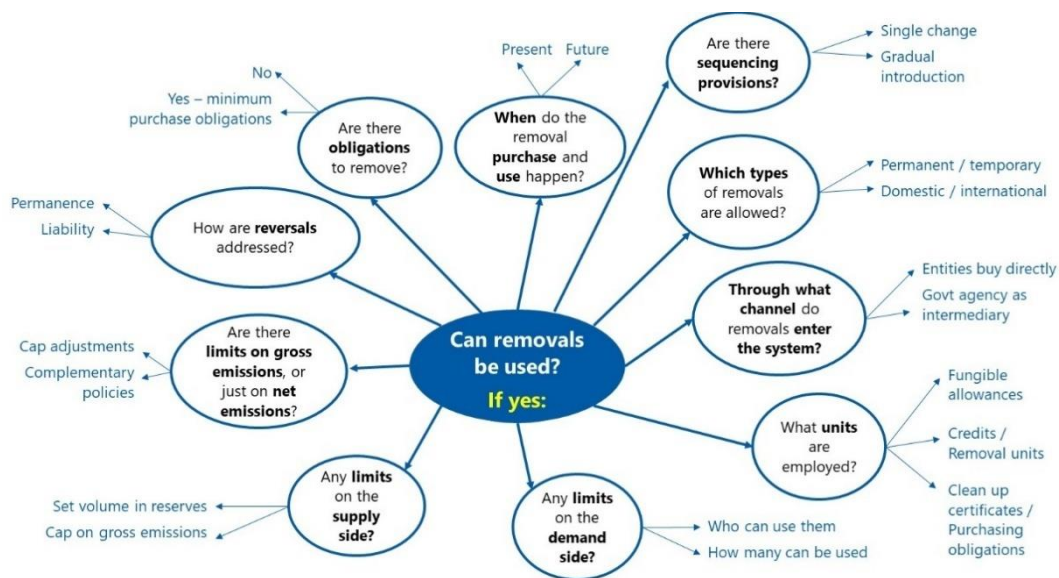
	CR1	CR2	CR3	CR4	CR5
Net emissions	Certain, determined by the cap		Uncertain, dependent on removal units used. <i>Uncertainty can be reduced if financing is provided to support removals, e.g. through contracts for difference</i>	Certain, determined by the cap, <i>conditional on the public purchasing program being provided sufficient funding to purchase the removals by which the cap is increased</i>	Certain, determined by the cap
Gross emissions	Uncertain <i>Uncertainty up to the ceiling of the limit Uncertainty can be reduced if financing is provided to support removals, e.g.</i>	Uncertain and unlimited <i>Uncertainty can be reduced if financing is provided to support removals, e.g. through</i>	Certain, determined by the pre-increased cap	Certain, determined by the cap	Uncertain, dependent on MSR releases, but limited

	through contracts for difference	contracts for difference			

2.2. Measures discarded at an early stage

A number of measures have been proposed in the literature and in stakeholder consultations for the potential integration of removals and international credits into ETSs. Several dimensions are relevant to designing these options. This figure provides a few examples.

Figure 2: Dimensions for the inclusion of removals in ETSs



Source: La Hoz Theuer (2024)

A few measures and dimensions have been discarded for this impact assessment:

- Demand-side restrictions based on a sector-specific judgement of what emissions are ‘hard-to-abate’.** For example, a restriction where only a particular sector or only a particular emissions source would be eligible to make use of removal units, thereby limiting the benefit from the additional space for gross emissions in the system. Establishing limits on who can use removal units entails implicitly defining which emissions are unavoidable and which of those should remain in society - which is highly disputed, subject to change and can be defined in myriad technical, societal, political and economic terms. Demand-side restrictions create substantial administrative complexity, requiring regulators to continuously assess and categorise which emissions qualify as "hard-to-abate" across diverse industries, whilst opening the system to lobbying pressure as sectors compete for preferential treatment and opening the door to political and technical disputes. They are also likely to fragment the market and reduce economic efficiency. Imprecisions in the decision-making by the regulator can further lower economic efficiency of the system. Such deliberations and decisions were considered to be politically unfeasible at this stage. In addition, as long as removals remain more expensive than conventional allowances, demand-side restrictions would not be binding, but they would nevertheless shrink the pool of potential buyers, so that removals may sustain higher prices for a longer period.
- Obliging entities to cover a percentage of their ETS emissions with removals.** For example, requiring that ETS-covered entities cover a certain percentage of ETS compliance obligations with removal units. Removals are a way to provide flexibility

to ETS operators, rather than as an obligation to purchase more expensive compliance units for their ETS-covered emissions. While purchase obligations may be an effective way of incentivizing removals and are aligned with the polluters pay principle if corresponding to the additional emissions spaced offered in the EU ETS by removals, they are considered unfeasible within the scope of the EU ETS review at this stage. In the long run, this may be reconsidered in the light of net-negative objectives.

- **Establishing separate removal mandates or carbon take-back obligations, or extended emitter responsibility instruments through the EU ETS**, e.g. establishing a separate ‘removals trading system’, imposing removal obligations on selected sectors/entities, or requiring that e.g. fossil fuel producers surrender removal units for their scope 3 emissions, i.e. the CO₂ contained in their products. Such instruments are not considered viable options for EU ETS review at this stage, due to the lack of political feasibility of imposing new obligations on existing ETS-covered and/or on new entities. An analysis on the viability of establishing separate instruments for incentivizing removals outside the EU ETS lies beyond the scope of this analysis. In addition, regarding a removals trading system established over the wider economy based on an ‘ability to pay’ is considered contrary to the polluters pay principle. Such a system would enable the increase of the cap of EU ETS, thus allowing the sectors covered to benefit from the corresponding emission space, while imposing the cost of the removals on other actors that do not influence the emission being compensated¹⁸. Nevertheless, it should be noted that the polluter pays principle will not be implemented perfectly as financial support is necessary to cover the price differential between removals and allowances. Such models should be analysed in the future as they may play a role in complementing towards net-zero and, more importantly, be essential towards achieving net-negative emissions¹⁹.
- **Establishing a central carbon bank (CCB)**. Proposals for the establishment of a CCB vary, but often include the tasks of managing the procurement of removal units, providing financial support to removal suppliers beyond the allowance price, acting as a warehouse for removal units, managing removal risks (such as from reversals), and managing price volatility and scarcity in the EU ETS by controlling the supply of compliance units, among others. Such an institution is not considered, among others due to the significant institutional and governance complexity. A rule-based system is considered favourable for market stability, transparency and avoiding political pressures. A simpler variant of this design, involving a public authority that manages a public purchasing programme, is envisioned as part of CR4 and CR5. The CCB has also been proposed as the institution to manage ‘clean-up certificates’, which would enable entities to emit while mandating future removal. These are discarded due to the lack of political feasibility as a result of their complexity (among others, requiring setting interest rates, collateral, and the creation of new credits); the environmental risk resulting from any mistakes in managing this complexity leading to an under delivery of the removals that justified increased emissions; and the delay in incentivising removals that could ensue.

¹⁸ This would not apply in case the removals trading obligation would be imposed also on entities that are directly involved in the polluting activity, such as the fossil fuel providers for the carbon embedded in their products.

¹⁹ CONCITO and CarbonGap’s analysis of a removals trading system is an example of studies that should continue being developed to gain further understanding of the potential functioning of such systems: <https://concito.dk/files/media/document/Modelling%20a%20Removal%20Compliance%20System%20in%20the%20EU.pdf>

- **Using international credits for compliance in the ETS directly through operator integration.** This was something often proposed in the open consultation but considered undesirable at this stage. Integrating the international credits to EU climate framework should be implemented preserving the principles of integrity and stability of the EU ETS. See section 3.1 on minimum requirements for removals integration. Allowing direct use of international credits for operators for their ETS compliance obligations as a means to create additional emissions space is **an option which cannot be implemented simultaneously** with the adjustment of the ETS cap to the EU-wide 85% domestic ambition target, which forms the basis for the impact assessment (see part I of this Annex on the cap). In other words, if a direct use of international credits through operator integration was allowed in addition to adjustment of the ETS cap, the 2040 EU domestic climate ambition would not be met. Thus, integrating the international credits by operators would require setting the ETS cap in line with an EU-wide 90% ambition target instead. Besides this first consideration, there are several drawbacks to direct integration into the EU ETS.

The EU has had direct experience of integration of Certified Emission Reductions (CERs) from the Clean Development Mechanism (CDM) into the EU ETS and discontinued this approach. Studies have raised concerns about the impact of this integration on the effectiveness and integrity of the EU ETS²⁰. The past experiences showed that allowing operators to purchase credits and use them directly for ETS compliance can be problematic. By contrast, adjusting the ETS cap equivalent to the amount of international credits that will be bought from projects outside of EU, is a straightforward approach that aligns with the fundamental principles of the system, ensuring a clearly defined cap, while still granting additional emission space.

Integrating international credits through operator purchasing involves considerable challenges. Firstly, under the Paris Agreement, all countries need to contribute adequately to efforts needed to achieve the Paris Agreement temperature goals. Private entities are not well placed to assess the issue of adequacy of the climate contribution of the countries. Economic theory would suggest that operators would seek to maximize their profits and acquire a maximum amount of the cheapest credits that they are legally allowed to use. Secondly, operators would need to navigate a complicated international credit market, expand their administrative capacities, and adhere to stringent often complex integrity criteria for credit purchasing. Additionally, it can be challenging for the public authorities responsible for the international credits to maintain rigorous oversight and compliance in relation to credit integrity. These issues would undermine the quality standards and other guarantees that the European Climate

²⁰ See e.g. Cames et al. 2016a; de Bruyn et al. 2016, Schneider and Kollmuss 2015; Schneider L.R. 2011, Zhang and Wang 2011, European Commission (2011)
 Cames et al. 2016. Cames, M., Harthan, R.O., Fussler, J., Lazarus, M., Lee, C.M., Erickson, P. and R. Spalding-Fecher (2016b), How Additional is the Clean Development Mechanism? Analysis of the application of current tools and proposed alternatives, Prepared for DG Clima (CLIMA.B.3/SER12013/0026r.) by Oko-Institut, INFRAS and Stockholm Environment Institute
 de Bruyn S, Schep E, Cherif S, Huigen T (2016) Calculation of additional profits of sectors and firms from the EU ETS 2008–2015, Delft: CE Delft
 Schneider L, Kollmuss A (2015). Perverse effects of carbon markets on HFC-23 and SF6 abatement projects in Russia. *Nat Clim Chang* 5:1061–1063
 Zhang and Wang (2011). Zhang J, Wang C (2011) Co-benefits and additionality of the clean development mechanism: An empirical analysis. *J Environ Econ Manag* 62(2):140–154
 European Commission (2011). Study on the Integrity of the Clean Development Mechanism.

Law prescribes for the use of international credits. Also, once the credits would be acquired, a corresponding adjustment would need to be made in the emission balances and NDCs of the EU and of the third country: direct purchase by private entities would make ensuring this very challenging.

Moreover, smaller companies, in particular, may struggle due to limited administrative resources, creating an uneven playing field where only larger companies would be able to make use of this flexibility efficiently. Also, restrictions would need to be enforced, such as limits on the percentage of emissions covered by credits or a first-come-first-serve approach, increasing complexity, lack of predictability and administrative burden further. Lastly, when there is a difference in price between the EU ETS and international credits, there is a distributional issue as to who benefits from the difference in the price. In the past, the operator integration of international credits to ETS benefitted operators by giving them certain limited rights to exchange CERs and ERUs into allowances. Additionally, it can be challenging for the public authorities responsible for the international credits to maintain rigorous oversight and compliance in relation to credit integrity.

The overall objective of introducing the international credit as a flexibility to the EU 2040 climate target is to introduce flexibilities in the reaching the target by ensuring not the entire target needs to be met domestically (including ETS). Adjusting the ETS cap is more cost-effective and efficient than direct operator integration to achieve this, minimizing complexity and administrative load for market participants. Consequently, the option of integrating credits directly through operator purchasing has been discarded from this impact assessment due to the additional complications and uncertainties it introduces.

2.3. Assessment of the measures

This section assesses each of the measures along economic, social and environmental impacts. The analysis assumes that only permanent domestic CDR certified as BioCCS and DACCS are included in the EU ETS, as per the conclusions of section 3. Moreover, the analysis draws on the projections of removals in the 85% scenario in the PRIMES model.

Table 3: Quantitative assumptions for the inclusion of CDR in the EU ETS in PRIMES (EU) and POTEnCIA

Volumes per source of non-fossil CO2 stored underground	2035	2040	2031-2040
Power generation	5 ;20	30; 40	125 ; 240
Industry	0 ; 5	0 ; 15	0 ; 75
Biomass processing	0 ; 2	0 ; 2	0 ; 20
Air	0	7; 12	20 ; 35
TOTAL	5 ; 30	45 ; 60	175 ; 330

Removals % of gross emissions with cap at gross current scope	1.5% ; 5%	15% ; 18	3.5%; 6%
Removals % of gross emissions with cap at net current scope + waste	1% ; 4%	12%; 20%	3%;6%
Removals % of gross emissions with cap at gross current scope + waste + landfills	1% ; 4%	10%; 13%	2.5%; 5%

Sources: PRIMES and POTEnCIA

Table 4: Technology costs assumptions

Years	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Average BioCCS removal unit price estimate (EUR)	214	210	207	203	200	196	192	188	184	180	176
Average DACCS removal unit price estimate (EUR)	428	403	378	352	327	302	297	292	288	283	278

Technology costs from European Commission: Directorate-General for Climate Action, Ramboll Management Consulting, Witteveen, E., Marton, C., Bert, N. et al., Carbon removals in the EU – Review of current carbon removal projects and early-stage financing, Publications Office of the European Union, 2025^{21 22}

Based on these technology costs, removal units from BECCS are expected to become cost competitive vis-à-vis the allowance price in 2036-38, whereas DACCS removal units would not reach cost competitiveness within the period.

It is important to note that the CDR supply figures in Table 3 present the modelled optimal supply for target achievement from the model runs (see Annex 4 Analytical methods for more information). They are related to but distinct from estimates on CDR supply potential. The CDR supply assumed above lies within the estimates of CDR supply in a recent Commission study, which estimates around 4Mt of BioCCS and DACCS per year in 2030 and 15-25 Mt per

²¹ European Commission: Directorate-General for Climate Action, Ramboll Management Consulting, Witteveen, E., Marton, C., Bert, N. et al., Carbon removals in the EU – Review of current carbon removal projects and early-stage financing, Publications Office of the European Union, 2025, <https://data.europa.eu/doi/10.2834/0004994>

²² The cost of DACCS and BECCS follow a complex structure subject to many factors, as shown in the following report on CCUS in the EU: European Commission: Joint Research Centre, Clean Energy Technology Observatory, Carbon capture utilisation and storage in the European Union – Status report on technology development, trends, value chains and markets. – 2025, Publications Office of the European Union, 2025, <https://data.europa.eu/doi/10.2760/0214409>

year in 2035, all of which will require the successful development of geological CO₂ storage capacity in the EEA.

Equally, it is important to note that (i) CDR cost and supply estimates are highly variable and uncertain²³ – and thus on their cost-competitiveness and potential impact on the EU ETS – and (ii) can be significantly affected by policy support for CDR outside the ETS. An effective contract for difference scheme, for example, could create a compelling business case for CDR and bridge large cost differentials, enabling significant CDR inflows into the EU ETS where none would have existed otherwise. Such public subsidies will in particular be essential to scale-up removals. The assessment below thus tries to withhold judgement on the cost-competitiveness of removal units in the ETS, notwithstanding the figures contained in the table above. In particular, this means that the assessment below does not rely on the cost differential between removal units and the carbon prices as a potential ‘solution’ to any risks that an effective inclusion of CDR in the EU ETS would entail.

Those expected CDR volumes can be compared to the size of the cap in each policy option (including aviation and new sectors, *incl. non-CO₂ and offshore*) PRIMES scenario (EEA), showing how much of the emissions space (gross emissions) of the EU ETS is covered by removals, which is between 2.5% to 5% of the cap during the period and between 10% to 13% in all cap options by 2040. The higher shares would correspond to PO1, followed by PO2 and then PO3.

Finally, it should be noted that the current cap of the ETS may be adjusted as part of this review in accordance with the future 2040 target and increased as a result of the potential expansion to new sectors. Changes to the Market Stability Reserve may also impact liquidity. Therefore, the full impact of the measures on integration of carbon removals analysed in this chapter can only be assessed in combination with the measures on MSR, cap and scope as part of the policy options.

2.3.1. *Economic impacts*

2.3.1.1. *Conduct of business*

Costs on the conduct of business stem from effects of changes to the allowance price (i.e., EU ETS compliance costs), from market dynamics, and from transaction costs.

2.3.1.1.1. *EU ETS compliance costs*

What are the expected costs on the allowance price? Affects the ETS compliance cost for businesses and the cost of essential and intermediate inputs.

The following compliance cost effects apply to CR1 ‘Limited operator integration on top of the cap’:

Removal units increase compliance unit supply and affect allowance prices depending on their price. This is primarily the case once abatement becomes more expensive than removal, although expectations of future CDR cost declines and availability can already lower EUA prices before parity is reached. Under current assumptions however, and in the absence of additional support to CDR suppliers through e.g. CCfDs, the compliance cost impact would likely be minimal in early years and increase as CDR technologies mature and costs decline. The need for financial support to scale up CDR was strongly advocated for by open

²³ JRC, 2025, “Clean Energy Technology Observatory: Carbon Capture, Utilisation and Storage in the European Union - 2025 Status Report on Technology Development, Trends, Value Chains and Markets”, <https://publications.jrc.ec.europa.eu/repository/handle/JRC144142>

consultation respondents, with many citing CCfDs²⁴. If and when removal units become cost competitive in the EU ETS, they can reduce the allowance price compared to a situation where no CDR is allowed in (under current assumptions, BECCS would become cost competitive in 2036-2038, with DACCS not reaching cost competitiveness within the period). This effect on compliance costs would be attenuated by the limit for CDR use (as the quantitative limit would restrict the extent of any allowance price reduction) and, more importantly, by the technical potential of the technology and the slope of its marginal cost curve. Regulatory uncertainty can play an important role in longer-term price expectations. For example, if ETS market participants expect the regulator to relax or remove the CDR limit in the future, then expectations for the future allowance price would approximate expectations on future CDR costs. It is worth noting that, given a certain scarcity level and assuming usual enforcement, under CR1 much of the risk from CDR technologies (e.g. under-delivery, price risk) would be borne by ETS regulated entities. This is because lower-than-expected CDR volumes and/or higher-than-expected CDR prices (assuming that the cap is not relaxed and that compliance is enforced) could mean significant increases in the ETS price – such that ultimately, operators bear the risk of CDR not materializing.

Uncertainty on future CDR costs could also affect prices in the short term. With the inclusion of CDR in the EU ETS, the availability and price of removal units would become another uncertain variable in the compliance strategy of operators. Operators thus would need to estimate not only future EUA prices (in terms of abatement costs across industries) but also future CDR costs and availability. This could complicate investment decisions in long-term abatement projects.

The following compliance cost effects apply to CR2 ‘Unlimited operator integration on top of the cap’:

Similar to CR1 ‘Limited operator integration on top of the cap’, removal units would increase compliance unit supply and affect allowance prices if and when marginal abatement costs equal or exceed marginal removal costs, with much of the CDR risk borne by ETS regulated entities. Here, however, there would be no limit on CDR use. Removal units would thus act as a de-facto price ceiling, albeit a soft one that is determined by the slope of the CDR supply curve at volumes deliverable within compliance timelines. Expectations for the future ETS price would be anchored to expectations on future marginal CDR costs and delivery volumes, which could amplify the effects of uncertainty about future CDR costs and availability, complicating long-term abatement decisions as compared to CR1. While overall a broad majority of stakeholders in the open consultation (70%), from a diverse range of stakeholders, expressed support that the use of removals by regulated entities should be subject to some restrictions and not be unlimited, some stakeholders argued in favour of allowing for a limitless use of CDR in the

²⁴ The form of this financial support varied but contract for differences was the most often cited as a financial instrument that could help to address the current gap that exists between the ETS price signal and the higher abatement cost associated with the more early-stage removal technologies. In addition, other financial instruments supported involved such as state aid and grants and other financial measures to de-risk the investments necessary to scale up carbon removals. A distinction was made in the categorisation when respondents specifically mentioned R&D support (34 responses) that was more linked to innovation funding to help bring down the costs of these technologies over the medium to longer term. The need for financial support for building up the infrastructure required to support carbon removals in terms of both the storage and transportation of CO₂ was frequently raised by the respondents. Demand side measures to help ensure a market for carbon removals was strongly supported by the respondents with 52 responses. Amongst the range of proposals on what demand side measures would be most suitable to scale up carbon removals, the need for procurement of CDR credits by governments was often suggested alongside specific targets for removal use to further help stimulate demand.

EU ETS in order to address emissions in hard-to-abate sectors and to lower the cost of compliance.

The following compliance cost effects apply to CR3 ‘Limited operator integration under the cap (one-in-one-out)’:

Under CR3, the regulator would pre-increase the number of conventional allowances in circulation through an increase in allowance auction volumes distributed throughout the period. This increase in conventional allowances would not be conditional on removal units coming in. This would reduce scarcity in the EU ETS and exert downward pressure on the price - thereby reducing compliance costs compared to the baseline. Conversely, the use of removal units would trigger the cancellation of a conventional allowance from future auctions, thereby creating an upward price pressure. The time lag between CDR use and allowance cancellation could create temporal arbitrage opportunities. The net effect on compliance costs would depend among others on marginal abatement costs, on the removal supply curve and on complementary CDR support instruments.

It is important to note that the reduced scarcity from the increase in conventional allowances could affect the cost-competitiveness of removal units in the ETS.

- If removal units are not cost-competitive in the ETS before the allowance volume increase from CR3, then reduced scarcity under CR3 would reduce the allowance price, making removal units less cost-competitive and no removal units would enter the EU ETS (absent complementary support instruments for CDR).
- If removal units are cost competitive in the ETS before the allowance volume increase from CR3, then the effect depends on whether they remain cost-competitive even after the reduced scarcity from CR3. If removal units cease to be cost-competitive, then the previously described scenario applies. If removal units remain cost competitive, then some removal units would flow into the system.

The following compliance cost effects apply to CR4 ‘Public authority integration through regular auctions under the cap’:

The allowance price is expected to go down as compared to the baseline in line with the increased availability of allowances as removal-backed allowances become available. Under CR4, the risk of under-delivery (e.g. in the context of long-term purchase agreements) and price risk from CDR technologies is borne by the regulator.

The following compliance cost effects apply to CR5 ‘Public authority integration through MSR on top of the cap’:

Under CR5, removal units are an instrument of market stabilization. While the same volume of CDR would flow into the MSR as compared to (the maximum volume allowed under) CR1, CR3 and CR4, the effect of CDR introduction on the allowance price would depend on if and when such MSR releases occur. The effect would thus depend on MSR design, including rules around invalidation and order of release of allowances and removals. This could mean that some of the removal units purchased by the regulator would not make it into the market.

In fact, as described in section Annex 8 Part III on the MSR section, under the parameters of MSR1 and of MSR3 (the two measures included in the modelled policy options for the MSR) the MSR is expected to release units only in the mid-2030s. Barring large releases due to sudden price increases, for both MSR1 and MSR3 there remains “sufficient” allowances in the reserve by 2040 – such that it seems possible that no removal units would enter into circulation in the 2031-2040 period. The inclusion of removal units in the MSR would affect market expectations, e.g. by prolonging the MSR and providing an additional inflow of units

after 2040, although it seems possible that allowance prices would be higher than in other measures considered here, albeit lower than the baseline. Transparency and predictability are facilitated if the authority's procurement strategy (volumes, types of CDR, prices paid if public) and MSR release rules are clearly communicated, but some uncertainty would remain. As under CR4, in CR5 the CDR under delivery and price risks are borne by the regulator.

2.3.1.1.2. *Market dynamics*

Will it be possible to ensure that the carbon market keeps functioning well with the integration of carbon removals into the ETS?

Expected impacts on the functioning of the market (e.g. trade volumes, market fragmentation, flow of allowances and regularity of supply, transparency and predictability for market participants) can affect the allowance price and, accordingly, the ETS compliance cost for businesses and the cost of essential and intermediate inputs. The impacts are assessed qualitatively. Modelling results are provided for the policy options in the main body of the impact assessment.

*The following market dynamics effects apply to all measures that entail **operator integration** between the EU ETS and CDR suppliers - that is, all options where EU ETS operators can purchase removal units directly from CDR suppliers:*

This applies to CR1 ('Limited operator integration on top of the cap'), CR2 ('Unlimited operator integration on top of the cap'), and CR3 ('Limited operator integration under the cap (one-in-one-out)').

There would be a clear market access pathway for CDR technologies in the ETS. This, however, would be contingent on removal units actually being used in the EU ETS. The actual flow of removal units would depend on the relative price between abatement and removal costs. As prices and costs stand (see Tables 3 and 4), and in the absence of additional support to CDR suppliers through e.g. carbon contracts for difference (CCfDs), very few if any removal units would enter the EU ETS before the end of 2031-2040. Nevertheless, even before significant physical removal unit inflows, expectations about future CDR flows and costs could reshape operators' EUA banking and hedging, affecting liquidity and price formation.

The EU ETS supply of 'permits to emit CO₂' would no longer be determined only by the public sector decisions on the issuance of allowances, but also by the physical reality of carbon removals for which certified removal units are generated. These would be two distinct sources of supply but lead to direct price competition between abatement in the ETS and CDR costs within the limits for CDR supply (if applicable). Market transparency and price formation in the CDR market would depend on how the primary market is structured. While over-the-counter (OTC) trades would provide for low transparency, exchange-based trading and centralized auctions (as currently planned in the UK)²⁵ could improve price transparency as well as information about CDR technology costs and availability. It seems possible that the CDR market would see purchases not only for EU ETS compliance, but also for voluntary demand and, potentially, for compliance demand (e.g. by national governments) towards national target achievement and as a means of supporting the development and deployment of CDR technologies.

The functioning of the market for removal units would depend on the units employed (see section 4.2. unit differentiation) and on how limits are enforced (see section 4.4 on limits). If limits are enforced at the Union Registry 'border' and removal-backed allowances have the

²⁵ See 'Route to market' under:

<https://assets.publishing.service.gov.uk/media/687f61598adf4250705c9765/uk-ets-ggrs-main-response.pdf>

same compliance value as conventional allowances, the market should function as it does today. This holds when removal-backed allowances are indistinguishable from conventional EUAs. If, instead, removal-backed allowances are differentiated (e.g., tagged) and attract a price premium, the market could bifurcate into two instruments with potentially different liquidity and pricing.

CDR supply concentration (which is likely in early, small markets) could enable suppliers to exercise market power, which could among others impact prices and liquidity.

Operator integration would likely mean lower predictability of demand as compared to measures with integration through public authority. In absence of further CDR policy support, the revenue uncertainty could lead to slower and ‘lumpier’ capacity additions on the CDR supply side, thus also affecting the regularity of supply. This could lead to limited transparency and predictability for market participants on both ETS and CDR sides, because of the uncertainty on the ETS price on one side and on the CDR costs on the other. See further discussion on this under ‘Target achievement/environmental’.

*The following market dynamics effects apply to measures that **limit** the volume of CDR that can flow into the EU ETS (that is, all options except for CR2 (‘Unlimited operator integration on top of the cap’)):*

In the primary CDR market, the direct competition and fungibility between abatement and removal applies only within the limit. There would be limit-induced price distortions in the primary CDR market when constraints bind, preventing effective price discovery after that point. In that case, removal units would face a price discount vis-à-vis conventional allowances, as was the case when Kyoto credits were allowed in the EU ETS, due to the uncertainty on the possibility to use of the removal units that results from the limit. On the other hand, limits to the use of removal units can contribute to preventing cost-ineffective abatement deterrence.

If limits are enforced at the Union Registry ‘border’ and removal-backed allowances have the same compliance value as conventional allowances, the secondary market should function as it does today. This holds when removal-backed allowances are indistinguishable from conventional EUAs. If, instead, removal-backed allowances are differentiated (e.g., tagged) and attract a price premium, the secondary market could bifurcate into two instruments with potentially different liquidity and pricing.

Limiting the use of removal units means that the benefit to CDR suppliers is limited to the permissible volume; the extent to which this is relevant in the short and medium term will depend on how ‘tight’ the limit is compared to current CDR capacity. Absent robust policy instruments supporting CDR development and deployment beyond the ETS, a limit of between 175 and 330 Mt (85% scenario) applied to the whole phase is, however, very unlikely to bind the supply side during the 2031-2040 period. If removal units are cost competitive in the ETS such that the limit is binding, then it will be necessary to ration the (cheaper) removal units as demand for them could exceed the allowed supply. See section 1.4.4 Consideration on Limits for an analysis.

Particular market dynamics effects of CR1 (‘Limited operator integration on top of the cap’):

(See above on general market dynamics effects related to operator integration and to integration with limits).

The use of removal units could allow for a (limited) increase in gross emissions in the ETS, supporting higher trade volumes and higher liquidity. This, however, is contingent on removal units actually being used in the EU ETS – which, at the current price differentials, would require other CDR support instruments to bridge the gap.

Particular market dynamics effects of CR2 ('Unlimited operator integration on top of the cap'):

(See above on general effects related to operator integration).

A lack of limits in CDR use in the EU ETS could mean a much higher inflow of CDR units if and when removal costs become competitive vis-à-vis abatement inside the ETS. An increase in gross emissions can increase the size of the market and make it more liquid, facilitating smoother market functioning.

A lack of limits would also mean that removal units would not trade at a discount vis-à-vis conventional allowances, which allows in theory for a cost effective mix between abatement and removal. This measure, however, presents a higher risk of cost ineffective abatement deterrence.

Particular market dynamics effects of CR3 ('Limited operator integration under the cap (one-in-one-out)'):

An important characteristic of this measure is the one-off increase in the volume of conventional allowances through an increase in auction volumes distributed throughout the period. This is what creates the extra “space” for an increase in gross emissions by ETS regulated entities, in line with the expected flow of CDR units in the EU ETS. This increase in allowance volume allows for a (limited) increase in gross emissions, which can lead to higher liquidity and smoother market functioning. Unlike CR1 ('Limited operator integration on top of the cap'), the additional space for gross emissions is created even if removal units fail to make it into the EU ETS. This is because the extra space for gross emissions is generated by the initial increase in allowances, rather than by the actual flow of removal units into the EU ETS.

The use of removal units in the EU ETS leads to one allowance being withdrawn from a future allowance auction. The reduction of future auction volumes (due to the ‘swapping’ for the removal unit) could generate uncertainty on future compliance unit supply, as the fluctuations will be hard to predict. It would also be necessary to align this with MSR provisions, e.g. if the one-in-one-out mechanics requires that an allowance be withdrawn from auction while MSR rules require that more allowances be made available. Market effects from the unit ‘swapping’ would be mediated by the volume of units flowing in, the transparency of unit flows, and the time to adjustment of the auction volume. Rules for the cancellation of allowances should be designed such that large players cannot strategically time CDR use to influence allowance cancellations and future prices. It is also worth noting that the yearly safeguard limit (set equal to the auction volumes of the following year and meant to act as a backstop in case removal units drop radically in price and/or increase in supply) can have effects on the latter years of the phase. This is because (a) auction volumes are set to decrease over time; (b) removal units may become more available in later years of the period and, potentially, (c) removal units may be cheaper and more abundant than currently envisaged by the regulator. Put together, this could mean that the safeguard limit may be binding towards the latter years of the phase. Given current assumptions (see table 3), however, this seems unlikely to be the case. Under the 85% scenario, the modelled total yearly CDR supply never surpasses the auction volume of the following year. A constraint would only apply if the total allowable CDR supply for the entire period were to flow into the ETS in the year of 2040 alone].

Particular market dynamics effects of CR4 ('Public authority integration through regular auctions under the cap'):

The purchase of CDR units allow for the increase in cap and with it of gross emissions in the ETS, supporting higher ETS trade volumes and liquidity. Importantly, and unlike CR1

(‘Limited operator integration on top of the cap’) and CR2 (‘Unlimited operator integration on top of the cap’), this measure would not depend on CDR being cost competitive for the higher availability of units to be felt in the market. This is because the regulator ensures the supply and would subsidize the difference between the CDR cost and the ETS allowance auction price. This is an important advantage of CR4 as compared to e.g. CR1 and CR2. The difference on this matter between CR4 and measures such as CR1 and CR2, however, depends on the cost competitiveness of removal units in the ETS and the extent to which different measures are accompanied by effective support mechanisms that similarly bridge the cost differential between abatement and removal. In situations where removal units are cost competitive in the ETS, the intermediation by the public authority could reduce market efficiency. CR4 can reduce market uncertainty for both ETS operators and removals operators, as it decouples the inflow of removals-backed allowances from the relative price signal between abatement and removals, with procurement volumes and timing that are administratively chosen under (high) uncertainty. Several stakeholders in the open consultation mentioned the advantages of increased liquidity but also raised concerns over loss of market efficiency in cases of public authority integration.

The supply of removal-backed allowances into the ETS would be predictable, as it would be determined by the public authority's pre-set purchase volumes and auction schedule. This could support market stability. Rules (or unit buffers) would be necessary to provide clarity on auctioning schedules in case of CDR procurement delays or under-delivery by CDR suppliers.

Transparency and predictability for operators are facilitated if the authority's procurement strategy (volumes, types of CDR, prices paid if public) and auctioning rules are clearly communicated. An effective CDR price discovery would require a well-designed CDR purchasing strategy.

There would be no fundamental change to the way the primary market for allowances works for operators. The regulator would remain as the sole provider of allowances in the primary market as it would centralize the interaction with CDR providers. Nevertheless, also in this case we would expect a market for CDR units to operate outside the EU ETS, e.g. for voluntary demand and, potentially, for demand by national governments towards target achievement and CDR support.

Particular market dynamics effects of CR5 (‘Public authority integration through MSR on top of the cap’):

This measure would see no immediate effect on trade volumes, as CDR units are kept in the MSR and only released in times of scarcity. As already mentioned under the CR5 analysis regarding ‘EU ETS compliance costs’, under current assumptions it is possible that no removal units would enter into circulation through the MSR in the 2031-2040 period.

By replenishing the MSR, CR5 would extend the MSR's operational life beyond that implied by the number of (conventional) allowances in the reserve and current MSR's rules and parameters. Consequently, CR5 prolongs the market stability service that the MSR provides to the EU ETS. Moreover, and compared to CR4, measure CR5 could be more responsive to market needs than a fixed and predetermined schedule.

As in the case of CR4, there would be no fundamental change to the way the primary market for allowances works for operators, as the regulator would remain as the sole provider of allowances.

It is worth noting that with the exception of CR2 (‘direct integration without a limit, net cap’), in all measures discussed above the limit for CDR use is the same, but measures differ in terms

of when and how the extra compliance units (and thus the extra ‘space’ for gross emissions and the corresponding effect on market dynamics) flow into the ETS. Under CR1 (‘Limited operator integration on top of the cap’), gross emissions only increase if removal units are cost competitive vis-à-vis the allowance price (also taking into account support policies outside the EU ETS). By contrast, under CR3 (‘Limited operator integration under the cap (one-in-one-out)’), gross emissions increase as a result of the initial increase in the allowance volume and thus do not depend on removal units actually flowing in. Under CR4 (‘Public authority integration through regular auctions under the cap’), the increase in compliance units is reflected from the start in the increased cap, and their release is predictably scheduled alongside those of regular allowances via the auction calendar. Under CR5 (‘Public authority integration through MSR on top of the cap’), the increase in compliance units would occur in line with MSR rules and be less predictable.

2.3.1.1.3. *Transaction costs*

What are the expected transaction costs on EU ETS operators? Influenced among others by the channel through which operators procure compliance units, contract standardisation and market infrastructure, and risk management needs.

CR1 ‘Limited operator integration on top of the cap’: Direct market access through e.g. standardized contracts would minimize intermediary fees. However, higher transaction costs compared to a baseline of no CDR integration would nevertheless apply to the extent that operators would have to evaluate e.g. the reliability of CDR technologies and suppliers (due diligence costs) when engaging in forward purchase contracts. The inclusion of another compliance unit would mean that operators could face higher portfolio management complexity - optimizing between allowances, CDR types, and timing, including risk management costs.

CR2 ‘Unlimited operator integration on top of the cap’: Similar effects as under CR1, amplified by the fact that operators would potentially have to track a larger and more dynamic CDR market (if removal units are cost competitive in the ETS) and manage higher exposure to CDR costs.

CR3 ‘Limited operator integration under the cap (one-in-one-out)’: Similar as under CR1, with extra operational complexity from tracking the one-in-one-out mechanics.

CR4 ‘Public authority integration through regular auctions under the cap’: For operators, transaction costs related to CDR purchases under this measure would be lower than under measures with operator integration (CR1-CR3) as operators would acquire all allowances (including removal-backed ones) through regular ETS auctions or the secondary market. There would be no need to engage in separate procurement of CDR units.

CR5 ‘Public authority integration through MSR on top of the cap’: same effect as under CR4.

2.3.1.2. *Public authorities and budgets*

What are the expected impacts on revenues and costs for the regulator, e.g. allowance auction revenues, removal unit purchase costs, and administrative costs?

The investment needed to support the development and deployment of CDR technologies does not a priori change materially across the measures assessed here, and public finance has a crucial role to play²⁶. Public disbursement can occur through the EU ETS (e.g. through measures CR4 and CR5) and/or through other support policies (e.g. CCfDs or a public purchasing programme). In either case, total expenditure could be similar if the regulator has a

²⁶ See footnote 18

clear commitment towards procuring enough CDR that guarantees the extra gross emissions headroom for operators (CR1 and CR2) or to deliver the net emissions outcome (CR3).

That said, the measures do vary considerably in terms of risk distribution and upfront finance for CDR development and deployment – and this latter point can materially affect the viability of achieving the climate targets, especially if CDR technologies do not reach the scale required on time. For example, apparent ‘cost savings’ for the regulator from CR1, CR2 and CR3 (notably from not having to invest into the purchase of removal units) entail risk transfers to the private sector that could materialize as higher costs for the regulator later on, e.g. if CDR technologies do not scale as required in time for target achievement, and especially if the regulator is left with little time to react to a CDR supply shortfall.

Generally, fiscal costs across the measures considered here are different from the fiscal costs in the baseline of no CDR integration, in which the ETS would ultimately reach absolute zero emissions. This is because the measures considered here increase the regulatory ‘space’ for residual emissions under the ETS, which means that part of the mitigation costs that would have been incurred by regulated entities move onto the regulator in one way or another. This can happen in various ways. First, a decrease in scarcity is likely to lead to reduced allowance auction revenues to Member States²⁷. Moreover, using removal units rather than conventional allowances towards compliance obligations would mean that CDR suppliers are the ones receiving payments from operators, rather than the Member State through allowance auctions. Also, the integration of CDR into the EU ETS would require regulation and oversight on CDR eligibility and market surveillance, thus resulting in administrative costs.

CR1 (‘Limited operator integration on top of the cap’) and CR2 (‘Unlimited operator integration on top of the cap’), in theory, would entail lower direct EU ETS purchase costs for the regulator as compared to CR4 and CR5, although, in the absence of public investments in CDR through other policies, risks that the CDR development and deployment not take place in time for the CDR scaleup required and that the extra ‘space’ for residual emissions inside the ETS therefore not materialize.

CR3 (‘Limited operator integration under the cap (one-in-one-out)’) would see a similar effect as for CR1 and CR2 in lower direct EU ETS costs for the regulator not having to purchase the removals itself, again with the need for further support policies to ensure that CDR development and deployment take place in time for the CDR scaleup required. This is aggravated by the initial reduction in scarcity, which could reduce incentives for abatement and investment in removal by regulated entities – thus potentially requiring further investments in abatement and removal by the regulator outside the ETS. Effects are also expected on auction revenues. Under CR3, Member States would see an increase in the number of allowances for auction, but it is unclear whether this would entail higher revenues as the increase in the allowance volume may be offset by a price drop due to the reduced scarcity.

CR4 (‘Public authority integration through regular auctions under the cap’) would see the regulator purchase removal units even if they are not cost competitive vis-à-vis the allowance price. This would create an avenue to bridge the price gap between abatement and removals and thereby provide significant support to the development and scale-up of CDR technologies. Importantly however, this would entail arranging for a significant financial endowment from the ETS auction revenues, which could be politically challenging but necessary to ensure the necessary amount of removals is purchased. Thus, CR4 would likely entail significant costs for the regulator in e.g. the procurement of removal units, although it seems possible that

²⁷ The final outcome depends on if the decrease in prices is counterbalanced sufficiently by the increase in supply, such that the overall the auction revenues remain equal or are even higher despite the lower prices.

procurement methods such as reverse auctions could yield lower overall transaction costs than if purchases were done by a large number of individual regulated entities in the primary CDR market, and would need to be compared with the administrative cost of complementary support measures needed under CR1 and CR2 (e.g. CCfDs). Compared to CR5, measure CR4 has the advantage of the predictability of the regulator in recouping some of the CDR purchase costs by auctioning removals-backed allowances in the market.

CR5 ('Public authority integration through MSR on top of the cap') would be similar to CR4 in that the regulator would purchase removal units even if they are not cost competitive in the EU ETS, providing material support to the development and deployment of CDR technologies but requiring a significant endowment of funds to do so. Different from CR4, in CR5 there is less predictability on the ability of the regulator to recoup CDR purchase costs through allowance auctions, as MSR allowance releases would follow MSR triggers, which provide for less predictability than pre-set schedules. It seems possible, however, that by the time the MSR kicks in, auction prices be higher than they would have been under CR4 – thus yielding higher auction revenues. Nevertheless, even if the difference were not as stark between CR4 and CR5 regarding the overall flow of expenditures and revenues, the predictability with which they happen would have a crucial impact. As already mentioned under the CR5 analysis regarding '*EU ETS compliance costs*', under current assumptions it seems possible that the MSR would auction no removal units in the 2031-2040 period. Releases start in the mid-2030s and the MSR has an extensive number of allowances to support liquidity in the EU ETS in the 2030s, under the parameters examined in above.

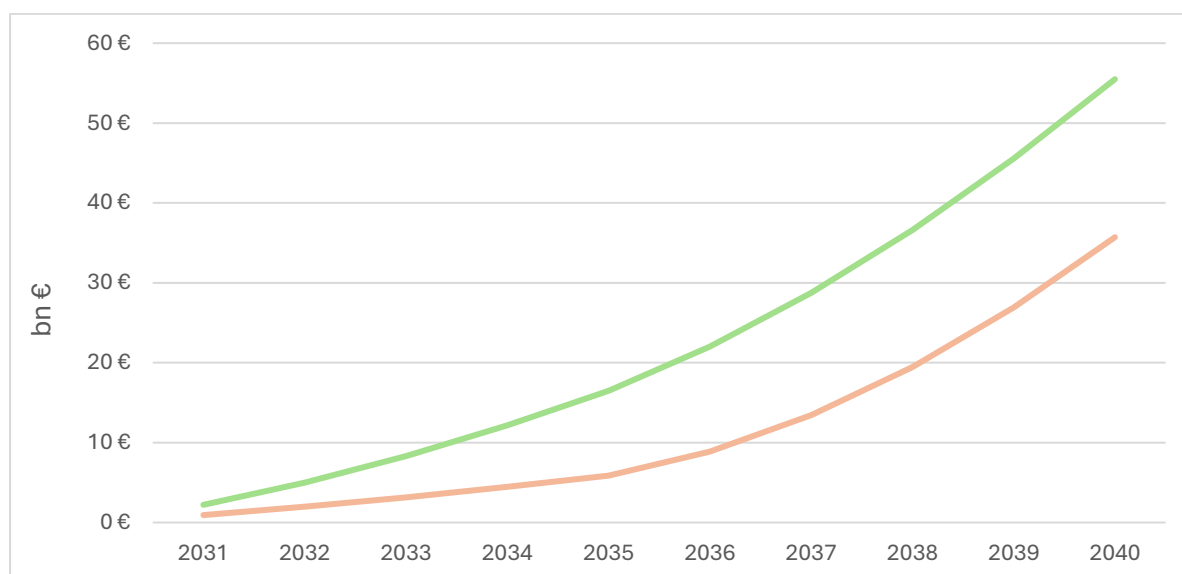
Estimated fiscal costs in CR4

The fiscal cost for the public authority in CR4 is calculated as the investment requirements (i.e., tonnes procured) minus revenues from allowance sales made by the public authority to ETS participants. It should be noted that the following are illustrative calculations based on an 85% ambition scenario for 2031-2040. The investment requirements and final fiscal cost for a potential removal integration as per CR4, strongly depend on the price of removals, total volume of removals to be purchased, the final ambition level set out, the corresponding ETS prices, the ratio of BioCCS to DACCS in the portfolio, and timing of the purchase of the removals compared to the sale of the allowances. In particular, the timing of the purchase of the removals compared to the sale of the allowances can have an impact on the final fiscal cost, while it is likely that it cannot be fully optimised (e.g. delay in the sale of allowances to a time when ETS prices are highest and purchase of removals when the removal prices have decreased) due to the need to kick start the market, and the uncertainty in ETS and removal prices.

- Total investment required for the purchase of CDR

The following graph represents the cumulative cost BioCCS and DACCS in each of the two models considered, PRIMES and POTEnCIA (see Table 3), based on the technology costs and tonnes demanded from each technology, (i.e. **portfolio costs overtime**). POTEnCIA models a higher volume of removals, thus shows higher upfront investment costs for the purchase by the public authority (EUR 55.5 billion) compared to PRIMES (EUR 35.7 bn) based on average costs, which include costs and thus revenues for CO₂ storage operators in the EEA.

Figure 3: Cumulative PRIMES and POTEnCIA average costs



Source: PRIMES (in red) and POTEnCIA average costs (in orange)

These costs are based on technology costs set out below, with a range of estimates for 2030, 2035 and 2040 that were linearly extrapolated between given years with data. Cost decreases achieved by 2040 significantly shape the results, given how low they are relative to current removals costs and the expected future ETS prices.

Considering different technological costs, upfront investment needs amount to between EUR 46 and EUR 65 billion in POTEnCIA and between EUR 29 bn and EUR 43 bn in PRIMES (ranges based lower and upper bound of technology costs).

Table 5: CDR technology cost estimates in Euros

Technology costs (EUR)	2030			2035			2040		
	BECCS ²⁸	DACCS	Biochar	BECCS	DACCS	Biochar	BECCS	DACCS	Biochar
Lower bound	167	288	66	163	201	50	160	185	37
Average	214	428	141	196	302	113	176	278	88
Upper bound	261	567	215	228	402	175	192	370	138

Source: see footnote 21²⁹

²⁹ See footnote 21. The cost estimates for the CDR technologies are based on a comprehensive literature review, supplemented by survey findings and conducted interviews. Literature sources provided baseline estimates for current and future costs, while survey responses provided a means for partial validation and refinement. Given the uncertainty surrounding the current and future costs of all CDR technologies, costs were represented as ranges, with most likely upper- and lower bound limits. These uncertainties make precise

For reference, PRIMES estimates the following unit costs of removals (includes transport, storage and capture), which are closer to the lower bound for BECCS, to the lower bound for BioCCS except in 2040, and to the higher and mid-point bound for DACCS, depending on the year:

Table 6: PRIMES CDR cost estimates

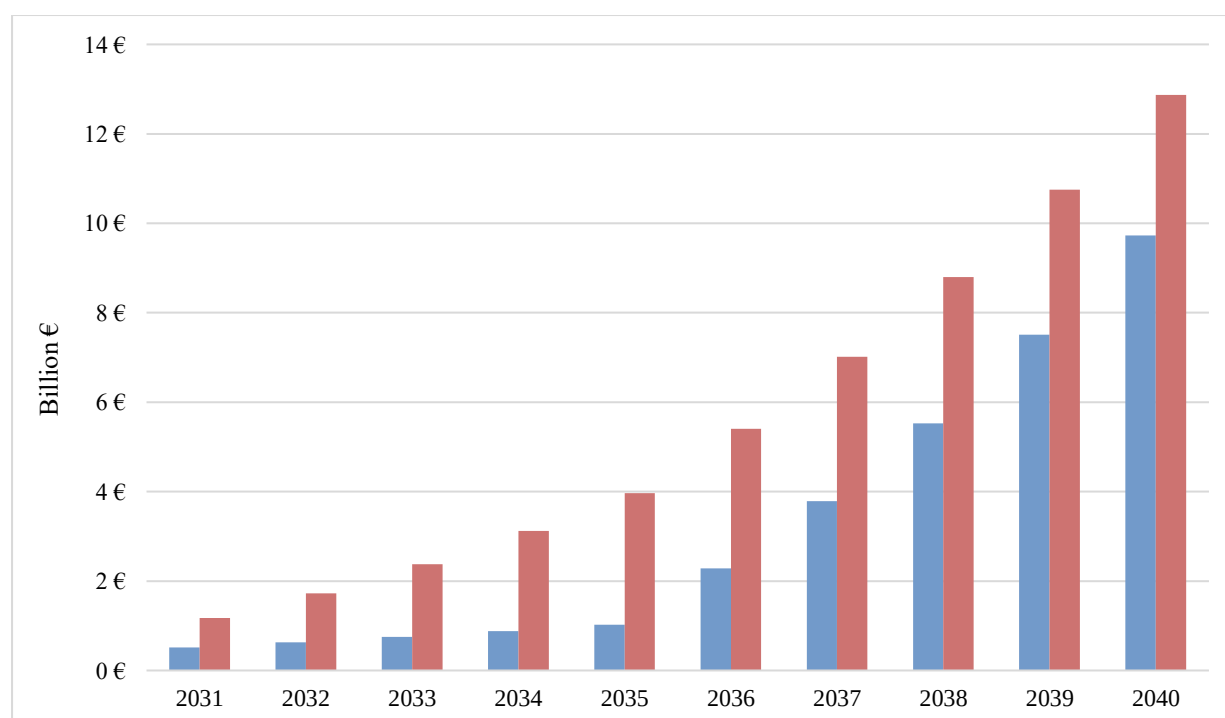
EUR 23/tCO ₂	2030	2035	2040
Cost of capture & transport & storage: DACCS	518	375	251
Cost of capture & transport & storage: BECCS	171	159	148
Costs of capture from biomass processing	66	65	64

Source: PRIMES

- Expected revenue generation from removal-backed allowances

Similarly, the expected revenues from the sale of removal-backed allowances is higher in POTEnCIA, as it models higher removal volumes of BioCCS and DACCS than PRIMES.

Figure 4: PRIMES and POTEnCIA revenue generation from removal-backed allowances



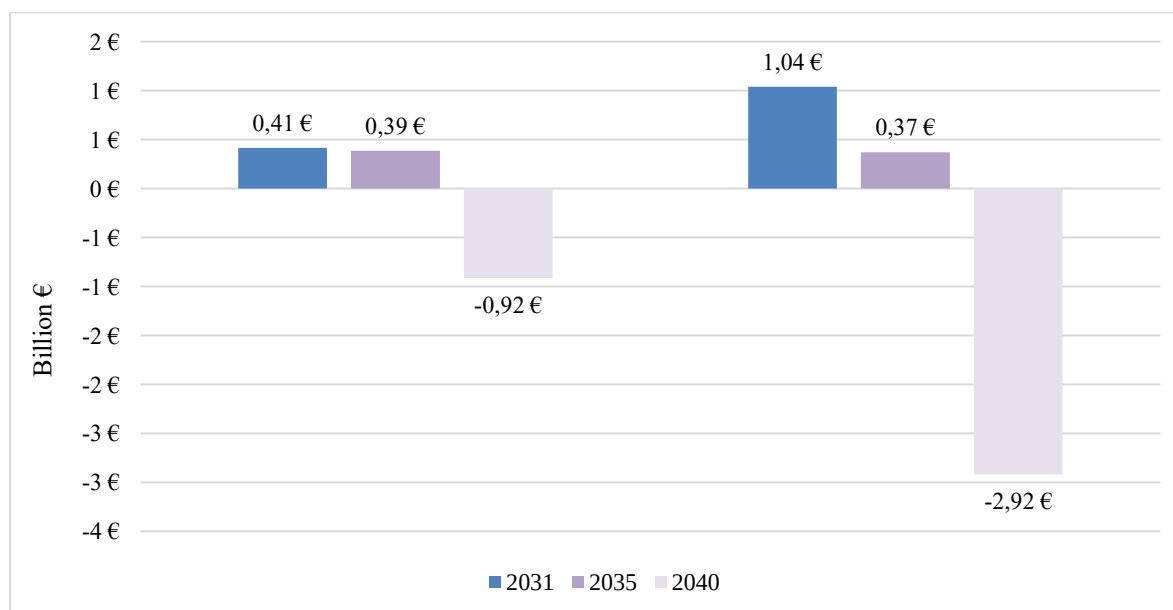
PRIMES 85% BioCCS and DACCS results are shown on the left (blue), and POTEnCIA 85% BioCCS and DACCS are shown on the right (red)

- Final fiscal cost

forecasting challenging. Reliable cost estimates are only available for BECCS. For other BioCCS technologies, there is limited and less reliable data on TRL, costs and scalability, resulting in a broader and more uncertain cost range. For this reason we assume BECCS costs to be equivalent to BioCCS costs for this exercise.

Considering the results above, PRIMES and POTEnCIA result in final costs for the public authority between EUR 1 bn and EUR 0.37bn for 2031 and 2035, and both give negative costs for 2040, as seen in the following graph.

Figure 5: Final fiscal costs in PRIMES and POTEnCIA



PRIMES 85% BioCCS and DACCS results are shown on the left, and POTEnCIA 85% BioCCS and DACCS are shown on the right.

Concretely, based on average technology costs, the purchasing programme under PRIMES would have an illustrative final fiscal cost of Euro EUR 3 bn and of EUR –1.7bn under POTEnCIA.

Negative fiscal costs result for 2040 mean that there are net revenues from the sale of CDR allowances into the ETS (i.e., overall removals costs are lower than the carbon price). This suggests that the sale of removals into the EU ETS could **potentially cover the full cost of the purchasing programme and even raise additional funds** to purchase more removals or contribute to other funds (e.g., Innovation Fund).

However, as mentioned at the start of this section, significant caveats and assumptions must be considered.

- .

- Fiscal cost for CR1-CR3 and CR5

Assuming that it is decided to ensure the same emissions space to the ETS sectors under CR1–CR3, with the aim of avoiding carbon leakage and achieving the net-target contribution, the cost of CR1–CR3 should be similar to CR4, as the public authority would pay the full price of each CDR credit upfront but then recover the price difference with EUAs when the removal-backed EUAs are auctioned, covering only the price difference in the end. The exact amounts will depend on the timing of the purchase of the removals and the sale of allowances.

For CR5, the investment needs (i.e., fiscal cost) of the purchasing programme for the MSR option is equal to the investment needs calculated above, because we assume for this policy option that there is no release of MSR allowances into the EU ETS, and therefore no revenues are obtained from the sale of the removal-backed allowances to ETS participants (unlike the

public authority option where revenues are collected and used to fund the purchasing programme – see below).

2.3.2. *Social impacts*

2.3.2.1. *Employment*

CDR integration into the EU ETS can influence employment positively, mainly through its impact on the pace and predictability of domestic CDR deployment and associated supply chains. The precise extent of the impact on **jobs in the CDR industry** can differ per measure.

- Measures that provide predictable demand and bankable revenue streams for removals (CR4 and CR5) are more likely to catalyse near-term investment and job creation in the European CDR industry.
- Operator-integration measures (CR1–CR3) can deliver similar employment benefits if complemented by CDR policy support outside the ETS. Unlimited integration in CR2 may create further benefits, as it removed the uncertainty generated by the limit (see section 1.4.4.1) and allows more removals to enter the system, if they are price competitive, although this effect may be counterbalanced by the mitigation deterrence impact on the ETS. Absent support measures, however, the weaker visibility of demand in CR1-3 may delay investment decisions and temper job growth.

Regarding **jobs in** ETS industries, the introduction of removals transforms the system from one that goes to absolute zero to one that can sustain a positive cap. While other ways of maintaining a positive cap exists, the choice to implement one of them (removals integration) supports the EU's competitiveness and thus employment. Nevertheless, if cheaper CDR displaces abatement action in certain sectors, it prevents the generation of jobs in ETS clean industries. As a result, some jobs **in the CDR industry** may represent a shift from cleaner industries rather than net-increase.

Estimates from Boston Consulting Group conclude that the development of the CDR industry could bring substantial economic growth and also significant job creation. They conclude that by 2050, the CDR sector in Europe could support up to 670,000 jobs. This growth trajectory indicates substantial employment opportunities across various sectors involved in CDR, including engineering & manufacturing, energy, and (digital) services. Concretely, if CDR develops as modelled in the 1.5°C- and 2°C-compatible scenarios, the job potential in the CDR industry is expected to increase gradually, with a relatively modest growth in the next years. By 2035, however, the sector could already support 125,000-180,000 jobs in broader Europe. The job potential is estimated based on current sector ratios of jobs per EUR 1 million value added.

2.3.2.2. *Income distribution, social protection, and social inclusion (of particular groups)*

The assessment of the impacts on income distribution, social protection and social inclusion is undertaken quantitatively at the policy option level in main body of the impact assessment.

2.3.2.3. *Fundamental rights*

Fundamental rights afford basic legal protection for political, social, and procedural rights to individuals and legal entities. The Charter of Fundamental Rights of the European Union (the Charter) is an instrument of primary EU law that enshrines the fundamental rights people enjoy in the EU. All measures were assessed having regard to the relevant EU instrument and it was concluded that they maintain full respect for human and fundamental rights.

As discussed in section 1.2.3.3 below, the measures will have impacts on Article 37, which states with regards to environmental protection that a “high level of environmental protection and the improvement of the quality of the environment must be integrated into the policies of the Union and ensured in accordance with the principle of sustainable development”. Fundamental rights could be affected by measures’ impact on environmental target achievement and by an increase in competition for land-use to increased biomass demand, as discussed regarding climate target achievement in that and biodiversity in that section.

2.3.3. *Environmental impacts*

The assessment of environmental impacts assumes equivalent environmental quality between an abatement and removal and makes abstraction of the broader environmental impacts of the different removal types, which is a matter addressed by the CRCF Regulation and methodologies. This assessment focuses on the difference between the integration options against the baseline in terms of environmental impacts.

2.3.3.1. *Climate target achievement*

To what extent could the inclusion of CDR into the ETS affect the achievement of EU climate targets? Expected impacts on EU-level target achievement in terms of risk to the achievement of EU climate targets given the uncertainty in supply and cost of CDR.

The analysis below considers risks to target achievement along several dimensions: Net and gross emissions, certainty within them, and control by the regulator on the balance between abatement and removal; cost effectiveness in target achievement; abatement deterrence;³⁰ support to CDR development and deployment as essential elements of achieving EU climate targets; and risk distribution on the achievement of environmental targets.

Climate target achievement effects of CR1 (‘Limited operator integration on top of the cap’):

Emissions, certainty levels, control levels: Under CR1 there would be a clear limit on both gross and net emissions, with constraints by the regulator on the balance of abatement and removals inside the ETS. For as long as abatement costs remain lower than removal costs, only conventional allowances would be used.³¹ Once abatement costs are equal to or higher than removal costs, then gross emissions could increase within the CDR limit. This would create some uncertainty on gross emissions, but always within bounds. For as long as CDR is too expensive or public CDR support is lacking, the extra ‘space’ for gross emissions would not be used and the gross limit would not be achieved.

Cost effectiveness: There is direct price competition between abatement in the ETS and CDR costs within the limit, with real-time market signals about CDR technology costs and availability and price visibility through direct market participation. CR1 would provide for cost-effective mitigation action as long as the limit isn’t binding (which, as discussed above, is likely to be the case except in the presence of robust CDR support measures). A cost-effective mix of abatement and removal could facilitate political support for the ETS even if compliance costs increase. If and when the limit becomes binding, the system would lose in cost-effectiveness, although this could be somewhat mitigated by the role of the limit in addressing abatement deterrence.

³⁰ Abatement deterrence relates to expected impacts on reduced or delayed abatement action by ETS covered entities due to the introduction or expectation of carbon removals and the uncertainty in their costs and availability.

³¹ Excluding non-compliance demand (eg towards voluntary carbon neutrality claims) and noting that expectations of future CDR volume and costs can impact EUA banking and investment behaviour before cost parity.

Abatement deterrence: The CDR limit would mean that the CDR cost would not act as a (soft) price ceiling for the ETS once CDR becomes cost-competitive in the ETS, thereby reducing abatement deterrence risks. This, however, would be valid only to the extent that there is policy credibility for the CDR limit. E.g. if ETS market participants expect the regulator to relax or remove the CDR limit, then expectations for the future price would approximate expectations on future CDR costs, such that CDR could be perceived as a soft price ceiling by market participants.

Support to CDR development and deployment: Under CR1, the operator integration of CDR in the EU ETS would expose CDR suppliers to the ETS price risk as well as to a lack of predictability in the timing of demand – both of which present challenges for investment decisions and project finance.³² This is a concern raised by several stakeholders in interviews and in the open consultation, where two thirds of respondents argued for the need for complementary measures, with CCfDs most often cited as a financial instrument to support CDR development and deployment and bridge the cost differential between removals and abatement in the EU ETS while safeguarding the competitiveness of European industry. The severity of these uncertainties would depend critically on whether CDR is cost competitive in the ETS and whether non-ETS policy measures are able to provide effective support to CDR development and deployment. Absent such policies and without a stable or predictable price, long-term planning and investment in CDR could remain highly risky. Similarly, leaving decisions on the timing of removal unit purchase to operators could mean very low support to CDR development and deployment in the early phases, leading to the risk that CDR technologies would not scale up as necessary. A policy mix – including bankable revenue streams and enabling infrastructure - will be necessary to make sure that CDR development and deployment ramps up in time not only to (a) achieve EU targets, but also to (b) ensure the extra ‘space’ for residual emissions in the EU ETS to enable cost-efficient abatement while mitigating carbon leakage risks. At the same time, some stakeholders in the open consultation cautioned against CDR limits as they can increase regulatory and demand-side risks for investments.

Risk distribution on environmental targets: given a certain EU ETS scarcity level and assuming that EU ETS obligations are enforced, under CR1 much of the risk from CDR technologies (e.g. under-delivery, price risk) would be borne by operators – such that if e.g. CDR turns out to be more expensive than expected, allowance prices would increase and ETS regulated entities would thus be subject to higher prices. This risk could be transferred to the regulator if EU ETS prices reach politically unsustainable levels, such that the regulator must intervene by e.g. purchasing removal units (potentially at higher prices) and making them available in the market, and/or by weakening climate targets. In such cases, carbon leakage also presents a significant risk.

Climate target achievement effects of CR2 (‘Unlimited operator integration on top of the cap’)

Emissions, certainty levels, control levels: The volume of conventional allowances would determine the maximum net emissions in the system, but there would be no limit on gross emissions (as there would be no limit the volume of removal units that could be used in the system). This also means that the regulator does not have control over decarbonization pathways within the ETS: in the absence of restrictions on the use of CDR in the ETS, the government would not be able to guide decarbonization pathways in terms of choices on abatement vs removals through the EU ETS, and use of removals outside the ETS. This,

³² Dynamic, market-based pricing can reward lower-cost and higher-performing CDR providers, thereby supporting incremental efficiency gains. However, for capital-intensive technologies such as bioCCS and DACCS, this signal is very likely insufficient to unlock investment.

however, is only true once CDR become cost competitive. In the short to mid-term, public support could guide the choice between abatement and removal to a great extent.

Cost effectiveness: Direct price competition between abatement and removal, with real-time market signals about CDR technology costs and availability and price visibility through direct market participation. Incentives for abatement in ETS covered sectors would be fully merged with incentives for CDR, equalizing price signals and, in theory, enabling an economically efficient allocation of activities if CDR is deliverable at scale and in the absence of market failures. A cost-effective mix of abatement and removal could facilitate political support for the ETS even if compliance costs increase. However, economically ineffective abatement deterrence can arise from uncertainties in removal prices and quantities, and support to CDR development and deployment is very likely to require accompanying policy instruments.

Abatement deterrence: This measure brings the highest risk of abatement deterrence of all. As CDR functions as a de-facto soft price ceiling³³ in the EU ETS once cost-competitive, operators would need to estimate the future price and availability of removal units in order to estimate the cost-effectiveness of long-term abatement investments. As CDR technologies are still in early stages of development and deployment, however, these figures remain highly uncertain. This uncertainty can lead ETS regulated entities to delay investments in abatement and lead to a high-emissions lock-in. This, in turn, could make long-term targets more expensive to reach, especially if CDR technologies perform worse than expected. This can undermine target achievement if mitigation costs become economically unsustainable. The risk of abatement deterrence was the most frequently cited reason by stakeholders in the open consultation opposing the integration of CDR in the EU ETS.

Support to CDR development and deployment: Same effects as under CR1 (ETS price risk and lack of early incentives from EU ETS demand towards development and deployment of CDR technologies). Compared to CR1, measure CR2 has the advantage that CDR suppliers would not face the uncertainty of a limit to the demand for removal units in the EU ETS.

Risk distribution on environmental targets: Same effects as under CR1 in terms of the risks of under-delivery and price from CDR technologies being borne by ETS regulated entities – with the aggravating factor that under CR2, the abatement deterrence effect could lead to higher gross emissions as compared to CR1, thus correspondingly increasing the risk of failure in meeting climate targets. As under CR1, this risk could be transferred to the regulator if EU ETS prices reach politically unsustainable levels and leakage risks would also apply.

Climate target achievement effects of CR3 ('Limited operator integration under the cap (one-in-one-out)')

Emissions, certainty levels, control levels: The regulator controls gross emissions and the maximum net emissions. Because the use of a CDR unit implies the cancellation of an allowance, the use of removal units reduces net emissions as compared to the (increased) volume of conventional allowances. Unlike CR1, under CR3 the increase in gross emissions occurs even if removal units are not cost-competitive in the ETS. As a result, a key risk of this approach is the achievement of the net contribution of the ETS, which is uncertain – there is a *maximum* level of removals that can be used (how low net emissions can go) but not a *minimum* (how high the net emissions can go) as there is no removal obligation). As long as removals are not cost competitive, the net would equal the gross, missing the target.

³³ CDR serves as an effective price ceiling if CDR supply is elastic and at scale; otherwise deterrence stems from expectations rather than realised ceilings.

Cost effectiveness: Similar effects as in CR1 in terms of direct competition and cost-effectiveness, albeit with the disadvantage that ETS prices would fall as a result of the reduced scarcity in the system, which may undermine long-term cost effectiveness.

Abatement deterrence: Same effects as in CR1 in that limits to the use of CDR could help address abatement deterrence risks. Under CR3 however, the initial increase in the volume of allowances could lead to (a) lower prices, thereby dampening abatement action and (b) reduced political credibility by market participants of the willingness of the regulator to maintain the scarcity of the system – both of which could exacerbate abatement deterrence effects.

Support to CDR development and deployment: Same effects as under CR1 (ETS price risk, CDR usage limits, and lack of early incentives from EU ETS demand towards development and deployment of CDR technologies).

Risk distribution on environmental targets: Under CR3, the CDR under-delivery and price risks would be borne by the regulator, as the ‘space’ for additional gross emissions would be created through the initial increase in conventional allowances, before removal units become available. If removal units fail to enter the ETS at the scale of the CDR limit, then net emissions from the ETS would be higher than in all other measures considered here. A credible plan would be required for the regulator to ensure that EU climate targets are achieved despite the increased net emissions under the EU ETS. This effect is aggravated by the fact that the initial reduction in scarcity and accompanying downward price pressure could decrease abatement action and interest in supporting CDR development and deployment.

Climate target achievement effects of CR4 (‘Public authority integration through regular auctions under the cap’)

Emissions, certainty levels, control levels: The regulator would have control over both net and gross emissions, albeit subject to timely procurement and delivery of contracted CDR. The purchase of removal units and corresponding issuance of additional (removal-backed) allowances by the regulator would allow gross emissions in the ETS to increase, while maintaining the same level of net emissions. Assuming the procurement of CDR happens on schedule, there is thus certainty on the achievement of net and gross emissions targets. Smaller-than-expected CDR purchases would mean not reaching the net target emissions, assuming all else constant. Compared to measures CR1 and CR2, the increase in allowable gross emissions would be significantly more predictable, as the regulator would increase the cap by the amount of the removal units it sets out to buy, and auction them into the EU ETS even if removal units are not yet cost competitive vis-à-vis the allowance price (the regulator would thus bridge the cost gap between abatement and removal).. Predictability could in theory depend on rule-based procurement schedules and adjustment measures (e.g. to reflect CDR supply growth), if the auctioning of removals-backed allowances was conditional on the delivery of the removals. However, the measure is designed so the public authority bears the risk of being able to buy the right amount of removals, and the market benefits of the transparency and predictability provided by the increased cap.

Cost effectiveness: under CR4 there would be no direct competition between abatement inside the ETS and removal outside the ETS, as the regulator would intermediate the relationship between both markets. This can lead to market inefficiencies. For example, pre-set purchase volumes might not always align with the dynamically optimal level of CDR use if abatement or CDR costs change unexpectedly, which could lead to welfare loss compared to a perfectly flexible market. In terms of overall target achievement however, while this can entail short-term welfare losses within the narrow scope of the EU ETS (due to high CDR unit costs as

compared to ETS abatement), this effect could be compensated by a decrease in necessary public expenditures for CDR support through other measure.

Abatement deterrence: The introduction of additional (removal-backed) allowances at auction lowers ETS price compared to the baseline, inducing downward price pressure and reducing the incentive for abatement action inside the ETS. Nevertheless, the introduction of CDR through a public authority seems likely to face lower abatement deterrence effects than measures that make use of direct integration (CR1, CR2 and CR3); as operators would not need to purchase CDR units directly and they would not have the possibility to directly substitute abatement by CDR, so abatement signals could be less directly eroded.

Support to CDR development and deployment: The regulator can choose to (or be effectively obliged to) purchase CDR even if initial costs are high (e.g., for DACCS, bioCCS). This is much more likely to be effective in supporting CDR development and deployment than any measures with operator integration (CR1, CR2 and CR3) and was the most frequently cited reason by stakeholders supporting this option in the open consultation³⁴. The regulator can make strategic long-term investments in procuring initially expensive but promising engineered CDR to stimulate innovation and cost reductions, which could enhance overall economic efficiency in achieving deeper decarbonization goals in the future even if initially more expensive.

Risk distribution on environmental targets: Under CR4, the CDR under-delivery and price risks are borne by the regulator, who bridges the cost differential between abatement and removal. Assuming the procurement of CDR happens as planned, there would be certainty on the achievement of net emissions targets. This would also reduce carbon leakage risks compared to other measures considered here.

Climate target achievement effects of CR5 ('Public authority integration through MSR on top of the cap')

Emissions, certainty levels, control levels: The regulator has control and certainty over net emissions, as well as control (albeit not full certainty) over gross emissions. This is because the regulator controls the volume of conventional allowances that are released into the market, but the volume of removal-backed allowances depends on the rules and functioning of the MSR. The rules-based functioning of the MSR means the release of removals is neither entirely predictable nor is it under the control of the regulator other than through the initial setting of MSR rules. To the extent that the MSR does release removal-backed allowances, then this allows gross emissions in the ETS to increase, while maintaining the same level of net emissions.

Cost effectiveness: similar effect as under CR4, although under CR5 the effect takes place in response to MSR triggers rather than in a smooth fashion.

Abatement deterrence: Under CR5, the integration of CDR functions more as a safety valve through the MSR than as a routine source of additional compliance units. As such, the abatement deterrence effect of CR5 seems likely to be lowest across all measures considered

³⁴ Demand side measures to help ensure a market for carbon removals was strongly supported by the respondents with 52 responses. Amongst the range of proposals on what demand side measures would be most suitable to scale up carbon removals, the need for procurement of CDR credits by governments was often suggested alongside specific targets for removal use to further help stimulate demand. Others commented specifically that in the short to medium term, a central EU body could act as a buyer, offering offtake agreements to help CDR developers secure predictable revenue and reach investment-grade scale.

here, as it is the measure that establishes the largest ‘distance’ between the ETS and the CDR market.

Support to CDR development and deployment: same effect as in CR4 (more likely to be effective in supporting development and deployment than any measures with direct integration, and the regulator can make strategic long-term investments).

Risk distribution on environmental targets: same effect as under CR4, albeit with the aggravating effect that under CR5, the regulator has less certainty on the timing of recouping of costs through allowance auctions. The uncertainty in the release of allowances means CR5 reduces the risk of carbon leakage to a lesser extent than CR4 or CR3.

2.3.3.2. *Biodiversity and other land-use impacts of biomass use*

Does the integration of removals in the ETS lead to an over incentivization of biomass?

The availability of sustainable biomass is constrained, and dedicating crops at scale for energy entails competing with food, materials, and conservation. Thus, large-scale biomass use (e.g. from bioCCS) for CDR can create significant land, water, and biodiversity trade-offs. The integration measures in this impact assessment can contribute to that negative impact to the degree they incentivise additional BioCCS.^{35,36} It is important to note, however, that the primarily levers in addressing risks from biomass over-reliance lie not in the choice of the measure for CDR integration, but primarily on the establishment of strict sustainability criteria, accounting for indirect land-use change, and effectively internalizing externalities from biomass use. The CRCF rules address partly these concerns (see section 3.1.2.4).

Broadly speaking, the more effective a measure is at incentivizing CDR deployment (see ‘Support to CDR development and deployment’ in the preceding section), the bigger the effect of additional biomass use is expected to be. Private sector integration routes CR1 and CR3 would likely see little effect on additional biomass use during the 2031-2040 period, except if further CDR policy support is put in place, as BioCCS is only expected to become price competitive from 2038. CR3 would have the additional effect of the reduced scarcity in the system – and lower prices – making technologies such as bioCCS even less competitive. If there is CDR support outside the ETS however, these measures would see an increase in biomass demand in line with biomass eligibility criteria and the relative cost competitiveness across CDR technologies, bounded by the CDR limit. The same would apply under CR2, albeit with the aggravating factor that the absence of limits on CDR use would mean that once bioCCS becomes cost-competitive in the ETS, CR2 could see a sharper increase in biomass demand compared to measures with CDR limits.

Meanwhile, the public integration routes CR4 and CR5 would provide more predictable support through the ETS, and thus affect biomass use accordingly. However, the purchasing facility can react better to cost developments as well as any emerging concerns related to the overuse of biomass and manage related sustainability risks. In addition, limiting CDR could increase the reliance on and consumption of biomass as bioenergy use may be the only abatement option for some emissions.

³⁵ Vermeulen, Hanne and Rasmussen, Martin Birk, Concito 2024, “Towards a sustainable deployment of BioCCS in the EU”

³⁶ Lara-Sophie Wähling, Mathias Fridahl, Tobias Heimann, Christine Merk, “The sequence matters: Expert opinions on policy mechanisms for bioenergy with carbon capture and storage”, Energy Research & Social Science, <https://doi.org/10.1016/j.erss.2023.103215>

2.3.4. *Summary*

A summary comparison of the measures is provided in the table below. Measures are rated as compared to the baseline of no CDR integration. As highlighted above, the assessment suspends judgement on the existence of policy support for CDR outside the ETS, and, accordingly, on the cost-competitiveness of removal units in the ETS.

Table 7: Comparison of measures against the baseline of no integration in the ETS (cap tending towards absolute zero).

Criterion	CR1 ('Limited operator integration on top of the cap')	CR2 ('Unlimited operator integration on top of the cap')	CR3 ('Limited operator integration under the cap (one-in-one-out)')	CR4 ('Public authority integration through regular auctions under the cap')	CR5 ('Public authority integration through MSR on top of the cap')
Economic Conduct of business / EU ETS Compliance costs	+ Cost-reduction if CDR is competitive	+ / ++ Cost-reduction if CDR is competitive	+++ Initial downward price pressure due to reduced scarcity. (Further) cost-reduction if CDR is competitive	+++ Downward pressure due to additional supply of (removal-backed) allowances	+ / ++ MSR provides cost-containment
Economic Conduct of business / Market dynamics	+ Increase in gross emissions and trade volumes only if CDR is competitive	+ / ++ Increase in gross emissions and trade volumes only if CDR is competitive; unlimited increase in gross emissions thereafter.	+ / ++ Increase in gross emissions and trade volumes in advance to CDR becoming cost-competitive Reduction of future auction volumes due to swapping could generate uncertainty on future supply.	+++ Increase in gross emissions and trade volumes in advance to CDR becoming cost-competitive. Most predictable across the measures.	+ / ++ Increase in gross emissions and trade volumes in response to scarcity triggers.
Economic Conduct of business / Transaction costs	- CDR purchase costs and portfolio complexity	- - CDR purchase costs and portfolio complexity; lack of limit increases CDR exposure.	- / - - CDR purchase costs and portfolio complexity, with extra complexity from tracking the one-in- one-out mechanics	0 Operators acquire all compliance units through regular ETS auctions or the secondary market	0 Operators acquire all compliance units through regular ETS auctions or the secondary market
Economic /	0	0	-	-	---

Public authorities and budgets	Low direct EU ETS costs for the regulator compared to CR4 and CR5, but requires public investments in CDR through other policies.	Low direct EU ETS costs for the regulator compared to CR4 and CR5, but requires public investments in CDR through other policies	Low direct EU ETS costs for the regulator compared to CR4 and CR5, but requires public investments in CDR through other policies Initial reduction in scarcity could increase pressure on regulator in ensuring target achievement.	High direct EU ETS costs for the regulator compared to CR4 and CR5, but relieves the need for equivalent public investments through other policies for CDR integration in the ETS. Possibility of recouping some of the CDR purchase costs through allowance auctions	High direct EU ETS costs for the regulator compared to CR4 and CR5, but relieves the need for public investments in CDR through other policies. Low predictability of recouping CDR purchase costs through allowance auctions
Target: environmental	+ Certainty on net emissions (baseline conventional allowances). Gross emissions can increase up to the limit. Abatement and CDR cost competition up to the limit. Moderate risk of abatement deterrence Little effective support to CDR development absent other policies.	0/+ Certainty on net emissions (baseline conventional allowances). Gross emissions can increase without limit. Abatement and CDR cost competition Risk of significant abatement deterrence Little effective support to CDR development	-0/+ Uncertainty on net emissions. Use of CDR reduces net emissions, but pre-increased volume of allowances leads to uncertainty in net target. Gross emissions rise to the increased allowance volume (certainty) Detrimental effects of reduced allowance price due to lower scarcity Abatement and CDR cost competition up to the limit Little effective support to CDR development.	++ Certainty on net emissions (baseline conventional allowances), assuming the purchasing programme's endowment is calculated correctly and is sufficient. Gross emissions increase up to the limit (certainty). No competition between abatement and CDR Low risk of abatement deterrence. Effective support to CDR development.	+ Certainty on net emissions. Gross emissions can increase up to the limit (if MSR triggers are reached) No competition between abatement and CDR Low risk of abatement deterrence. Effective support to CDR development.

	Operators bear CDR risk.	Operators bear CDR risk.	Operators bear CDR risk re price impact, but not in terms of emissions space available.		
Biomass	0 Very low effective demand in medium term in absence of other CDR support policies	- Very low effective demand in medium term in absence of other CDR support policies Lack of limit to CDR supply once removal units are cost-competitive.	0 Very low effective demand in medium term in absence of other CDR support policies ETS price reduction from reduced scarcity could make bioCCS less competitive in absence of other CDR support policies	-- Regulator demand for CDR units increases demand for biomass, although the regulator can decide how much BioCCS it will buy	-- Regulator demand for CDR units increases demand for biomass, although the regulator can decide how much BioCCS it will buy

The inclusion of CDR in the EU ETS entails a complex set of variables and decisions, with wide-ranging impacts and trade-offs. None of the questions and design considerations considered here have obvious or undebatable solutions. CDR is a nascent industry with varied price and volume projections. This results in a risk of not assessing correctly the size of the removals cap increases and support measures, which is relevant for all options – what differs is the consequence, which can be either missing the gross or net target.

The baseline measure ‘no integration of removals’ is not considered for inclusion in the policy options because the premise of this impact assessment is that the EU ETS sectors should, as polluters, fully pay or at least contribute to the cost the additional emissions space provided under the cap due to the generation of removals. In addition, this impact assessment considers measures that ensure the ETS’s net contribution to emissions reductions. No integration, as a result, would lead to the ETS cap ultimately reaching zero if EU ETS sectors are not financing the removals they benefit from (‘no integration with an absolute zero cap’). This measure runs contrary to the EU’s competitiveness and the environmental objective of avoiding carbon leakage. A ‘no integration’ measure could be combined with ‘a positive cap’, whereby allowances are still issued and public budgets or other sectors purchase of the removals necessary to compensate the corresponding emissions. This measure protects the EU’s competitiveness and avoids carbon leakage. It could lead to the same costs as integration through a public purchasing programme (CR4), as Member States would withhold all the revenues from the auctioning of allowances (albeit lower due to the increase in supply). That revenue could be assigned to purchase removals. However, this disconnection between removals purchasing and the space in the cap risks breaking the link between the polluters and the removals necessary to compensate for the additional emissions. It leads to a higher risk of diverting public funding to competing objectives and thus not generating sufficient removals. To maintain a clear accounting and assignment of responsibility, CR4 is preferred and no integration with a positive cap is discarded.

On balance, measure CR4 seems to provide the best combination of environmental and economic impacts, which are the most relevant in the assessment of these measures.

CR4 provides the lowest cost of compliance for ETS operators as it guarantees the gross emissions (matched only by CR3), thus is best at avoiding carbon leakage and increasing liquidity, with the smoothest market dynamics and without transaction cost for businesses, who operate in the ETS market as usual purchasing only conventional allowances. At the same time, net emissions are guaranteed -conditional on the purchasing programme being endowed with sufficient budget and the purchasing happening according to schedule- and abatement deterrence is only lower in CR5. While the most important downside of CR4 is the public cost, the apparent ‘cost savings’ for the regulator from CR1, CR2 and CR3 (notably from not having to invest into the purchase of removal units) entail risk transfers to the private sector that could materialize as higher costs for the regulator later on, e.g. if CDR technologies do not scale as required in time for target achievement, and especially if the regulator is left with little time to react to a CDR supply shortfall. And while CR4 would likely entail significant administrative costs for the regulator in e.g. the procurement of removal units, it seems possible that procurement methods such as reverse auctions could yield lower overall transaction costs than if purchases were done by individual regulated entities in the primary CDR market, and the administrative cost would need to be compared with the administrative cost of complementary support measures needed under CR1 and CR2 (e.g. CCfDs).

Compared to CR5, measure CR4 has the advantage of the predictability of the regulator in recouping some of the CDR purchase costs by auctioning allowances in the market. The higher fiscal cost of CR5 and higher carbon leakage risk resulting from the uncertainty in release of

removal units seems, combined with the high fiscal cost, seems only acceptable if the priority is to pursue the option with lowest abatement deterrence. However, it should be considered if avoiding abatement deterrence will have, overall, a worse environmental impact than the loss in public budget and increased carbon leakage risk, or the over dependence on biomass as alternative abatement option. Both CR4 and CR5 have an equally positive impact in providing a certain source of demand for CDR.

Regarding the measures with private sector integration of removals, the main choice appears to be between prioritising (a) achieving EU targets at the price of putting the risk from CDR technologies (e.g. under-delivery, price risk) on operators (net cap options CR1-CR2) or (b) ensuring the extra 'space' for residual emissions in the EU ETS to enable cost-efficient abatement while mitigating carbon leakage, at the risk for the EU that the ETS does not reach its net contribution (gross cap option CR3). To avoid facing this choice and ensure both the environmental impact and protect the EU's competitiveness, removals would need to be financially supported outside the ETS in measures CR1-CR3. Although the net target achievement is certain, the abatement deterrence risk is highest among all options assessed in CR2. The abatement deterrence is lower in CR1 and CR3 as a result of the limit, which in turn leads to a loss of cost-effectiveness when the limit becomes binding. However, the limit is expected to be binding if at all, late in the period. All three options incentivise CDR only when price competitive with the ETS, so early incentivisation will depend on public support outside the ETS. CR3 will have a slightly lower incentivisation as ETS prices would lower in view of the increased cap.

In conclusion, CR4 seems to achieve the best balance of environmental and economic impacts. CR1 and CR3 follow, while CR5 seems less advantageous due to its uncertain result for gross emissions and high fiscal cost, and CR2 due to having the highest abatement deterrence and only a potentially better cost-efficiency in exchange compared to CR1.

3. TYPE OF REMOVALS TO BE CONSIDERED FOR INTEGRATION

3.1. Minimum requirements on the removal types for integration

This section explores the question of which types of carbon removal could be considered for inclusion in the EU ETS, whilst ensuring the environmental integrity of the system.

3.1.1. CRCF Regulation to certify EU carbon removals

The CRCF Regulation 2024/3012 came into force in December 2024. The Regulation's aim is to accelerate the development and uptake of carbon removal activities in the EU by providing a consistent framework to recognise carbon removal (and soil emission reduction) claims that are of high quality, regardless of the type of carbon removal activity the claim originates from. The Regulation provides quality criteria for carbon removals, and rules for third party verification of the authenticity of those removals (or soil emission reductions). Furthermore, the Regulation foresees the setup of a CRCF Registry within 4 years from entry into force of the Regulation (therefore due 2028). Note also that currently the scope of the CRCF Regulation is carbon removal activities that take place within the EU only (not in third countries).

The European Commission (DG CLIMA) has developed implementing rules to support the third party verification of removals and ensure that carbon removal activities are following the requirements of the Regulation, and methodologies to set out in detail how different types of carbon removal activity comply with the quality criteria and specifically how to quantify the carbon removal units that can be issued. It is foreseen that verification under the CRCF will operate via Commission recognition of independent certification schemes, similar to the

mechanism for the Commission to recognise voluntary schemes for bioenergy sustainability under the Renewable Energy Directive.

Since the CRCF Regulation has been developed after the last ETS revision, it is not explicitly mentioned in the ETS Directive review clause, but it is the key EU Regulation that aims to address the quality of carbon removals and to provide criteria and methodologies for how to quantify and certify those removals. Section 4.1 of this report discusses the relationship between the EU ETS and the CRCF and to what extent any carbon removals allowed in the EU ETS would have to be certified under and/or meet the requirements of the CRCF Regulation, noting that the quantification approach for carbon removed varies between the EU ETS and the CRCF.

The CRCF Regulation distinguishes three groups of carbon removal activities that can generate different types of carbon removal units: permanent carbon removals (such as direct air capture with carbon capture and storage (DACCS), or biomass with carbon capture and storage (BioCCS),³⁷ and some applications of biochar³⁸); carbon farming (such as peatland rewetting, farming practices accumulating soil organic carbon or afforestation); and carbon storage in products (e.g. carbon storage in construction products).

Note that the Commission, supported by the Expert Group on Carbon Removals, is developing CRCF methodologies for all the abovementioned carbon removal activities and is exploring the possibility to develop methodologies for other approaches such as Enhanced Weathering, Ocean Alkalinity Enhancement or Direct Ocean Capture. The latter two are, however, not included in this table due to their current significant uncertainties.

3.1.2. Requirements for which types of carbon removals to include in the EU ETS

The different types of carbon removal activities have different characteristics.

The inclusion of any removals into the EU ETS rests on the fundamental assumption that a negative tonne of carbon removed is equivalent to a tonne of carbon emitted within the ETS. An EUA is a right to emit one tonne of CO₂e in the EU ETS, under the cap. A negative emission removes one tonne of CO₂e from the atmosphere. Therefore, if considered equivalent, a tonne of carbon removal used in the EU ETS should be considered to cancel out the emission, therefore meaning that no right to emit (no EUA) is needed for that tonne of CO₂e. The equivalence of a removal unit and an EUA means equivalence in terms of not only the quantity, but also the length of time and global warming potential (GWP) of the removal and allowance.

When considering the equivalence of EUAs and removals, the “like-for-like” concept is suggested as guiding principle, meaning a source of emissions and an emissions sink correspond in terms of their warming impact, and in terms of the timescale and durability of carbon storage. For example, fossil carbon is stable in the lithosphere over millennia if it is not extracted and burned, therefore mitigating measures (e.g. offsets) that aim to neutralise the effect of these emissions must persist for a comparable, geological-timescale. Although all CO₂ once emitted, whether originally sourced from the lithosphere or biosphere, persists in the active carbon cycle for centuries to millennia, it may be appropriate to balance shorter-duration carbon released from biogenic carbon stocks (e.g. forests and soils) with comparably temporary storage in like stocks. This could imply that to cancel out an EUA, which represents a tonne of

³⁷ BioCCS is defined in the draft CRCF methodology as “a carbon removal activity in which biogenic CO₂ produced by the oxidation of carbon in biomass is captured and transferred for permanent storage.”

³⁸ Where the biochar meets all necessary requirements, the most widely used application of biochar for soil amendment is considered as permanent carbon removal under the CRCF as well as under several private carbon standards such as Verra, Puro or Isometric voluntary.

fossil CO₂e, it is appropriate to have a “permanent” removal that can be stable over a similar geological timescale as the emission. This is also the reason for the Commission to require that removals considered for inclusion in the ETS can show the carbon is “safely and permanently” stored.

Ensuring equivalence is subject to several challenges to ensure that the exact same GHG impact is cancelled out by the removal. There needs to be certainty that the precise amount of carbon is safely and permanently removed and will not be re-emitted, and there are appropriate liability mechanisms in case it is. The approach to quantify and monitor, report and verify the carbon removals also needs to be robust and transparent. Furthermore, associated environmental impacts from the carbon removal project activity beyond the carbon removal itself, should be considered if carbon removals are to be allowed into the EU ETS, such as impacts on land-use or biodiversity. Finally, the level of technological maturity of each potential removal solution is relevant to consider, although mainly as it relates to uncertainty in terms of understanding the quantification and monitoring of removals and understanding any risks. As a result, the determination of which types of carbon removal could be allowed into the EU ETS should consider:

- a) Permanence of removals
- b) Monitoring and liability for reversals
- c) Minimum MRV requirements and uncertainty
- d) Environmental impacts
- e) Technological maturity

3.1.2.1. *Permanence of removals*

The ETS review clause states that carbon removed from the atmosphere should be “safely and permanently stored”.

In the open consultation, there was strong support for including permanent removals in the EU ETS, while integrating temporary CRCF removal units into the EU ETS proved very divisive, attracting the highest level of strong disagreement across all CDR-related options, leading to an overall larger share of respondents against their integration. 83% of respondents to the open consultation strongly agreed or agreed with the statement that “permanent removals certified under the CRCF should be allowed for use by EU ETS regulated entities towards their ETS compliance obligations”, whereas only 38% of respondents strongly agreed or agreed with the corresponding statement for temporary removals compared to 41%, from a diverse range of sectors and stakeholder types, strongly disagreeing or disagreeing, mainly citing unreliable quantification methods and risks to market stability.

Mechanisms to compensate temporary removals when they expire³⁹ bring a significant risk to environmental integrity and mean that companies accumulate risks that they might have to compensate for those removals in future. Therefore, only permanent carbon removals that can demonstrate that the carbon will be safely and permanently removed and stored for a period exceeding several centuries should be considered for integration into the ETS.

The CRCF regulation provides a transparent and robust framework to identify carbon removal activities that can be considered permanent in European context. The CRCF regulation defines permanent carbon removals activities as the withdrawal of carbon dioxide from the atmosphere and its storage for several centuries, therefore for at least 200 years. It should be noted that the

³⁹ This would be similar to the CDM approach which requires replacement of units issued for forestry projects to account for non-permanence. These non-permanent units, however, accounted for less than 1% of all issued CERs.

three permanent carbon removal methodologies currently established by delegated act (DACCS, BioCCS and biochar have been designed to ensure a duration of storage that goes well beyond 200 years, possibly beyond several millennia.

3.1.2.2. Liability for monitoring and reversals

Liability here refers to who is required to monitor the risk of reversal/leakage and what they are required to do if a reversal or leak is detected.

Liability requirements for DACCS and BioCCS in the CRCF methodologies are aligned with the liability provisions of the CCS Directive and ETS Directives. Those rules could be applied to any CCS-type removal activity but do not apply for biochar since these activities do not transport nor store CO₂.

Similarly to the recognition of carbon permanently chemically bound in products by the EU ETS, the requirements from the biochar methodologies do not provide for monitoring of reversals (and thus attach a liability to them) because the production and use of biochar ensure the permanent storage of carbon in a stable and inert solid form for several centuries or millennia. A discount factor is applied to the unit generated, currently set at 2.5%, covers sufficiently the very low risk of reversal.

3.1.2.3. Minimum Monitoring, Reporting and Verification (MRV) requirements/Uncertainty

Different carbon removal project activities have different levels of uncertainty associated with monitoring and reporting the amount of carbon captured and permanently stored. The level of uncertainty largely depends on the MRV approach associated with each carbon removal activity type.

Removals into geological storage in general, provide higher levels of certainty in the volume of carbon removed because the CO₂ captured and stored can be physically measured and monitored. By contrast, nature-based removals may rely on modelling of complex “open” natural systems to estimate the rate of CO₂ removal and storage and are therefore associated with higher levels of uncertainty in the actual volume of carbon that is removed.

There is a question on what level of uncertainty could be tolerated if such a removal unit is to be used to cancel out an EUA which represents a tonne of actual measured emissions. Overall, DACCS, BioCCS offer a high level of certainty of the amount of carbon captured and stored. Monitoring requirements for geological storage of CO₂ are set out in the CCS Directive, which the CRCF also refers to.

The ETS has strict MRV requirements concerning reporting and verification of direct emissions to determine the number of EUAs that need to be surrendered. The Monitoring & Reporting Regulation (MRR EU 2018/2066) of the ETS already includes provisions for monitoring activities covered by the EU ETS which are linked to permanent storage of CO₂ - CO₂ transport and CO₂ storage in geological sites. For CO₂ transport, the sources included are – combustion, if not included already under the EU ETS Directive, fugitive emissions, vented emissions and emissions from leakage. For CO₂ storage, the sources are venting, fugitive emissions and leakage. These same rules are applied to DACCS and BioCCS that involve transport and storage of CO₂ as they are part of the activities explicitly covered by the EU ETS.

For biochar, the main uncertainty is the degradation rate of the stored carbon over time. The CRCF methodology proposes two approaches to quantify the stable fraction of biochar in which carbon is stored for several centuries or millennia. The first one is based on conservative IPCC decay function parametrised by the hydrogen to carbon ration (H/C) of the biochar and

the annual average temperature at its location of application. The second approach requires reflectance assessment of the biochar through thermochemical and microscopy analysis. There are no ongoing monitoring requirements after it has been demonstrated that the biochar has been applied to the land, or that it has been incorporated into a product.⁴⁰ While research has shown that a part of the biochar is highly stable that can be characterised through reflectance assessment with confidence), some consider that this methodology is not yet sufficiently tested. Although it has not been proven wrong, there is a shortage of studies confirming its robustness. In particular, there is a lack of long-term field studies to have certainty on the potential release of stored carbon in biochar over long time periods.

3.1.2.4. *Environmental impacts*

As well as requiring all life cycle GHG emissions to be included in the calculation of net carbon removals, the CRCF Regulation includes additional criteria to ensure the sustainability of carbon removals.

Concretely, CRCF operators generating carbon removals need to comply with the do no significant harm principle and additional specific requirements related to the type of carbon removal activity they are operating, in particular:

- The use of biomass for any carbon removal activity should comply with the sustainability requirements set out in the Renewable Energy Directive.
- In order to ensure the avoidance of unsustainable demand for biomass raw material, operators of BioCCS activities should demonstrate that any new facility processing biomass for heat or electricity production would still be economically viable without the carbon removal activity. This is to prevent that the revenues from CRCF make the economic case to build a new bioenergy plant. For existing facility processing biomass, the operator shall demonstrate that the nameplate energy generation capacity of the facility has not increased by more than the amount necessary to supply energy for the capture process.
- For biochar, there are explicit limits set for heavy metal and organic contaminant contents. The activity also needs to demonstrate that “the local agricultural context has been considered and that it is reasonable to expect no overall negative effect on agricultural production or soil health and no significant reductions in the storage of other soil organic carbon through positive priming effects from the application of biochar. Where significant loss of other soil organic carbon or deleterious impacts on agricultural productivity, on biodiversity, on ecosystems receiving the biochar and the ones located downstream in the watershed, soil health, or on any other environmental aspects are considered likely by the certification body, no carbon removal units shall be issued in relation to that applied quantity.”
- There is also a possibility for voluntary compensation for biomass used by carbon removal activities, to support the regeneration of natural carbon stocks used for the generation of permanent carbon removals.
- Legislative changes may be required to address the fact that, in the current legislative set-up, removals generated within the EU ETS and verified inside the ETS would have to comply with the RED sustainability criteria but would not automatically have to comply with the broader sustainability requirements of the CRCF.

⁴⁰ Section 1.2.2.2 Monitoring period of draft Delegated Regulation Annex: Carbon removals and carbon farming – methodologies for certifying permanent carbon removals

Concerns for biomass sustainability were raised many times in the stakeholder consultations. In the interviews, several stakeholders mentioned that the current way the ETS treats biomass is problematic. Biomass is currently zero-rated under the ETS, which is in line with IPCC guidelines. The theory is that this is accounted for upstream when the biomass is harvested. However, there is no incentive to reduce biomass use and no limits on biomass use in the ETS and the accounting argument becomes especially tricky when biomass crosses international borders. Furthermore, the zero rating of biomass in the ETS eliminates downstream incentives for better biomass choices, and neither the ETS nor the CRCF distinguish between different biomass types, despite some biomass types having much shorter carbon cycles than others (e.g. food waste versus forest biomass). Several of the market observers interviewed felt that introducing additional rewards for capturing and storing biogenic CO₂ could create a "double incentive" on top of the already strong incentive to use biomass in the ETS, further increasing demand for biomass, despite declining land sinks and insufficient upstream incentives through the LULUCF Regulations. It was stated by several stakeholders that the current reliance on the RED (through the ETS and the CRCF) may not provide adequate safeguards to protect LULUCF objectives. Stakeholders recommended that the biomass accounting and incentive structure be reviewed more holistically before allowing biomass-based removals into the ETS.

Carbon removal activities that could be added to the CRCF in the future such as enhanced weathering, Ocean Alkalinity Enhancement and Direct Ocean Capture – for which no CRCF methodologies have not yet been developed– may have environmental risks and impacts that would need to be further assessed, and the CRCF methodologies should include requirements to mitigate any risks identified.

All “do no significant harm” and sustainability requirements and feedstock constraints for removals should be aligned between the CRCF and removal activities that take place within the EU ETS, to ensure a level playing field and high-quality carbon removals. Additional sustainability criteria beyond the CRCF methodologies are not considered for the removal units to be included in the ETS. However, in a wider context, the incentive structure for biomass should be reviewed.

3.1.2.5. *Technological maturity*

The different technological solutions for removing carbon are at different levels of maturity. While DACCS and BioCCS are at the demonstration stage⁴¹, other novel approaches are still more theoretical and require further research and pilot project development to assess practical viability. A starting assumption to include a removal type in the EU ETS should be that there is a methodology adopted under the CRCF. CRCF methodologies should ensure that removals are quantified in a robust and conservative manner and that appropriate monitoring and liability requirements are in place and sustainability risks are addressed. Ensuring that the risk of reversal is well understood and there is appropriate monitoring and liability in place is especially important for more novel removal options for which the long-term carbon removal impact may be less well understood. If this is the case, the main remaining issue from including early-stage technologies in the EU ETS is that the volume of removals that could be generated would be very limited, which is not necessarily a risk but may not help to provide a significant new source of allowances in the EU ETS.

⁴¹ See meta-review on the TRLs reported for the various technology types of DAC and BECCS, showing the average, minimum and maximum levels: European Commission: Joint Research Centre, Clean Energy Technology Observatory, Carbon capture utilisation and storage in the European Union – Status report on technology development, trends, value chains and markets. – 2025, Publications Office of the European Union, 2025, <https://data.europa.eu/doi/10.2760/0214409>

It should be noted that even when the CRCF methodologies are adopted, the whole Regulation is still new. Lessons will be learned as the methodologies are tested and scaled up in the market. Therefore, there will always be some risk that some elements do not work as expected. The CRCF regulation will be reviewed on a regular basis and at least every four years for what concerns permanent carbon removal methodologies. This review will have to account for technological and scientific progress and innovation, in particular improvements in monitoring, reporting and verification.

As a result, the existence of an adopted CRCF methodology is a fundamental and basic requirement before a removal technology can be considered for inclusion in the EU ETS. In addition, especially for the more novel carbon removal technologies, those methodologies should be allowed some time for wider scale roll out and further testing before allowing those units into the EU ETS.

3.1.3. Overview of conclusions on removal types

Table 9 shows an assessment of different removal activities against the criteria set out. As summarised there, DACCS and BioCCS could meet all the criteria to be included in the EU ETS, once the CRCF methodology for permanent removals is adopted. The main issue is biomass sustainability, for which stakeholders raised concerns that there are no limits on the amount or type of biomass that can be used in the ETS and the existing incentive structure (across RED, ETS, CRCF and LULUCF sectors) are not well aligned. Currently DACCS and BioCCS offer the lowest levels of uncertainty associated with carbon stored and captured and an MRV framework that is most compatible with the ETS approach.

Biochar will generate permanent removal units under the CRCF. It can meet many of the criteria in the table below. The draft CRCF methodology does include minimum criteria for the quality of biochar, which is considered a key factor for a high-quality biochar project. However, the CRCF does not include ongoing monitoring or liability provisions. Considering the low risk of reversal of the fraction of biochar that is identified by the CRCF methodology on biochar as stable, and the use of a conservative factor in the quantification of the permanent fraction of the biochar, no further monitoring is required beyond the point at which the biochar is demonstrated to have been applied to the land or incorporated into a product.

Depending on the type of carbon removal integration within the ETS, biochar can be an option to consider, as it is today the carbon removal solution most ready for near-term deployment. For instance, it could be easier to address the remaining concerns on MRV uncertainties through a public purchasing authority than through a direct integration at the level of the ETS regulated entities. However, removal units are likely to be lower cost than other permanent removal options, therefore the Commission should consider carefully if and how to allow biochar removal units to be integrated as this could have a larger impact on the ETS market than other removal options. On a global level, biochar carbon removal capacity could reach approximately 2.8 MtCO₂ per year by 2030 and 4.3 MtCO₂ per year by 2035, while EU biochar carbon removal capacity could reach 5–7 MtCO₂ per year by 2035.⁴²

⁴² Concretely, according to the study from European Commission: Directorate-General for Climate Action and Ramboll Management Consulting, Carbon removals in the EU – Review of current carbon removal projects and early-stage financing (Publications Office of the European Union, 2025, <https://data.europa.eu/doi/10.2834/0004994>), on a global level, the estimated biochar carbon removal capacity is projected to continue expanding. The State of Carbon Dioxide Removal 2024 (Pongratz et al., 2024) suggests an increase from 0.2 MtCO₂ per year in 2021 to 0.8 MtCO₂ per year in 2023, with an annual growth rate of approximately 0.3 MtCO₂. If this trend persists, global biochar carbon removal capacity could reach approximately 2.8 MtCO₂ per year by 2030 and 4.3 MtCO₂ per year by 2035. This growth does not

The Commission should consider the full range of policy options to support the scale-up of biochar. Furthermore, as the research into biochar is relatively limited (although expanding all the time), we consider that there is currently insufficient long-term research to judge whether the decay functions are sufficiently conservative for all applications of biochar.

Other more novel approaches such as enhanced rock weathering could meet the criteria in future but currently requires further research.

constraints e.g., available land, biomass) from McKinsey (2023) and Babiker et al. (2023) for potential scaling of carbon removal technologies by 2050, suggesting that these capacities are plausible. In Europe, the current capacity of 0.2 MtCO₂/a in 2023 is expected to increase to 2.3 MtCO₂/a by 2030, according to the European Biochar Industry Consortium (2024). If growth continues in line with the estimated capacities for 2023 and 2030, and assuming an exponential trajectory, EU biochar carbon removal capacity could reach 5–7 MtCO₂ per year by 2035. These projections are consistent with those of the Rocky Mountain Institute (2023), which also anticipates significant scaling of biochar carbon removal capacity in the coming decades, albeit on a global scale. In the survey conducted for the study, European biochar companies indicated they aim to remove 2.4 MtCO₂ per year by 2030 and 5.3 MtCO₂ per year by 2035, however, the extent to which this estimated future capacity is feasible, remains to be seen. These estimates provided by stakeholders might be too optimistic, meaning these could reflect ambitions rather than realistic expectations.

Table 8: Overview of criteria applied to different domestic carbon removal activities

	DACCS	BioCCS	Biochar	Enhanced Weathering
Permanent Storage	Yes	Yes	Yes	Yes
Liability provisions	Defined (CCS/ETS Directives)	Defined (CCS/ETS Directives)	Permanence of storage addressed by requirements at production. No liability provisions (as for permanent CCU under the ETS).	No CRCF methodology
Minimum MRV requirements/Uncertainty	Defined, measurement-based MRV, low uncertainty Ease of MRV high	Defined, measurement-based MRV, low uncertainty Ease of MRV high	Test biochar quality and monitor to point of application on soil or incorporation in products. Ease of MRV high	Modelling involved; high uncertainty Ease of MRV low
Environmental impacts (positive)	No	Yes - Energy production	Yes - If used for soil enhancement: Soil fertility, water, possible decrease of N ₂ O	Yes - Soil amelioration, nutrient source
Environmental impacts (negative)	High energy use (competing with renewable electricity demand for abatement)	Biomass sustainability concerns – mitigated by compliance with RED and limit on additional biomass use	Biomass sustainability concerns – mitigated by limiting to wastes and residues (if primary product) and RED compliance	Challenges for scaling up rock extraction, potential risk of soil contamination
Technological maturity Wide-scale testing	TRL 6-8 Well- tested quantification of technical solution mature	Well-tested quantification of technical solution mature	Most of the carbon removals currently delivered on voluntary market are from Biochar activities. Decay function could benefit from broader testing after approval of the methodology	Requires further testing after approval of methodology
Overall recommended for inclusion in EU ETS	Yes	Yes	Depends on the type of integration of carbon removals with ETS	Needs further research

4. CROSS CUTTING DESIGN CONSIDERATIONS OF THE MEASURES

This section examines the remaining cross-cutting design considerations of all the measures.

4.1. Equivalence between CRCF and EU ETS GHG units

The CRCF Regulation provides a framework for quantifying and certifying carbon removal activities in the EU. This section discusses the equivalence between the GHG calculation in the CRCF and in the EU ETS.

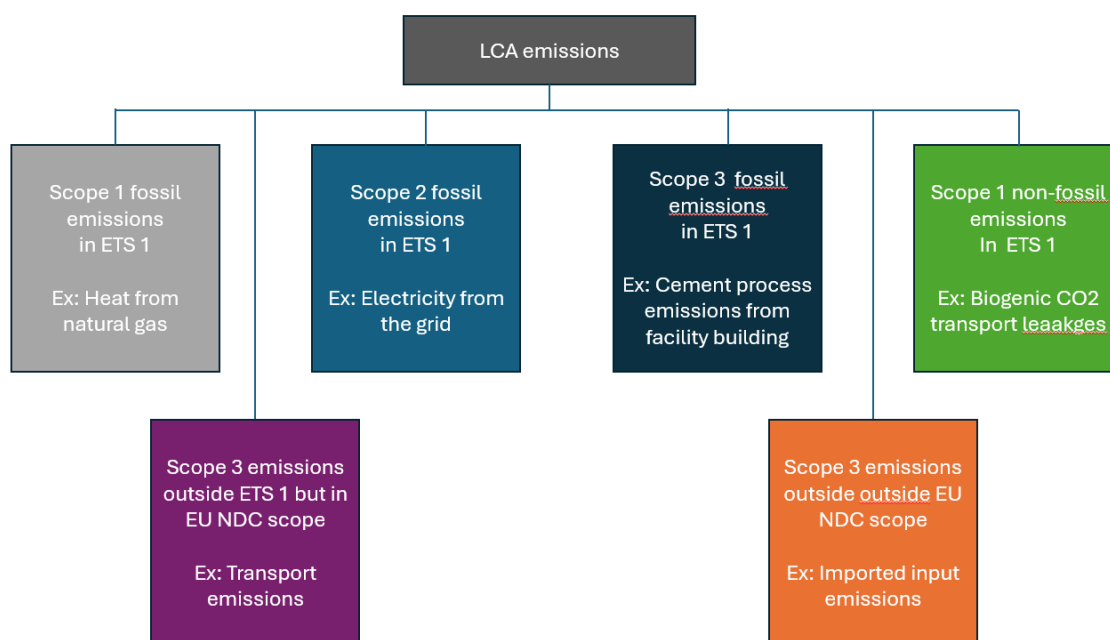
The CRCF and the ETS take different approaches to calculating emissions. The CRCF Regulation (Article 4) sets out the high-level EU approach to quantify net carbon removals, i.e. deducting several emissions from the actual CO₂ removed at the point of capture (gross removals). In practice the issuance of a CRCF certified unit should always mean that one net tonne of carbon has been removed from the atmosphere. The detailed methodologies, which will set out the exact scope of emissions per activity type, are in development, and due to be adopted during 2025.

The CRCF certifies the net removal credits generated by a specific activity over the certification period, by deducting the emissions generated during the lifetime of the project (life cycle assessment or 'LCA') and the baseline from the gross removals (the tonnes captured for storage). The following depicts the formula for net carbon removals resulting from the CRCF Regulation:

Figure 6: Net emissions formula for CDR under the CRCF



Figure 7: Emissions included in life-cycle emissions calculation



Some of these LCA emissions are subject to surrender obligations under the ETS:

- From the energy use (scope 1 fossil fuel use or scope 2 electricity)

- Scope 3 emissions e.g., emissions from the cement production used in building the facility
- Emissions from CO₂ leaks in the transport or at injection of CO₂ in geological storage sites.

If one CRCF unit is directly exchanged for one EUA, emissions already covered by the EU ETS (for which an EUA has been purchased and surrendered) would be quantified again in the CRCF calculation and deducted from the amount of carbon removal that can be claimed.

Emissions would be paid for through the ETS and not allowed to be counted towards the CRCF carbon removal quantification, thus decreasing the amount of carbon removal units that can be claimed and increasing the cost of that removal unit. Meanwhile, emissions under the ETS are subject to the cap, so that the emissions taking place to generate removals reduce the space for other emissions in the ETS, leading to a climate neutral impact if they are not accounting in the value of the removal when used in the ETS.

To avoid what can be considered ‘double counting’ of emissions, an **exchange rate**⁴³ between removal units and EUAs could be implemented to ensure that the net carbon removals do not include ETS emissions.

Differently from applying a purely gross emissions calculation, this would still include the non-ETS LCA emissions and the baseline emissions if changed from zero as it is currently, which can be considered a fair calculation of the climate benefit of removals. Most of the time, this would mean more than one EUA being issued for one carbon removal unit, since the emissions covered by the ETS would have to be added to the net removal benefit to get the gross removal figure.

In this case, each carbon removal activity certified under CRCF should clearly identify the ETS counted emissions to allow for a simple adjustment. Trading of removals could be considered complex as there wouldn’t be a high degree of transparency on what 1tCO₂ of carbon removal is worth in the ETS, because the calculation will be dependent on each project and certification period. Standardised conversion rates could avoid this complexity, but they do not seem suitable as the level of double counting will vary highly from project to project.

The different approaches between the CRCF and ETS is acknowledged in the CRCF methodology for DACCS/BioCCS. The methodology includes a specific reporting requirement to determine the amount of emissions that are covered and allows to identify those that are already within the EU ETS and quantify that on a project activity’s certificate of compliance. EU ETS. This could facilitate the exclusion of ETS emissions from the calculation of net removals and therefore allow a CDR supplier selling their removal units into the ETS to calculate a project-specific exchange rate for conversion of a removal unit into an EUA.

In most cases, the magnitude of this issue is expected to be small. The largest contributor is electricity use, and whilst technologies such as DACCS are electricity intensive, the CRCF methodologies encourage the use of renewable electricity. There could, therefore, potentially be a big difference for a DACCS plant if they are using grid electricity today, although noting that as the grid decarbonises, this difference becomes smaller. However, in an hypothetical scenario where taking the net approach would reduce the amount of removals that can be claimed by around 25% if using grid average electricity for DACCS, the DACCS plant would get 25% more EUAs in the conversion than a DACCS plant using renewable electricity, which

⁴³ The arguments put forward refer to a model in which operators buy removals in the VCM and bring them into the ETS. The exchange would be simpler if the public authority would integrate removals within the ETS. This option does not seem feasible to the moment (public v private integration is part of the impact assessment analysis).

could create a negative perception of unfairness and almost a perverse incentive not to use renewable electricity.

While the proposed reporting of emissions that are already covered by the ETS on CRCF certificates could be used to calculate the appropriate exchange rate, this approach would lead to the creation of individual exchange rates for each carbon removal project activity. Furthermore, since the basis for the issuance of certified removal units is periodic re-certification, a re-calculation of the project exchange rate will be required during each re-certification. As a result, exchange rates between removal units and EUAs may even differ for each issuance of removal units from each CDR project activity.

Without a standardised exchange rate, administrative burden will increase, and the functioning of the removals market will be affected as certified removal units from different projects will have a different values in the ETS, depending on the amount of ETS emissions covered. Furthermore, if a conversion factor is applied when removal units enter the ETS, CRCF units could have different values inside the ETS and outside, which adds to the market complexity and perception risk, on top of the un-level playing field for different CRCF uses.

Stakeholders interviewed and respondents to the open consultation questionnaire were rather split on the question of whether to allow gross removals into the ETS (with an exchange rate) or net (one-to-one CRCF unit for an EUA). The main argument for gross removals is to not pay for the same tonne of carbon twice. However other stakeholders argued for net, arguing mainly on the basis of not diluting environmental integrity, avoiding complexity and ensuring consistency with the voluntary carbon market.

Conclusion: The CRCF approach guarantees a net climate benefit as part of its quantification methodology since units issued consider net emissions, with any upstream emissions being deducted from the amount of removals that can be claimed. Therefore, allowing the direct exchange of one CRCF removal unit for one EUA would always be a conservative approach. A one-to-one exchange would also ensure minimum administrative burden and perception risk, regardless of how removals are integrated in the EU ETS. It would also support market functioning since all eligible units would have the same value for the purposes of the EU ETS.

4.2. Unit differentiation

It is necessary to decide how removal units will be treated under the Union Registry for ETS compliance purposes. The choice of unit impacts among others market design and price formation, as well as practical elements of the operation of registries.

ETSs worldwide differ in their approach to CDR-related units for ETS use. In the New Zealand ETS, CDR suppliers are included within the scope of the ETS and receive allowances that have equal compliance value, but that are distinguishable from other allowances in the market. This allows, among others, for a premium to be paid for removal-backed allowances (e.g. by voluntary buyers). Units from permanent forests, for example, trade at a premium as compared to other allowances.⁴⁴ In all other ETSs currently making use of CDR units, CDR projects lie outside the scope of the ETS and receive carbon credits. Such credits are often only usable in the ETS subject to limits and restrictions. Jurisdictions, however, differ in how those carbon credits move within their registries. Under the California Cap-and-Trade Program, for example, carbon credits are issued by approved crediting programs (the Climate Action Reserve and the American Carbon Registry), which list projects and issue ‘registry offset credits’ (ROCs). ROCs are not compliance instruments in the Cap-and-Trade Program. Rather, ROCs must be

⁴⁴ See <https://www.mynativeforest.com/carbon-price-nz>

reviewed and converted by the regulator (the California Air Resources Board) into ‘ARB-issued Compliance Offset Credits’ (often referred to as ARBOCs) to be usable in the Program’s registry (the Compliance Instrument Tracking System Service).⁴⁵ ARBOCs are traceable to the original ROC, which is an important feature of the system’s approach to liability: in some situations (e.g. in case of fraud or over-issuance⁴⁶), the regulator may invalidate ARBOCs; if such ARBOCs had been surrendered for compliance, then the ETS regulated entity must replace them with valid compliance instruments. Other systems use different approaches. In Phase 3 of the EU ETS for example, certain units from Kyoto Protocol instruments were accepted but had to be converted into EUAs by the Union Registry before they could be used towards EU ETS compliance obligations. The converted EUAs carried equal compliance value as regular EUAs, and were fully fungible – that is, there were no restrictions on what regulated entities could do with those KP unit-backed EUAs as compared to regular ones.

Decisions on unit use are related to but distinct from decision on whether removal units are generated by the CRCF and/or inside the EU ETS. If units are generated by the CRCF, then a decision must be made on whether these units can be traded and surrendered as such by ETS regulated entities, or whether they should be converted into allowances for use inside the Union Registry. And to the extent that any allowances are generated for removals (e.g. for the conversion of CRCF units, and/or for allowances generated inside the scope of the ETS), then it is necessary to decide whether removal-backed allowances should be distinguishable from conventional allowances.⁴⁷ Three broad options seem available:

1. CRCF units are traded (and surrendered) as such by ETS covered entities.
2. Removal units are converted into (or issued as) removal-backed allowances that are identifiable as a removal, and traceable to the activity that generated it.
3. Removal units are converted into (or issued as) allowances that are indistinguishable to market participants from conventional allowances.

In all options, operators could use a unit towards their compliance obligation, albeit potentially subject to limits as discussed in (section 4.4.1. Considerations on CDR limits). We assume that all units would be equally bankable. Design choices on limits and units can interact – for example, unit differentiation can be a requirement if limits on CDR use apply at the moment of unit surrender, or if different limits apply to e.g. different CDR technologies. Here, we assume that CDR limits would be enforced upon the unit entering the Union Registry and would be technology neutral. Unit differentiation can also be a requirement for some permanence and liability provisions in case of reversals. Here, we assume that liability for reversals is addressed through the CCS directive and other CRCF provisions. Moreover, the analysis below suspends judgement on the cost competitiveness of removal units in the EU ETS market.

A key disadvantage of option (a) and, to some extent, (b) is that they would imply that different units can be surrendered for compliance, leading to market fragmentation and increasing complexity. This can have important market dynamics effects by fragmenting the ETS market, affecting among others the market liquidity (especially if multiple prices arise) and hedging complexity for operators. Unit differentiation can also create confusion in the market,

⁴⁵ See <https://ww2.arb.ca.gov/our-work/programs/compliance-offset-program/arb-offset-credit-issuance>

⁴⁶ Note that this does not apply in case of reversals, which are managed primarily through buffer accounts.

⁴⁷ We distinguish ‘conventional’ allowances from e.g. removal-backed allowances. Present-day EUAs are conventional allowances in that they represent the right to emit one tCO₂e under the scope of application of the EU ETS. While the scarcity imposed by the ETS drives emission reductions, the use of a conventional allowance for compliance enables a tCO₂e to reach the atmosphere unabated.

especially if there is concern over the relative compliance value of different units. In the past, for example, auctions of fully fungible aviation allowances failed to clear because they were erroneously perceived by market participants as being different. In that regard, option (c) provides the simplest and most straightforward approach from the point of view of market dynamics as well as of regulatory complexity.

An advantage of options (a) and (b) is that they provide the market with information on how the allowance was generated, which can be valuable if, for example, there is a higher willingness to pay for (certain types of) removal-backed allowances. In interviews conducted for this impact assessment, stakeholders primarily supported option (b), in part because there is an expectation that removal units will fetch higher prices than conventional allowances, e.g. where operators choose to pay a premium for removal-backed allowances in order to make (voluntary) carbon neutrality claims.⁴⁸ However, the opposite can also apply. Public concern over the quality of removal units could lead to a risk perception by market participants that removal units are or could be less valuable than conventional allowances, especially if there is a concern that the regulator amend rules for the use of removal units in the ETS. Unit differentiation can also enable the regulator to enforce demand-side liability and/or cancel allowances in case of e.g. fraud, as in the case of California.

The UK Government, in its consultations on the potential inclusion of removals in the UK ETS⁴⁹, did not consider option (a). Under option (b), they considered two options: (b1) generic differentiation (b2) differentiation by technology type. 84% of stakeholders in the UK consultation supported differentiation, with most supporting generic differentiation. Moreover, 76% of stakeholders believe that removal-backed allowances would see a price premium compared to conventional allowances. The UK government has concluded that there are important benefits to a generic differentiation of allowances, e.g. from increased transparency and the potential for price discovery. It considers that a generic differentiation provides a balanced approach, achieving the benefits of price discovery and transparency while mitigating potential impacts on liquidity⁵⁰. The UK government also noted that demand for removal-

⁴⁸ It is worth noting that removal unit price premiums that rely on voluntary demand would require an understanding of what claims regulated entities can make by using removal units inside the ETS. E.g. in a situation where some operators regulated by the ETS would like, in addition to complying with their ETS obligations, to make a voluntary carbon neutrality claim by purchasing only removal units. This ‘dual purpose’ of removal units in the ETS could boost demand and drive up their price vis-à-vis conventional allowances. It is unclear, however, in what situations operators would have a legitimate carbon neutrality claim. It seems likely that in most cases, the regulated entity would be able to make a legitimate claim of carbon neutrality. In some cases, however, it seems possible that a waterbed effect could negate a true carbon neutrality claim. It seems that a waterbed effect could exist in a situation where removal units are cost-competitive in the ETS and where there are limits on CDR units entering the ETS (that is, supply-side limits rather than demand-side limits – see section on considerations of limits). In that case, entities wishing to make voluntary claims would have a higher willingness to pay for the removal units – thus potentially increasing their market price, but nevertheless leaving the same number of compliance units for other operators in the market. It seems that in this situation, operators willing to pay a premium for removal units would consume the (limited) removal units supply and that CDR suppliers would get more income than they otherwise would, but that total net emissions from ETS regulated entities would remain unchanged as compared to a counterfactual where the operator did not make the carbon neutrality claim. This relates crucially, also, to defining what constitutes truthful and not misleading carbon neutrality claims – which is also related to ongoing discussions related to the Green Claims Directive.⁴⁸ We recommend more analysis on this issue.

⁴⁹ See <https://www.gov.uk/government/consultations/integrating-greenhouse-gas-removals-in-the-uk-emissions-trading-scheme>

⁵⁰ <https://assets.publishing.service.gov.uk/media/687f61598adf4250705c9765/uk-ets-ggrs-main-response.pdf>

backed allowances over conventional allowances could come from ETS participants looking to meet corporate climate commitments through the purchase of high-integrity removals.⁵¹

Conclusion: The analysis above portrays a complex picture of advantages and disadvantages. Still, it is preferred to follow option (c) – removal units are converted into (or issued as) allowances that are indistinguishable to market participants from conventional allowances. This avoids market fragmentation and reduces regulatory complexity, at least in the early phases of CDR integration into the EU ETS. This could be reviewed later on as the regulator and market participants gather experience with the use of CDR in the ETS. However, option (c) is most compatible with measures CR4 and CR5, where the regulator can enforce the CDR limit directly. This option is compatible with other measures in case a supply-side limit applies at the point of exchange in the Union Registry, as is assumed to take place, instead of at the time of surrendering. Demand-side limits would likely require unit differentiation to avoid the establishment of ex-ante quotas.

4.3. Who carries out the conversion in the private sector integration option (CR1-CR3)

If removal units are used for compliance in the EU ETS, and if units flow into the ETS through a operator integration (CR1-CR3), and if removal units are generated through the CRCF outside the ETS, and if the CRCF unit must be converted into an allowance at within the Union Registry, then the next question is who effects the conversion. This can be done by the ETS operator and/or by CDR operators, i.e., the CDR supplier (considerations on conversions by the regulator are covered under the supply side CDR limit, see ‘regulator control’). This wouldn’t affect dynamics on the secondary market, but could affect dynamics in the primary market.

Having ETS operators carry out the conversion has the advantage that the regulator would interact only with operators, without the need to have CDR suppliers engage with the Union Registry. Having more operators engage with conversion could reduce risks of market manipulation by CDR suppliers if CDR supply is concentrated.

Having CDR suppliers carry out the conversion has the advantage that the market is simpler for ETS operators, as they would purchase only EUAs (possibly tagged as removal-backed), remaining within a market with strong financial market safeguards and established controls. This would reduce the administrative burden for operators and eliminate the need for them to trade CRCF units, albeit by transferring part of the administrative burden to CDR suppliers. Depending on whether there are limits on CDR use and how they are applied, this approach could incentivize CDR suppliers to move quickly into converting CRCF units into EUAs as a means of safeguarding part of the ‘space’ under the limit.⁵² If the regulator chooses to address the net/gross accounting issue through an exchange rate (see section 4.1 Equivalence between CRCF and EU ETS), having the CDR suppliers make the conversion could facilitate market dynamics as suppliers would know the batch-specific CRCF-to-ETS equivalence ex-ante, removing uncertainty for operators about how many ETS-surrenderable units a CRCF batch yields. Moreover, having fewer counterparties performing conversion could enable a simpler approach to processes within the Union Registry. Finally, this approach could also yield more

⁵¹ It also noted that corporate net-zero claims using ETS removal allowances must follow best-practice guidance, with the UK Government proposing endorsement of the Voluntary Carbon Market Initiative's code in its consultation on voluntary carbon and nature markets

⁵² It is unclear whether this would have material effects (e.g. on liquidity) on the primary market, as trades would likely respond primarily to the cost-competitiveness of removal units in the ETS.

flexibility for the regulator in applying liability provisions directly to CDR suppliers (e.g. in cases of fraud), beyond CRCF provisions.

It is important to note that the choice of who carries out the conversion interacts with provisions on the enforcement of CDR limits (section 4.4. Consideration on limits) and with the differentiation of units (section 4.2. Unit differentiation). For example, demand-side limits without unit differentiation would require conversion by operators, but demand-side limits with unit differentiation would still be compatible with CDR supplier conversion. Supply-side limits (how many removal units can be into converted) seem compatible with both options.

4.4. Considerations on CDR limits

As discussed elsewhere in this analysis, CDR limits can be key in safeguarding the integrity of the system, especially in the early phases of CDR integration and also in the later phases when costs may come down. In the open consultation, 42% of respondents agreed or strongly agreed with the statement “The use of CRCF removals by ETS regulated entities should not be unlimited, but subject to restrictions” - several of them citing the need to ensure environmental integrity and market stability, as well as questioning the fungibility between CDR and abatement under the ETS. On the other hand, 28% disagreed or strongly disagreed with the statement, e.g. citing that limits would constrain cost-effective compliance options as well as increase regulatory and demand-side risks for investments. Interestingly, support for the question on limiting gross emissions (“There should be a limit on gross emissions by ETS1 regulated entities (not only net ones)”) yielded somewhat different results, with 29% agreeing or strongly agreeing with the statement (often citing that a gross cap must be maintained to ensure real emission reductions) and 37% disagreeing or strongly disagreeing with it.

With the exception of CR2 ‘Unlimited operator integration on top of the cap’, all measures outlined above would see a limit to the flow of removal units into the EU ETS. Several important considerations apply. First, limits must be consistent with other design choices and be enforceable. Second, limits can create uncertainty for both sellers and buyers, in the sense that CDR suppliers and ETS operators may face uncertainty on whether they will be able to claim part of the ‘space’ within the CDR limit. Finally, they can affect market dynamics through their influence on the formation of current and expected future prices. It is important to note, however, that concerns apply mainly to the extent that the CDR limit is or is perceived to be binding, which, given current assumptions, would require significant support to CDR development and deployment outside the ETS to bridge the cost differential between removal units and abatement in the ETS.

CDR limits can be categorized as supply side or demand side.

a) Supply-side CDR limits

Supply-side CDR limits control how many removal units can flow into the ETS, without any further regulation on who can make use of those units, or how many removal units each individual operator can use.

One supply-side approach is to have the regulator control the purchase and release of removal units, thereby ensuring adherence to the CDR limit. This is compatible with measures CR4 ‘Public authority integration through regular auctions under the cap’ and CR5 ‘Public authority integration through MSR on top of the cap’. This approach, however, is not consistent with the measures involving integration through operators (CR1 ‘Limited operator integration on top of the cap’ and CR3 ‘Limited operator integration under the cap (one-in-one-out)’). Regulator control has the advantage that uncertainties on the supply side could be mitigated through clear purchasing schedules as well as clear commitments on the balance of purchases across

technologies. Rule-based and competitive removal unit purchases can promote transparency for the supply side, and the ability of the regulator to bridge the price differential between CDR costs and EU ETS prices is also a large advantage. Nevertheless, the intermediation by a public authority can introduce market distortions and inefficiencies, e.g. if the regulator can't adjust to the evolution of CDR technologies sufficiently quickly – which, in turn, requires rules and clarity to enable predictability. On the demand side, regulator control can reduce uncertainties if removal units would be auctioned together with conventional allowances and following the same rules. As removal units would be sold at the same price and at the same time as conventional allowances, price formation there would likely remain largely unchanged as compared to the current situation.⁵³

Another supply-side approach is to employ a first come, first served approach. In this approach, the CDR limit would be used up as removal units flow into the system. This approach is in principle compatible with all measures considered here – albeit redundant for measures that involve integration through a public authority (CR4 ‘Public authority integration through regular auctions under the cap’ and CR5 ‘Public authority integration through MSR on top of the cap’). It would be necessary to define when the portion of the CDR limit would be considered to have been ‘used up’ – e.g. when a removal unit moves into the Union Registry, or when it is surrendered for compliance. Using up the limit as units flow into the Union Registry could advantage CDR technologies with higher technological readiness and shorter investment cycles, as those could move quickly to take the space under the CDR limit – albeit primarily if the CDR limit is or is perceived to be binding. Using up the limit as removal units are surrendered for compliance could allow more time for removal units to flow into the system, thereby however also pushing demand-side uncertainties on the available space within the limit towards the end of the timeframe to which the limit applies.⁵⁴ Note that these options interact with other design considerations, e.g. unit differentiation.

In principle, a first come, first served CDR supply limit could be set for the whole period or on a yearly basis (a yearly limit could also be either constant or increase over time, e.g. to reflect the likely volume of available removal units in the market). Establishing limits by period could be simpler to implement than yearly ones and provide more flexibility to adjust to the deployment of CDR supply on the ground. The key downside of limits by period is the back-loading of the risk and potential for end-of-period volatility. This could potentially be managed through annual sub-limits that incentivize early surrender, although noting that such sub-limits could increase regulatory complexity.

A key advantage of the first come, first served approach is that it rewards the frontrunners, as they can secure a piece of the limit, which is also when removal units are expected to be less cost-competitive vis-à-vis conventional allowances (although this depends on the interaction with other CDR support instruments).

A key challenge of the first come, first served approach is that it can create uncertainty for both the demand and the supply. Notably, operators (and intermediaries) can engage in forward purchase contracts for removal units but end up not being able to use the units if, by the time they receive the units, the CDR limit has already been used up. As future contracts represent

⁵³ Auctions could also be organized to allow for differentiation of conventional and removal-backed allowances. The UK, for example, is currently planning for multi-product auctions as a means of delivering removal-backed allowances into the UK ETS. Whether removal-backed allowances auctions clear at the same price as conventional allowances depends among others on auction design and risk premiums for different units.

⁵⁴ The timing risk could potentially be addressed through a pre-surrender ‘booking’ of the CDR limit, e.g. through a pre-surrender CDR account that would guarantee the ‘space’ within the limit to operators.

the vast majority of the traded value in the EU ETS⁵⁵, this uncertainty could significantly affect the market. Similarly, CDR suppliers could invest in CDR supply but fail to guarantee a slice of the CDR limit by the time their units are ready to reach the market. Moreover, a first come, first served approach could push smaller players out of the CDR market if large players move quickly to take the allowable CDR volume. Also, intermediaries could engage in speculation by capturing a share of the limit. It is important to note, however, that these concerns apply mainly to the extent that the CDR limit is - or is perceived to be - binding.

In order to address uncertainties for CDR suppliers, and in addition to either of the two options above, the regulator could potentially allocate a portion of the limit on the supply side (that is, to individual CDR suppliers) – thus guaranteeing to them access to the CDR market. For example, the regulator could guarantee a particular CDR supplier that it would be able to sell at least 1000 removal units into the EU ETS, should they become available. It would be necessary for the regulator to devise methods to allocate (a portion of) the limit to those CDR suppliers, perhaps similar to electricity capacity markets, although this would likely mean a significantly higher involvement by a public authority than a pure ‘operator integration’ approach, requiring transparent rules (including allocation criteria) and an ongoing process to fairly and efficiently allocate the portion of the limit to individual CDR suppliers. The development of such a mechanism lies outside the scope of this report and could be subject to high complexity – an initial investigation of options for this report yielded no viable result. Should a viable option be identified, then it may be important to address the risk of CDR under-delivery, as reserving the limit to CDR suppliers that under-deliver could mean that fewer CDR units are available in the EU ETS than originally envisaged. This could potentially be managed through an ‘overbooking’ of CDR supply, which in turn could lead to the limit being overshot if the overbooking is too large – presumably, the regulator could commit itself to purchasing the removal units (e.g. for use outside the EU ETS or in the next ETS period) even if they surpass the EU ETS limits.

b) Demand-side CDR limits

Another option is to establish a limit per operator, e.g. by setting a maximum percentage of compliance obligations that can be fulfilled with removal units, as done in the ETSs in e.g. California and Québec. This approach is in principle consistent with all measures considered here. Again, in this case, this approach is redundant with regards to CDR limit enforcement for measures that involve integration through a public authority (CR4 ‘Public authority integration through regular auctions under the cap’ and CR5 ‘Public authority integration through MSR on top of the cap’), but it would provide the regulator the possibility to ensure equal access by operators to the removal units being made available.

Limits per operator would likely facilitate or force the participation of small and medium-sized regulated entities to participate in the CDR market as compared to the first come first served approach, allowing for a fairer distribution of the flexibility across regulated entities – which can be relevant in particular in a smaller market with dwindling liquidity. Establishing limits per operator would also avoid creating the uncertainty to the demand side on whether removal units purchased through forward contracts would be allowable towards compliance obligations. A potential disadvantage of this approach is that a CDR limit of between 175 and 330 Mt for the whole period and for 11000+ operators could be spread too thin to warrant the transaction costs of purchasing removal units, thus potentially leaving part of the ‘space’ awarded by removal units unused. This, however, seems unlikely to be the case; first, because the importance of the CDR market as in terms of unit supply in the EU ETS is expected to increase

⁵⁵ Veyt, 2024 Year in Review EU ETS: Flattening out, [2024 Year in Review EU ETS: Flattening out | Veyt](#)

markedly during the period, such that we expect that small ETS operators also engage in removal unit purchases over time once units become cost competitive.

The volume of allowable CDR use could be set for the whole period and/or on a yearly basis. A limit by period could be simpler to implement than a yearly one, ensure better access to the extra ‘space’ by each operator, and finds precedent in the way international credit entitlements were allocated during phase III of the EU ETS. Limits per operator could also, in theory, be adjusted to reflect judgements on what constitutes ‘hard to abate’ emissions – which, as outlined below, is considered politically unfeasible at this stage. Nevertheless, making such a percentage number explicit could present a significant political challenge if sectors and/or Member States pressure to favour some sectors over others in the access to removal units.

Importantly, the application of a limit per operator is influenced by (a) where units are generated and whether they are differentiated; (b) who does the conversion, (c) when the limit is enforced (e.g. at conversion or at surrender) and (d) on what basis the allowable limit is calculated (e.g. ex ante on the basis of past emissions, ex-post on the basis of compliance obligations, etc). It will be important for the regulator to ensure the package of options is coherent. For example, setting a maximum percentage of compliance obligations that can be fulfilled with removal units would require that units be differentiated, as the limit would be enforced at surrender. If removal units are not differentiated for market participants, then the limit cannot be enforced at the point of surrender, as operators would not be able to tell different units apart. In this case, the application of the limit would have to be carried out upstream, e.g. at the point of conversion of CRCF units into allowances in the Union Registry. This in turn would likely require that the conversion be carried out by the operator, based on a pre-established quota, e.g. on the basis of past emissions as done for Kyoto units in the EU ETS phase III. Defining this pre-established quota, however, would require careful consideration to foster fairness and avoid perverse incentives, and could be subject to extensive political debate.

4.4.1. CDR limits if removal units are generated inside the EU ETS

A second key consideration pertains to the compatibility between the way that removal units are generated (whether inside the ETS and/or outside the scope of the ETS, under the CRCF) and the enforcement of CDR limits inside the EU ETS. This interaction will need to be managed, in particular if removal units can be generated inside the EU ETS (e.g. where a BECCS plant is regulated under the EU ETS and can certify removals through its EU ETS MRV process) and where CDR limits are or are expected to be binding. In such a situation, further regulations (such as entity-specific limits for the generation of removal units) must be in place to make sure that limits are enforceable and applied fairly across ETS-covered CDR suppliers. Most stakeholders interviewed strongly preferred a ‘CRCF only’ approach for the certification of removal units.

Under a first come first served approach, a first consideration is one of fairness in processing times and transaction costs – as large differences in the treatment of removals generated inside vs outside the ETS could lead to de facto preferential access to the CDR limit. Avoiding this situation could entail harmonizing rules across the EU ETS and the CRCF, and/or allocating a portion of the limit to individual CDR suppliers as described above. It could also be necessary to establish maximum limits on the volume that CDR suppliers can generate within the ETS – which would likely require provisions for the issuance of other units (e.g. through the CRCF) once ETS limits for CDR have been exhausted. This, however, can lead to significant complexity and uncertainty for CDR suppliers.

Enforcing limits per operator while generating removal units inside the ETS would likely entail high complexity. It would mean that operators would be limited in how many of their ‘own’

removal units they would be allowed to use – with other units sold to the market, but again under maximum limits on the volume that CDR suppliers can generate within the ETS and with accompanying provisions for the issuance of other (e.g. CRCF) units once ETS limits are breached.

In general, allowing for the generation of removal units inside the EU ETS while at the same time imposing limits to CDR use inside the ETS requires the establishment of an internal limit and seems likely to lead to high complexity for CDR suppliers. Such an approach could also be perceived to be unfair towards CDR suppliers if they are subject to the ETS (with what it entails in terms of monitoring and reporting plans and verification), to then allow only a portion of their removal units to be issued as EUAs.

Where the limit is only implicit through the public authority integration and inside generation is only allowed for existing ETS installations to compensate their own emissions, the set-out becomes less complex.

4.5. Timing and sequencing

The inclusion of CDR into the EU ETS requires a thoughtful timing and sequencing strategy, aimed at optimizing advantages while mitigating potential risks.

On timing, the CRCF Registry is due in 2028. With a buffer of one year for the CRCF Registry to operate, CDR integration into the ETS could start at the earliest in 2030 and would require a testing period for the registries to interface. In addition, the likely timely entry into force of changes needing transposition and adoption of implementing and delegated acts is 1 January 2029 at the earliest.⁵⁶ Therefore, integration is proposed for 2031, noting that in the beginning the integration could be largely symbolic due to low volumes.

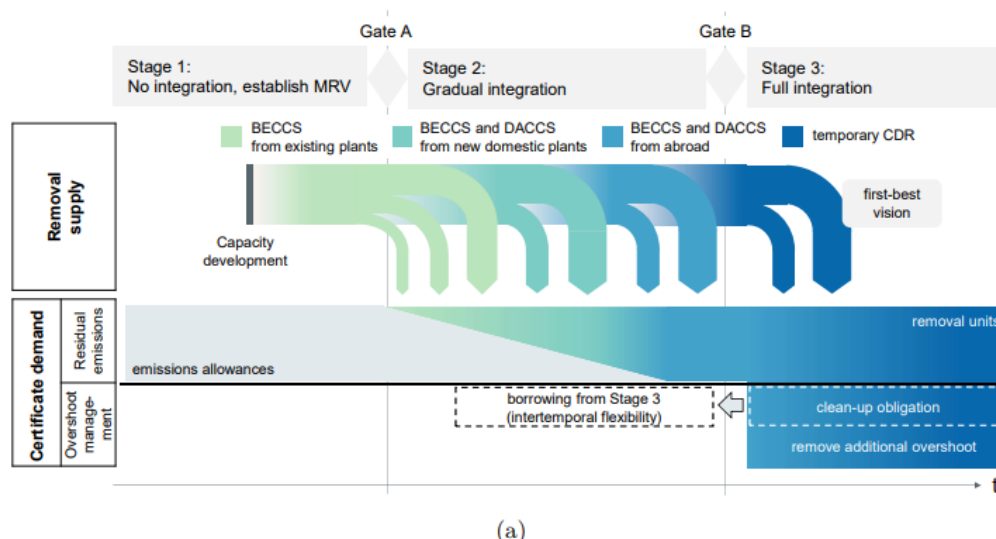
On sequencing, respondents to the open consultation leaned in favour of a speedy introduction of CDR in the EU ETS, with 38% of respondents disagreeing or strongly disagreeing with the statement ‘The use of CRCF removals by the ETS1 regulated entities should be phased in slowly over time’, mainly citing cost-efficiency, and 29% agreeing or strongly agreeing with it, citing the need to ensure market stability, environmental integrity, and a certain share of emission reductions before allowing offsets. By contrast, the overwhelming recommendation of the literature (see e.g. Burke and Gambhir 2022, Rickels 2022, Sultani 2024, ESABCC 2024, Verbist 2025) favour a gradual rather than immediate full-scale integration process. Gradual integration was also strongly supported by stakeholders in interviews. An incremental approach would enable the EU ETS to evolve alongside advancing CDR technologies and growing comprehension of their implications – inside and outside the ETS. The literature advocates for using early stages to develop comprehensive MRV frameworks (which in the EU’s case has been developed through in the CRCF methodologies) to guarantee fundamental quality standards for CDR credits under consideration.

Once essential quality control is in place - as is the case in the EU - many scholars endorse a progressive development of integration approaches over time. This could begin with more restricted interaction mechanisms, e.g. funding CDR advancement external to the ETS through targeted financing (potentially sourced from ETS revenues); as expertise accumulates and CDR technologies advance in cost-effectiveness, scalability, and environmental performance, the EU could advance with limited inclusion in the EU ETS, e.g. through a public authority and/or the MSR. The end goal of a sequencing strategy, as proposed by e.g. Sultani et al. (2024) and

⁵⁶ Following the same timeline as for maritime in the July 2021 proposal, which was challenging and where transposition is still pending.

Verbist et al. (2025), could involve a more comprehensively integrated marketplace where high-quality, durable removals become fully interchangeable with EUAs. See Figure 9 for a concrete example, where panel (a) pictures the a sequencing of CDR into the EU ETS (from separated systems to full integration), and panel (b) describes the safeguards that must be fulfilled in order to progress across stages.

Figure 8: Stage-gate approach with three governance stages of integrating CDR into the EU ETS



(a)

	Gate A to gradual integration (Stage 2)	Gate B to full integration (Stage 3)
Opening conditions (unlocked when...)	• Certification & MRV for permanent CDR in place • Sustainability criteria established (biomass) • Market stability reform to account for CDR	• Risks (abatement deterrence, excessive biomass use) addressed • First-best regulatory framework in place (major decisions about architecture to be made)
Related processes	• Potential CDR subtargets • 2026 MSR Review • CRCF elaboration	• Assessment of merging ETS I and ETS II in 2031 • Potential further ETS extensions
Tentative timeline	Until 2030; connected to "Fit-for-90" package (2040 target)	Until 2040; connected to "Fit-for net-zero" package (2050 target)

(b)

Source: Sultani et al. (2024)

A key element of sequencing thus pertains also to the impact of CDR inclusion on climate ambition in terms of both net and gross emission limits. Under the Danish proposal for CDR inclusion under the EU ETS, for example, the inclusion of CDR would initially see no effect on gross emissions from the ETS⁵⁷. In the UK ETS, the cap was set assuming that CDR would take place in the UK economy, thereby increasing the limits for gross emissions under the UK ETS vis-à-vis a baseline of no CDR in the economy. Generally, the recommendation from the literature is one of conservativeness with regard to CDR inclusion, which seems advisable in particular when it comes to effects to ETS ambition. Accordingly, limits to CDR use in the EU ETS are a key regulatory lever.

A staged implementation approach for incorporating CDR into the EU ETS could therefore start with an integration through public authority (CR4 or CR5) subject to stricter limits to collect information and evaluate governance structures. Advancing toward more extensive operator integration frameworks would ideally follow proven success in these initial phases,

⁵⁷ Danish Ministry of Climate, Energy and Utilities. Denmark's position paper on integrating permanent carbon dioxide removals in the EU ETS.

clear demonstration of CDR technology advancement (cost, scalability, environmental reliability), comprehensive impact evaluations, and ensuring the system's ability to effectively manage related risks and shocks. Therefore, this impact assessment has only considered measures for the 2031-2040 period as part of the sequencing step after MRV development in the CRCF. Beyond 2040, alternative or complementary mechanisms to the measures considered in this impact assessment, may need to be developed to reach net-zero in 2050 and net-negative emissions thereafter.

4.6. Purchasing permanent carbon removals

Purchasing permanent carbon removal needs a clear strategy on how and when to purchase this carbon removals. Option CR1, CR2 and CR3 constrain the type of removals to be used in an ETS context but the operator is free to decide on what to buy, among the types of removal allowed for compliance, on the timing of the purchase and to some extent on the contractual arrangements for the purchase of the removals. Options CR4 and CR5 would, on the other hand, require defining the timing and the approach for the purchasing of permanent carbon removals under a public authority.

4.6.1. Timing of purchasing

Three main types of contractual agreement can be identified for the timing of removals purchases:

- **Pre-purchase agreement:** The purchasing programme pays a CDR supplier upfront in exchange for a commitment from the CDR supplier to deliver carbon removal certificates in the future.
- **Offtake agreement:** The purchasing programme makes a contractual agreement with a CDR supplier, agreeing to buy a specific amount of future CDR credits at a specific price at a specific time in the future, with the payment made on delivery. Offtake contract duration can differ depending on technology and supplier, e.g. Frontier signs offtake agreements with delivery timelines of 2-5 years.⁵⁸ Longer-term agreements are also possible, e.g., German industrial emissions reduction contracts offer a related model and have contract durations of up to 15 years.⁵⁹
- **Ex-post payments:** The purchasing programme purchases CRCF credits once the removals have occurred and have been certified.

These different purchase timings offer different strengths and weaknesses are summarised in the table below.

Table 9: Purchase timing strengths and weaknesses

Criteria	Pre-purchase	Offtake	Ex-post Payment
Buyer security (considering risk of non-delivery & underperformance)	Low – Buyer pays upfront; risk of project failure, delay, or supplier overestimation.	Low-medium – Payment only on delivery, but still risk of delay, non-compliance.	High – Payment occurs only after certification of removals.

⁵⁸ See <https://frontierclimate.com/apply/offtake>

⁵⁹ https://www.klimaschutzvertraege.info/thema/informationen_fuer_unternehmen_konkret

Bankability for suppliers <i>(provide or enable access to financing for investment)</i>	High – Provides liquidity and upfront capital; enables investment in early-stage facilities.	High – EU-backed contracts are bankable and can be used to secure private financing.	Low – No guaranteed revenue; little support for high-CAPEX or low-TRL suppliers.
Administrative complexity <i>(considering complexity and burden for administrator)</i>	High – Requires careful due diligence, risk mitigation, and potentially complex liability.	Medium – Requires structured contracting and milestone tracking but less upfront financial risk.	Low – Simple transactional process with minimal administrative burden.

Developing the capacity within the EU to deliver a substantial amount of permanent removals will require several years, especially for BioCCS and DACCS. During the first phase of the purchasing program, offtake agreements could offer long lead-time carbon removal approaches the guarantees that investors demand to support the scaling up of permanent carbon removals and the delivery the quantity of removals necessary to achieve EU climate ambition.

Different payment timings can be combined. For example, offtake agreements could be established with a share (e.g. 25%) paid upfront, balancing the suppliers' needs for funding and liquidity. This ensures that carbon removal suppliers can invest and develop their technologies and infrastructure so that they can deliver carbon removals in the future but poses additional risks of non-delivery for the purchasing programme.

4.6.2. *Methods for purchasing carbon removals in public integration measures (CR4 and CR5)*

Purchasing programmes can carry out their purchases using different approaches, including competitive project-based tendering, reverse auctioning and flat rate price. Each of these approaches can be adapted to meet the different needs of different CDR technologies. The strengths and weaknesses of these purchasing methods are summarised in Table 2.

- Competitive project-based tendering

Individual projects are competing for funding, in exchange for providing carbon removal units at agreed dates in the future. The selection of projects is based not only on the price per tonne removed but also additional criteria. Possible criteria include quality, permanent removal type, as well as broader criteria such as potential for regional development and job creation. Separate tenders can be run for different technologies, in order to ensure a diverse portfolio. Competitive tenders are generally run ex ante, before removals are delivered (or investments confirmed), and are therefore most appropriate for pre-purchase or offtake agreements.

- Reverse auction

The tendering procedure is awarding the removals contracts to the cheapest qualifying bids until the budget is exhausted. Suppliers that meet prequalifying criteria make bids, specifying the volume and price of removals they can provide. Reverse auctions can have open bids, incentivising suppliers to offer lower prices. The procuring authority then selects winning bidders, starting with the lowest price offers until the procuring authorities budget is exhausted (or CDR quantity target has been met). The 'reverse' aspect refers to the auctions structure, where multiple sellers compete to sell to a single buyer, rather than the other way around.

Similarly for competitive project-based tendering, it should also be possible to have separate calls for separate technologies under the reverse auction format. If this means that there are few suppliers per technology, the reverse auction may not be an efficient purchase method, as there would be limited competition to drive the price down.

The Swedish BECCS support scheme provides an example of a reverse auction for permanent CDR with the specificity that the scheme does not purchase the full removal but provides subsidies that allows suppliers to also benefit from carbon credit sales on voluntary carbon markets, though this is then factored into the decision of the subsidy that is paid.

- Flat rate price

A flat-rate price involves the purchaser committing to purchase ex post any number of removals that can be delivered at a given, pre-determined price. The available subsidy is awarded on a first-come, first-served basis until the available budget is exhausted. The price per tonne of CO₂ set is paid to all suppliers who meet defined quality criteria. It may also be possible to differentiate flat-rate prices between different types of CRCF units, with different rates set for different CRCF activities. Flat-rate prices operate as a price floor for CDR suppliers, increasing revenue certainty and decreasing investment risk.

Similar to a Feed-in-Tariff (FiT), the flat-rate price can be agreed on through a long-term contract, potentially drawing on experiences with procuring renewable energy (e.g. including clause to adjust prices overtime). Denmark has these mechanisms in place for subsidies from its CCS fund.

Table 10: Purchase methods: strengths and weaknesses

Design considerations	Competitive project-based tendering	Reverse auction	Flat-rate price
Administrative complexity of the tool (and admin costs)	Medium: complex and time consuming to evaluate proposals	Medium: cheapest offers win the bids but some complexity in designing an effective auction	Low: simple transparent subsidy for removals. Less conflict with state aid and WTO rules
Fiscal burden / cost to the regulator of support	Medium: competitive process but with a financial risk from potential supplier default	Low: risk of financing upfront costs remains with the supplier	High: Misaligned rates could overcompensate suppliers
Ability to differentiate between different types of projects	High: can evaluate based on multiple criteria	Medium: different auction can be set for different types of removal	Medium: different rate can be set for different types of removals
Appropriateness for supporting different technologies	High: Scope to support a range of technologies through selection criteria	Medium-high: possible to have separate calls for separate technologies, but the main selection	Medium-high: possible by specifying rates per technology

		criterion is cost-effectiveness	
To what extent does the method deliver least costs / drive down future costs	High: incentive to provide lowest price in offer	High: incentive to provide lowest price in offer	Low

4.6.3. *Methods for supporting carbon removal markets when operators purchase removals (CR1-3)*

Due to the expected gap between the ETS price and the cost of permanent removals until 2035 (for BioCCS, based on some price estimations until 2038; for DACCS, during the whole phase 2031-2040), options CR1, CR2 and CR3 with the purchasing of carbon removal directly by ETS operators could require a mechanism to support in early stage the development of carbon removal markets, such as carbon contracts for difference (CCfD) and fixed-premium support.

- Carbon Contracts for Difference

Carbon Contracts for Difference is an example of this support. In this model, and in the context of carbon removals, a counterparty (typically a public authority) commits to paying to the carbon removal supplier, the difference between an agreed minimum (strike price) in the future if the reference market price falls below this level over the duration of the contract, de-risking investments in carbon removal activities. A key challenge with CCfDs is establishing the reference price, which requires a functioning carbon removals market to determine it. Different CCfD reference prices could be established for different types of carbon removals.

An important design feature for CCfDs is that when the market price of the removal rises above the strike price, the public authority can potentially be compensated by the supplier (two-way CCfD), e.g. the supplier sells carbon removal credits at the market price but if this is in excess of the strike price, some or all of this difference is paid back to the public authority. This model can provide revenue stability for suppliers, while lowering financial risks for the public authority.

However, Carbon Contracts for Difference (CCfDs) can place financial risk on the public authority when long-term contracts promise a high price for carbon removals, and actual market prices stay low. To manage this risk effectively, it's crucial to have clear budgeting plans and mechanisms to cap potential liabilities.

- Fixed-premium support

Contrary to a CCfD, in a fixed-premium approach, the public authority provides a subsidy that is not impacted by the fluctuation of the market price, reducing uncertainty when budgeting the public support. In this model, the public authority organises an auctioning and carbon removal suppliers bid the lowest subsidy they require in euros per tonne of CO₂ removed from the atmosphere. If successful, they receive this premium for up to ten years after the project begins producing certified removals. Payments are made only after the carbon removal has been verified (e.g. certified under CRCF). A similar approach is used by the European Commission to support the development of renewable hydrogen under the Innovation Fund.

To avoid withdrawal of project from winning bids after the auctioning, it is important to mitigate the risk of overly aggressive bid prices that turn out to be unviable at the finalisation of the project.

ANNEX 8: PART III – MARKET STABILITY RESERVE

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1. OVERVIEW OF THE MARKET STABILITY RESERVE (MSR)

1.1. Introduction and overview

The Market Stability Reserve (MSR) was established in 2015 by Decision (EU) 2015/1814 of the European Parliament and of the Council⁶⁰ ('the MSR Decision'), as a structural mechanism within the EU ETS to address critical imbalances in the carbon market. Specifically, the MSR was designed with two primary objectives: first, to reduce the historical surplus of allowances that had suppressed carbon prices and weakened investment signals for low-carbon technologies; and second, to enhance the resilience of the EU ETS by introducing supply-side flexibility to respond to future demand shocks. Its design was revised in 2018, before becoming operational in 2019, and again in 2023 to align with the European Green Deal and stricter climate targets under the European Climate Law. The current annex is focusing on the next review of the MSR which is due in 2026, pursuant to Article 3 of the MSR Decision.

Under its original design in 2015, the MSR dynamically adjusted the supply of allowances in response to market conditions, using the Total Number of Allowances in Circulation (TNAC) as a key indicator. In broad terms, the TNAC in a given year, is calculated as the cumulative number of allowances issued and not placed in the reserve minus the cumulative tonnes of verified emissions, since 2008 and the end of that given year. When the TNAC exceeded an upper threshold of 833 million, the MSR withdrew 12% of the surplus annually from auction volumes and placed these allowances into the reserve. Conversely, if the TNAC were below a lower threshold of 400 million, the MSR released 100 million allowances per year from the reserve back into the market. These thresholds and intake rates provided a predictable, rule-based, and transparent framework for supply adjustments in the EU ETS. In practice, by 1 June every year (y), the Commission calculates and publishes the TNAC of the previous year (y-1), which can trigger MSR action in the form of intakes or releases of allowances spread over a period of 12 months, from September y to August y+1.

By 2018, it became clear that the MSR's original design was insufficient to address the persistent surplus of allowances that had accumulated due to the financial crisis, complementary policies, and the inflow of international credits.⁶¹ This surplus continued to depress carbon prices and delay low-carbon investments. To strengthen its impact, the 2018 revision doubled the intake rate from 12% to 24% of the TNAC until 2023 and introduced a mechanism to permanently invalidate allowances held in the reserve above the previous year's auction volume. These changes aimed to accelerate the reduction of the surplus and ensure the MSR could more effectively stabilise the market and support the EU's climate goals. With the first intakes starting in January 2019 based on the revised rules, the calculated values for TNAC declined from about 1694 million allowances in 2016 to about 1112 million in 2023. Moreover, about 2515 million allowances were invalidated at the beginning of 2023 (see Figure 1).⁶²

In 2023, the MSR was further revised to ensure it remains a robust tool for stabilising the EU carbon market and supporting the Union's enhanced climate targets of the European Climate Law. The intake rate of 24% was maintained (instead of declining to 12% from 2024), reflecting the continued need for a swift decline in the surplus of allowances. To address the 'threshold effect,' where small changes in the TNAC can trigger disproportionately large MSR

⁶⁰ Decision (EU) 2015/1814 of the European Parliament and of the Council of 6 October 2015 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and amending Directive 2003/87/EC, [OJ L 264](#), 9.10.2015, p. 1.

⁶¹ See [Ellerman et al \(2016\)](#)

⁶² See the Official MSR Indicator announcements in 2018 and 2024 for the reported TNAC values. The reported invalidation value is from the announcement in 2023.

intakes, an upper buffer was introduced so that if TNAC is between 1096 million and the 833 million the MSR intake is calculated as TNAC-833 million, rather than 24% of TNAC which applies when TNAC is greater than 1096 million.

To reduce uncertainty and complexity, the invalidation threshold was fixed at 400 million allowances removing the dependence of this threshold on previous year's auction volumes. Additionally, the calculation of the TNAC was simplified, and starting with the 2024 TNAC calculation, the supply and demand for allowances from the aviation sector is also incorporated to better reflect market dynamics. In the first year of reporting following the revision, the calculated value of TNAC remained stable at 1148 million in 2024. At the start of 2024 and 2025, 382 million and 271 million allowances were invalidated, respectively, bringing the cumulative number of permanently invalidated allowances to 3167 million at the beginning of 2025.⁶³

1.2. Conclusions of the evaluation and future challenges for the operations of the MSR.

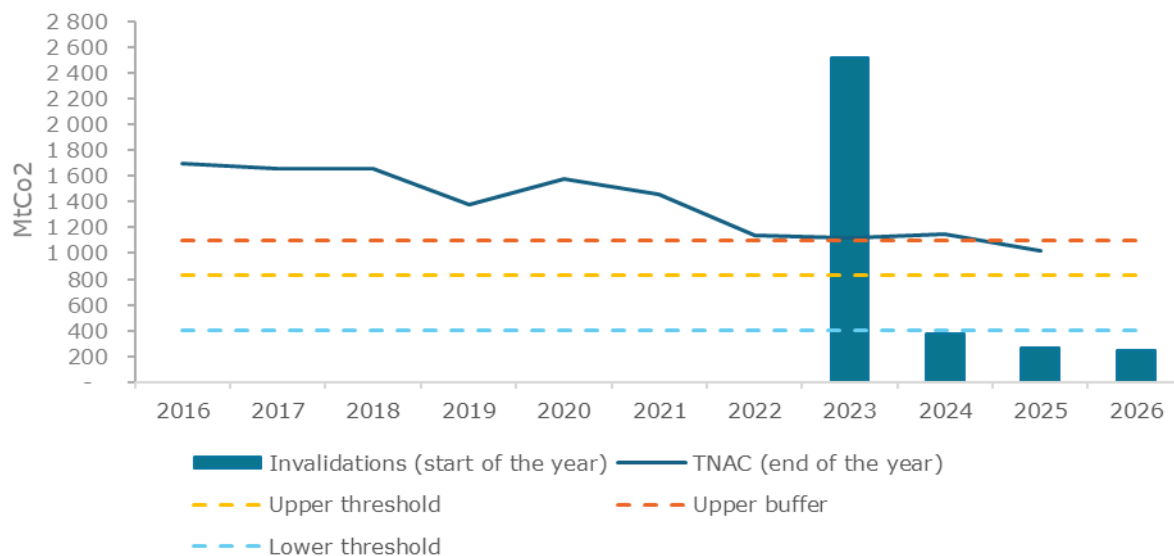
In the current evaluation of the MSR and the EU ETS design, the Commission assessed the effectiveness of the MRS between 2018 to 2024 through two main specific objectives: (i) to reduce allowances surplus in the market built up over Phases II and III and (ii) mitigate the build-up of new demand-supply imbalances in order to strengthen the resilience of the EU ETS. The Commission concluded that the MSR has successfully achieved its first specific objective of reducing the historical surplus in the allowance market.

However, while the MSR helped curb the emergence of new imbalance from 2013 onward, it did not fully absorb the surplus of allowances. As a result, a demand-supply imbalances still exists, meaning it partly achieved its second objective of strengthening the future resilience of the EU ETS market. Moreover, the evaluation concluded that MSR has proven to be efficient with large benefits only a few direct costs. Finally, the evaluation concluded that the MSR has been largely coherent with complementary policies, with any counterintuitive actions being effectively addressed.

Based on the evaluation, this Impact Assessment does not suggest a complete redesign but rather proposes targeted refinements to ensure that the MSR remains fit for the future. Crucially, these refinements preserve the MSR's core principle: across all policy options considered in this Annex, the MSR must remain a rule-based and transparent framework for supply adjustments in the EU ETS. This applies to intake and release rates, which should remain governed by pre-defined rules rather than discretionary, price-based interventions or political interference. Maintaining this rule-based approach helps avoid market distortions and ensures that market participants can anticipate how the system will respond, including where uncertainties may interact or combine. This, in turn, helps safeguard the credibility of the carbon price signal and the certainty needed to underpin long-term decarbonisation investments.

⁶³ See the Official MSR Indicator announcement in 2025 for the reported TNAC values in 2024. The reported invalidation values in 2024 and 2025 are from the announcements in 2024 and 2025 respectively. If an Article 29a release is not triggered during 2025, further 276 million allowances will be invalidated on 1 January 2026.

Figure 1: MSR since 2017⁶⁴



Source: Own illustration

1.3. Challenges for the future operations of the MSR.

Despite the reassuring conclusions of the effectiveness and efficiency of the MSR, there are several challenges for the future operations of the MSR. The EU ETS and MSR are currently undergoing a significant change, moving from a period of allowances surplus to a tighter market where allowances are becoming increasingly scarcer over time. This shift is driven by not only the current cap design, which rapidly declines the number of allowances in circulation, but also due to the current invalidation mechanism in place, which gradually decreases the volume of allowances held in the MSR over time as the need for releases arises. As a result, as the market becomes tighter, inefficiencies may become more pronounced and could lead to the following risks:

- **Increased in price volatility:** when fewer allowances are available, a small number of large market participants may be able to influence the market prices. These players may adopt strategic behaviour, such as buying and holding allowances to build inventory reserves or speculate on future price increases. As a result, this reduces even further the number of allowances actively circulating in the market, constraining liquidity and likely increasing price volatility.
- **Higher bid-ask spreads:** tighter markets naturally lead to wider bid-ask spreads. With limited allowances available for trading, sellers demand higher premiums to reflect greater uncertainty about future availability. This in turn results in a higher effective transaction cost for market participants.
- **Less price transparency:** in tighter markets, trading activity tends to shift away from transparent public exchanges to more transactions bilaterally, where prices, volumes and terms are not publicly disclosed. This contrast with on-venue transactions which operations tend to be more transparent, creating a clear, real-time price signal for the entire market.

Given the significant changes in the allowances market under the current design, the MSR faces a new set of challenges that necessitate revision. First, the key parameters of the MSR were set

⁶⁴ The value for invalidations in 2026 based on the current data should therefore be considered provisional.

a long time ago and are fixed against a backdrop of a cap and emissions that declined rapidly since then. This is likely to create an unbalanced system.

Second, the composition and nature of allowance demand are shifting significantly. The power sector, whose allowance demand is relatively well-understood, has decarbonised rapidly, leading to a declining share in overall demand. This trend is set to continue. In contrast, the share of emissions from the industrial sector is growing, yet its allowance demand patterns remain rather opaque. Similarly, maritime transport has only recently entered the system, and international aviation and waste may soon follow, adding further complexity to market dynamics.

Third, the growing share of non-compliance entities as active participants in EU carbon markets introduces another layer of complexity. The allowance trading by these entities improves liquidity in the market, act as financial intermediaries for smaller compliance entities and provide financial derivative products that the compliance entities value. The European Securities and Markets Authority (ESMA) has been tasked to monitor the activities of financial entities to ensure highest level of market integrity and transparency and avoid any risks of abuse of market power that could potentially affect market stability.⁶⁵ From a broader perspective, the likely integration of removals in the EU ETS, as well as the phase-in of CBAM and the phase-out of free allocations further reshape the market, while the 2040 climate target has important implications for the ETS contribution to decarbonisation efforts beyond 2030, reinforcing the need for a robust MSR. Recent studies highlight the benefits from a more dynamic, adaptive and simpler MSR to safeguard market stability, recognizing the limits of the instrument's effectiveness in responding to higher frequency volatility in the allowance market. A forward-looking approach to revising the MSR is essential to address these emerging complexities.⁶⁶

2. PARAMETERS OF THE MARKET STABILITY RESERVE

To establish a strong and rigorous foundation for revising the MSR and its parameters, a scoping exercise employing multiple methods was undertaken to guide the formulation of alternative measures systematically. The approach began with desk research and literature review, drawing upon recent academic studies, policy analyses, and technical reports on MSR performance with a focus on identifying emerging challenges and limitations of the existing MSR setup particularly in the post-2030 timeframe.⁶⁷ This analytical foundation was supplemented by insights from the MSR Evaluation which has been part of a back-to-back exercise together with this Impact Assessment.

Additionally, targeted interviews were conducted with stakeholders from power, energy, industry, maritime and aviation sectors; financial actors; academic experts; public sector stakeholders; and civil society.⁶⁸ Combined with input from the open public consultation ('OPC') on the ETS and MSR evaluation and review, the interviews aimed to capture the

⁶⁵ In accordance with article 10 (6) of the ETS Directive, the European Securities and Markets Authority (ESMA) was given a mandate for market oversight. [ESMA \(2022\)](#) finds no evidence of current problems but acknowledges the need for continues monitoring of EU carbon markets. The consecutive annual reports from ESMA on carbon markets from [2024](#) and [2025](#) confirm these findings.

⁶⁶ See [European Commission \(2021\)](#), [Borghesi et al \(2023\)](#) and [European Commission \(2025\)](#). For simplicity, the rest of this Annex refers to [European Commission \(2021\)](#) as 'the 2021 MSR Review'.

⁶⁷ See [European Commission \(2025\)](#) which includes an extensive literature review and stakeholder consultation.

⁶⁸ For the current project, 13 MSR-focused stakeholder interviews were conducted. Five of these were with academic experts, two with market exchanges, three with public official working on MSR, three with industry associations. Additionally, several industry groups (six) and NGOs (three) responded to a few targeted MSR questions in interviews conducted for other thematic areas.

diverse perspectives and experiences on MSR functioning and gather insights on the evolving market landscape that may not yet be fully reflected in published academic and grey literature. This multipronged approach ensured that the formulation of alternative measures was grounded in both theoretical and empirical evidence as well as practical experience of market participants and analysts, providing a solid foundation for identifying the parameters requiring revision, developing approaches for their improvement, and formulating concrete policy measures to enhance the functioning of the MSR.

The MSR operates through seven key parameters that collectively determine the mechanism's response to market conditions. Each parameter not only serves a specific function in the mechanism's operation but also interacts with other parameters in determining the response of the MSR to market developments. However, their current calibration reflects market conditions and policy priorities that may no longer be appropriate for the emerging challenges facing the EU ETS. Sections 2.1 to 2.5 briefly describe each parameter based on qualitative research and analysis as well as the stakeholder perspectives on whether they need to be revised to improve MSR functioning.

As regards the broader question of the role of the MSR going forward, the top priorities for most respondents to the OPC, mainly from companies/businesses and business associations, were to prevent excessive EU ETS price volatility (38% of respondents) and to increase market liquidity (26% of respondents), noting that multiple answers were possible by allowing respondents to elaborate on their selection. The third answer, supported mostly by NGOs and environmental organisations, was a continued use of the MSR as a tool to address the surplus in the market (18% of respondents). 6 respondents (2%) selected "None of the above" and 47 respondents (18%) were unsure. Going forward, there

2.1. Upper threshold and upper buffer

The *upper threshold* of 833 million represents the level above which the MSR begins withdrawing allowances from auction volumes, as TNAC values above this threshold indicate a high surplus in the allowance market (i.e. more liquidity in the market than is consistent with a healthy supply-demand balance). The value of the threshold was originally set based on the typical hedging needs of regulated entities in the early 2010s, particularly those in the power sector who sell their output forward and may choose to hedge their future liabilities by holding allowances beyond their immediate compliance needs.

This threshold, therefore, may no longer reflect a healthy balance between allowance supply and demand as the composition and nature of allowance demand change, as there will be increasing scarcity of allowances and as the climate policy landscape evolves. The 2021 MSR Review, recent academic assessments and reviews, as well as the recent horizon scanning exercise commissioned by the European Commission, all suggest that it may be time to recalibrate the value of this parameter.⁶⁹ A recalibration can ensure that its value does not become misaligned as the cap and emissions decline according to the cap-and-trade logic combined with the ambitious EU climate targets.

When the MSR was legislated in 2015, co-legislators anchored its activation to the TNAC, using a band with an upper threshold (833 million) that would trigger intakes from auctions to the MSR, and a lower threshold (400 million) that could trigger releases from the MSR to the auctions. The original impact assessment carried out by the by the European Commission to inform the MSR design, set out the principles for the mechanism as follows. The trigger should be quantity-based, objective, and linked to a stock measure of market surplus, so that auction

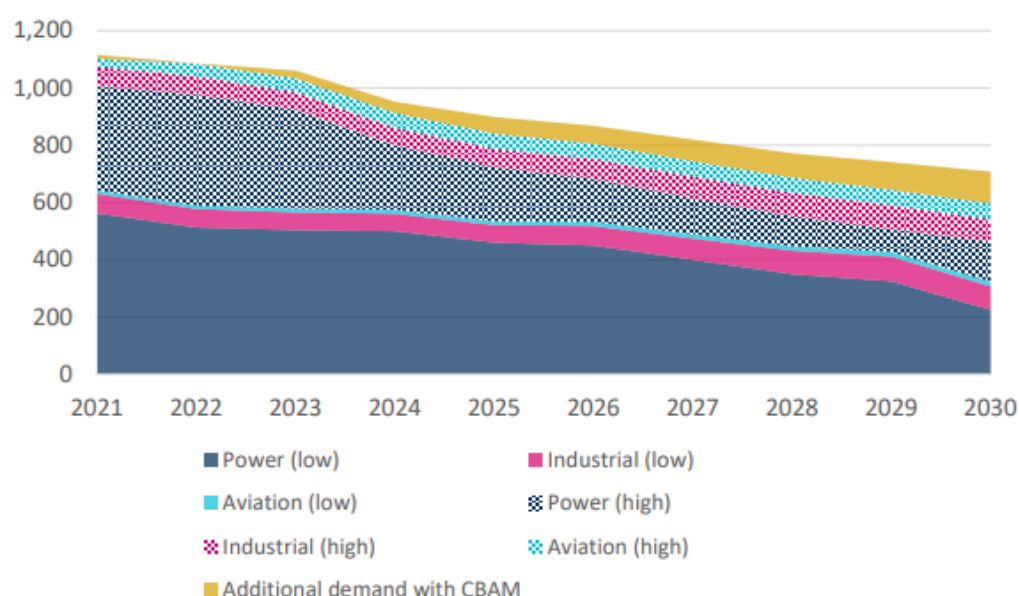
⁶⁹ See [European Commission \(2021\)](#), [Borghesi et al \(2023\)](#) and [European Commission \(2025\)](#).

volumes reduced when the surplus is too high and increase when it is too low.⁷⁰ The European Commission (2014) assessed alternative trigger concepts and sizes and concluded that fixed TNAC thresholds offered a transparent and rule-based way to respond to shocks without discretionary intervention, coupling those thresholds with intake and release rates sized to have a material effect on auction volumes. While the lower threshold was specified to anticipate future releases and maintain symmetry, at the time the most immediate task of the MSR was to reduce the historical surplus that had accumulated, and most attention was therefore focused on the specification of the upper threshold.

The 2021 MSR review's supporting analysis of industrial hedging suggests that, unlike the power sector, industrial hedging is more heterogeneous across subsectors, driven by differing exposure to international competition, pass-through abilities, and contract structures.

Quantitatively, Appendix 2 of the 2021 MSR review indicates that plausible ranges of industrial hedging could amount to a few hundred million allowances at most when aggregated EU-wide over typical horizons, but with substantial uncertainty bands (see figure 2 reproduced from the review). In the figure, total hedging demand declines steadily toward 2030, with the power sector driving most of the reduction. Industry contributes a smaller, slightly increasing but uncertain portion, and aviation is smaller still but exhibits even greater uncertainty than industry.⁷¹

Figure 2: Estimated sources of hedging behaviour to 2030



Source: [European Commission \(2021\)](#)

European Commission (2025), which surveys emerging challenges for the EU ETS, reinforces these findings. As aggregate hedging needs trend down and become more heterogeneous, a materially tighter cap and a changing market composition further increase the need to recalibrate the MSR's upper threshold. Specifically, the cap rebasing in 2024 and 2026 and higher LRF shrink auction supply and overall market size, so that a given level of allowances

⁷⁰ See [European Commission \(2014\)](#).

⁷¹ The review's discussion of potential CBAM-related effects predated the Commission's CBAM proposal and the version which was eventually adopted.

in circulation accounts for a larger share of the market than before and, in turn, has a stronger influence on prices and liquidity.

Aviation within the EEA has been covered since 2012 but any future changes could concern a broader set of international aviation emissions being included in the EU ETS. The inclusion of maritime transport has been underway since 2024, increasing gross compliance demand and altering its pattern. Any further scope extensions would further reshape the composition and timing of allowance demand and associated hedging.

Non-compliance entities (primarily financial actors) play a growing role in the EU ETS. They provide liquidity, enable forward hedging, and warehouse allowances, helping compliance entities manage risk.⁷² Their market participation also makes TNAC harder to read. Higher holdings can reflect liquidity provision and forward-looking banking rather than an excessive surplus. In a tightening market, both the 2021 MSR review and European Commission (2025) note that TNAC can rise without indicating “excess.” If the upper threshold is too high or static, MSR action may be delayed.

Stakeholder interviews conducted for the current review also indicate that hedging behaviour is evolving as the market tightens and its composition may shift over time. Some stakeholders underscore that risk management covers pans both derivatives and physical banking, while available datasets (e.g., Union Registry, Commitments of Traders report) only partially reveal hedging volumes because intermediation obscures holdings.

Likewise, in the OPC, the second most frequently raised potential change to the MSR, mainly by businesses, was to make intake/release thresholds dynamic to reflect prevailing market conditions (15% of responses), while 7% of responses, largely from NGOs, supported adjusting fixed TNAC thresholds downward and 3% of responses, all businesses, upward.

The *upper buffer* is the newest feature of the MSR. It was introduced in 2023 and came into operation in 2024. It aims to mitigate the so-called threshold effect, whereby small changes in TNAC, just above the trigger, could trigger disproportionately large MSR responses. The upper buffer is currently set at 1096 million allowances but should in fact be seen as a function of the upper threshold and the intake rate, calculated as 'upper threshold / (1 – intake rate)'. The upper buffer creates a graduated intake mechanism: when TNAC is in the buffer zone defined by the upper buffer of 1096 million and the upper threshold of 833 million, intakes are calculated as the difference between TNAC and the upper threshold, rather than the standard percentage-based approach using the intake rate. It has not been applied as of 2025, as the 2024 TNAC remained slightly above the upper buffer.

While the introduction of the upper buffer addresses the concerns about undue market volatility due to the threshold effect, the specific parameter value will need to be reset if values of the upper threshold and intake rate change. This is because the current buffer zone of 1096-to-833 million is constructed to ensure that intake volumes decline smoothly towards zero as TNAC declines towards the upper threshold currently set at 833 million.

Stakeholders generally view the introduction of the upper buffer zone positively. Although it has not yet been activated, its presence reduces uncertainty arising from threshold effects. The OPC responses were not directly relevant to the upper buffer, but rather emphasised threshold

⁷² European Commission (2025) also cautions that increased participation by non-compliance (financial) actors can exacerbate liquidity frictions and price volatility if technical trading and heterogeneous strategies driving short-term moves become less anchored in fundamentals. It recommends closer monitoring and possible safeguards (e.g., better trading data, volatility/liquidity indicators, and position/holding constraints) to preserve market integrity and stability.

effects and symmetry. In the design-change question, 5% of respondents proposed adding a buffer also on the release side to avoid threshold effects. This could be considered consistent with maintaining graduated intake around the trigger.

2.2. Intake rate

The intake rate determines the speed at which allowances are withdrawn when TNAC exceeds the upper threshold. Until the 2023 revision, the rate had been on course to decline to 12% in 2024 but instead was maintained at 24% of TNAC (and applied only when TNAC is greater than the upper buffer discussed above). Absent further revisions, the intake rate will remain fixed at 24% until 2030 and revert to 12% thereafter. Given that the intake rate implicitly determines the width of the upper buffer zone, the reversion to 12% implied by the current legislation would require the upper buffer to be reset to 947 million after 2030 from its currently legislated value of 1096 million.

The intake rate is not a fixed number of allowances but a fixed share of TNAC. This means that the volume of intakes changes in proportion to the TNAC and does not suffer from the potential misalignment mentioned in the context of the upper threshold. At the same time, it is useful to consider whether an amendment to the current arrangement is helpful. By adjusting the rate at which excess surplus is reduced and width of the upper buffer zone, the intake rate has important and complex implications for the auction volumes and the volume of allowances in the MSR, holding all else constant. However, these implications are only realised if TNAC is above the upper threshold. Moreover, it is difficult to gauge the extent to which the expectations of the market participants reflect the already legislated decline from 24% to 12% in 2030.

European Commission (2014) assessed establishing an MSR featuring a percentage-based intake linked to the TNAC and analysed alternative trigger levels, intake sizes, and timing, in order to ensure adjustments would be sufficiently material to address surplus while avoiding excessive volatility. The 2021 MSR Review advised retaining a rule-based intake but reforming its operation to scale with the marginal surplus above the upper threshold, recommending that intakes remove roughly one third to one half of the marginal surplus in each intake period. European Commission (2025) notes that the co-legislators prolonged the increased annual MSR intake rate of 24% beyond 2023 and highlights that, as the cap tightens and hedging demand evolves, future calibration of MSR parameters should be considered to ensure responsiveness in a structurally scarcer market.

Stakeholder interviews conducted as part of this impact assessment indicate mixed opinions with some stakeholders favouring to maintaining the intake rate, at 24% for continuity and predictability, while others are open to amendments regarding how the rate is applied to improve responsiveness. Those favouring to maintain the intake rate at 24% consider that it provides reassurance that if a large excess surplus accumulates once again in the future, it will be removed rapidly. It should also be noted that the intake rate becomes a less relevant parameter over time, as the EU ETS moves from a period of surplus, where high intake rates allow for a fast reduction of the surplus to a period of market tightness where the MSR will start to release allowances to provide additional liquidity to the market.

In the OPC, respondents were overall more focused on adjustments to other parameters, with only a limited number of responses related to the intake rate. Overall, the OPC points to retaining a rule based intake and concentrating any revisions on threshold calibration and the timing of adjustments rather than altering the intake rate.

2.3. Lower threshold

When TNAC falls below the lower threshold of 400 million allowances, the release of allowances from the MSR back into the market is triggered. This parameter aims to prevent the emergence of a shortage (i.e. less liquidity in the market than is consistent with a healthy supply-demand balance) that could undermine efficient price formation and preclude the realisation of mutually beneficial allowance trades. As the composition and nature of allowance demand evolve and the market landscape changes with new sectors, participants, and rules, this threshold may require adjustment to maintain appropriate liquidity buffers.

Moreover, like the upper threshold, the notion of a healthy supply-demand balance also depends on the size of the market, which in turn is determined by rapidly declining annual caps and emissions of covered sectors. Therefore, keeping the lower threshold fixed at 400 million may imply that in the future the MSR is called into action even when there is no shortage in the allowance market. Therefore, a dynamic and declining lower threshold can be considered in a manner similar to and consistent with the approach taken for the upper threshold. Another important consideration regarding the lower threshold is the potential emergence of destabilising threshold effects in the future, as in the case of the upper threshold and buffer discussed above.

Stakeholder interviews conducted for the review emphasise aligning the lower threshold with the logic applied to the upper threshold as the market shrinks and structural scarcity emerges. Interviewees propose that the lower threshold should decline over time to remain proportionate to market size and consistent with a healthy supply-demand balance.

Stakeholder interviews conducted for the review emphasise aligning the lower threshold with the logic applied to the upper threshold as the market shrinks and structural scarcity emerges. Interviewees propose that the lower threshold should decline over time to remain proportionate to market size and consistent with a healthy supply-demand balance.

2.4. Release rates (general and Article 29a)

The *release rate of 100 million allowances per year* governs the speed at which the MSR responds to shortages. While this rate was designed to provide liquidity relief by guiding the TNAC back towards a healthy supply-demand balance, there are three potential issues.

First, the release of 100 million allowances may become excessive relative to the declining overall market size. Second, the release of allowances may arrive too late to address demand changes particularly in a potentially more volatile post-2030 market environment. Third, the releases from the reserve are limited by the number of allowances in the MSR which are currently fixed at 400 million. Consequently, under the status quo MSR will be empty after at most four instances of TNAC being below the lower threshold or less if Article 29a release is also triggered at some point in the future. This is because there is currently no provision for replenishing the MSR.

The OPC did not contain questions directly related to the fixed release rate of 75 million allowances per year. The responses rather point to adjacent design elements that affect releases.

Article 29a of the EU ETS Directive outlines a mechanism for releasing allowances from the MSR when the carbon price increases rapidly or is subject to important price fluctuations. This release is triggered if the average price of allowances over a six-month period exceeds 2.4 times the average price of the preceding two years, provided no allowances are simultaneously being released due to TNAC being below 400 million. When triggered, 75 million allowances are released from the MSR and added to the quantity to be auctioned, unless the reserve holds fewer than 75 million allowances, in which case the entire amount is released. This release occurs gradually over three months, starting no later than two months after the Commission confirms the price trigger condition, and follows the same allocation among Member States as when the allowances were initially placed in the reserve.

The release volume being fixed may provide certainty and predictability to the market participants when the mechanism is triggered. At the same time, as the cap and allowance supply decline, the effects of the fixed volume become greater. Therefore, it could be argued that, in order to maintain the existing effect of article 29a when cap and supply decline, the fixed volume may need to be amended/reduced to avoid that too many allowances are released (overshooting, the intended correction) given the overall lower volumes. On the other hand, maintaining the current release rate, at least until the next review in 2031, could be justified by the fact that this mechanism is aimed at addressing exceptional circumstances of excessively high price movements, so the mechanism would need to be effective enough to tackle such situations.

A very large majority of stakeholders which expressed views on the EU ETS and the MSR through the OPC and position papers did not express a specific position on the Article 29a release mechanism, suggesting low or no need for a revision. The OPC did not contain questions directly related to Article 29a and as a result, direct references to Article 29a in the OPC results were limited.

2.5. Invalidation threshold

The invalidation threshold, fixed at 400 million allowances since 2023, determines the maximum number of allowances that can be held in the MSR. Permanent invalidation is a critical element of the MSR design as it influences the cumulative cap and auction revenues.⁷³ This mechanism ensures that the MSR does not become an indefinite storage facility of an ever-growing number of allowances and establishes a fixed upper bound on the number of allowances that can be released to achieve the MSR's objectives. However, the fixed nature of this threshold may not align optimally with evolving market needs, the declining cap trajectory, hence future scarcity of allowances. As outlined above, the invalidation mechanism directly interacts with the release rate to determine the maximum duration the MSR can provide future market interventions.⁷⁴ Increasing the invalidation threshold or removing it altogether, all else constant, would allow for a bigger pool of allowances in the reserve and provide more flexibility in case of future liquidity problems. Given that it is projected that there are only a few years of future intakes by the MSR in the period 2027-2028 that may be subject to invalidation, it is recommended that any changes to the invalidation mechanism are implemented in the short term to maximise the impact of preserving allowances in the MSR for future release beyond 2030.

The evaluation of the MSR finds that the invalidation mechanism has successfully fulfilled its original purpose of eliminating the historical surplus of allowances that accumulated in the early years of the EU ETS, thereby restoring confidence in the system and supporting a robust carbon price signal. Given the evolving market context, a case can be made for discontinuing the invalidation mechanism entirely because future invalidations may be counterproductive to evolving market stability needs. Allowing a greater number of allowances to remain in the MSR rather than invalidating them could provide an essential liquidity buffer for managing future market tightness in the mid-2030s and beyond.

The potential integration of carbon removals into the EU ETS further complicates the calculus around the invalidation mechanism. Maintaining a greater number of allowances as a strategic reserve could provide a more reliable backstop for market interventions than relying solely on uncertain removal deliveries. This approach would allow the MSR to serve as a stabilizing

⁷³ See [European Commission \(2014a\)](#), [European Commission \(2014b\)](#), [Taschini & Kollerberg \(2019\)](#) and [Osario et al \(2021\)](#).

⁷⁴ In the future, a potential introduction of a lower buffer zone would also affect this duration.

force during potential supply shortages in the late 2030s and early 2040s, when allowance scarcity may otherwise drive sharp price increases that could undermine market functioning and investment predictability.

Perspectives of stakeholders interviewed regarding the invalidation mechanism reveal disagreements about its continued relevance and implementation.

Likewise, in the OPC, the potential change to the MSR most frequently raised, in close to a quarter of responses, mainly by businesses, was to adjust the invalidation rule for holdings in the reserve above 400 million.

2.6. Market Stability Reserve revision scope

The accumulated evidence from recent academic as well as stakeholder outreach indicates potential benefits from revising the MSR to enhance its effectiveness in the evolving market landscape. However, the question on the extent of these revisions requires careful consideration of the trade-offs between preserving the MSR's proven track record and adapting it to fundamentally different market conditions and challenges.

Different conceptions of MSR revision can be organised along a spectrum from operational to fundamental changes, though this distinction represents a continuum rather than discrete categories. Moving towards the more fundamental end are novel innovations that would transform the MSR's core function. An important consideration in this context is the need for simplification and continuity. Therefore, the next section develops the measures which span this spectrum focusing on the operational end.⁷⁵

3. POLICY MEASURES FOR THE MARKET STABILITY RESERVE

This section describes the specific measures assessed for the current review, to study the various MSR changes that may be implemented and become effective from 2028, i.e. the first realistic date by which the EU legislative process can reasonably be expected to conclude. The measures MSR1 to MSR3 presented below span the operational end of the reform spectrum introduced in the previous section. The impact of these measures must be assessed against two counterfactual scenarios MSR0 and MSR0+ which are motivated and described below.

3.1. Description of measures

3.1.1. Baseline

The baseline scenario for the current Impact Assessment forms the main reference point for the policy option-level analysis undertaken in this report. It represents a legal default configuration, strictly respecting the current legislation, in which the MSR parameters remain unchanged compared to today (a detailed definition is provided in the main impact assessment report). However, the currently legislated cap trajectory and MSR design could lead to a vastly over-constrained system in the 2030s. This baseline is therefore not well suited to be used as a starting point in the MSR measure-level analysis.

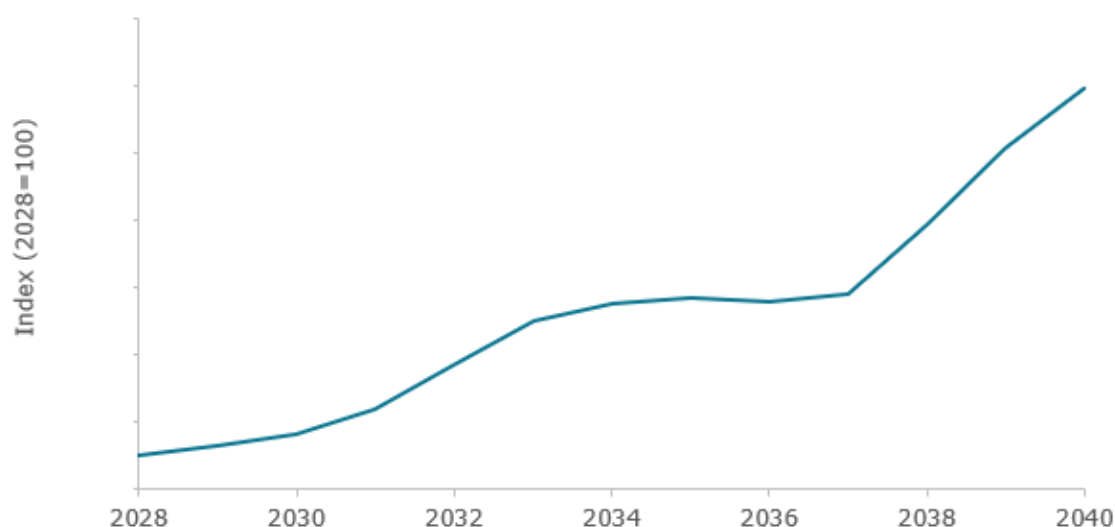
To demonstrate this, the baseline scenario was simulated using the POLES-Enerdata model, which calculates the EUA price evolution, based on a supply-demand equilibrium. Indexed price curves are presented to illustrate overall annual price trends compared to 2028. Such illustrations require careful interpretation as modelling relies on uncertain assumptions and may not capture actual short term price movements, which can be driven by other factors

⁷⁵ These measures are designed and assessed with the aid of the POLES-Enerdata model. While the quantitative assessment under the MSR does not include removals integration through the MSR, one such measure is assessed qualitatively in Annex 8 sub-section on removals.

outside the scope of this assessment. The indexes are therefore used to show trends - such as relative annual price increases and directional movements - and to serve as a comparison framework across measures, rather than to deliver precise price forecasts. This approach applies to all measures modelled in Annex 8.

As shown on Figure 3 below, baseline scenario exhibits a modest price increase until 2030, followed by a steeper rise in 2035 and a significant price spike in 2040.

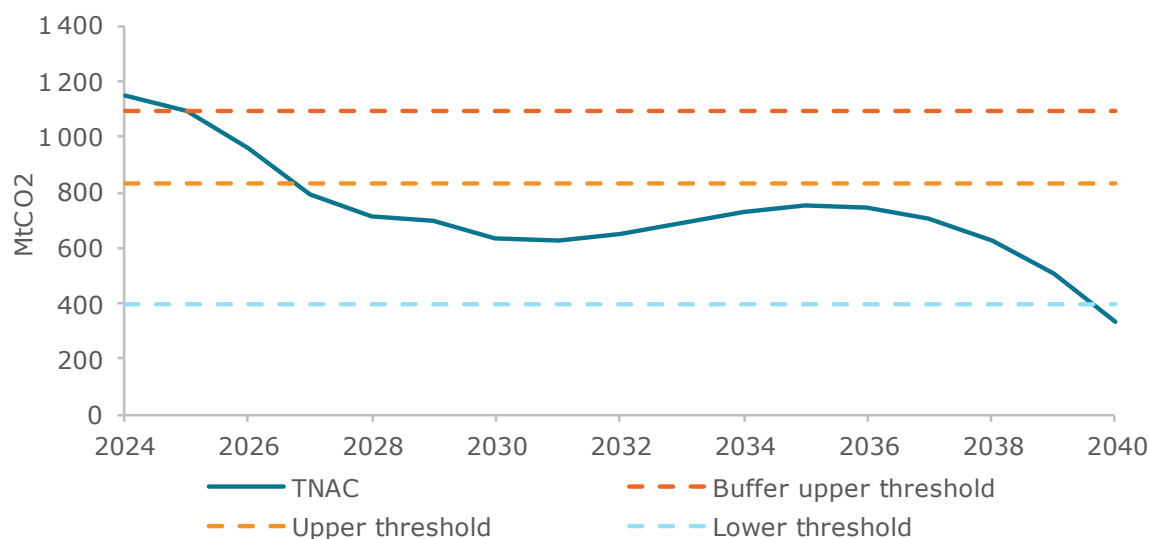
Figure 3: Baseline scenario - EUA indexed price evolution



Source: POLES-Enerdata model run - baseline scenario

The TNAC evolution shows a counter-intuitive trajectory in this baseline, with a phase of slow increase between 2030 and 2036, before starting to significantly decrease. With a high constraint on the market, and with such a price, the expectations would be for the TNAC to drop more quickly. This does not happen because, in the POLES-Enerdata model, actors have an 8-year anticipation period, which forces them to plan for the future scarcity at all times. The increasing TNAC up to 2036 is therefore explained by actors anticipating that future scarcity will be harder to face than current scarcity, meaning that they prefer to decarbonise in the early future and save EUAs on their registry accounts for later use. This TNAC trajectory shows the limits of the current design, when combined with the 8-year anticipation of the modelling framework. The TNAC indicator remains high despite the general scarcity of allowances, because forward-looking actors are assumed to hoard allowances rather than surrender them. This in turn results in no MSR releases before 2040. MSR releases actually happen over 2041-2045, and the anticipation of this effect explains the plateau in the price trajectory around 2034-2037. In 2045, the MSR is empty and cannot continue to release allowances. In anticipation of this, the price increases sharply from 2037.

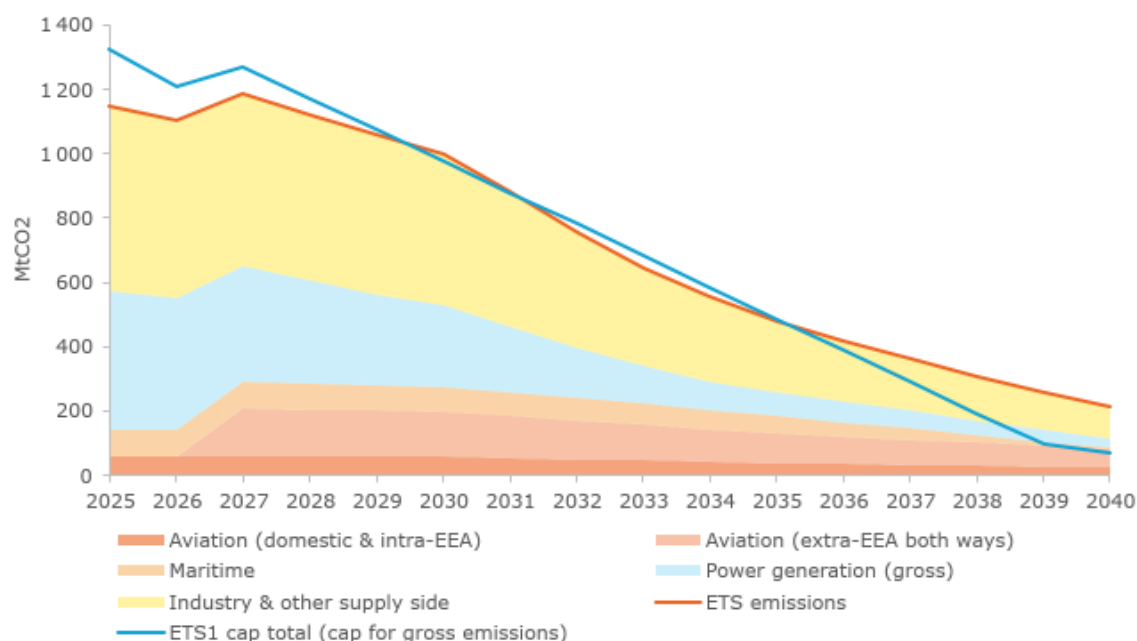
Figure 4: Baseline scenario - TNAC evolution



Source: POLES-Enerdata model run - Baseline scenario

The comparison of ETS-covered emissions and the corresponding cap also helps to understand the model results (Figure 5). By 2030, the EU ETS emissions are broadly in line with the cap (from a historical situation where they were below it). In the period 2030-2035, they have to decrease very quickly, even faster than the (already ambitious) cap, because the decrease rate of the cap after 2035 cannot be followed by emissions, as the model shows. Most easy-to-abate emissions have been reduced by then, and the remaining emissions require longer to further reduce. The annual decrease of emissions is progressively reducing, whereas the cap keeps linearly decreasing. Hence, after 2035, the emissions above the cap have to be covered by the surplus which was built by then (and after 2040, by the MSR releases as well).

Figure 5: Baseline scenario - EU ETS emissions and cap



Source: POLES-Enerdata model run - Baseline scenario

The modelling results from this baseline scenario are insightful, but not necessarily realistic. In a more realistic projection, rather than hoard allowances for a scarcer future, we could expect actors to use up the historical surplus much earlier. This would lead the TNAC to drop quickly, and to release of allowances from the MSR earlier. This would in turn lead to slower price evolution in the short term, but even faster supply constraint from 2033, which could rapidly deplete the reserve and lead the TNAC to even become negative.

Yet, the baseline measure depicts a scenario in which no changes in the overall ETS design have been implemented. As a result, this might not provide a meaningful point of departure as different MSR design options should be appropriately tested against a future carbon market closer to what is being proposed in this impact assessment (i.e. changes in the size of cap, emissions reduction trajectory, the scope⁷⁶, among others).

Therefore, in addition to the baseline, the MSR0 presents a scenario in which the ETS is amended in line with the agreed 2040 target, but no changes are made to the MSR. This scenario - the Core Working Assumption Scenario (CWAS) - serves as a starting point and an appropriate comparison for all the MSR measures considered in the impact assessment.

3.1.2. Measure MSR0: Core Working Assumption Scenario (CWAS)

The MSR0 measure, also referred to as the Core Working Assumption Scenario, is defined as meeting a 90% economy-wide emission reduction target in 2040, and features the inclusion of 50% of the international extra-EEA aviation in the ETS scope. This enables the analysis to rely on a robust and meaningful starting scenario, with notably an adjusted cap trajectory, from which different measures will be incorporated and assessed.

The MSR0 scenario is first generated with the PRIMES model, within the same workstream as the preparation of the Baseline & Policy options scenarios. For the MSR measure-level analysis, the POLES-Enerdata model is calibrated to reproduce the main assumptions and equilibrium from the PRIMES model. More information about the production of the Core Working Assumption Scenario for the measure-level analysis of the MSR using the POLES-Enerdata model is included in Annex 4.

In terms of MSR design, MSR0 corresponds to the baseline configuration. The TNAC calculation and all MSR parameters remain as they currently are, e.g. the upper threshold stays constant at 833 million EUAs and the lower threshold at 400 million EUAs. In particular, the intake rate reverts to 12% after 2030 in the MSR0 measure. The upper buffer value from 2031 onwards is therefore adjusted to accommodate for this. While current legislation fixes this value at 1096 million EUAs, MSR0 and all following measures calculate the upper buffer parameter based on the below formula, depending on the upper threshold and the intake rate:

$$\text{For each year } y: \text{upper buffer}(y) = \frac{\text{upper threshold}(y)}{1 - \text{intake rate}(y)}$$

3.1.3. Measure MSR0+: Augmented Core Working Assumption Scenario (ACWAS)

Building on MSR0, MSR0+ maintains all current MSR parameters and operational rules while implementing a few straightforward and targeted improvements:

⁷⁶ All policy options assume at some extent an expansion in scope covering removals, waste, CCU, aviation, and maritime. These are treated as an exogenous addition to both to supply and demand. Because these segments still make up only a small share of the overall ETS market, they are not expected to have a major effect on carbon prices. Therefore, significant change in hedging behaviour is considered unlikely due to the expansion of the scope.

- Technical correction of the TNAC to account for net aviation demand for the period 2012-2023.
- Introduction of a lower buffer to avoid threshold effects.
- Stopping the invalidation mechanism from 2027 onwards.
- Maintaining the intake rate at 24% beyond 2030.

Representing the most operational end of the reform spectrum, MSR0+ is effectively an augmented version of the Core Working Assumption Scenario against which further MSR measures should be compared.

While Article 1(4a) of the MSR Decision requires that net aviation demand be reflected in the TNAC calculation from 2024, no such requirement exists to account for the cumulative impact of net aviation demand over 2012-2023, hence there is no legal obligation for such correction. However, in order to bring the calculated TNAC more in line with the actual surplus on the market, the first improvement introduces a technical correction to the TNAC formula in 2028, effectively reducing the TNAC calculated for 2027 by 173 million allowances to account for this cumulative impact.⁷⁷

The second improvement introduces a lower buffer parameter, defined as the difference between the lower threshold and the release rate. The current MSR parameters therefore imply a lower buffer value of 300 million EUAs.

For each year y: lower buffer(y) = lower threshold(y) – release rate(y)

This lower buffer adjustment mirrors the logic behind the introduction of the upper buffer in the 2023 MSR revision. When the TNAC is between the lower threshold and the lower buffer, TNAC minus 300 million allowances are released from the MSR, rather than 100 million under the current rules.

*For each year y: if TNAC(y) < lower buffer,
EUAs released = release rate = 100 million*

*if lower buffer < TNAC(y) < lower threshold,
EUAs released = TNAC(y) – lower threshold*

where ‘EUAs released’ corresponds to the releases defined based on TNAC(y), which will effectively be released between September y+1 and August y+2.

One potentially significant implication of this improvement is the lengthening of the time it may take for the MSR to be depleted. Under the current rules and assuming Article 29a release is not triggered, if TNAC drops below the current lower threshold of 400 million allowances four times, the MSR holdings will decline to zero. The adoption of a lower buffer, holding all else constant, allows MSR holdings to remain positive for significantly longer if TNAC remains between 300 and 400 million allowances. The OPC responses support measures to avoid threshold effects and sustain liquidity (5% explicitly proposed a lower buffer, 15% favoured dynamic thresholds, and volatility/liquidity were the top open text themes), consistent

⁷⁷ An additional correction could consist in adjusting the TNAC to reflect allowances used for flexibility purposes under Article 6 of Regulation (EU) 2018/842 (the Effort Sharing Regulation). The [2025 TNAC Communication](#) estimated a cumulative volume of such allowances at approximately 36 million in 2025, with potential for a further increase until 2030. This adjustment has not been included in the present measure level assessment. The mechanics of such an adjustment on the distinct MSR options are expected to be similar to the adjustment for aviation, though smaller in magnitude, as the size of this adjustment would be limited, depending on the amount of cumulative allowances used by the Member States flexibility under the Effort Sharing Regulation.

with adopting a lower buffer that would smooth releases and prolong MSR holdings when TNAC is between 300 million and 400 million.

The third adjustment featured in MSR0+ consists in stopping the invalidation mechanism as of 2027 (the last invalidations would be done by 31st December 2026). This proposed change is supported by a large majority of stakeholders. The idea is to enable the MSR to enter the scarcity-oriented future of the ETS with a larger number of EUAs in the reserve and therefore enable it to contribute more to a healthy market liquidity moving forward. Such adjustment is time sensitive as it can effectively lead to a larger reserve only as long as the MSR is still triggering intakes, hence the modelling considers such adjustment already as of 2027 to maximise its potential impact in the analysis. The OPC responses support ending invalidation as the most mentioned MSR change overall: 13% selected adjusting the invalidation rule in the design change question, invalidation was the - most cited theme in - follow-up- open text (47% of mentions, many calling for cancellation), and coordinated submissions pressed to pause or halt invalidation.

The modelling for the MSR0+ measure was done in a progressive manner, sequentially adding the different improvements. The intermediate analysis with and without the invalidation mechanism confirmed that maintaining the current invalidation mechanism leads to an extremely tight reserve of 400 million allowances, even with a lower buffer mechanism. The reserve would be fully depleted in 2040. As demonstrated in sections below, the removal of invalidation in measures MSR1 to MSR3, increases the reserve at the start of the period, allowing for more margin in the system in the late 2030s, to accommodate for shocks and to prepare for the post-2040 period.

Finally, the fourth improvement included in MSR0+ is related to the MSR intake rate, which is maintained constant at 24% after 2030, instead of decreasing to 12% as in the existing legislation. This change maintains the intake rate at its current value, which is now well understood and accepted by market participants and thus provides simplicity. It also maintains the current value of the upper buffer through the relationship between the buffer and threshold described in Section 2.1. Therefore, the intake rate only makes a difference when the TNAC is above the upper buffer, i.e. when a high surplus develops, which would then justify a stronger response by the MSR. The OPC responses provide some support for maintaining the 24% intake rate beyond 2030 (8%) and very limited support for reverting to 12% (2%), indicating a cautious preference to avoid lowering the rate.

MSR0+ therefore serves as an augmented baseline. Measures MSR1-MSR3, which all include the improvements in Measure MSR0+ in order to test the implications of specific additional changes. Table 1 summarises the specification of key MSR parameters in MSR0 and MSR0+.

Table 1: Overview of the MSR design in MSR0 and MSR0+

UB: upper buffer	Implied by UT and IR: $UB(y) = \frac{UT(y)}{1-IR(y)}$	
UT: upper threshold	833 Mt constant (unchanged)	
IR: intake rate	24% until 2030 12% after 2030	24% constant
LT: Lower threshold	400 Mt constant (unchanged)	

LB: Lower buffer	No buffer	Implied by LT and RR: $LB(y) = LT(y) - RR(y)$
RR: Release rate	100 Mt constant	
Invalidation mechanism	unchanged	Dropped as of 2027
29R: A29a release	75 Mt constant (unchanged)	
TNAC calculation	unchanged	Technical correction for 2027 TNAC

3.1.4. Measure MSR1

MSR1 builds upon MSR0+ and adjusts the level of two MSR parameters, the upper and lower thresholds, while maintaining their static nature. The upper buffer and lower buffer are therefore automatically adjusted as well, through the formulas presented above.

The upper threshold is lowered from 833 million EUAs to 650 million EUAs from 2028 onwards. The rationale for this change is based on updated estimates of hedging needs by regulated entities stemming from literature review and stakeholder interviews. The OPC responses indicate measured support for recalibrating fixed TNAC thresholds, with more selections for lowering than raising them (7% vs 3% in the design change question), and threshold adjustment recurring in open text (15% of mentions).

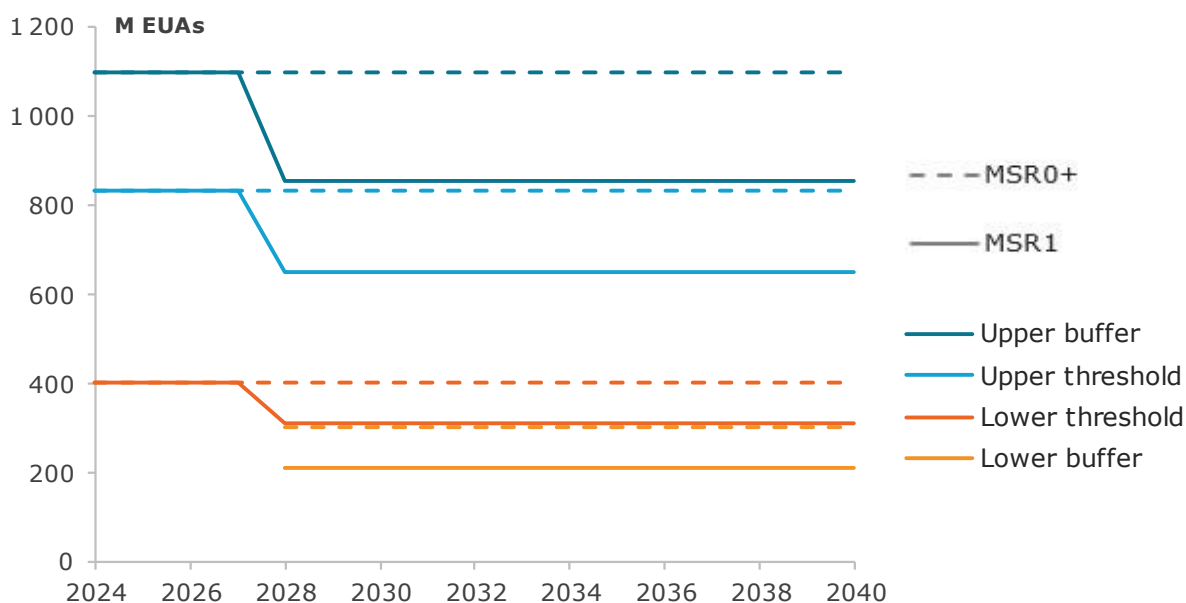
As detailed in Section 2.1, the initial value of 833 million EUAs was proposed and justified on the basis of estimated hedging needs at the time of its introduction. These needs have evolved since, leading to a necessary update of the threshold. Factors that explain the evolution of hedging needs include first and foremost the reduction (and expected future reduction) of the EU ETS-covered emissions, and particularly those of the power sector. The reduction in the corresponding hedging needs was only partially offset by progressively growing needs of hedging from other sectors (industry, aviation and maritime). Overall hedging needs are estimated to have reduced to around 650 million EUAs, a value consistent with expectations from different market analysts interviewed by the European Commission.

The reduction in the upper threshold value amounts to 183 million EUAs, which is in the same order of magnitude as the technical correction in the TNAC introduced in measure MSR0+ (173 million EUAs). Even if the modifications are not correlated, the level of the TNAC and upper threshold fall by similar amounts. The relative position of the TNAC compared to the upper threshold is therefore maintained, offering a form of continuity in the operations of the MSR.

In addition to the upper threshold adjustment, MSR1 also includes a recalibration of the lower threshold, with the same relative magnitude as the upper threshold (around 22%). This maintains the ratio between the upper threshold and lower thresholds, before and after the recalibration. It implies reducing the lower threshold to 310 million EUAs from 2028 onwards (down from 400 million EUAs up to 2027).

Both the upper and lower buffer are automatically impacted by these changes, but keep the same logic as implemented in measure MSR0+, with the same formulas. Figure 6 illustrates how the MSR thresholds and buffer are affected in measure MSR1.

Figure 6: Measure MSR1: illustration of the parameter adjustments



Source: Own visualisation derived from the POLES-Enerdata model

This minimalist approach, with limited changes compared to MSR0+ enables testing of whether targeted parameter recalibration can address key challenges in a smaller market, while preserving the predictability and rule-based nature that has made the MSR politically acceptable and operationally successful.

3.1.5. Measure MSR2

MSR2 introduces the same adjustments as in MSR1 in 2028 and then goes beyond by making some MSR parameter values dynamic after 2028, namely the upper and lower thresholds, as well as the release rate. These parameters evolve over time, with calculations based on the cap LRF, with the rationale that, for the MSR to fulfil its objectives with a market that progressively decreases in size, its parameters are also required to decrease to adapt to the market. This principle is backed by numerous contributions from stakeholders, who generally underline that having parameters evolving with a decreasing market is an important feature of an adequate and future-proof MSR.

As in MSR1, in MSR2, the upper threshold is lowered to 650 million EUAs in 2028, and the lower threshold to 310 million EUAs. As a reminder, the release rate stands constant at 100 million EUAs in 2028 (as in MSR1 and MSR0+).

Then, from 2029 onwards, these three parameter values are decreasing following the same LRF as the cap, with the formulas below:

For each year y :

$$\text{upper threshold}(y) = \text{upper threshold}(y - 1) - \text{upper threshold}(2028) * \text{LRF}(y)$$

$$\text{lower threshold}(y) = \text{lower threshold}(y - 1) - \text{lower threshold}(2028) * \text{LRF}(y)$$

$$\text{release rate}(y) = \text{release rate}(y - 1) - \text{release rate}(2028) * \text{LRF}(y)$$

For the present measure-level assessment based on the MSR0 working scenario, the LRF values used are the currently legislated LRF until 2030 (4.4%), then 3.4% for the period 2031-2035 and 2.65% for the period 2036-2040. These values were calculated as implied LRFs in

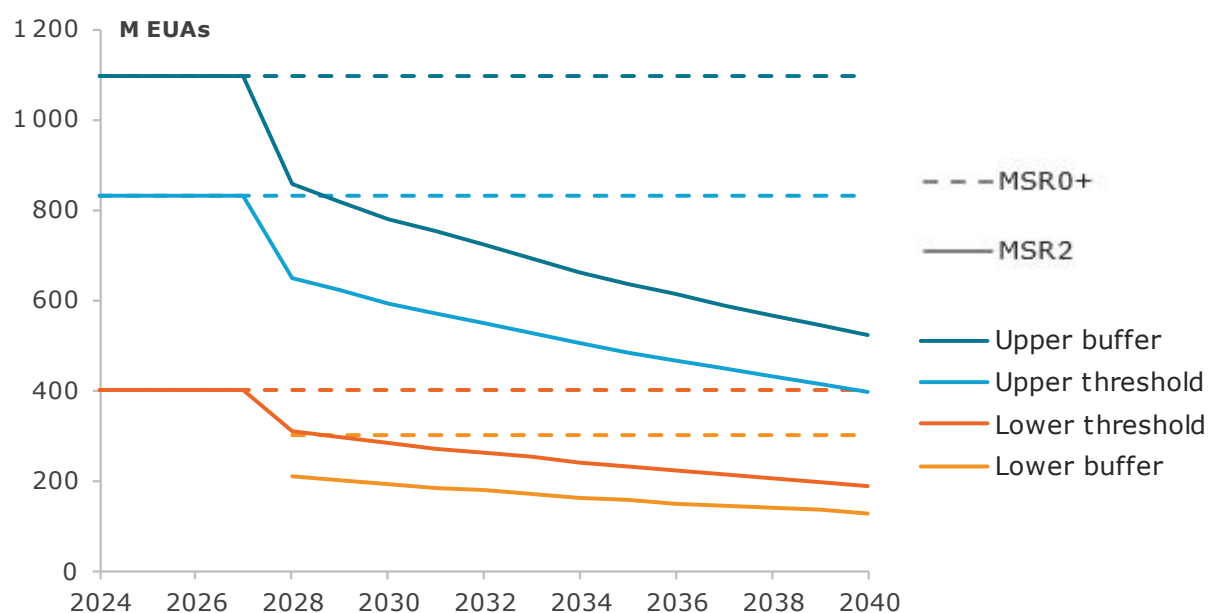
the period 2031-2040 based on the intermediate results of the PRIMES 90% scenario used in the calibration of POLES-Enerdata for the MSR0 scenario (see also the methodological Annex 4).

As previously explained for MSR1, the upper buffer and lower buffer are automatically adjusted based on these updated values for the thresholds and the release rate, with the same formula as presented before.

The remaining MSR parameters, and notably the intake rate, are not changed as compared to MSR0+. Since the intake rate is already expressed as a percentage of the TNAC, if the market (and hence TNAC) decreases, the potential volume of intake will also adjust accordingly.

Figure 7 illustrates how the MSR thresholds and buffer are affected in measure MSR2, as compared to MSR0+. The release rate is also adjusted in this measure (as explained above) but not depicted in the figure. The resulting levels of the annual buffers, thresholds and release rate for this configuration are also presented in Table 2 below.

Figure 7: Measure MSR2: illustration of the parameter adjustments



Source: Own illustration derived from the POLES-Enerdata model

Table 2: Measure MSR2: dynamic parameters decreasing with LRF (4.4% in 2028-2030, 3.4% in 2031-2035 and 2.65% in 2036-2040 for the 90% target configuration)

Million EUAs	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Upper buffer	855	818	780	649	623	598	573	548	528	509	489	470	450
Upper threshold	650	621	593	571	549	527	504	482	465	448	431	413	396
Lower threshold	310	296	283	272	262	251	241	230	222	214	205	197	189
Lower buffer	210	201	192	184	177	170	163	156	150	145	139	134	128

<i>Million EUAs</i>	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Release rate	100	96	91	88	84	81	78	74	72	69	66	64	61

This measure introduces rule-based responsiveness by replacing static MSR parameters with dynamic ones that decline with the same LRF as the cap, applied to their respective 2028 reference values. The rationale is that dynamic adjustment mechanisms could help ensure that the MSR remains balanced and effective as fundamental market conditions change over the assessment period. In addition to proposals to this effect in the literature and stakeholder interviews, MSR2 also addresses the review clause in Article 3 of the MSR Decision requiring the assessment of a potential adjustment of the thresholds in line with the LRF.

3.1.6. Measure MSR3

MSR3 keeps the same idea of having dynamic parameters adjust to a market decreasing in size. However, it has been built with a more empirical approach. Parameters were derived by testing numerous candidates iteratively with the objective of achieving a good balance between the following considerations:

- Progressively decreasing TNAC, in line with the decrease in EU ETS emissions.
- Enabling the MSR to release substantial amounts of EUAs to support market liquidity, with sufficient volume remaining in the reserve in 2040, to maintain its ability to operate thereafter, and to accommodate for possible unanticipated shocks.
- Smoothing price increases, with no strong peaks or fluctuations, indicating a healthy EUA supply-demand balance.

In practice, MSR3 introduces the following changes to the MSR parameters.

- The initial lower threshold stays at 400 million as in MSR0+.
- After 2028, the upper threshold, the lower threshold and the release rate all decrease at the same yearly rate of 4% per year, with the following formulas:

For each year y:

$$\text{upper threshold}(y) = \text{upper threshold}(y - 1) * (1 - 4\%)$$

$$\text{lower threshold}(y) = \text{lower threshold}(y - 1) * (1 - 4\%)$$

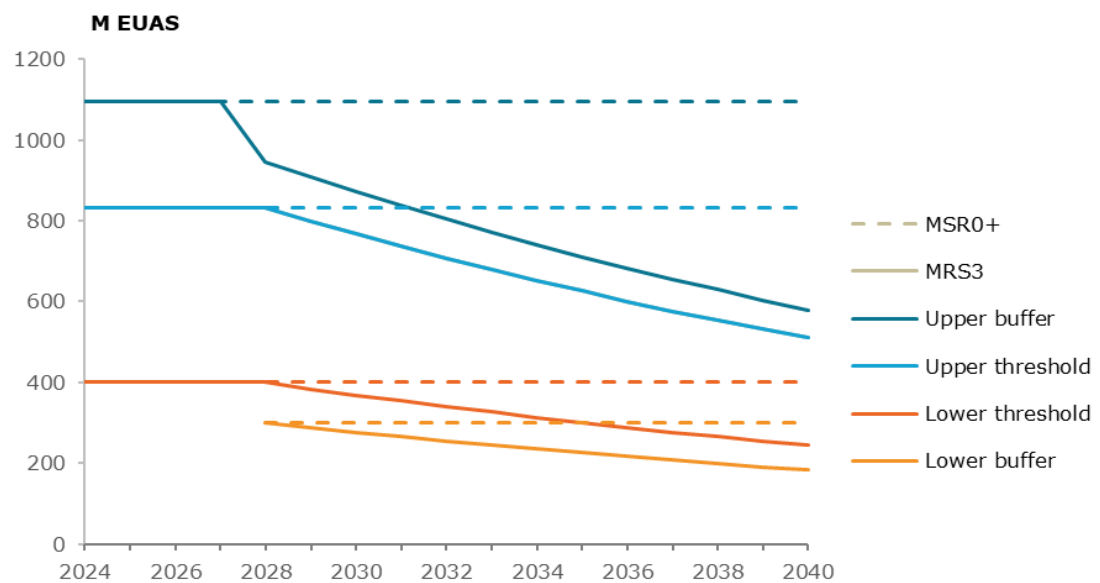
$$\text{release rate}(y) = \text{release rate}(y - 1) * (1 - 4\%)$$

The 4% decrease rate has been calibrated to obtain a good balance across the considerations explained above.

In contrast to MSR0+, MSR1 and MSR 2, the intake rate is reduced to 12% compared to 24% after 2028. Both buffers are automatically adjusted based on the same formula as shown previously.

Figure 8 illustrates how the MSR thresholds and buffer are affected in measure MSR2, as compared to MSR0+. The release rate is also adjusted in this measure (as explained above) but not depicted in the figure. The resulting levels of the annual buffers, thresholds and release rate for this configuration are also presented in Table 3 below.

Figure 8: Measure MSR3: illustration of the parameter adjustments



Source: Own visualisation derived from the POLES-Enerdata model

Table 3: Measure MSR3: dynamic parameters decreasing at a yearly rate of 4 % per year

Million EUAs	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Upper buffer	947	909	872	837	804	772	741	711	683	656	629	604	580
Upper threshold	833	800	768	737	708	679	652	626	601	577	554	532	510
Lower threshold	400	384	369	354	340	326	313	301	289	277	266	255	245
Lower buffer	300	288	276	265	255	245	235	225	216	208	199	191	184
Release rate	100	96	92	88	85	82	78	75	72	69	66	64	61

The suggested approach allows to obtain similar upper threshold values as in MSR2, although with a slightly smoother trajectory as the percentage decrease is constant, which is not the case in MSR2 (with the LRF changing in 2031 and 2036). In MSR3, the decrease is applied year-on-year and hence it is progressive, constant and proportionate to declining levels of the thresholds. The decline trajectory in MSR3 is therefore simpler and more straightforward. In MSR2, with parameters decreasing over three periods (pre-2030, 2031-2035, and up to 2040), the yearly proportional decrease of the parameters exhibits ups and downs. This is not the case in MSR3.

Based on the same principles as MSR1 and MSR2, namely the introduction of dynamic parameters and taking account of hedging needs, the precise design of MSR3 was obtained through an iterative process, learning from successive simulations to find an optimal set of parameters. The formulation of the final design remains relatively simple, with a single percentage decrease for the three targeted parameters. The decrease rate is set empirically, and

is not correlated to the LRF, which is calibrated for the cap decrease, and not necessarily optimal for the MSR parameters themselves.

Table 4 below provides a summary of the definitions of measures MSR0 through MSR3, in terms of MSR parameters and their respective values/formulas.

Table 4: Summary of the MSR measures definitions

	MSR0	MSR0+	MSR1	MSR2	MSR3
UB: upper buffer	Implied by UT and IR: $UB(y) = \frac{UT(y)}{1-IR(y)}$				
UT: upper threshold	833 Mt constant (unchanged)		650 Mt constant from 2028	650 Mt in 2028 Decreases with LRF after	833 Mt in 2028 Decreases at 4%/year after
IR: intake rate	24% until 2030 12% after 2030		24% constant		12% constant from 2028
LT: Lower threshold	400 Mt constant (unchanged)		310 Mt constant from 2028	310 Mt in 2028 Decreases with LRF after	400 Mt in 2028 Decreases at 4%/year after
LB: Lower buffer	No buffer	Implied by LT and RR: $LB(y) = LT(y) - RR(y)$			
RR: Release rate	100 Mt constant			100 Mt in 2028 Decreases with LRF after	100 Mt in 2028 Decreases at 4%/year after
Invalidation mechanism	unchanged	Dropped after 2027			
29R: A29a release	75 Mt constant (unchanged)				
TNAC calculation	unchanged	Technical correction for 2027 TNAC			

3.2. Discarded measures

The scoping exercise identified a of potential reforms ranging from operational parameter adjustments to fundamental institutional innovations. Three measures that concern fundamental reforms of the MSR (price-based triggers, higher-frequency indicators, and the creation of a European Carbon Central Bank ‘ECCB’) were ultimately discarded before undertaking the quantitative impact assessment.

While these measures have theoretical merit, they face significant institutional barriers, require multi-year preparation timelines, and represent departures from the MSR's established operational principles, hence are not feasible for implementation by 2028. The current revision therefore focuses on operational refinements that address potential parameter misalignments while preserving the rule-based, transparent framework that has made the MSR both politically acceptable and operationally successful so far.

3.2.1. Price-based triggers

A price-based MSR would replace or supplement the existing quantity triggers for TNAC with mechanisms that make the MSR respond to EUA price movements. Such approaches include price ceilings and tiers, cost containment mechanisms, auction reserve prices and have strong economic credentials: prices are observable continuously rather than calculated annually with a certain time lag, incorporate forward-looking market expectations about scarcity, and provide explicit planning parameters for investment decisions. Price-based market stability mechanisms are in use in California, the UK, and Washington State, among others. Through the Article 29a release mechanism, the MSR itself has a rule- and price-based element to respond to significant price movements.

Price-based triggers are discarded for the current review, as a quantity-based approach was deliberately chosen when establishing the MSR in 2015, grounded in the belief that prices of allowances should be determined by the market and not influenced by a price range set by the regulator. The OPC synopsis report indicates that while a majority respondents called for measures to improve MSR predictability and reduce price volatility, only a small minority explicitly advocated for a price-based mechanism.

3.2.2. Higher-frequency indicators

Higher-frequency indicators could complement rather than replace TNAC-based triggers, incorporating measures such as volatility indices, liquidity metrics, derivatives market data, and position concentrations to enhance MSR responsiveness. The OPC synopsis report indicates that 10% of respondents explicitly called for shortening MSR response time through more frequent adjustments. These views align with concerns raised about TNAC's limitations in an evolving market.

The development of complementary indicators and associated rules to trigger MSR intervention is discarded for the current review due to substantial practical barriers. Current data infrastructure suffers from significant gaps in granular understanding of trading, hedging, and banking activities, with regulatory and academic stakeholders acknowledging that existing systems were not designed for EU ETS monitoring purposes and have fundamental data availability issues. Developing robust indicators would potentially require expanded ESMA mandate and resources. Moreover, no consensus exists on which specific indicators to adopt.

3.2.3. European Carbon Central Bank

A European Carbon Central Bank (ECCB) would be a new EU institution modelled conceptually on the European Central Bank with authority over carbon market management. In principle, numerous ECCB design variants exist, differing substantially in scope of mandate and governance architecture. Existing proposals range from narrow rule-based mechanisms focused solely on allowance reserve management and market oversight to broader discretionary frameworks encompassing multiple market functions.

The ECCB option was discarded for two reasons. First, other stakeholders raised objections to discretionary ECCB designs and their political-institutional infeasibility. Interviews with market operators and industry associations revealed strong rejection of discretionary institutional approaches, with preference for the MSR's predictable, transparent, volume-based operation as central to political acceptability and market confidence. Second, establishing a new EU institution requires multi-year political processes to define mandate, governance structures, institutional composition, independence safeguards and accountability mechanisms, rendering implementation infeasible in the context of the 2026 review and highly ambitious even for the 2031 review timeline.

4. ASSESSMENT OF THE MEASURES

4.1. Modelling results

MSR measures were assessed quantitatively with the POLES-Enerdata model. The model allows to simulate the EU energy systems, and notably the ETS-covered sectors, with annual results up to 2050. An optimisation module is added on top of the energy systems simulation to model the EU ETS market operations, including an explicit representation of the MSR design. The tool therefore allows to analyse, under different MSR design configurations, the endogenous evolution of key indicators such as the ETS-covered emissions, the TNAC, the MSR operations and the EUA price evolution. It is important to recall that the MSR measures are assessed based on a scenario with an adjusted ETS cap trajectory meeting a 90% economy-wide emission reduction target in 2040 and featuring the inclusion of 50% of the international extra-EEA aviation in the ETS scope in addition to the current scope.

The MSR0 scenario (CWAS) is the starting point for the MSR measure-level analysis. Measure MSR0+ (ACWAS) is then introduced to envision changes considered necessary to the existing design of the MSR. It serves as the basis for the development of further measures, MSR1 to MSR3, which were implemented in the model. Their respective results are analysed in this section. A sensitivity analysis is also conducted to verify assess each measure's robustness in the presence of EUA supply or demand shocks.

A more comprehensive description of the modelling approach is provided in Annex 4. As outlined in the methodological annex, for the purpose of the below measure assessment, MSR scenarios were assessed on the basis of a 90% economy wide reduction target.

The next section (Section 5), analyses of the most promising measures (MSR1 and MSR3) in the broader context of policy options: it tests how they perform when packaged together with the other elements of EU ETS design that form the policy options of the main impact assessment. For alignment purposes, it is important to note that the results for the policy options analysis for PO1, PO2 and PO3 which make use of the MSR1 and MSR3 scenarios, were assessed on the POLES Enerdata model to take account of the 90% emission reduction target for 2035 and 85% for 2040 in comparison with 1990 instead of a 90% economy wide reduction target.

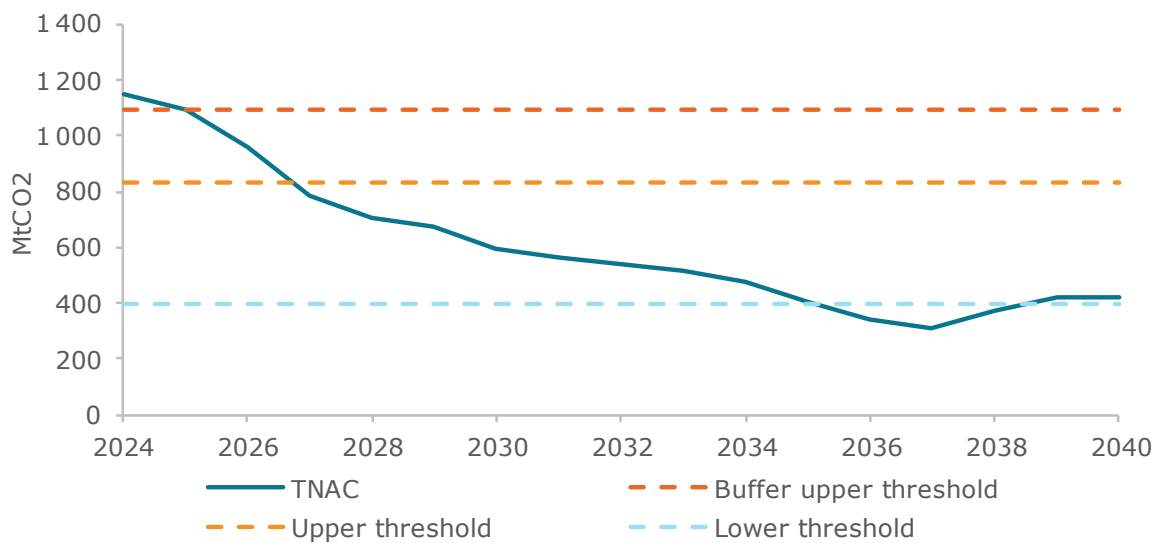
The present measure level analysis does not incorporate the 2025 TNAC published on 28 May 2026⁷⁸ in the POLES-Enerdata model, which resulted in an intake of 190 million allowances in the MSR over a period of 12 months from September 2026 until August 2027. The POLES-Enerdata model estimates for 2025 a higher TNAC than the official TNAC as it projects greater emissions reductions than those observed in 2025. This, in turn, impacts results for future MSR operations and consequently EUA prices. A more complete description of the impact of the adjusted 2025 TNAC on the policy options results is provided in in section 5.4.

4.1.1. Results from measure MSR0 (CWAS)

Historically, the TNAC has always been above the MSR upper threshold and buffer, leading to continued intakes by the MSR since it started operating. In measure MSR0, as shown on Figure 9, the TNAC progressively drops, going below the upper threshold in 2027. After that, it continues to decrease, although remaining in the neutral zone (i.e. between the upper and lower thresholds) until 2035, after which it spends three years below the lower threshold, before coming back up in the neutral zone again in 2039.

⁷⁸ See the European Commission Publication of the [TNAC Communication 2025](#).

Figure 9: MSR0 results - Evolution of the TNAC and MSR thresholds



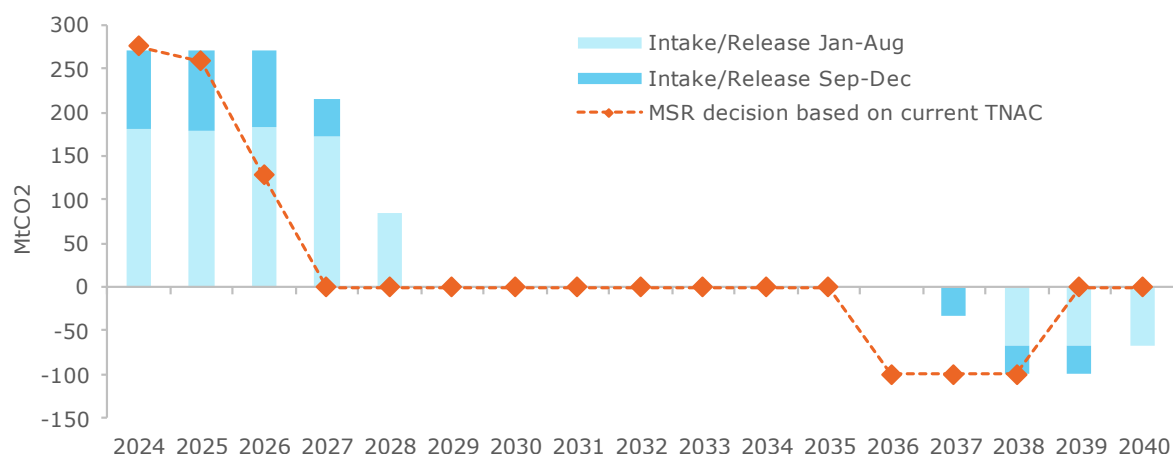
Source: Own visualisation derived from the POLES-Enerdata model

This TNAC evolution translates into the following operations carried out by the MSR (illustrated on Figure 10), specifically the curve ‘MSR decision based on current TNAC’, which corresponds to the quantity of allowances to be absorbed or released from the MSR. To recall, by 1 of June every year y , the TNAC of the previous year $y-1$ is published, which can trigger intakes or releases of allowances spread over a period of 12 months, from September y to August $y+1$. Therefore, the MSR operation in year y can be calculated based on the following formula:

$$MSR\ operation\ (y) = \frac{2}{3} * TNAC\ (y - 2) + \frac{1}{3} * TNAC(y - 1)$$

The last decision to intake additional EUAs is based on the 2027 TNAC. Considering the lag between the MSR decision and actual intakes, the last EUAs are absorbed by the MSR in August 2028. Then, the MSR become inactive until September 2037, time at which it starts releasing allowances, since the 2036 TNAC has crossed the lower threshold. The EUAs released over 2037-2040 enable the TNAC to get back to the neutral zone, as observed above. MSR operations are illustrated in Figure 10.

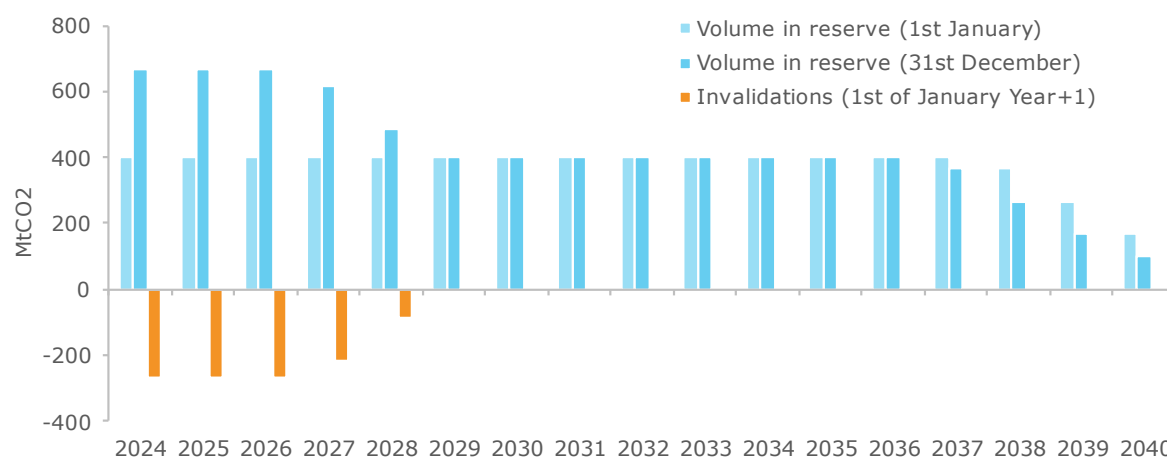
Figure 10: MSR0 results - MSR operations



Source: Own visualisation derived from the POLES-Enerdata model

The amount of EUAs in the reserve (Figure 11) is capped at 400 million with the invalidation mechanism, which leads to a total of 1,111 million EUAs invalidated over 2024-2028. Cumulative releases between 2037 and 2040 amount to about 300 million EUAs, leading the remaining volume in the MSR to drop to only 100 million by 2040. This leaves a limited capacity for the MSR to keep operating in later years and keeps a relatively low margin in the case of an unanticipated event which could cause an EUA demand shock (only 1 year of additional releases available assuming no releases due to the Article 29a being triggered previously).

Figure 11: MSR0 results – Stock of EUAs in the MSR (January 1st) & invalidations

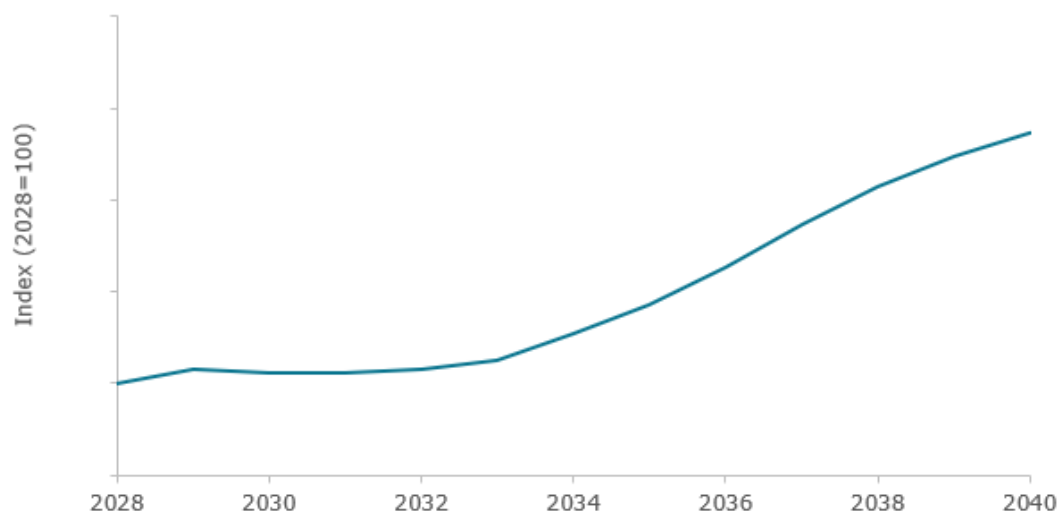


Source: Own visualisation derived from the POLES-Enerdata model

Figure 12 shows that EUA indexed price⁷⁹ for MSR0 is expected to increase until 2029. Then, it stabilizes for about 3 years before starting to increase quickly in the second half of the 2030 decade. In other words, the market becomes tight relatively quickly after 2033, and the MSR release is not early or strong enough to counter that effect.

⁷⁹ The difference between the price trajectories obtained from POLES-Enerdata and those used in the initial PRIMES-based 90% scenario are analysed and explained in Annex 4.

Figure 12: MSR0 results – EUA indexed price evolution



Source: Own visualisation derived from the POLES-Enerdata model

Figure 13 below shows the EU ETS-covered emissions resulting from the MSR0 scenario. These emissions are steadily decreasing through 2040, by 8%/year on average, despite the addition of the departing extra-EEA aviation emissions in the ETS scope in 2027. Emissions from the power sector are decreasing fast and reach low levels by 2040 (about 40 MtCO₂), while industrial emissions reduce more progressively to 170 MtCO₂ in 2040. Combined, aviation and maritime emissions amount to 110 MtCO₂ in 2040, about half their 2027 levels.

Figure 13: MSR0 results - EU ETS emissions

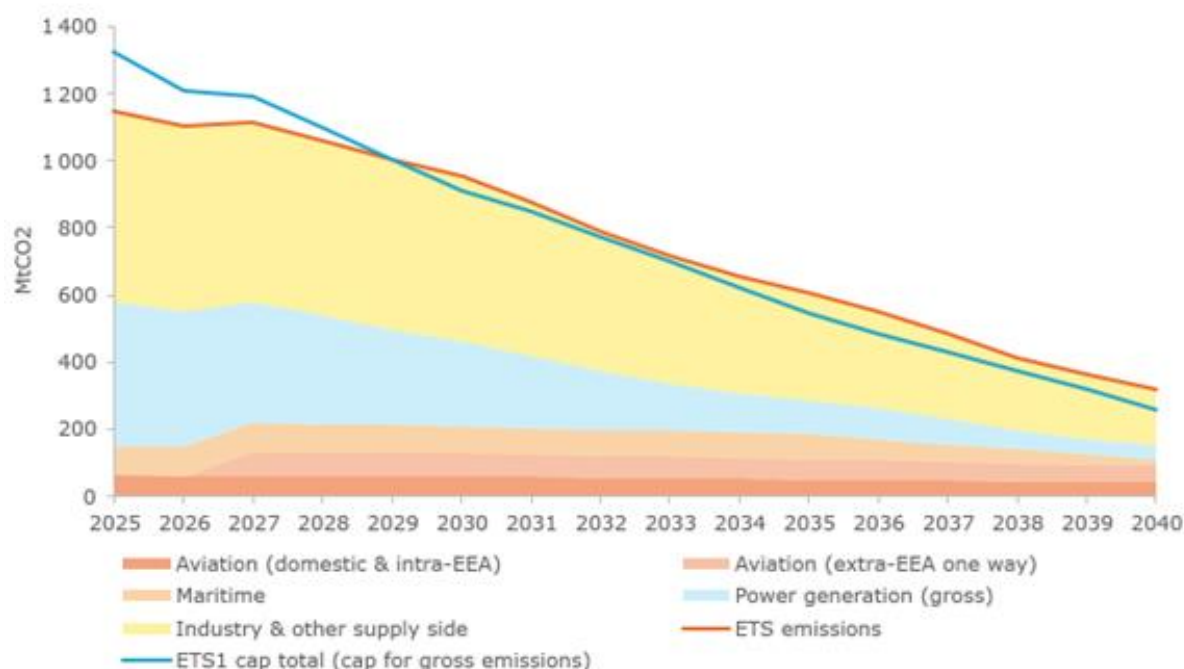


Figure 13 above shows a misalignment in the POLES-Enerdata model between the EU ETS emissions and the cap, which can be explained by two factors. First, there is a historical surplus of allowances on the market, part of which is held by market participants and part of which sits in the MSR. These allowances can later be used for compliance, on top of the allowances

supplied through free allocations and auctions according to the yearly cap. Secondly, the model's methodology solves the compliance problem with rolling anticipation periods of 8 years, allowing for some banking effects. Therefore, yearly emissions observed in the POLES-Enerdata model are not necessarily aligned with the cap, which can be seen as realistic for these two reasons.

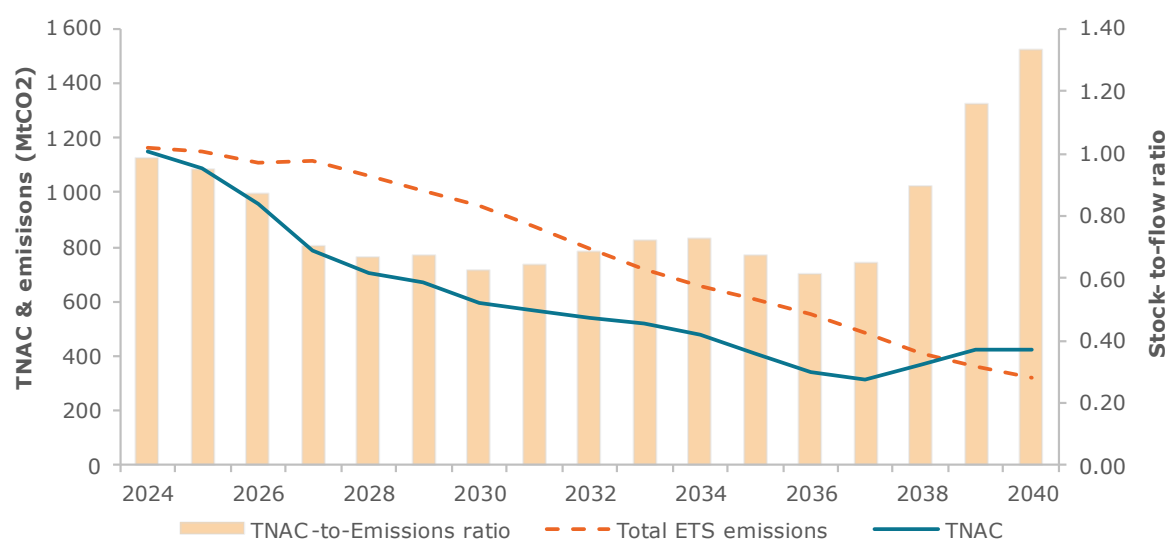
Finally, an interesting indicator when considering the liquidity of the EU ETS is the *stock-to-flow ratio* between the TNAC and the annual emissions. This ratio is presented in Figure 14. It can be interpreted as the number of years' worth of emissions that actors hold in their registry accounts in the form of allowances. These EUAs are notably used for hedging and banking, and it is therefore healthy for the market to feature some surplus.

If the stock-to-flow ratio is too low, it means that the surplus is too low and the market faces scarcity, and it could lead to a high price increase. Typically, less than 3-4 months of emissions in stock, i.e. a TNAC-to-emission ratio below around 0.25-0.3, is assumed to be too limited for market stability.

A stock-to-flow ratio that is too high corresponds to a situation of oversupply of allowances, which could also be unfavourable to the market. It takes in this situation time for the ETS-covered emissions to reach the cap, indicating that the price signal might be weakened. In modelled simulations (though not in historical observation so far), a high ratio could also indicate anticipation of future tightness (hoarding) as discussed in Section 3.1.1. A full year of emissions in stock (i.e. a TNAC-to-emissions ratio of 1) is considered much too high for a healthy functioning of the market. Hence, it is assumed that a sweet spot for the TNAC-to-emission ratio would be between 0.3 and 0.6, for the market balance to be healthy.

In MSR0, we observe a ratio declining towards this range in the beginning of the simulation period (around 2030), but then it rises again and ends around 1.3 by 2040, much higher than expectations for an adequate liquidity.

Figure 14: MSR0 results - TNAC-to-Emissions ratio



Source: Own visualisation derived from the POLES-Enerdata model

4.1.2. Results from measure MSR0+ (ACWAS)

Summary. Compared to MSR0, the improvements introduced in measure MSR0+ prove very useful in some ways, the lower buffer and removal of the invalidation mechanism improve

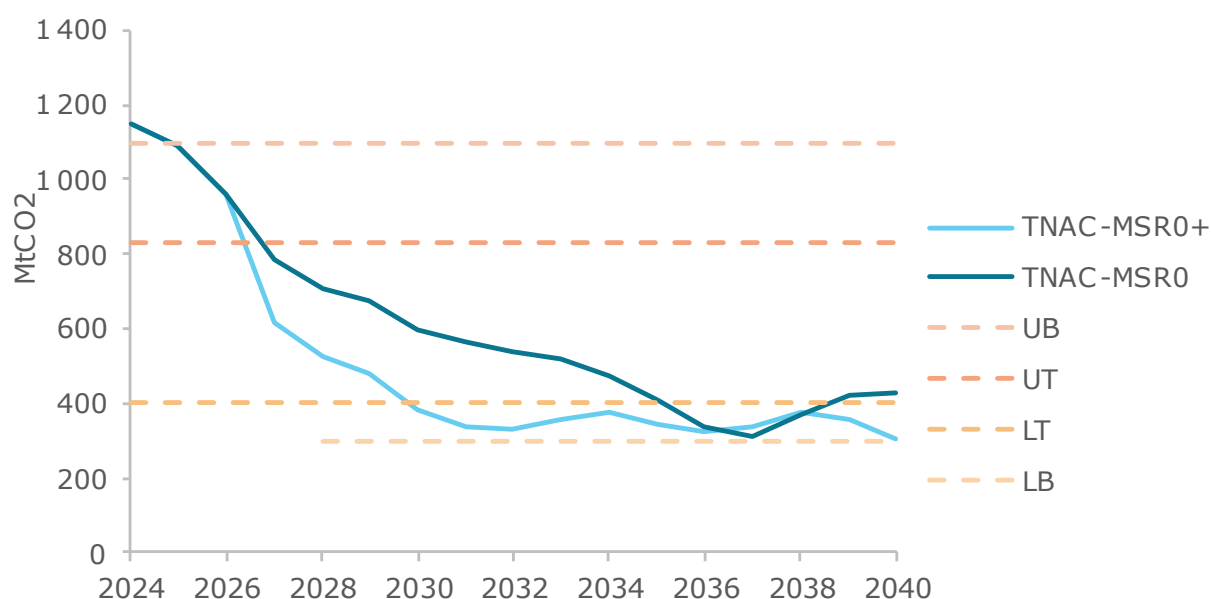
market liquidity, prevent the TNAC from oscillating too strongly, and enable the MSR to have a higher number of EUAs in the reserve, thereby strengthening its ability to release allowances when these are required. However, the price trajectory in MSR0+ is problematic, with prices initially falling, then starting a steep climb as in MSR0 but even earlier. This risks jeopardising the short-term business case for the decarbonisation investments required in the long-term, and demonstrates the need for further adjustments to MSR design parameters.

Detailed results. Measure MSR0+ introduces a set of technical improvements to the MSR design, with a technical correction for the inclusion of the historical net aviation demand to the 2027 TNAC, the end of the invalidation mechanism as of 2027, the addition of the lower buffer as of 2028, and the continuation of the 24% intake rate after 2030.

Some of these adjustments have noticeable impacts on the TNAC evolution, as shown in Figure 15.

The TNAC technical correction brings the 2027 TNAC close to the middle of the neutral band (range between upper and lower thresholds in which the MSR is inactive), at around 600 million EUAs. Then it follows a decreasing trend as in the MSR0 simulation and crosses the lower threshold already by 2030. After this date, the MSR starts to release allowances, which supports the stabilisation of the TNAC. The TNAC does not leave the lower buffer zone until 2040 (i.e. stays between 300 million and 400 million EUAs for the whole decade), with limited fluctuations.

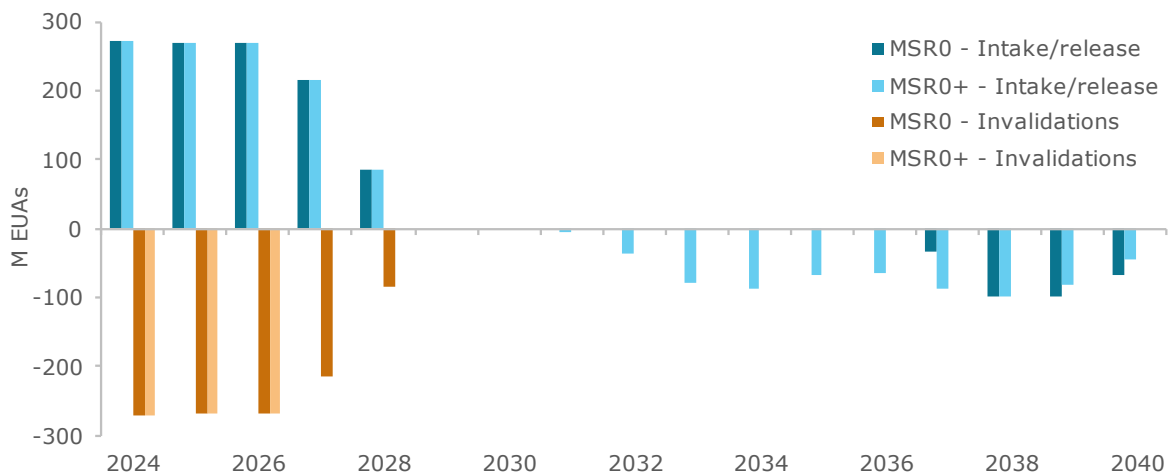
Figure 15: MSR0+ results - Evolution of the TNAC and MSR thresholds



Source: Own visualisation derived from the POLES-Enerdata model

The changes included in measure MSR0+ do not affect the amount of intakes at the beginning of the period (up to 2028) as compared to MSR0, as shown in Figure 16. However, the releases start much earlier, in 2031 rather than in 2037.

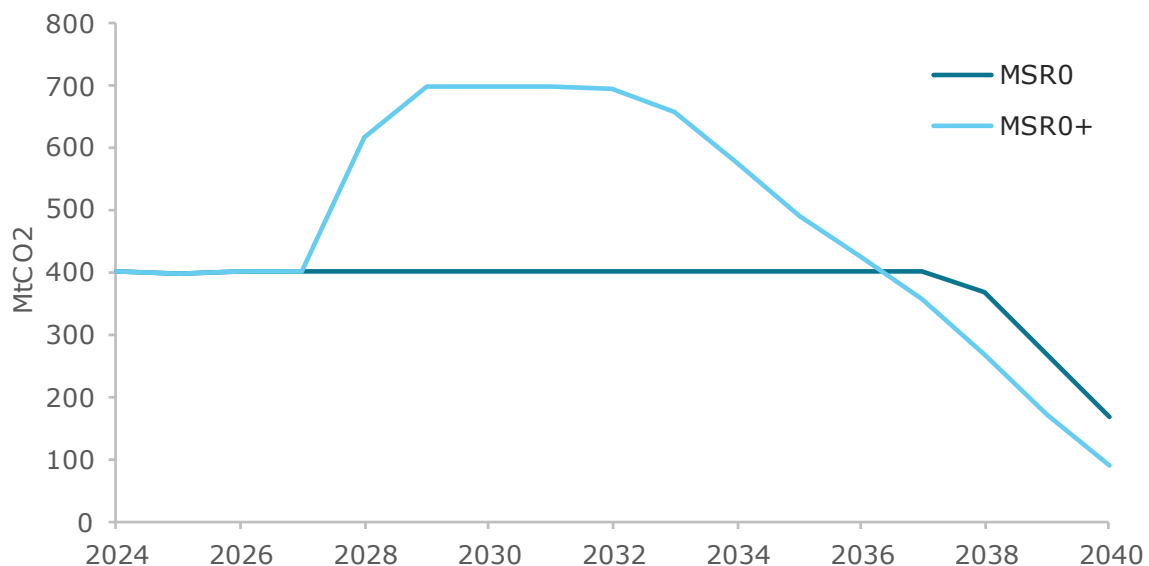
Figure 16: MSR0+ results - MSR operations and invalidations



Source: Own visualisation derived from the POLES-Enerdata model

MSR0+ cumulatively releases more than twice as much as MSR0 by 2040. This is partly because the reserve is larger (by around 300 million EUAs) due to the suppression of the invalidation mechanism. Hence, the total EUAs sitting in the reserve in 2029 are about 700 million, as compared to 400 million in the MSR0 configuration. However, this larger stock is depleted at an even higher rate in the MSR0+ simulation than in MSR0. Therefore, by 2040, the remaining stock in the reserve is only of about 90 million EUAs. This leaves only a small room for additional adjustment in the event of an unanticipated demand shock and seems insufficient for the MSR to continue operating in the 2040s.

Figure 17: MSR0+ results – stock of EUAs in the MSR (January 1st)



Source: Own visualisation derived from the POLES-Enerdata model

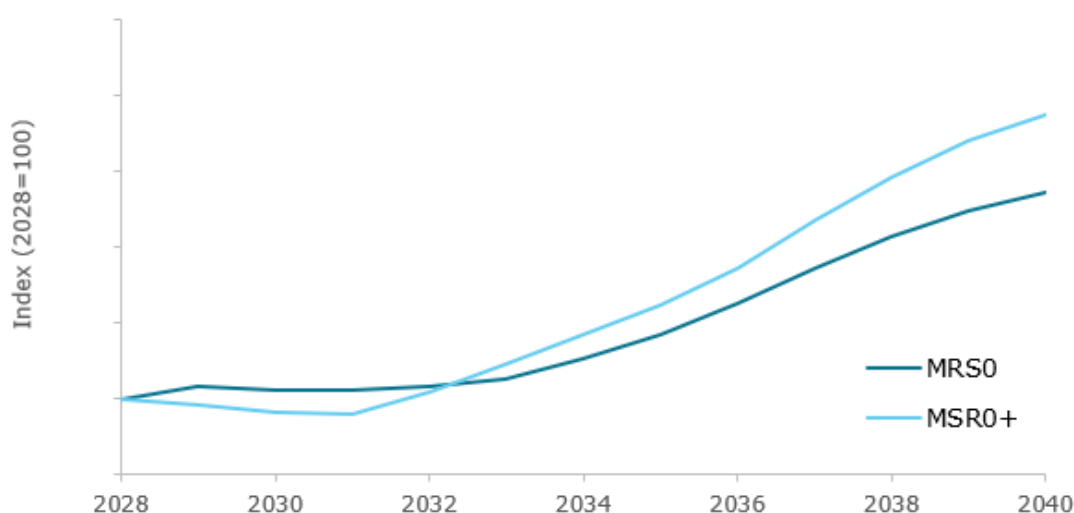
In Figure 18, MSR0+ leads to faster but similar price increases compared to MSR0 after 2034.⁸⁰ However, in the shorter term, the additional and earlier releases by the MSR add supply and

⁸⁰ Since the chart is expressed in index terms, higher indexed curve for MSR0+ than MSR0 after 2032 does not indicate higher absolute carbon prices. Instead, it reflects a faster rate of price increase relative to the base

liquidity to the market and thus lead to a lower price between 2029 and 2031. Overall, there are two potential issues with the evolution of the price in MSR0+, both of which are related to the 8-year foresight assumption of the modelling framework.

First, the price tends to decrease until 2031 in relation to 2028 price, as actors anticipate the additional MSR releases in the early 2030s. In the real world, such a development would send mixed signals for the actors investing in the decarbonisation of their activities. However, the anticipation of a subsequently tighter market kicks in soon, increasing the price quickly and steadily after 2032, which could prove very challenging for the regulated entities, who would face rapidly rising carbon costs and have only little time to adjust and decarbonize their activities. The lack of a stable and progressively increasing price signal in MSR0+ constitutes a large obstacle to industrial decarbonisation investment, demonstrating the need to consider further MSR design adjustment measures.

Figure 18: MSR0+ results – EUA indexed price evolution

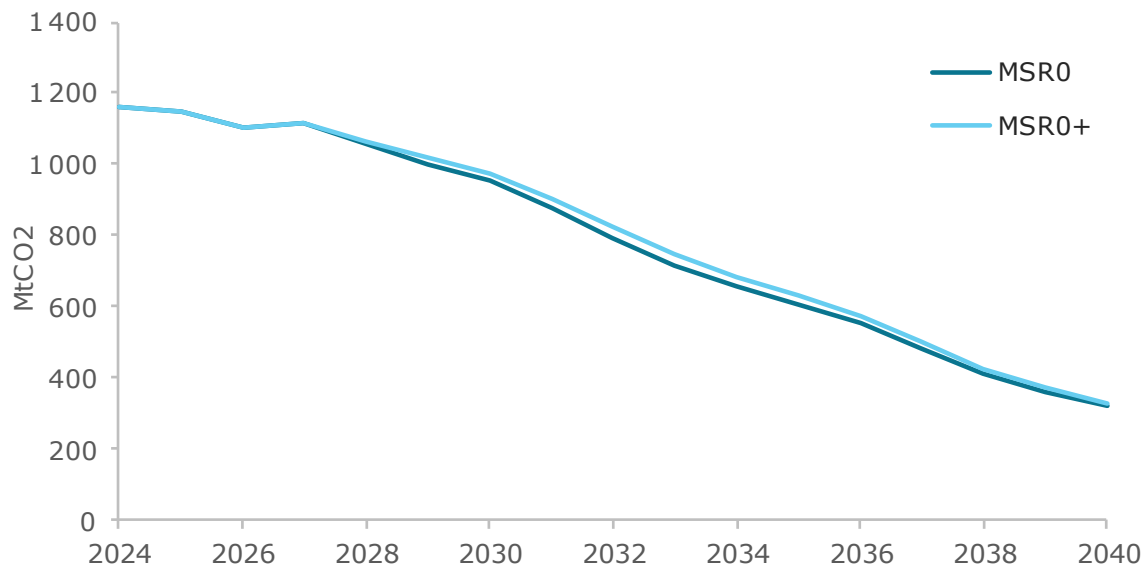


Source: Own visualisation derived from the POLES-Enerdata model

The EU ETS emissions are slightly higher in MSR0+ than in MSR0, especially around 2030, due to the factors mentioned above. Emissions then remain broadly in line with the MSR0 trajectory and tend to converge to its 2040 value.

year. In other words, MSR0+ shows a steeper upward trajectory, meaning prices grow more rapidly over time, even though they remain below the absolute price levels observed under MSR0.

Figure 19: MSR0+ results - EU ETS emissions



Source: Own visualisation derived from the POLES-Enerdata model

4.1.3. Results from measures MSR1 to MSR3

Summary. MSR1, which features a limited and simple adjustment of the MSR thresholds, improves some of the measured indicators compared to MSR0+. It smooths the price trajectory somewhat by delaying and dampening MSR0+'s short-term fall and subsequent sharp increase, thereby lessening concerns over the short-term case for decarbonisation investments. In addition, even though significant volumes of EUAs are released by 2040 in MSR1, the remaining 2040 stock remains above 300 million EUAs. This constitutes a useful margin for the MSR to keep intervening after 2040, and to further adjust the market balance in the case of a deviation from the modelled scenario, as studied in the following section.

MSR2 and MSR3 envision more fundamental changes to the MSR design with dynamically decreasing thresholds and release rate after 2028. This type of approach is called for by many stakeholders and allows to prepare the MSR for a future where the market will progressively decrease to a smaller size. Measure MSR2 aims to use an existing measure of the market decrease, the cap's LRF, to adjust the MSR parameters, while MSR3 is calibrated empirically to obtain a satisfactory constant yearly decrease rate for those parameters.

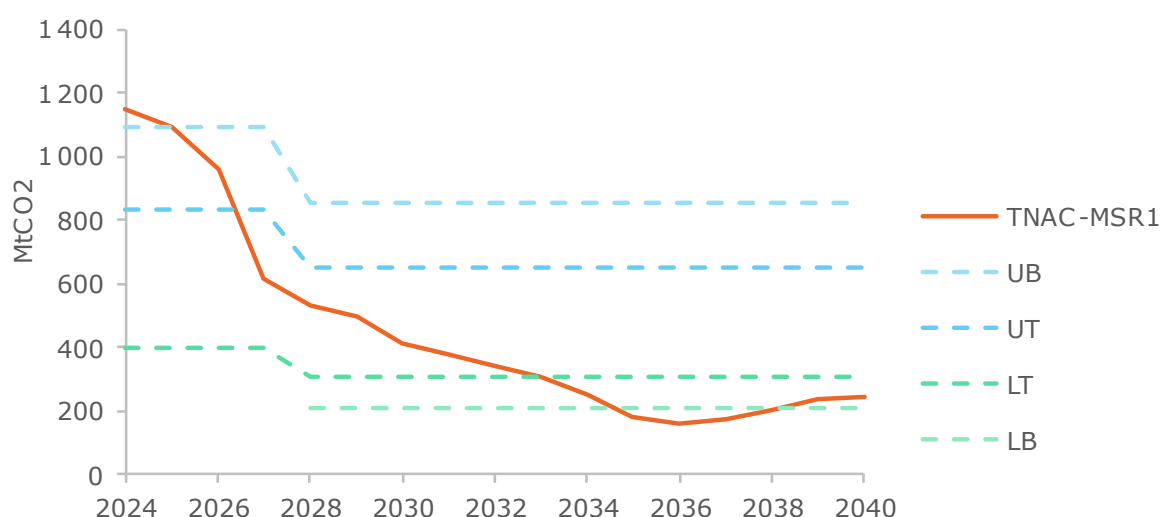
MSR2 fails to deliver satisfactory results, with a very tight market in the medium term (2030-2035) and almost no releases by the MSR before 2040, despite the market tension. On the other hand, measure MSR3 allows for a smooth and progressive decrease of the TNAC, a smooth increase in the EUA price, and a release of appropriate amounts of EUAs before 2040. It also keeps a significant amount in the reserve allowing for its further operation in later years, thereby providing a margin in the case of unanticipated shocks. It also delivers a more stable spread over time of the TNAC-to-emission ratio, a good measure of market liquidity.

Based on the detailed analysis (below), two measures are brought forward for the sensitivity analysis in the Section 4.2: MSR1, as a simpler adjustment of the current design, and MSR3, which provided the most satisfactory results overall.

Detailed results. Measure MSR1 is based on MSR0+ and features an immediate and one-time adjustment of the upper and lower thresholds of the MSR in 2028, with constant values

thereafter. This results in the lowering of the neutral band as compared to MSR0+. Therefore, the decreasing TNAC observed in MSR1 crosses the lower threshold in 2033, later than in MSR0+. MSR releases hence occur later in the period as well. The TNAC then keeps decreasing for a few years and drops below the lower buffer, before the EUAs released counter the decreasing trend. The TNAC then progressively starts increasing and gets back into the lower buffer zone between 2036 and 2040.

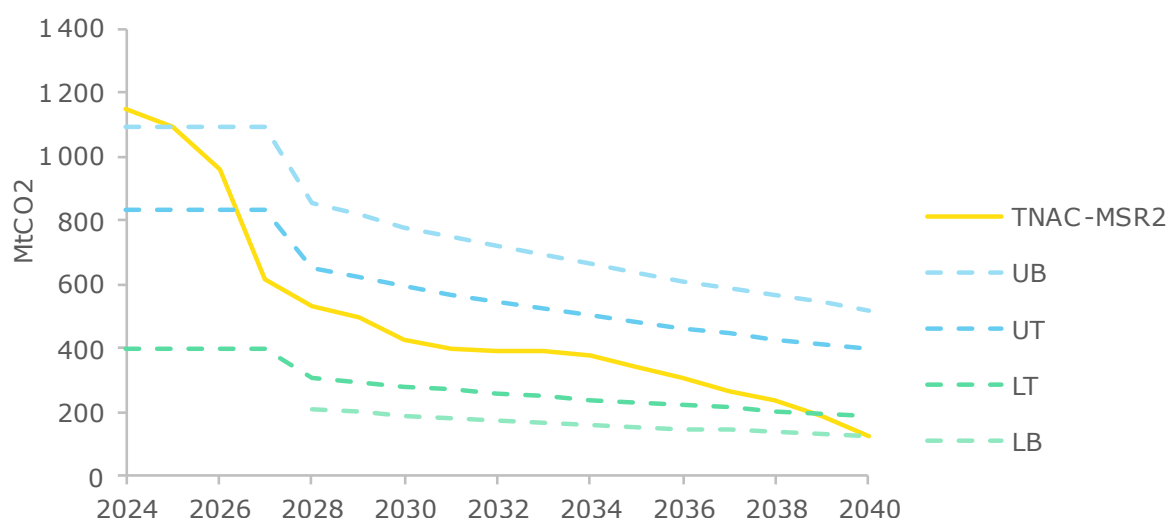
Figure 20: MSR1 results - Evolution of the TNAC and MSR thresholds



Source: Own visualisation derived from the POLES-Enerdata model

Measure MSR2 is based on MSR1, with the same adjustments on the thresholds applied in 2028. From that point, it introduces a dynamic component, with the parameter values of the thresholds and the release rate decreasing over time in line with the cap LRF. The decreasing lower threshold causes the TNAC to remain longer in the neutral band than in MSR1 or MSR0+ and crosses the lower threshold in 2039 (see Figure 21). It decreases throughout the period, but more slowly than in MSR1 because, in the absence of releases, actors are further incentivized to decarbonise their activities and hold allowances for future use, leading to sharper EUA price increases over 2030-2035, but ultimately avoiding MSR1's even sharper increases in the late 2030s. With the additional emission reductions achieved, the TNAC decreases slower than in MSR1.

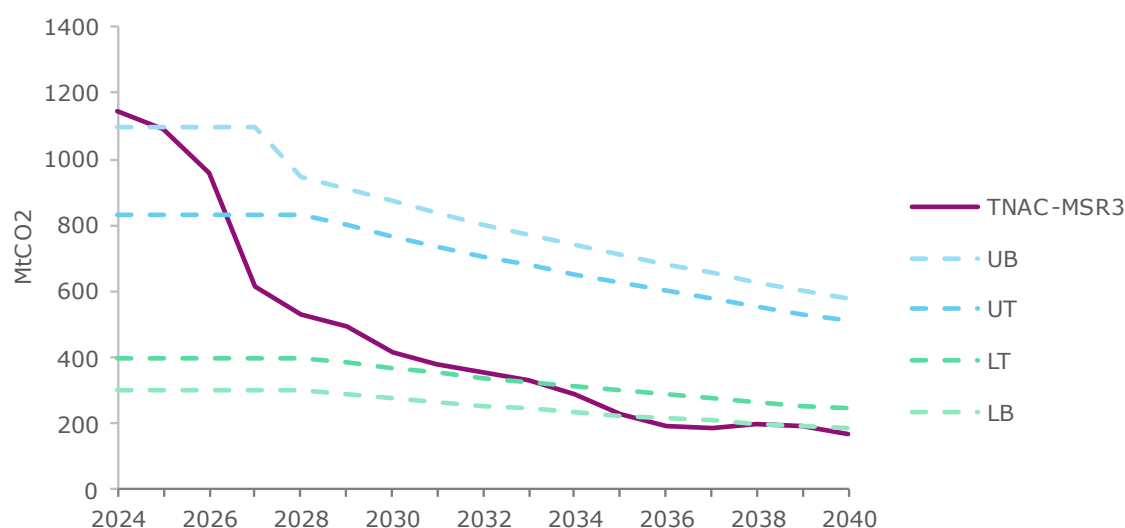
Figure 21: MSR2 results - Evolution of the TNAC and MSR thresholds



Source: Own visualisation derived from the POLES-Enerdata model

Measure MSR3 envisions a different MSR design than MSR2, although also featuring dynamic decreasing thresholds. First, the lower threshold stays at 400 million EUAs in 2028; and second, the decrease of the thresholds and the release rate are based on a fixed yearly decrease rate, instead of the LRF-based mechanism. In MSR3 the level of the lower threshold remains above its level in MSR2 throughout the period to 2040. The TNAC progressively decreases and drops below the lower threshold in 2034. It then keeps decreasing until just below the lower buffer, before stabilizing for a few years and starting to decrease again in 2040.

Figure 22: MSR3 results - Evolution of the TNAC and MSR thresholds

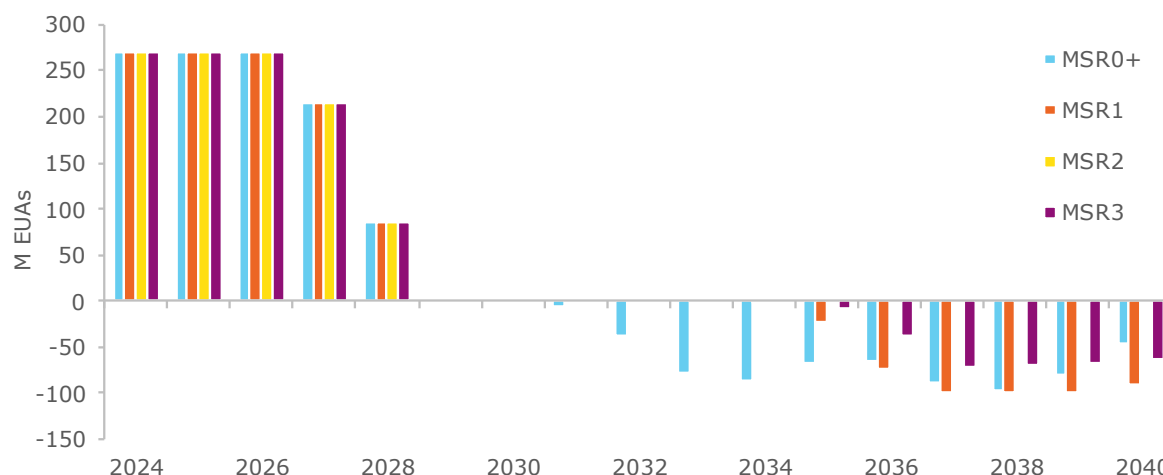


Source: Own visualisation derived from the POLES-Enerdata model

The TNAC evolutions in measures MSR1 to MSR3 lead to substantial differences on MSR operations. In all three measures, the adjustments induce a postponement of the first EUA releases, as compared to MSR0+. In MSR1, significant releases are triggered from 2035 onwards, with a cumulative volume of releases in the next decade of around 490 million EUAs. In MSR2, almost no releases happen before 2040, with only 3 million EUAs released in 2040.

In MSR3, releases start in 2035 with lower values compared to MSR1 (and a fortiori MSR0+), reaching cumulative releases of about 320 million EUAs by 2040. MSR operations are presented in Figure 23.

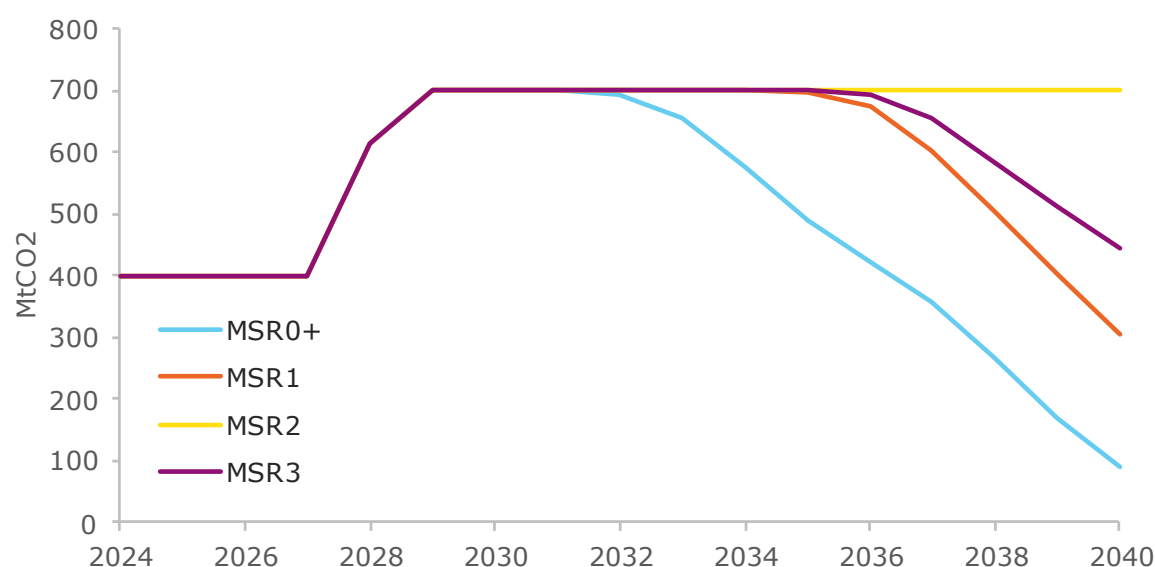
Figure 23: MSR1-to-MSR3 results - MSR operations



Source: Own visualisation derived from the POLES-Enerdata model

All of the measures from MSR0+ to MSR3 stop the invalidation mechanism as of 2027 and have similar intakes at the start of the period, leading to the accumulation of about 700 million EUAs in the MSR in 2029. By 2040, this initial stock depletes at a different pace in the different measures. With significant volumes released as soon as 2031 in MSR0+ (where there is no adjustment of the lower threshold), leading to a largely empty reserve by 2040. With the delayed EUA releases in measure MSR1-to-MSR3, the stocks remaining by 2040 are higher. In MSR1, the reserve volumes drop down to around 300 million EUAs by 1st January 2040, whereas in MSR3, this amounts to 450 million EUAs. In MSR2, with virtually no releases by then, the reserve stock remains around 700 million EUAs, as shown in Figure 24.

Figure 24: MSR1-to-MSR3 results - stock of EUAs in the MSR (January 1st)



Source: Own visualisation derived from the POLES-Enerdata model

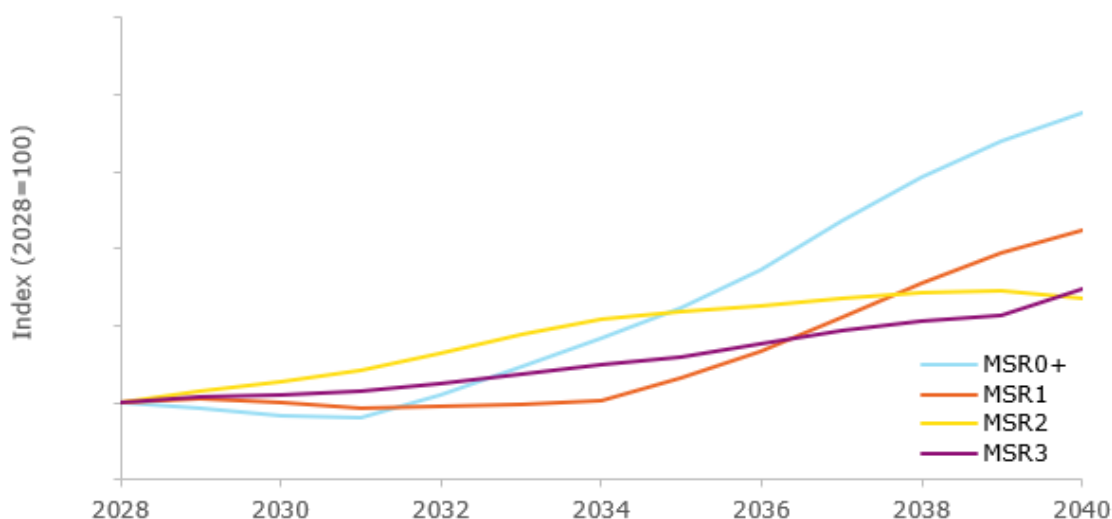
The previously presented TNAC trajectory and corresponding MSR operations have notable impacts on the indexed price trajectories produced by the POLES-Enerdata model. These are presented in Figure 25 below. With the delay in MSR releases, the MSR1-3 scenarios delay or postpone the immediate fall in EUA prices seen in MSR0+, thereby also softening that scenario's sharp increase in prices from 2031.

In MSR1, the simple lowering of the thresholds delays the price fall and subsequent increase observed in MSR0+ by around 3 years. Despite this pause, the scenario is therefore exposed to the same criticism as MSR0+ regarding the weakening of decarbonisation incentives in the short-term, extreme market tightness in the long-term, and questions over whether such an outcome is credible outside of the modelled framework.

In MSR2, the absence of releases prior to 2040 leads to a relatively tight market in the early 2030s, with the price increasing much higher than in the other measures (over twice as high as the MSR0+ and MSR1 prices in some years). The sharp increase slows down after 2035, and the 2040 price in MSR2 is even lower than that in MSR1, with additional decarbonisation efforts triggered by higher prices paying off in the later years of the studied period.

Measure MSR3 allows for a progressive, steady increase in the price throughout the period, marking a healthy supply-demand balance on the market. It more generally brings a form of stability to the EU ETS price signal, with a slow and steady price increase, providing a well-balanced environment for actors to invest in the decarbonisation of their activities.

Figure 25: SR1-to-MSR3 results – EUA indexed price evolution



Source: Own visualisation derived from the POLES-Enerdata model

All measures present close trajectories in terms of EU ETS emissions. Measure MSR0+ leads to cumulative emissions over 2026-2040 of around 11,280 MtCO₂. MSR1 to MSR3 all lead to slightly lower emissions than MSR0+, of respectively -0.6%, -3.9% and -1.5%. These variations are mostly due to the different cumulative release volumes, which are higher in MSR0+ and lowest in MSR2. By 2050, these differences in cumulative emissions reduce, as the remaining EUAs are released from the reserve, and differences in the cumulative volumes released converge to zero.

As a measurement of market liquidity, Figure 26 shows the TNAC-to-emissions ratio. In all measures, the ratio decreases from its high historical values to about 0.55 in 2027 with the

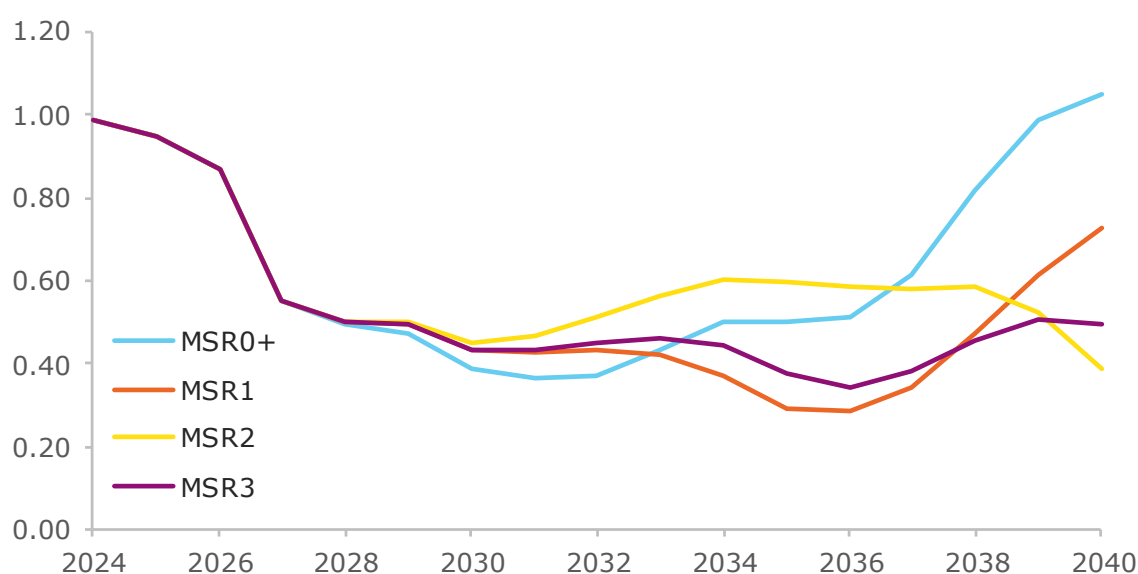
TNAC technical correction. It then slightly decreases by 2029, after which the different measures start to substantially diverge.

As previously noted in the MSR0 case, measure MSR0+ sees its ratio skyrocket after 2036, which puts the market balance into question in this scenario. Adjustments made as part of measure MSR1 allow to reduce this effect, although not completely correcting it. The MSR1 ratio also features a lower minimum value in 2036, of about 0.28.

In MSR2, the stock-to-flow ratio increases over 2030-2034 and then stabilizes at around 0.6 for four years before sharply dropping over the last two years.

Finally, measure MSR3 features the lowest spread in terms of TNAC-to-emission ratio over time. The ratio is generally stable over the period, with a noticeable convex minimum around 2036. It remains between 0.34 and 0.55 over 2027-2040, confirming a healthy market balance, as observed through the indexed price evolution. MSR3 thus provides the most progressive and smooth evolution on the market.

Figure 26: MSR1-to-MSR3 results - TNAC-to-Emissions ratio



Source: Own visualisation derived from the POLES-Enerdata model

Table 5 provides a summary of the main results of the measures MSR0 to MSR3. The analysis starts from MSR0, a core working assumption scenario which maintains the current MSR design forward. A first set of improvements to this case are introduced in MSR0+. However, the results obtained, as well as the analysis of stakeholder's input call for further adjustments to the MSR design.

Table 5: MSR measures summary dashboard

	MSR0	MSR0+	MSR1	MSR2	MSR3
When is LT < TNAC < UT ?	2027-2035	2027-2029	2027-2032	2027-2038	2027-2033
First year of release from MSR	2037	2031	2034	2040	2035

	MSR0	MSR0+	MSR1	MSR2	MSR3
Cumulative volume of release by 2040 (M EUAs)	300	657	489	3	318
Cumulative emissions over 2026-2040 (MtCO ₂)	11,016	11,282	11,214	10,845	11,117
Stock of EUAs in the MSR in 2040 (M EUAs)	167	89	303	700	459
Stock of EUAs in the MSR in 2050 (M EUAs)	0	0	0	265	8
TNAC-to-Emission ratio spread over 2027-2040	0.61-1.33	0.36-1.05	0.28-0.72	0.39-0.60	0.34-0.55

Note: values for MSR3 are based on 4.1% parameter instead of 4.0%.

4.2. Sensitivity analysis on selected measures

Measures MSR1 and MSR3 have been selected to be further tested with a sensitivity analysis, replicating a variety of techno-economic shocks that could impact the carbon market resulting in an increase or decrease in demand for EUAs over different time horizons. A full description can be found in Appendix 1 of this annex. Table 6 summarises the resilience of the MSR system (designs MSR1 and MSR3) in the face of these shocks.

As well as the liquidity spreads discussed in the previous section, the table considers two additional indicators. First, the convergence of the TNAC back to the no-shock trajectory, a few years after the shock is introduced, which is a good indicator of the MSR's ability to adjust to specific contexts. This convergence is more notable in MSR3. Second, the convergence of emissions back to their original trajectory is an interesting indicator to monitor. In that regard, both MSR1 and MSR3 lead to satisfactory alignments in emissions in the presence of shocks.

Table 6: Sensitivity analysis – key indicators for system resilience

	MSR1	MSR3
TNAC converging back to the no-shock trajectory	+	++
Emissions converging back to the no-shock trajectory	++	++
TNAC-to-Emission ratio spread over 2027-2040	0.28 - 0.75	0.33 - 0.63

Overall, the simpler MSR1 design already provides some resilience in the EU ETS, in particular up to 2035. However, the more refined MSR3 design shows stronger performance, allowing for the price impacts to be better kept under control, and leading to much improved indicators towards the end of the 2030s. MSR3 therefore seems to provide a more future-proof option.

4.3. Economic impacts

The design of the MSR directly affects how well the EU ETS functions through several economic channels, notably market liquidity (adequate allowance availability for compliance, hedging and banking), price predictability (stable signals for decarbonisation investment) and business planning certainty (manageable costs and foreseeable regulatory environment). This section assesses measures MSR0+ through MSR3 against these criteria primarily using the results from the POLES-Enerdata model in Section 2.1.

4.3.1. Liquidity in the EU ETS

Market liquidity in the EU ETS context refers to adequate allowance availability to meet compliance obligations and support hedging and banking activities. An MSR design which is fit for purpose should feature timely intakes and releases of appropriate size when the market experiences surplus or scarcity, maintain relatively stable liquidity in relation to covered emissions, and avoid premature reserve depletion, preserving shock-absorption capacity and post-2040 flexibility.

Liquidity is assessed through several indicators: TNAC levels and trajectories in relation to the upper and lower thresholds and buffer zones; the evolution of the stock of allowances in the MSR indicating capacity for future interventions; the TNAC-to-emissions ratio spread which is a proxy for liquidity consistency relative to compliance needs; and the timing and volume of MSR releases.

Table 7: Summary of liquidity analysis

MSR option	Description	Conclusion
MSR 0+	Intakes into the MSR cease in the late 2020s across all modelled measures, as TNAC drops below the upper threshold. In MSR0+, releases begin earliest among the measures and proceed most aggressively, with substantial cumulative volumes released by 2040. This improves near-term liquidity relative to MSR0, with allowance availability more consistent relative to compliance needs. However, the reserve depletes rapidly, leaving minimal intervention capacity for potential shocks and for post-2040 interventions. This is true even though stopping invalidations after 2027 increases the number of allowances for release. The lower buffer successfully enables graduated releases when TNAC enters the lower buffer zone, avoiding abrupt threshold effects and preventing an even more rapid depletion of the reserve.	In short, MSR0+ delivers strong near-term liquidity improvement at the expense of sustained intervention capability in the medium and long term.
MSR 1	Releases under MSR1 start several years later than MSR0+. Nevertheless, substantial cumulative volumes are released by 2040. Critically, the measure preserves meaningful intervention capacity in 2040, while maintaining sufficient reserve stock for potential shocks and for multiple post-2040 releases. The TNAC-to-emissions ratio under MSR1 falls within a narrower range than in MSR0+ over the assessment period, indicating more stable liquidity in this measure.	MSR1 delivers balanced liquidity performance, adequate releases when needed, preserved long-term intervention capacity, and stable supply-demand dynamics through minimalist recalibration.

MSR2	In MSR2, where key parameters decline at time-dependent LRFs, negligible releases occur before 2040 despite market tightening, as evidenced by significantly higher prices than in all other measures assessed. This measure also features the largest stock in the MSR in 2040, as this reserve will have remained largely inaccessible when liquidity is needed. The TNAC-to-emissions ratio remains relatively narrow, but this reflects consistently tight market conditions during the first half of the 2030s rather than effective MSR intervention through releases.	In MSR 2 the LRF-based calibration prevents the mechanism from fulfilling its function to augment liquidity when needed.
MSR3	MSR3 generates moderate releases starting in 2035, with meaningful cumulative volumes released by 2040. The TNAC-to-emissions ratio under MSR3 falls within a narrow range over the assessment period, similar to MSR1 while maintaining greater reserve depth for potential shock absorption, including potential Article 29a activations during the 2030s, and for post-2040 operations.	Under MSR 3 the uniform decline across upper threshold, lower threshold, and release volumes creates internally consistent dynamics. MSR3 avoids both MSR0+'s rapid reserve depletion and MSR2's locked reserve problem, providing timely liquidity provision while preserving intervention capacity. MSR3 has the advantage it adapts to a shrinking market as compared to MSR1.

Both MSR 1 and MSR3 measures demonstrate robustness under the tested shock scenarios, though through different mechanisms as further described in appendix 2 of Annex 8. MSR1 relies on recalibrated static thresholds providing predictable intervention triggers, supported by adequate baseline reserve capacity. MSR3 achieves a similar result through dynamic parameters that adjust intervention timing and release volumes to evolving market conditions, backed by deeper reserve stocks that sustain intervention capacity across scenarios.

4.3.2. Price Volatility

Price volatility affects regulated entities' ability to plan investments, manage compliance costs, and execute hedging and banking strategies. This analysis focuses on volatility patterns across years relevant for medium-term investment planning and compliance strategies.

Rather than formal statistical volatility metrics, the assessment relies on graphical analysis of price trajectories and their evolution under baseline and shock scenarios. The four measures exhibit markedly different inter-annual volatility patterns as outline in Table 8 below.

Table 8: Summary of volatility analysis

MSR scenario	Assessment	Conclusion
MSR0+	MSR0+ demonstrates a non-monotonic trajectory, with prices declining from 2028 to 2031, before reversing direction and increasing rapidly by 2040. This directional reversal in the late 2020s represents volatility	Price decline followed by steep year over year price increases as from 2031.

	through both the sign change and the subsequent acceleration in price growth The pace of price increases post-2031 is particularly pronounced, with year-on-year changes substantially larger than in other measures.	
MSR1	MSR1 exhibits a similar non-monotonic pattern to MSR0+, though delayed any price increase by approximately three years. Prices stabilise in 2030 and show limited fluctuation through the early 2030s before accelerating sharply after 2034. While partially avoiding the early decline observed in MSR0+, MSR1 still features a pronounced hiatus-to-surge pattern. The transition from relative price stability to rapid escalation after 2034 generates substantial year-on-year percentage changes similar in magnitude to those observed in MSR0+.	MSR 1 observes stabilisation followed by a relative rapid escalation of prices after 2034. MSR1 generates a hiatus-to-surge pattern vulnerable to amplification under certain shocks. Nevertheless, year over year volatility remains within reasonable boundaries.
MSR2	MSR2 exhibits a non-monotonic trajectory distinct from MSR0+ and MSR1, with rapid early-period price increases followed by a decline at the end of the assessment period. Prices increase sharply from 2028 to 2030, substantially above all other measures, and continue escalating rapidly through the mid-2030s, before declining in 2040. The steep price escalation in the 2030-2035 period generates the highest annual price growth across all measures, with prices exceeding MSR0+ and MSR1 by factors of two during specific years. MSR2 surges first then reverses, representing an inverted non-monotonic pattern that combines rapid early acceleration with late-period reversal in direction.	MSR 2 provides for the highest annual price growth across all measures. MSR 2 that combines rapid early acceleration with late-period reversal in direction consequently higher level of volatility
MSR3	MSR3 demonstrates the lowest inter-annual volatility across the assessment period. Prices increase progressively from approximately in 2030 up until 2040, maintaining consistent directional momentum without abrupt accelerations, plateaus, or reversals. Year-on-year price changes remain relatively uniform throughout the period, avoiding both the directional reversals of MSR0+/MSR1/MSR2 and the extreme early-period escalation of MSR2. This smooth, gradual trajectory provides the most stable inter-annual price evolution among the four measures.	MSR 3 provides for a smooth, gradual trajectory and the most stable inter-annual price evolution among the four measures. MSR 3 provides for the most stable and gradual price evolution over time. MSR3 also maintains progressive price evolution with superior shock resilience.

4.3.3. Conduct of business

Conduct of business considerations assess how each measure's liquidity and volatility characteristics affect regulated entities' operational decision-making. Two dimensions are central: market conditions that enable effective risk management, and mechanism predictability that supports credible price expectations.

Table 9: Conduct of business analysis

	Market conditions for operational decision making	Predictability

MSR 0+	Problematic market conditions: MSR0+ sends inconsistent signals for investment planning: prices decline when forward-looking entities would expect tightening markets, then surge rapidly	MSR0+ offers predictability through maintaining static thresholds.
MSR1	More suitable market conditions: TNAC within the neutral band until the mid-2030s, MSR1 exhibits wider spreads and hiatus-to-surge price dynamics.	MSR1 offers predictability through recalibrated static thresholds.
MSR2	Problematic market conditions: early-period price escalation followed by late reversal creates a non-monotonic pattern unhelpful to compliance and investment planning or hedging and banking strategies.	MSR2's LRF-based parameter dynamics introduce substantial complexity: thresholds and release rates decline annually at varying paces
MSR3	More suitable market conditions: TNAC within the neutral band until the mid-2030s. MSR3 demonstrates narrower TNAC-to-emissions ratio spreads and smoother price trajectories. Better response to unexpected shocks.	MSR3 employs a single annual decline rate across relevant parameters, balancing adaptation to market shrinkage with relative simplicity and transparency. The constant percentage adjustment creates predictable parameter trajectories.

From a conduct of business perspective, MSR0+ and MSR2 exhibit significant weaknesses: problematic liquidity conditions combined with high volatility; early or delayed releases and non-uniform price dynamics. MSR1 and MSR3 perform better through adequate liquidity provision, directional price stability, and mechanism designs support forward planning: MSR1 through minimalist recalibration preserving familiarity and MSR3 through uniform adaptive parameters balancing responsiveness and transparency, as well as better response to shocks (see Section 4.2).

4.3.4. Recommendation based on economic impacts

Based on the economic impact assessment across liquidity, price volatility, and conduct of business dimensions, MSR1 and MSR3 are recommended to advance to policy option-level analysis. Both measures avoid problematic TNAC dynamics that trigger premature or excessively delayed releases, demonstrate adequate reserve capacity sustaining MSR intervention capability through 2040 and beyond, and generate directional price stability conducive to forward planning and risk management. MSR0+ and MSR2 are not recommended to advance to policy option-level analysis due to structural weaknesses identified across these dimensions.

4.4. Social impacts

Social impacts of MSR measures cannot be meaningfully assessed at the measure level for three principal reasons. First, the POLES-Enerdata model generates projections for allowance prices, emissions profiles for covered sectors, and MSR-related variables like TNAC and release volumes, but does not capture labour market dynamics, household income distribution, or social welfare indicators required for social impact assessment. Second, social impacts result from interactions across multiple thematic areas. Third, MSR measures influence social outcomes exclusively through indirect general equilibrium channels requiring integrated economy-wide modelling, available only at the policy option level.

4.5. Environmental impacts

This section assesses the impact of MSR measures on cumulative EU ETS emissions over 2026–2040, which are meaningful than annual emissions from a climate impact perspective. Across MSR0+, MSR1, MSR2 and MSR3, cumulative emissions over 2026–2040 are governed by how the MSR modifies net allowance supply in the 2030s through the timing and size of releases.

Table 10: Summary assessment of cumulative emissions 2026-2040

	Assessment of cumulative emissions for distinct MSR scenario's
MSR0+	MSR0+ produces the highest cumulative emissions: early and comparatively large releases are sustained for an extended period, raising totals over the window relative to other designs
MSR1	MSR1 lowers cumulative emissions relative to MSR0+ though a delayed onset of releases, although overall cumulative emissions remain higher than under MSR3
MSR2	MSR2 yields the lowest cumulative emissions of all measures, but for reasons that are problematic for market functioning: dynamic thresholds retreat with the cap and suppress releases even under tight market conditions, effectively forcing early abatement via persistent scarcity.
MSR3	MSR3 delivers a clearer reduction in cumulative emissions than both MSR0+ and MSR1: uniform annual declines in thresholds and release volumes provide timely liquidity while preserving credible scarcity while preserving intervention capacity, avoiding both premature depletion and locked-reserve dynamics.

The above ranking on the basis of emission impacts implies a trade-off: designs that release earlier and more forcefully raise cumulative emissions; designs that keep scarcity high reduce cumulative emissions but risk compromising market functioning if reserves become inaccessible.

On cumulative emissions grounds, MSR3 is the preferred design among the viable options. It delivers lower cumulative emissions than MSR1 while maintaining liquidity and intervention capacity, albeit by a small margin. MSR1 remains a suitable alternative, achieving a modest reduction versus MSR0+ but less than MSR3. MSR0+ is not recommended on emissions grounds, as early and comparatively large releases raise cumulative emissions over 2026–2040. MSR2 yields the lowest cumulative emissions but does so through locked-reserve dynamics that compromise market functioning; it is therefore not recommended despite its emissions outcome.

4.6. Summary

This section synthesises the measure-level assessment of MSR1, MSR2, and MSR3 relative to MSR0+ across economic, social, and environmental impact dimensions, based on results across Section 4. Table 11 summarises the key impacts using a four-point scale: substantial improvement (++), moderate improvement (+), moderate deterioration (-), substantial deterioration (--), or no change/cannot be assessed (0).

Table 11: Key impacts of MSR1, MSR2 and MSR3 compared to MSR0+

Economic impacts			
Liquidity	+	--	++

Price volatility	+	--	++
Conduct of business	+	--	++
Social impacts			
Employment	0	0	0
Income distribution, social protection, and social inclusion	0	0	0
Fundamental rights	+	0	+
Environmental impacts			
Cumulative emissions	+	++	++

MSR3 delivers substantial improvements across all economic impact categories. It maintains narrower TNAC-to-emissions ratios through timely releases whilst preserving deeper post-2040 intervention capacity, demonstrates the lowest inter-annual price volatility with smooth trajectories resilient to shocks, and provides superior market conditions through uniform adaptive parameters balancing responsiveness with transparency.

MSR1 achieves moderate improvements through minimalist recalibration, though it exhibits wider liquidity spreads and hiatus-to-surge price dynamics vulnerable to amplification under supply-side shocks. MSR2 shows substantial deterioration: locked-reserve dynamics prevent releases when needed, generating the highest annual price growth and inverted non-monotonic patterns that severely complicate compliance planning.

Regarding social impacts, employment and income distribution cannot be assessed at measure level. However, MSR1 and MSR3 contribute positively to fundamental rights through viable designs that preserve carbon price signal effectiveness, enhancing environmental protection under Article 37 of the Charter. MSR2 maintains baseline respect for fundamental rights but may not deliver this enhancement due to compromised market functioning.

On cumulative emissions, both MSR2 and MSR3 deliver substantial reductions relative to MSR0+, with MSR1 achieving moderate reductions. MSR2's lowest cumulative emissions result from sustained scarcity that compromises market functioning. MSR3 achieves comparable emissions reductions whilst maintaining better economic performance.

Finally, in terms of simplicity of design, MSR1 is the closest to the current design with constant thresholds and release rate, while MSR2 and MSR3 both introduce a layer of complexity with dynamically adjusted thresholds and release rate. MSR3 is however slightly less complex than MSR2 as it uses a single annual decline rate for all dynamically adjusted parameters.

In conclusion, while MSR1 provides a viable alternative with moderate improvements, MSR3 is the preferred option. This is because its dynamic parameters better reflect the cap and are more responsive to the need of the EU ETS market. In addition, MSR3 delivers the clear environmental benefits while overall preserving a better economic performance and a positive social contribution. By contrast, MSR2 is not recommended despite greater emissions reductions.

5. THE MARKET STABILITY RESERVE IN OVERALL POLICY OPTIONS

In light of the results analysed in the previous section, MSR1 and MSR3 are taken forward as policy options, meaning that in the main impact assessment, they are bundled into policy packages with other elements of EU ETS design. MSR1 is part of policy option 1 (PO1) and MSR3 is part of policy options 2 and 3 (PO2 and PO3).

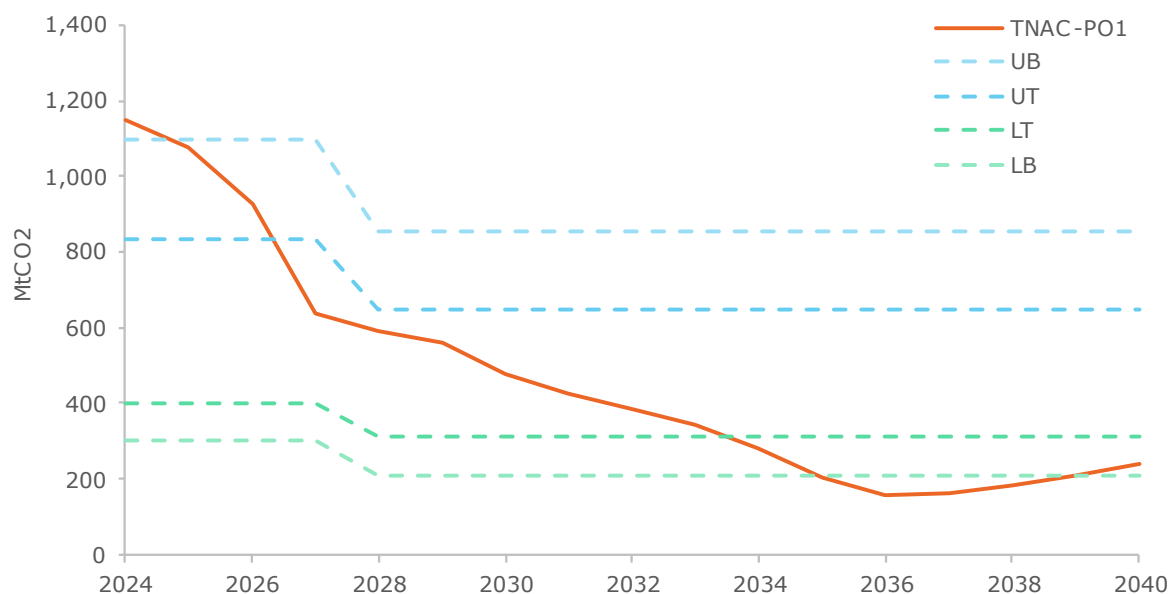
These designs are tested for an EU ETS contribution to the 90-85% economy-wide emissions reduction target, which allows to validate the parameters of the MSR configuration (including the decline rate of parameters in the MSR3 design) in the context of the final considered scenarios⁸¹.

This section presents the detailed modelling results of the policy option level analysis (PO1, PO2 & PO3), with a more detailed specific focus on the MSR than in the MSR main Impact Assessment document. The results for PO2 and PO3 are identical given certain MSR modelling limitations as regards the integration of removals and the different sector scope in the two policy options, but a short qualitative assessment is included in Section 5.3.

5.1. Modelling results

The first policy option PO1 is based on the MSR1 measure for the MSR design. Under this measure, new thresholds are set as of 2028 (650 million for upper threshold, 310 million for lower threshold), release rate maintained at 100 million and these parameters are then kept constant over the time in period up until 2040.⁸² In the PO1 simulation based on the POLES-Enerdata model run, the TNAC steadily decreases from 2027 onwards, similarly to the MSR1 run. It crosses the lower threshold in 2034. Moreover, TNAC decreases below the lower buffer before staying at 237 million in 2040. Due to the static releases in MSR1, 100 million allowances are being released each year from 2036 until 2040.

Figure 27: PO1 results - Evolution of the TNAC and MSR thresholds



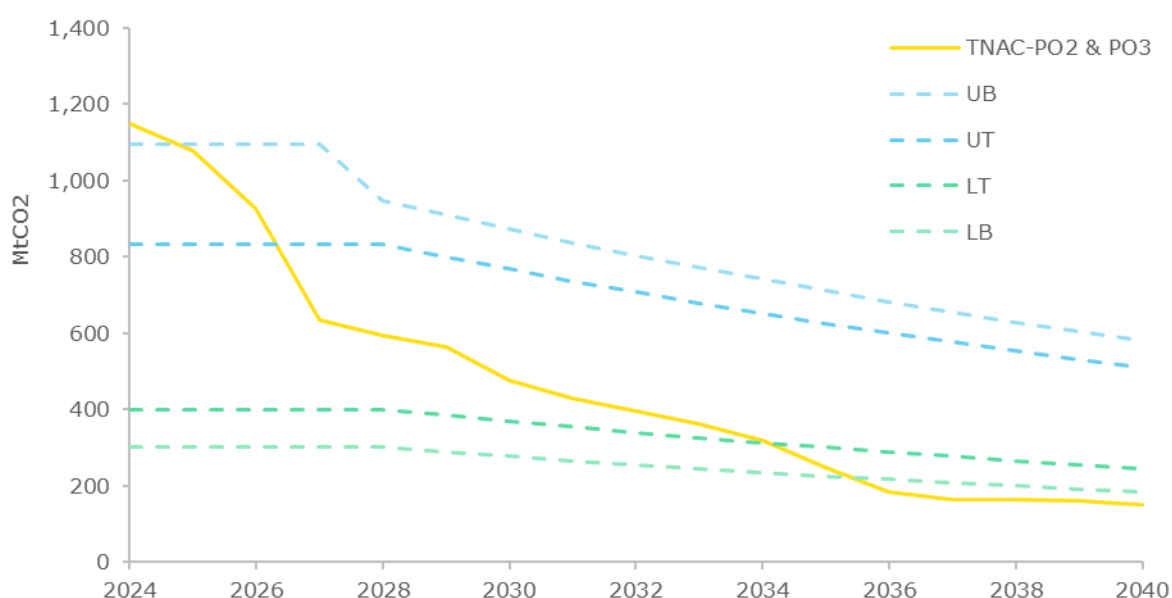
⁸¹ The effects of the timing of supply of free allowances are further assessed in section 5.5.

⁸² Note that PO1 also assumes that 1) no invalidations take place after 2028 which implies that a balance of allowances builds up in the MSR; 2) a lower buffer is introduced from 2028; and 3) both upper and lower buffers are adjusted as needed to avoid threshold effects.

Source: Own visualisation derived from the POLES-Enerdata model

PO2 and PO3 are based on the MSR design from the MSR3 measure. Under this measure, new upper thresholds are set as of 2028 (650 million), 400 million maintained for lower threshold, release rate maintained at 100 million. All these parameters are then declining at a fixed proportional rate of 4%.⁸³ In these policy option runs, the TNAC drops below the lower threshold in 2035. After that, TNAC further drops below the lower buffer until 2040. During this period, the MSR is expected to release between 18 million and 70 million EUAs each year, inducing progressive declines in TNAC at an average rate close to that of the thresholds.

Figure 28: PO2 & PO3 results - Evolution of the TNAC and MSR thresholds

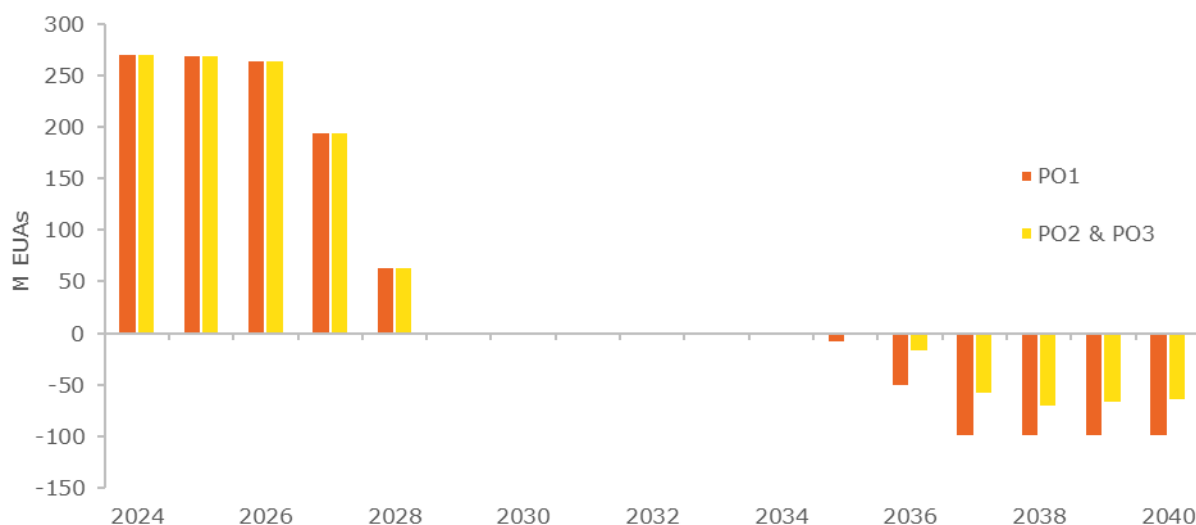


Source: Own visualisation derived from the POLES-Enerdata model

The TNAC evolutions in PO1 on the one hand, and PO2 and PO3 on the other hand, lead to significant differences in MSR operations relative to the baseline scenario. The releases start in 2035 in PO1, one year earlier than in PO2 & PO3. However, the cumulative amount of EUAs released over 2034-2040 is higher in PO1 than in PO2 and PO3, with a yearly average of 66 million EUAs for PO1 compared to 40 million EUAs in PO2 and PO3.

⁸³ PO2 and PO3 also include the changes described in the previous footnote.

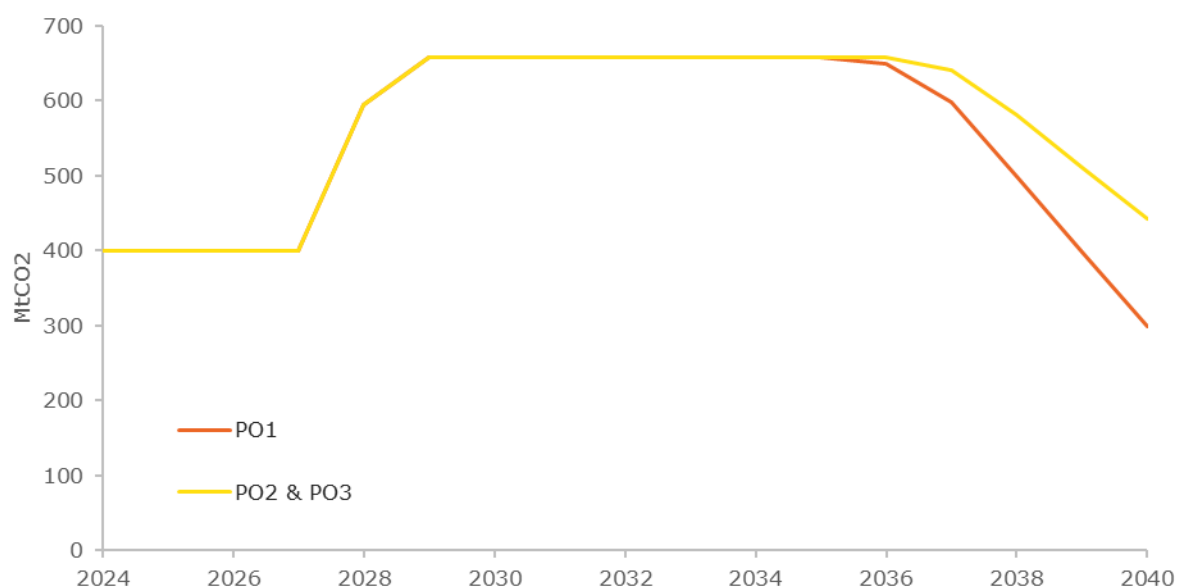
Figure 29: Policy options results - Evolution of MSR operations



Source: Own visualisation derived from the POLES-Enerdata model

This mechanically leads to a difference in the evolution of the stock of EUAs in the MSR. All considered policy options include the termination of the invalidation mechanism after 2027 which implies an accumulation of about 659 million EUAs in the MSR by 2029. By 2040, this initial stock declines according to different profiles under PO1 on the one hand, and PO2 and PO3 on the other hand. The latter options see releases starting later than in PO1, but with lower quantities released. Eventually, the stock remaining by 2040 is higher for PO2 and PO3 than in PO1, with 442 million EUAs left in the MSR reserve compared to 298 million EUAs. These stocks determine the capacity of the MSR to continue responding to shocks to the liquidity beyond 2040.

Figure 30: Policy options results - stock of EUAs in the MSR (January 1st)

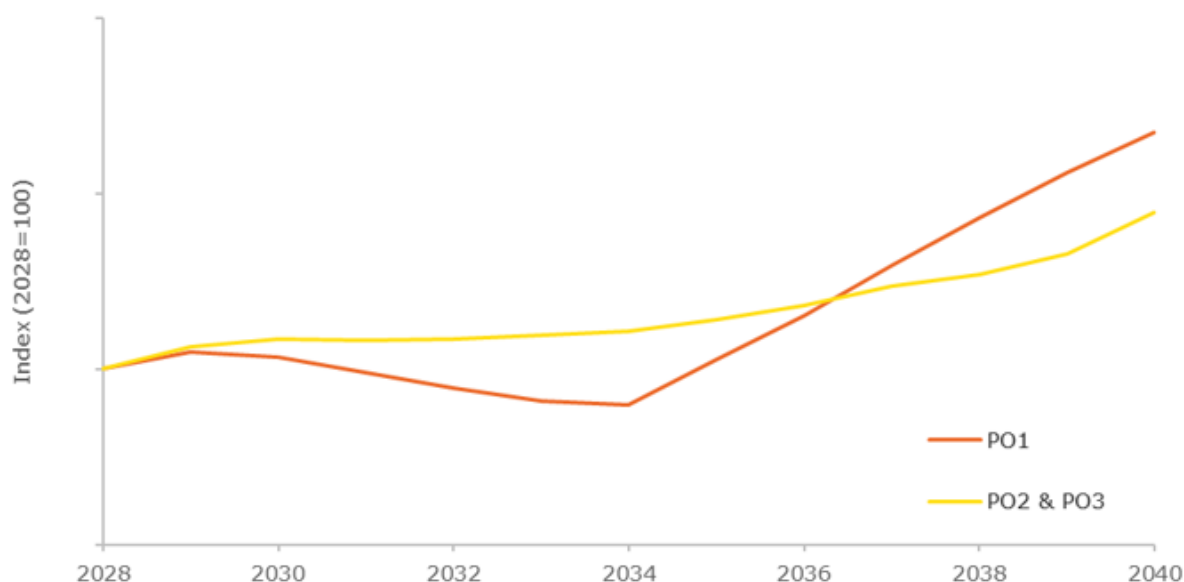


Source: Own visualisation derived from the POLES-Enerdata model

The previously presented TNAC trajectory and corresponding MSR operations have notable impacts on the indexed price trajectories produced by the POLES-Enerdata model. PO1 features the same hiatus in EUA indexed price in late 2020s already observed in the measure-level assessment of MSR1, as well as a small decline in early 2030 and the following rapid price increase after 2034. Accordingly, this policy option is undermined by the same drawbacks in terms of lack of continuity in market tightness across the studied horizon.

For PO2 and PO3, the MSR3 design allows for a monotonic and steady increase in the price throughout the period up, indicative of a healthy supply-demand balance on the market. Only a couple of years over 2030-2032 see a stagnation of the price and delay the overall steady increase dynamic. Thus, the MSR3 design remains broadly in line with initial expectations from the market in the PO2 and PO3 environment. More generally, as observed in the MSR3 measure before, the design used for PO2 and PO3 brings a form of stability to the EU ETS price signal, with a progressively increasing price signal, providing a well-balanced environment for actors to invest in decarbonisation activities while leaving them time to undertake the necessary transformations (i.e. not exposing them to rapid price increases).

Figure 31: Policy options results – EUA indexed price evolution



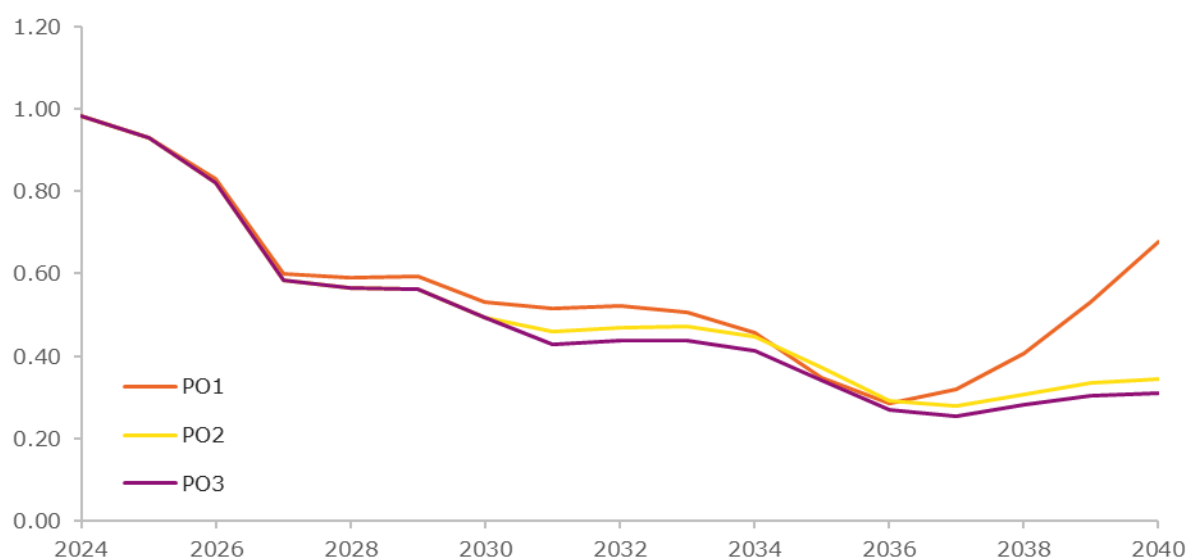
Source: Own visualisation derived from the POLES-Enerdata model

The TNAC-to-emissions ratio is calculated as an approximate measurement of market liquidity. In all measures, the ratio decreases from its high historical values to about 0.6 in 2027 with the TNAC technical correction. It then slightly decreases by 2039, after which the different policy options start to diverge. Starting in 2027, the PO2 & PO3 options include extra-EU aviation one-way emissions, not included in PO1, explaining the slight translation between their respective trajectories after 2027 (before other factors make them diverge further). Likewise, the inclusion of hazardous waste and landfills emissions from 2031 in PO3, not covered in PO2, creates the translation between their respective curves, otherwise comparable in evolution.

In PO1, the decrease continues slow until 2036 to 0.29, a year after the first release from the MSR takes place. After that, due to the continued annual releases, the ratio rises again and

reaches its maximum value in 2040 (0.68), exhibiting a u-shaped pattern. For PO2 and PO3, the ratio starts to increase again in 2038, due to the first MSR releases, and then oscillates in a narrow band by maintained by ongoing releases by the MSR, suggesting a steady state for this indicator. The spread of the ratio for the 2027-2040 period is slightly lower for PO2 (0.28-0.59) compared to PO3 (0.25-0.59). although both are within an acceptable range. The PO1 spread is wider (0.29-0.68), and features values on the relatively high range in the last years of the period (above 0.6).

Figure 32: Policy options results - TNAC-to-Emissions ratio



Source: Own visualisation derived from the POLES-Enerdata model

The following table provides a summary of the main results of the policy option analysis.

Table 12: PO summary dashboard

	Baseline	PO1	PO2	PO3
When is LT < TNAC < UT ?	2027-2039	2027-2033	2027-2034	2027-2034
First year of release from MSR	2041	2035	2036	2036
Cumulative volume of release by 2040 (M EUAs)	0	461	282	282
Cumulative emissions over 2026-2040 (MtCO ₂)	10,350	10,690	11,817	12,379
Cumulative emissions over 2026-2040 (MtCO ₂) – excl. waste, landfills and extra-EU aviation for comparability	9,687	10,690	10,598	10,598
Stock of EUAs in the MSR in 2040 (M EUAs)	400	298	442	442
Stock of EUAs in the MSR in 2050 (M EUAs)	0	0	0	0
TNAC-to-Emission ratio spread over 2027-2040	0.68-2.05	0.29-0.68	0.28-0.59	0.25-0.59

The liquidity indicators in the table above suggest that all policy options represent material improvements compared to the baseline. Notably, PO2 and PO3 perform better on the TNAC-

to-Emission ratio, with a spread remaining within a narrower range of 0.25-0.59, closer to the generally accepted range of 0.3 to 0.6 for a balanced market with sufficient liquidity, compared to PO1's broader spread of 0.29-0.68. Moreover, the price increase towards the end of the assessment period is also more moderate and monotonic for PO2 and PO3 relative to PO1. Similar to the measure-level analysis, PO2 & PO3 offer a progressively increasing price signal that emerges from a market environment with sufficient liquidity and incentivises regulated entities to invest in decarbonisation. As for the environmental impact, cumulative emissions excluding waste, landfills and extra-EU aviation shows that all policy options have similar emissions reductions over the period, though slightly above the baseline. However, PO2 and PO3 appear to deliver marginally lower cumulative emissions than PO1.

On this basis, PO2 and PO3 under MSR3 are considered the preferred options, as they achieve emissions reductions comparable to PO1 while providing stronger economic performance.⁸⁴

5.2. Price volatility analysis

Regarding price volatility, it is important to note that within-year price volatility cannot be assessed quantitatively with the modelling approach employed in this analysis. Moreover, all the policy options assessed share the same Article 29a release mechanism, whose objective is to address high price movements, so cannot be distinguished in this regard. More generally, high price volatility, whether within-year or inter-annual, tends to occur in markets characterised by low liquidity. Nonetheless, the inter-annual variability of the price paths shown reveals information about the comparative stability offered by the different policy options. PO1 exhibits a notable price dip around 2032-2033, followed by a rapid and steep increase through to 2040, which would prove challenging for regulated entities facing first steady, then declining and then rapidly rising carbon costs with only little time to adjust their decarbonisation strategies. In contrast, PO2 and PO3 demonstrate a more progressive and monotonic price trajectory throughout the assessment period, offering a credible and steady price signal that facilitates long-term investment planning.

5.3. Modelling limitations on integration of removals and sectoral scope coverage

The PO2 and PO3 policy options consider different approaches for the integration of removals in the ETS, via a net cap or a gross cap. As explained in the methodological annex, given the use of exogenous values for removals in the POLES-Enerdata model, the results obtained above are identical in the two options. In practice, this is a simplification used for the modelling analysis, which does not take into account some effects presented below, which are assumed relatively limited by 2040 so that results are considered robust.

With time, the EU ETS will see its covered emissions decrease, along with a greater integration of removal units. Regardless of the approach to removals integration, this means that the volume of remaining emissions which corresponds to removal units will increase and become the dominant part of ETS emissions. The difference then lies in the question of who bears the risk that these removals will materialise and in the time dimension of pricing, as well as in the interaction between the price of EUAs and the cost of removals.

In PO2 and PO3, with direct integration of removals, the deployment of BECCS and DACCS is directly incentivised by the EUA price. This is therefore a situation of an endogenous development of removals, responding to the price signal generated by the EU ETS. It implies that the abatement cost of the removals technologies is taken into account in the equilibrium price formation, albeit under different cap levels. Consequently, the carbon price should reflect

⁸⁴ See also in Annex 3.

this development and progressively converge towards the marginal cost of removal technologies unless the removals would be supported by contracts for difference. This mechanism is not captured in the modelling developed in this study. The PO1 philosophy envisages a different approach. In this scenario, the removal units are expected to be available on the market with a set volume as determined by a public authority which procures and auctions a predetermined volume of removal units, regardless of their abatement cost. Consequently, it is the public authority, not the regulated entities, that face the price signal emanating from the removals market and reflecting the marginal abatement costs for removals.

In addition to these differences in the approach to removals integration, the three policy options differ in terms of sectoral scope coverage, with PO1 maintaining roughly the current scope, while PO2 expands the scope to municipal waste incineration and PO3 also includes hazardous waste incineration and landfills. In general, a larger ETS scope implies a larger supply of EUAs, but also a stronger demand from the additional sector covered. The market is hence larger, but differences in market tension and price formation depend on many factors, including also on the ability of the additional sectors to deliver emission reductions in line with their respective cap. Enlarging the coverage of the ETS also allows to access new decarbonisation potentials and therefore increase the potential for economical optimisation by leveraging the easiest-to-abate emissions first.

5.4. Adjustment of the official TNAC in 2025

The results for policy options PO1, PO2 and PO3 presented in Section 5.1 are based on a modelled TNAC on the basis of the POLES-Enerdata model, derived from the cap and projected future emissions reductions in line with a 90-85% target in 2040. According to the POLES-Enerdata modelling, the 2025 TNAC would stand at 1,078 million allowances, compared with the official 2025 TNAC of 1,023 million allowances published on 29 May 2026⁸⁵.

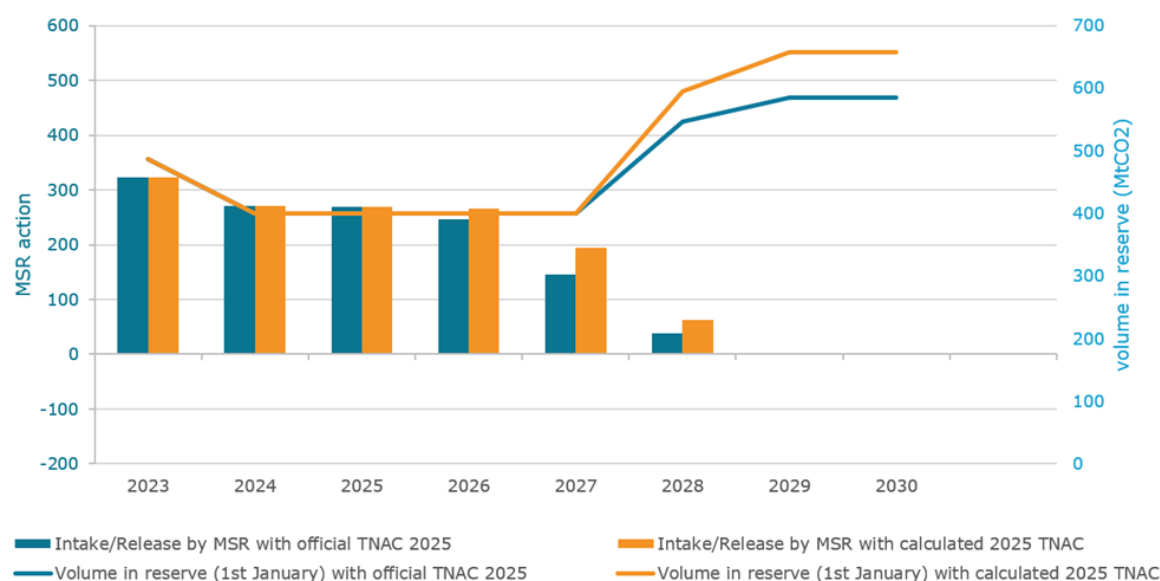
This gap of 55 million allowances is explained by the fact that the model simulation assumes stronger emissions reductions than those observed in 2025. As a result, this difference affects not only the future TNAC projections throughout the period but also the future operations of the MSR and, consequently, the EUA price developments. This section provides a qualitative assessment of the main implications for the policy option results when adjusting for the 2025 TNAC.

According to the modelled TNAC, the MSR absorbs 245 million intakes in 2025 and 96 million in 2026, with no further intakes after 2027 as TNAC no longer stands between the upper threshold and buffer. Adjusting to the official 2025 TNAC, the MSR operation results in lower intakes, with a 190 million intake in 2025 and 58 million in 2026. For the same reason explained for the model, no additional MSR intakes are expected to occur after 2027.

As a result, the MSR reserves using an adjusted TNAC would amount to 585 million allowances by 2030 compared to 659 million in the model, a difference of 74 million allowances. While this gap is not insignificant, it remains within acceptable boundaries and will have only a limited effect on MSR releases in the future. Importantly, the size of the reserve will remain sufficient to stabilise the market if supply tightens after 2030. The core trajectory of MSR operations remains in line with expectation and the conclusions of the POLES-Enerdata modelling.

⁸⁵ See the European Commission Publication of the [TNAC Communication 2025](#).

Figure 33: MSR operations and reserve volume for calculated and official TNAC



Source: Enerdata calculations based on static MSR representation of PO2-MSR3+ with -4.0% configuration

5.5. Assessment of the timing of supply on MSR operations.

This section assesses the impact of the use of the remaining free allocation buffer 2021-2030 on the supply and consequently on MSR operations until 2040. The Directive⁸⁶ establishes a buffer equal to 3% of the total quantity of allowances that would otherwise have been auctioned, to be used where demand for free allocation before 2030 would trigger the application of a uniform cross-sectoral correction factor. In the absence of such a trigger, the allowances concerned would have been auctioned gradually in Phase V.

However, as the buffer will be fully used for free allocation to industry operators between 2028-2030⁸⁷, this will result in a sooner and more concentrated allocation of allowances than would otherwise have been in case of auctioning and will have an impact on the functioning of MSR operations.

The starting point is the results for policy options PO1, PO2 and PO3 presented in Section 5.1, which are based on a modelled TNAC on the basis of the POLES-Enerdata model, derived from the cap and projected future emissions reductions in line with a 90-85% target in 2040.⁸⁸

The use of these free allowances by industry operators can be threefold: i) a part of these allowances will be used by industry operators to surrender against (additional) emissions during this period; ii) a part of these allowances will be monetised either to obtain funding for investments in decarbonisation of industrial process, reducing future emissions and demand for allowances or simply to raise capital for other costs; and iii) part of these allowances may be banked by industry operators for future usage in the next decade.

The effects of the full allocation of the 3% buffer to industry operators as free allowances in the period up to 2030 may delay industry decarbonisation in the short term by reducing the

⁸⁶ Articles 10a (5a) and 10a (5b) of the ETS Directive

⁸⁷ Commission implementing regulation C(2026) 4372 final

⁸⁸ Results may be similar to those observed under the S1 or S4 MSR sensitivities set out in the Appendix 1 below, as both present a shock regarding a lower emissions reduction than expected, whether occurring as a one-off event or as a progressive trajectory, affecting MSR operations and ETS prices.

incentive to invest in emissions cuts. A higher TNAC and a weaker demand reduction may result most likely in downward pressure on ETS prices in the short term in the period 2028-2030 as compared to the scenario outlined in section 5.1. As regards the longer-term effects, the use of the earlier free allowances by industry operators, may result in higher emissions and higher TNAC over the period 2031-2040. Therefore, the downward pressure on ETS prices is likely to be prolonged while MSR releases are expected to be delayed compared to the results highlighted in section 5.1.

As part of this proposal and set out in Annex 9 of this Impact Assessment, 400 million allowances will be supplied to the industry stakeholders starting ahead of 2030 to finance industrial decarbonisation investments, known as the ‘investment booster’. These allowances are to be allocated based on a fixed carbon premium to eligible projects within the Union on a ‘first in, first served’ basis. It is then expected that these investment-linked allowances will scale up gradually in the early period 2030-2035, followed by a gradual phase out by 2040. The introduction of the booster also introduces a significant volume of allowances that will come to the market gradually in for a maximum period of 10 years subjective to project implementation. Consequently, this additional volume will likely further affect the liquidity and future ETS future prices.

The above assessment demonstrates that the proposed changes to the MSR to adjust parameters dynamically over time would still allow the MSR to deliver on its policy objectives: to address risks of an increased surplus, remain resilient to supply shocks and take account of a shrinking cap. This is because the effect of the increase in the TNAC combined with the changes in thresholds would ensure that the market is balanced for a longer period, resulting in the TNAC to reach the lower threshold at a later time and releases being delayed towards the late 2030s. The dynamic thresholds would also ensure that any surplus in the market would be addressed by the intake rates, followed by to the overall evolution of the shrinking market. Therefore, the current calibration of parameters as outlined in section 5.1 remains appropriate.

APPENDIX 1. MSR SENSITIVITY ANALYSIS ON SELECTED MEASURES

Measures MSR1 and MSR3 have been selected to be further tested with a sensitivity analysis.⁸⁹ Indeed, the results presented above are derived from a single scenario run, which depends on multiple assumptions. It is therefore important to verify that these designs still function in the event of deviations from the base case. These deviations originate from uncertainties in the diverse assumptions used: economic context, availability of decarbonisation technologies, structural imbalances, etc.

In practice, the sensitivity analysis consists in adding a number of “shocks” in the system, run the modelling, and observe the deviations in the results. The various shocks tested aim to represent different types of deviation to the base run and are presented below. The shocks are introduced in the model in the form of an exogenous net supply-demand balance, which impacts the market operations through either an additional demand or an additional supply of EUAs. This, in turn, impacts the TNAC trajectory, the overall supply-demand equilibrium and therefore the price formation and the operations of the MSR.

Some of the shocks represent discrete events such as an economic crisis and are therefore modelled as unanticipated shocks. This means that actors, over their modelled anticipation

⁸⁹ As per the analysis for the measures options, sensitivity scenarios are constructed with an adjusted ETS cap trajectory meeting a 90% economy-wide emission reduction target in 2040 and featuring the inclusion of 50% of the international extra-EEA aviation in the ETS scope in addition to the current scope.

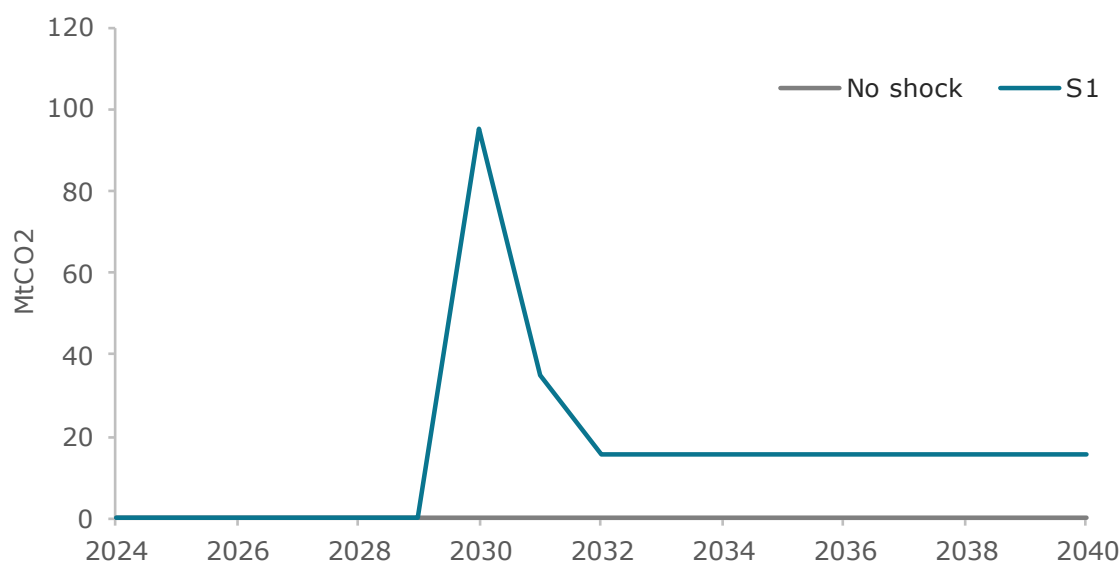
horizon, do not adjust to the shock before it is introduced. On the other hand, some shocks represent structural imbalances, happening progressively, and are therefore anticipated by actors, within their modelled horizon.

A. Definition of the shocks

The first shock introduced in the model (S1) aims at representing a large economic crisis, which would typically lead to a cyclical drop in EU ETS-covered emissions, and therefore to a relative oversupply of EUAs. This type of shock is, by essence, unanticipated. The value used to model this type of shock is inspired from two historical events, which had a similar magnitude of impacts on the ETS-covered emissions: the 2009 crisis and the COVID pandemic. In both events, emissions have dropped by around 10% year-on-year (in 2009 and 2020, respectively). Then, as compared to a reference point, the recovery from the economic crisis happened over a couple of years and was not necessarily complete: the long-term absolute values for emissions remain below a reference case.

In the S1 shock, it is therefore assumed that a crisis happens in 2030 with a -10% impact on emissions (using the MSR0 emissions as reference). In subsequent years, emissions are lowered by 4% from MSR0 values in 2031 and 2% in 2032. Thereafter, it is assumed that the difference in emissions with the reference case remains constant. The obtained net supply-demand balance corresponding to S1 is illustrated in Figure 34 below.

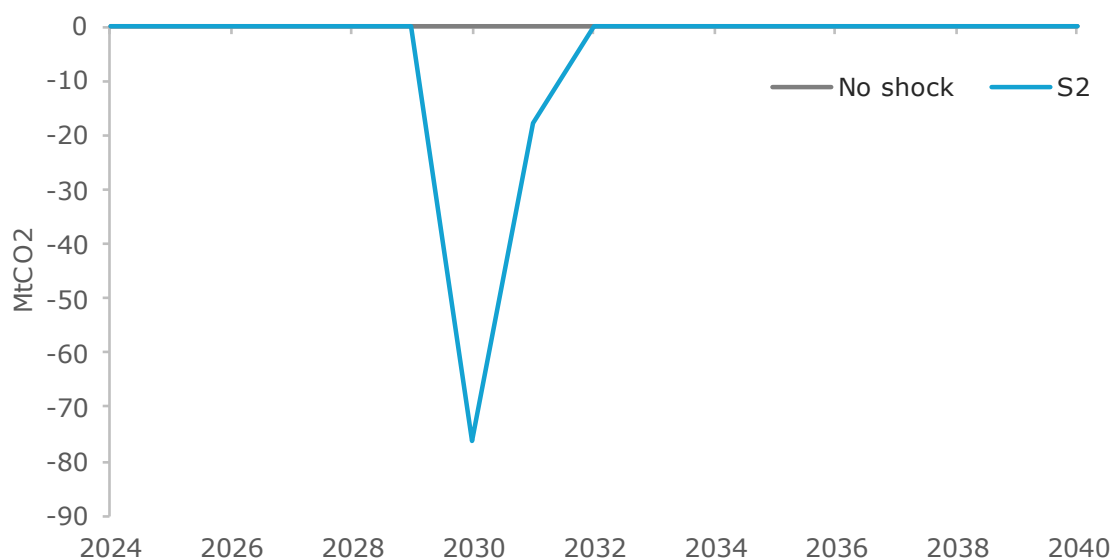
Figure 34: S1 shock definition - Additional exogenous net supply-demand balance



Source: Own visualisation derived from the POLES-Enerdata model

The second shock introduced, S2, envisions an unexpected cyclical shock in the opposite direction, i.e. a shock which creates a net demand of allowances, as compared to the base case. This can, for instance, echo the 2022-2023 gas crisis where additional coal-fired power generation was used, leading to higher emissions than initially expected. More generally, S2 can also represent a large-scale unavailability of decarbonized technologies (e.g. nuclear fleet unplanned unavailability, decarbonisation technologies massive supply chain disruption, etc.). Although the typical magnitude of such events is typically smaller, the envisioned shock introduces the following deviation in emissions from the MSR0 base case: +8% in 2030, +2% in 2031, and then back to normal from 2032 onwards. The corresponding net EUA demand input exogenous to the model is presented in Figure 35.

Figure 35: S2 shock definition - Additional exogenous net supply-demand balance

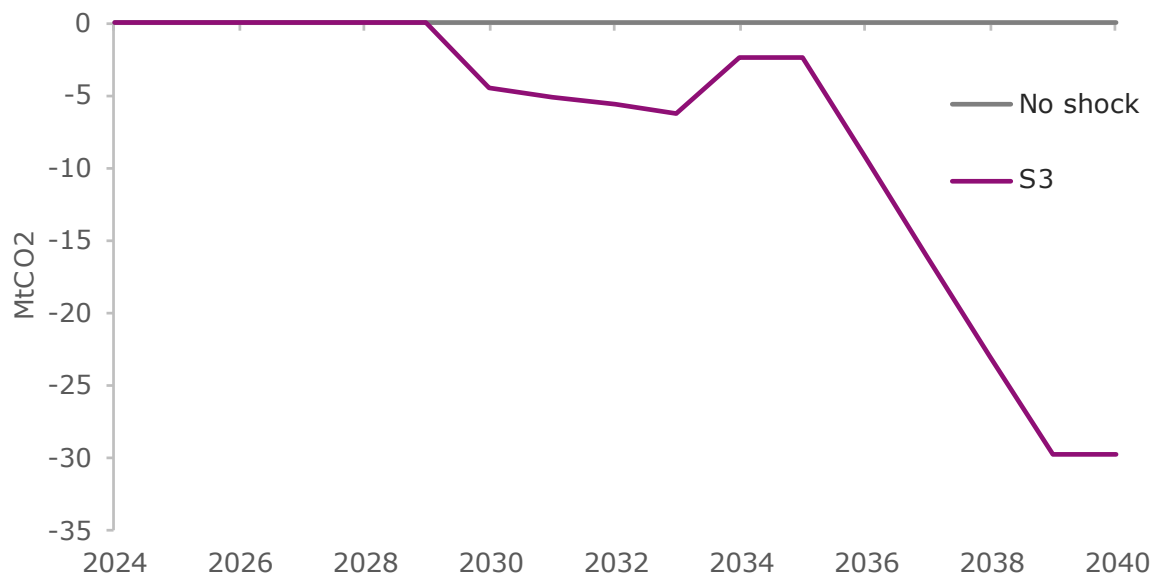


Source: Own visualisation derived from the POLES-Enerdata model

The third shock introduced, S3, represents a case of late availability of carbon removal technologies, namely BECCS and DACCS. It assumes that this delayed removals availability would be reflected on the cap for gross emissions in the EU ETS scope, without assuming an explicit integration of removals in the EU ETS scope. The additional net supply-demand balance introduced in S3 therefore corresponds to a delay of four years in the development of BECCS and DACCS, as compared to the MSR0 base case. It is illustrated in Figure 36.⁹⁰ The non-monotone trajectory corresponds exactly to a four-years delay in the availability of removals and is therefore directly derived from the removal development pathways considered. This shock is assumed anticipated by actors, as removal development projects are regularly announced and publicized by their operators and developers.

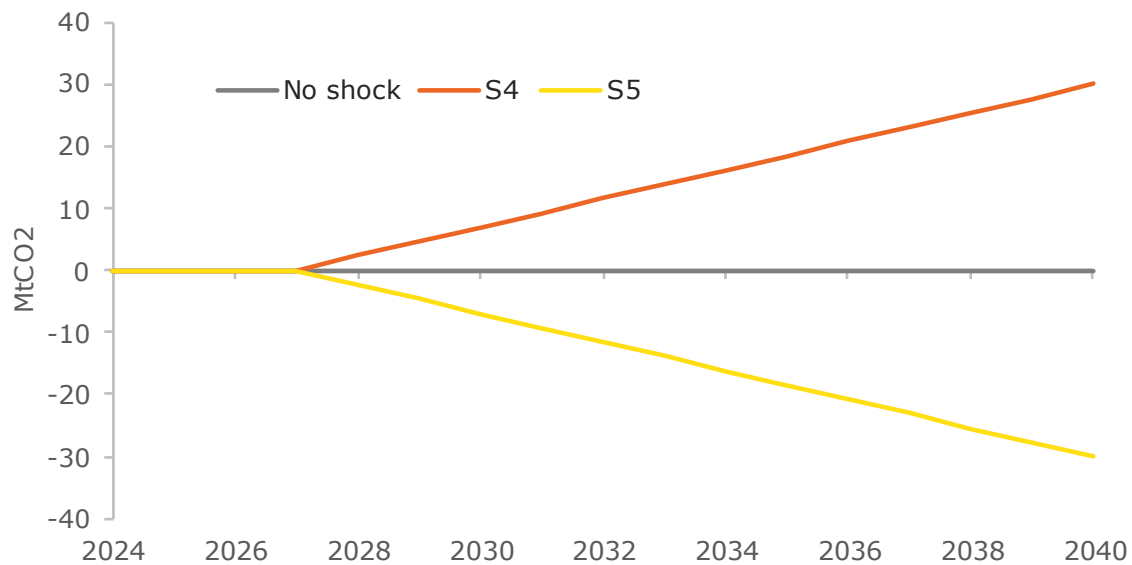
⁹⁰ The curve profile is not monotone and represents the difference in removals due to the four-year delay assumed here. For example, the value in 2030 corresponds to the difference between the baseline assumption for removals development in the PRIMES scenario and that for 2026.

Figure 36: S3 shock definition - Additional net supply-demand balance



The fourth and fifth shocks, S4 and S5, represent progressive structural imbalances, as compared to the base case. S4 and S5 are symmetrical, with S4 corresponding to a positive supply-demand balance and S5 to a negative supply-demand balance. Both these shocks are anticipated by actors in the modelling. Shock S4 aims to represent any deviation from the base scenario leading to a decreased demand of EUAs, such as an accelerated decarbonisation through other policy instruments than the EU ETS, e.g. regulatory measures by Member states, or thanks to cheaper decarbonisation technologies than expected. It could also represent a slower economic growth, or a lower demand from the aviation and maritime sectors (considered exogenously in the model), etc. Conversely, shock S5 represents deviations leading to an increase demand of EUAs compared to the base case: slower decarbonisation (weaker regulatory policies, more expensive decarbonisation technologies), higher economic growth, higher emissions from aviation and maritime sectors, etc. The modelled net supply-demand balances for S4 and S5 are illustrated in Figure 37 and are assumed to increase linearly from 2027 to 2040, representing a progressive and continued deviation.

Figure 37: S4 and S5 shock definition - Additional net supply-demand balance



Source: Own visualisation derived from the POLES-Enerdata model

B. Results from the shock sensitivity analysis

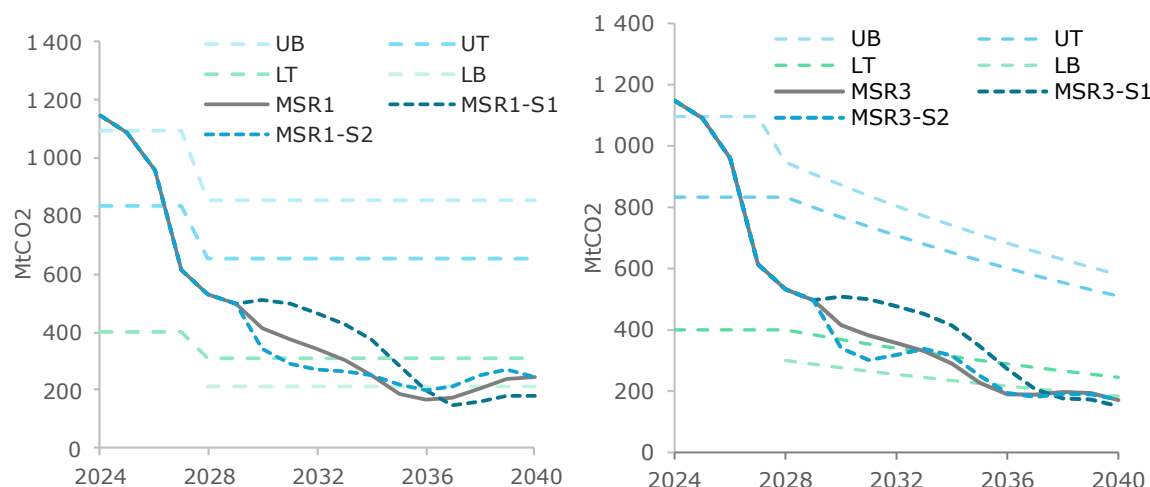
This section presents the main results from the analysis of the five shocks defined above. All five shocks are designed as high-magnitude events, hence allowing to consider large deviations from the base measure scenarios. It focuses first on the impacts of cyclical shocks S1 and S2. Shocks of a more structural nature, S3 to S5, are then analysed, before concluding on the system resilience induced by the two candidate measures.

C. Cyclical shocks

Both S1 and S2 shocks are designed to represent punctual events perturbing the EU ETS, as compared to the base scenario. Their overall shapes are rather symmetrical, although it is assumed that S1 brings a long-term deviation in the emission trajectory, which is not the case in S2 (as presented above).

Figure 38 below shows the resulting TNAC trajectories, in the POLES-Enerdata model, when applying the S1 and S2 shocks on measures MSR1 and MSR3. For both measures, introducing shocks S1 and S2 has a substantial impact on the TNAC in the early 2030s. The date of the first MSR release is consequently shifted by a few years forward or backward. Differences are decreasing, yet remain, between the MSR1 original scenario and the shock sensitivities by 2040. In the case of MSR3, the TNAC seem to converge by around 2037 in the three model runs.

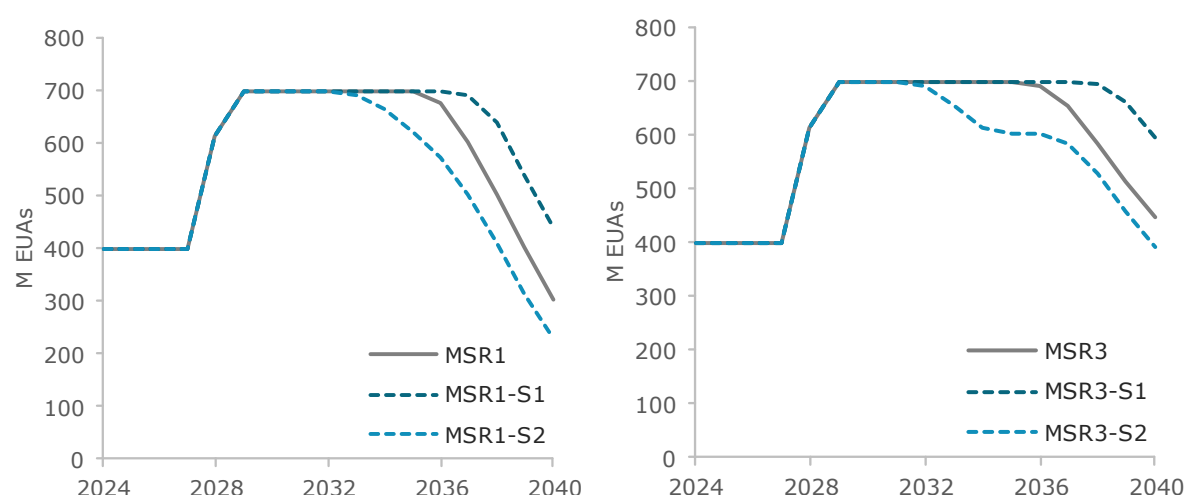
Figure 38: MSR sensitivity analysis - S1 & S2 - TNAC evolution for MSR1 (left) and MSR3 (right)



Source: Own visualisation derived from the POLES-Enerdata model

In both measures, the S1 shock leads to later releases by the MSR, and S2 leads to earlier releases. The MSR indeed helps the market to stabilize in the presence of these punctual shocks, in the intuitive direction. In the case of an economic crisis inducing lower emissions in S1, releases by the MSR are postponed, as the market has higher liquidity. Symmetrically, in S2, as the market gets tight quicker, the MSR releases earlier to ease market tension. The stock of EUAs in the MSR is shown in Figure 39, from which one can also derive the MSR operations. The cumulative releases by 2040 under the MSR1 configuration range from 258 million EUAs in S1 to 470 million EUAs in S2 (as compared to 398 million EUAs in the base MSR1 scenario). In the case of MSR3, these range from 105 million EUAs in S1 to 309 million EUAs in S2 (as compared to 255 million EUAs in the base MSR3 scenario).

Figure 39: MSR sensitivity analysis - S1 & S2 – stock of EUAs in the reserve for MSR1 (left) and MSR3 (right)



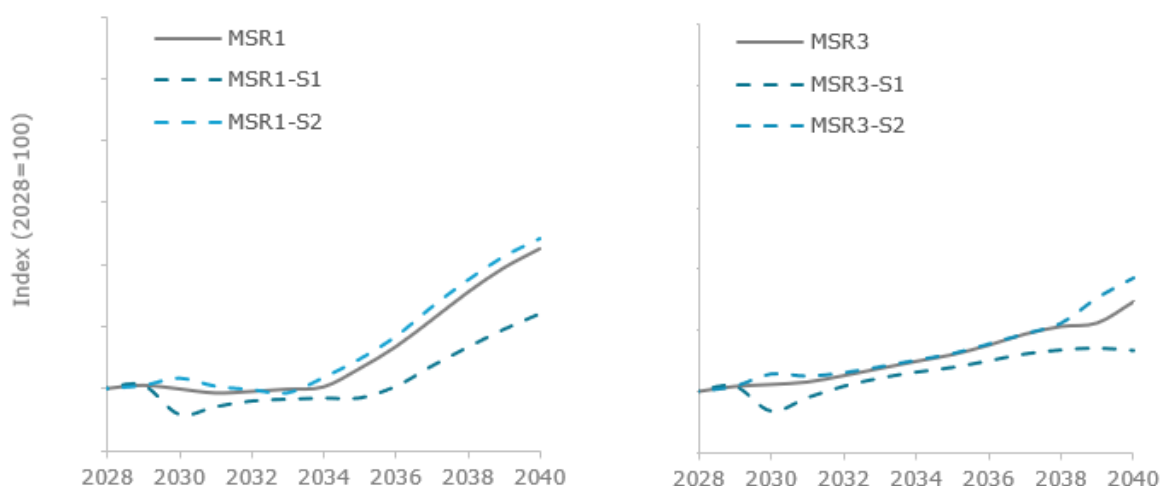
Source: Own visualisation derived from the POLES-Enerdata model

Figure 40 displays the indexed price evolutions with the S1 and S2 shocks, under MSR1 and MSR3. As expected, introducing high magnitude punctual shocks to the system leads to

substantial impacts on the price trajectories. The price evolution is affected by different factors. Intuitively, the punctual deviation in the EUA supply-demand balance at the time of the shock shifts the price equilibrium on the market. In the case of S1, the effect is lasting over time, as the exogenous supply-demand balance remains constant after 2032. In the case of S2, the long-term impact is more limited but still exist.

Beyond that direct effect, there are dynamic effects which can further impact the price. First, a change in the price at the time of the shock impacts the incentives for actors to reduce their emissions. Hence, this leads to lower emission reductions for a period of time, which can in turn affect the future demand of EUAs and could temporarily drive down their price. Second, the actors are modelled as anticipating over a rolling time horizon of 8 years, which means that they adjust to a possible future scarcity in the system. In S2, with the MSR starting to deplete towards the end of the 2030s, a lower stock in the MSR could lead to an increased price, with actors beginning to anticipate for future scarcity, and conversely for S1.

Figure 40: MSR sensitivity analysis - S1 & S2 – EUA indexed price for MSR1 (left) and MSR3 (right)

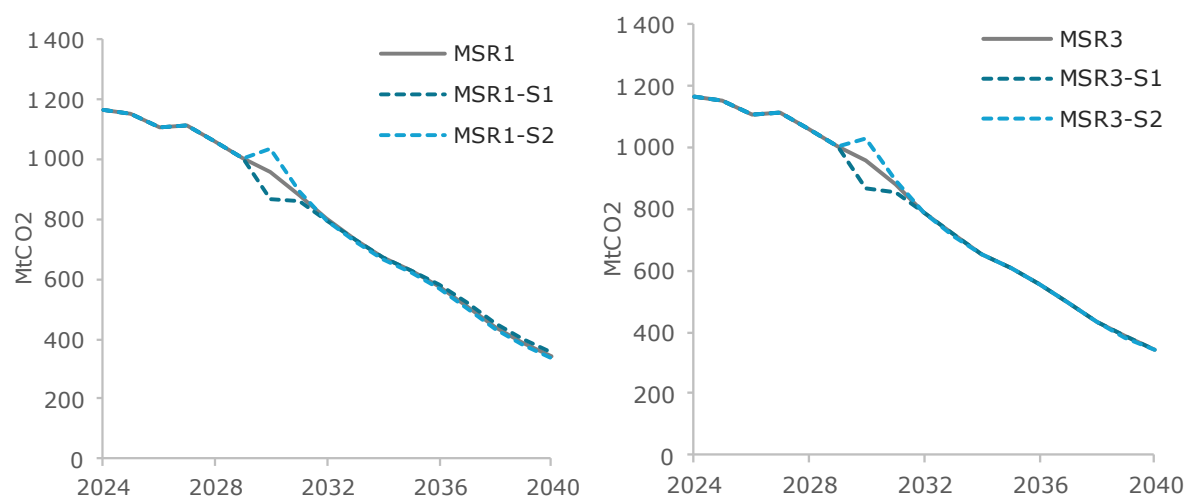


Source: Own visualisation derived from the POLES-Enerdata model

For both MSR1 and MSR3, the S1 and S2 shocks lead to broadly similar shapes for the price trajectories, as compared to the initial runs. In both cases, the S2 shock has lower impacts on the price than S1, which is explained by a slightly lower magnitude of the punctual shock, as well as no permanent effect. With MSR1, the S1 shock leads to a lower 2040 price than the base MSR1 scenario, and the S2 shock to higher price. With MSR3, the long-term price impacts in 2040 are lower in S1 and higher in S2, although up to 2037 the spread was much lower.⁹¹

⁹¹ The increase in the price gap between 2037 and 2040 is due to the effect of the MSR, which will release for the first time in S1 2037 (as shown in Figure 39, where the MSR reserve begins to decline in 2037). Consequently, the increase in prices would slow down between 2037 and 2040 for MSR3-S1.

Figure 41: MSR sensitivity analysis - S1 & S2 – EU ETS emissions for MSR1 (left) and MSR3 (right)



Source: Own visualisation derived from the POLES-Enerdata model

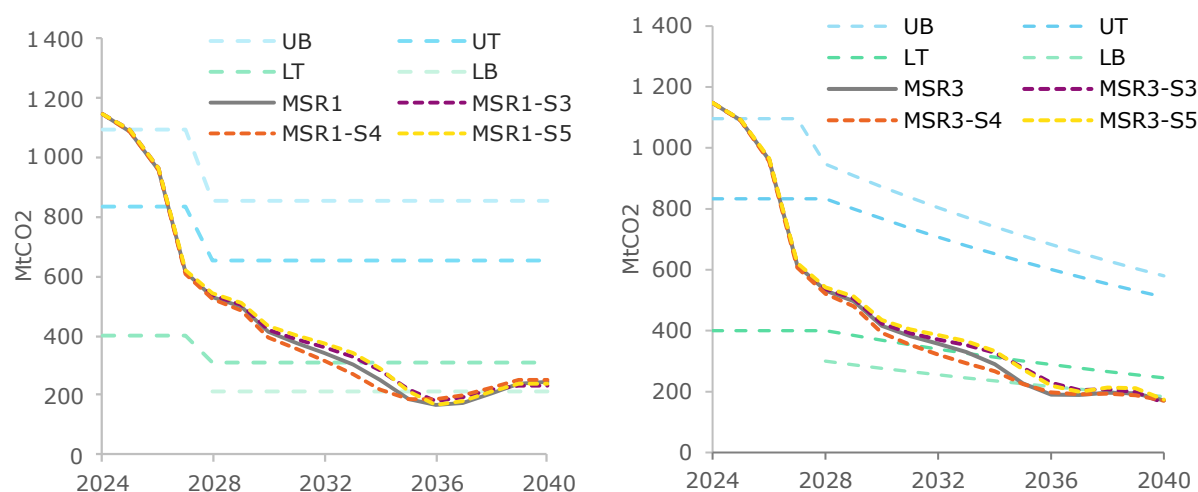
In terms of EU ETS-covered emissions, shown in Figure 41, the S1 and S2 shocks mostly lead to a two-year divergence, with emissions quickly aligning again on the base trajectory. Minor differences subsist in MSR1 with roughly 15 MtCO₂ in 2040, while in MSR3 the differences are almost inexistant.

D. Structural shocks

As opposed to the S1 and S2 shocks previously analysed, the S3 to S5 shocks are of a more structural nature. They lead to progressive and increasing deviation from the base run, in terms of exogenous supply-demand balance added to the POLES-Enerdata model, as explained previously.

The evolution of the TNAC trajectories, with the three shocks, under the MSR1 and MSR3 configurations, are provided in Figure 42 below. For both MSR1 and MSR3, the trajectories slightly deviate from the base case, although to a moderate degree, and tend to progressively align with it by the end of the 2030s.

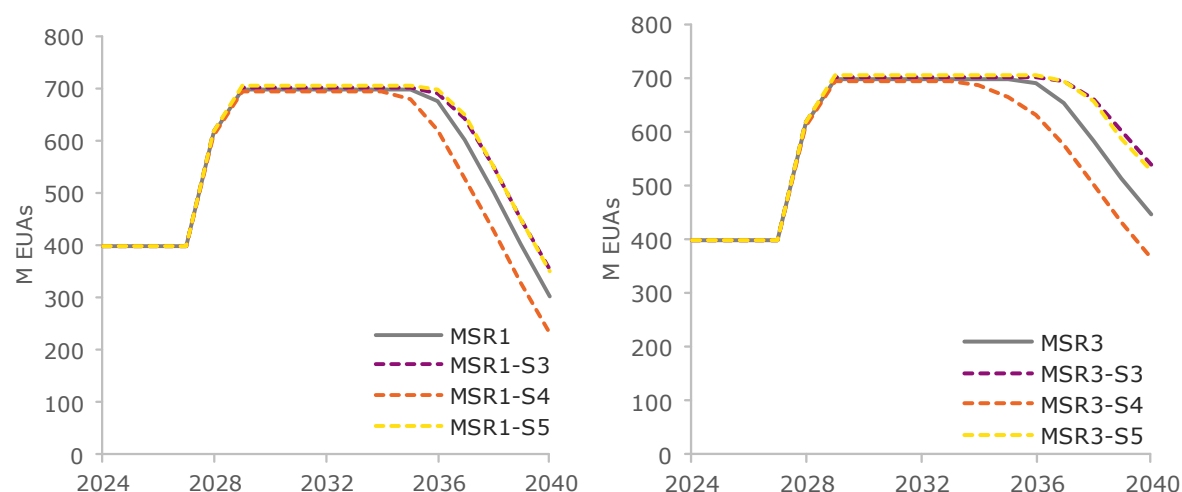
Figure 42: MSR sensitivity analysis – S3 to S5 - TNAC evolution for MSR1 (left) and MSR3 (right)



Source: Own visualisation derived from the POLES-Enerdata model

The MSR is adjusting well to the 3 shocks and supports market stability by releasing EUAs earlier or later in the system (depending on the direction of the shock). These adjustments can be observed by looking at the stock of EUAs in the MSR, presented in Figure 43. They lead to different remaining stocks by 2040, ranging from 230 to 350 million EUAs in MSR1 and from 370 to 540 million EUAs in MSR3.

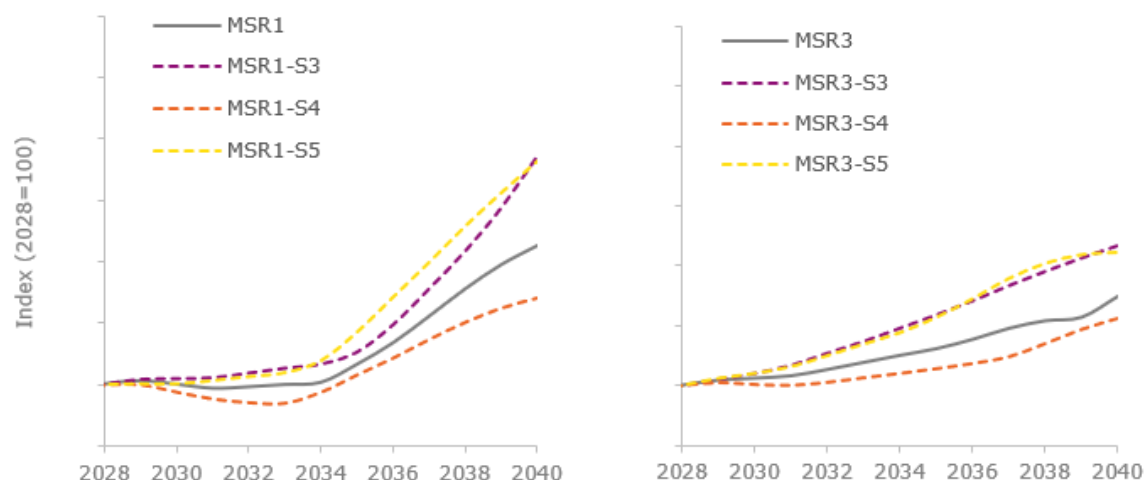
Figure 43: MSR sensitivity analysis - S3 to S5 – stock of EUAs in the MSR for MSR1 (left) and MSR3 (right)



Source: Own visualisation derived from the POLES-Enerdata model

In terms of the EUA price, structural shocks S3 to S5 lead to substantial impacts, as compared to the base MSR1 and MSR3 runs. The structural deviations in the supply-demand equilibrium lead to significantly higher price trajectories for S3 and S5, and lower price trajectories for S4, in both cases (as shown in Figure 44)

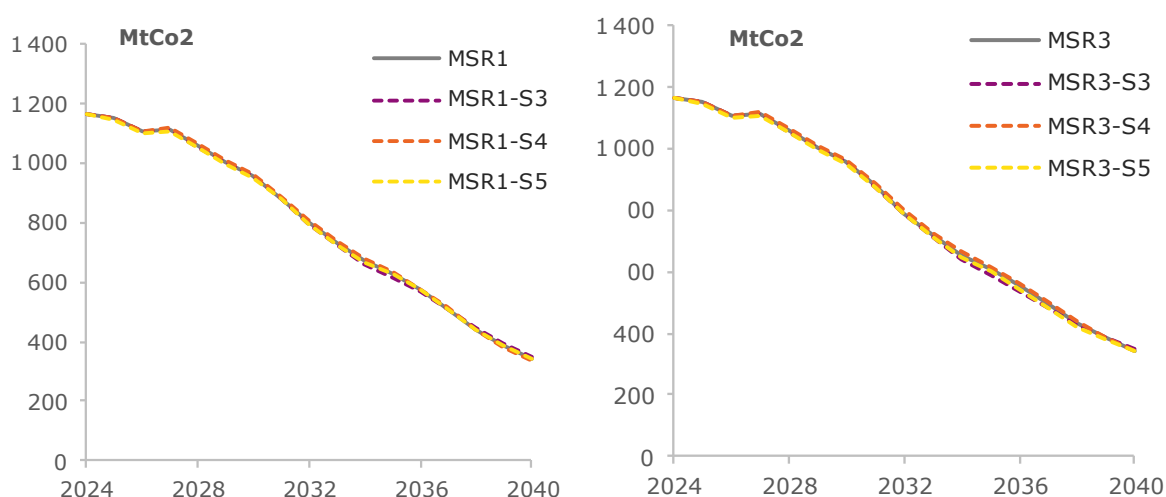
Figure 44: MSR sensitivity analysis – S3 to S5 – EUA indexed price for MSR1 (left) and MSR3 (right)



Source: Own visualisation derived from the POLES-Enerdata model

As shocks are implemented as an exogenous net demand for EUAs, i.e. inelastic to the price, and with an important magnitude, it is expected that they induce significant variations to the price trajectory. In the case of MSR1, the deviation between the base case and the shock sensitivities increases progressively up to 2035, and then quickly increases. With the MSR3 design instead, the price deviations are more progressive over the whole period, with smoother index curves by 2040.

Figure 45: MSR sensitivity analysis – S3 to S5 – EU ETS emissions for MSR1 (left) and MSR3 (right)



Source: Own visualisation derived from the POLES-Enerdata model

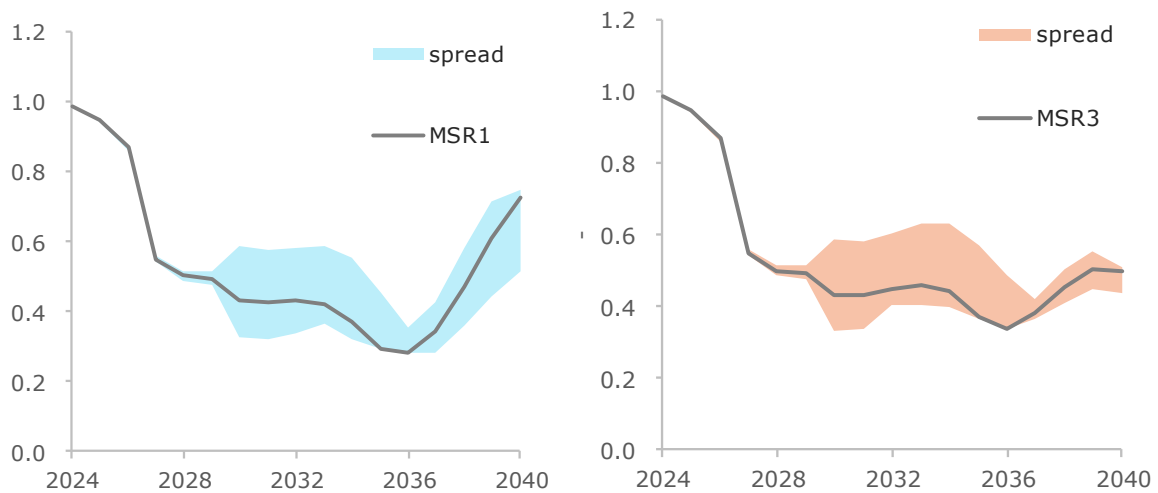
Finally, the impacts of S3 to S5 shocks on EU ETS-covered emissions is relatively limited, as illustrated in Figure 45. Under both MSR1 and MSR3, resulting emissions remain close to their respective base runs, with a difference in cumulative emissions over 2025-2040 of less than 1%. By 2040, maximum differences in emissions are about 11 MtCO₂ in MSR1 and 4 MtCO₂ in MSR3.

Resilience of candidate MSR measures to shocks

Both MSR1 and MSR3 designs enable the MSR to operate in the good direction when presented with shocks, as shown above. To conclude on their respective performance in terms of system resilience, a set of relevant indicators is examined below.

First, Figure 46 shows the maximal spread (over shocks S1 to S5) of the TNAC-to-emissions ratio for both MSR1 and MSR3. Up to 2037, the two measures present similar spreads, with values contained between 0.3 and 0.6, sign of a healthy surplus. In MSR1, the values then rise quickly and get mostly out of this zone by 2040 (0.52-0.75), which shows some limits of this measure already by 2040. On the other hand, MSR3 sees its ratio staying in the 0.3-0.6 zone, with a narrowing spread at the end of the period, which shows higher resilience. This design indeed manages to get the ratio to similar values in the presence of very different shocks.

Figure 46: MSR sensitivity analysis – TNAC-to-emissions ratio, maximum spread across S1-S5 – MSR1 (left) and MSR3 (right)



Source: Own visualisation derived from the POLES-Enerdata model

Regarding indexed prices over difference shock scenarios, while MSR1 satisfactorily manages to maintain a relatively close price spread up to 2034, it fails to contain divergences in the price trajectories obtained in different shock by 2040. The more elaborated design tested in MSR3 performs better, with smoother price trajectories and a smaller 2040 spread.

In addition to the TNAC-to-emission and price spreads discussed above, two additional items are brought forward. First, the convergence of the TNAC back to the no-shock trajectory, a few years after the shock is introduced, is a good indicator of the MSR's ability to adjust to specific contexts. This convergence is noticeable in the case of MSR1, although not entirely, and is further observed in MSR3. Second, the convergence of emissions back to their original trajectory is an interesting indicator to monitor. In that regard, both MSR1 and MSR3 lead to satisfactory alignments in emissions in the presence of shocks.

The sensitivity analysis focuses on MSR1 and MSR3 as these measures demonstrate greater viability regarding liquidity under baseline conditions.⁹² Testing shock scenarios serves to assess the robustness of viable MSR designs rather than further diagnosing the structural weaknesses already identified in MSR0+ (reserve depletion) and MSR2 (locked reserve

⁹² “Baseline” in this section denotes the no-shock scenario for the respective measure (MSR1 and MSR3) and is distinct from baseline references in the report.

dynamics). Five shock scenarios are examined (Appendix 1 for detailed descriptions). The shocks are introduced in the model as exogenous adjustments to the net supply-demand balance, impacting market operations through either additional demand or additional supply of EUAs. S1 and S4 increase the net supply-demand balance, while S2, S3, and S5 decrease it.

Under shock profiles S1 and S2, both MSR1 and MSR3 exhibit the expected and directionally appropriate liquidity responses as demonstrated by the evolution of TNAC in Figure 38 and Figure 39. S1's increased net supply-demand balance (loosening) elevates TNAC trajectories in both measures and delays releases. MSR3 exhibits greater TNAC sensitivity. It is important to note that despite the relatively large negative shock to the demand for EUAs under S1, no intakes are triggered even with the dynamic and declining thresholds of MSR3.

Conversely, S2's tighter net supply-demand balance (tightening) accelerates TNAC decline, triggering earlier releases in both measures that are cumulatively larger over the assessment period. Reserve stocks respond accordingly: under S1, MSR3 preserves approximately 600 million EUAs by 2040 versus MSR1's 450 million EUAs, while under S2 both measures experience faster depletion though MSR3 retains a higher stock in 2040. The differential reserve preservation reflects MSR3's larger baseline stock and adaptive release calibration, providing greater post-2040 intervention capacity across both demand scenarios.

S3, S4, and S5 produce more modest liquidity impacts than S1 and S2, with TNAC trajectories remaining closely aligned to baseline conditions in both measures. As with S1 and S2, these shock scenarios do not trigger intakes and release dates move forward or backward as expected by a few years relative to the respective baselines. S4, which increases the net supply-demand balance, exhibits the most pronounced effect on reserve dynamics. Under S4, both MSR1 and MSR3 experience accelerated depletion from the mid-2030s, with MSR1 reserves declining to approximately 250 million EUAs by 2040 compared to 300 million EUAs under baseline, while MSR3 maintains approximately 370 million EUAs versus 460 million EUAs under baseline. S3 and S5, which decrease the net supply-demand balance, produce marginally slower reserve depletion. MSR stocks in 2040 are moderately above baseline in both measures. The consistent TNAC evolution across S3-S5 scenarios despite varying shock directions reflects the relatively smaller magnitude of these perturbations compared to S1 and S2. MSR3's larger baseline reserve provides sustained intervention capacity advantage across all three scenarios, though the S4 combination demonstrates that sufficiently strong supply-side shocks can materially compress this buffer.

ANNEX 9: INDUSTRIAL DECARBONISATION BANK

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1. INTRODUCTION

Abating industrial emissions in the EU represents important challenges. So far, progress has been moderate (17% reduction in 2023 compared to 2015⁹³), through energy efficiency and fuel switch and partly due to closure of industrial installations or reduction of the industrial output. The EU ETS evaluation indicates that in many industrial sectors (e.g. steel, cement or chemicals), the carbon price signal (together with regulatory framework) has not been strong enough to drive the transformational change. Reaching the 2040 climate target and climate neutrality in 2050 will require deep GHG emissions reductions of 70 to 85% by 2040 (compared to 2015) across all industrial sectors⁹⁴. Achieving these reductions while expanding and modernising the EU's industrial base will demand **significant capital investments** (CAPEX) in decarbonisation - see section 'Investment needs and system costs' in Annex 8. These investments will also require **even larger operational expenses** (OPEX)⁹⁵. Investments in decarbonisation technologies are essential to enable decoupling of the industrial emissions from the industrial output.

The **carbon price signal** from the EU Emissions Trading System (EU ETS) together with Free Allowances phase-out and Carbon Border Adjustment Mechanism (CBAM) phase-in, already provide strong incentives for industrial decarbonisation, while protecting against carbon leakage. In addition, carbon pricing works hand-in-hand with **regulatory measures** such as targets and requirements on energy efficiency, renewable energy or decarbonised mobility and industry. However, many investments for decarbonisation, in particular in energy-intensive industries (EIIs), today still **lack a business case, at current and expected carbon prices and regulatory measures** still need time to be fully implemented and firmly influence investment decisions. This is one of the central topics of the 2024 Draghi report. In reaction to growing carbon price, industry can respond by reducing output especially if the demand for 'green' products is low or uncertain. Upcoming initiatives concerning lead markets and green premium that they can offer will be alleviating this risk but in the short term the cost gap ('green' vs fossil technologies) needs to be covered.

In this context, the Innovation Fund (IF), whose first call for proposals was launched in 2020, has established itself as the key EU instrument to support **commercial demonstration/first-of-a-kind** (FOAK) deployment of innovative low-carbon technologies in energy-intensive industries (EII), renewables, energy storage and mobility. It has also successfully tested support mechanism for the roll-out of more mature decarbonisation technologies with auctions for RFNBO hydrogen and decarbonised industrial process heat. With over 200 projects in the portfolio, it has proved to **play a crucial role** in accelerating technological progress, bankability and deployment of innovative climate solutions across the EU, particularly for **high-risk, capital-intensive, first-of-a-kind/early commercialisation industrial decarbonisation projects** that private instruments cannot support at comparable scale or risk tolerance. At the same time, its continued oversubscription of call budgets (up to 20 times and on average nearly 5 times for all calls for proposals) highlights the private sector's interest in investing in decarbonisation projects, provided a **viable business case is enabled by subsidies that complement regulatory and carbon pricing policies**. In recent years, the IF has also started to address more mature technologies via pilot and targeted auctions for renewable and electrolytic low-carbon hydrogen and electrified and direct-renewable process heat. Going

⁹³ Eurostat

⁹⁴ Impact assessment accompanying the 2040 Climate Target proposal. SWD(2023) 63 final.

⁹⁵ Estimated at approximately EUR 300 billion annually, covering essential resources such as clean electricity, and hydrogen in Impact assessment accompanying the 2040 Climate Target proposal. SWD(2023) 63 final.

forward there is a need to scale up this type of support in order to ensure a competitive selection of projects for cost-effective support of decarbonisation technologies.

As the EU ETS cap becomes more stringent, continued innovation support with broad sectoral coverage and capacity to address both technical and scale-up risks remains essential to address the emissions most difficult to abate and to further develop and diversify low-carbon solutions across EU industry⁹⁶. However, current **IF resources are expected to be fully committed by 2028**, resulting in a temporary ‘void’ (2028–2030) in support from EU ETS revenues to industrial decarbonisation until the next programming period begins.

In absence of the IF, there is **no EU funding instrument that has the necessary resources** to provide the necessary **volume and duration** of subsidies to support innovation and, even more so, for the broad deployment of industrial decarbonisation technologies. In part, this role could be taken up by the future European Competitiveness Fund (ECF), proposed as part of the next Multiannual Financial Framework. The ECF is proposed to allocate EUR 26.2 bn to support for Clean Transition and Industrial Decarbonisation out of the total EUR 234 bn budget. However, the ECF’s clean transition window is expected to have a broader scope than the current IF and are still dependent on the outcome of the legislative process. State Aid could be another source of funding, given streamlined requirements and procedures recently enacted in the Clean Industrial Deal State aid Framework (CISAF)⁹⁷. However, national approaches will remain inherently fragmented, lacking the ability to exploit the economies of scale and efficient allocation of resources the single EU market can provide, and will be limited by national fiscal constraints.

Already in 2024, the Draghi report⁹⁸ outlined very concrete recommendations as regards industrial decarbonisation:

- (1) Reinforce relevant funding support for the decarbonisation of EIIs, starting by earmarking ETS revenues.
- (2) Simplify, accelerate and harmonise subsidy allocation mechanisms. Adopt common instruments across Member States, such as the European Hydrogen Bank and Carbon Contracts for Difference.

This is why the **Clean Industrial Deal (CID) Communication**⁹⁹ announced the **Industrial Decarbonisation Bank (‘IDB’)** to address the scale-up and roll-out of more mature industrial decarbonisation projects (notably in EIIs) across all Member States:

*The Commission will **propose an Industrial Decarbonisation Bank** aiming for **EUR 100 billion** in funding based on funds in the Innovation Fund, additional revenues resulting from parts of the ETS as well as the revision of InvestEU (...). The Industrial Decarbonisation Bank will **maximise emission reductions**. It will use ETS allowances reserved for this purpose as part of the architecture of the EU ETS to support projects*

⁹⁶ The IF evaluation report also recommends that a more focused support for innovative decarbonisation projects could be achieved by application and evaluation process simplification, introduction of completion bonds/penalties, award criteria revision, possibility to cover a larger share of the funding gap, support for existing investments, targeted support for SMEs and start-ups.

⁹⁷ Communication from the Commission – Framework for State Aid measures to support the Clean Industrial Deal (Clean Industrial Deal State Aid Framework) (C/2025/3602)

⁹⁸ European Commission, *The Future of European Competitiveness: Part A: A competitiveness strategy for Europe*, 2024, https://commission.europa.eu/document/download/97e481fd-2dc3-412d-be4c-f152a8232961_en?filename=The%20future%20of%20European%20competitiveness%20_%20A%20competitiveness%20strategy%20for%20Europe.pdf.

⁹⁹ Communication from the Commission – Clean Industrial Deal: A joint roadmap for competitiveness and decarbonisation COM/2025/85 final

*with carbon emission reduction as a metric to enable technology-neutral support across industrial sectors, **including through carbon contracts for difference**. It will be designed to ensure a **competitive selection and a fair distribution of support across Member States**. It will complement the ETS price signal and help bridge the funding gap in both capital and operational expenditures.*

The proposal for the IDB in the CID makes a clear **commitment to use a dedicated part of EU ETS allowances to support the business case for clean industrial transformation of the EII**. This model has worked successfully for the IF as well.

The endowment of the IDB proposed in the CID is **EUR 100 bn**. If IDB supported the industrial decarbonisation projects at the intensity of between 50 to 100 EUR/tCO₂ (on top of the EU ETS price), over 10 years, it could address between 40% and 20% of the industrial emissions in the EU (200Mt – 100Mt CO₂). Beyond this very simple indication, the sections below provide a dedicated analysis on expected impacts. Comparing the IDB budget to the total investment needs in industry (EUR 30-50 bn/year) as well as their operational expenditure (around EUR 300 bn/year), the IDB represents only a fraction of expenditure. This is justified considering that it should only cover projects ‘funding gap’ and not the costs that can be covered by the market revenues or private investors and that there will be other instruments supporting the transition: ECF, State aid and Free Allocation.

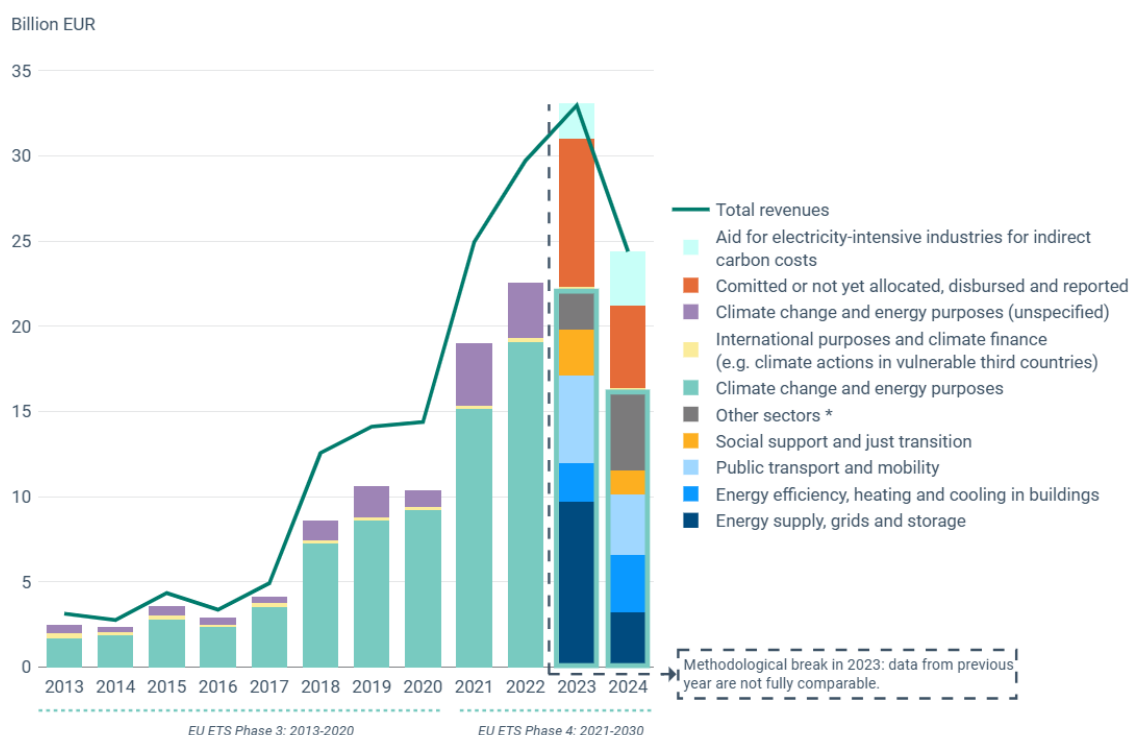
Following the Clean Industrial Deal and meeting of the EU leaders in Alden Biesen on deepening the single market, reducing economic dependencies and boosting competitiveness, at the March European Council the ‘Investment Booster’ was announced¹⁰⁰. The ‘Investment Booster’ will be the first stage of the IDB. Starting ahead of 2030, 400 million ETS allowances will finance industrial decarbonisation investments with focus on speed and solidarity. Speed will be ensured as support will become available on a ‘first come, first served’ basis. Solidarity will ensure guaranteed access to a share of this financial support for lower-income Member States.

The source of the endowment of the IDB (including the ‘Investment Booster’ phase) and the continuation of the IF can build on the existing EU ETS distribution which assigns a fixed volume of allowances from Member State auctioning and from Free Allocation (including from the phase in of CBAM) or, alternatively, from a fixed share of the EU ETS cap which would ensure a more balanced contribution. The sourcing based on a share of the EU ETS cap would alleviate the dependency on the allowances from the CBAM phase-in and would allow a stronger Member State component in the IDB set up. It is clear from the EU ETS use of auctioning revenues reports that currently a very small¹⁰¹ share of the EU ETS revenues is used to support decarbonisation of EIIs. The IDB could offer a structural solution for returning the EU ETS revenues to the EII through investment support.

¹⁰⁰ https://ec.europa.eu/commission/presscorner/detail/en/statement_26_663

¹⁰¹ EEA, see: <https://www.eea.europa.eu/en/analysis/indicators/use-of-auctioning-revenues-generated>

Figure 1: MS auctioning revenues and reported usage (in billion EUR)



Source: EEA

The IDB could use different allocation mechanisms (e.g. auctions, administratively set schemes) to award support in different forms such as: Regular grants, Carbon fixed premia (CFP), Carbon Contracts for Difference (CCfD), fixed or variable premium per unit of green product credits or other types of support – see different options assessed in Section 3. With a budget of EUR 100 billion in funding, the IDB could significantly contribute to reducing industrial GHG emissions; leveraging private investment to modernise the EU industrial base and creating jobs; and boosting industrial competitiveness, especially if combined with stronger EU industrial policy – see impacts assessed in Section 3.4.

Additionally, the CID Communication indicates that a support instrument for CBAM goods at risk of carbon leakage, which can promote decarbonisation efforts and help maintain competitiveness. In view of the increasing rate of the CBAM phase-in and the proportional Free Allocation phaseout rate, a permanent solution for the period after 2030 is needed, which can leverage CBAM resources assigned to the IDB, as well as benefit from the Fund's governance and allocation mechanisms and forms of support. The IDB's support mechanisms should be adequate for the CBAM sectors; a consolidated approach (in contrast to a 'patchwork' of fragmented and overlapping instruments) would increase the impact of public spending and be more accessible for industry across EII sectors.

With the IDB addressing the scale-up and roll-out in the EIIs as well as the specific needs of the CBAM sectors, the **IDB would keep its key focus** on addressing technical and scale-up risks of **innovative technologies** to a **broad sectoral coverage** (EIIs but also renewables, energy storage, clean tech-manufacturing, buildings, mobility). Both programmes would have distinct scopes, minimising the risk of overlaps, preventing 'forum shopping' by the projects and offering tailor-made solutions for all stages of the technology development, for all relevant sectors. Importantly the entire investment journey from R&I to industrial deployment of the EIIs is also proposed to be covered under the European Competitiveness Fund (ECF). The IDB

will be therefore placed within the governance of the future ECF to ensure that both funding instruments are complementary and operate with synergies notably when ECF work programmes are developed.

Importantly, the rollout of the decarbonisation technologies in EIIs will lead to a significant increase in electricity consumption and as a result an expansion of power generation capacities and infrastructure will be needed as described in the modelling work underpinning the climate neutrality scenarios. Power generation expansion and decarbonisation will also bring the investment needs. Innovative clean power generation technologies could be supported under the continuation of the Innovation Fund as well as ECF and clean power rollout could be supported under the ECF, National and Regional Partnership Plans, Modernisation Fund as well as State aid. The IDB, while focusing on the EIIs investment, should also ensure that decarbonisation projects foster the broader energy system integration. As example of such approach is the design of the IF auction for process heat decarbonisation that included the electricity consumption requirements¹⁰².

As the EU advances on the climate neutrality pathway, technologies currently funded by the IF will have to be deployed more widely and at even larger scale (e.g. e-fuels, CCS, green steel) and with the technologies proven, public support could mostly address the commercial risks. At the same time, the IF will be needed to **‘go the last mile’** of the decarbonisation effort with technologies that are currently at low technology readiness levels (e.g. Direct Air Capture, electric cement kilns, alternative materials to steel, cement or chemicals) and yet are essential to achieve the EU’s net-zero objective. The IF could also bring **alternative technologies to those known today**¹⁰³ to maturity that **could be more cost-efficient, better abate GHGs or better diversify the technology portfolio** to increase the resilience of the EU (e.g. in case there is a scarcity of some essential components/raw materials necessary for them). Such funding mechanism is essential for the EU to secure **technological leadership** and building the basis for **competitive advantage** on the global markets. While the proposed ECF also targets this stage of the technology development of the decarbonisation technologies, its resources will be allocated across multiple sectors and policy objectives, in accordance with work programmes, hence the IF that recycles EU ETS revenues back to ETS sectors and has a dedicated focus on innovative decarbonisation projects should continue.

The rationale to continue the IF is also the clear conclusion from the IF Evaluation that is attached to the ETS Directive revision proposal. The evaluation clearly states that the Fund’s attractiveness stems from its unique position to bring innovative low-carbon technology to commercial application (crossing the ‘valley of death’) and to overcome technical, commercial, regulatory, and infrastructural risks. The Fund’s additionality demonstrated in the evaluation report is very high.

While it is too early in the Fund’s implementation to draw the conclusion on the Fund’s efficiency in reducing GHG emissions, the expected GHG emission avoidance is very large. In addition, supported projects represent a diverse portfolio across sectors and technologies, driving large-scale industrial decarbonisation and the deployment of key mitigation technologies. The geographical balance of the IF portfolio is also constantly improving.

¹⁰² See the Terms and Conditions of the heat auction here: https://climate.ec.europa.eu/document/download/b55d8315-2eef-4618-aa4c-75f72abb4e95_en?filename=news_20251010_tc_heat_auction_en.pdf

¹⁰³ Further technologies may also emerge from current research work as indicated in the IEA reports, see: <https://www.iea.org/reports/clean-energy-innovation>

Finally, the IF has demonstrated high external coherence with EU climate and industrial policies. Its flexible design demonstrated a high degree of adaptability to future policy and responsiveness to market realities, based on a lean and efficient governance model, allowing it to remain highly relevant to evolving policy priorities and confirming its strategic role in delivering EU decarbonisation objectives.

2. SCOPING

2.1. Problem definition

The **structural problem** is that existing carbon price signal and perception of its future developments together with regulatory measures are **not sufficient on their own to firmly** enable the business case for investments in decarbonisation technologies for industries. This is for example illustrated in this Bruegel report¹⁰⁴ which indicates clearly the lack of progress in deployment of decarbonisation solutions in energy intensive industries (notably steel, cement, chemicals). Industrial sectors continue to face significantly higher costs for producing low-carbon products, often due to lack of economies of scale¹⁰⁵. In the steel and cement sectors, estimates suggest that procurement cost for low-carbon steel could range from around 33% in a low-cost scenario to as much as 70% in a high-cost scenario, compared to conventional technologies and considering current CO2 costs¹⁰⁶. Public **financing could help bridge this gap** and create solid business case for the green products but is currently **not available at a necessary scale, duration and effectiveness**.

Innovative decarbonisation technologies, which are at first- or second-of-a-kind stage, face high technological and commercial risks, long investment cycles, infrastructure barriers and require significant upfront capital investment. **Decarbonisation technologies**¹⁰⁷ have a funding gap throughout their operation or are perceived to have a funding gap at currently anticipated carbon price levels and therefore will not attract sufficient private investment **enabling scale-up or roll out**. There are several drivers of this problem, illustrated by the figure below.

¹⁰⁴ Bruegel, 2025. “Clean industrial transformation: where does Europe stand?”, <https://www.bruegel.org/sites/default/files/2026-04/clean-industrial-transformation%3A-where-does-europe-stand%3F-10687.pdf>

¹⁰⁵ Mission Possible Partnership (MPP), E3G and the Industrial Transition Accelerator (ITA) (2025). Building the EU’s Clean Industrial Future: Unlocking Investment through Lead Markets.

¹⁰⁶ VUB Brussels School of Governance (2024). Public procurement of steel and cement for construction, assessing the potential of lead markets for green steel and cement in the EU.

¹⁰⁷ Some projects have funding gap in early years that can be compensated by revenues in later years (that could be addressed by loans or equity-taking).

Figure 2: Problem definition

	Private sector issues	Public sector issues
Problem drivers	Private investment in industrial decarbonisation are held back by regulatory uncertainty, technology risks and uncertain price outlooks (carbon, electricity, gas) Number of market failures persist: missing risk markets, ETS not fully internalising the climate change damage, short-termism of investments, unfair global competition	Public funding (EU, national) available is not commensurate with investment challenge in terms of volume (EUR) and duration (years) National and EU public funding programmes are often rigid, complex, fragmented and overlapping. Public funding available is not used in the most effective manner, i.e. maximising the success rate of the projects. Public funding available is not used in the most efficient manner, i.e. achieving the best GHG abatement/spending ratio. State aid does not bring the benefits of the EU-level competition
Problem definition	There is no business case for majority of decarbonisation technologies in the industry. Industrial decarbonisation projects still have a funding gap and are considered too risky for the private sector.	Private sector needs to carry out the bulk of investments, public sector participation can catalyze it. Current public funding programmes are not sufficient to address this challenge, lacking scale, necessary duration and the effectiveness
Consequences	Private investments alone will not deliver the industrial decarbonisation on the scale needed for climate neutrality	The current size, duration and effectiveness of the public funding will not be sufficient to catalyse the private sector to meet the investment challenge.
	Industry will delocalize outside Europe Carbon prices will rise to politically unsustainable levels and EU will miss the net-zero trajectory	

As illustrated above, there are the two problem drivers which relate to the **private sector**:

1. Private investment in industrial decarbonisation is held back by a perceived **regulatory uncertainty in terms of post-2030 climate and energy framework, technology risks and uncertain price outlooks** for carbon price, energy vectors (notably electricity), raw materials/feedstocks and, to lesser extent, equipment costs. This reluctance to invest will delay and increase the costs (e.g. because of higher cost of equity or debt) for the decarbonisation of EII, particularly if financing is left solely to the private sector.
2. A **number of market failures** is still present (missing markets for risk sharing/insurance, need for spillover effects, carbon price not fully internalising the climate change damage, short-term nature of investments decisions). In addition, **European goods exported into global markets** can be exposed to carbon leakage pressure from producers in countries that do not face comparable carbon pricing. Similarly, investments in decarbonized technologies may also happen elsewhere if investment conditions and long-term outlooks are not positive and supportive in the EU.

Other problem drivers concern the **public sector**:

3. **Public funding** (EU, national) available is **not commensurate with the EII decarbonisation investment challenge** in terms of volume (EUR) and duration (years). Lack of such public funding undermines the private sector willingness to commit their part of resources as private actors need to ensure the return on investment over the entire project lifetime. Capital markets are not different from other markets in terms of competition for resources: if there are other activities which are less risky/with better return than industrial decarbonisation projects, the scarce resources will be committed to those other activities. Public support is needed to de-risk private investment and bring the risks/returns to the levels of other sectors that compete for investments.

4. Public resources are scarce; there are many competing claims on them (e.g. defence) so they should be used **effectively** (making sure the industrial decarbonisation projects materialise and deliver GHG abatement).
5. Public resources should be used in **the most efficient manner** (i.e. with the largest abatement achieved per each EUR spent, notably through a high leverage effect of private investment and smart risk-sharing). While State aid is a very efficient way of supporting decarbonisation projects (thanks to a number of safeguards against overcompensation), it does not bring the **benefits of EU-level competition that the EU-level instruments can bring** (as also highlighted in the recommendation of Draghi report) and does not provide support in all MS. The benefits of the EU-level competition are clearly seen in the results of the IF so far, which has a very high leverage of the private capital (4.5 multiplier effect) and abatement proportional to subsidies.
6. National investment programmes are often rigid, complex and fragmented. With the exception of IPCEI and RRF, national funding programmes do not fully exploit the benefits of **the EU single market** (leading to subsidy races, a patchwork of requirements to comply with, national not EU champions supported etc.). The IDB, by working at a scale on the EU level, with streamlined procedures and opening ‘as a service’ feature developed for the Innovation Fund to channel also State aid¹⁰⁸, could help to make the EU funding landscape less complex.

It is clear that EU-level public funding that reacts to such market failures cannot simply replace the private sector. Instead, it can ‘catalyse’ the private investment, act as ‘seed’ funding and mitigate some of those investment risks. To achieve the best outcome, public sector funding needs to provide support in the most **effective (i.e. will supported projects materialise and achieve the expected GHG abatement)** and **efficient manner (i.e. achieving the best rate of GHG abatement to spending)** by leveraging the private investment. Considering that private sector tolerance of higher risk is aligned with expected profits, there can be a **potential trade-off between effectiveness and efficiency**. A very efficient scheme that maximises the participation of public funding, will necessarily push more risks towards the private sector and thus become less attractive for private sector. Even if public funding is secured by an efficient project, if that project faces difficulties, i.e. unexpected cost increases, it might be abandoned by private investors - putting at risk the effectiveness of support (the IF evaluation early findings suggest that 7 % of IF projects have terminated prematurely due to adverse changes in market fundamentals or corporate decisions that were not anticipated in the project proposals and could not be detected during the evaluation process).

Consequently, a balance needs to be struck and **different ways of boosting efficiency can be explored**, such as drawing on the benefits of the EU-level competition, adapting dynamically to market conditions (e.g. by support in the form of variable premiums), safeguarding against the overcompensation (e.g. upside sharing mechanisms via a CCfD scheme), and public support taking the form of guarantees rather than grants to achieve the best possible leverage

¹⁰⁸ Because of the limited budget available, the IF calls have been largely oversubscribed. Due to high competition many projects do not obtain IF funding despite meeting the quality requirements in the IF evaluation. To support those projects with alternative means, MS can set up national schemes to grant national funding. In this way, the national authorities can use the IF selection process ‘as a service’. This reduces the national checks to the minimum and maximise synergies between the IF and national funding possibilities. The results of IF assessment are passed on to the national authorities and MS would remain responsible for disbursing the national funding and for monitoring the project implementation. ‘As-a-service’ has been operationalised for three IF auctions so far and new streamlined rules for it have been presented for ‘regular’ grants in the CISAF.

of private capital. In essence, the necessary remuneration for the private sector's investment in riskier projects needs to be ensured so that they can have a solid business case and materialise.

In absence of large (in terms of budget and duration) EU funding mechanism driven by the public sector, **private investments alone will not deliver the industrial decarbonisation** at the scale and within the time needed for achieving climate neutrality by 2050 and investments will be fragmented amongst the Member States. Certain technologies will not be deployed with a risk to resilience of the EU economy and its competitiveness. Lack of or delayed investments in industrial decarbonisation will lead to industry falling behind competitors who adopt cleaner technologies, potentially losing market share to more sustainable businesses, creating a technological lag that can result in industries being less adaptable to future disruptions and demands, lose out on opportunities for growth and leadership in emerging sectors and increase emissions contributing significantly to climate change and the EU missing the net-zero target as a result.

Affected stakeholders are **all economic actors** as they all consume products of industry (e.g. fertilisers needed for agriculture are produced by chemical industry, services rely on electricity that together with industry is in the EU ETS) and especially in **the industry sector** that will be confronted with increasing carbon prices and growing pressure of the international competition. Also, **society as a whole** is affected (as all society actors will consume products of industry, some will work in the industry, some will have part of their pensions linked to performance of industrial stocks and all will be affected by climate change).

The **action to address this problem is best to be taken on the EU level**. The Draghi report highlights that the differences in legislations between the EU and other countries aimed to reduce greenhouse gas emissions create near-term investment needs for EU companies that their competitors do not face. For example, the report states that for the four largest EIIIs (chemicals, basic metals, non-metallic minerals and paper), decarbonisation is projected to cost EUR 500 billion overall over the next 15 years. In this critical situation, underinvestment by the private sector remains a persistent challenge in the EU, affecting a broad spectrum of investment types, including infrastructure, innovation, green and digital transitions, and industrial capacity. Despite a high level of private savings, the investments into are lagging behind¹⁰⁹.

Fostering decarbonisation investments advancing EU competitiveness needs to be coordinated at EU level to be truly effective. To decarbonise industry, the EU can develop a cohesive internal market for net-zero technologies and low-carbon products, enabling economies of scale, reducing costs and emissions, and fostering efficient deployment of new technologies across the single market. Climate change is a trans-boundary problem, the solution to which has important internal market dimensions, and EU action can effectively complement and reinforce regional, national and local action. Pooling resources at the EU level can maximise the impact and added value of investment on the ground, and lead to economies of scale in organising competitive selections of the best projects, leading to more impactful investments, reducing administrative costs, increasing efficiency by avoiding multiplication, fostering cross-border investments, and therefore making public funding more cost-effective than if each Member State acted independently.

By creating a strong and predictable business case for decarbonisation technologies across the single market, it strengthens the EU international competitiveness in industrial decarbonisation

¹⁰⁹ SWD/2025/555 final accompanying the proposal for a Regulation of the European Parliament and of the Council on establishing the European Competitiveness Fund ('ECF').

technologies, while supporting the preservation and transformation of energy-intensive industries and their jobs within the EU.

An instrument designed and implemented at EU level can effectively avoid intra-EU competition between national support schemes, which could otherwise lead to market fragmentation and subsidy races. Differences in financial capacity, economic structure and industrial profiles mean that some Member States are less able to finance large-scale decarbonisation investments, so relying on national financing alone would risk widening disparities. An EU-level IDB type instrument can help ensure a level-playing field between market participants by channelling support towards the most cost-effective and efficient decarbonisation solutions, irrespective of their location, and by enabling projects to reach scale at EU level. This avoids proliferation of smaller, fragmented national schemes that could distort competition, increase administrative complexity and ultimately lead to higher overall costs for achieving climate objectives.

Acting at EU level enhances the coherence of investment by aligning support with EU wide strategic priorities such as climate neutrality, the accelerated roll-out of clean energy and electrification, with completed interconnections and grids, as well as clean manufacturing, competitiveness, energy security and high-quality employment, while ensuring fair competition for the best projects across Europe. It also supports high-skilled industrial jobs, facilitates knowledge transfer and delivers risk-reduction benefits that spill over to competitors and society at large, therefore justifying an EU-level instrument.

2.2. Objectives

In the medium term, the **general objective** of the IDB is to **enable the investments in the industrial decarbonisation projects, at the necessary scale** consistent with longer term (2040/2050) climate objectives. Enabling those investments will allow to decouple industrial output from GHG emissions and decarbonize the EU economy while enhancing strategic industrial capacities and thus competitiveness of the EU economy. Deployment of such industrial decarbonisation projects, especially if coupled with effective EU industrial policy such as lead markets requirements, can help boosting competitiveness of EU EII in the transition to a net zero-economy.

The specific objectives of this initiative for both private and public sector are as follows:

1. **For private sector: creating the business case for private investment** in the EU with public support counterbalancing the market failures, regulatory uncertainties and disadvantages compared to global competitors. This objective of creating the business case is the central element of the Clean Industrial Deal and the IDB can deliver it. In the longer-term perspective, the role of the IDB should diminish as industrial decarbonisation technologies are increasingly deployed on market terms. In the long term, all decarbonisation technologies should follow the footsteps of renewables in power generation that after years of subsidies are now competitive with fossil fuels in many regions without subsidies.
2. For the **public sector**: creating a public funding instrument with the following features:
 - a. with **sufficient budget and duration** that are commensurate with the investment challenge and the **funding gap** that industrial decarbonisation projects will still have. This instrument needs to be able to support the critical mass rather than a handful of industrial decarbonisation projects in Europe.
 - b. operating in a **simple and flexible** way and thus attractive for supporting projects in **EII sectors, technologies and company sizes in all Member States**

- (because all industrial players need to decarbonise). Operating in a simple manner, will also reduce the administrative burden for the Commission.
- promoting the large-scale deployment of low emission technologies in industry broadly speaking and including **sectors producing CBAM goods exposed to remaining risk of carbon leakage**
 - maximizing projects success rate** considering the inherent trade-off with cost efficiency as described above.

Achieving the general and specific objectives will contribute to a significant share of industrial decarbonisation, while supporting the resilience of the EU industrial base. The deployment of industrial decarbonisation projects will support the modernisation of the EU economy, reduce dependencies and import costs of fossil fuels, build ‘new engines of growth’ with local manufacturing of decarbonisation technologies and make the EU economy more resilient by producing more ‘local industrial products and diminishing dependencies on third countries. If this effort is paired with more ambitious industrial policy, the development of the internal market for industrial decarbonisation technologies can also increase competitiveness of the EU on global markets. The figure below illustrates the complete intervention logic.

Figure 3: Intervention logic

	Private sector issues	Public sector issues
Problem drivers	Private investment in industrial decarbonisation are held back by regulatory uncertainty, technology risks and uncertain price outlooks (carbon, electricity, gas) Number of market failures persist: missing risk markets, ETS not fully internalising the climate change damage, short-termism of investments, unfair global competition	Public funding (EU, national) available is not commensurate with investment challenge in terms of volume (EUR) and duration (years) National and EU public funding programmes are often rigid, complex, fragmented and overlapping. Public funding available is not used in the most effective manner, i.e. maximising the success rate of the projects. Public funding available is not used in the most <u>efficient</u> manner, i.e. achieving the best GHG abatement/spending ratio. State aid does not bring the benefits of the EU-level competition
Problem definition	There is no business case for majority of decarbonisation technologies in the industry. Industrial decarbonisation projects still have a funding gap and are considered too risky for the private sector.	Private sector needs to carry out the bulk of investments, public sector participation can catalyze it. Current public funding programmes are not sufficient to address this challenge, lacking scale, necessary duration and the effectiveness
Specific objectives	Create the business case for private investment, private support compensating for the market failures and uncertainties	Create a public funding instrument with sufficient budget and duration Create an attractive public funding instrument: - operating in simple and flexible way, - addressing all sectors, in all countries Create an attractive public funding instrument supporting sectors producing CBAM goods Create a public funding instrument that maximizes success rate and leverage of private capital
General objective	Investments in industrial decarbonisation happen at a scale, ensuring that carbon prices remain at acceptable level and industry stays in the EU. Industry decarbonises on along the net-zero trajectory	

2.3. Baseline

There is a clear need to provide EU funding support to both innovative and more mature decarbonisation technologies in the industrial sector. The Clean Industrial Deal announced **the IDB, aiming for EUR 100 billion in funding**, so that a sizable impact can be made on decarbonising the EU industry. The policy options assessed in this IA will look at possible ways to allocate the support by the IDB, the different forms of support and the possibilities to ensure geographical balance in providing this support.

The baseline assumes a continuation of the IF for the period 2031-40 using the existing IF instruments (‘regular’ calls for proposals, auctions and financial instruments¹¹⁰) and providing

¹¹⁰ IF can provide support via (1) ‘regular’ grants based on the evaluation of multiple award criteria and in form of the lump sum payments linked to reaching project’s milestones as early as of Financial Close and (2)

existing IF types of support ('classic grants' with lump sum payments, fixed premium grants linked to the low-carbon product output and loans) to a broad range of innovative decarbonisation technologies (beyond the EIIs). The IF would mostly address technology and scale-up risks. **The IDB should thus focus on addressing the scale-up and roll-out of decarbonisation technologies in the EIIs only** and address market risks of such technologies. The different scopes of the IDB and IF are proposed in the figure below.

The continuation of the IF should also address the European Court of Auditors' recommendation to simplify and improve project evaluation methodologies to ensure more accurate evaluation of financial and technological maturity of projects, and GHG emission reduction potential, as well as for increased flexibility on the project implementation timeline.

The options analysed in this IA concern only the **ways that the IDB resources can be used** to best serve the decarbonisation objective.

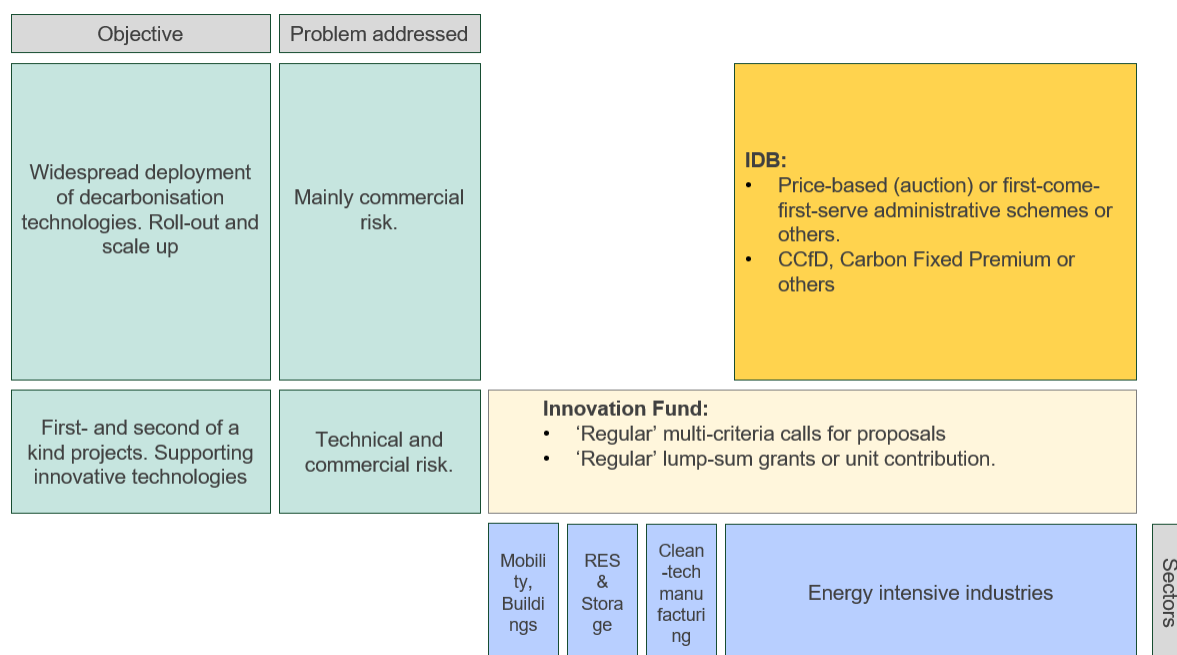
Furthermore, as part of the next Multiannual Financial Framework, the European Commission proposed a Regulation to establish the future **European Competitiveness Fund (ECF)**, with expected resources of EUR 234 billion to invest in strategic technologies and to benefit the entire Single Market. The ECF focuses on four windows, including the Clean Transition and Decarbonisation window (with proposed resources of EUR 26.2 billion for the period 2028-2034). The scope of this window is however much broader, in terms of objectives (not only decarbonisation but also other environmental objectives such as biodiversity and air, water and soil pollution), in terms of covered sectors (mobility, buildings, industry, agriculture, power generation), in terms of the kind of activities funded and the type of support (grants, loans and others). Continuation of the InvestEU programme is proposed to play a key role in the ECF delivery.

In the operation of both ECF and the IDB, a delineation should be sought to avoid the overlaps between the three programmes, 'forum shopping' by the projects and instead ensure that there is EU funding support for all stages of the technology development in the EU. While the final shape of the ECF will only be known at the end of the legislative process, complementarity will be ensured by IDB being placed in the ECF governance framework and by designing appropriate coordination mechanisms.

Likewise, **State aid** will continue to play a significant role in providing support for decarbonisation technologies but in a fragmented manner and without the full benefits of the EU-level competition. A promising way of bringing the benefits of the EU-level competition to national State aid is deploying 'as-a-service' feature, which was developed for the IF and should also be also enabled under the IDB.

auctions based on the price-only competition and in the form of unit cost contribution as of Entry into Operation and (3) financial instruments such as loans or guarantees.

Figure 4: Proposed scopes of the IF and IDB



The policy options in terms of possible allocation mechanism and form of support will be assessed against this baseline.

3. POLICY MEASURES

The figures below summarises the policy measures assessed that in turn are combined into policy options

Figure 5: Overview of policy measures

Options on IDB allocation mechanism	Options on IDB form of support	Options for IDB to ensure geographical balance
1. Multi-criteria call for proposals 2. Auctions 3. First-in, first served administrative scheme	1. 'Regular' grants covering the funding gap 2. Carbon Fixed Premium (CFP) 3. Carbon Contracts for Difference (CCfD)	1. EU-level competition, no geographical balance 2. National allocations 3. Part of the budget for EU-level competition and part of the budget for national allocations

Across the entire IA, three policy options have been developed for each area of actions that combine specific policy measures into meaningful 'packages' fully addressing problem drivers and related objectives. The options differ in the degree of change that they entail to the current system. *Policy option 1 Aligning ambition and improving incentives* includes the measures that, overall, lead to least change compared to policies in place in 2026. *Policy option 2 Aligning ambition and extending scope and corresponding incentives* includes measures that introduce

moderate innovations or changes to the system. *Policy option 3 Aligning ambition and extending scope and incentives comprehensively* alters most substantially how the system works.

For simplicity and comparability, all policy options focus on the same ‘good’ - carbon abatement be it as one of the award criteria in PO1 or through providing administratively fixed premium for each unit of abatement (PO2) or by providing Carbon Contract for Difference to mitigate the risks linked to carbon price changes.

Figure 6: Overview of policy options

Policy Option (1)	Policy Option (2)	Policy Option (3)
1. 'Regular' multi-criteria calls for proposals 2. 'Regular' grants covering the funding gap 3. EU-level competition and soft measures on geographical balance	1. Administrative schemes 2. Fixed premium, 3. Balance between national envelopes and EU-level competition	1. Auctions, 2. Carbon Contracts for Difference, 3. Strong national envelopes

3.1. Measures on how the support should be allocated

There are a number of allocation mechanisms that can be deployed and in most of the cases they can be chosen regardless of type of support to be allocated (see Section 5.2). The measures selected below represent the most common type of mechanisms, reflecting the experience of the IF and the Modernisation Fund as well as the national support schemes for the industrial decarbonisation.

Measure AM.1	Multi-criteria call for proposals
Measure AM.2	Auctions
Measure AM.3	First-in, first served administrative schemes

The following allocation mechanisms are not all mutually exclusive, e.g. auctions can be implemented as multicriteria-auctions and shortlists designed by MS may be subject to multicriteria assessments of the projects on the EU level.

3.1.1. Measure AM.1: Multi-criteria call for proposals

Example: IF current ‘regular’ calls for proposals

Multicriteria calls for proposals invite project developers across sectors to submit applications against a **defined number of award criteria**. Each criterion will be scored by evaluators and there is a possibility of weighting the criteria scores. On the EU-level, the Innovation Fund grant mechanism is a leading reference: it has used calls that score proposals on five award criteria i.e. GHG emission reduction, degree of innovation, project maturity, scalability, and cost efficiency - alongside call specific sub-criteria. This allocation mechanism allows selecting projects fulfilling a number of criteria and search for excellence across all of them.

Multicriteria calls provide a **high level of precision of the project selection** against tailored objectives. They are flexible instruments that can accommodate complex, integrated projects.

They also allow qualitative factors to be recognised, e.g. resilience or innovativeness, in addition to price.

Multicriteria calls are **particularly suitable for ‘regular’ grants** allowing to account for various parameters beyond pure cost-efficiency. As such, multi-criteria award procedures are focused on the quality and excellence of project proposals and imply an extensive project proposal by the applicant, an external expert evaluation team to ensure a thorough and independent evaluation and a strong role of the executive agency to ensure a project delivers on all aspects that were assessed. While the application and evaluation processes are very demanding, they do not guarantee that projects will be delivered. High level of competition also elicits projects with very ambitious deliverables/high cost-efficiency that in the end may not materialise. Certain attrition in the awarded projects portfolio can happen with the negative impact on the overall effectiveness of the scheme.

3.1.2. Measure AM.2: Auctions

Example: IF current auctions for hydrogen or heat

While auctions can include other award criteria (as in the above multicriteria approach), their primary intent is to **allocate support based on competition on price**. Therefore, auction-based support requires the definition of a specific, homogeneous auction good on standardised terms as fixed premia or variable premia, possibly in relation to a market price (e.g. fixed subsidy or variable subsidy on top of market price per one kWh renewable electricity produced/one tonne of CO₂ abated/one kg of RNFBO produced) so that bids can be ranked in a form of a merit order (with the lowest bids winning).

Auctions can be implemented on demand- or supply- side, as one-sided or double-sided auctions¹¹¹ and include a wide range of design choices. **Design choices** include bid components, volume/budget caps, baskets/topics, eligibility criteria, monitoring, reporting and verification arrangements and potential non-price criteria such as minimum greenhouse gas improvement, sustainability or resilience criteria. All these elements constitute ‘auction design’ and are often presented as **Terms and Conditions**¹¹². These Terms and Conditions need to be determined and known at latest when the auction opens to guarantee a transparent bidding process, with applicants having full knowledge on all their rights and obligations.

Auctions are widely used in MS (e.g. for renewables in power generation) and **at EU-level they have been pioneered under the Innovation Fund**. Auctions can be designed with very broad objective (i.e. maximising GHG abatement) or to specifically cater to the needs of individual sectors (i.e. subsidising a specific product output).

As auctions allow less of in-depth due diligence on the financial maturity, a recommendable feature of auction-based support is that it is **performance based**: payments are only made upon delivery of the auctioned good. For that reason, auctions are best suited for mature, ‘near market’ industrial abatement options where the technical risk is limited (and is borne by the applicant), but the market risk is still relatively high. A specific feature of auctions are ‘**bid bonds**’ or ‘**completion bonds**’ (a penalty for the applicant in case the project does not sign a grant agreement or is not implemented), to avoid speculative bidding.

¹¹¹ In one-sided auctions, awardees are either on the supply or on the demand side. Ensuring the offtake (or respectively supply) of the defined good is left to auction participants. In double-sided auctions, both the production and demand side participate in the competitive bidding procedure. Next to determining strike prices, the double-sided auction also serves to make matches between supply and demand.

¹¹² E.g. [T&Cs of the IF hydrogen auction](#) or [T&Cs of the IF heat auction](#).

Auctions allow for competitive funding allocation and thus lead to high cost-efficiency. As above, high level of competition elicits projects with very high cost-efficiency sometimes linked to higher risk-taking that in the end may not materialise, especially if confronted with less positive market developments. This is to the detriment of the effectiveness of the scheme. Depending on its design, auctions can be administratively simple (one-sided, price-only) or become complex instrument, such as when multi-criteria are implemented or double-sided auctions are used. Auctions are best suited for awarding a premium linked to the unit of production or GHG abatement.

3.1.3. *Measure AM.3: 'First-in, first served' administrative schemes*

Example: tax credits under the US IRA programme linked to the output of green product

This type of allocation schemes offers a 'first-come first-served' funding window where all eligible applicants receive support until funds run out. The instrument is often used for **standardised support measures** (e.g. with fixed lump sum amounts or fixed premia linked to the unit of production) where the policy goal is **quick market uptake** rather than maximising cost-efficiency and price discovery (as in auctions) or excellence of the proposals in multiple aspects (as in regular grants). Administrative schemes are well-suited to favour **front-runners** because the limited budget is taken by those who are first to reach pre-defined milestone (application, Final Investment Decision, Entry into Operation, etc.). On the other hand, late-comers take the risks that funds run out.

This measure can have many features similar to the auctions, in particular: (1) definition of a **homogeneous/standardised good**, (2) establishment of **Terms and Conditions**, including completion or bid bonds (3) **performance-based payments** (upon delivery of the good). However, the fundamental difference with auctions is that the **specific support amount is administratively determined ex-ante** (and not via competition on price). As such this measure characteristic is similar to feed-in tariffs as used by Member States for renewable electricity in the past¹¹³, or the tax incentives for a number of low carbon technologies (H2, CCUS) in the US Inflation Reduction Act¹¹⁴. At the EU level some calls under the Connecting Europe Facility were similar, e.g. calls for installation of EVs charging points, as they offered multiple 'cut-off' dates for the submission of proposals¹¹⁵ and a fixed amount of support per charging point.

Consequently, such schemes work best for **more mature, standardised technologies/products** for which the costs can be estimated relatively accurately ex ante, rather than for more innovative projects. Such schemes provide limited precision of the project selection against tailored objectives. Since the objective is to award funding quickly, authorities typically apply a simple eligibility check and standardised grant once the project is delivered. Such approach is assumed for the evaluation of this measure. If there are project drop-outs it is easy to select a new project from the application queue. However, eligibility checks can also be designed in more complex manners and demand detailed documentation. **Guardrails for such administrative schemes** might be needed such as: 'booking' systems¹¹⁶, per

¹¹³ The revision of State aid guidelines in 2014 implied a transition towards auction based support

¹¹⁴ For example, the US IRA 45Q tax credit provides a tax credit of 85\$/tonne for every tonne of CO2 captured and permanently stored in geological formations

¹¹⁵ https://cinea.ec.europa.eu/funding-opportunities/calls-proposals/cef-transport-alternative-fuels-infrastructure-facility-afif-call-proposal_en

¹¹⁶ There needs to be the system that shows the 'application queue' of projects that are eligible and can claim the support once they meet a pre-defined milestone. Once such an 'application queue' exhausts the budget, projects are put on the reserve list. There could be still many changes to the 'application queue' but it is

applicant- caps, technology baskets and clear MRV (monitoring, reporting, verification) requirements.

The administrative schemes may work with any **form of support** discussed in the Section 5.2. They require very little administrative effort and with an effective ‘booking’ system can deliver high level of effectiveness as it is very easy to replace the projects dropping out. Also, with an administratively set amount of support it is easier to establish higher returns for private investors, making projects more immune to adverse market conditions and thus increasing the likelihood of projects to be delivered. As trade-off such schemes provide very **limited precision** in project selection and have an implicit **risk of overallocation of support**. This risk of overcompensation would be detrimental to the overall efficiency of the scheme, as less efficient undertakings would be supported and this could increase the cost of the transition. Such risks can be mitigated by the upside-sharding mechanisms/claw-backs.

3.1.4. *Other measures*

MS proposing a shortlist of projects

Beyond those main measures, there could be others, notably MS proposing a shortlist of projects as is, for example, the case for the current Modernisation Fund

Under such a support allocation mechanism, **MS create a pipeline of national projects and submit them for approval and funding** under a common EU facility. The EU Modernisation Fund (MF) is an example. Like the IF, it uses EU ETS allowance revenues but focuses support on lower income MS. It allows varied forms of support (i.e. grants, premiums, guarantees, loans, capital injections) based on national investment proposals. Those proposals are reviewed against MF priority areas as well as its legal requirements (notably eligibility and State aid compliance) that are defined on the EU level.

This allocation mechanism relies on national planning through which MS can more easily cluster investments with enabling infrastructure, related value chains and their national industrial strategies. The ability to choose projects and instruments gives MS flexibility and provides a **high level of precision to select projects based on specific objectives on Member State level**. At the same time, the mechanism will not perform as well towards the EU-level objectives. It is highly dependent on the selection criteria, which can favour cost-efficiency or excellence across a number of criteria or alignment with other national objectives (e.g. is the project relevant for the National Energy and Climate Plan) and whether these selection criteria are developed on the EU or national level. If criteria are developed entirely on the national level, there is a risk of misalignment with the EU-level objectives. In terms of coherence with other EU funding programmes, it depends on the design chosen by the MS to identify the shortlist and there is potentially a risk of overlaps with EU funding programmes. As with the administrative schemes, there is a risk of overcompensation, potentially detrimental to the overall efficiency of the scheme. Such risks can be mitigated by the upside-sharding mechanisms/claw-backs.

Shortlists curated by Member States may work with any **form of support** described in the Section below, however the implementation of more complex forms of support such as CCfDs is less likely due to fragmented MS markets and limited administrative capacity in smaller countries.

guaranteed that once project is part of the queue and reaches the pre-defined milestone, it will receive the support. For project on the reserve list, they would only receive support if there are dropouts from the queue.

3.2. Measures on what form the support should take

There is a number of forms the public support can take and, in most of the cases, the form can be chosen regardless of the allocation mechanism (see Section 5.1) but will be influenced by the choice of technology/sector/product and whether they operate on a mature or on a nascent market (with a reference price or not). The measures selected below are not an exhaustive list but represent the most common types of support and are largely reflecting the experience with the Innovation Fund.

Measure FSFS.1	Regular' grants
Measure FSFS.2	Carbon Fixed Premium (CFP)
Measure FSFS.3	Carbon Contracts for Difference (CCfD)

3.2.1. Measure FS.1: 'Regular' grants

Example: IF 'regular' grants

'Regular' grants (also called 'investment' grants) provide **upfront capital** to cover part of the cost of low-emission installations or infrastructure. Grants are **non-repayable forms of support**. They are typically awarded through competitive, often multi-criteria calls for proposals or administrative schemes and disbursed in the form of lump-sum payments upon the reaching of pre-defined milestones. Grants are among the **most widely used support tools** for industrial decarbonisation. At the EU level, the most well-known grant mechanism for industrial decarbonisation projects are grants under the IF. These grants can address **60% of the funding gap** and are disbursed in lump-sums upon achievement of certain milestones and at least 75% of GHG abatement claimed in the application. Grants can be also established to cover a given share of CAPEX/all eligible costs and can have monitoring arrangements with varying levels of strictness¹¹⁷. If grants are disbursed ahead the entry into operation and some part of support is not retrieved in case technology does not work out, the grants can participate in shouldering the technology risks.

'Regular' grants are a **common instrument** and are generally **applicable for a wide range of projects** (simple and complex), technologies and sectors. 'Regular' grants are effective in addressing **the initial investment barrier**, which makes them well suited for **capital intensive** projects with **high technology risk** that need support in the early project phase (construction). 'Regular' grants, if covering a large share of the project's funding gap, can make the project bankable but do not shield it from adverse market conditions (e.g. grants are rarely indexed to the inflation, do not cater to unforeseen changes in costs or revenues) or guard against overcompensation. On the flip side, there is **no budgetary risk** for the administration as the amount of support is fixed in advance.

3.2.2. Measure FS.2: Carbon Fixed Premium (CFP)

Example: IF heat auction

A Carbon Fixed Premium (CFP) provides a **fixed payment per tonne of CO₂ avoided**. As opposed to CCfDs (see below), CFP schemes are not linked to the actual carbon market price.

¹¹⁷ If not conditional to certain performance requirements, grants do not guarantee long-term viability or operational performance and hence their effectiveness regarding GHG emission reduction is limited. If performance requirements are included, their effectiveness can be improved, which comes with additional complexity for MRV.

The IF auction for heat decarbonisation is a simplified¹¹⁸ CFP scheme. Unlike the ‘regular’ grants, a CFP provides **support once a project is operational**, so the **technology risk remains almost entirely with the project** and there is no support during the capital-intensive investment phase. As ‘regular’ grants, CFP can make the project bankable but will not ‘shield’ it from adverse market conditions (e.g. lower carbon price than anticipated at the time of the application and – more importantly – changes in costs or revenues).

Consequently, CFPs are a **relatively simple** form of support with very limited budget risk as amount of support per tonne of CO₂ avoided of support is fixed in advance and payments depend on the output volume (which can also be capped) but not on market/carbon prices. Their simplicity enables fast deployment of **market-ready decarbonisation technologies**. The static support level may lead to overcompensation or unforeseen cost gaps. CFPs are applicable across sectors and technologies, but technology baskets are required to account for structural cost differences.

3.2.3. Measure FS.3: Carbon Contracts for Difference (CCfD)

Example: German CCfD scheme

Carbon Contracts for Difference (CCfDs) are a **form of support that guarantees a fixed carbon price** for industrial decarbonisation projects. The instrument works by compensating for differences between a reference carbon price (the EU ETS) and a project’s strike price, aiming to **level the cost difference between a conventional fossil-based production process and the alternative decarbonised process**. If the reference price falls below the strike price, the administrative body pays the price difference to the project developer; if the reference price exceeds the strike price, the project developer repays the surplus to the support giver. In the case where the reference price falls below the strike price, the support paid to the project developer is meant to offset the additional costs of low-emissions production processes. Limitations and additional rules to modulate this basic principle may apply. It is possible to provide indexation to other (than carbon), which would however, further increase complexity of the scheme.

An example of application is the CCfD scheme in Germany under its program called *Klimaschutzverträge* in the first round, now announced to continue under the name *CO₂-Differenzverträge*. The program offers 15-year contracts with payments linked to CO₂ and (to a limited extent) energy prices to compensate companies from the additional capital and operational costs of switching from fossil-based to climate-neutral technologies. Austria and France have also implemented CCfDs which differ in design and more European countries, e.g. Denmark and the Netherlands, have announced or are in the early stages of developing CCfDs.

As CFPs, CCfDs provide **support once a project is operational**, so the **technology risk remains almost entirely with the project** and there is no support during the capital-intensive investment phase. Unlike CFPs, they not only **make the project bankable** but also ‘**shield**’ it **from adverse market conditions**, i.e. unexpected carbon price developments and changes in energy prices if indexation is implemented in the policy design¹¹⁹.

¹¹⁸ Abatement is calculated with automatic formula that applies emission factors to amount of the electricity produced (using ETS heat benchmark or emission factors of fossil fuels in case of proven decommissioning)

¹¹⁹ In the German CCfDs the indexation to electricity and hydrogen prices was foreseen for projects (and more for the conventional reference) acknowledging that the costs of energy vectors cannot be fully passed through to consumers. Pass-through is impossible considering that most of the projects compete on the global markets.

CCfDs can catalyse large and complex projects by bridging the carbon price gap and thus work hand in hand with the ETS market. The instrument implies a high **administrative complexity** for bidders and the administration. It is particularly **suited for large-scale capital-intensive projects in EITs**. CCfDs offer high design flexibility, making them suitable for both simple and complex processes. Potential payback after carbon prices exceed strike prices may deter bidders or impact the operational phase but are an important element reflecting shared risks. Administrative bodies need to provide budgetary provisioning as there is uncertainty about price developments and consequently payouts to the projects.

3.2.4. Other measures

1. Fixed premium per unit of green product

Similar form of support to carbon fixed premium but, necessarily, more-technology specific is a fixed premium per unit of green product. An example is **IF hydrogen auction**.

This mechanism provides a **fixed premium for each unit of low-emission product produced (e.g. tonne of steel or cement)**. The premium is independent from market prices of goods and is typically paid per unit produced, much like the auctions under the Innovation Fund allocate funds through a fixed-premium auction to support the production of renewable hydrogen. To some extent also the US IRA tax credit support was supposed to amount to the fixed support per unit of product (albeit delivered in the form of tax credits).

Similar to CFP, this form of support provides **support once project is operational**, so the **technology risk remains almost entirely with the project** and there is no support during the capital-intensive investment phase. Such support can make the project bankable but will not shield it for adverse market conditions (e.g. higher production inputs costs than anticipated at the time of the application or lower prices for the produced good).

Consequently, this is **relatively simple** form of support with very limited budget risk as amount of support per unit of green product is fixed in advance and payments depend on the output volume (which can also be capped) but not on market/carbon prices. This form of support is well suited to **close the funding gap through predictable support payments to more mature technologies** and thus for the scale-up of low-emission technologies and products. The instrument can be applied in various sectors and for different technologies, in which a specific homogeneous good eligible for funding can be identified. Due to a variety of green products, **a sector-specific approach will be required**.

2. Variable premium for the unit of the green product

Just like CCfDs are introducing variable premium into the CFPs, there can be also variable premium applied to support for the unit of the green product. An example would be national electricity CfD schemes for wind offshore projects.

A variable premium adjusts the support level based on market conditions-specifically: the difference between the cost of low-emission and conventional (end) product prices. A variable premium **requires a product-specific design**, such as a reference product price for a traded good, which consequently **limits its applicability across different sectors**. It could be applicable for final goods (e.g. steel, cement, aluminium, fertilisers, glass) as well as intermediate goods, such as heat. However, for heterogeneous final products or intermediate products without evident reference prices (or price index) such type of support would not be possible. This instrument is designed to 'shield' the projects from all revenue risks on the nascent markets where there is high volatility of the green products. For more mature markets, forms of support that leave more risks with market participants may be more justified. Finally,

for this type of support, administrative bodies can face uncertainty about final payouts to the projects and needs to do provisioning (i.e. reserve the budget) accordingly.

3. Instruments other than grants

Beyond those main options, further support options designed to address very capital-intensive investments and to strengthen the financing side of projects may be relevant, such as guarantees, loans, and equity instruments. While such instruments alone cannot address projects with significant funding gap, they could be combined with grant options to create a more robust financial model.

3.A public guarantees for production of low-carbon product

Example: performance guarantees for clean-tech manufacturing projects.

Public guarantees reduce lender risk, improve access to private capital and lower the cost of capital. They can be a vital element to making projects bankable, but in contrast to operational support **their impact on GHG emission reduction** is only indirect. Guarantees do not directly **close cost gaps to conventional production** as they do not provide direct revenue support for CAPEX and OPEX costs.

3.B equity type of instrument and direct loans

Example: loans and equity taking

Equity-type instruments involve public investment in return for a share of project ownership or future returns. Similar to public guarantees, equity-type instruments and direct loans can improve access to private capital and lower the cost of capital. They can be a vital element to make projects bankable by absorbing early-stage risk (in the case of equity), but in contrast to operational support their **impact on GHG emission reduction is only indirect**. As public guarantees, equity-type instruments and direct loans **do not directly close cost gaps** to conventional production as they do not provide direct revenue support for CAPEX and OPEX.

Additional considerations

Monetisation of EU ETS allowances or payments in allowances:

Regardless of the option chosen from the menu of main options above, an overarching aspect of providing funds to projects covered by the IDB concerns the monetisation of EU ETS allowances. Normally, funding is provided in Euros, with their monetisation realised through the auctioning of allowances on the EU ETS Common Auction Platform e.g. as currently done under the IF. Most options discussed above use a performance metric linked to GHG abatement. It would therefore be possible to bypass the intermediate step of first monetising the EU ETS allowances but instead assigning such allowances directly to the successful projects, with their monetisation being left to the project owner. Different implementation options can be envisaged. Settlement of support directly in allowances is applied successfully already in the support of sustainable aviation fuels¹²⁰. Depending on the detailed design of the support scheme in question, this example could also be followed under the IDB.

¹²⁰ Commission Delegated Regulation (EU) 2025/723 of 6 February 2025 supplementing Directive 2003/87/EC of the European Parliament and of the Council by laying down detailed rules for the yearly calculation of price differences between eligible aviation fuels and fossil kerosene and for the EU ETS allocation of allowances for the use of eligible aviation fuel.

3.3. Measures on ensuring geographical balance in IDB

In the design of the IDB, a balance needs to be struck between two partially conflicting objectives: on the one hand to support the most cost-effective projects (because these are often the least financially risky, and the most mature projects are in the best-suited locations) and on the other hand, to help projects in all Member States to decarbonise, providing related spillover effects (on employment, supply chains, knowledge-sharing) and maintaining political support across Member States for industrial decarbonisation.

The Clean Industrial Deal Communication indicates the importance of designing the IDB ‘to ensure (...) a **fair distribution of support across Member States**’. Fair geographical distribution (also called ‘geographical balance’) of funds is a key aspect for certain Member States. Several measures of addressing the geographical balance are assessed below.

Measure GB.1	EU-level competition, no geographical balance measures
Measure GB.2	National allocations for MS in terms of overall IDB spending
Measure GB.3	Combining EU-level competition with national allocations

3.3.1. Measure GB.1: EU-level competition

In this measure, **IDB funding would be allocated based on pure excellence**, i.e. for projects that perform best on one or set of **award criteria** and based on the **EU-level competition**. This is how the **Innovation Fund** has been operating albeit with some soft measures aiming for more geographical balance (e.g. technical assistance provided to the National Contact Points). It has to be recognised that performance of projects in the EU-level competition is partly linked to their locations (i.e. considering infrastructure, economic/industrial structures, energy prices, presence of ‘national champions’, supply and demand centres, knowledge and workforce, innovation ecosystem, taxation etc) but performance is also driven by the project’s inherent features regardless of the location, notably in terms of technology deployed.

Benefits of the EU-level competition are clearly visible through observed cost-efficiencies of deploying decarbonisation technologies, GHG abatement to be achieved and contributions to achieving the EU climate and industrial policy objectives to be achieved by currently selected IF portfolio. Such approach could be reconducted to the IDB, but it would imply that projects in certain Member States can be less competitive, resulting in a geographical imbalance in terms of funding distribution. Based on the experience of the IF, the imbalances are more visible in certain sectors (e.g. if projects are dependent on electricity prices that are markedly lower in certain countries) rather than across the economy, and geographical balance improves over time as national project ecosystems develop (national administrations’ capacity to support projects, availability of consultancies, projects communities). In the longer term the balance might be improving without any dedicated measures. Nevertheless, in the short term dedicated actions might be needed, considering the importance of the EU cohesion and that all Member States need to participate in industrial decarbonisation, that subsidised projects have large spillover effects and can kickstart the new clusters and centres of excellence.

3.3.2. Measure GB.2: National allocations for MS in terms of overall IDB spending

In this measure, support from the IDB would be allocated still based on competition and funding would be awarded to projects that perform best on the award criteria, but projects would be awarded within the limit of pre-established national **allocations** (i.e. shares of overall

IDB budget that are earmarked for spending on projects in a given Member State). Such national allocations could be defined based on Member States' contributions to the IDB (e.g. in terms of EU ETS allowances contributed), industrial national GHG emissions to abate/already abated, GDP or industrial value added. The allocations could be defined for individual Member States or certain groups of Member States.

Compared to measure GB.1, this measure would ensure that **support granted by the IDB achieves a geographical balance as defined upfront** (and derived from metrics described above such as MS contributions in terms of EU ETS allowances). In essence, projects located in all MS can be supported and this is important knowing that all MS face the challenge of industrial decarbonisation and funded projects also have important spillover effects on national industrial structures.

As an example, if national allocations were linked to industrial emissions yet to abate, it would ensure that Member States with currently higher emissions, and thus greater needs for deployment of decarbonisation technologies, receive proportionate support. As an alternative, the sizes of national allocations could be linked to emissions abatement achieved, whereby Member States would be incentivised to reduce their emissions to access greater financial support. This would create a direct link between performance and funding.

Regardless of the specific method for defining national allocations, such an approach also has inherent shortcomings as it does not fully enable the benefits of EU-level competition. EU-level competition would be constrained by national allocations and disregard that certain MS offer more favourable locations in terms of renewables endowment, labour cost, or better proximity to industrial clusters. That would be partially missing opportunity for the EU as a whole to pursue a 'smart specialisation' of countries or regions, which offers a possibility to strategically use its strengths so that the EU can best compete on global markets. This approach also poses a risk of IDB 'compartmentalisation', i.e. having IDB funding opportunities fragmented into multiple national compartments which prevents economies of scale at EU level. This would be especially problematic if the IDB would also feature sectoral/technology or other compartments as the individual budget allocational would become small.

A variation of this approach is **introducing a cap on an excessive number of projects from a given MS**. This would not achieve a geographical balance upfront but would help to achieve a more balanced portfolio. The cap would only be triggered if a country starts to secure the funding for a disproportionately large number of projects.

3.3.3. Measure GB.3: Combining EU-level competition with national allocations

In this measure, a certain share of the IDB funding could be distributed to projects based on pure excellence, i.e. through an EU-level competition (like in measure GB.1), while the rest of the funding could be distributed also on the EU-level but respecting pre-defined national allocations (like in measure GB.2). There could be different splits between the two approaches, e.g. 50/50 or 70/30.

This measure would allow the EU to benefit from the advantages of both measures GB.1 and GB.2. While the EU-level mechanism leads to the best cost-efficiency, economies of scale and the optimal location of projects, national allocations allow a more balanced approach, providing funding to projects in all MS and delivering the resulting spillover effects.

3.3.4. Other measures

In addition to those main measures, other initiatives could be considered to increase geographical balance of projects to be supported by the IDB. Those initiatives can be

implemented from the beginning of the operation of the IDB or at a later stage during its implementation when it is possible to take stock of the geo-balance as shaped by the early funding rounds and adjust it - as needed. As for the main measures analysed above, additional initiatives could aim at several funding rounds and the portfolio of instruments, or at a single funding round.

‘Soft’ measures, as currently implemented under the Innovation Fund, could be explored: (1) technical assistance for National Contact Points in Member States with low effective participation aiming to increase the overall quality of the Innovation Fund applications, (2) training sessions for Member States National Contact Points for outreach and communication, (3) including geographical balance considerations in providing Project Development Assistance, (4) bonus points/tie-breaker/similar mechanisms to favour applications from MS which are lagging behind.

The ‘as-a-service’ feature developed for the IF (both auctions and ‘regular’ grants) if also applied to the IDB could help to increase the geographical balance. In practice, it means for the IF that Member States can complement any IF call for proposals with national funding schemes which are dedicated only to projects located in their territory. This allows Member States to benefit from the IF’s evaluation process to identify and support promising projects on their territory that were not selected for funding. Participation of Member States is voluntary and dependent on the availability of budget at national level. The support is considered State aid and therefore has to be approved by the Commission. Thanks to close alignment between the evaluation under the IF and State aid assessment, the approval of the Commission can be streamlined and accelerated. Four MS have already opened an ‘as service’ schemes linked to the Innovation Fund. A similar approach could be enabled under the IDB on the condition that there is a close alignment of the IDB with the State aid requirements. This approach could be also *a way to implement* the national allocations.

A ‘right of first use’ of the EU ETS allowances could also be explored. In practice, it would mean that the IDB’s resources would reflect the contribution of Member States to the ETS and would be reserved for a certain period (e.g. 3 years) for applicants under the IDB selection process for the specific Member State. If fewer projects apply or are selected from that MS under the IDB than expected, the remaining budget returns to MS and it would be allowed to spend it under the general conditions for the use of EU ETS auction revenue set by the EU ETS Directive. This approach could be also *a way to implement* the national allocations.

MS could also be involved in the provisioning (in case the type of support chosen is the variable premium, e.g. CCfD). In practice, MS could create national or regional provisions or guarantee schemes that complement the EU mechanism, sharing the risk of adverse market conditions that would require higher payments for schemes that work with variable premium. This approach can increase the total amount of funding given a smaller part of the EU funding would need to be mobilised for the provisioning. Managing risk-sharing in a joint manner would require a clear legal framework and governance and coordination mechanisms.

MS could be involved in the governance of the IDB, participating in setting the priorities that the IDB can serve and defining the funding instruments, as seen in existing successful method developed under the IF Expert Group.

3.4. Assessment of the measures

3.4.1. Expected impacts

Assessment of impacts (in terms of abatement to be achieved and private investment mobilised) is limited to assessment of the Baseline only since Baseline already defines the size of the IDB

(EUR 100 bn) and the policy options concern the ways IDB budget would be spent that would have negligible impacts on the overall impacts especially taking into account the trade-off between cost-efficiency (for very competitive calls for proposals) and effectiveness (for schemes that allow more robust financial model) – see also Annex 3 on summary of costs and benefits for the whole initiative.

The baseline assumes a **continuation of the current Innovation Fund with** for the period 2031-40, with the same instruments ('regular' grants and auctions) and the type of support currently provided (lump sum payments or fixed premium for the unit of low-carbon product/GHG abatement). In the past years, IF has been testing the support for scale-up/roll-out more mature technologies (i.e. going beyond the first-of-a-kind (FOAK) type of projects) by deploying auctions, awarding a fixed premium once projects enter into operation. While the IF has been clearly successful in deploying auctions for specific technologies (attracting impressive numbers of bidders and clearing at very low prices), it clearly lacks the 'firepower' to offer scale-up/roll-out support to all industrial sectors – at the necessary scale.

Given foreseen budget amounts, the IF cannot be a solution for both innovative and more mature industrial decarbonisation technologies. It would remain effective but at a small scale, limiting its impact on emission reductions and providing limited chances for the EU to secure technology leadership. Likewise, creating the **IDB for mature technologies only and without a complementary innovation and FOAK support pillar** would risk focusing on mature technologies only, neglecting the early, high technology risk projects that are needed to close remaining gaps in the decarbonisation portfolio and/or increase cost efficiency of decarbonisation in the longer term. Support for FOAK type of projects and scale-up/rollout of more mature technologies are necessary and complementary.

The impact of the IF portfolio of projects awarded so far was analysed in the IF evaluation report that is attached of the ETS Directive revision proposal and provides indication on the impact of the IF programme as a whole as well as of IDB.

Box: Impact of the IF

The IF evaluation report indicates that the current impacts of the IF grants awarded in the period 2020-25 (EUR 12.7 bn that covers 2020-2024 calls for proposals, including auctions) bring the GHG abatement of 871Mt (over the first 10 years of projects' operation) with **an average (potential) funding efficiency of EUR 13/tonne of CO₂**. The Fund has leveraged around EUR 45.2 billion in total investments against EUR 11.08 billion in grants (a leverage ratio of about 1:4), with private financing accounting for most of the additional resources mobilised. The Fund also demonstrates the capacity to mobilise investments beyond direct project investments (in the supply chain, offtakers, logistics and transport), generating an additional EUR 4.33 of indirect investment in the EU per euro budget spent – corresponding to approximately EUR 49 billion over the programme period analysed.

The IF has also many **spillover effects**. Other projects can replicate the technologies that are demonstrated by the IF. For the purpose of the IF evaluation, the potential spillovers were assessed with a survey. In this survey beneficiaries reported that their projects are expected to trigger innovations and open new markets, with wider sectoral diffusion extending emission reductions beyond the projects themselves. Certainly, further replication of the decarbonisation technologies has positive impacts on growth and job creation in many value chains. Survey respondents stressed that, conversely, stopping the Fund would significantly constrain technology deployment, reduce EU competitiveness, and risk industrial relocation.

Assuming the same multipliers apply to the entire IF budget (EUR 40 bn), the fund is expected to deliver very large abatement, leverage of private investment and spillover effects. The impact of the IF could potentially be further enhanced by simplifying its procedures, expanding its administrative capacity, honing the fund's focus on innovation only and enabling more flexibility in its financial design.

For the IDB and continuation of the IF, the current IF multipliers could also be applied to estimate the likely impact on GHG abatement and the impact on private investments, but that would require that IDB follows the same method of **competitive calls for proposals** on the EU level (no geographical or sectoral allocations) and **sizing the support like the IF does** (i.e. relevant cost methodology that is a simplified funding gap approach and allowing 60% coverage of this funding gap which requires projects to find additional private investment or other public support). It has to be stressed that the IF supports innovative technologies at the beginning of the diffusion phase. These aim at learning and scaling effects, and consequently project developers often invest their own resources or take corporate loans.

In order to maximise the attractiveness and effectiveness of the IDB support, this current approach of the IF could be revised making the IDB support to be awarded through administrative scheme and administratively fixed premium, allowing more robust financial model with higher returns for the investors and providing the final piece of the projects financial model so that after the IDB support the Final Investment Decision of the project can be taken.

On the other hand, the IDB would likely have even bigger impact in terms of GHG abatement and leverage, given that it would be operating in the context of higher EU ETS prices, a more established regulatory framework and more mature decarbonisation technologies. The IDB may deliver increased leverage and operate with even lower support levels by focusing on the scale-up/roll-out of decarbonisation technologies and uniquely addressing the commercial risks. However, there are many uncertainties on the horizon, no least in terms of carbon and

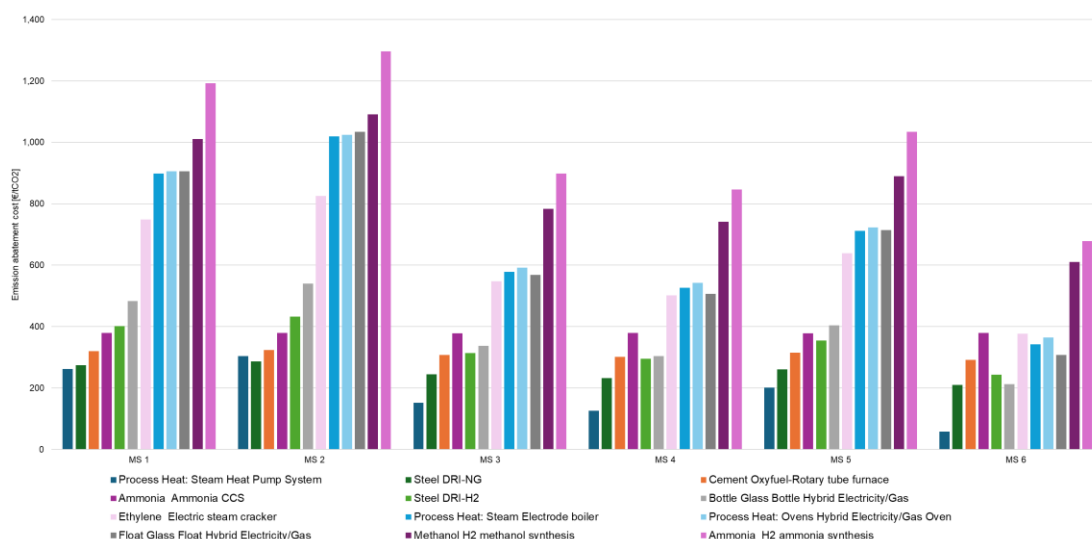
energy prices in the EU, costs of feedstocks and raw materials, costs of the technologies that cover ‘the last mile’ of the net zero pathway in EII and other trends that could lead to additional cost increases.

Considering all the uncertainties and the fact that there is no clear preferred policy option that emerges from the analysis, in order to assess the impact of the IDB, a bespoke methodology was applied. A **bottom-up, techno-economic model** was developed allowing to follow a technology- and Member State-specific approach. For simplicity, the model simulates successive funding rounds under the IDB that reflect auction logic (i.e. ranking and awarding the bids representing the lowest abatement costs) and thus derives a ‘merit order’ in terms of GHG abatement costs across all relevant industrial sectors and Member States.

3.4.1.1. Methodology

As the first step, the model calculates GHG emission abatement costs for a wide range of energy-intensive industrial processes in each Member State on an annual basis until 2040. Each energy-intensive process considered in the model is representative of a specific industrial sector and reflects the current production capacity of that sector in the respective Member State. This approach ensures comprehensive coverage of all major industrial sectors relevant for industrial decarbonisation. Figure below illustrates the assumptions on abatement costs in selected MS.

Figure 7: Abatement costs assumptions



Source: Fraunhofer

GHG emission abatement costs are defined as the discounted¹²¹ total cost per tonne of CO₂ avoided when switching from a conventional fossil-based technology to a low-emission alternative. Discount factors play a significant roles in decreasing the future revenues and costs of the project, for projects with a funding gap typically increasing this funding gap. In economic terms, this cost corresponds to the level of subsidy a project would need to request per tonne of CO₂ avoided, i.e. a carbon fixed premium (CfP), to achieve cost parity with the fossil reference technology over a defined support period. A support duration of ten years is assumed. Accordingly, the model incorporates projected developments of the EU ETS and energy prices with perfect foresight over the full support period. The model outcome provides the cost gap of an investment in clean technology compared to the fossil conventional technology. Discount

¹²¹ Discounting is performed with the use of WACC (weighted average cost of capital) that was calculated by Fraunhofer with the use of IF [Relevant Costs methodology](#) and gives differentiated results across MS.

rate assumptions clearly influence cost-efficiency of the scheme, in most cases increasing the funding gap this, however, reflects the economic realities of decarbonisation projects needing either loans or equity to support their investments which increases the overall costs of the projects and thus the need of the support. Discount rate assumptions reflect optimistic assessment of investors on the risk profile of the IDB supported projects, which is justified by the design of the IDB modelled (a non-repayable subsidy, perfectly sized to the funding needs and guaranteed over 10-year period).

With the design of the IDB modelled as non-repayable subsidy, perfectly sized to the funding needs and guaranteed over 10-year period combined with moderate assumptions on WACC, the economic actors' perfect foresight, this approach assumes maximum efficiency in the allocation mechanism of public support without transaction costs and results should be interpreted as an optimistic scenario.

The model assumes that the IDB subsidy fully covers the additional costs of the decarbonisation project (during the support duration) and does not account for potential additional revenues from green lead markets. There is also no assumption on possible upside sharing mechanism that could be attached to the support (e.g. in case project realises very high profit it would be shared with the public authority that operates the IDB). In this simulation and amongst the policy measures analysed in this Impact Assessment there are no fundamental differences in the risk distributions between the public and private actors. Different models could be envisaged but it would require different sets of instruments to be analysed (e.g. loans, guarantees, equity stakes, contract for difference for the green products) and on more granular level (e.g. remuneration and seniority of the debt, remuneration of equity, fixed premium addressing only a part of the funding gap etc).

Economic input parameters are taken from the impact assessment of the EU 2040 climate target modelling, while technology-specific assumptions are based on literature review as well as internal data and expertise from Fraunhofer ISI and for simplicity do not feature the learning effect (i.e. the reduction of technology costs over time).

In practical terms, the model first computes the *levelised cost of production* (LCOP) for both the conventional fossil and the most advanced low-emission alternative for each relevant EII sector per Member State. Based on the cost difference and the associated GHG abatement achieved by the low-emission technology, the GHG emission abatement costs are calculated as follows:

GHG emission abatement cost

$$= \frac{\text{LCOP}_{\text{Clean}} - \text{LCOP}_{\text{Conventional}}}{\text{GHG emission intensity}_{\text{Conventional}} - \text{GHG emission intensity}_{\text{Clean}}}$$

To estimate a realistic pipeline of potential projects applying for the IDB support in each funding round, the model builds on data from installations registered under the EU ETS. These data provide detailed overview of existing industrial installations by activity and Member State that are expected to undergo transformation. Based on the technical lifetime of conventional plants, an annual replacement rate is calculated and assumed as the pipeline of projects potentially willing to invest in low-emission technologies.

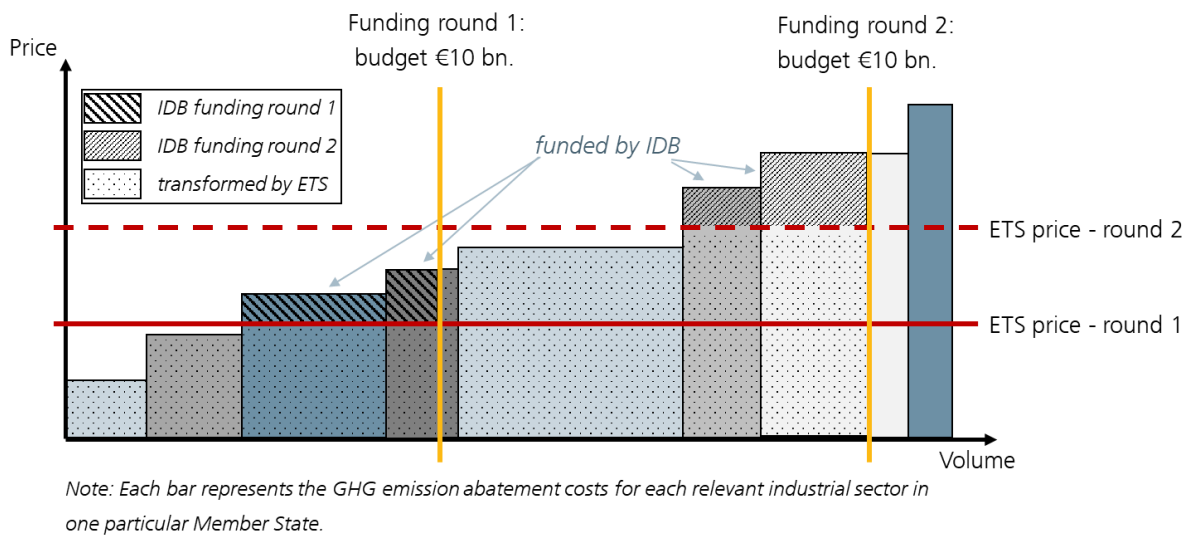
For each simulated funding round under the IDB, the resulting project pipeline is combined with the GHG emission abatement costs to establish a merit order curve. Projects with abatement costs below the considered average EU ETS price are assumed to proceed with transformation without IDB support (i.e. assuming no windfall profits). The average EU ETS price reflects the price projections over a period of 10 years. For example, projects switching

to a low-carbon technology in 2030, have to reflect the EU ETS price developments of ten years - consequently until 2039 - in their calculation of the cost gap of their business case. Projects requiring additional support are awarded in the IDB auction until the budget is exhausted. Thereby, the requested support per tonne of CO_{2eq} abated is considered as the difference between abatement costs and EU ETS price, as follows:

$$\text{Requested specific support} = \text{GHG emission abatement cost} - \text{ETS price}$$

To simulate the operation of the IDB over time, it is assumed that EUR 10 billion of support are allocated in ten consecutive support rounds (first round in 2030 until last round in 2039). Projects that do not receive support remain in the pipeline and are considered again in subsequent auction rounds. Unused budget is shifted to the following auction. Each year, new projects enter the pipeline, the merit order curve is recalculated, and the selection process is repeated. Figure below visualises this approach.

Figure 8: Modelled consecutive support logic for two consecutive funding rounds



Source: Fraunhofer

To evaluate the support cost efficiency, the weighted average support per tonne GHG emission abated of each funding round is calculated as follows:

$$\text{Weighted average support need} \left[\frac{\text{EUR}}{\text{t}_{\text{CO}_2}} \right] = \frac{\text{IDB support} \text{ — [EUR]}}{\text{Total emission reduction} [\text{t}_{\text{CO}_2}]}$$

This figure provides the average amount of support for a ton of additional emission reduction, considering the different support volumes of each awarded sector and Member State in the particular funding round.

In addition to the IDB impact on GHG emissions reduction, the model enables the quantification of the direct **leverage effect of public support on private investment**. This factor is calculated as follows:

$$\text{Direct leverage effect} = \frac{\text{IDB support}}{\text{Private investment expenditures}}$$

The IDB support covers the total cost gap including CAPEX and OPEX, while the private investment expenditures only represent the CAPEX for the low-emission technology. For

technologies with a high share of OPEX in total expenditures (OPEX-intensive technologies), typically in EII, the leverage effect tends to be smaller compared to CAPEX-intensive technologies such as renewable energy plants.

Besides the direct leverage effect, indirect leverage effects of the support are to be expected. However, the model does not allow quantifying them. To do so, further analysis on system- and macro level would be required. Consequently, indirect leverage effects can only be derived qualitatively: As the switch to low-carbon technologies in most cases is linked to a fuel switch from fossil to electricity, indirect leverage effects of IDB support are related to investments in the renewable energy system, i.e. renewable power generation, storage and infrastructure but also in establishing a hydrogen economy including electrolyzers as well as CO₂ infrastructure.

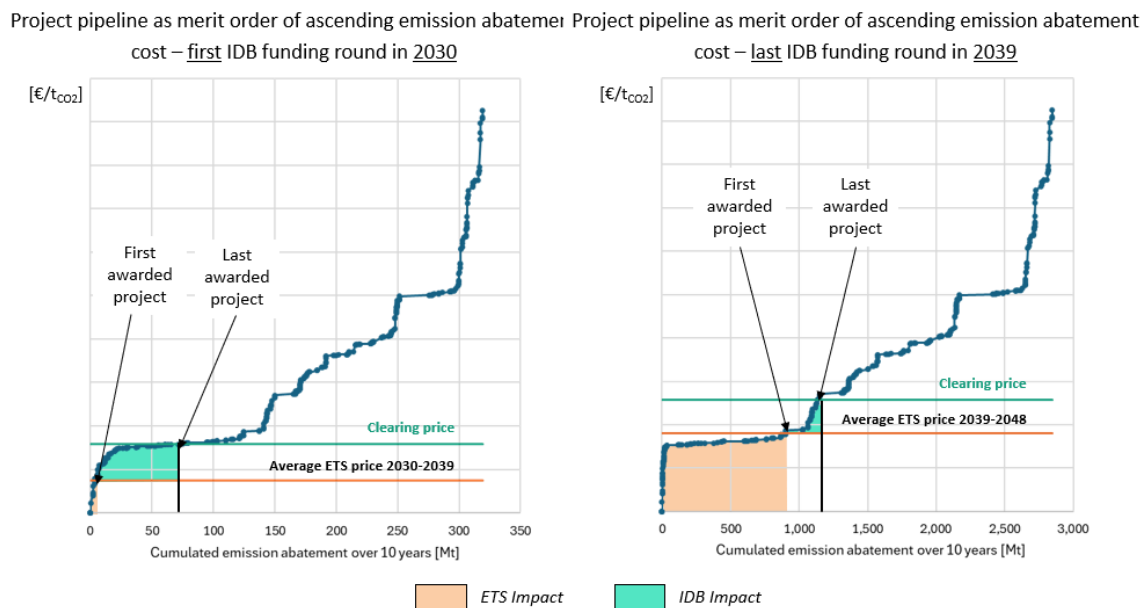
3.4.1.2. Expected GHG abatement

The model results indicate **cumulative GHG emission abatement of 1,630 Mt CO₂ over a ten-year period**, based on a total budget of EUR 100 bn allocated across ten funding rounds with EUR 10 bn funding volume in each annual round. Over the assumed support period of ten years, the resulting **weighted average awarded support amounts to EUR 60/t CO₂ abated**.

This support is modelled to bridge the remaining cost gap - covering both CAPEX and OPEX - of the low-emission technologies deployed in funded projects, compared to the incumbent fossil-based technologies, after accounting for the average EU ETS price stemming from the scenarios underpinning the 2040 climate target.

The model simulates an auction and thus a merit order curve is established for each funding round that illustrates the remaining (after the effect of the EU ETS price) cost gap of the project pipeline. Each data point of the merit order curve represents a specific combination of industrial sector and Member State. Figure below presents the results of the first modelled auction round in 2030 and, for comparison, of the final round in 2039. The y-axis represents the GHG emission abatement costs, while the x-axis shows the cumulative cost gap of the project pipeline in the respective funding round. Applying the logic of an auction, the annual IDB budget of EUR 10 bn is allocated to the projects with the lowest GHG emissions abatement costs. Projects that are not awarded support in a given funding round remain in the project pipeline and are carried forward to subsequent rounds. As a result, the merit order curve expands over time, reflecting the growing pool of projects competing for support in each successive auction.

Figure 9: Illustration of impacts of the IDB funding rounds in 2030 and 2039



Source: Fraunhofer

Projects that reach cost parity with the conventional fossil-based technology solely through the EU ETS price development do not face any remaining cost gap in the respective year. These projects are therefore located below the orange horizontal line, which indicates the average EU ETS price applicable in the respective funding period. These projects are assumed to invest in low-emission technologies solely motivated by the EU ETS price.

The black vertical line represents the budget constraint of the IDB funding round, set at EUR 10 billion in every year. The auction clearing price emerges at the point where the merit order curve intersects with the available budget. The difference between the clearing price and the EU ETS price reflects the level of support provided through the IDB for the last awarded project. The green area depicts the total IDB funding volume of the respective auction round.

Comparing results in 2030 and 2039, it can be observed that as the EU ETS price increases it has an increasingly transformative effect on its own and the IDB support progressively addresses more and more expensive decarbonisation options. While the IDB impact is sizeable, the potential for decarbonisation also grows with each successive round as only share of the projects can receive the funding.

When evaluating the model results with regard to Member States and sectors, the results suggest a significant share of IDB budget would be allocated to a limited number of industrial sectors and Member States under a competitive bidding approach. In this context, the industrial sector, and more specifically the underlying production processes, prove to be more relevant for support allocation than differences in national energy price levels alone. Firstly, efficient electrification technologies in medium temperature processes (i.e. below 200°C), such as those commonly found in the paper industry, do not require public support in most MS when EU ETS prices are at levels assumed in the impact assessment for the 2040 climate target.

Most of the support is allocated to process heat electrification in medium temperature levels in MS with higher electricity cost and high temperature electrification in Member States with low electricity cost. Additionally, the application of direct reduction of primary steel, using

hydrogen is supported in the model. Carbon capture and Storage (CCS) in cement & lime is another sector supported by the IDB.

In contrast, processes characterised by substantially higher cost gaps, such as the production of synthetic hydrocarbons for the chemical industry or synthetic fuels for maritime and aviation, are not awarded support in the purely technology-neutral auction simulation. An approach that prioritises projects with the lowest cost gaps inherently favours projects with smaller abatement cost, leaving higher cost but strategically relevant technologies unsupported unless budget earmarking for specific sectors is introduced.

At the same time, differences in energy prices across Member States also affect abatement costs and remaining cost gaps. While in some Member States the EU ETS price proved to be sufficient to close cost gaps in certain industrial sectors, this is not the case in others. This becomes particularly evident for processes such as primary steel production, electric steam cracking, and glass manufacturing.

Overall, Member States with comparatively low electricity prices would emerge as the most competitive. Geographical balancing could counteract these distributional effects. In turn, any geographical or sectoral steering of support under the IDB would therefore reduce allocative efficiency in this static modelling framework, and, as a consequence, lower the amount of GHG emission abatement achieved per euro of public support. It should be noted, however, that this assessment does not capture potential regional or sectoral learning effects, possibility of future electricity prices evolution and technology diffusion over time¹²².

3.4.1.3. *Direct leverage effect*

For the analysed Member States and technologies, the direct investment leverage effect varies between 5% and 75%, depending on the sector and technology considered. Across all modelled supported projects, the weighted average direct investment leverage amounts to 45%.

The production of energy-intensive basic materials generally requires substantial upfront investments (CAPEX) in production plants with long technical lifetimes, typically ranging from 15 to 25 years. At the same time, operating costs, particularly energy-related OPEX, account for a dominant share of total production costs. This trend becomes even more pronounced for low-emission technologies.

Energy-related OPEX, in particular for electricity, hydrogen, and related infrastructure costs are not reflected in the direct leverage effect. Nevertheless, the IDB support creates stable demand signals for such energy-related investments beyond the boundaries of EII. As a result, an additional indirect investment leverage effect can be expected on system and macro level. However, this indirect effect cannot be quantified within the scope of the applied model.

3.4.1.4. *Limitations*

The model applies a generic approach to depict a broad range of emission reduction technologies and many countries. This comes at the expense of level of detail. The results do not include sensitivity analyses for EU ETS and energy prices. As EU ETS and energy cost dominate the LCOP, they have a significant impact on the overall results. Next, the model assumes perfect foresight, perfect economic efficiency and no transaction costs. Variation from these assumptions would reduce the impact of the available budget. The model does not reflect

¹²² Technology diffusion was not assumed because of relatively short time span considered in the assessment. The technology diffusion impacts would come once a larger cohort of projects funded by the IDB come into operation and with an inevitable time-lag of at least few years between the launch of the instrument and projects becoming operational.

any effect of support on the EU ETS prices, which are anticipated but whose estimation would require full energy system modelling. Lastly, it is assumed that investments in production capacities are done in the MS where currently conventional production is deployed. Relocation within the EU in relation to the most favourable production factors and outside the EU would significantly change the pipeline of projects requiring support and would potentially impact the model results. The model reflects this aspect only partially by triggering investments at the most economic location first.

3.4.1.5. *Limited differences in impacts across the policy options*

The differences between the IDB options on allocation mechanism, form of support or geographical balance are **too subtle to have sizeable impacts on GHG abatement or size of private investment, so only a qualitative assessment is proposed below**. Certain options are expected to be more efficient (auctions, variable premia – see Section 3.4.2) so they could be expected to have **larger positive impact on GHG abatement, greater leverage of private investments and larger spillover effects**. But this is very much dependent on the specific design and circumstances (notably the level of competition). For example, in the operation of the Innovation Fund, it appeared that for RFNBO hydrogen production, the amount of subsidy requested via the ‘regular’ grants of the IF is as low as in the auctions (even though economic theory finds the auction to be a the most efficient instrument). Certainly, the high level of competition in the IF ‘regular’ grants and the fact that they cover only 60% of the relevant costs (i.e. simplified funding gap) has helped to increase the efficiency. Also, the desired efficiency of the tools must be weighed against the risk of portfolio attrition (i.e. projects dropping out to the detriment of the overall efficiency).

Establishment of the IDB will bring advantages for many sectors. **All actors across the EU economy will benefit from the continuation of the IF and establishment of the IDB since all actors** consume industrial products. In particular, actors in **the industry sector** will be confronted with increasing carbon prices unless decarbonisation solutions can be deployed at a scale. Finally, **society - as a whole** - will draw benefits from industrial decarbonisation supported by the two instruments as the entire society consumes industrial products, a part of society works in the industrial sector, some have part of their pensions linked to the performance of industrial stocks and all will benefit from climate change mitigation.

Though the EU is a front-runner in climate ambition, this does not guarantee that it will be **competitive at the global stage in deploying decarbonisation solutions** and securing a strong position in producing such solutions for the global markets. Building on the EU’s competitive advantage starts with establishing a business case and requires additional industrial policy measures to avoid building dependencies and promoting EU-made solutions. This goes beyond the remit of the IDB and will be partly addressed by the Industrial Accelerator Act (IAA). The IDB can apply the Union origin requirements of IAA, similar to the IF hydrogen auctions that applied the resilience requirements put forward by Net Zero Industry Act.

3.4.2. *How do the policy measures and options compare?*

The assessment is based on a system of rating, focussing on effectiveness, efficiency and coherence:

- (negative): the policy option/measure has a negative effect
- = (neutral): the policy option/measure has no significant effect
- + (low positive): the policy option/measure has a modest positive effect
- ++ (moderate positive): the policy option/measure has a significant positive effect

+++ (high positive): the policy option/measure strongly advances effectiveness, efficiency or coherence.

First of all, measures are assessed in detail and then policy options combining measures are assessed in the synthetic manner.

3.4.2.1. Effectiveness

In the tables below policy measures are compared in terms of their effectiveness, i.e. likelihood of achieving the objectives. To be noted that in most of the cases the effectiveness or efficiency would be defined by combination of allocation mechanism with the form and size of support and would depend on much more granular features of the support mechanism (e.g. penalties for non-delivery, milestones upon which support is disbursed, level of due diligence applied to financial model at the stage of evaluation, etc.).

All main policy measures (that are later combined into Policy Options) are assessed and for allocation mechanism and form of support also one additional measure for more comprehensive overview.

Table 1: Effectiveness of measures on allocation mechanism

	Measure AM.1: multi-criteria call for proposals	Measure AM.2: auctions	Measure AM.3: administrative schemes	MS propose a shortlist
SO1: creating the business case for private investment	++	++	+++	+
	Depending on specific design (e.g. how large share of the funding gap is covered) but in essence, sufficient to create business case.	Depending on specific design (e.g. presence of completion bond) but in essence, sufficient to create business case. There are risks for the administrative body of non-delivery if penalty regimes and prequalification criteria are weak. Strategic bidding by large players that may crowd out smaller actors can also happen. Conversely if prequalification and penalties are too strict, underbidding may occur.	Depending on specific design (e.g. how application process is managed and at what stage (pre-FID) projects are sought) but in essence, sufficient to create business case and even allow the higher return on investment depending on level of compensation fixed. A clear and simple mechanism so very easy to communicate and integrate corporate in planning and decision making.	Depending on specific design (e.g. how application process is managed and what selection criteria are applied by MS) but in essence, sufficient to create business case. There is a risk of lengthy decision-making which makes establishing business case more difficult.

SO2: create an instrument with sufficient budget and duration	The choice of measure does not have an impact on achievement of this objective			
SO3: create an instrument operating in simple and flexible way and thus suitable for addressing all sectors in all countries	+	++	+++	++
	The design complexity of multicriteria calls is generally high, as the criteria need to be clearly defined and operationalised. Processes for potential multi-stage application procedures need to be defined and implemented. The administrative burden is high for both applicants and authorities. Applicants must provide substantial documentation, align project details across a variety of document types, and provide robust contractual evidence from project partners¹²³. Authorities must run multistage evaluations, due diligence, grant agreement negotiations, and long-term monitoring against	The design complexity of auctions depends on the range of objectives. Auctions tend to use bid prices as the main selection criterion, which simplifies the allocation mechanism. Auction can be implemented as multicriteria auctions to pursue further goals beyond cost-effectiveness and price discovery. This increases complexity. The exact administrative burden is strongly linked to the auction model, e.g. potential clawback or payback features. One-sided auctions are less complex than double-sided auctions (that need an additional administrative body involved that acts as a bridge between end-users	This measure is fast to deploy with low design complexity, minimal barriers to entry, making support disbursement quite predictable for applicants. It can be effective in kickstarting supply for standardised low-emission technologies or products. The administrative burden of this mechanism is low. All sectors can be addressed in one administrative scheme, but level of support should be differentiated or there is a risk of windfall projects.	The design complexity of such an allocation mechanism is lower on EU level compared to a centrally managed mechanism, but higher on Member State level – and multiplied with the number of different designs applied in each Member State. The administrative burden is distributed and significant at national level. MS must coordinate project selection, concrete instrument design, stateaid compliance, with the EU level governance and disbursement processes. There is potential for excessive heterogeneity and fragmentation of project pipeline because selection criteria, standards and risk

¹²³ Additional challenge is often assessing credibility of the statement made by applicants (e.g. regarding stated counterfactuals).

	milestones and verified abatement. All sectors can be addressed in one call for proposals but depending on call design, some sectors of types of projects can be favoured.	and the auctioning authorities). Standardised documentation and auction terms and conditions keep transaction costs for the auctioneer lower than in multi-criteria calls for proposals. Addressing all sectors in one call is challenging since there is need for a homogenous auction good. This can be addressed by auction baskets or other discriminatory elements.		management can vary by MS. All sectors can be addressed in one national shortlist but there is no control over the choice of projects or criteria set on the national level.
SO4: create an instrument that supports sectors producing CBAM goods	The choice of measure does not have an impact on achievement of this objective, it is the call design that has the impact.			
SO5: create an instrument that maximises success rate of the projects.	+	+	++	-
	Risk of high dropout rate/project dropouts (i.e. projects not materialising confronted with costs increases or other unforeseen difficulties) especially if call design does not allow some flexibilities in cost calculation, funding gap coverage etc.	Risk of highest dropout rate due to competitive nature of auctions that reward risk-taking by the bidders can be moderated by specific features as completion bonds and elements of due diligence as part of qualifications. Reserve list is usually limited so it is difficult to	It is assumed that authorities would apply a simple eligibility check and provide a standardised grant once the project is delivered. If there are project drop-outs it is easy to select a new project from the application queue. Consequently, while there is a high risk of dropout rate, an	Risk of high dropout rate if projects are not duly vetted in terms of financial maturity and if the administrative process is longer due to interactions between MS and the EC.

	Reserve list is usually limited so it is difficult to replace dropouts by the new projects.	replace dropouts by the new projects.	administration can operate a very long reserve list at a very low administrative cost that will enable to replace the dropouts seamlessly.	

Table 2: Effectiveness of measures on type of support

Effectiveness (likelihood of achieving the objectives)	Measure FS.1: Regular grants	Measure FS.2: CFPs	Measure FS.3: CCfDs	Fixed premium per unit of decarbonised product
SO1: creating the business case for private investment	++	++	+++	++
	Sufficient to create business case since (depending on the exact rules), grants are generally able to close cost gaps to conventional production. Risks for projects are especially reduced at early stages (i.e. construction phase), while cost and price-related risks remain throughout the operational period.	CFPs effectively incentivise GHG reductions as support is only paid for operation and avoided emissions. They are designed to close the cost gap. However, as the support is static, changing market conditions may open up new cost gaps or lead to windfall profits (mainly with a view to carbon and energy prices). The level of risk for the beneficiary depends on the specific design. Theoretically, variable costs can also be mitigated via	CCfDs effectively incentivise GHG reductions as support is only paid for operation. Their link to the EU ETS price might disincentivise operation during longer periods in which the carbon price is above the strike price (due to the payback obligation albeit other market participants would need to face the same conditions). They are designed to close the cost gap. Bidders define the height of their bid and can thus tailor their support need. Fluctuation of input factors may affect the economic viability of supported projects.	A fixed premium effectively incentivises GHG reductions as support is only paid for operation (production of low-emission unit). While aiming to close the cost gap, a fixed premium per output unit is less certain to close the cost gap compared to floating support measures. Changing market conditions may alter the actual cost gap, while the funding remains static. This translates to some risk for the beneficiary, as the static support level may lead to over- or under-compensation in

		indexation in a fixed premium (which would run against the simplicity of CFPs though).	Indexation of input factors can mitigate these cost-related risks but imply additional complexity. CCfDs provide floating de-risking regarding the carbon price. There is a cash-flow risk related to high carbon prices (and subsequent payback obligations). Other than carbon variable costs can also be mitigated via indexation (which would further increase complexity of the scheme).	changing market conditions.
SO2: create an instrument with sufficient budget and duration	The choice of measure does not have an impact on achievement of this objective. It has to be, however, noted that a variable premium will involve a sizeable budgetary risk on the side of the administration, which requires budgetary provisions and hence might diminish the budget available for the allocation. In case of CCfDs, indexation to energy prices might also be needed which will require additional budgetary reserves.			
SO3: create an instrument operating in simple and flexible way thus addressing all sectors in all countries	+	++	+	++
	The design complexity of the instrument depends inter alia on the exact procedure for project selection and performance requirements (i.e. multicriteria selection is more complex and performance requirements imply significant MRV efforts).	CFPs have some design complexity, as a (specific) reference scenario is needed to determine the avoided emissions. The administrative complexity for bidders and support givers is comparably low.	CCfDs generally come with a high design complexity, resulting from high data input needs, a large number of parameters, and the need for regular adjustments. Their design and related complexity can be adjusted according to the respective process / technology to be supported.	A fixed premium per output unit has some design complexity, as the low-emission products need to be specified/defined. The administrative complexity for bidders and support givers is comparably low. However, MRV is needed to verify

	Also, the administrative complexity of the instrument depends inter alia on the exact procedure for project selection and performance requirements that need to be monitored. All sectors can be addressed.	However, depending on the actual support design, monitoring compliance and verifying emission reductions across diverse industries can be required. All sectors can be addressed.	The administrative burden for bidders is generally high , requiring sophisticated financial modelling and carbon accounting, which may prevent some small and medium-sized enterprises (SMEs) from participating in the support mechanism due to capacity constraints. There is also high administrative complexity for the administration , as regular calibration (e.g. of energy price indices) is required and CCfDs require monitoring compliance and verifying emission reductions across diverse EII industries. All sectors can be addressed.	low-emission production. All sectors can be addressed.
SO4: create an instrument that supports sectors producing CBAM goods	The choice of measure does not have an impact on achievement of this objective, it is the call design that has the impact.			
SO5: create an instrument that maximises success rate	++	++	+++	++
	There only sizeable difference is between (1) grants/fixed premia and (2) variable premium. A static support level (for measures B1, B2 and B4) can lead to overcompensation and the price and cost risks remaining with the project will increase its cost of capital. A variable premium is the most efficient as it adapts to the market			

of the projects.	circumstances and actual revenues of the project. Some stakeholders, however, indicate that institutional investors have preference for the fixed premium as it provides more visible funding flows, simplicity and, depending on the design, can allow higher remuneration of those investors. On the other hand, as the variable support measures decrease the investment risk (e.g. CO2 and energy price risk), they also decrease the return needs for investors. Low risk investments are cheaper (i.e. they have a lower cost of capital) and may attract more private capital. On the contrary, fixed premiums do not alter the risk profile of the investment per se (WACC remains constant), and, therefore, may be less beneficial in terms of attracting additional investments. It is possible that in the early years, the fixed premium would be preferable to create business confidence in the scheme and could progressively be replaced by a variable premium.

Table 3: Effectiveness of measures on geographical balance

Effectiveness (likelihood of achieving the objectives)	Measure GB.1: EU-level competition	Measure GB.2: National allocations for MS in terms of overall IDB spending	Measure GB.3: A part of the budget for EU-level competition and another part of the budget for national allocations
SO1: creating the business case for private investment	The choice of measure does not have an impact on achievement of this objective.		
SO2: create an instrument with sufficient budget and duration	The choice of measure does not have an impact on achievement of this objective albeit if extreme approach to compartmentalisation is applied, the national allocations (GB.2) may turn out to be too small to support large-scale investments.		
SO3: create an instrument operating in simple and flexible way thus addressing all sectors in all countries	+	+++	++
	Competition on the EU level is a simple method but depending on different factors of competitiveness, projects in certain countries or regions might perform better and secure larger share of funding. This approach might fail to address the specific needs and challenges of	National allocations is a simple method. National allocations ensure that project in all countries can benefit from the funding. This approach offers the best alignment of funding with the scale and type of the decarbonisation	Combination of the EU-level competition and national allocations is a simple method. National allocations ensure that project in all countries can benefit from the funding albeit the EU -level allocation is still rewarding the

	individual industries or regions, potentially leading to missed opportunities for targeted interventions, and it may exacerbate existing inequalities. Due to strong variety in operational cost, esp. energy cost, across MS, EU wide competition may lead to systematic over- and under-compensation of recipients in such MS.	challenges each Member State faces. This approach ensures the best outcome in terms of the geographical balance. Still to be noted that in case of limited amount of funding available for smaller Member States, it might not be sufficient to support the construction of any single commercial-scale project and to elicit the necessary level of competition ('fragmentation of funding')	pure excellence on the EU-level. This approach ensures the second best outcome in terms of the geographical balance.
SO4: create an instrument that supports sectors producing CBAM goods	The choice of measure does not have an impact on achievement of this objective.		
SO5: create an instrument that maximises success rate of the projects.	The choice of measure does not have an impact on achievement of this objective.		

3.4.2.2. *Efficiency*

In the table below measures are compared in terms of their efficiency, i.e. relationship between the expected benefits of a policy measure and the resources required to implement it.

As discussed above, for the purpose of analysis of impacts it was assumed that the IDB support fully covers the additional costs of the decarbonisation project during the 10-year support period and does not envisage neither potential additional revenues from green lead markets nor possible upside sharing mechanism that could be attached to the support. Many of the assumptions taken reflect a favourable outlook and thus projected cumulative GHG emission abatement of 1,630 Mt CO₂ over a 10-year period needs to be considered as an optimistic scenario. This result can be expected from the allocation mechanism structured as competitive bidding and would necessarily decrease if different method is chosen.

Amongst the policy measures analysed in this Impact Assessment there are no fundamental differences in the risk distributions between the public and private actors. Different models could be envisaged but it would require different sets of instruments to be analysed (e.g. loans, guarantees, equity stakes, contract for difference for the green products) and on more granular level beyond the scope of this IA (e.g. remuneration and seniority of the debt, remuneration of

equity, fixed premium addressing only a part of the funding gap etc). Such models and their specific features would have also a significant bearing on the overall efficiency of the support.

Table 4: Efficiency of measures

	Measure AM.1: multi-criteria call for proposals	Measure AM.2: auctions	Measure AM.3: administrative schemes	Measure: MS propose a shortlist
Comparison of measures on the allocation mechanism.	++	+++	++	++
	Cost efficiency in multicriteria calls is likely limited, unless cost-efficiency is also an award criterion. A recurring challenge in multicriteria calls is cost discovery. When responding to multicriteria calls for proposals, projects do not competitively bid on a single ‘price’ metric, meaning project pricing information may not reflect the true subsidy amount needed to support project realisation. These ‘information rents’ can in turn result in higher subsidies per tonne of CO₂ avoided or per unit of low-emission product than necessary, especially for more mature decarbonisation technologies	Auctions by definition enable competitive price discovery and typically deliver higher cost efficiency per euro spent than the other allocation mechanisms. The likely effect on private investment mobilised and GHG abatement is the highest. Medium administrative burden for application and evaluation stage. Production-based support typically operated with such a scheme performs less strong in the initial project phases, but incentivizes during the	Lower cost-efficiency compared to other measures because there is no ‘discovery’ of the subsidy need and if administratively fixed levels of remuneration is high there is a risk of overcompensation/windfall profits. Funds can be captured by the fastest rather than the most impactful or cost-effective projects and well-resourced applicants may ‘queue’ ahead of smaller players. Additionally, there is a risk that support will be given to projects that would have proceeded regardless of whether they received public support, creating a high risk of windfall profits. The likely effect on private investment mobilised and GHG abatement is lower. Low administrative burden for application and evaluation stage. Production-based support typically operated with such a scheme performs less strong in the initial project phases, but incentivizes during the operational phase.	In principle, the mechanism would risk performing less well on cost-efficiency, but thorough check of costs and benchmarking can limit this risk. Impact depends on the design made on the national level but it does not benefit from EU-wide competition. Likely, lower cost-efficiency compared to other measures. The likely effect on private investment mobilised and GHG abatement is lower. Low administrative burden (on the EU level) for application and evaluation stage.

	Consequently, the likely expected on private investment mobilised and GHG abatement could be lower. Highest administrative burden for application and evaluation stage (monitoring efforts depends on the call design).	operational phase. Production-based support typically operated with such a scheme performs less strong in the initial project phases, but incentivizes during the operational phase.		
	Measure FS.1: Regular grants	Measure FS.2: CFPs	Measure FS.3: CCfDs	Measure: fixed premium per unit of decarbonised product
Comparison of measures on the type of support provided.	++	++	+++	+
	Lower level of cost efficiency because a static support level can lead to overcompensation and the price and cost risks remaining with the project will increase its cost of capital. On the other hand, the investors see predictable funding inflows which provide simplicity and predictability. Efficiency will depend on very granular design features (how is the grant calculated, are there upfront payments, how is the premium defined etc). All of these features will influence the project’s risk profile and influence the cost of capital. The likely effect on private investment mobilised and GHG abatement will depend on this more granular design.		Highest cost-efficiency compared to other measures as variable premium adapts to market conditions and avoids overcompensation. The likely effect on private investment mobilised and GHG abatement is higher. Highest administrative burden.	
				Lower level of cost efficiency. A static support level can lead to overcompensation but if the market situation is adverse, price and cost risks remain with the project will increase its cost of capital. Depending on the granular design there can be very different impact. The likely effect on private investment mobilised and

	Lower burden for the administration that provide the support.			GHG abatement is lower. Lower administrative burden
Comparison of measures on the geographical balance	Measure GB.1: EU-level competition	Measure GB.2: National allocations for MS in terms of overall IDB spending	Measure GB.3: A part of the budget for EU-level competition and another part of the budget for national allocations	
	+++	+	++	
	The best efficiency achieved due to EU-level competitions that favours the most mature projects, with the best locations, benefiting from the favourable national industrial structures and national policies. In the long term, this measure can lead to missing some opportunities in countries/regions that are hampered by lack of administrative capacity/lack of innovation ecosystem rather than structural factors of their industry/economy .	The least efficient measure because it does not benefit from the EU-level competition.	The ‘second best’ measure which draws to large extent the benefits of the EU-level competitions and yet safeguards part of funding for national project. Possibly it avoids missing opportunities in terms of unlocking the potential of all EU MS in terms of industrial decarbonisation.	

3.4.2.3. Coherence

In general, there will be a strong interplay between the IDB and other climate and energy policies that will be implemented to reach the 2040 climate target and 2050 climate neutrality. The IDB will not be adding to the level of ambition of these targets and policies but will be an

enabler, by addressing the lack of business case of the industrial decarbonisation projects. As a general rule, the stronger the policies and/or their implementation, the lighter the amount of support to be provided by the IDB. Typically, with strong carbon prices and mandates for energy efficiency and renewables, the support of the IDB will need to be less onerous and can shift more towards income stabilisation.

As to interaction with other enabling policies that support the investments, the synergies should be sought in order to maximise their combined impact taking into account the magnitude of the investment challenge. The main interaction will take place with other funding instruments on the EU and national level. On the EU level, the final design of the European Competitiveness Fund (ECF) will be of key importance and common governance of the ECF with the IDB will help to ensure synergies. An example of avoiding overlaps could be focusing the IDB on EII projects that require a grant and the ECF on EII projects that require other financial instruments. Another example could be assessment and necessary adjustment between the respective work programmes/funding rounds of the IDB and ECF that would minimise the interplay. The respective rules on combined support would ensure that there is no ‘double funding’. Interplay with national support mechanisms (mostly taking form of State aid) will also be important. This can be discussed at relevant fora with the MS and, as a minimum, the State aid/IDB rules on combined support would ensure no overcompensation. The most efficient approach has already been pioneered by the ‘as-a-service’ feature of the IF calls for proposals, whereby MS can use the IF evaluation process and benefit from the EU-level competition in order to support project located on their territory. Prioritisation of the use of EU ETS national revenues to support projects in the scope of the EU ETS, notably via ‘topping up’ the EU ETS funds (e.g. IDB, IF, MF) would also increase the coherence between the national and EU-level funding.

Finally, IDB will interact with other instruments that influence the business case of the decarbonisation projects, notably the (Conditional) Free Allocation (FA), CBAM and indirect costs compensation (ICC). All those instruments improve the business case of the decarbonisation projects, so they have to be considered when sizing the IDB levels of support. For example, today the IF (or many State aid schemes) require the funding gap analysis for projects to be supported that explicitly takes into account:

- costs of electricity (with ICC, if relevant),
- revenue from the sale of final products (with CBAM affecting the prices offered by importers, if relevant)
- Free Allocation (both for the project itself and its competitors)

Similar approach could be applied when sizing the fixed premia (based on funding gap estimation of an illustrative projects considering ICC, FA and CBAM) and would naturally happen in the competitive bidding process where projects are incentivised to reveal their true costs in order to put an attractive bid that is likely to be awarded. It can be expected that an implementation of the ICC, (conditional) FA and CBAM that is strongly oriented towards investment support will reduce the amount of support to be provided by the IDB. Consequently, IDB could support more projects with smaller amounts and deliver overall bigger abatement (than what is discussed in Section 3.4.1.2 Expected GHG abatements). Larger group of sectors could therefore become beneficiaries of the IDB earlier on with positive spillover effects on the downstream sector.

To be noted that the investments eligible under the conditional FA would be similar to ones eligible for IDB support. In such case, it could be envisaged that the installation that receives the IDB support is considered to automatically fulfil the FA conditionality.

In the tables below measures are compared in terms of their coherence with other EU initiatives. In terms of coherence the measures on geographical balance or type of support make little difference. Only possible unintended consequences are discussed for the type of support and coherence is not discussed for measures on geographical balance (too small differences to be highlighted). Some subtle differences depending on allocation mechanism are identified below.

Table 5: Coherence of measures on allocation mechanism

	Measure AM.1: multi-criteria call for proposals	Measure AM.2: auctions	Measure AM.3: administrative schemes	Measure: MS propose a shortlist
Coherence with other EU funding programmes	++	++	++	+
	Regardless of the instrument chosen, IDB will focus on: • decarbonisation of EII • decarbonisation technologies going beyond FOAK, i.e. scale-up and roll-out of technologies that have been already demonstrated and commercialised. • and projects that have a funding gap. This stage in the ‘investment journey’ (from research to deployment on EU-level) is currently addressed only in very small extent by the IF (with insufficient resources) and could potentially be addressed by ECF (also with insufficient resources). The internal coherence with continuation of the IF can be ensured by restricting IF to FOAK kinds of projects. Also coherence with ECF can be ensured by, for example, focusing ECF for EII for funding instruments other than grants.			It depends on the design chosen by the MS to identify the short-list, there is potentially a risk of overlaps with EU funding programmes.
Coherence with other national funding programmes	++			+++
	Regardless of the instrument chosen, IDB can overlap with national funding programmes. This risk can be minimised by deploying an ‘as-a-service feature’ redirecting national spending to the EU-level instrument (see assessment of measures GB.1-C.4)			It depends on the design chosen by the MS to identify the short-list but MS should be able to control better the risk of overlaps
Coherence with EU initiatives and policies	Regardless of measures chosen, IDB will work hand in hand with the EU ETS and other regulatory decarbonisation measures. It can also align with objectives of industrial policy (e.g. on resilience)			
Possible unintended consequences	-	-	-	-
	Risk that multiple	Risk that uniform rules will not fully	Risk of under- or over-compensation	Risk that governance and

	award criteria are used to pursue too many objectives at the same time.	cater to the specificities of the different sectors. This could be mitigated by establishment of auction baskets.	albeit there could be mitigation measures put in place.	strategic oversight could remain challenging.

Table 6: Coherence of measures on the type of support

Possible unintended consequences	Option FS.1: Regular grants	Option FS.2: CfPs	Option FS.3: CCfDs	Options B.4: fixed premium per unit of decarbonised product
	+	+	++	+
	Risk of overcompensation or, conversely, insufficient subsidy once the market conditions change.		Risk of large liability in case carbon prices fall to very low level.	Risk of overcompensation or, conversely, insufficient subsidy once the market conditions change.

3.4.2.4. Assessment of policy options

	Policy Option (1)	Policy Option (2)	Policy Option (3)
	'Regular' multi-criteria calls for proposals 'Regular' grants covering the funding gap - EU-level competition and soft measures on geographical balance	- Administrative schemes - Fixed premium, - Balance between national allocations and EU-level competition	- Auctions, - Carbon Contracts for Difference, - Strong national allocations
Effectiveness	++	+++	++
Efficiency	+++	++	+++
Coherence	++	+++	++

In terms of effectiveness: Moderate impact of PO1 is expected as it addresses well the funding gap of industrial decarbonisation projects but represents operational complexity, high risk of projects' dropouts, administrative burden and geographical imbalances.

In contrast, strongly positive of PO2 is expected as it addresses well the funding gap of industrial decarbonisation projects and offers simplification, attractive financial model as well as clear rewards for 'front-runner' projects. The risk of unspent resources is minimised. There

is a strong alignment of funding with the scale and type of the decarbonisation challenges and proposal strikes a balance between the EU-level competition as well as geographical balance.

Finally, moderate impact of PO3 is expected as it addresses well the funding gap of industrial decarbonisation projects but with some design complexity and incentives for more risky projects. There is a risk of projects' dropouts and administrative burden while benefits of EU-level competition are less well pronounced.

In terms of efficiency: Policy Option 2 in theory is the less efficient that policy options working tools that require higher level of competition but other policy options there inherently attract more risky projects that in the end might not be implemented (if faced with adverse market conditions etc).

In terms of coherence: As climate action progresses and the hardest to abate emissions have to be reached, the EU ETS's instruments to support investment become more relevant to ensure the investments take place. The strengthened support provided by the continuation of the Innovation Fund and new Industrial Decarbonisation Bank are coherent with the carbon price signal and regulatory framework (both also driving the investments but currently not fully sufficient) as well as with other EU-wide funding mechanisms (targeting other stages of the technology development or 'investment journey') as well as with State aid rules that enable the funding on the national level. In addition, the set-up of the 'as-a-service' feature could enable even better integration of the State aid and EU-level funding if applied to the IDB funding instruments.

3.4.3. The preferred option

As the Innovation Fund would focus primarily on first- and second-of-a-kind projects in EIIs and beyond, the IDB would focus on more mature technologies in the EIIs. The IF would continue to focus on early-stage, high-risk projects with strong innovation and knowledge-sharing value, using primarily grants and performance-based payments. The IDB would build on the IF's projects (or projects supported by similar national funding instruments) successfully demonstrating and commercialising technologies, offering a more tailored support mechanism to accelerate replication and full-scale deployment. Complementary and sequential instruments would ensure continuity of support and reduce the 'valley of death' between demonstration and market uptake.

After assessing the impacts, effectiveness, efficiency and coherence of the three sets of policy options for IDB, all options have their respective advantages and drawbacks, and some options perform better than the others on certain aspects. Ultimately, their merits and the shortcomings are also very much dependent on the complete and detailed funding instrument design (e.g. as is the case of the IF calls for proposal or IF auctions Terms & Conditions) as well as the realities of the industrial sectors, technologies or products the instrument wants to address and whether those sectors/technologies/products operate on mature or nascent markets with reference price or not.

The choice of sectors, technologies or products that are to be supported will have a significant impact on choice of certain options, notably of allocation mechanism. The IDB will aim to support all EIIs sectors, but its specific funding instruments will, most likely, need to have some more narrower focus (certain sectors or goods or technologies only) in order to be effective and answer to political priorities. Typically, auctions can only work with homogenous, well defined good. The choice of objectives for the funding instrument will be equally significant. Auctions and administrative schemes are less-well suited to pursuing excellence across a range of objectives (cost of abatement but also resilience, project maturity

or others). Finally, the choice of sectors, technologies or products will have a bearing on whether the support mechanism seeks short-term efficiency (focus on the lowest cost will leave initially costlier options not developed) or more longer-term efficiency and more diverse technology portfolio by providing support to initially more expensive but otherwise promising technology options.

None of the options inherently have the best design to ensure the **optimal combination of maximum efficiency** (i.e. no overcompensation) and the **maximum effectiveness** (i.e. making sure the projects are delivered on time). Likewise, none of the options on geographical balance inherently have the best design to ensure the best efficiency (by drawing on the EU-level competition) and geographical balance in terms of ensuring that projects in all countries can secure a fair share of funding. This is why a careful balance will have to be struck in terms of choice of instruments over the entire lifetime of the IDB, and in the design of finer details of the instruments (completion/bid bonds, penalties for non-delivery, non-price criteria, potential for replication, reward for the front-runner, upside sharing mechanisms) and in considerations of interactions with conditional Free Allocation¹²⁴ and Indirect Cost Compensation.

From the IF experience, it is clear the specific instrument design will be decisive for the final outcome in terms of efficiency, effectiveness and coherence. This has become apparent also in national contexts, where for instance auctions for renewable power have performed very differently across MS and in the context of changing market circumstances. For the past IF instruments, their success has been largely derived from designing IF calls together with industrial stakeholders, institutional and private investors and project developers themselves.

Considering the variety of national and sectoral circumstances, changing policy priorities and new challenges that might arise on the pathways to carbon neutrality, there can be no ‘one size fits all’ approach. Ultimately, funding mechanisms need to cater to a variety of national, sectoral and market circumstances. As a result, there is **no preferred** allocation mechanism, type of support or ways to ensure the geographical balance. Instead, **a toolbox of funding instruments is needed under the IDB** to keep full flexibility in adapting the tools to policy priorities and industrial realities. Across the IA, three policy options have been developed for each area of actions that combine specific policy measures into meaningful ‘packages’ addressing problem drivers and related objectives. The options differ in the degree of change that they entail to the current system. In addition, for the IDB the logic of the 2 phases in the IDB is reflected in Policy Option 2 and 3.

In the first phase of the IDB, there are many uncertainties for the industrial decarbonisation projects. Consequently, there is an urgent need to provide support that creates **solid business cases** against the backdrop of existing market failures, uncertain market outlooks and short-termism of the investment decisions. This is why the Commission in the early years of the IDB operationalisation could start with **administrative schemes awarding a carbon fixed premium** to all projects that enter into operation by a given date (within the budget available) and aim to strike the balance between the EU-level competition and national allocations (notably for solidarity purposes). Such approach would facilitate creating business confidence, avoiding high drop-out rate and risk of speculative bids that unnecessarily block public funding and providing the incentives for front-runner projects – which will be essential in the first year of the IDB operation. The main goal should be **optimising the effectiveness of support** (i.e. ensuring that projects happen on the ground). This approach would deliver the ‘Investment

¹²⁴ To be noted that investments eligible under the conditional Free Allocation would be similar to ones eligible for IDB support. In such case, it could be envisaged that the installation that receives the IDB support is considered to automatically fulfil the Free Allocation conditionality.

Booster’ that was announced at the European Council in March 2026¹²⁵ as the first stage of the IDB with 400 million ETS allowances made available starting ahead of 2030 to finance industrial decarbonisation investments with focus on speed and solidarity. This approach is integrated in the Policy Option 2 in the Impact Assessment.

In the second phase of the IDB, as technologies mature, EU ETS prices increase and regulatory frameworks fully take effect, the Commission could move to auctions for a variable premium in the form of Carbon Contracts for Difference in order to **optimise the efficiency of the support**. This could be combined with stronger national allocations, in the form of ‘as a service’ contributions or by applying by the Commission ‘right of the first use’ to ensure that decarbonisation projects materialise in all countries and bring positive spillover effects to them. This approach is integrated in the Policy Option 3 in the Impact Assessment. Other allocation mechanism, forms of support and tools to incentivise geographical balance explored in this Annex might be also needed in order to best stimulate the investment in the industrial decarbonisation on the way towards 2040 climate target.

¹²⁵ https://ec.europa.eu/commission/presscorner/detail/en/statement_26_663

ANNEX 10: AVIATION

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1. DESCRIPTION OF THE AVIATION MEASURES

For aviation, the measures vary on the geographical scope of application (AS) of the ETS carbon price, or on the availability of support for the uplift of sustainable aviation fuels (SAF).

1.1. AS0: Baseline

The EU ETS would apply to most departing and arriving flights from EEA from the start of 2027, if no amendment to the ETS Directive was adopted. Currently, the flights exempted from this scope are those incoming from Switzerland and the UK, which are covered by carbon pricing systems. The ETS Directive also permanently exempts flights to and from around 75 Least Developed Countries and Small Island Developing States¹²⁶. Other incoming flights could be exempted if this is considered optimal interaction. This is not assumed in the baseline, but it would reflect the EU's fair share of emissions while maintaining equal treatment of aircraft operators on routes, with the EU regulating departing flights, while other countries would be responsible for flights to the EEA¹²⁷. AS2 acts as this variation. Costs from CORSIA offsetting could also be deducted, as described in AS2, although this variation is not modelled here.

1.2. AS1: Current scope prolongation contingent on CORSIA implementation

This measure applies in case the Commission assessment finds that CORSIA has been sufficiently implemented by key third countries and has been strengthened (see section 5 below). The EU would continue to apply the ETS and CORSIA according to the current scope, as long as CORSIA implementation is maintained and strengthened. This means that the EU ETS carbon price would continue to apply to flights within and between EEA States, as well as to departing flights to Switzerland and the UK. For countries that should be participating in CORSIA offsetting but are not doing so, the EU ETS would apply in both directions. Emissions between some countries would not be covered by a carbon price¹²⁸. CORSIA would apply to remaining flights between participating countries. Airlines would have to offset emissions above the negotiated baseline¹²⁹ until 2035 when CORSIA is set to end. In 2032 the ICAO Council is set to consider the termination of CORSIA, its extension or any other improvements beyond 2035¹³⁰, which could be decided upon at the ICAO Assembly in autumn 2034. Should CORSIA end, a new solution to ensure meaningful carbon pricing of international aviation emissions would need to be found. The Commission would report on changes of CORSIA's emissions coverage in its annual Carbon Market Report.

1.3. AS2: Departing flights with CORSIA offsetting cost deduction

This measure applies in case the Commission assessment of CORSIA is that it has not been implemented by key third countries and has not been strengthened (see section 5 of this Annex, *Assessment of CORSIA pursuant to Art. 28b of the ETS Directive*). In this case, EU ETS

¹²⁶ As defined by the United Nations, except for States with a GDP per capita equal or exceeding Union average.

¹²⁷ This approach has been noted as a practical way to solve the issue of Common but Differentiated Responsibilities and Respective Capabilities, which has been a longstanding challenge in the UNFCCC context. See example [here](#).

¹²⁸ CORSIA and the EU ETS exempt flights involving Least Developed Countries and Small Island Developing States. From January 2027, CORSIA should become mandatory for flights between 34 countries (resulting in offsetting above the baseline). Unless they voluntarily participate, flights involving other countries are not covered by CORSIA. As of 2025 and the latest list applicable to 2026, 130 countries voluntarily participate in CORSIA, accounting for 51% of emissions from international aviation.

¹²⁹ As of 2024, the CORSIA baseline is 85% of 2019 CO₂ emissions, meaning around 500 Mt CO₂ per year are not addressed by CORSIA. See: ICAO *CORSIA Central Registry: Information and Data for Transparency, Part II: Total CO₂ emissions for 2019 Aggregated for all Aeroplane Operators on each State Pair*, 2022.

¹³⁰ ICAO [Assembly Resolution A42-22](#).

coverage would *remain* unchanged for 107 countries¹³¹, and would apply to around 85¹³² additional destination countries, with the possibility for airlines to deduct CORSIA offsetting costs. Where the ETS carbon price applies and the country participates in CORSIA, airlines can deduct CORSIA offsetting costs to avoid double charging. AS2 would entail cap adjustments proportionate to the extension in scope of the ETS carbon price. To preserve the environmental integrity of the ETS, the deduction would be accompanied by the cancellation of an equivalent amount of allowances. The geographic scope is expected to result in increased ETS revenues, part of which would be used to extend support for SAF uplift by an additional amount of allowances¹³³.

1.4. SAF0: Baseline, support expires in 2030

The ETS Directive reserves a maximum of 20 million allowances from 1.1.2024 until 31.12.2030 for the use of eligible fuels on routes covered by the ETS carbon price (Article 3c(6)). Without action by the European Parliament and the Council, this support would expire or run out.

1.5. SAF1: extension of support by medium amount

The support available in the ETS Directive would be extended by a medium amount from 2028 to continue providing the immediate incentive that the EU ETS gives for use of e-fuels and biofuel and ensure a smooth transition between the current support and the extension. The support focuses on the cleanest alternatives to kerosene. Support would be coupled with conditionalities, such as having a long term off-take contract agreement in place, to further incentivise lasting emissions reductions and support long-term investments in the decarbonisation of aviation. See analysis and amounts in section 8.

1.6. SAF2: extension of support by higher amount

The support available in the ETS Directive would be extended by a larger amount compared to SAF1 and focus on the cleanest alternatives to kerosene i.e. electrification and e-fuels. Support would be coupled with conditionalities to further incentivise and accelerate emissions reductions and support long-term investments in aviation decarbonisation. It would entail the same cap adjustments as in SAF1, proportionate to the extension in scope of the ETS carbon price. See analysis and amounts in section 8.

1.7. AS general elements

Several elements apply in a uniform manner across all options. On geographic scope, the ETS Directive as in force since 2023 permanently exempts flights to and from around 75 Least Developed Countries and Small Island Developing States¹³⁴. This exemption is maintained across all measures. In case of **hub carbon leakage**, the ETS would apply in both directions, on an equal-treatment-on-routes basis.¹³⁵ This would mean that if displacement of emissions to a hub outside Europe were to be found, the aim would be to bring emissions back into the scope of climate measures by applying a meaningful carbon price. Impacts would depend on a case-by-case basis, applied in an equal manner on route(s) concerned. The linear reduction factor is

¹³¹ Refers to EU ETS coverage for EEA countries, departing flights to Switzerland and the UK, and EU ETS exemption for around 75 Least Developed Countries or Small Island Developing States.

¹³² The [UN](#) currently recognises 193 countries: removing the countries in the footnote above leaves 86 countries. ICAO members in 2026 are the same, except that Liechtenstein is not a member, and Cook Islands are a member of ICAO but not the UN.

¹³³ As foreseen by the ETS Directive Article 3c(6), penultimate paragraph.

¹³⁴ As defined by the United Nations, except for those States with a GDP per capita equal or exceeding Union average.

¹³⁵ The EU ETS carbon price would apply to any airline flying on that route.

set for the ETS as a whole and is 4.4% in the baseline and all options, for detail see subsection 5.1 of the Impact Assessment. In addition, the EU could provide “ETS-as-a-service” to interested third countries, which could receive a share of the revenues for climate purposes. However, this is not included in the modelling.

Outermost regions¹³⁶:

The EU ETS temporarily exempts **domestic flights to and from outermost regions**¹³⁷ (e.g. Tenerife – Madrid; Madeira – Lisbon), as well as flights between two different outermost regions of the same Member State (Madeira - Azores) until 31 December 2030. From an environmental perspective, this exemption covers about 7% of EU ETS aviation emissions¹³⁸. CORSIA does not foresee any special status or exemptions for remote or outermost regions. The remaining exemption is set to expire, as all sectors of the economy must contribute to addressing the climate challenge. ETS carbon pricing applies on **flights between any EEA country and outermost regions**¹³⁹ since 2024. *Table 1* compares data between 2019 and 2024. For flights that have been covered by the ETS since January 2024, it shows an increase of activity of 22% since 2019 and of 10% since 2023 (when these emissions were not covered by carbon pricing). This suggests no correlation between ETS coverage of these flights and demand. See further analysis in subsection 6.2 below.

Table 1: 2024 vs 2019 traffic comparison by route, absolute activity and as percentage of total aviation activity under the ETS.

Route	2019		2024	
	Number of flights	% of total ETS flights	Number of flights	% of total ETS flights
Total under ETS	9251097	100%	8831184	100%
Non-domestic routes between an OMR and any EEA destination	97197	1%	118442	1%
+ OMR-UK	60156	1%	77209	1%
+ OMR-CH	3024	Negl.	3806	Negl.
Route between an OMR and its mainland	91619	1%	113000	1%
+ exempted under PSO	409	Negl.	164	Negl.
Route within the same OMR	2448	Negl.	7433	Negl.
+ exempted under PSO	104828	1%	108764	1%
Route between two different OMRs of the same MS	16171	Negl.	13916	Negl.

¹³⁶ French Guiana, Guadeloupe, Martinique, Mayotte, Reunion Island and Saint-Martin (France), Azores, Madeira (Portugal), The Canary Islands (Spain).

¹³⁷ Within the meaning of Article 349 of the Treaty on the Functioning of the European Union.

¹³⁸ In 2024, the EU ETS covered 64Mt CO₂ of aviation emissions, compared to 0.013 Mt CO₂ emissions from flights between outermost regions of the same member state (exempted until December 2030) and 4.3Mt CO₂ emissions from flights to/from outermost regions from/to their respective Member State (considered as domestic, exempted until December 2030).

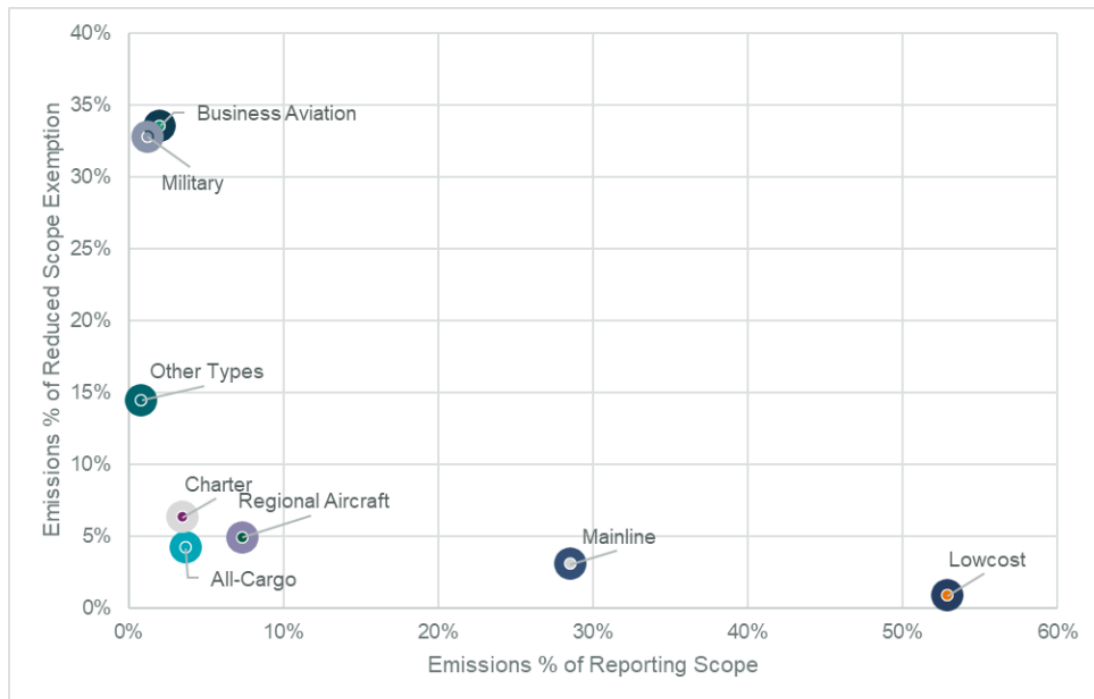
¹³⁹ Other than Domestic.

+ exempted under PSO	604	Negl.	843	Negl.
Total exempted under PSO	164853	2%	129077	1%

Negl. Stands for negligible, for figures that would round to 0.0%.

Private & business jets inclusion: Currently the EU ETS provides for an exemption for aircraft with a total mass below 5700 kg; for flights of non-commercial aircraft operators with annual emissions less than 1000 tonnes; and for flights of commercial aircraft operators with yearly emission less than 10000 tonnes or less than 243 flights in each four-month period¹⁴⁰ on full scope. The majority of emissions from business aviation come from flights to or from the EU. The combined effect is that the majority of business aviation is *de facto* exempted from any obligation of reporting or surrendering allowances. Business aviation flights which are exempted from the EU ETS amounted to 2% of emissions of the intra-EEA scope in 2024 but represent 34% of all exempted emissions. As demonstrated in Figure 1 below, only military flights achieve the same imbalance, while notably mainline and low-cost airlines show high emissions coverage with minimal exemptions applied to them.

Figure 1: Scale of exempted emissions by type



Source: Ricardo analysis of Eurocontrol data

A core complexity is that business aviation spans both commercial and non-commercial operations¹⁴¹, making clear categorisation difficult. Therefore to ensure simplification and appropriate internalisation of the climate impacts (D2) of private and business aviation, all

¹⁴⁰ This corresponds approximately to one return flight a day.

¹⁴¹ [Decision \(EC\) No 2009/450 of 8 June 2009 on the detailed interpretation of the aviation activities listed in Annex I to Directive 2003/87/EC of the European Parliament and of the Council](#) provides that commercial aircraft operators are those that hold an air operator's certificate (AOC) and the characteristic of being commercial is linked to the operator and not to the flights in question. This means that a commercial operator (one holding an AOC) may perform non-commercial flights, but those would be considered commercial under the EU ETS.

options include lowering the emissions threshold for all aircraft operators to 500 tCO₂ irrespective of their commercial status to increase the reach of carbon pricing.

This element introduces a “proxy” for defining private and business flight that is operationally precise for monitoring and compliance under the EU ETS and does not rely on the commercial status of the operator, which proved inefficient in identifying business aviation flights. These flights have not paid an ETS carbon price in the past, contradicting the polluter pays principle, as these planes usually have four to fourteen times higher per-passenger emissions than the average economy-class passenger¹⁴², coupled with far superior financial resources. Every emitter and every person needs to contribute¹⁴³. Considering the large carbon footprint per passenger of these flights, it is appropriate to cover these in line with the geographical scope under all policy options.

The Commission proposes considerable administrative simplification for any newly covered aircraft operators as well as further simplification for low activity operators already covered. This includes simplified monitoring and reporting, a waiver of verification as well as exclusion for aircraft operators with very low EU ETS surrender obligation. Please see subsection 7.2 for details, including simplification measures applicable to all operators.

2. WHAT ARE THE IMPACTS OF THE MEASURES

This section assesses the environmental, economic and social impacts of each aviation measure. To note, the measures SAF1 and SAF2 are assessed separately in the context of AS2 scope. This is because the revenues from AS2 scope are needed to finance SAF1 and SAF2.

2.1. AS0: Baseline

When accounting for the increasing use of SAF as mandated by ReFuelEU aviation and global SAF uptake projections by ICAO, global¹⁴⁴ aviation CO₂ emissions should decrease to 590Mt CO₂ in 2040. Without accounting for the use of SAF, these emissions would increase: from 690 Mt CO₂ in 2024 to 763Mt CO₂ in 2040. See Table 2 for emissions modelling which accounts for SAF use, and further detail in the aviation support study¹⁴⁵. When comparing the measures, the biggest impact can be seen in the “Extra-EEA (outbound)” segment where the ETS either applies (AS0), CORSIA applies (AS1), or the ETS applies with a deduction of CORSIA offsetting costs (AS2). For the economic impacts of the baseline, consult the Impact Assessment.

Table 2: AS0: Aircraft CO₂ emissions for 2024, 2040, emissions from SAF are zero-rated

Type of route	AS0 CO ₂ emissions (MtCO ₂)	
Year	2024	2040
Domestic	16	10
Intra-EEA + departing to UK/ CH	54	33
Extra-EEA (outbound)	76	49
International non-EEA related routes	466	436

¹⁴² Transport & Environment, [Private jets: can the super rich supercharge zero-emission aviation?](#), 2025, And Carbon Market Watch, [Sky polluters, time to chip in... Citizens, time to cash in!](#), 2025.

¹⁴³ [Political Guidelines 2019-2024](#).

¹⁴⁴ Inside Europe: domestic and non-domestic and departing flights to Switzerland and the UK, outside Europe: non-domestic only.

¹⁴⁵ Support for the review by the Commission concerning the implementation of ICAO’s CORSIA, and for Commission reports on certain types of flights, social impacts, and air connectivity of islands, remote territories and Iceland, by WSP July 2026 forthcoming. Referred to as “aviation support study”.

Global: inside EEA: domestic & non-domestic; outside EEA: non-domestic	689	589

2.2. AS1: Current scope prolongation contingent on CORSIA implementation

When accounting for the increasing use of SAF, global aviation CO₂ emissions should decrease to 599Mt CO₂ in 2040. Without accounting for the use of SAF, in AS1 global aviation emissions would increase 2% above the baseline to 775Mt CO₂ in 2040. See Table 3, and further detail in the aviation support study. As above, the biggest difference can be seen in the Extra-EEA (outbound) flight segment.

Table 3: AS1: Aircraft CO₂ emissions for 2040 and vs AS0, emissions from SAF are zero-rated

Type of route	AS1 CO ₂ emissions (MtCO ₂) in 2040	Percentage change vs baseline
Domestic	10	+/-0% vs AS0
Intra-EEA + departing to UK/ CH	33	+/-0% vs AS0
Extra-EEA (outbound)	54	+10% vs AS0
International non-EEA related routes	436	n/a
Global	599	+2% vs AS0

Competition aspects: Competitive distortions for **airlines** may arise when policies do not apply equally on routes, and where they are not enforced equally, under whichever policy option. Enforcement has been crucial for the success of the EU ETS to date¹⁴⁶. All options apply uniformly per route to all airlines so do not create distortions. Airlines with a higher share of flights on ETS-covered routes may be less able to cross-subsidise from other routes, but this choice is not simple and comes at a price. Past studies argue that the risk of such cross-subsidisation is minimal¹⁴⁷. This is consistent with the 2021 Aviation ETS Impact Assessment. The application and enforcement of CORSIA is different from the EU ETS and assessed in section 5 below.

The 2021 impact assessment found that carbon leakage risks such as **tourist destination** switching, were low, due to the nature of air travel (passengers usually know where they want to go and prefer direct flights¹⁴⁸), also confirmed by external studies¹⁴⁹. Emissions reductions and the absence of carbon leakage, from the application of the Fit-for-55 policies, have been identified also when modelling these policies for global aviation, while carbon leakage to other sectors is mostly identified in case aviation fuel demand reduction leads to overall fuel price reductions¹⁵⁰. A previous study also concluded that demand has historically been relatively insensitive to cost changes¹⁵¹. The aviation support study finds that AS1 can lead to distortion of the level playing field more than the baseline or AS2, when comparing a flight within the EEA versus a flight from the EEA to a third country. The opposite is true for an incoming flight to the EEA from a third country versus a flight between two third countries: AS1 results in a

¹⁴⁶ Following some airlines paying fines for non-compliance for their flights within the EU, all major airlines have maintained compliance with the system.

¹⁴⁷ CE Delft, Giving wings to emissions trading: inclusion of aviation under the European emissions trading scheme (ETS): design and impacts, 2005; CE Delft and MVA. Implications of EU emissions trading scheme for competition between EU and non-EU airlines, 2007. These studies have not been updated since, but continue to be referenced in relevant literature.

¹⁴⁸ Verma, T., Rebelo, L., Araujo, N., *Impact of Inter-Country Distances on International Tourism*, 2019.

¹⁴⁹ E.g., SEO & NLR, *Aviation Fit For 55 – Ticket Prices, Demand and Carbon Leakage*, 2022.

¹⁵⁰ Wei, T., Kallbekken, S., *Carbon leakage from aviation under the European Union Fit for 55 policies*, 2024.

¹⁵¹ ICF et al., *Assessment of ICAO's global market-based measure (CORSIA) pursuant to Article 28b and for studying cost pass through pursuant to Article 3d of the EU ETS Directive*, 2020, p. 236.

more level playing field than AS2 (no ETS application on routes under AS1 apart from flights to the UK and Switzerland).

2.3. AS2: Departing flights with CORSIA offsetting cost deduction

When accounting for the increasing use of SAF as mandated by ReFuelEU aviation, aviation CO₂ emissions should decrease to 595Mt CO₂ in 2040. Without accounting for the use of SAF, in AS2 global aviation emissions would increase 1% above the baseline to 768Mt CO₂ in 2040. See Table 4, and detail in the aviation support study. As above, the biggest difference can be seen in the extra-EEA (outbound) flight segment. There is no difference for those flights which are already covered by the ETS today, showing that an extension to departing flights is not expected to affect intra-European flights.

Table 4: AS2: Aircraft CO₂ emissions for 2040 and vs AS0, emissions from SAF are zero-rated

Type of route	AS2 CO ₂ emissions (MtCO ₂)	Percentage change vs baseline
Domestic	10	+/-0% vs AS0
Intra-EEA + departing to UK/ CH	33	+/-0% vs AS0
Extra-EEA (outbound)	54	+4% vs AS0
International non-EEA related routes	436	n/a
Global	595	+1% vs AS0

Competition: For competition between airlines and tourist destinations in AS2 please refer to the description and comparison in AS1.

Auction revenues: In AS0, auction revenues from aviation would be highest, as the ETS applies to incoming and departing flights. Total revenues would be projected at EUR 20bn in 2030, EUR 24bn in 2035, and EUR 38bn in 2040. In AS1, auction revenues would be lowest, as the scope of ETS application is smallest. Total revenues would be projected at EUR 6bn in 2030, EUR 7bn in 2035, and EUR 11bn in 2040. In AS2, which applies the ETS to departing flights and includes the possibility to deduct CORSIA offsetting costs, revenues would be projected at EUR 13bn in 2030, EUR 14bn in 2035, and EUR 23bn in 2040. To be noted, these are the auction revenues before any deductions for ETS-financed targeted support. As presented below, SAF2 would likely exhaust auctioning revenues of AS2.

CORSIA costs: Tables 5 and 6 show the amount of CORSIA offsets to be bought for EEA departing flights and the corresponding costs per policy measure. In AS0, CORSIA costs would be lowest, since the implementation of CORSIA is currently set to end by 2027. In AS1, CORSIA costs are highest, because appropriate CORSIA participation is assumed (all countries that should implement CORSIA from 2027 do so, and all countries that currently implement CORSIA continue to do so). In AS2 CORSIA costs are medium. In 2024, CORSIA costs were zero as aviation CO₂ emissions on international routes were below 500Mt in 2023.

Table 5: Offsets to be bought for CORSIA for EEA departing flights in policy measures

Policy measure - scope	Offsets for EEA departing flights (in million)		
	2024	2030	2035
AS0 (baseline)	0		
AS1 (clean cut)	0	13	20
AS2 (departing flights)	0	10	15

Table 6: Costs for CORSIA for EEA departing flights in different policy measures

	CORSIA Costs (in billion EUR2023)

Policy measure - scope	2024	2030	2035
AS0 (baseline)	0		
AS1 (clean cut)	0	0.4	2
AS2 (departing flights)	0	0.3	1

2.4. SAF0, SAF1, SAF2

SAF support is analysed in more detail in section 8, including use of auction revenues. The level of SAF uptake is assumed to be in line with the legal mandate of ReFuelEU Aviation. Possible uptake levels above ReFuelEU mandates are not modelled, given large uncertainties in this nascent market, high price differentials with fossil kerosene, and to avoid overestimating available supply. Therefore, the environmental impacts under SAF1 and SAF2 are assumed to be the same. SAF is zero-rated under the EU ETS, meaning it is counted as if it had no emissions. However, in general SAF still results in emissions¹⁵².

Competition between airlines: In all SAF measures, all commercial airlines operating flights covered by the ETS scope are eligible to access the SAF support, pending their demonstration of SAF uptake and available allowance volumes. This provides a level playing field to all airlines operating under the ETS. The ReFuelEU SAF mandates apply to all flights departing from Union airports, independent from their destination. Under AS1 geographic scope, part of the flights subject to ReFuelEU mandates would receive ETS SAF support with the mandates being the main reason for airlines to pay SAF costs. Under AS2 geographic scope, the scopes almost¹⁵³ align and most flights would be subject to the mandate as well as eligible for the SAF support, ensuring a level playing field between airlines irrespective of whether they operate more intra-EEA or extra-EEA flights. Therefore, SAF1 and SAF2 improve the level playing field the most, SAF2 with higher amount of support reserved would additionally ensure this for longer. However, it comes with the opportunity cost of not using these allowances for other climate purposes.

Competition between tourist destinations: Considering SAF measures depend on the geographic scope, please refer to subsections 2.2 and 2.3 on AS1 and AS2. SAF2, due to the greater amount of support made available, supports the level playing field more than SAF1.

3. FURTHER ANALYSIS ON POLICY OPTIONS

3.1. Analytical tables complementing the Impact Assessment

Please see below analytical tables to complement subsection 6.2.3.3 of the Impact Assessment. All numbers are based on the aviation support study, which contains further detail.

Table 7: Passenger demand, ticket prices, cargo demand and rates in 2040 for extra-EEA departing flights

Passenger demand in million passengers in 2040			
Extra-EEA departing flights			
	Baseline	PO1	PO2/ PO3

¹⁵² For instance, zero-rated Hydroprocessed Esters and Fatty Acids (HEFA) results in 65 to 69% of GHG emissions savings, Alcohols to Jet (AtJ) in 65% to 70% and Biomass Gasification + Fischer Tropsch (Gas + FT) in 85% to 95%. Source: [Study supporting the impact assessment of the ReFuelEU Aviation initiative – Final report](#), 2021, p. 154.

¹⁵³ The difference is that the ETS exempts flights to Least Developed Countries and Small Island Developing States, whereas ReFuel still applies to flights to these destinations.

First/ business	18	19	18
% change vs. baseline	n/a	+2%	+1%
% change vs. 2024	+59%	+62%	+61%
Economy	139	146	142
% change vs. baseline	n/a	+5%	+3%
% change vs. 2024	+47%	+55%	+51%
Low-cost	56	62	59
Vs baseline	n/a	+11%	+5%
Vs 2024	+29%	+43%	+36%
Ticket prices in EUR(2023) per passenger kilometre in 2040			
First/ business	0.35	0.32	0.33
% change vs. baseline		-7%	-3%
% change vs. 2024	+30%	+21%	+25%
Economy	0.084	0.078	0.081
% change vs. baseline		-7%	-3%
% change vs. 2024	+30%	+21%	+26%
Low-cost	0.064	0.056	0.060
Vs baseline		-12%	-6%
Vs 2024	+59%	+40%	+50%
Cargo demand in million tonnes in 2040			
Cargo demand	7	7	7
% change vs. baseline		6%	3%
% change vs. 2024	+37%	+45%	+41%
Cargo rates in EUR(2023) per tonne kilometre in 2040			
Cargo rates	0.53	0.49	0.51
% change vs. baseline		-8%	-4%
% change vs. 2024	9%	Negl.	5%

To show the effect of ETS scope and ETS-financed SAF support side by side for cargo, compare results for 2035 in table 8:

Table 8: Cargo demand and rates in 2035

Cargo demand in million tonnes in 2035				
	Baseline	PO1	PO2	PO3

Cargo demand	6	6	6	6
% change vs. baseline		4%	2%	3%
Cargo rates in EUR(2023) per tonne kilometre in 2035				
Cargo rates	0.519	0.488	0.501	0.497
% change vs. baseline		-6%	-4%	-4%

Source: Aviation support study

Table 9 shows kerosene and SAF costs over time. Kerosene costs decrease because the share of kerosene in the fuel mix decreases, while the share of SAF increases. SAF costs rise very significantly, because they start from a very low share of the fuel mix in 2024, and because SAF costs are higher than kerosene costs. See the aviation support study for detail.

Table 9: Kerosene and SAF costs for airlines for extra-EEA departing flights

Fossil fuel costs in billion EUR (2023) in 2040			
Extra-EEA departing flights			
	Baseline	PO1	PO2/ PO3
Fossil fuel	15	17	16
% change vs. baseline	n/a	8%	4%
% change vs. 2024	-22%	-16.2%	-19.2%
SAF costs in billion EUR (2023) in 2040			
Extra-EEA departing flights			
SAF	199	215	207
% change vs. baseline	n/a	+8%	+4%
% change vs. 2024	+9009%	+9698%	+9338%

Source: Aviation support study

The aviation support study finds different evolutions of the **carbon cost compared to total fuel cost**¹⁵⁴ between 2023 and 2035/2040: the share of the carbon cost decreases under PO1 and increases under PO2/3 (modelling takes into account the CORSIA offsetting cost deduction). Carbon cost is defined as the cost that is internalised through carbon pricing, i.e. costs for ETS and CORSIA.

Table 10: Carbon costs as a percentage of fuel costs over time for intra-EEA and departing flights

Intra-EEA and departing (domestic, intra, and extra-EEA flights)	
Policy option	Carbon costs as % of fuel costs (incl. carbon)

¹⁵⁴ This includes cost of fossil kerosene, SAF, and the carbon price.

	2024	2030	2035	2040 (%)
Baseline (full scope)	8%	25%	24%	29%
PO1 (clean cut)		10%	12%	10%
PO2 (departing flights, medium SAF support)		15%	18%	20%
PO3 (departing flights, larger SAF support)		15%	9%	20%

Source: Aviation support study.

Table 11: Carbon costs as a percentage of total operating costs over time for intra-EEA and departing flights

Intra-EEA and departing (domestic, intra, and extra-EEA flights)				
Policy option	Carbon costs as % of total operating costs			
	2024	2030	2035	2040 (%)
Baseline (full scope)	2%	7.4%	7.8%	10.3%
PO1 (clean cut)		3%	4%	3%
PO2 (departing flights, medium SAF support)		4%	6%	7%
PO3 (departing flights, larger SAF support)		4%	3%	7%

Source: Aviation support study.

Table 12: Carbon costs as a percentage of fuel costs (incl. carbon) over time for extra-EEA flights

Extra-EEA flights (departing + incoming)				
Policy option	Carbon costs as % of fuel costs (incl. carbon)			
	2024	2030	2035	2040 (87%)
Baseline (full scope)	0%	25%	25%	30%
PO1 (clean cut)		2%	6%	0%
PO2 (departing flights, medium SAF support)		12%	15%	16%
PO3 (departing flights, larger SAF support)		12%	8%	16%

Analysis relating to SAF support and ETS revenues in subsection 6.2.3.3 of the Impact Assessment:

The figures in table 13 show annual snapshots, therefore the SAF support for the year 2035 shows as larger than the cap in that year. However, it would be financed by cumulative revenues from the previous years (therefore not resulting in a negative cap overall). Total EUA demand corresponds to all aviation CO₂ emissions covered by the ETS. The aviation cap net of SAF support is what remains of the cap, once the SAF support is deducted. Compliance costs are what airlines have to pay in the end, i.e. total demand minus ETS-financed SAF support.

Table 13: Aviation EUA demand in million EUAs, aviation cap, cap net of SAF support, and compliance cost in EUR million

	Total EUA demand (m EUAs)	Aviation cap (m EUAs)	Aviation cap net of SAF support (m EUAs)	Compliance cost (m EUR)

<i>Baseline 2030</i>	181	67	67	20
<i>Baseline 2035</i>	171	45	45	24
<i>PO1 2030</i>	54	21	21	6
<i>PO1 2035</i>	51	14	14	7
<i>PO2 2030</i>	119	44	19	10
<i>PO2 2035</i>	109	29	29	15
<i>PO3 2030</i>	119	44	19	10
<i>PO3 2035</i>	110	29	-56	4

Table 14 shows the compliance cost for CORSIA, ETS and the total compliance cost for both combined for the year 2035. The ETS cost is net of SAF support, i.e. it shows what airlines have to pay in the end. CORSIA costs are shown for EU airlines on participating routes, but due to technical limitations they do not include costs for flights between two third countries outside Europe, such as a flight between Malaysia and Indonesia operated by an EU airline. For further detail, see Annex 4.

Table 14: Compliance costs for ETS and CORSIA – 2035 snapshot, for global international aviation (intra-EEA: domestic and non-domestic, extra-EEA: non-domestic only)

Compliance cost for ETS and CORSIA in 2035			
<i>In EUR bn 2023</i>	<i>CORSIA</i>	<i>ETS</i>	<i>Total</i>
<i>Baseline</i>	0	24	24
<i>PO1</i>	3	7	11
<i>PO2</i>	3	16	18
<i>PO3</i>	3	4	6

Additional analysis on subsection 6.3.1.4, impact on employment and skills

Tables 15 and 16 show that there is a positive relationship between passenger demand and employment: higher passenger demand goes hand in hand with higher EEA airline employment. However, employment is not directly proportionate to passenger growth.

Table 15: EEA aircraft operator employment over time in policy options and the baseline

EEA aircraft operator employment in 1000 employees				
Flight segment: EEA departing flights				
	Baseline	PO1	PO2	PO3
2024	560			
2035	630	640	636	641
% change vs. baseline		2%	1%	2%
2040 (87%)	699	715	706	706
% change vs. baseline		2%	1%	1%
Change over time: 2040 (87%) vs 2024	25%	28%	26%	26%

Source: Aviation support study.

Table 16: EEA passenger demand over time in policy options and the baseline

Passenger demand in million passengers Flight segment: EEA departing flights				
	Baseline	PO1	PO2	PO3
2024	823			
2035	943	951	948	958
% change vs. baseline		1%	1%	2%
2040 (87%)	1069	1083	1076	1076
% change vs. baseline		Negl.	Negl.	Negl.
Change over time: 2040 (87%) vs 2024	30%	32%	31%	31%

Source: Aviation support study.

Additional analysis on abatement cost

Table 17 below shows the cost of reducing one tonne of CO₂ emissions with SAF and e-SAF in Europe. Firstly, the cost is shown based on conservative SAF/ e-SAF price assumptions, which were used for all aviation-specific modelling. Then the cost difference is shown using PRIMES price assumptions. This could give an upper and a lower bound for abatement cost using SAF. Emissions can also be reduced through technology and operational improvements, the cost of which varies widely¹⁵⁵, and their potential to reduce emissions can be limited (e.g. operational measures). The ETS price incentivises any such efforts chosen by operators. For comparison, in the maritime sector, the marginal abatement cost for using hydrogen¹⁵⁶ is EUR 763 in 2025 and modelled to decrease to EUR 247 by 2040 taking into account the carbon price. For maritime biofuels, the marginal abatement cost is EUR 190 in 2025, modelled to decrease to negative EUR 93 by 2040, i.e. those fuels are expected to be cheaper than conventional fossil fuel by then. For methanol, the marginal abatement cost is EUR 924 in 2025, modelled to decrease to EUR 329 by 2040.

Table 17: Additional analysis on abatement cost

Cost of CO₂ reduction using SAF (in EUR'23/tCO₂)						
			2025	2030	2035	2040
<i>Kerosene price assumptions</i>			824	886	949	969
<i>Conservative fuel price assumptions</i>						
Bio SAF	1	Price difference	543	512	469	451
	2	Remaining price difference after ETS	455	391	313	182
	3	<i>Final price difference incl. SAF support</i>	228	362	235	104
E-SAF	4	Price difference	n/a	2468	2449	2443
	5	Remaining price difference after ETS	n/a	2355	2304	2193
	6	<i>Final price difference incl. SAF support</i>	n/a	942	922	877
<i>PRIMES fuel price assumptions</i>						
Bio SAF	7	Price difference	404	358	305	352

¹⁵⁵ The [Destination 2050 Roadmap 2025](#), table 14, describes some measures as cost neutral (operations), whereas others are estimated in billions (e.g. fleet renewal).

¹⁵⁶ The maritime sector can use a broad mix of decarbonisation alternatives (different fuel technologies or blending with conventional fuels). However, the market maturity of these alternative fuels remains limited today. While hydrogen is also an option for aviation decarbonisation (and eligible for ETS-financed support), its use and thus cost structure are different for aviation.

	8	Remaining price difference after ETS	315	237	149	83
	9	<i>Final price difference incl. SAF support</i>	<i>158</i>	<i>219</i>	<i>112</i>	<i>47</i>
E-SAF	10	Price difference	n/a	880	769	689
	11	Remaining price difference after ETS	n/a	767	624	439
	12	<i>Final price difference incl. SAF support</i>	<i>n/a</i>	<i>307</i>	<i>250</i>	<i>176</i>

Source: Aviation support study and own calculations

4. IMPACTS ON THE LEVEL PLAYING FIELD (FOCUS ON HUBS)

Aviation operates in an international competitive environment. Generally, changes in operating costs, ticket prices and demand affect the level playing field for example:

- If airlines pay different carbon costs when operating on the same route or if certain airlines bear a high proportion of costs because a larger share of their operations are in higher carbon cost routes;
- If a reduction in demand due to higher carbon costs affects some airlines, but not others with which they are in competition;
- If carbon costs lead to investment in airports outside higher carbon cost areas instead of within the higher cost area;
- If policies implemented equally across routes are not enforced equally e.g. because different actions are taken by different states.

Airport hubs¹⁵⁷ with large shares of transfer passengers may face an unlevel playing field compared with other hubs subject to laxer rules¹⁵⁸, causing differences in operating costs, ticket prices, itinerary choice, etc. The aviation support study finds that the impact of policy options on ticket prices and demand may, in certain cases, lead to passenger shift from EEA hubs to non-EEA hubs. Passenger shifts may lead to carbon leakage¹⁵⁹ if they cause an overall increase in global emissions.

Ticket prices, risk of passenger shifts and carbon leakage at airport hubs: The aviation support study defined a set of case studies for quantitative analysis. All case studies cover flights to destinations outside the EEA. They compare a return trip with a transfer at an EEA hub¹⁶⁰, direct flights to/from EEA airports, or a transfer at a hub outside the EEA ('non-EEA hub'). Routes differ on whether they are covered by the ETS carbon price and/ or ReFuelEU or not. The resulting ticket price differences help assess impacts on hub-switching and CO₂ emissions.

- Case study 1 (CS1): EEA to Asia via an EEA hub versus via London
- CS2: EEA to Asia via an EEA hub versus via Istanbul
- CS3: North America to EEA via an EEA hub versus via Algiers
- CS4: North America to Asia via an EEA hub versus via Dubai

¹⁵⁷ Please see section 2 for more details on impacts on airlines and tourist destinations.

¹⁵⁸ These could be related to climate policy, but equally to other policies such as labour laws or passenger rights. The latter are out of the scope of this assessment. Note that itinerary choice is a function of journey time, cost, number flight segments, available flight frequency and characteristics of the origin and destination airports.

¹⁵⁹ In the EU's 2025 Carbon Market Report, carbon leakage is defined as a situation that could occur if ETS-regulated activities were moved to non-EU countries with less ambitious climate policies, leading to an increase in overall greenhouse gas emissions.

¹⁶⁰ Case studies are built on an average EEA hub, based on selected airports: Amsterdam Schipol, Frankfurt Main, Paris CDG, Munich, Madrid Barajas, Rome Fiumicino, Athens, and Vienna Schwechat. For the analyses of flights to and from EEA hub airports, averages were taken across all relevant routes. For the analyses of flights to and from the non-EEA airports, averages were taken across relevant routes to/from that airport. Please see the support study for more information.

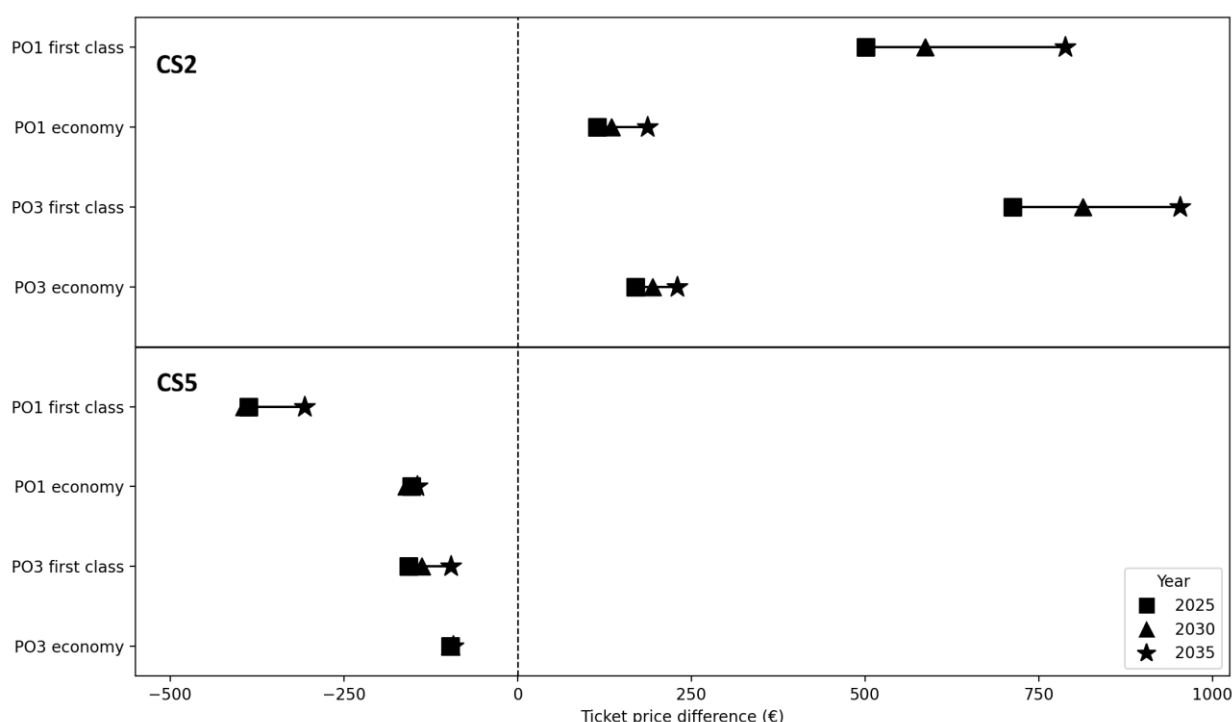
- CS5: EEA to Asia directly versus connection via Istanbul.

4.1. Ticket prices¹⁶¹

Key findings are that **some routes that use a hub outside the EEA are already today cheaper than routes using an EEA hub**. This is true for CS2, CS3, CS4. This is independent from the ETS scope, as the ETS does not apply on any of these routes, but ReFuelEU does. Figure 2 below shows **cumulative effects**: it adds the effect of policy options on top of the existing price differences. For example, if the itinerary using a non-EEA hub in CS3 is today EUR 90 cheaper than using an EEA hub, then any cost/ benefit of the policy options is added to that (e.g. an extra cost of EUR 10 is shown as a EUR 100 difference, not as a EUR 10 difference). For simplicity, Figure 2 covers PO1 and PO3 only, in the 2025-35 time period. PO2 is similar to PO3, slightly less favourable towards EEA-hubs, since it offers less ETS-financed SAF support. See detail in the aviation support study.

The biggest ticket price differences for all case studies are found in the baseline, because there is added carbon cost for both flight legs, and no SAF support. For PO1 and PO2, the price differences are 3 and 1.5 times smaller than in the baseline for all case studies, meaning they reduce the price gap between the original and alternative routes. In all case studies, first class ticket price differences are higher than economy class price differences, because premium class travellers are less sensitive and airlines generally pass on a higher share of costs to them. In PO3, the results are similar but higher SAF support in PO3 reduces relative prices more than in PO2.

Figure 2: Ticket price difference between original and alternative itinerary for 2025-2035. Comparison of case studies 2 and 5, for PO1 and PO3, for economy and business class.



CS2: EEA to Asia via an EEA hub versus via Istanbul | CS5: EEA to Asia directly versus connection via Istanbul

Reading key: In CS2, for an economy ticket in PO3, the price was EUR 170 cheaper with the alternative route in 2025 compared to the original route (via EEA hub/ direct from EEA), while it would be about EUR 195 cheaper in 2030 and EUR 230 cheaper in 2035. In general, where a plot goes below zero, the original itinerary is cheaper.

¹⁶¹ Not considering value of change in flight time.

When we only look at the impacts of POs (i.e., disregarding base ticket price differences), the differences in cost to passengers are smaller (ca. -10%), since the base ticket price also accounts for a share of that difference.

4.2. Risk of passenger shift

The risk of passenger shift depends on ticket price differences, but also on factors that are more difficult to quantify, such as preference of service (at certain airports or airlines) and timing of available flight alternatives. The below analysis focuses on price sensitivities, while considering value of change in flight time.

The impact of policy options on the risk of passenger shift is most visible in 2035, where SAF support continues to be available in PO3, but the medium amount of SAF support in PO2 is modelled to have run out. Table 18 shows that passenger shift risks are similar, but smallest in PO1, followed by PO3 (higher amount of SAF support) and PO2 (medium amount of SAF support).

Across policy options, some risk of passenger shift is found in CS2, CS3 and CS4, with very small risk in CS1 and CS5. Concretely, extending the scope to all departing flights (be it under PO2 or 3) would only slightly affect the competitiveness of EEA hubs and airlines by potentially causing a shift of passengers to non-EEA hubs. In PO1, these shifts remain below baseline levels; CS1 shows neither shifts nor hub carbon leakage because the original route is cheaper.

Table 18: Passenger shift risk comparison by case study and by scenarios for 2035.

	Million passengers	CS1	CS2	CS3	CS4	CS5
Baseline	Baseline	13	13	16	13	24
	Reduction	Negl.	1	1	1	0
		2%	9%	6%	6%	0%
PO1	Baseline	13	13	16	13	24
	Reduction	0	1	1	Negl.	0
		Negl.	7%	5%	4%	0%
PO2	Baseline	13	13	16	13	24
	Reduction	0	1	1	1	0
		Negl.	8%	5%	5%	0%
PO3	Baseline	13	13	16	13	24
	Reduction	0	1	1	1	0
		0%	8%	5%	4%	0%

4.3. Risk of hub carbon leakage

The risk of hub carbon leakage behaves differently from the risk of passenger shifts. If passengers shift from a European- to a non-European carrier, this does not necessarily increase emissions, it may decrease emissions, for example if the overall route is shorter, more efficient aircraft are used. However, if all other aspects are equal and less SAF is used on the overall route, this would increase emissions.

CO₂ emissions decrease most in PO2 and the baseline, and decrease least or remain unchanged in PO1. Limited hub carbon leakage is observed in specific case studies at specific moments in

time under PO1 and the baseline. Overall, there is hardly any hub carbon leakage, although in most cases emissions are displaced outside of Europe. The risk of passenger shift is lower than in the baseline for all policy options, as the baseline extends carbon pricing without additional SAF support. In **PO1**, CS1 shows no hub carbon leakage because the original route is cheaper and passenger behaviour is expected to remain unchanged. In CS2 and CS3 (and, to a lesser extent, CS4), CO₂ emission reductions due to the ETS make up for CO₂ emissions increases outside the ETS scope, so there is no hub carbon leakage in CS2 and CS3 and minor hub carbon leakage in CS4 (versus -2% under the baseline). PO1 also reduces the minor leakage under the baseline in CS1 and CS5. **PO2/3** show no hub carbon leakage in CS2, CS3, and CS4; and similar to PO1, PO2/3 mitigate the negligible leakage under the baseline in CS1 and CS5. See detail in the aviation support study.

5. ASSESSMENT OF CORSIA PURSUANT TO ART. 28B OF THE ETS DIRECTIVE

Article 28b(2) of the ETS Directive requires the Commission to assess CORSIA and progress towards the Long Term Aspirational Goal. A short assessment is below, with more detail in the aviation support study.

5.1. Ambition

CORSIA ‘baseline’: How and at what level the CORSIA ‘baseline’ is set is decisive for ambition, because emissions below this threshold are not addressed. Since September 2022, the CORSIA ‘baseline’ has not changed. It is set to 85% of 2019 international aviation emissions¹⁶² for the emissions covered by offsetting (i.e. the absolute amount of the baseline is not fixed, it is recalculated and for example higher if more countries participate).

The initial CORSIA baseline from 2018 has been revised twice, in 2020 and 2022. The initial baseline foresaw compensating international civil aviation CO₂ emissions growth (‘carbon-neutral growth’ from 2021 to 2035) compared to average CO₂ emission levels in 2019 and 2020. The first revision, i.e. excluding 2020 from the baseline definition for 2021-23, was made in response to the COVID-19 pandemic. The second baseline revision in 2022 sets the baseline at 100% of 2019 CO₂ emission levels for 2021, 2022 and 2023, and establishes a baseline at 85% of 2019 CO₂ emission levels for 2024 to 2035. This is higher than the average of 2019-2020 emission but lower than 2019 emission levels. Beyond the baseline, the calculation of the Sector’s Growth Factor also takes into account the individual growth of airlines from 2033 onward¹⁶³. In 2021-2023, emissions remained below 2019 levels, thus no offsets were required¹⁶⁴. For the period 2024-26, the ICAO Secretariat calculated CORSIA Annual Sector’s Growth Factor (SGF) for 2024 at 15.4%¹⁶⁵.

Level of participation: The Commission is required to assess whether non-EEA states considered to be participating in CORSIA represent more or less than 70% of international aviation emissions, based on the most recent emission figures (ETS Directive Article 28b(3), point (b)). This approach aims to incentivise all countries which should participate in CORSIA

¹⁶² ICAO, [Assembly Resolution A41-22](#), point 11, 2022.

¹⁶³ Originally, individual growth was supposed to taken into account from 2030 with 20% weight and from 2033 with 70%, but at the ICAO Assembly in 2022 the application was delayed to 2033 with 15% weight.

¹⁶⁴ 2021: [CORSIA Annual Sector Growth Factor \(SGF\)](#); 2022: [2022 CORSIA Annual Sector Growth Factor \(SGF\)](#); 2023: [2023 CORSIA Annual Sector Growth Factor \(SGF\)](#).

¹⁶⁵ [CORSIA-Annual-SGF2024-4ed-Rev1-2025.pdf](#).

when it becomes ‘mandatory’ to implement the scheme¹⁶⁶. Overall, the EU encourages all countries to participate.

The assessment mandated by the ETS Directive sets out clear parameters for the calculation of the 70% threshold, using the most recent available data. The numerator counts international aviation emissions represented by “*states listed in the implementing act adopted pursuant to Article 25a(3)*”, meaning states other than EEA countries, Switzerland and the United Kingdom. The numerator therefore includes emissions from routes between the States listed in the implementing act, as well as routes between an EEA Member State or Switzerland or the United Kingdom and these states. The assessment follows the route-based principle, i.e. assuming that any flight on these routes is subject to CORSIA offsetting, even if it is operated by a carrier hailing from a non-participating state¹⁶⁷. This prevents underestimation. The denominator of this calculation is all “*international aviation emissions*”, meaning all emissions on routes between two ICAO countries. Figures published¹⁶⁸ by the ICAO Secretariat are used for this calculation, which are either directly reported by countries, or else gap-filled by the ICAO Secretariat according to an agreed methodology. The calculation is as follows:

$$\frac{\text{CO2 emissions relating to non – European States on routes between countries participating in CORSIA offsetting}}{\text{CO2 emissions on international routes}}$$

CORSIA implementation by third countries in national law: The submission of ICAO to the UNFCCC COP30¹⁶⁹ expects 134 countries to participate in CORSIA offsetting in 2027. This includes the 130 countries volunteered for 2026, and also Brazil, Russia, India and China.

Concerning the biggest emitters, China (12.35% of 2018 global Revenue Tonne Kilometre or RTK) has never publicly confirmed its intention to participate in CORSIA offsetting. To date, no formal legislative processes or regulatory activities could be traced on CORSIA compliance.

China openly challenged the fairness of CORSIA several times. In 2016¹⁷⁰, China considered carbon neutral growth, the basic principle of CORSIA, “*is short of scientific justification, fairness and feasibility*” and is “*constituting de facto prejudices against developing countries in their growth of international air transport in the future*”. China also questioned ICAO’s jurisdiction to set standards for emission units in its 2016 and 2019 Reservations¹⁷¹ (“*ICAO can recommend offsetting products for preferred consideration, but should not make decisions for sovereign States*”) and stated that units established by the UNFCCC should be used (“*As the UNFCCC is the main arena for global actions against climate change, States should be encouraged to give priority to the use of emission units endorsed by UNFCCC and the Paris Agreement. There is no need for ICAO Council to make different decisions in this regard.*”). In

¹⁶⁶ Countries had the largest share of international aviation activity in 2018 measured in ‘revenue tonne kilometres’, meaning how much paying cargo or passengers an airline moved, and how far. These 34 States are listed in [International-RTK-rankings 2018 SIDS LDC LLDC.pdf](#).

¹⁶⁷ CORSIA’s route-based approach means that wherever the airline is based, it should always be subject to offsetting requirement on routes between two participating states. The airline’s ‘home country’ is the only responsible for the airline’s CORSIA compliance. For example: Airline A from country A which is exempt from CORSIA should still participate in offsetting when it flies covered routes between participating countries B and C. Country A is meant to be responsible to ensure airline A’s compliance on these flights, for there to be a level-playing field.

¹⁶⁸ The ICAO Secretariat publishes this document on an annual basis. For 2024, it was published in October, entitled “[Total Annual CO2 Emissions and Information for Aeroplane Operators](#)” Part III.

¹⁶⁹ [SBSTA63-ICAO-submission_Final2.pdf](#).

¹⁷⁰ 2016 Reservation: [China_en.pdf](#).

¹⁷¹ 2019 Reservation: [china_EN.pdf](#).

2019, China (together with Russia) called carbon neutral growth “*unfair and unequal*”¹⁷². In its 2019 Reservation China challenged again the principle of carbon neutral growth: “*China opposes to using the goal of carbon neutral growth from 2020 as the baseline of CORSIA. We affirm that States should determine the CORSIA baseline by themselves and reinforce their actions gradually based on national circumstances.*” China also notified differences to CORSIA¹⁷³, where they reserved the right to decide on their participation in the offsetting. In this 2019 Reservation, China questioned the exclusivity of CORSIA: “*ICAO has no right to prohibit Member States from using other market measures for addressing aviation emission.*”. China repeatedly expressed their wish to acknowledge the common but differentiated responsibilities (CBDR) principle for CORSIA as well, a principle the application of which the US continuously refused in ICAO. In its 2019 Reservation, China considered that “*emission reduction in international aviation is an integral part of the global climate governance*”. In the 2022 Reservation¹⁷⁴ China reiterated this statement, and its wish to apply CBDR, while announcing reservations towards the goal of carbon neutral growth and also towards the net zero carbon emissions by 2050, meaning a reservation towards the full text of the Resolution on CORSIA. The latest expression of China’s wish to apply CBDR was in their submission to the ICAO Assembly session in September 2025¹⁷⁵. In the same submission, China proposed an initiative called Green Air Silk Road¹⁷⁶ and insisted that CORSIA implementation is voluntary, involving voluntarily defining the baseline and the eligible credits for offsetting. In accordance with this submission, China submitted a Reservation to the Assembly resolutions on climate change and CORSIA¹⁷⁷, where it significantly reduced the number of reservations. Unlike previous reservations, this latest reservation is not against the CORSIA Resolution A42-22 in its entirety, but it maintains reservations towards the key principles of CORSIA like carbon neutral growth or the exclusive use of CORSIA eligible units. In 2018, China submitted to ICAO differences listing diverging implementation of monitoring, reporting and verification rules, on definition of sustainable aviation fuels, on emission unit definition and on the timeline for implementation, among others, also stating that China will decide on its own when it will join CORSIA (submitted differences are not publicly available).

The US (11.35% of 2018 global RTK) has no legally binding implementation in place. The US Federal Aviation Administration (FAA) reports emissions of all aircraft operators that are to report under the CORSIA rules to ICAO, but airlines are not obliged under US law to report to FAA, thus the FAA estimates the emissions for those who do not report. Accordingly, CORSIA is explicitly voluntary in the US¹⁷⁸, where there is no implementation of the offsetting in their national law¹⁷⁹, neither can any relevant legislative initiative be identified, although the US has

¹⁷² Submission of China and Russia to the 40th session of the ICAO Assembly, 2019 [Perspectives on the fair and equitable CORSIA implementation pathway](#), 2019.

¹⁷³ Text not publicly available, but referred to in China’s 2019 Reservation.

¹⁷⁴ 2022 Reservation: [China EN.pdf](#).

¹⁷⁵ [Submission of China to the 42nd session of the ICAO Assembly](#) 2025: *The Assembly is invited to recognize that international aviation emissions reduction is an important part of global effort to address climate change, and it should follow the principles of equity, common but differentiated responsibilities, and respective capabilities, with States making national determined contributions based on their national circumstances and stages of development*”.

¹⁷⁶ [DGCA/60 - DP/07/14](#)

¹⁷⁷ 2025 Reservation: [China EN.pdf](#)

¹⁷⁸ [Notice of CORSIA Monitoring, Reporting, and Verification Program](#): “Use of the term “will” in this document is aspirational only and is not intended to be read as imposing any obligation or right on either the FAA or Program Participants.”

¹⁷⁹ “The requirement to monitor, report, and verify CO₂ emissions is independent from offsetting,” and “offsetting of emissions under CORSIA, which may require rulemaking or other action, will be addressed at a future time.”

never officially filed a reservation on the ICAO resolutions on CORSIA itself. At ICAO, the US has the standing position of refusing the application of CBDR viewing it as inconsistent with the Chicago Convention's non-discrimination provisions for international aviation. The US expressed this objection first in their reservation in 2013¹⁸⁰: *“For reasons that are well known, the United States does not consider that the principles of the United Nations Framework Convention on Climate Change, including the principle of «common but differentiated responsibilities and respective capabilities» apply to ICAO, which is governed by its own legal regime”*. This was confirmed again in 2016¹⁸¹ and repeated this again in 2019¹⁸². At the latest ICAO Assembly session in September 2025, the US referenced their objection to the application of this principle¹⁸³. At the latest Assembly session, the US expressed its explicit wish that ICAO returns to its core responsibilities, because ICAO *“has extended itself far beyond its proper mandate - wasting critical resources on social programs or climate financing initiatives work that has nothing to do with the safety, security, and efficiency of the global air transportation system.”*, and therefore making the US contribution to the ICAO budget dependent on the fulfilment of these core responsibilities¹⁸⁴. The US approach towards CORSIA and ICAO’s climate policy is also influenced by its most recent National Security Strategy that states *“We reject the disastrous “climate change” and “Net Zero” ideologies that have so greatly harmed Europe, threaten the United States, and subsidize our adversaries.”*¹⁸⁵ ICAO’s Long-Term Aspirational Goal ‘LTAG’ is a net-zero emissions target. In January 2026, President Trump ordered the US administration to withdraw from the United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC), UN’s scientific body.

The Russian Federation (2.91% of 2018 global RTK) has never reported emissions to the ICAO Secretariat. Russia announced its reservation towards the entire idea of a global market-based measure in 2016¹⁸⁶: *“the Russian Federation does not see a way to announce its participation in the proposed version of GMBM implementation”*. Russia expressed the same refusal at the Assembly session in 2019: *“The Russian Federation declares that it does not find affordable to join this Resolution as whole”* and intends to file differences to the SARPs when it finds it fit¹⁸⁷. After the 41st session of the ICAO Assembly it stated again that *“the Russian Federation does not consider itself bound by the provisions of the [...] ICAO Assembly resolution [on CORSIA]”*¹⁸⁸. Accordingly, it is not expected that Russia would apply the MRV or the offsetting of CORSIA to their airlines unless circumstances would significantly change.

For other biggest emitters, Brazil (0.78% of 2018 global RTK) has legislation in place for the mandatory CORSIA MRV from 2022 and also for offsetting from 2027 (Agência Nacional de Aviação Civil (ANAC) 743 of 15 May 2024). India (1.35% of 2018 global RTK) has legislation in place for both the MRV and for the offsetting as of 2027 (Civil Aviation Requirements, Section 10 – Aviation Environmental Protection, Series ‘C,’ Part I 2018).

Share of emissions covered by CORSIA offsetting obligation: ETS Directive Article 28b(3), point (b) describes the test to evaluate the level of participation in CORSIA. This point requires

¹⁸⁰ 2013 Reservation: [United States en.pdf](#).

¹⁸¹ 2016 Reservation: [United States en.pdf](#).

¹⁸² 2019 Reservation: [USA en.pdf](#).

¹⁸³ [HarmonyHub](#) at 2:11:10 and [ICAO minutes](#).

¹⁸⁴ [U.S. Transportation Secretary Sean P. Duffy to Deliver Speech Highlighting U.S. Priorities at ICAO | US Department of Transportation](#)

¹⁸⁵ [2025-National-Security-Strategy.pdf](#)

¹⁸⁶ 2016 Reservation: [Russian Federation en.pdf](#).

¹⁸⁷ 2019 Reservation: [russia EN.pdf](#).

¹⁸⁸ 2022 Reservation: [Russia EN.pdf](#).

that the “most recent available data” is used for this purpose. Therefore, the data from the CORSIA Central Registry (CCR) for the reporting year 2024¹⁸⁹ is used. Level of participation of ICAO contracting States applies only to the year for which those States participate in. In 2024, 93 States were considered to be applying CORSIA for the purpose of the ETS Directive and were included on the list adopted pursuant to Article 25a(3) of the ETS Directive¹⁹⁰. Table 19 shows the relevant total emissions for 2024 to be applied in the calculation. Using these figures, the level of participation in 2024 stands at 51% coverage of international aviation emissions. Accordingly, the condition is not fulfilled. As shown in Table 19, the result is the same if the 2024 emissions data is used with 2026 participation (that is already known).

Table 19: CORSIA test results based on level of participation

Total CO ₂ emissions on international routes in 2024 MtCO ₂ : 597		
Level of participation	Results	
	Emissions (million tCO ₂)	Impact of States Participating
Best Case Scenario (BCS): 2026 volunteer list + all mandatory countries	446	75%
BCS without United States	288	48%
BCS without United States and China	208	35%
BCS without Russian Federation	438	73%
BCS without China	344	58%
2026 volunteer list	302	51%

Source: Commission analysis based on CCR 2024 emissions

Quality of offset credits: The quality of the carbon credits under CORSIA was initially assessed pursuant to Article 28b of the ETS Directive in Annex 10 of the 2021 Commission Impact Assessment¹⁹¹. In line with the Emissions Unit Criteria (EUC)¹⁹², to fulfil the CORSIA requirements, the credits must: represent emission reductions that would not have occurred otherwise (additionality); be accurately measured, reported, and verified (MRV); be permanent; ensure that they will not lead to any increase in emissions elsewhere (carbon leakage); and only be claimed once towards any climate target (avoidance of double counting). These criteria are cumulative.

The 2021 assessment clarified the central role of the Technical Advisory Body (TAB) as the ICAO expert group that evaluates and recommends to the ICAO Council the eligibility of programmes to generate CORSIA-eligible credits. It has also identified a number of shortcomings undermining the quality of the approved credits.

Some of these shortcomings have structural nature (e.g., Emission Unit Criteria applied by TAB on programme level, rather than on project or type of activity level) and are still unaddressed. It is to be noted that no revision of CORSIA’s EUC took place so far, in the ICAO triennial periodic review, in 2022 and 2025¹⁹³. The associated guidelines have however been

¹⁸⁹ ICAO., Reporting year: 2024

¹⁹⁰ ICAO’s [Chapter 3 State Pairs](#) lists 126 States for 2024, while Commission Implementing Regulation (EU) 2024/2850 of 11 November 2024 on the list of States which are considered to be applying CORSIA for the purposes of Directive 2003/87/EC in 2024 lists 93 states.

¹⁹¹ [SWD\(2021\) 603](#) final.

¹⁹² [ICAO document - CORSIA Emissions Unit Eligibility Criteria, March 2019.](#)

¹⁹³ [CORSIA Periodic Review.](#)

updated and embedded into the TAB application form. At the CAEP/13 meeting the results on Article 6.2 and Article 6.4 of the Paris Agreement at the UNFCCC COP29 were discussed and it was agreed that task C.04 (EUC Management) will present its recommendations in SG2026 (October 2026), in order to ensure that relevant developments under the Paris Agreement are taken into consideration by the Emissions Unit Criteria and/or the related Guidelines for Criteria Interpretation.

Other, newer shortcomings relate to how ICAO accounts for the developments on offset credits in other UN fora, for instance, the progress of international climate negotiations on operationalisation of Article 6 and related provisions of the Paris Agreement.

The 2021 UNFCCC Glasgow Climate Conference (COP26) agreed on a set of rules for Article 6. Accordingly, TAB updated its interpretation¹⁹⁴ of the CORSIA criteria to reflect the Article 6 operationalisation, complementing the information¹⁹⁵ contained in the EUCs, and the Guidelines for Criteria Interpretation¹⁹⁶. TAB recommended that the CORSIA written attestations¹⁹⁷ from project host countries national focal points should correspond to the content of the authorizations as agreed under Article 6. This alignment demonstrated the ICAO willingness for coherent approach towards double counting even if it did not prevent the risk of host countries double claiming the emission reductions, the latter going beyond the capacities of the UN to regulate how countries implement their climate targets.

Another prominent example is the definition of the baselines of the projects generating carbon credits. At COP26, countries agreed that baselines must be conservative and below ‘business as usual’ emission projections. In 2022, TAB resolved to interpret the reference to “conservative” in CORSIA criteria accordingly. The ICAO Council agreed to update the Guidelines for Criteria Interpretation, meaning the requirement on baselines is a mandatory provision.

While the finalisation of the Article 6 rulebook took place at COP29, there is still some on-going work (e.g. consolidated registry for the centralised trading mechanism under Article 6.4 - the Paris Agreement Crediting Mechanism, PACM). TAB resolved to monitor on a regular basis all Article 6 developments, and these should continue to inform further the TAB interpretations, but in practice, these interpretations are not applied consistently.

Despite full operationalisation of the PACM (including adoption of foundational standards, first crediting methodologies, governance, interim registry, etc.), its eligibility to supply CORSIA eligible credits, is still to be decided upon in the upcoming meetings of the ICAO Council. The TAB is tasked to report back on its progress of its assessment of the PACM in the 239th session of the Council (November 2026). Until now, the ICAO Council approved ten programmes to supply CORSIA eligible credits for the 2024-2026 compliance period (first phase of CORSIA)¹⁹⁸, and more recently, in November 2025, it approved the first four programmes for the first three years (2027-2029) of the second phase of CORSIA (2027-

¹⁹⁴ [Clarifications March-2025.pdf](#) .

¹⁹⁵ [ICAO document - CORSIA Emissions Unit Eligibility Criteria, March 2019](#).

¹⁹⁶ Guidelines for Criteria Interpretation is available in the [Application Form, Appendix A](#) - Supplementary Information on the TAB.

¹⁹⁷ The attestations should specify any steps taken, to prevent mitigation associated with units used by operators under CORSIA from also being claimed toward a host country’s national mitigation target(s)/pledge(s).

¹⁹⁸ The eligible programmes for the first phase are: American Carbon Registry (ACR), Architecture for REDD+ Transactions (ART), BioCarbon Fund Initiative for Sustainable Forest Landscapes (ISFL), Climate Action Reserve (CAR), Forest Carbon Partnership Facility (FCPF), Global Carbon Council (GCC), Gold Standard (GS), Isometric, Thailand Verified Emissions Reductions Programme (T-VER), Verra Verified Carbon Standard (VCS).

2035)¹⁹⁹. As there was no offsetting required during the pilot phase of CORSIA (2021-2023), our assessment is therefore not focused on this pilot phase.

Three of the eligible programmes, Architecture for REDD+²⁰⁰ Transactions (ART), Gold Standard (GS) and Verra Verified Carbon Standard (VCS), issued the first CORSIA-eligible carbon credits, respectively for High-Forest Low-Deforestation (HFLD) activities²⁰¹ by ART and mostly for cookstoves projects by GS and VCS²⁰². At present, these credits are the only eligible credits that are available for CORSIA compliance (part of eligible CORSIA programme and subject to Article 6 authorization letter), but there are many jurisdictions that are in the process of registering HFLD activities under ART and that could retroactively generate a larger number of eligible carbon credits²⁰³. In addition, Forrest Carbon Partnership Facility also allows for HFLD crediting. Similarly, there are many cookstoves projects under the different programmes.

Following the above-described ICAO's developments on CORSIA credits since the 2021 assessment, and with confirmed compliance demand from the first phase of CORSIA, the assessment on the offsets quality focuses on examining the quality of mitigation activities²⁰⁴. To inform the assessment the aviation support study relies on the EU Carbon Credit Environmental Integrity (CENVI) model²⁰⁵, to which we add the latest ICAO and UNFCCC documentation available²⁰⁶. These two types of activities (HFLD and cookstoves) are also the ones that can account for large share of potential issuance in the future. Cookstoves projects under the *Gold Standard*²⁰⁷ have the highest estimated share of total issuance potential amongst all activities under CORSIA first phase and first three years of the second phase (25%), while HFLD has 4%, but as indicated previously this percentage can grow significantly in coming years.

Our assessment of the environmental integrity of CORSIA-eligible offset credits reveals significant challenges when considering the types of activities identified above and methodologies used. Despite efforts to align CORSIA criteria with international standards and Article 6 of the Paris Agreement, important shortcomings persist, particularly in the areas of baseline conservativeness. HFLD activities in Guyana are characterised by baseline methodologies that inadequately reflect conservative emission projections, posing a risk of overestimating emission reductions. This is also confirmed by the UNFCCC Report on the technical expert review under Article 6.2 of Guyana²⁰⁸. Similarly, cookstoves activities under some of the already applied methodologies suffer from inaccuracies in calculating non-

¹⁹⁹ American Carbon Registry (ACR), Architecture for REDD+ Transactions (ART), Gold Standard (GS), Verra Verified Carbon Standard (VCS). More information here: [CORSIA Eligible Emissions Units, April 2026](#).

²⁰⁰ Reducing emissions from deforestation and forest degradation.

²⁰¹ [Guyana Announces World's First Carbon Credits for Use in UN Airline Compliance Programme](#).

²⁰² [Gold Standard Labels First Credits as Eligible for CORSIA Compliance | GS](#); [Verra Applies First CORSIA Labels to Credits - Verra](#)

²⁰³ [ART Winter 2025 Newsletter - ART Architecture for REDD+ Transactions](#).

²⁰⁴ Mitigation activities that started their first crediting period on or after 1 January 2016, in respect of mitigation outcomes that occur between 1 January 2021 and 31 December 2026.

²⁰⁵ CENVI model is developed under the Horizon Europe project "ACHIEVE – Achieving High-Integrity Voluntary Climate Action", [Home](#) > [ACHIEVE](#) and focuses on additionality, robust quantification of emission reductions or removals, permanence, and avoiding double issuance. The CENVI criteria are derived from the criteria established under CORSIA, the ICVCM (Integrity Council for the Voluntary Carbon Market) [ICVCM Leading the way to a high integrity Voluntary Carbon Market](#) and the CCQI (Carbon Credit Quality Initiative) [The Carbon Credit Quality Initiative - Home](#).

²⁰⁶ The ICAO publicly available material related to CORSIA and TAB; the UNFCCC Technical expert reviews under Article 6.2.

²⁰⁷ [Gold Standard | GS](#)

²⁰⁸ UNFCCC, [Report on the technical expert review under Article 6, paragraph 2, of the Paris Agreement](#), 2025.

renewable biomass fractions and conversion factors, potentially inflating their mitigation impact. The lack of sufficiently robust methodologies to address these issues undermines the credibility of the credits within CORSIA.

In addition, the support aviation study delves in greater detail in the mitigation activity types that account for large share of carbon credits with findings confirming the environmental integrity risks observed in HFLD and cookstoves, for the majority of the current CORSIA eligible credits²⁰⁹.

Sustaining environmental integrity requires using crediting methodologies better aligned with best practice in existing carbon crediting programmes such as the PACM, empirical data and ensuring rigorous oversight of project implementations. This would also require updates to the EUC, more rigorous application of the TAB interpretations by the TAB, higher scrutiny by ICAO Council of the TAB recommendations and possible diverging opinions, and overall, higher resources being attributed to the TAB to undertake its programme analysis.

Long-Term Aspirational Goal (LTAG): In October 2022 the ICAO Assembly adopted the LTAG through Resolution A41-21, establishing a net-zero carbon emissions goal by 2050 for international aviation²¹⁰. The LTAG is based on a report by ICAO's Committee on Aviation Environmental Protection (CAEP)²¹¹, which provides a sectoral emissions outlook for different scenarios (IS0-IS3) of deployment of in-sector decarbonisation measures (i.e. SAF adoption, aircraft technology and operational efficiency improvements), requiring different uptakes of out-of-sector measures (i.e. market-based measures) to reach net-zero. The A41-21 Resolution explicitly states that LTAG "*does not attribute specific obligations or commitments in the form of emissions reduction goals to individual States*", meaning that LTAG is an aspirational framework rather than a binding commitment.

Critically, the A41-21 Resolution explicitly requires the ICAO Council to regularly monitor implementation processes across all elements of the basket of measures towards achieving LTAG. The 42nd ICAO Assembly reaffirmed work to achieve the global average fuel-efficiency improvement of 2% per annum from 2021 to 2050 and, in addition, endorsed a global aspirational vision to reduce CO₂ emissions by 5% by 2030 through the use of SAF, low-carbon aviation fuels (LCAF) and other cleaner energies²¹². Such provisions form the two interim targets to LTAG 2050 net-zero goal.

ICAO's LTAG framework employs a state-led monitoring approach, combining voluntary State Action Plans (SAPs) reporting with scenario-based progress tracking. The Conference on Aviation and Alternative Fuels (CAAF) serves as the primary forum for reviewing progress and adjusting ambition levels, with the next CAAF/4 scheduled for 2028. At its 42nd Session, the ICAO Assembly adopted Resolution A42-21, implementing a LTAG Monitoring and Reporting (LMR) methodology to track past and future progress toward the LTAG, leveraging existing ICAO information streams including the annual LTAG Stocktaking, and SAPs. The LMR methodology aims to introduce a tiered, backward- and forward-looking assessment

²⁰⁹ The support study assesses the integrity risks for 39 out of the 252 carbon credit categories as eligible under CORSIA. They correspond to 56% of the issuance potential for CORSIA's first phase. None of the carbon credit categories are assessed to have low integrity risks. Only 15% of the issuance potential is classified as medium risk and 15% is classified as high risk. The majority of the issuance potential (70%) is classified in the support study as very high risk.

²¹⁰ ICAO, Resolution A41-21: [Consolidated statement of continuing ICAO policies and practices related to environmental protection - Climate Change](#), 2023.

²¹¹ ICAO CAEP, [Report on the feasibility of a long-term aspirational goal \(LTAG\) for international civil aviation CO2 emission reductions](#), 2022.

²¹² ICAO, Resolution A42-21: [Consolidated statement of continuing ICAO policies and practices related to environmental protection - Climate change](#), 2025.

system to evaluate historical emissions performance against projected trends and update future decarbonisation pathways based on the latest data. The LMR framework will also monitor implementation support and financing, and review delivery of the 2030 global aspirational vision and the CAAF/3 Global Framework. The methodology will be implemented in phases, with the first assessment report to be delivered to the 43rd ICAO Assembly in 2028.

The 2022 LTAG report outlines three integrated scenarios (IS) “IS1”, “IS2”, and “IS3” that are based on cumulative emissions reductions through in-sector decarbonisation measures by 2050, compared to the baseline “IS0” scenario, of: 39%, 68%, and 87%, respectively. While the uptake of alternative fuels is at the core of all scenarios, the LTAG report acknowledges the limits of in-sector measures and the need to address residual emissions through out-of-sector solutions such as carbon removal technologies or high-quality offsets. The LTAG projects cumulative CO₂ emissions from international aviation between 2020 and 2050 at approximately 23 Gt (IS1), 17 Gt (IS2), and 12 Gt (IS3), respectively, which compare to the whole-economy 1.5°C (50% probability) and 2°C (67% probability) Paris-aligned carbon budgets of 500 Gt CO₂ and 1150 Gt CO₂, respectively. Table 20 compares IS cumulative emissions with the estimated carbon budgets for international aviation (2020–2050) consistent with 1.5 °C and 2 °C temperature targets²¹³.

Table 20: Difference between ICAO LTAG Integrated Scenarios’ cumulative emissions and Paris-aligned carbon budgets.

		Difference between Paris-aligned budgets and LTAG ISs cumulative emissions in Gt CO₂ (Budget % coverage)					
Scenario		Compared to 1.5°C Budget			Compared to 2°C Budget		
		2% share	2.4% share	3.9% share	2% share	2.4% share	3.9% share
IS1	23	16.5 – 17 (350 – 380%)	15.2 – 15.8 (295 – 320%)	10.3 – 11.3 (180 – 200%)	8.1 – 9.2 (150 – 170%)	5.1 – 6.4 (130 – 140%)	-6.2 – -3.9 (80 – 85%)
IS2	17	10.5 – 11 (260 – 280%)	9.2 – 9.8 (220 – 240%)	4.3 – 5.3 (130 – 145%)	2 – 3.2 (110 – 120%)	-0.9 – 0.4 (95 – 103%)	-12.2 – 9.9 (70 – 60%)
IS3	12	5.5 – 6 (185 – 200%)	4.2 – 4.8 (150 – 170%)	-0.7 – 0.3 (95 – 100%)	-3 – -1.8 (80 – 90%)	-5.9 – 4.6 (70 – 70%)	-17.2 – 14.9 (40 – 45%)

Table 20 suggests that the uptake of in-sector measures foreseen in the LTAG may be insufficient to place international aviation on a 1.5 °C trajectory by 2050; any “1.5 °C-compatible” outcome will require substantial removals or out-of-sector measures in addition to IS3-level transformation, as well as concessions in terms of carbon budget spending to the aviation sector. IS3 is the minimum ambition consistent with a 2 °C pathway, while IS2 can only be reconciled with a 2°C Paris pathway if the current share (2.4%) or higher share (3.9%) of total emissions for aviation is assumed. Residual emissions under IS3 in 2050 are comparable to CORSIA's projected offset volumes (140 and 225 Mt CO₂ per year by 2035 assuming broad implementation). ICAO estimates that cumulatively between 2024 and 2035,

²¹³ The Paris-aligned carbon budget for international aviation has been estimated based on alternative aviation’s shares to the Paris-aligned carbon budgets (2%, 2.4%, 3.9%) and a 60–65 % range for the share of international aviation in total aviation CO₂. Please see the support study for detail.

with broad State implementation, CORSIA could offset up to 1.5 Gt CO₂²¹⁴. However, there are uncertainties around CORSIA's ambition and accountability (see section 5 above and below). CORSIA, in its current form, is not structured to deliver the deep in-sector decarbonisation underpinning the LTAG scenarios, because it is far cheaper for airlines to use offset credits (out-of-sector emissions reductions) rather than CORSIA eligible fuels (CEFs, which directly reduce emissions in the sector). This is because carbon credits are magnitudes cheaper than CEF²¹⁵. The emissions reductions in the LTAG rely mainly on SAF use. ICAO's recently established support instruments – the ACT-SAF programme and Fininvest Hub initiative from the 42nd Assembly – aim to stimulate SAF capacity. As of June 2025, 109 ACT-SAF partner States and 146 partner organizations joined the programme. The ACT-SAF programme comprises twenty-three SAF feasibility and implementation studies, with contributions from France, the Netherlands, the European Union, United Kingdom, and Airbus. Further initiatives are planned by Austria, Côte d'Ivoire, Italy, Republic of Korea, and Switzerland. The Fininvest Hub aims to facilitate access to financing for SAF projects, and was launched in September 2025. In addition, achieving the LTAG 2050 net-zero target requires sustained and expanded out-of-sector carbon removal mechanisms also after 2035, necessitating carbon removal technologies, infrastructure development and robust governance frameworks to ensure high-quality offsets. The current level of activity across the key LTAG decarbonisation pillars – SAF uptake, technology design and efficiency, operational improvements – remains misaligned with IS2 and IS3 requirements according to the aviation support study. Policy commitments and investments made in this decade will be critical in determining whether international aviation is on a credible trajectory toward net-zero by 2050.

CORSIA Eligible Fuels (CEF) are fuels complying with CORSIA Sustainability Criteria and certified by an ICAO-approved Sustainability Certification Scheme (SCS). By utilising CEFs, aircraft operators are entitled to claim emissions reductions and reduce offsetting requirements.

CEF rules become implementable upon adoption: once revised requirements or sustainability criteria are introduced by ICAO, they must be applied in full by all participating operators and states enforcing CORSIA, with compliance verified through certification and monitoring, reporting and verification (MRV) procedures. CORSIA sets requirements for international aviation with implementation relying on each ICAO Member State MRV to ensure the integrity of CEF sustainability claims. While the framework establishes harmonised standards for MRV, individual countries have the flexibility to interpret and apply these measures according to their own national circumstances, which can result in variable approaches.

CORSIA sustainability criteria were approved by the ICAO Council in June 2019 for the pilot phase (2021-23) and expanded in November 2021 for Sustainable Aviation Fuels (SAF) produced from January 2022, and in November 2022 for Low-Carbon Aviation Fuels (LCAF) produced from January 2024. As of the 2024-26 CORSIA phase, 14 sustainability themes apply to SAF and LCAF²¹⁶.

²¹⁴ ICAO Executive Committee, [Assembly - 42nd session Agenda Item 17: Environmental Protection – Carbon Offsetting and Reduction Scheme for International Aviation \(CORSIA\)](#), 2025

²¹⁵ See subsection 6.1.1.5 of the Impact Assessment for a price comparison. While the uptake of CORSIA eligible fuels (CEFs) is expected to contribute to up to 30% of the overall neutralisation of CO₂ emissions (~0.4 Gt CO₂ in the highest CEF deployment scenario compatible with LTAG's IS3) required by CORSIA between 2024 and 2035, the effectiveness and credibility of the mechanism relies on the availability and integrity of offsets, with the cheapest LTAG decarbonisation pathway exclusively relying on offsets for neutralising emissions.

²¹⁶ Sustainability themes and related criteria are found in ICAO official document "[CORSIA Sustainability Criteria for CEF](#)".

CORSIA relies on ICAO-approved certification schemes to verify sustainability across the fuel supply chain, with regular audits and transparent chain-of-custody tracking for all certified fuels. CORSIA has been consistently expanding its certification schemes over its implementation phases. The fuel lifecycle (LCA) methodology was first adopted in 2019 with regular updates²¹⁷ to assess the performance and sustainability profiles of feedstock and conversion technologies. CORSIA recognises conversion pathways compliant with relevant American Society for Testing and Materials (ASTM) standards (ICAO, 2023). Feedstocks classification determines the starting point of the LCA, including indirect effects, and comprises primary products and co-products; by-products; wastes, and residues.

CORSIA mandates a minimum 10% life cycle GHG emission reduction requirement for CEF compared to the fossil jet fuel baseline (89 gCO₂e/MJ) (ICAO, 2024), comprising direct and indirect emissions.

Inevitably, CORSIA's global scope requires global representativeness thus broader variability of fuel's carbon intensity but also the assumption that CEF are uplifted close to point of production and thus the exclusion of emissions from CEF imports. This assumption is not representative for the EU, a feedstock and fuel/energy net importer. Due to the lack of calculated EU-relevant aviation fuel-specific default factors, CORSIA's explicit SAF default values are compared with the road-type biofuel default factors from RED III. This comparison highlights differences with CORSIA's aviation fuel dedicated values.

CORSIA details sustainability requirements for the protection and the accessibility of - among others – water, soil, and air resources, the handling of chemicals as well as conservation of biodiversity and ecosystem services. ReFuelEU Aviation, and RED – and hence EU ETS – also look at GHG emissions reductions and land-use changes²¹⁸. Overall, CORSIA's sustainability framework for eligible fuels is robust in its breadth of coverage and certification requirements. The framework's effectiveness in delivering net benefits depends on robust implementation and ongoing reviews, including the reliable accounting of emissions from indirect land use change.

CORSIA's route-based approach means that only flights between participating states are subject to offsetting requirements. Conversely, the gradual approach, along with the opportunity to offset emissions out of the aviation sector purchasing carbon credits at lower abatement costs per tonne of CO₂e compared to CEF uptake may not incentivise early adoption of CEF.

5.2. Accountability

No Enforceability: The legal instrument by ICAO for CORSIA, the Standard and Recommended Practices (SARPs)²¹⁹, and its degree of legal strength is described in the 2021 Impact Assessment²²⁰. CORSIA is based on a resolution adopted by the ICAO Assembly, which is not binding unless implemented in national law, and the same goes for the detailed

²¹⁷ <https://www.icao.int/CORSIA/corsia-eligible-fuels>

²¹⁸ For a comparison between the Environmental Sustainability Themes in CORSIA and the European legal framework for SAF, please refer to the support study.

²¹⁹ SARPs are the technical specifications adopted by the ICAO Council in accordance with Article 37 of the Chicago Convention in order to achieve "*the highest practicable degree of uniformity in regulations, standards, procedures and organization in relation to aircraft, personnel, airways and auxiliary services in all matters in which such uniformity will facilitate and improve air navigation*". Annex 16 of the Chicago Convention is dealing with Environmental Protection, and its Volume IV, with CORSIA. Today, ICAO manages not less than 12,000 SARPs across the 19 Annexes of the Chicago Convention.

²²⁰ [SWD\(2021\) 603](#) final.

rules in the form of ICAO Standards and Recommended Practices²²¹. National implementation varies widely (see detail in the aviation support study). Although for 2026, 130 countries (accounting for 363Mt albeit including intra-EEA flights and flights between the EEA and Switzerland and the UK CO₂ emissions in 2024) volunteered for the implementation of CORSIA, big emitters, like China, Russia or India, representing a significant share of global aviation emissions, do not participate yet. Most of them did not indicate their intention either to implement CORSIA in their national legal system (Russia for example signalled its intention not to participate). As the implementation of CORSIA depends on legislative action by third countries, this means uncertainty and needs to be kept under scrutiny. Continued participation in CORSIA is also not guaranteed, as countries can withdraw from it²²². In comparison, the EU ETS applies in a consistent manner across all EU Member States, irrespective of the nationality of the aircraft operator and it is enforced through effective financial penalties that also require the environment shortfall to be made up. By contrast, ICAO has no instruments at its disposal to enforce compliance, and thus no penalties can be enforced by ICAO (the CORSIA SARPS explicitly state²²³ that only the ‘home State’ of the airline can enforce CORSIA).

Accordingly, without national legislation in place, CORSIA remains voluntary in that country, even if the ICAO Resolution would mention mandatory participation for that country²²⁴, raising level playing field issues with countries having implemented CORSIA in a legally binding manner. For assessing the binding nature of CORSIA it is also to note that certain important elements of the compliance framework, like the baseline for calculating the Sector Growth Factor, or “mandating” countries above the 0.5% share of 2018 RTK to participate in the offsetting, are not part of the SARPs, but are defined rather in Assembly Resolutions²²⁵. As above, Assembly Resolutions have different binding nature than standards. Previous assessments remain valid, as CORSIA has not changed: the enforceability of ETS is higher than that of CORSIA.

Transparency: The lack of freedom of information policy and global mechanism for public request of information is described in the previous Impact Assessment Report²²⁶. Analysis of ICAO’s February 2025 Committee on Aviation Environmental Protection (CAEP) meeting highlights issues with transparency²²⁷. Delegates, who include representatives of States, industry, other international bodies and NGOs, must sign a non-disclosure agreement to participate, prohibiting them from sharing any documents with external parties. Delegates are exposed to unlimited financial liability if found to break these conditions. CAEP working papers are released once the ICAO Assembly takes a decision, i.e. when it is too late to influence the decision-making process. The same applies for key meeting documents, many

²²¹ Study for the Directorate General Climate Action of the EU Commission, [Possible legal arrangements to implement a global market based measure for international aviation emissions](#), 2025.

²²² Mauritius withdrew from voluntary participation in CORSIA from 1 January 2026: [CORSIA States for Chapter 3 State Pairs](#)

²²³ ICAO International Standards and Recommended Practices, [Point 1.3.2. Annex 16 to the Convention on International Civil Aviation -Environmental Protection-Volume IV](#), July 2023.

²²⁴ ICAO Resolution A41-22 states in point 9.e.: “Second phase applies from 2027 through 2035 to all States that have an individual share of international aviation activities in RTKs in year 2018 above 0.5 per cent of total RTKs or whose cumulative share in the list of States from the highest to the lowest amount of RTKs reaches 90 per cent of total RTKs, except Least Developed Countries (LDCs), Small Island Developing States (SIDS) and Land Locked Developing Countries (LLDCs)

²²⁵ These elements are mentioned in the SARPs as “Note”, and Notes do not constitute part of the SARPs, as stated in the SARPs themselves.

²²⁶ Aviation ETS Impact Assessment (SWD(2021)603).

²²⁷ Influencemap.org, [Corporate Capture and the UN International Civil Aviation Organization; Continued Corporate Influence at the United Nations’ Aviation Agency: An Update of InfluenceMap’s 2022 Report](#), 2025.

official negotiation documents and documentation on climate-related topics and policies presented during the CAEP meetings, and which make recommendations to the Assembly. Furthermore, ICAO's report on the February 2025 CAEP meeting costs \$605 (EUR 526²²⁸). The media cannot attend CAEP meetings or working group negotiations, whereas e.g. IMO allows and expressly encourages this for its Marine Environment Protection Committee meetings²²⁹. While the names of delegates are known, their employment or affiliations are not disclosed, although state delegations can and do include representatives of the aviation industry. The lack of transparency reduces opportunities for external scrutiny and accountability and exacerbates the risk of policy capture. The aviation support study contains suggestions to address this.

Despite ICAO publication of findings from TAB responsible for making recommendations to the ICAO Council on CORSIA emission units, important information such as the quality of credits, details of projects being supported, and histories of the offset projects are not available in the published document. Without accessible information on programme implementation, offset quality, and compliance verification, stakeholders cannot independently judge the climate performance of CORSIA offset credits²³⁰.

Overall, lack of transparency stems from inherent ICAO processes and the transparency governance rather than from CORSIA rules. The system performs well in data quality and reliability with robust verification processes and standardised methodologies. In 2025, 128 countries reported international aviation CO₂ emissions to ICAO, and ICAO has capabilities to perform gap-filling in case of non-submission²³¹. Information availability on CORSIA implementation and compliance is good despite scattered offset program data and undisclosed technical group documents.

6. ANALYSIS PURSUANT TO ARTICLE 30(8)

Article 30(8) of the ETS Directive requires analysis of environmental and climate impacts of short-haul flights, private- and business jets, social impacts and connectivity. For further detail see the aviation support study. This section focuses on short-haul and connectivity, while private and business jets are covered in section 7 below, and the impact assessment covers social impacts in subsection 6.3.1.4.

6.1. Short-Haul Flights and Their Impacts

In 2019, about half of EEA departing flights (3.7m) were up to 1,000 km long. Short-haul flights in the EEA are expected to increase by one-fourth by 2040 compared to 2025 levels²³². Smaller airports²³³ have a higher share of short flights.

Environmental and Climate Impacts: In 2019, flights under 1,000 km produced 18% of CO₂ emissions of departing flights from EU/EEA airports. The shorter the flight, the higher the CO₂ emissions intensity per passenger km, due to higher fuel required for take-off and climb. These flights generated approximately 112t of NO_x and 300t of particulate matter, which contribute to both pollution and warming effects. Data show that the ETS covers 96% of short-haul

²²⁸ Exchange rate on 21/11/2025

²²⁹ International Maritime Organization, [Attending IMO Meetings](#).

²³⁰ Source: support study.

²³¹ ICAO [submission](#) to UNFCCC SBSTA63.

²³² Source: support study.

²³³ The share of airports counting more than 80% of their flights being shorter than 1,000km is 54% for small airports and 13% for larger airports. "Smaller airport" here refers to an airport that is not defined as a "Union airport" as set out in Article 3 of Regulation (EU) 2023/2405 (ReFuelEU Aviation).

emissions. Studies²³⁴ of different short-haul flight segments find higher emissions cuts on these routes since the introduction of the ETS.

The potential for modal shift (substitution) depends on the distance covered by the flight. Approximately one fifth of flights in major European aviation markets (France, Germany, Italy, and Spain) have high substitutability potential (distances less than 400 km), about three fifths have medium potential (400-800 km), and one fifth have low potential (over 800 km). Spain stands out with a higher share of flights under 400km, reaching nearly half of short-haul flights, largely due to inter-island trips, a similar pattern seen in Greece (but replacing those by sea would increase transportation time). Mitigation measures presented hereafter do not propose Commission action and fall outside the scope of the Taxonomy²³⁵.

High-Speed Rail (HSR) dramatically reduces passenger usage of short-haul flights. An opening of competing HSR routes can reduce air travel by up to 80%, and by 50-60% on routes exceeding three hours. The presence of multiple operators on the same route leads to higher frequency, greater capacity, and differential pricing. However, HSR is generally more expensive than flying, especially on international routes. Case studies included France's ban for routes where a similar train journey of less than 2 hours and 30 minutes is possible. The European Commission's high-speed rail plan should also support modal shift, e.g. with the action to connect all European capitals and areas of over 250k inhabitants by 2040²³⁶. Finally, the climate gain for HSR is excellent, with a ratio of 1-to-37 (i.e. per-passenger kilometre emissions are 37 times lower than for aviation). **Ferries** offer a crucial alternative on island routes. They are more effective when integrated into multimodal routes and when direct offshore connections are available. The environmental benefits of ferries are positive, ranging from a climate gain ratio of 1-to-1.5 to 1-to-10. Future technological improvements, such as electrification, could enhance this ratio to 1-to-37.

Sustainable Aviation Fuels (SAF): At smaller airports where short-haul flights dominate, there is full ETS-financed SAF support covering 100% of the remaining price difference between SAF and fossil kerosene. Prioritising modal shift where rail in particular provides an appropriate level of service could free up limited SAF supply²³⁷. SAF use improves the climate gain, at about 1-to-3 for biofuels and 1-to-4 for synthetic fuels (source: aviation support study).

Electric and Hydrogen Flights are technologies with lower energy density compared to fossil kerosene or SAF. Electric planes currently allow for a limited number of seats (19 or less) and flight time (up to 45 minutes)²³⁸. This means electric planes are specifically relevant to the very short-haul market (e.g., flights within outermost regions and island archipelagos²³⁹) or unmanned aircrafts (e.g. cargo/mail in remote regions, military). Hybrid electric-kerosene planes show more potential in terms of seats and length of flights, with a target range of up to

²³⁴ Kang, Yicheng & Liao, Sha & Jiang, Changmin & D'Alfonso, Tiziana, [Transportation Research Part A: Policy and Practice](#), Elsevier, vol. 162(C), pages 236-252, [Synthetic control methods for policy analysis: Evaluating the effect of the European Emission Trading System on aviation supply](#), 2022.

Fageda, X., & Teixidó, J. J., Journal of Environmental Economics and Management, 111, 102591, [Pricing carbon in the aviation sector: Evidence from the European emissions trading system](#), 2022.

²³⁵ See Commission response to Aarhus review request ref. IR/2024/870406.

²³⁶ The [high-speed rail plan](#) sets out concrete actions, such as: removing cross-border bottlenecks, with options for speeds above 250 km/h; developing a coordinated financing strategy enhancing cross-border ticketing and booking systems; EU-level harmonised standards and processes.

²³⁷ More fuel efficient technologies and aircraft also reduce SAF use, although fleet renewal may result in a global increase of the fleet, resulting in higher emissions.

²³⁸ Mukhopadhyaya, Graver, International Council on Clean Transportation, [Performance analysis of regional electric aircraft](#), July 2022.

²³⁹ Apostolidis A, Donckers S, Peijnenburg D, Stamoulis KP, [Electric Aircraft Operations: An Interisland Mobility Case Study](#), Aerospace. 2024; 11(3):170, 2024.

500km²⁴⁰. While hydrogen-fuelled aircrafts are facing significant barriers for hydrogen distribution and storage, their potential for the short-haul segment is higher, with routes expected to cover at least the full range to 1,000km²⁴¹. The emissions intensity of a fully electric flight or a fully hydrogen-powered flight compared to kerosene ranges from 1-to-2 to 1-to-10, depending mainly on grid CO₂-intensity for electric flights²⁴² and production of the hydrogen (“green hydrogen” from a near-zero CO₂-intensity grid is beneficial²⁴³ otherwise barely, even for “blue hydrogen”, originated from carbon capture)²⁴⁴.

According to the latest assessment report of the IPCC, demand-side mitigation options in end-use sectors can reduce 40–70% of global greenhouse gas emissions by 2050 compared to emissions under currently implemented policies, while supporting well-being for all²⁴⁵. This may also be relevant for short-haul flights. Question some air travel needs would support achieving the remaining emissions reductions.

Modal shift towards high-speed rail and ferries offers the most significant emissions reduction potential for short-haul flights, particularly where they provide appropriate levels of service. SAF has a lower but good mitigation potential, while electric, hybrid and hydrogen aircraft can be an interesting avenue to support decarbonisation.

6.2. Connectivity: outermost regions, islands and remote territories

Especially when land transport is unavailable, limited, or impractically time consuming (e.g. for same-day travel), air connectivity can support the economic development of outermost regions (OMR), islands and remote territories. As described in the 2021 Impact Assessment, changes in the cost of flying or the frequency of available flights can affect the access by residents of these areas to education, training, healthcare, social networks, goods and services to a greater extent than for other, less-isolated regions. When examining impacts, we also consider **Iceland**. As shown in the Impact Assessment (section 6.2.3.3), the impact of the policy options on ticket prices is likely to be limited.

The EU ETS includes special provisions for OMR, islands, and remote territories. Several flight routes involving OMR are not covered by a carbon price until the end of 2030²⁴⁶. In 2024,

²⁴⁰ World Economic Forum, [How hybrid planes could make aviation more sustainable](#), 2024.

²⁴¹ Busch, A., Gülzow, A., & Hanke-Rauschenbach, R., *Hydrogen-powered aircraft: Energy demand and performance estimates for 2035 and 2050*. DLR Institute of Engineering Thermodynamics, 2021.

²⁴² Chen, H., Rutherford, D., Wolfram, P., & Pavlenko, N. (2022), International Council on Clean Transportation, *Performance analysis of regional electric aircraft*, 2022. Braun, C., Grimme, W., & Oesingmann, N., *Life cycle assessment of hybrid-electric aircraft technologies: A review*. DLR – German Aerospace Center, 2024.

²⁴³ International Energy Agency. (2023). *Global hydrogen review 2023*. IEA. <https://www.iea.org/reports/global-hydrogen-review-2023>

Ricks, W., Xu, Q., & Jenkins, J. D. (2023). Minimizing emissions from grid-based hydrogen production in the United States. *Environmental Research Letters*, 18(1), Article 014025. <https://doi.org/10.1088/1748-9326/acacb5>

²⁴⁴ Zheng, W., Li, Y., Rutherford, D., & Pavlenko, N., International Council on Clean Transportation, *Hydrogen fuel-cell retrofits for regional aviation*, 2023.

Clean Sky & Fuel Cells and Hydrogen Joint Undertaking, *Hydrogen-powered aviation: A fact-based study of hydrogen technology, economics, and climate impact*, 2020.

Ablon, D. J., & Sinnott, M., *The Aeronautical Journal*, *Abating CO₂ and non-CO₂ emissions with hydrogen propulsion*, 2024.

²⁴⁵ IPCC, *Summary for Policymakers. In: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P.R. Shukla, J. Skea, R. Slade et al. (eds.)]*, Cambridge University Press. DOI: 10.1017/9781009157926.001, 2022.

²⁴⁶ See ETS Directive, Article 28a: Flights between an outermost region of a Member State and the same Member State outside that outermost region, flights within the same outermost region, and flights between different outermost regions in the same Member State are exempted from the requirements of Article 12(3), Article

excluded emissions under the EU ETS amounted to a total of 2.5 MtCO₂²⁴⁷. In addition, Member States can designate socially necessary flights to operate under Public Service Obligations (PSOs²⁴⁸) to ensure socially necessary connectivity on routes which would otherwise not be sufficiently served. PSOs and airfare subsidies currently cover routes from 70% of OMR and islands particularly supporting inter-island flights and connections to mainland airports²⁴⁹. PSO emissions have increased by about 80kt since 2019 and they are excluded from the ETS. Finally, airlines using eligible SAF on flights departing from airports on remote islands and OMR²⁵⁰, even those not covered by the carbon price, can receive ETS-financed SAF support to cover 100% of the remaining price differential between the SAF used and fossil kerosene.

Nearly all²⁵¹ OMR, islands and remote territories had more passengers and flights in 2024 compared to 2019. Although ACI Europe²⁵² finds a decrease in the number of destinations served at airports in these regions (especially at smaller airports) in the same timeframe, the traffic increase reflects the overall increase in connectivity of these regions. In the case of OMR, emissions from non-domestic EEA flights (covered by the EU ETS) increased by 14% in 2024 compared to 2019, exceeding 4MtCO₂, which corresponds to 6% of all emissions under the aviation ETS²⁵³. Emissions between OMRs and their mainland slightly increased between 2024 and 2019, while emissions from flights within the same OMR and different OMRs within the same Member State²⁵⁴ increased by 9%. PSOs covered 93% and 48% of these flights' emissions in 2024 and 2019, respectively. CO₂ emissions reached 10 Mt for connections to and from EU remote regions and islands, and 1 Mt for Iceland, mostly driven by the higher activity, especially in Greek and Italian islands, as well as Malta.

The effects of changes in connectivity patterns on remote areas can vary depending on whether the destination is a hub or a smaller airport, and where the airport is located. Flights to large intra-EEA hub airports with extensive connecting flights, and a region's mainland airport can enhance labour mobility, productivity, and attract investments. Flights to smaller airports with fewer connections may not provide similar economic stimulation but enable regional connectivity. Connections to other smaller international destinations (intra- and beyond EEA) generally provide economic rather than social benefits, mostly through tourism-driven seasonal connectivity. In addition, the relation between air connectivity and economic growth is not equal across European regions. In particular, high-income, high-connectivity regions showing

14(3), and Article 16 of the ETS Directive until 31 December 2030. Such derogations were established in the 2023 amendments of the ETS Directive (Directive (EU) 2023/958); before January 2024, flights to/from outermost regions and EEA countries were excluded, while flights within outermost regions were included.

²⁴⁷ Source: Ricardo aviation support study.

²⁴⁸ Official Journal of the European Union, [COMMISSION NOTICE Interpretative guidelines on Regulation \(EC\) No 1008/2008 - Public Service Obligations \(PSO\) \(2017/C 194/01\)](#), 2017.

²⁴⁹ Interisland routes involving all eight airports of the Canary Islands are covered by PSOs. Airlines operating some PSO interisland routes receive direct financial compensation, and island residents are eligible for a 75% government airfare subsidy. In the French OMRs, all airports except Mayotte and Saint Martin offer routes subject to PSOs that mainly connect to Paris. In the Portuguese OMRs, a PSO covers 15 interisland routes in the Azores and connections between Madeira and the Azores. In addition, a mobility aid is available for residents for flights to/from the Azores and Madeira. Source: Commission analysis based on Eurocontrol data.

²⁵⁰ Flights departing from airports on islands smaller than 10,000 km² without a road or rail link to the mainland or airports that do not qualify as Union airports (i.e. airports in outermost regions and small airports with less than 800 thousand passengers or 100 thousand tonnes of cargo annually). ETS Directive Article 3c.

²⁵¹ In French outermost regions and Corsica the number of flights has decreased by 17% and 8%, respectively.

²⁵² Airport Council International (ACI) Europe, [Airport Industry Connectivity Report 2025](#), 2025,

²⁵³ Commission's own calculations based on Eurocontrol monitoring.

²⁵⁴ Before January 2024 flights within outermost regions were included in the EU ETS.

signs of saturation (i.e. where additional air travel capacity no longer facilitates business growth, e.g. in Ireland and Cyprus), as well as regions where tourism is mostly domestic, show limited dependence on air travel for economic development, as additional air connectivity may no longer add significant GDP per capita. Moreover, in regions with good rail network, air connectivity can even lead to worse economic performance²⁵⁵. Several remote areas and small islands have a high share of domestic flights, which are important for national integration and facilitate access to national services. Of the studied regions, Corsica, Cyclades, Lesvos/Limnos, Sardinia, and Sicily stand out with a high share of domestic connections, including to the hubs of Paris, Athens, and Rome, indicating strong mainland connectivity. In contrast, the majority of flights from Ibiza, Mallorca, Corfu, Crete, and the Dodecanese islands are to international intra-EEA and UK destinations (these have been covered by the ETS carbon price since 2012). This indicates a higher share of tourist flights. The relatively high numbers of total flights and flights per population of these regions suggest stable air connections with their mainland.

In general, international flights to/from OMR, islands, and remote territories²⁵⁶ contributed to below 10% of total emissions of those flights in 2024, with exceptions being Cyprus (16%), Madeira (16% together with the Azores), and more notably from Ireland and Iceland (both at 50%). Only Dublin Airport and Keflavík Airport are hub airports in such territories²⁵⁷ that offer connections with international destinations (i.e. North America). ACI Europe classified both airports as “Niche & Smaller Hubs”, for which the risk of hub-carbon leakage, thus of connectivity changes, may be smaller than at larger hub airports with more transfer traffic. For both airports, London Heathrow is the main alternative hub for indirect flights between Europe and North America, where the UK ETS currently applies with a similar regulatory stringency and compliance costs as the EU ETS. As shown in Case study 1 in section 4 above, however, the risk of hub carbon leakage for these types of indirect intercontinental routes is expected to remain small under all policy options. Furthermore, despite the connections offered from Cyprus and Madeira to extra-EEA destinations in the Middle East and the Americas, respectively, airports in these islands mostly operate touristic flights rather than serving as connecting hubs. Finally, airlines with hub operations at airports in OMR, such as Azores Airlines and Binter Canarias, are likely to face limited risk of hub switching because hub operations focus on onward connections to airports within the respective island group.

7. PRIVATE & BUSINESS JETS INCLUSION

As required under Article 30(8), point (b) of the ETS Directive, in 2026 the Commission shall provide an assessment of the environmental and climate impacts of exempted flights performed by small aircraft or non-commercial operators with low emissions, and consider options to reduce those impacts. This assessment should be taken into account for the future revision of the ETS Directive. As it may be extremely challenging to achieve a position concerning the inclusion of business aviation into the Energy Tax Directive²⁵⁸, it is even more important to seriously look into this issue of exempting certain aircraft operators and flights from the EU ETS.

Despite representing a small fraction of overall aviation activity, private jets contribute disproportionately to total aviation emissions, releasing 5 to 14 times more CO₂ per passenger

²⁵⁵ NEF and T&E, Chapman, A., Pot, F., New Economics Foundation, [The economics of air transport in Europe](#), 2025.

²⁵⁶ Extra-EEA destinations (other than Switzerland and the UK), which are not covered by the ETS carbon price.

²⁵⁷ Dublin Airport (ICAO: EIDW) and Keflavík Airport (ICAO: BIKF) are the only airports within these regions with significant hub operations. Source: support study.

²⁵⁸ European Council Council of the European Union ; Economic and Financial Affairs Council, [Economic and Financial Affairs Council - Consilium](#), November 2025.

compared to commercial flights²⁵⁹, coupled with far superior financial resources. Looking ahead, in Europe, 29% of business aviation operators expect to log more flight hours in 2026 than in 2025²⁶⁰, and business aviation is expected to grow at an average rate of 1.4% per year between 2024 and 2050 under a high Eurocontrol outlook scenario²⁶¹.

71% of the recorded private jet flights in 2023 in the EU were domestic or intra-EU flights, and most flights cover less than 900km and last under two hours²⁶². Under the EU ETS, 67% of emissions from private jets in the EU are exempted from carbon pricing²⁶³, as many flights fall below the thresholds for aircraft mass, annual emissions and flight numbers, or fly mainly to and from outside the EEA.

The Call for Evidence highlighted business jets as a focal point in discussions around aviation regulation and environmental impacts. Environmental organisations and NGOs stress the rapid growth of private jet emissions. They call for the full inclusion of business aviation in the ETS, the removal of exemptions, and the use of CO₂ price multipliers to address the sector's significant climate impact comprehensively. Public authorities have also called for a reassessment of the exemption for private flights operators emitting less than 1 000 tonnes of CO₂ per year, noting that it may allow high-emission, luxury flights to avoid regulation. Conversely, according to business aviation associations, private jets may enhance connectivity, especially in remote areas, and facilitate time-sensitive international missions.

The purpose of this assessment is to review the exemption of business aviation operators, who may be operating aircraft below 5.7 tonne maximum take-off weight²⁶⁴ and often do not hold an air operator certificate (AOC) falling within the list of non-commercial operators²⁶⁵ under EU ETS. These flights have not paid an ETS carbon price in the past.

Business aviation does not have a single, universally accepted definition, as it is determined by the purpose of the flight rather than the operator's identification. While international organisations offer varying interpretations, all emphasise the operational nature of the activity as the defining factor. A core complexity is that business aviation spans both commercial and non-commercial operations, making clear categorisation difficult. This means that business aviation operations are also performed by commercial aircraft operators under EU ETS, but these operators have a different exclusion threshold²⁶⁶. According to the Eurocontrol data analysed in the aviation support study, only 20% of the 2024 in-scope emissions in the business aviation market segment were performed by non-commercial operators. This shows that while most business aviation operators might be mainly non-commercial operators, the total emissions of the commercial business aviation operators are far superior, emphasizing the need to address business aviation under both commercial and non-commercial status.

Emissions from the business aviation market segment do not specifically fall within any of the existing exemption categories. Figure 3 demonstrates that during 2024 business aviation fell within all existing exemption categories with varying magnitude. The largest quantity of exempted emissions from business aviation fell under exemption category (j) under the row on

²⁵⁹ ICCT, Sitompul, D., Rutherford, D., [https://theicct.org/publication/air-and-ghg-pollution-from-private-jets-2023-jun25/Air and greenhouse gas pollution from private jets](https://theicct.org/publication/air-and-ghg-pollution-from-private-jets-2023-jun25/Air%20and%20greenhouse%20gas%20pollution%20from%20private%20jets) , 2023.

²⁶⁰ Honeywell, *2025 Global Business Aviation Outlook* , 2025.

²⁶¹ Eurocontrol, *Eurocontrol Aviation Long-Term Outlook: Flights and CO₂ emissions forecast 2024-2050* , 2024.

²⁶² ICCT, Sitompul, D., Rutherford, D., [Air and greenhouse gas pollution from private jets](https://theicct.org/publication/air-and-ghg-pollution-from-private-jets-2023-jun25/Air%20and%20greenhouse%20gas%20pollution%20from%20private%20jets), 2023.

²⁶³ Carbon Market Watch, *Policy Brief*, August 2025.

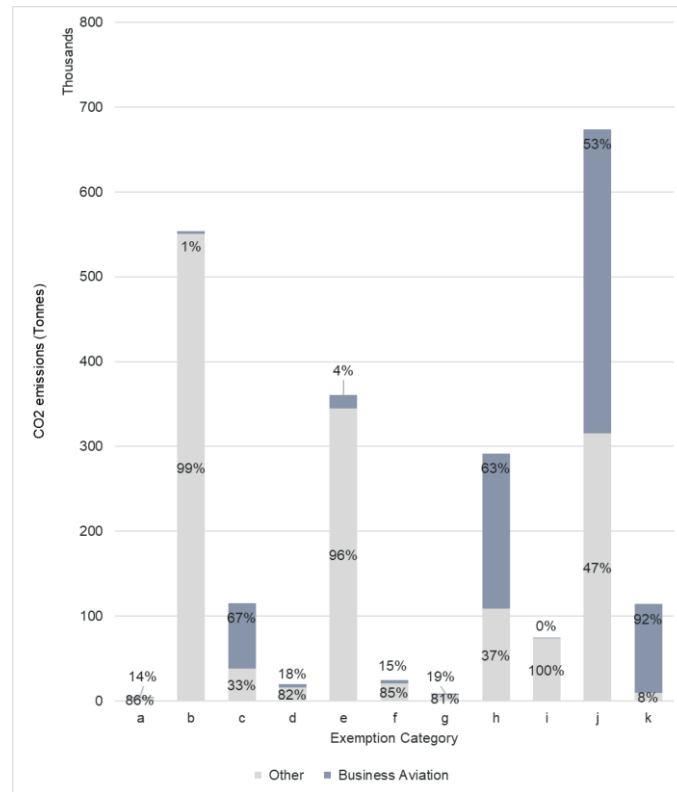
²⁶⁴ Exemption (h) of the entry 'Aviation' of Annex I.

²⁶⁵ Exemption (k) of the entry 'Aviation' of Annex I.

²⁶⁶ Exemption (j) of the entry 'Aviation' of Annex I.

aviation under the Annex I of the ETS Directive, 358k tonnes CO₂ representing 53% of total exemptions under that exemption category. Emissions from business aviation make up more than 50% of exempted emissions under exemption categories (c)²⁶⁷, (h), (j) and (k). This underlines the necessity to evaluate exemptions under points (h) and (k) as well as (j), as these exemptions are exempting the most business aviation flights.

Figure 3: 2024 surrender scope exempted emissions from the business aviation



Source: Ricardo analysis of Eurocontrol data

Considering the above, the analysis for inclusion of private and business jets under the EU ETS should first look into setting a new threshold for the exclusion of certain flights/aircraft operators in a way that simplifies the framework, then try to find a definition for the business flights, allowing for an appropriate treatment of these flights, distinct from the ordinary treatment.

7.1. New threshold

The current exclusion categories for low aviation activity (j) and (k) are also referred to as the “*de-minimis* thresholds”. Exemption category (j) exempts from the EU ETS commercial aircraft operators that emit less than 10 000 tonnes of CO₂ per year or who operate fewer than 243 flights per 4-month period for three consecutive periods. In addition, exemption category (k) exempts non-commercial aircraft operators operating flights with total annual emissions lower than 1 000 tonnes per year. This exemption applies until the end of 2030. Both of the *de-minimis* thresholds are based on the full aviation activity as covered by the Annex I to the Directive (i.e. all flights departing or arriving in the EEA).

²⁶⁷ Flights related to search and rescue, fire-fighting flights, humanitarian flights and emergency medical service flights authorised by the appropriate competent authority. In his category, while the flights might be operated by smaller aircraft traditionally used by business aviation, the purpose of the flight has a positive social impact.

7.1.1. Challenges observed with the current approach and solutions proposed

Commercial status of an aircraft operator does not necessarily indicate the full nature of their activity. Business jets operators may operate as both commercial and non-commercial operators. Non-commercial operators that perform flights other than business flights would generally be exempted due to other exemptions based on the nature of flight²⁶⁸. This may lead to situations where it is beneficial for a business aviation operator to start operating as a commercial operator, applying an increased *de-minimis* threshold and ultimately avoiding the ETS obligation and gaining unfair advantage²⁶⁹.

CORSIA is implemented in Member States via the ETS Directive. There is a number of differences between the EU ETS and CORSIA, one being the *de-minimis* rules. CORSIA has only one exclusion threshold, irrespective of the commercial status of the operator, based solely on annual emissions. The fact, that the EU ETS has two thresholds, one of those based on two different factors (emissions and number of flights), makes the alignment between the two market-based measures more complicated. For market-based measures addressing aviation emissions, solely the level of emissions should be indicative.

Under exemption (j), having the two *de-minimis* thresholds leads to situations where an operator may be exempted based on their number of flights, while their emissions are relatively high. According to the aviation support study, in 2024, 44 commercial operators (7% of total) were exempted based on the flight number threshold only, emitting on average 48 000 tonnes of CO₂ per operator in Annex I full scope (62% of total exempted emissions under exemption (j)). This led to 83 000 tonnes of CO₂ within the surrender scope not addressed.

The current *de-minimis* thresholds apply to the full geographical scope under Annex I, while the surrender obligation is based on a different, limited geographical scope, as flights for which allowances have to be surrendered does not include flights outside the EEA (except to Switzerland and the UK). This may lead to situations where an aircraft operator falls under the scope of EU ETS by exceeding the full scope *de-minimis* thresholds, but at the same time such operator had no flights within the surrender scope or had a very limited number of flights due to diversions or other circumstances. In these cases, the EU ETS compliance obligations (MRV and surrendering) may be disproportionate. According to the Union Registry data for 2024, 5 operators were not excluded based on the thresholds while reporting 0 emissions under the reduced scope, 40 operators reported less than 100 tonnes of CO₂, totalling 2 041 tonnes of CO₂.

To address all of the above challenges, to ensure level playing field, to simplify the exclusion rules and to align with CORSIA, a new threshold should have the following characteristics:

- Eliminate the commercial/non-commercial distinction between aircraft operators;
- Eliminate the threshold based on number of flights;
- Use one common *de-minimis* threshold for all operators based on their aviation activity as per full scope, expressed in CO₂;
- Introduce a new simplification *de-minimis* threshold for operators that have very low aviation activity under the surrender scope.

²⁶⁸ Military flights, search and rescue, fire-fighting flights, humanitarian flights, emergency medical service flights, flights performed under visual flights rules, or public service obligation flights.

²⁶⁹ PWC et al., [ETS Aviation small emitters](#), 2014.

7.1.2. Common de-minimis threshold based on full aviation activity

The primary goal of updating this *de-minimis* threshold is to ensure appropriate internalisation of the climate impacts, especially that of private and business aviation.

Considering this goal, it is appropriate to adjust the new common threshold to, at minimum, the level of the current non-commercial operators' threshold (1 000 tCO₂), in order to avoid any additional exclusions of non-commercial business operators. Table 21 shows how a new *de-minimis* threshold would impact on the number of operators additionally included in the EU ETS and their corresponding emissions on full scope as well as the percentage of the total operators and their emissions that are currently excluded. The annual emissions threshold set at 0 shows that currently, 2 808 aircraft operators are excluded from the EU ETS, these operators emitted almost 4 million tCO₂ on full scope and over 800 000 tCO₂ under the current EU ETS surrender scope.

Table 21: Emissions and number of aircraft operators (AO) included in EU ETS based on emissions threshold on full scope

Annual Emissions Threshold (tCO ₂)	Total additional emissions included in current EU ETS (tCO ₂) <u>AS1</u>	% of 2024 exempted emissions included in EU ETS	% of 2024 total EU ETS emissions included in EU ETS	Total additional emissions included in EU ETS (tCO ₂) <u>full scope</u>	% of 2024 exempted emissions included in EU ETS	% of 2024 total EU ETS emissions included in EU ETS	Total additional number of AO included in EU ETS (tCO ₂)	% of 2024 exempted AO included in EU ETS
0	815k	100%	1,3%	3.939k	100%	6,4%	2808	100%
50	811k	99,5%	1,3%	3.925k	99,7%	6,4%	2269	81%
100	803k	98,6%	1,3%	3.895k	98,9%	6,3%	1853	66%
200	785k	96,4%	1,3%	3.823k	97,1%	6,2%	1356	48%
500	737k	90,4%	1,2%	3.625k	92,0%	5,9%	739	26%
1000	667k	81,8%	1,1%	3.379k	85,8%	5,5%	383	14%
5000	346k	42,5%	0,6%	2.538k	64,4%	4,1%	12	0%
10000	-2	-0,2%	0,0%	1.780k	45,2%	2,9%	-97	-3%

Source: Eurocontrol

Increasing the emissions threshold above 1 000 tCO₂ consistently reduces the number of commercial AOs included in the ETS and increases the number of non-commercial AOs exempted. When the annual emissions threshold rises from 1 000 to 5 000 tCO₂, the number of additional commercial AOs included in the ETS decreases, while the number of non-commercial operators exempted increases. The resulting net inclusion drops sharply from 382 to only 12 operators. At an emissions threshold of above 5 000 tCO₂, the resulting number of additional non-commercial aircraft operators exempted always exceeds the number of commercial Aircraft Operators brought within the EU ETS. This demonstrates why setting the new common threshold above 1 000 tCO₂ is not coherent with the goal of covering business aviation and fully implementing the polluter pays principle.

The new common thresholds set at 1 000 tCO₂ or 500 tCO₂ both ensure completing the set goal and maintaining justified exclusion for aircraft operators with very low aviation activity and

avoiding disproportionate administrative burden on competent authorities. However, these thresholds may nevertheless present a challenge of increased administrative effort, therefore a new exclusion simplification threshold, based on the surrender scope, is described in the next subsection and is accompanied by substantial further simplification, which is more closely described and analysed in subsection 7.2.

7.1.3. New simplification threshold based on surrender scope

The single exemption threshold introduced above ensures the polluter pays principle. However, it is important to note that this threshold is based on the full scope, which is not the current scope of surrender obligation, nor is this scope analysed in either policy options. Therefore, it would still be possible that an aircraft operator is included in EU ETS based on this single threshold, while having only very few flights, hence very low total emissions, within the geographic scope with surrender obligation.

It may therefore be appropriate to introduce a new simplification *de-minimis* threshold that fully excludes operators from EU ETS that have very little surrender obligation.

Tables 22 and 23 show how much emissions and how many operators would be excluded due to this new simplification threshold considering the current full scope thresholds and the new common full scope threshold, set at 500 tCO₂ and 1 000 tCO₂ respectively. It is important to consider the new common threshold in order to first identify the total pool of additional operators included in EU ETS and identify the operators that would be excluded from this pool based on their emissions within the surrender obligation scope as a second step. Both tables show results for the surrender obligation scope considered under the policy options – AS1: clean cut and AS2: departing flights.

For example, under the clean-cut geographical scope (AS1), Table 22 shows that this simplification threshold set at 200 tCO₂/year would in 2024 exclude 121 aircraft operators (with the current exclusion thresholds), emitting 7 kt CO₂. Considering the new common full scope threshold at 500 tCO₂, 331 additional AO would get excluded, out of the 739 additionally added due to the new common threshold (from Table 21), based on this simplification threshold, corresponding to 25 kt CO₂ emissions. In total, under option AS1 considering a 200 tCO₂ minimum surrender threshold, a total of 452 AO would get excluded with emissions of 32 ktCO₂. Under the departing flights scope (AS2), the same simplification threshold would in 2024 exclude 1 aircraft operator, corresponding to 140 tCO₂. Under the new common threshold 500 tCO₂, 3 additional AO would get excluded corresponding to 164 tCO₂. In total, under option AS2 and 200 tCO₂ simplification threshold, 4 AO would get excluded corresponding to 304 tCO₂.

Table 22: Emissions and number of AOs exempted based on the new simplification *de-minimis* threshold based on surrender scope – figures for new common full scope threshold set at 500 tCO₂

Annual Emissions Threshold (tCO ₂)		AS1		AS2	
		AO in EU ETS based on old full scope threshold	AO newly in EU ETS due to new full scope threshold	AO in EU ETS based on old full scope threshold	AO newly in EU ETS due to new full scope threshold

0	tCO ₂ excluded	0	0	0	0
	AO excluded	24	42	0	0
50	tCO ₂ excluded	1k	3k	0	Negl.
	AO excluded	60	131	0	2
100	tCO ₂ excluded	3k	9k	0	Negl.
	AO excluded	93	224	0	2
200	tCO ₂ excluded	7k	25k	140	Negl.
	AO excluded	121	331	1	3
500	tCO ₂ excluded	21k	60k	1k	102k
	AO excluded	161	438	2	277
1000	tCO ₂ excluded	54k	140k	47k	208k
	AO excluded	207	551	65	431

Source: Eurocontrol

Table 23: Emissions and number of AOs exempted based on the new simplification de-minimis threshold based on surrender scope: figures for new common full scope threshold of 1000 tCO₂

Annual Emissions Threshold (tCO ₂)		AS1		AS2	
		AO in EU ETS based on old full scope threshold	AO newly in EU ETS due to new full scope threshold	AO in EU ETS based on old full scope threshold	AO newly in EU ETS due to new full scope threshold
0	tCO ₂ excluded	0	0	0	0
	AO excluded	24	24	0	0
50	tCO ₂ excluded	1k	Negl	0	Negl.
	AO excluded	60	42	0	2
100	tCO ₂ excluded	3k	1k	0	Negl
	AO excluded	93	54	0	2
200	tCO ₂ excluded	7k	5k	Negl.	Negl.
	AO excluded	121	80	1	2
500	tCO ₂ excluded	20k	19k	1k	1k
	AO excluded	161	125	2	5
1000	tCO ₂ excluded	54k	70k	47k	54k
	AO excluded	207	194	65	74

Source: Eurocontrol

7.1.3.1. Administrative cost

To assess which threshold corresponds to a very low aviation activity that would justify exclusion from EU ETS and thus avoidance of surrender obligation for those emissions, this analysis compares the administrative cost associated with the monitoring, reporting and verification of the emissions as well as other fees associated with the EU ETS obligation, weighted against the EU ETS compliance revenues brought into the system. The ETS compliance cost is not included in the definition of administrative cost, as the compliance cost is a consequence of emitting CO₂ and the application of the polluter pays principle. However, it is understood that should the administrative cost associated with the compliance be higher than the compliance cost itself, it would constitute an unjustified burden.

As also stated in the impact assessments of 2017²⁷⁰ and 2021²⁷¹, the Commission published in 2014 a study by PWC et al.²⁷² (the small emitters study) that investigated the costs and benefits of the inclusion of small emitters in the EU ETS. It revealed amongst other things that the obligations with regard to MRV generate relatively higher administrative costs for small than large operators. The study also stated that compared to the level of EU ETS revenues raised from a small emitter, the administrative cost can be up to 4 times higher.

As per the aviation support study initial setup and onboarding (preparing monitoring plans, registration in the Union Registry, software adjustments) typically ranges for small operators between EUR 3 000–EUR 10 000, depending on operational complexity and data systems.

The ongoing MRV costs (annual data collection, reporting, verifier fees):

- a) Very small emitters (<1 000 tCO₂ full scope / < 300 tCO₂ surrender scope): EUR 1 000–EUR 5 000 per year.
- b) Small emitters (<25 000 tCO₂ full scope / < 3 000 tCO₂ surrender scope): EUR 2 000–EUR 7 000 per year.

The 2014 Small emitter study, as well as the figures included above, must be considered also taking into account the following developments:

- Regulation 2017/2392 simplified the MRV requirements for operators emitting less than 25 000 tCO₂ per year on full scope or 3 000 tCO₂ per year under the surrender scope of the EU ETS, allowing the use of EMIS Support Facility²⁷³ without the need for reporting or verification. Aircraft operators can purchase this service from Eurocontrol for an annual fee of EUR 400²⁷⁴. Being able to use this derogation essentially eliminates the ongoing MRV costs above. However, certain resources are still necessary for the download of the EMIS report as well as the submission.
- New entrants may face unavoidable cost related to set up and onboarding. However, Commission Implementing Regulation 2018/2066 provides for simplified procedures including simplified monitoring plan requirements for small emitters. Even further simplification on this point is foreseen as part of this design element and is described in more detail in subsection 7.2.
- Additionally, to the set up cost and specifically the Union Registry registration, it is important to note that there are currently 1 334 aircraft operators with an open Union Registry account, while in 2024 there was only 375 aircraft operators falling under the

²⁷⁰ [SWD\(2017\) 31](#) final.

²⁷¹ [SWD\(2021\) 603](#) final.

²⁷² PWC et al., *ETS Aviation small emitters*, 2014.

²⁷³ Formerly known as the EU ETS Support Facility. This service falls under the Eurocontrol Environment Management Information Service (EMIS) available to aircraft operators for purchase and to Member States.

²⁷⁴ EUROCONTROL, [Emissions trading system support facility \(ETS SF\)](#).

EU ETS scope and reporting their emissions²⁷⁵. It is therefore assumed that most of the newly added aircraft operators do, in fact, already own an open but excluded Union Registry account.

- The two previous points significantly lower the initial setup and onboarding costs.
- In general, the cost figures included in the small emitters study are largely outdated based on first years of entirely new compliance. In 2025, majority of aircraft operators, both EEA and extra-EEA, have in place sophisticated monitoring of their fuel use, not only for the purpose of EU ETS or other market-base measures, but also because fuel represents a large expenditure in their total operational costs and for safety reasons.
- The conclusions of the small emitters study on the comparison of the EU ETS revenues against the administrative cost for small emitters were based on the 2012 price of the EU ETS allowances varying between EUR 4 and EUR 5 per tCO₂. In 2024, the average auction price per ETS emissions allowance as published on the common auction platform was EUR 64,74²⁷⁶. This price is assumed to be increasing up to EUR 140 by 2035 due to the continuously tightening ETS cap. On the other hand, significant increase of the administrative cost, apart from inflation, is not assumed nor justified in the view of continuous simplification.
- No new comprehensive study including broad survey of the actual costs has been performed since the small emitters study.

Considering these points and ensuring this analysis does not underestimate the administrative costs, the following adjusted average costs are used:

- a) For initial setup and onboarding: EUR 3 000
- b) Ongoing MRV costs for very small emitters: EUR 700
- c) Ongoing MRV costs for small emitters: EUR 1 000

Table 24: Comparison of administrative costs and associated minimum ETS revenue for each simplification threshold in Tables 22 and 23.

Annual Emissions Threshold (tCO₂)	Administrative cost	Minimum ETS revenue (EUR at 2024 EUA price)	Minimum ETS revenue (EUR at 2035 EUA price)
0	3 700	0	0
50	3 700	3 237	7 000
100	3 700	6 474	14 000
200	3 700	12 948	28 000
500	4 000	32 370	70 000
1000	4 000	64 740	140 000

Source: Commission analysis

²⁷⁵ Majority (1 000) of the OPEN accounts were opened in 2012 when aviation was included in the EU ETS. Initially, the surrender obligation scope matched the geographic scope of Annex I and there was no derogation for non-commercial operators below 1 000 tCO₂ requiring many aircraft operators to open a Union Registry account at the time. Following the reduction of the geographical scope, many of these operators either do not report emissions since 2013 or may fall in and out of the scope from one year to another.

²⁷⁶ Commission Notice on the publication of the details for the calculation of the price difference between kerosene and relevant eligible aviation fuels and for the allocation of allowances for the use of eligible fuels under the EU Emissions Trading System established by Directive 2003/87/EC

Table 24 shows that the simplification threshold of 0 tCO₂ (current) is the only threshold that would result in higher administrative cost for the operator than the corresponding minimum ETS revenues stemming from their participation considering both the ETS revenues with known 2024 EUA price and projected 2035 EUA price. At 50 tCO₂ simplification threshold, the administrative cost would be higher than the 2024-based ETS revenues, but would be equal at an allowance price of 74 EUR. However, already at 100 tCO₂ simplification threshold the 2024-based ETS revenues are 75% higher than the administrative cost, while the 2035-based ETS revenues are almost four times higher.

Member States also incur costs to administer compliance for small emitters. As per the small emitters study, these amounted to EUR 1 070 per operator in 2011 and EUR 970 in 2012, with projected costs stabilising at approximately EUR 821 per year from 2013 onwards. While the underlying data are outdated, they can provide a proxy for assessing the potential administrative cost on Member States associated with expanding ETS coverage with more focus on business aviation operators. As per these estimates, all reviewed simplification threshold would deliver ETS revenues significantly higher than the administrative costs incurred by the Member States, except for the current 0 tCO₂ threshold.

7.2. Simplification

7.2.1. Small emitters and use of EMIS

Implementing Regulation 2018/2066 defines ‘small emitters’ as aircraft operators operating fewer than 243 flights per period for three consecutive four-month periods and aircraft operators operating flights with a total annual emissions in full scope lower than 25 000 tCO₂. Small emitters as well as aircraft operators that have total annual emissions in surrender scope lower than 3 000 tCO₂ are allowed to estimate the fuel consumption using tools implemented by Eurocontrol. Moreover, Article 28a(4) of the ETS Directive provides for a derogation for these low-emitting operators meaning that the reported emissions are considered verified if determined using the Eurocontrol EMIS. Small emitters can also take advantage of simplified monitoring plan requirements. Member States have been using EMIS successfully as a tool to perform order of magnitude checks and assess inclusion of operators in the EU ETS²⁷⁷. According to the ETS Evaluation Report (see Annex 15), 90% of small emitters use the Eurocontrol EMIS for their reporting.

While the Small Emitters Tool (SET) can be downloaded free of charge and used by eligible aircraft operator by inputting aircraft type and distance per flight, aircraft operators may also purchase the EMIS annual data for a fee of EUR 400. This gives them access to their detailed data as collected by Eurocontrol (departure and arrival aerodrome, date and time, aircraft type, distance flown, exemption code, etc.) as well as filled in ETS Annual Emissions Report (AER), which the aircraft operators only need to finalise by including their identification and contact details. Using EMIS significantly simplifies, if not eliminates, the monitoring and reporting obligation of aircraft operators, if eligible, it also eliminates the need for external verification and it allows the Member States to approve submitted AER swiftly lowering their administrative efforts as well.

It was identified that covering more emissions under the EU ETS also means having more aircraft operators covered by the system where most of the newly added operators would fall within the small emitter definition or below the 3 000 tCO₂ surrender threshold. However, it seems appropriate to increase the threshold for eligibility to use SET, EMIS and the verification

²⁷⁷ EASA, [European Aviation Environmental Report](#), 2025.

derogation, in order to ensure a smooth onboarding of all new operators while maintaining accuracy of the reported emissions.

Table 25 shows that currently there are 193 aircraft operators reporting under EU ETS with full scope emissions below 25 000 tCO₂ and therefore identifying as small emitter and being eligible to use simplified procedures including EMIS without verification. Considering the new common full scope threshold set at 1 000 tCO₂, total of 543 operators would fall within the small emitter definition and under this scope being set at 500 tCO₂, would include a total of 900 operators. The table shows corresponding full scope emissions for these operators as well as their emissions under surrender scopes AS1 and AS2.

Table 25: Emissions and number of AOs eligible to use simplified procedures based on the full scope threshold

Scope		AO in EU ETS based on old full scope threshold	AO in EU ETS based on new full scope threshold- 1,000tCO ₂	AO in EU ETS based on new full scope threshold- 500tCO ₂
Full scope	tCO₂ eligible	1,156,501	2,574,776	2,822,333
	AO eligible	193	543	900
AS1	tCO₂ eligible	452,904	1,070,202	1,140,594
AS2	tCO₂ eligible	788,109	1,749,978	1,903,812

Source: Eurocontrol

Additionally, this simplification also includes big emitters (operators not identified as small emitters), that have a low aviation activity under their surrender scope. This threshold is currently set at 3 000 tCO₂, which allows those emitters to also benefit from using SET and EMIS without verification. Table 26 shows how many operators can benefit from these simplified procedures in addition to the operators identified in Table 25. At the current threshold and surrender scope, it is an additional 120 operators. This means that already under current conditions, a total of 313 aircraft operators can benefit from these procedures that help reduce administrative efforts in terms of both time spent and costs associated. Increasing this threshold to 5 000 tCO₂ and 10 000 tCO₂ would increase the number by another 13 and 37 operators respectively. Under the surrender obligation scope AS2, this threshold does not increase the number of operators that can use simplified procedures significantly above the operators already identified in Table 22. This is because in Table 26 only operators with full scope emissions above 25 000 tCO₂ are considered where one can assume a large part is due to flights falling within AS2 (intra-EEA and departing flights).

Table 26: Additional (to table 23) emissions and number of AOs eligible to use simplified procedures based on the threshold on surrender scope

Annual Emissions Threshold (tCO ₂)		AS1	AS2
3000	tCO ₂ eligible	51,526	0
	AO eligible	120	0
5000	tCO ₂ eligible	103,076	3,898
	AO eligible	133	1
10000	tCO ₂ eligible	278,665	3,898
	AO eligible	157	1

Source: Eurocontrol

7.2.2. Aircraft operator identification

One of the challenges in including more small emitters and especially business aviation operators is the identification of aircraft operators. Implementing Regulation 2018/2066 provides for rules to identify the aircraft operator responsible for a flight based on the filled-out flight plan. The identification of an aircraft operator for the purpose of EU ETS (ETS ID) follows the identification for the purposes of Eurocontrol Central Route Charging Office (CRCO)²⁷⁸. In most cases (certainly for scheduled commercial operations), the identification of the aircraft operator is identical to the entity paying for the route charges. However, for aircraft operators without an assigned ICAO designator²⁷⁹ or where they do not use this designator for certain flights for various commercial reasons, it may become significantly more complicated to identify the aircraft operator using for example the fleet list declaration²⁸⁰. In some of these cases, the entity having the CRCO account may be a service management company²⁸¹ which may or may not actually operate the flight. This potential split of the CRCO invoices between several aircraft operators has been also used in past in order to avoid compliance with EU ETS, by ensuring each aircraft operator falls under the de-minimis threshold individually even if the total CRCO traffic would place them above the threshold. According to Eurocontrol, who receives the fleet declaration lists and identifies the ETS aircraft operators, situations arise where the management company was unable to share the contact details of the owner of the aircraft due to confidentiality agreements in their contracts.

In order to eliminate this rather complicated and untransparent identification practises and to further simplify the overall EU ETS compliance, the aircraft operator for the purposes of EU ETS should be identified as the entity billed for the Eurocontrol route charges. This simplification would not cause any difference in current practice and identification of aircraft operators that perform scheduled commercial operations using their ICAO designator, but it would significantly simplify the identification of smaller aircraft operators and where service management companies are used. The entity in charge of the CRCO invoices should be identified as ETS aircraft operator, de-minimis thresholds should be assessed based on this Eurocontrol data and should the operator fall within the EU ETS, the entity will have obligations under the EU ETS (MRV and surrender obligation). This entity should then ensure their own arrangements on potential re-invoicing the EU ETS compliance costs, as well as the CRCO charges, to the entities they deem responsible for the emissions. However, this burden should no longer fall onto Eurocontrol or the Member States.

Any further simplifications concerning monitoring plans and submission of annual emission reports for operators using EMIS would be covered in a revision of the Implementing Regulation 2018/2066 following the revision of the ETS Directive.

²⁷⁸ EUROCONTROL, [Effective cost-recovery system](#).

²⁷⁹ The designator consists of three-letter indicator for use on the international aeronautical telecommunication service and for aircraft identification by air traffic control (ATC). The designators are listed in ICAO Document 8585/214.

²⁸⁰ EUROCONTROL, [Fleet declaration](#), 2024.

²⁸¹ Service management companies offer a variety of services from filing a flight plan and paying route charges on behalf of the operators to providing crew and full flight operations services. Some management companies also provide services related to the ETS obligations on behalf of their clients. Depending on the actual service provided, a service management company may be considered an aircraft operator under the current legislation. However, identification of these services from flight plans and CRCO invoices is not possible.

7.3. Summary of the design element on business aviation

To ensure the appropriate internalisation of climate impacts of most, if not all aviation, this element explored setting a new threshold for inclusion of aircraft operators in the EU ETS. The practical examples showed that different treatment between commercial and non-commercial operators is not justified and that using number of flights as an exclusion threshold for commercial operators is inefficient. Moreover, neither of these specific points is included in CORSIA. Therefore, eliminating both of these points constitutes a first step for an updated threshold.

Once the commercial status of the operator and number of flights is eliminated, the new common *de-minimis* threshold on full scope was explored. However, it was also identified that while a common *de-minimis* full scope threshold will offer significant simplification in identifying whether an operator is or is not covered by EU ETS, minimising potential for compliance avoidance, this will inevitably bring in more aircraft operators into the EU ETS whose emissions based on the surrender scope (AS1 and AS2) may be significantly lower. The assessment therefore explores setting up a new simplification *de-minimis* threshold based on the surrender scope, exempting operators below this threshold from EU ETS. To further lower or eliminate the administrative burden on aircraft operators and Competent Authorities, it explored how the small emitters threshold as well as eligibility to use Eurocontrol EMIS without the need for verification could be further extended.

The common full scope threshold at 500 tCO₂ and 1 000 tCO₂ were identified as the most balanced options. Additionally, the administrative cost comparison allowing to identify the right balance between the administrative cost and the ETS revenues identified the simplification threshold at 100 tCO₂ as the most appropriate and balanced. Following these conclusions, at a 100 tCO₂ simplification threshold, under policy option AS1, the common full scope threshold of 500 tCO₂ results in net 422 additional aircraft operators²⁸² and 1 000 tCO₂ results in net 235 additional aircraft operators. However, all of these new operators can benefit from the small emitter identification and further simplification by using EMIS without the need for verification with the eligibility threshold increased to 5 000 CO₂ on surrender scope. In terms of administrative effort and ETS revenues each of the additional aircraft operators will bring in additional ETS revenues higher than the administrative cost associated with ETS compliance while ensuring aviation appropriately contributes to the EU decarbonisation. Detailed summary of this element can be found in the Table 27.

Table 27: Final summary and comparison of threshold options and policy options

	500/AS1	500/AS2	1 000/AS1	1 000/AS2
Net additional AO	422	737	235	380
Total AO covered by EU ETS	867	1182	680	825
Total AO eligible for simplified procedures (% of total)	716 (83%)	899 (76%)	529 (78%)	542 (66%)
Net additional emissions in million tCO₂	0.7	2	0.7	2

²⁸² This is a net amount of aircraft operators brought into EU ETS as this value considers the additional operators brought in due to the new common threshold but it also takes into account the exempted operators under the new simplification *de-minimis* threshold which is excluding also operators currently covered by EU ETS.

Net additional ETS revenues (million EUR based on 2024 EUA price)	47	139	43	129
Net additional ETS revenues (million EUR based on 2035 EUA price)	102	300	93	279i

7.4. Business flight definition

As noted, there is no universally agreed definition of business aviation or business flight. For the purposes for the ETS, it is necessary to have such a definition in order to continue the analysis on the inclusion of private and business aviation which is included in the aviation support study as well as to ensure that these flights can be easily identified in case of specific targeting of these flights.

There is a number of existing approaches to identify business flights which are reviewed in more details in the aviation support study. The Eurocontrol Market Segment Rules²⁸³ classification system offers an operationally applicable framework, combining conceptual clarity with practical rules that facilitate regulatory compliance under the EU ETS. It includes two types of identification – first, based solely on aircraft type (typical business jets) and second, aircraft types that are larger and usually used in scheduled air transport (but that can be reconverted into business aviation aircraft) identified in combination with the ICAO flight type ‘N’ for non-schedule air transport operations or ‘G’ for general aviation as included in item 4 of the flight plan. This is fully implementable in practice as using the aircraft types identified in flight plans is aligned with other identifications used in EU ETS (such as identification of aircraft operator) and is already included in Eurocontrol EMIS.

7.5. Other impacts

The previous subsections analysing the inclusion of private and business aviation provide a comprehensive analysis of the environmental, climate, economic and financial impacts of this inclusion as well as solutions where this impact might be disproportionate (new simplification de-minimis threshold and further simplification). This subsection will focus on other impacts this inclusion may have.

Social impacts: The revenue generated from the inclusion of previously exempted flights in the EU ETS within the business aviation segment would primarily benefit the national governments of the Member States through the auctioning of allowances. Member States are required to use all of their auction revenues for climate- and energy-related purposes. Business aviation is not used by wide public but only by a very limited group of citizens, therefore the overall social impact is positive.

Connectivity: Private and business aviation is not used for scheduled commercial operators; therefore, this inclusion has limited impact on the overall connectivity .

8. SAF SUPPORT ANALYSIS

The 2023 revision of the ETS Directive provides a support mechanism for the use of certain aviation fuels. To incentivise early uptake of the best-performing alternative fuels in terms of emissions reduction potential, 20 million EU ETS allowances, estimated at around EUR 1.5 billion, are set aside from 1 January 2024 until 31 December 2030. The Directive also states

²⁸³ Eurocontrol, [Market Segment Rules](#), 2022. In 2025, Eurocontrol conducted a partial review of the market segment rules, covering All-Cargo and making minor revisions to Business Aviation and Low-Cost. The updated rules have been applied retroactively, effective from January 2025.

that the allocation of these allowances may take into account possible support from other schemes at national level²⁸⁴.

The allowances cover all or part of the remaining price differential between fossil kerosene and the specified aviation fuels used by commercial aircraft operators on flights covered by effective carbon pricing through the EU ETS. A level playing field is ensured, with all airlines treated equally that operate on these routes.

In order to operationalise this support mechanism, Commission Delegated Regulation (EU) 2025/723²⁸⁵ establishes rules for the yearly calculation of the price difference between eligible aviation fuels and fossil kerosene, taking into account incentives from the price of carbon, from harmonised minimum levels of taxation, and the rules for allocating the resulting allowances.

8.1. Current support

The current mechanism is in place until 2030 or until the reserve of 20 million allowances is exhausted. Aircraft operators can apply for support related to sub-sonic flights falling under the surrender scope and flights between an outermost region and an airport in the same Member State. In 2024, according to the prices published by the Commission²⁸⁶, the support per tonne of eligible fuel was up to EUR 7 526 for an RFNBO²⁸⁷ with 100% support and EUR 573 for biofuel²⁸⁸ uplifted at a Union airport, with no reduction from other national support schemes. This resulted in allocation to 53 commercial aircraft operators of 1.3 million allowances²⁸⁹ (EUR 100 million) for the use of total 110 000 t of eligible fuels in 2024 (0.7% of total aviation fuel reported under EU ETS in 2024).

The aviation industry as well as non-governmental organisations welcome this mechanism and the incentive for first movers it offers and are united in the belief that this mechanism should continue and be expanded²⁹⁰.

The current EU ETS mechanism has 18.7 million allowances still available. According to Commission estimates, as well as the aviation support study, unless supplemented, the allowances under the current mechanism could run out in 2028.

²⁸⁴ Article 3c(6), fourth paragraph.

²⁸⁵ Official Journal of the European Union, *Commission Delegated Regulation (EU) 2025/723 of 6 February 2025 supplementing Directive 2003/87/EC of the European Parliament and of the Council by laying down detailed rules for the yearly calculation of price differences between eligible aviation fuels and fossil kerosene and for the EU ETS allocation of allowances for the use of eligible aviation fuels*, OJ L, 2025/723, 16.4.2025, [ELI](#), 2025.

²⁸⁶ Official Journal of the European Union Commission, *Notice on the publication of the details for the calculation of the price difference between kerosene and relevant eligible aviation fuels and for the allocation of allowances for the use of eligible fuels under the EU Emissions Trading System established by Directive 2003/87/EC*, OJ C, C/2025/2934, 27.5.2025, [ELI](#), 2025.

²⁸⁷ Drop-in renewable fuels of non-biological origin as defined in *Article 2, point (36), of Directive (EU) 2018/2001* and that are certified in compliance with Article 30 of that Directive.

²⁸⁸ Aviation biofuels produced from feedstock listed in *Part B of Annex IX to Directive (EU) 2018/2001* and that are certified in compliance with Article 30 of that Directive.

²⁸⁹ Official Journal of the European Union, *Commission Decision of 12 September 2025 on instructing the central administrator to enter changes to the national aviation allocation tables of Member States into the Union Registry to account for the use of eligible aviation fuels in the year 2024*, OJ C, C/2025/5004, 16.9.2025, [ELI](#), 2025.

²⁹⁰ For instance, EasyJet advocates for an extension of the SAF support mechanism until at least 2040 in its response to the Call for Evidence for an evaluation and impact assessment on the EU ETS, similarly to SkyNRG. Business & Science Poland advocates for an extension of the FEETS mechanism to 2050 (BSP, *Sustainable Transport Investment Plan Business & Science Poland position*, 2025).

8.2. Extension of the support

This section presents an assessment of alternative design variations for the SAF support mechanism for the period from 2028 up to 2035, and in section 8.2.5. also analyses longer support. Several factors influence the amount of EU ETS allowances allocated and are a matter of this analysis. These include the volume of SAF used, the availability of allowances, fuel prices of fossil fuels and SAF (current and future) and level of direct ETS SAF support.

8.2.1. Assumptions

This analysis uses SAF use assumptions and SAF prices different from those used in the general modelling approach described in Annex 4. This includes the following reasons:

- PRIMES organises SAF sub-categories as bio-kerosene and synthetic kerosene, however for this analysis more granular identification of biofuels is needed. It is necessary to distinguish between advanced biofuels²⁹¹ and other biofuels (in this section referred to as 'biofuels') as those have different levels of support.
- For the SAF support analysis, it is crucial to use conservative SAF prices (realistic or overestimated) rather than too optimistic and underestimated. This is because the support is based on the actual price difference between fossil kerosene and SAF, therefore the smaller that difference is (low SAF prices) the longer any amount of reserved allowances for this purpose would last. However, the approach using lower SAF prices may result in a recommendation to reserve an insufficient amount of allowances. It is therefore appropriate to be prudent and use higher SAF prices and hence higher price differences, which will result in an amount of allowances that would not run out prematurely.

The SAF projections use the following principles:

- Overall share of SAF used corresponds to the ReFuelEU Aviation mandate in 2025, 2030 and 2035. Biofuels intermediate values are interpolated. Only the minimum mandated shares for RFNBOs are assumed (2028-29: 0%; 2030-31: 1.2%, 2032-34: 2%, 2035: 5%).

Advanced biofuels scale up to 15% of total biofuels by 2030²⁹². Post-2030, advanced biofuels scale linearly with the aim of reaching 85% of all biofuels by 2040²⁹³.

Table 28 presents projected fuel prices for the three SAF types and fossil kerosene. These are built on the following assumptions (for the full list see the aviation support study):

- Fossil fuel price projections based on PRIMES model post-2030 scenarios.
- RFNBOs prices considered constant until 2035 under a conservative estimate²⁹⁴.

Table 28: SAF price projections, by SAF type, 2028 to 2035 (EUR per tonne)

	2028	2029	2030	2031	2032	2033	2034	2035
Fossil Kerosene	799	811	824	835	847	859	870	882
Biofuels	2,291	2,280	2,269	2,259	2,248	2,238	2,228	2,217
Advanced biofuels	2,705	2,636	2,566	2,515	2,464	2,413	2,361	2,310
RFNBOs	8,465	8,465	8,465	8,465	8,465	8,465	8,465	8,465

²⁹¹ Biofuels produced from the feedstock listed [in Part A of Annex IX to Directive \(EU\) 2018/2001](#) and that are certified in compliance with Article 30 of that Directive.

²⁹² EASA, [SAF Market](#), 2025. Skyng, [SkyNRG & ICF release Sustainable Aviation Fuel Market Outlook](#), 2025.

²⁹³ As per assumptions of SAF usage used for 2040 within the PRIMES model post-2030 projections

²⁹⁴ Based on the conservative assumption that the first volumes of RFNBO will be produced in 2030 and will be scaling up too slowly for the price to decrease within 5 years.

Source: Aviation support study

Moreover, this analysis focuses only on the three types of SAF that are most likely to be uplifted during the lifetime of the support mechanism. However, other types of SAF²⁹⁵ would continue to be eligible for the support with direct support level aligned. Electric aviation should also be included, with direct support at least equal to that of RFNBOs.

8.2.2. Support level alternatives

The assessment considers the current ETS support mechanism direct support levels (Alternative 0) and other options (Alternatives A, B and C) with distinct coverage of the fuel price differential between SAF and fossil fuel. These are presented in Table 29.

Across all alternatives, the support level for a fuel type reflects its market and technology readiness, where the nascent RFNBOs are eligible for the highest support, followed by advanced biofuels and lastly biofuels. Alternatives 0 and A apply fixed support levels for all fuels for 2028-2035, although Alternative A applies lower levels given increasing SAF market maturity. For RFNBOs, the lower support level is also desirable in order to allow for other support and incentives as presented in the Sustainable Transport Investment Plan²⁹⁶ or other national measures to eventually complement the ETS support. Alternative B features lower support levels for all fuels and phases out eligibility for biofuels from 2030 onwards, favouring advanced biofuels. Alternative C defines the support level as fixed financial incentive per tonne of fuel rather than as a percentage of price differential, in order to enhance predictability. These are presented in table 29.

Table 29: Value of fuel price differential covered, by SAF type and support mechanism option

	Biofuels	Advanced biofuels	RFNBOs
Alternative 0	2028-2035: 50%	2028-2035: 70%	2028-2035: 95%
Alternative A	2028-2035: 20%	2028-2035: 60%	2028-2035: 70%
Alternative B	2028-2029: 30% 2030-2035: 0%	2028-2035: 50%	2028-2035: 60%
Alternative C	2028-2029: EUR 500 per tonne 2030-2035: EUR 250 per tonne	2028-2035: EUR 750 per tonne	2028-2035: EUR 4 000 per tonne

In 2030, these alternative designs would lead to the effective fuel prices presented in Table 30. With lowering prices of advanced biofuels and their higher support over biofuels, their effective price would be lower than that of biofuels which is desirable. Except for Alternative 0, the effective price for RFNBOs stays somewhat elevated.

²⁹⁵ All SAF subcategories as included in [Annex to the Commission Delegated Regulation \(EU\) 2025/723](#).

²⁹⁶ European Commission Directorate-General for Mobility and Transport, [Commission unveils the Sustainable Transport Investment Plan: a strategic approach to boost renewable and low-carbon fuels for aviation and waterborne transport](#), November 2025.

Table 30: Effective fuel prices in 2030 after considering ETS cost and the ETS support mechanism

Fuel price 2030 (EUR/tonne)	Fossil kerosene	Biofuels	Advanced biofuels	RFNBOs
Alternative 0	EUR 1,165	EUR 1,717	EUR 1,585	EUR 1,530
Alternative A	EUR 1,165	EUR 2,048	EUR 1,726	EUR 3,355
Alternative B	EUR 1,165	EUR 2,269	EUR 1,866	EUR 4,085
Alternative C	EUR 1,165	EUR 2,019	EUR 1,816	EUR 4,465

8.2.3. Analysis of results

The amount of allocated EU ETS allowances under the alternative SAF support mechanism options was analysed for each SAF type and support year. Table 31 shows the cumulative number of EU ETS allowances allocated under the different alternatives of the support mechanism from 2028 to 2035 for the geographical scope AS2.

The results in Table 31 also show that the cumulative number of allowances needed by the support mechanism decreases by alternative, with Alternative 0 requiring the highest number of allowances, and Alternative C the lowest. The requirement under these alternatives is compared to the cumulative availability of allowances under the ETS aviation cap for years 2028-2035, as shown in the second part of the table. The results show that for Alternative 0 and A with comparably high levels of support granted, the number of allocated EU ETS allowances exceeds the number of allowances made available to the sector already in 2033 under Alternative 0 and in 2035 under Alternative A, making these two alternatives unattainable. Alternative B and C stay under this limit.

Table 31: Cumulative number of allocated EU ETS allowances

	2028	2029	2030	2031	2032	2033	2034	2035
Cumulative total number of allowances in million EUAs								
Alternative 0	14	29	78	131	208	286	366	511
Alternative A	6	14	47	83	136	191	247	351
Alternative B	8	18	43	69	109	151	194	280
Alternative C	7	14	39	67	107	150	193	275
Corresponding share of the cumulative aviation cap								
Alternative 0	28%	30%	55%	72%	95%	113%	128%	162%
Alternative A	13%	14%	34%	46%	62%	75%	86%	112%
Alternative B	17%	18%	31%	38%	50%	60%	68%	89%
Alternative C	14%	15%	28%	37%	49%	59%	68%	87%

8.2.3.1. Alternatives comparison

As per the previous subsection, the support levels in the current ETS support mechanism as well as support under Alternative A are discarded at this stage, as there aren't enough ETS allowances for this purpose. Only Alternatives B and C can be considered and they come with distinct advantages and drawbacks.

	Advantages	Drawbacks
Alternative B	- flexibility to adjust to fluctuating fossil fuel/SAF prices mostly avoiding distortions - support will last longer should SAF and kerosene price gap decrease	- difficult long-term predictability about the level of support received and the number of allowances; - early exhaustion of allowances in case of higher SAF prices and/or optimistic SAF uptake scenario
Alternative C	- price certainty and predictability for industry - incentivises cost reductions for SAF production, as the payment per tonne of SAF will remain stable - increased SAF competitiveness in case of lowering prices	- in case of significant SAF price reductions, this could result in over-subsidy - no mechanism to adjust support levels to volatile prices of SAF and fossil fuel - early exhaustion of allowances in case of optimistic SAF scenario - Biofuels support reduces availability of support for e-fuels

8.2.4. Preferred alternative

Both Alternatives B and C result in similar effective SAF prices in 2030. Alternative C continues to incentivise biofuels post-2030, whereas Alternative B favours advanced biofuels and e-fuels. The most requested improvement to the current SAF support mechanism by stakeholders was the increase of predictability of the support both for the aircraft operators and the fuel producers. Moreover, stakeholders voiced concerns with using a uniform SAF price for the mechanism as the prices vary across the EU depending on the location of delivery, as well as on individual contract terms.

At the same time, as SAF and e-SAF uptake gradually increase, it is important to provide the strongest incentive to drive down SAF prices and support the largest amount of (e-)SAF with the limited resources available. Alternative B provides these incentives, as it adjusts to price fluctuations and enables longer lasting support if (e-)SAF prices decrease. Market operators are experienced in dealing with price uncertainty of fossil kerosene and SAF. Alternative B operates in the same way as the current SAF support mechanism, so market participants and national competent authorities have the relevant administrative experience.

The prices for fossil fuel and SAF will continue being published in the EASA Technical Report. The SAF support would go further if other incentives, such as the harmonised minimum level taxation proposed on fossil kerosene or other Union-wide or national incentives are taken into account.

8.2.5. Total amount of allowances

Policy measures SAF1 and SAF2 extend ETS-financed SAF support by medium and higher amounts of allowances respectively. Besides that, the two options apply to the same geographic scope AS2– intra-EEA plus departing flights. The analysis considers the same SAF uplift in line with the ReFuelEU Aviation mandates under both options. While ETS-financed SAF support may incentivise higher uptake of SAF, this is not modelled given large uncertainties in this nascent market, high price differentials with fossil kerosene, and to avoid overestimating available supply. Therefore, the different amounts of allowances reserved for the SAF support mechanism will solely result in different years when the reserved allowances will be exhausted.

Reserving a medium amount of allowances under SAF1 will mean that a higher amount of allowances will go to auctioning, resulting in higher ETS revenues for Member States to use

for tackling climate change in aviation or other sectors. The medium amount is established as 140m allowances. Without limitations in the SAF mechanism, the medium amount of allowances would cover all SAF uplifted until 2032 (including 80% of the uplift in 2032) giving more than 5 years of continuous support. This amount would also fully cover all SAF uplift on flights covered by AS1.

SAF2, the higher amount of allowances, would draw on most of the aviation cap and support SAF uplifted in line with ReFuelEU mandates until and including 2035. Using Alternative B for the design of the support, 280 million allowances would be used for this purpose. Consequently, reserving 280 million allowances for the extension of the SAF support mechanism is proposed, while noting that this amount would use 89% of the current cumulative aviation cap up until 2035.

When looking at support for the period 2028-40, even using the full amount of the aviation cap for that period, support levels would have to be significantly reduced to last for the whole period or would run out shortly after 2035. This is mainly because the ReFuelEU blending mandate for fuel suppliers goes from 6% to 20% in 2035, and prices for SAF and e-SAF are not projected to decrease significantly. If support levels were to be kept the same as in alternative B, the cumulative aviation cap for 2028-40 would be spent before the end of 2036. Alternative B could also be followed until 2035, followed by an approximately 70% reduction of support levels to enable continued support until 2040. Else, continuous support at about 48% below alternative B would be feasible from 2028-40 if the entire aviation cap is used.

8.2.6. *Conditionalities*

The current SAF support system has very few conditionalities. Any extension should evolve and support overall aviation decarbonisation further. Future conditionalities could be based on input from the Sustainable Transport Investment Plan and stakeholder feedback in the open public consultation. These include but are not limited to:

- Existing conditionalities:
 - Only flights covered by the surrender obligation are eligible for the support.
 - Business flights are excluded from the support due to their polluting nature and superior resources available to be used for SAF uptake.
 - ‘First come, first served’ principle to incentivise first movers.
- Consistency with Regulation (EU) 2024/1735 establishing a common legal framework aimed at strengthening the Union’s resilience and security of supply of net-zero technologies²⁹⁷
- Long-term offtake agreement in place:
 - Aircraft operators would provide a long-term SAF offtake agreement. This is necessary for predictability of the support where support would be granted based on the multi-year agreement and crucially for the fuel producers and technology providers in order to reach Final Investment Decision. This condition would therefore incentivise uplift as well as production of these fuels.
 - Differentiated support could be introduced based on the agreement length (5-year contract leading to bigger support than 2-year contract).

²⁹⁷ The Regulation lists relevant technologies including plants for renewable fuels of non-biological origin (RFNBO), plants for sustainable alternative fuels and electric propulsion systems for air transport. Regulation (EU) 2024/1735 of the European Parliament and of the Council of 13 June 2024 on establishing a framework of measures for strengthening Europe’s net-zero technology manufacturing ecosystem and amending Regulation (EU) 2018/1724, OJ L, 2024/1735, 28.6.2024, ELI: <http://data.europa.eu/eli/reg/2024/1735/oj>.

- As long-term contracts may relate to a significant amount of fuel, volumes of allocated allowances for SAF uplift would be adjusted annually based on the volumes actually used as per the annual emissions report. Any unused allowances would be put back in the reserved pool and would be reused.
- Climate-neutrality plan
 - As established in EU ETS for installations, aircraft operators could be required to submit and follow climate-neutrality plans outlining their commitment to decarbonisation, including measurable actions and green investments.

9. OTHER CONSIDERATIONS

The *Global Solidarity Levies Taskforce: For People and the Planet* (GSLTF) was launched at COP28 in 2023 to explore progressive tax measures that generate predictable revenue for climate and development, while ideally also discouraging greenhouse gas emissions. The European Commission is an observer to the taskforce since its launch, supporting the efforts to identify and develop innovative sources of funding for climate action²⁹⁸, especially for the most vulnerable countries.

In early 2025, the GSLTF identified the aviation sector on premium air travel and private jet fuel as among the measures that are socially fair and have the greatest potential for adoption²⁹⁹. The following data illustrates the focus on aviation, and specifically luxury travel:

- Emissions are highly concentrated among a small share of the population at the upper end of the income spectrum. Studies suggest that only 2–4% of the global population flies internationally each year, and that just 1% of people are responsible for roughly half of global aviation emissions³⁰⁰.
- Premium-class seating is estimated to be 2.6 to 4.3 times more carbon intensive than economy class seating, depending on aircraft class due to the greater space and weight per passenger³⁰¹.
- Private aviation (i.e. private jets) produces 5 to 14 times more emissions per passenger-kilometre than commercial flights.³⁰²

Furthermore, analysis shows aviation taxation is limited compared to other sectors such as road or rail transport, and insufficiently³⁰³ internalises aviation's externalities, ranging from climate impacts of emissions to noise and air pollution³⁰⁴. A GSLTF study³⁰⁵ found that premium flyer levies could contribute to significant CO₂ emission reductions (4 to 10% below the baseline under middle rate, global coverage scenarios) and generate substantial revenues (EUR 62 to 84 billion annually).

²⁹⁸ General Secretariat of the Council of the European Union, [*Conclusions on climate finance in view of the 2025 UN Climate Change Conference \(COP30\) \(Belém, 10-21 November 2025\)*](#), October 2025.

²⁹⁹ Global Solidarity Levies Task, [*Force Synthesis of responses to the consultation on straw-man options for solidarity levies*](#), April 2025.

³⁰⁰ Gossling, Humpe, Global Environmental Change, [*The global scale, distribution and growth of aviation: Implications for climate change*](#), November 2020.

³⁰¹ Zheng, Shen, Kellogg, International Council on Clean Transportation, [*Designing an equitable aviation climate levy*](#), March 2025.

³⁰² Transport & Environment, [*Private jets: can the super rich supercharge zero-emission aviation?*](#), 2021.

³⁰³ Analysis showing that after increases to the aviation solidarity tax rates in France, the after-tax pricing of aviation represented only 34% of the cost of the sector's externalities in France in 2025, and this figure dropped to just 22% for long haul flights.

³⁰⁴ Litschgy A., Direction générale du Trésor, [*Air Transport Pricing and Taxation*](#), France, July 2025.

³⁰⁵ CE Delft, [*A Fair Share from Aviation: Solidarity Levies in Aviation: Options for a Coalition of the Willing*](#), 2025.

A Premium Flyers Solidarity Coalition³⁰⁶ was launched at the UN Fourth Financing for Development Conference in Sevilla in June 2025, with the support of the GSLTF Secretariat. The coalition calls for participating countries to introduce a ticket levy on premium flyers, or if they have one, make their ticket levy more progressive for upward harmonisation. It calls for participating countries³⁰⁷ to introduce taxation of kerosene for private jets.

³⁰⁶ The Coalition includes Benin, Djibouti, France, Kenya, Nigeria, Sierra Leone, Somalia, South Sudan, and Spain. Antigua and Barbuda, Brazil, Fiji, and Vanuatu are observers.

³⁰⁷ Consult the current membership here: <https://solidaritylevies.org/eight-countries-launch-solidarity-coalition-for-levies-on-premium-flyers/>.

ANNEX 11: MARITIME

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1. SUPPORT FOR EMISSIONS REDUCTION IN THE SHIPPING SECTOR

1.1. Scoping³⁰⁸

Several technological options exist to decarbonise maritime transport, ranging from energy-efficiency improvements to electrification, wind propulsion assistance or the use of emerging renewable and low-carbon fuels. For instance, a recent study³⁰⁹ has found that energy efficiency measures can reduce ship emissions by up to 40% and that about half of emissions savings from energy efficiency measures are considered cost-effective in 2030. Another study³¹⁰ showed that existing battery technology could cover the fuel needs of about one-third of the entire EU ferry fleet and that wind assistance propulsion is an effective fuel savings measure applicable to several vessel types and with ample market growth potential to 2050.

However, the uptake of these decarbonisation options is still being hampered by various barriers, which can be technological, but are mostly economic and market-related (e.g. shipowners making CAPEX and OPEX investments in low-carbon solutions that do not always capture the benefit). Recent analysis³¹¹ highlights the need for a more integrated and supportive financial framework to support the decarbonisation of the maritime industry, which is a sector characterised by high capital intensity, long asset lifetimes, and extended production lead time. Some of the key financing-related obstacles, include:

- Limited access to financing for innovative activities and technologies;
- Lack of financial instruments suited to the sector's characteristics;
- Insufficient financing tools to support EU shipbuilding activities.

According to high-level estimates based on the TRL of investment technologies, the annual volume of green finance required for the decarbonisation of the EU maritime sector is estimated from EUR 10.9 billion to EUR 44.0 billion, covering vessel fleet decarbonisation (EUR 2.4 - 8.5 billion) and infrastructure (EUR 8.5 – 35.5 billion)³¹².

When it comes to renewable or low-carbon fuels, the maritime sector can use a broad mix of possible decarbonisation alternatives (different fuel technologies as well as different possibilities for blending with conventional fuels for existing and emerging powertrains). However, the market maturity of these alternative fuels today remains limited. According to the EU's Sustainable Transport Investment Plan (STIP), one of the main hurdles for ramping up the market is the significant price difference compared with conventional fuels. Current price differentials range from approximately 1,5 to 5 times the cost of conventional fuels. The STIP estimates that the induced production of bio-SMF and e-SMF will require investment of between EUR 34.7 billion and EUR 46.7 billion by 2035.

Current use of ETS revenues

³⁰⁸ Further detail in Ricardo (forthcoming) "Support for the 2026 review of the ETS maritime study" of (member of WSP)

³⁰⁹ World Bank, 2025. "Keys to Energy-Efficient Shipping. World Bank". <http://hdl.handle.net/10986/43773> License: CC BY-NC 3.0 IGO."

³¹⁰ European Commission: Directorate-General for Climate Action and Ricardo, Electric vessels and wind-assisted propulsion systems- opportunities for the EU maritime industry and value chain – Final report, Publications Office of the European Union, 2026, <https://data.europa.eu/doi/10.2834/7505429>

³¹¹ Support study for the development of a living inventory of relevant instruments to support investments in the shipping sector, study for DG MOVE, Ricardo, December 2024, <https://op.europa.eu/publication-detail/-/publication/7e43a280-c0e5-11ef-91ed-01aa75ed71a1>

³¹² Waterborne Days 2025– Funding and financing for the European Waterborne Sector workshop, RICARDO's presentation

From 2013 to the end of 2025, the EU ETS has raised over EUR 258 billion through the sale of emission allowances since its launch. In 2025, ETS revenues reached EUR 43 billion. This went primarily to national budgets, alongside funding ETS programmes for a clean transition (i.e. the Innovation Fund and the Modernisation Fund) as well as part of the Recovery and Resilience Facility in line with the REPowerEU Plan.

National revenues generated from the EU ETS must be used for the purposes outlined in the ETS Directive, with a focus on decarbonisation. Member States must spend all of their ETS revenues on eligible climate-related expenditure. The ETS Directive thus already foresees the possibility for Member States to use their revenues to support measures to decarbonise the maritime sector (e.g. improvement of the energy efficiency of ships, ports, innovative technologies and infrastructure, and sustainable alternative fuels, such as hydrogen and ammonia that are produced from renewables, and zero-emission propulsion technologies). Although decisions on allocation remain the responsibility of individual Member States, the Commission strongly encourage them to allocate a part of their ETS revenues to maritime decarbonisation investments across the maritime cluster in Europe³¹³. Member States directed most of their 2024 ETS revenues to projects in the deployment of renewable energy sources, grids and storage (20%), the improvement of energy efficiency in industries and buildings (20%) and the development of clean public transport and mobility including maritime projects (22%).³¹⁴

Since shipping was only included in the ETS starting in 2024, many Member States are just beginning to incorporate the maritime sector into their plans for utilising ETS revenues. So far, activities funded or planned to be funded in the maritime sector through ETS revenues encompass a wide range of interventions, such as the construction of onshore power supply systems in ports, the greening of port areas, the development of climate-neutral vessels, modernisation of transport fleets, and the implementation of innovative technologies like semi-autonomous navigation

Innovation Fund supports the maritime transport sector

The Innovation Fund is one of the world's largest programmes supporting the scale-up of net-zero and low-carbon technologies. Established under the EU ETS Directive, it plays a central role in the European Green Deal and channels revenues from the EU Emissions Trading System into deployment of clean, competitive solutions across the European Economic Area.

Between 2020 and 2030, the Fund has an estimated budget EUR 40 billion sourced from the EU ETS. From 2020 to 2025, the Innovation Fund has given over EUR 4,8 bn in support of projects that decarbonise the transport sector, representing more than 35% of the funds committed. These projects support the production and use of sustainable fuels, the electrification of transport systems, the manufacturing and recycling of batteries for electric vehicles, the building and/or retrofitting of low- and zero carbon ships, airplanes and heavy-duty vehicles.

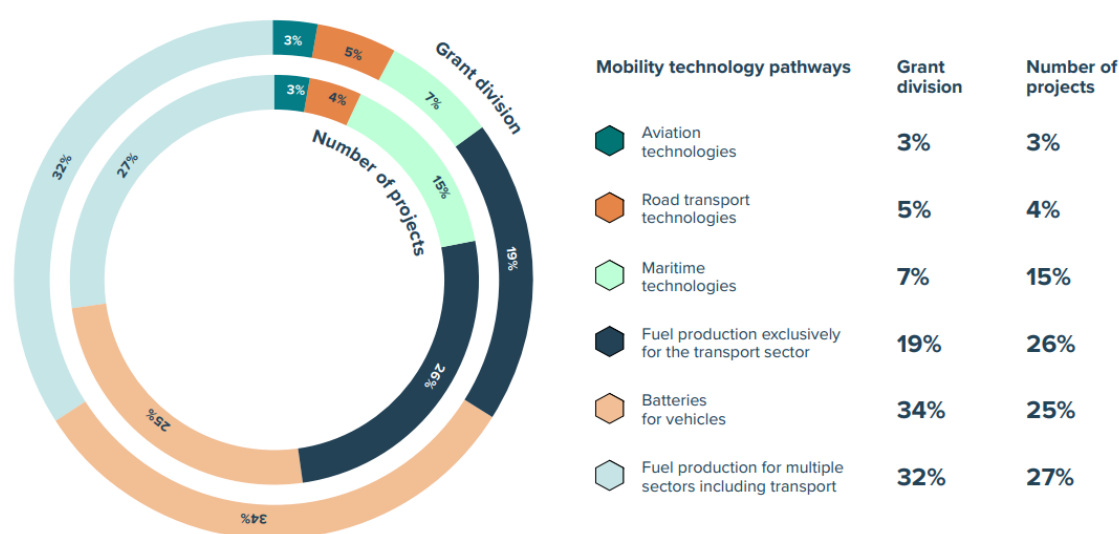
³¹³ COM(2026) 111 final COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS on the EU Industrial Maritime Strategy

³¹⁴ EU Climate Action Progress Report 2025: Strengthening competitiveness on the road to climate neutrality Chapter 2 - The EU Emission Trading System - Climate Action

The largest share of mobility projects in the Innovation Fund portfolio is related to fuel production (47 projects). Over 45 % of these projects are expected to exclusively supply their production to the transport sector, while the rest plan to have multiple potential off-takers, transport being among the key beneficiaries. Notably, the Innovation Fund supports hydrogen production, a key fuel and feedstock to produce eFuels and other synthetic fuels. While the Innovation Fund is open in principle to all companies around the world, the production of fuels is supported exclusively within the EU. Therefore, the Innovation Fund is not suited to support projects of Just and Equitable transition in SIDS and LDCs.

Figure 1: Projects supported by the Innovation Fund since 2020

Since 2020, the Innovation Fund has supported:



Source: EC, Innovation Fund – Mobility factsheet³¹⁵

For the maritime sector which has only become explicitly eligible to IF calls since the last EU ETS Revision, the Fund covers, among others, the production and use of sustainable fuels, the electrification of the maritime transport system, and the building and/or retrofitting of low- and zero carbon vessels. In this context, 20 million allowances will be deployed up to 2030 to support the decarbonisation of the sector through the Innovation Fund. Until the beginning of 2026, the Commission already supports 21 maritime related projects with a total of EUR 1,03 bn, including EUR 365,3 million through auctions for hydrogen-based fuels and EUR 202,3 million for projects related to construction/retrofitting of vessels.

Additionally, the Commission established the “auction as a service” and the “grants as a service” mechanism, which enables Member States to use their national budget resources to award support to projects (including maritime) located on their territory, while leveraging on the EU-wide competition and Innovation Fund evaluation and selection mechanism to identify the most competitive projects.

Summary of stakeholder views from the OPC

³¹⁵ European Commission: European Climate, Infrastructure and Environment Executive Agency, *Driving decarbonisation in mobility through the Innovation Fund*, Digital publications, 5 November 2025.

Thirty-one stakeholders mentioned the use of ETS revenues to support maritime decarbonisation. Stakeholders highlighted several areas where EU ETS revenues could be used to drive decarbonisation, including:

- Support the maritime sector in reducing GHG emissions, including companies, vessels and operations.
- Invest in clean fuels, technologies and infrastructure to enable the transition to low and zero emission shipping.
- Ensure EU ETS revenues are specifically and reliably used for maritime decarbonisation, so the funds support the sector's transition and allow long-term planning.

Twenty-three stakeholders highlighted the importance of bridging fuel cost gaps. Stakeholders highlighted that alternative fuels are currently significantly more expensive than conventional marine fuels, creating a financial barrier that hinders their adoption. Key suggestions to tackle this included:

- Reduce the financial burden on shipowners and operators by making alternative fuels more economically viable until they reach price parity with conventional fuels.
- Provide targeted support for early-stage uptake of sustainable fuels, ensuring that incentives help overcome initial market barriers.

Fourteen stakeholders also mentioned the use of financial mechanisms, including the use of the Innovation Fund, to support maritime decarbonisation and six stakeholders proposed measures to support fleet renewal, retrofitting, and deployment of clean technologies.

1.2. Policy measures

Establishment of an EU ETS support mechanism for Sustainable Maritime Alternative Propulsion (SMAP)

This policy measure considers whether a similar but broader approach to the ETS SAF mechanism could be used to effectively support the uptake of renewable and low-carbon maritime propulsion, as well as the uptake of appropriate low-carbon technologies. The aviation mechanism is established under the EU ETS Directive (Article 3c(6)). It uses allowances to incentivise the uptake of SAF by airlines on ETS flights by covering the price gap between SAF and fossil kerosene.

As a first step, it is necessary to acknowledge that the situation in maritime differs from aviation as there is a wider range of clean propulsion options, renewable and low-carbon fuels in maritime transport, whereas in aviation there is broadly only green kerosene (though produced via different routes and feedstocks) alongside electrification in the coming years. This range of propulsion pathways for the maritime sector should be supported, though this can add complexity to a support mechanism.

A future Sustainable Maritime Alternative Propulsion (SMAP) mechanism could have various aims, primarily to support the production of renewable and low-carbon maritime fuels in Europe by reducing the price gap compared to fossil fuels and support the production and manufacture of sustainable maritime clean propulsion in Europe, including the full range of

Net Zero maritime propulsion technologies listed in Union legislation³¹⁶. In addition to contributing to the decarbonisation of the maritime transport sector, such a mechanism could also support the EU's strategic autonomy by diversifying energy supplies, spurring innovation, and contributing to creating new opportunities for industrial growth and job creation in the EU.

In terms of design elements, different options could be considered, depending ultimately on the chosen aim of the mechanism.

Table 1: Possible design elements for a sustainable maritime alternative propulsion mechanism

Design element	Options
Eligible fuels or technologies	- Fuels produced and bunkered in the EU, and - Fuels zero-rated under EU ETS, or - Only certain types of fuels such as RFNBOs, or - Depending on what is (not) supported by a possible IMO mid-term measure (e.g. reward mechanism) - Low carbon technologies such as wind propulsion assistance or ship electrification: - Flettner rotors - Suction wing sails - Towing kites - Rigid and semi-rigid wing sails - Electric propulsion systems for waterborne transport
Beneficiaries	- Support could be received by shipping companies. Such an option would be in line with the existing support design, and it would ensure consistency with the logic of the ETS where the responsible entities are the shipping companies. - Support could be directed to fuel/ propulsion mechanism producers. Supporting the production side would entail a different design compared to the existing ETS mechanism. - When linked to other technologies, support could be directed to intermediaries providing performance-based services to decarbonise shipping, e.g. Energy Service Companies offering performance-based contracts to finance, install and maintain low-carbon solutions leading to guaranteed fuel savings.
How the price difference could be calculated	<i>price difference = eligible fuel price - (fossil fuel price + ETS price + FuelEU over-compliance reward through pooling + FuelEU avoided penalties + possible carbon pricing or reward from an IMO mid-term measure + [other relevant monetary benefits])</i>
Level of support	- Level of support could be differentiated by type of fuel or propulsion technology. - Priority could be given to EU origin (targeted EU preference criteria) - Another basis for differentiation could be the level of technology readiness and commercial availability, with alternative fuels with high

³¹⁶ See Commission Implementing Regulation (EU) 2025/1178 of 23 May 2025 on laying down rules for the application of Regulation (EU) 2024/1735 of the European Parliament and of the Council as regards the list of net-zero technology final products and their main specific components for the purposes of assessing the contribution to resilience.

	decarbonization potential but currently low readiness receiving higher level of support, and fuels with limited market but high potential receiving priority support until a more liquid market develops. • A phased-approach could also be implemented with alternative propulsion receiving a higher level of support in the first years, which is then reduced over time and phased out eventually. • Another basis for differentiation could be location, so as not to discourage remote areas or specific situations.
Type of incentive	• EUAs could be provided to shipping companies to cover a certain part of the price gap between eligible activity and fossil reference. A potential formula to allocate the allowances to shipping companies could be the following: $\text{Allocation [number of EUAs]} = \frac{\text{fuel used [ton]} \times \text{price differential} \left[\frac{\text{EUR}}{\text{ton}} \right] \times \text{level of EU support [\%]}}{\text{CO2 price} \left[\frac{\text{EUR}}{\text{EUA}} \right]}$ • Direct financial subsidy through e.g. bidding / auctioning system
Timeline:	• Built on the compliance cycle of EU ETS; • Depending on timeline linked to a possible IMO mid-term measure; or, • Until reserve of allowances is exhausted.
Scope	• In line with the EU ETS scope; or, • EU MRV scope

Designing a future mechanism along the characteristics of SAF support would certainly bring some benefits. It would ensure policy consistency and bring a coherent set of demand certainty for technology and fuel producers. Current EU ETS SAF support is also a well-understood system, and stakeholders seem to favour such an approach. However, to be effective, such a mechanism needs to reflect the many particularities of maritime transport, including the many propulsion options available to the sector. In this context, a possible mechanism could be characterised by the following main elements:

Table 2: Key aspects of a SAF-like sustainable maritime alternative propulsion mechanism

Key aspects	Description
Main purpose	Incentivising fuel switch and other low-carbon propulsion technologies by partially covering the price gap compared to the use of fossil fuel. Incentivising EU technology fuel production (NZIA).
Beneficiary	Shipping company – ETS/MRV responsible entity.
Scope	EU ETS scope: • 100% of fuels/energy used/avoided for intra-EU voyages, or when the ship is within EU ports; • 50% of fuels/energy used/avoided for extra-EU voyages.
Type of incentive	EUAs
Eligible fuels or technologies	Sustainable propulsion mechanisms and certified sustainable renewable and low-carbon fuels produced and bunkered in Europe, as and if applicable subject to

	zero-rating under the EU ETS and that fulfil specific life-cycle GHG intensity limit to be determined.
Price difference covered	The share of price difference covered would take into account the criteria set out in the above table, including the level of support envisaged for different situations, E.g. • 50% of the price gap for non-advanced biofuels or RFBNO fulfilling the Renewable Energy Directive criteria, except for feed-based biofuels; • 70% for advanced biofuels; • 90% for RFNBOs.
Timeline	• Implementation harmonised with the ETS compliance mechanism (e.g. monitoring, reporting and verification of fuel use embedded in the EU MRV process and transfer of EUA through the ETS registry done by Administering Authority).

Other measures: Payments to IMO Fund for the benefit of Just and Equitable Transition in SIDS and LDCs.

This measure would imply reserving a certain share of revenues from auctioning allowances concerning maritime emissions for payments on behalf of the EU to a possible future IMO Fund to support the decarbonisation of the maritime sector. The payments would be paid to such a future IMO Fund under the condition of benefitting projects in SIDS and LDC countries to invest in shipping's energy transition and to pursue a Just and Equitable Transition. Such payments could also help to frontload a future IMO Fund in the first years, to ensure support for SIDS and LDC countries at an early stage.

However, since the IMO adjourned its decision regarding the adoption of the IMO Net Zero Framework until autumn 2026, it is not possible to establish the impact any potential payments to such an IMO Fund would have nor how the payments would be distributed, and which countries would benefit. In turn, it is not possible to assess how possible payments to the IMO Fund would benefit the Just and Equitable Transition.

Other measures: Further mobilising financing for the decarbonisation of maritime transport through the Innovation Fund

While the maritime sector already benefits from the Innovation Fund support to scale-up net-zero and low-carbon technologies, the fund could further focus on the need of the sector, e.g. by continuing proposing dedicated windows for maritime decarbonisation. In that respect, the Commission already announced that it will open, in 2027, a dedicated maritime call. The budget and scope of this call will be determined as appropriate by the Commission notably based on the remaining Innovation Fund budget and the ETS pricing.

In practice, the Fund could continue to support the retrofitting of existing vessels and the construction of new low or zero emission ships. It could allow supporting a wide range of technologies, including alternative fuels (e.g. hydrogen, ammonia, methanol, biofuels), propulsion systems (e.g. wind-assisted, battery-electric, hybrid) or energy efficiency measures (e.g. waste heat recovery, hull design, air lubrication, optimisation tools). In addition, when combined with the concept of "grant-as-a-service" or "auction-as-a-service", dedicated Innovation Fund windows for maritime would help mobilising additional national resources to support the decarbonisation of the sector, including ETS auctioning revenues. It is not always easy for Member States' authorities to develop their own national programmes to support the

green transition of the shipping sector due to e.g. the cross-border nature of shipping (benefits may occur outside the Member State providing support), the need to fulfil State aid rules, the lack of precedent, the limited administrative capacity and technical expertise, the complexity of the sector which entails different needs and solutions (e.g. short sea shipping vs deep sea shipping) or the high technology diversity and uncertainty. For all these reasons, dedicated maritime support under the Innovation Fund used as a vehicle for “grant-as-a-service” have the potential to accelerate national action on shipping decarbonisation. They would allow Member States to “plug into” a well-established EU system and to externalise the administering complexity linked to the management of dedicated support programmes. Considering that shipping is a pan-European and international industry, such a measure would also avoid fragmentation and distortions in the market. It could also help address the risk of non-compliance with State-aid rules.

In addition, the Industrial Decarbonisation Bank is expected to play an important role in supporting the production of sustainable maritime fuels. It will support projects with carbon emission reduction as a metric to enable technology-neutral support across industrial sectors, including through carbon contracts for difference. It will be designed to ensure a competitive selection and a fair distribution of support across Member States. It will complement the ETS price signal and help bridge the funding gap in both capital and operational expenditures.

1.3. Assessment of policy measures

1.3.1. Economic impacts

Increasing the recycling of EU ETS revenues in the maritime sector through a new sustainable maritime alternative propulsion mechanism would improve the economic viability and attractiveness of shipping decarbonisation solutions.

However, such economic impacts would largely depend on the funding volume allocated to the mechanism. For this analysis, two different approaches have been considered. The first approach aims to support the uptake of RFNBO as additional support to reach the levels in FuelEU maritime (reaching at least 2%/year as from 2034). The second approach considers a volume of funding estimated based on a SAF-like share approach as used in the current ETS Directive.

The table below shows the estimated economic impacts of each option, assuming a sustainable maritime alternative propulsion mechanism designed in coherence with the current EU ETS support (see table above on key aspects). Establishing a sustainable maritime alternative propulsion mechanism to directly support the uptake of RFNBOs as additional support to reach the levels of FuelEU maritime objectives would require around 26 million EUAs over 2031-2040 to support the use and the production of EU sustainable propulsion. If a funding rate similar to the current SAF was applied, it would lead to around 46 million EUAs being attributed to bridge the price gap between sustainable propulsion and fossil fuels over 2031-2040.

Table 3: Economic impacts of different possible sustainable maritime propulsion mechanism variations

<i>SMAP mechanism variations</i>	<i>Key assumptions</i>	<i>Period</i>	<i>Support in M EUAs</i>
		2028-2030	11

Supporting RFNBOs uptake to meet FuelEU's objectives	- average maximum funding rate of the price gap of 90% for RFNBOs - ETS scope coverage (EEA)	2031-2040	26
SAF -like share of cap	- overall funding volume corresponding to initial SAF support {12%}.	2028-2030	21
		2031-2040	46

The amount of financial support in the form of EUAs would vary across the years, influenced by several elements, such as the ETS price (i.e. the higher the ETS price, the lower the price gap), or the objectives to be achieved in terms of sustainable propulsion uptake.

The additional administrative burden for shipping companies, administrative authorities and the EU is likely to be low as a sustainable maritime alternative propulsion mechanism could be built on existing reporting requirements and compliance cycles. Additional administrative burden could for instance come from the need to monitor, report and verify the origin of eligible fuels (e.g. bunkered and produced in the EU).

Depending on the funding volume attributed to the mechanism, it could support from around 0,5 Mtoe to 3 Mtoe of sustainable maritime fuels annually by 2035, which could significantly contribute to building-up sustainable maritime capacity in the EU.

Another approach that could be considered as a starting point to determine the volume of a SMAP mechanism is to cover the price gap to meet e.g. the GHG Fuel intensity trajectory under discussion at IMO. Such an approach would potentially require a total of up to 200 million allowances, just for fuels, if one assumes full funding of the price gap and no IMO rewards.

1.3.2. Environmental impacts

In terms of environmental impacts, the establishment of a sustainable maritime propulsion mechanism would directly support the increased use of sustainable maritime fuels and propulsion systems, which are key to unlock the decarbonisation of the maritime sector.

By 2035, it could help deliver an annual GHG emissions reduction in the range of 1,7 to 9 MtCO₂, depending on the funding volume made available.

However, this effect is not directly visible in the PRIMES maritime model since the different scenarios have all been modelled with the objective to achieve a certain level of GHG Fuel Intensity reduction.

1.3.3. Social impacts

By building up sustainable propulsion and renewable and low-carbon fuels capacity in the EU for maritime transport, a sustainable maritime propulsion mechanism would offer substantial opportunities for industrial growth and job creation in the EU, including in ports as energy hubs, in raw materials, refineries and the distribution network.

It could also help unlock the employment potential linked to the manufacturing and installation/retrofit of wind propulsion assistance in Europe, estimated at over 5,800 jobs in

2030³¹⁷, or the employment potential behind the use of electric ferries and RoPax vessels in Europe (around 800 jobs in 2024-2030).

The upscaling of Europe's sustainable maritime fuels and propulsion technology industry will also lead to the EU being more energy independent, including in case of external menaces hampering the energy supply. These key benefits are nevertheless not quantified.

2. MEASURES TO FURTHER MITIGATE THE RISK OF EVASION

2.1. Scoping

Evasive behaviours can be defined in a broad sense as operational adjustments from shipping companies that avoid GHG emissions under ETS scope, other than due to improvements in energy-efficiency or use of alternative fuels/cleaner ships.

Potential evasion risks include:

- *Relocation of transshipment operations*: The risk that vessel operators may decide to relocate container transshipment activities in non-EU ports to reduce EU ETS costs. The risk may depend on the container traffic flows at an individual port; it may be higher if the port is mainly used for the transshipment of containers that are not intended to enter the EU market.
- *Addition of evasive port calls at nearby non-EU ports or changes in order of port calls*: The risk that operators may add extra port calls to their routes (or change order of port calls) to reduce the length of the last leg before calling at an EU port (or the length of the first leg after leaving an EU port) and hence reduce their EU ETS compliance costs.
- *Shifting demand to other transport modes with higher environmental impacts*: The risk that freight companies may move freight transport from maritime to other modes, which have higher emissions than maritime.
- *Assigning best performing vessels to EU routes*: The risk that vessel operators may elect to use their most efficient vessels (with lowest emissions per tonne-mile) to routes that include calls at EU ports and use their less well-performing vessels on other routes.
- *Use of ships below size threshold*: The risk that vessel operators, particularly those that operate smaller vessels (but still above 5 000 GT), may choose to use vessels below the 5 000 GT threshold to avoid the need to surrender EU ETS allowances for their emissions. Using smaller vessels would result in more voyages being needed to deliver the same quantity of freight and thus likely overall higher emissions, having a negative impact on the environmental effectiveness of the policy.
- *Evasion linked to offshore service operations*: current MRV rules define a “port of call” in a way that may unintentionally incentivise use of non-EU bases by offshore vessels to evade ETS obligations.

The main driver of evasive behaviour is the financial incentive for shipping companies to minimise ETS compliance costs (including ETS payments or GHG mitigation costs) when these exceed the costs of evasion (additional costs related to vessel operations and port calls). This incentive may also depend on the companies' ability to pass compliance costs to final

³¹⁷ RICARDO, 2026, Opportunities of the green transition for the EU maritime industry and value chain (forthcoming) – figures for low scenario covering both direct and indirect jobs

consumers and on the application of other policies in third countries, which could result in other carbon pricing signals. Beyond economic considerations, other factors are likely to influence decision-making, including impacts on services (e.g. deviation or waiting times), feasibility of evasion (e.g. accessibility of non-EU ports, berth availability, network compatibility, investment policies), and specific risks (e.g. reputational concerns, geopolitics, global trade patterns).

Evasive behaviours from shipping companies are problematic in three main ways. First, they can undermine the environmental integrity of the EU ETS, as companies may surrender less allowances without actually reducing emissions. In some cases, evasion can even increase GHG emissions for equivalent transport activity (e.g. longer sailing distances or shifting operations to higher-emission transport modes). Second, evasive behaviours can reduce traffic and connectivity at EU container transshipment hubs, with wider economic impacts such as higher costs or reduced access to key overseas markets. Third, evasion can lower ETS revenues, reducing funds available to support maritime decarbonisation and broader climate objectives.

The application of the EU ETS to offshore vessels of 5 000 GT or above from 2027 may create evasion risks for this segment. Current EU MRV rules define a “port of call” as a stop for cargo loading/unloading, passenger embarkation/disembarkation, or crew changes for offshore vessels. This definition may not fully capture the activities of offshore vessels. Consequently, operators could re-route through non-EU ports to avoid triggering “port of call” requirements and EU ETS obligations. This could create a competitive disadvantage for vessels calling at EU ports, which must account for emissions during offshore activities, compared with vessels avoiding EU ports despite operating in EU EEZs.

Current measures to address evasion risks

To mitigate evasion risks, the ETS Directive includes a strict “port of call” definition (i.e. obligation to load/unload or embark/disembark cargo and passenger), which prevents companies from making artificial port calls for evasion purposes. In addition, “neighbouring container transshipment ports”³¹⁸ are excluded from the “port of call” definition. This means that stops at these non-EU ports cannot be considered under the Directive as the beginning or the end of a voyage, reducing incentives to stop at these non-EU hubs before or after calling EU ports. Based on the criteria set out in the ETS Directive, the Commission has established the list³¹⁹ of neighbouring container transshipment ports, which is to be updated biennially, and which currently includes important transshipment hubs such as the ports of East Port Said in Egypt and Tanger Med in Morocco. More recent data available to the Commission at the time of preparing this impact assessment indicates that two additional ports, Abu Qir and Damietta, in Egypt, also meet the criteria for neighbouring container transshipment ports and will be considered for the revision of the list.

However, the current anti-evasion measures may present several limitations:

- They may not cover adequately neighbouring transshipment ports that pose a risk but are below the current thresholds.

³¹⁸ Defined in Article 3ga(2) of the EU ETS Directive as ports where 1) the share of transshipment of containers exceeds 65% of the port’s total container traffic during the most recent twelve-month period for which relevant data are available, 2) the port’s location is outside the EU but less than 300 nautical miles from a port under the jurisdiction of a Member State, 3) the port is located in a non-EU country for which that non-EU country does not effectively apply measures equivalent to this Directive.

³¹⁹ Commission Implementing Regulation (EU) 2023/2297 of 26 October 2023 identifying neighbouring container transshipment ports pursuant to Directive 2003/87/EC of the European Parliament and of the Council, OJ L, 2023/2297, 27.10.2023, ELI: http://data.europa.eu/eli/reg_impl/2023/2297/oj

- Ships performing extra-EU journeys with an intermediary stop at a “neighbouring non-EU container transshipment ports” benefit from a lower ETS scope coverage for the leg to and from the EU, compared to ships doing similar journeys but with an intermediary stop in the EU.
- They do not apply to container ships doing journeys from and to non-EU ports, with an intermediary stop at a competing neighbouring non-EU port (such voyages fall outside the EU scope).
- They do not completely address the risk of companies using feeder vessels operating from neighbouring non-EU hub ports.
- They do not prevent containerships from adding an extra port call in ports not reaching the thresholds (e.g. in the UK) before entering or just after leaving the EU, with the objective to reduce their ETS exposure. Similarly, operators may change the order of calls to minimise their ETS costs.

Monitoring of evasion risks

The EU ETS Directive (Article 3gg) mandates the Commission to monitor the implementation of the ETS extension to maritime transport and report its findings biennially. One of the objectives of this monitoring clause is to detect possible changes in shipping companies’ behaviours, notably implementing or seeking alternatives to evade the requirements of the EU ETS Directive, with the aim to prevent such behaviours at an early stage.

The first report on the implementation of the ETS for maritime transport³²⁰ analysed key indicators for Q1–Q3 2024 related to potential evasive behaviours (transshipment relocation, evasive port calls, modal shift and shifts to smaller vessels). It found no evidence of major market changes attributable to the ETS. Traffic data showed no general trend in transshipment relocation or additional stops at neighbouring non-EU ports. The analysis also found no signs of modal shift to road transport or increased use of smaller vessels. Forward-looking indicators (route announcements and planned port investments) similarly showed no broader behavioural changes, aside from a few isolated cases of possible circumvention. No evidence was found of reduced services to EU islands or outermost regions. However, these findings should be interpreted with caution due to the analysis’ limitations and notably:

- the significant impacts of the Red Sea crisis on maritime traffic, which resulted in many shipping companies deviating their routes around South Africa, via the Cape of Good Hope. This created a large distortion in maritime traffic indicators in 2024 (compared to previous years), which made it more difficult to disentangle effects of EU ETS.
- the fact that 2024 was the first year of the ETS phase-in period, where only 40% of emissions were subject to ETS compliance costs, which reduces financial incentives of evasive behaviours.
- the limited time since its introduction. Given the high volatility of maritime traffic, particularly in transshipment operations, this partial coverage limits the ability to reach definitive conclusions from traffic data analysis. In addition, companies have limited experience in the implementation of the system for maritime emissions.

³²⁰ European Commission (2025), REPORT FROM THE COMMISSION Monitoring of the implementation of Directive 2003/87/EC in relation to maritime transport, available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52025DC0110>

- data limitations, particularly data on transshipment operations, which is not publicly available in a consistent manner for all ports.

The risk of evasive behaviours needs to continue being monitored closely, notably considering the end of the ETS maritime phase-in period in 2026 (i.e. 100% of emissions subject to EU ETS surrender obligations as from 2026), the entry into application of the FuelEU Maritime Regulation from January 2025 and the current lack of mid-term measures applied via the IMO.

Summary of stakeholder views from the OPC

A total of 29 out of 184 respondents rather agreed (11%) or strongly agreed (4%) that the current measures are effective in preventing shipping companies from evading the requirements of the EU ETS Directive. A further 23 respondents expressed a neutral view (13%). Smaller shares of respondents rather disagreed or strongly disagreed (24; 13%). The largest group indicated do not know (108, 59%).

Regarding specific suggestions, the most frequently mentioned view was the need for stronger monitoring and enforcement to prevent circumvention, including addressing rerouting, transshipment, and port call issues (11 mentions). Several stakeholders called for alignment with the IMO NZF and international harmonisation to maintain a level playing field (5 mentions), and enhanced coordination among authorities, including EU ports and third countries (5 mentions). Others highlighted the importance of stricter and proportionate penalties for non-compliance (4 mentions), use of digital tools and registries to improve tracking and transparency (3 mentions), and regular reviews and updates of ETS scope and measures (3 mentions).

Additional suggestions included clearer definitions of ports, transshipment, offshore, and exemptions to reduce loopholes (2 mentions) and exemptions or compensations for regions with unique logistical challenges (1 mention).

2.2. Policy measures

2.2.1. RE1: Revise the list of neighbouring container transshipment ports

This measure RE1, aims to revise the criteria used to identify “neighbouring container transshipment ports” under the ETS Directive. The revision could involve, for instance, lowering the current transshipment incidence threshold or increasing the minimum distance criterion. The objective is to ensure that the methodology adequately captures the non-EU ports where the risk of relocation of container transshipment activities is the highest.

Article 3ga(2) of the EU ETS Directive sets out the conditions for identifying neighbouring container transshipment ports. According to this provision, a port qualifies as a neighbouring container transshipment port when it meets several criteria. The port’s share of transshipment of containers must exceed 65 % of the total container traffic of that port during the most recent twelve-month period for which relevant data are available. The port must also be located outside the EU but less than 300 nautical miles from a port under the jurisdiction of a Member State. However, ports located in a third country where measures equivalent to the EU ETS Directive are effectively applied should not be identified as a “neighbouring container transshipment port”.

The revision of the list of neighbouring container transshipment ports is expected to further mitigate the risk of transshipment relocation by reducing the incentive to stop at non-EU hubs before or after calling at EU ports. At the same time, the revision seeks to ensure the proportionality of the measure.

In order to achieve these objectives, the revision may involve adjustments to one or more of the following elements:

- **Increase distance threshold:** Raising the distance threshold beyond 300 nautical miles could, in principle, extend coverage to additional non-EU ports that might benefit from evasion practices. However, as illustrated in the figure below, the vast majority of ports with a significant transshipment incidence are located within 300 nautical miles of the nearest EU port. The sole potential exceptions are the port of Ain Shukna (Egypt) and the port of Caucedo in the Dominican Republic (close to Guadeloupe), where container transshipment incidence is estimated at around 40%. On this basis, expanding the distance threshold would not result in a meaningful revision of the list. It is therefore proposed to maintain the current distance threshold.
- **Lower transshipment incidence threshold:** Transshipment incidence may be reduced below the current 65% level to cover additional non-EU ports, which still have a high potential to attract transshipment activities from EU ports. It is proposed to lower transshipment incidence threshold to 50%. This follows a port hub definition in the literature³²¹ and it would safeguard the proportionality of the measure as the exclusion from the definition of ‘port of call’ would continue applying to certain non-Union ports, where the transshipment of containers accounts for most container traffic. As per the analysis in Figure 2, this change of threshold could lead, in the short-term, to the identification of one additional “neighbouring container transshipment port” (besides the two ports already on the list and the two additional ports identified by virtue of recent available data) namely the port of Tekirdağ in Türkiye.
- **Increase list review frequency:** The list of neighbouring container transshipment ports is currently updated every two years. This frequency may be insufficient to capture major disruptions in the shipping market, which can rapidly alter transshipment patterns. One option would be to review the list on an annual basis, to ensure that it remains fully aligned with market developments. More frequent, or ad-hoc updates based on shorter time series than the current two-year period, would also ensure enough flexibility to swiftly consider neighbouring ports under development or subject to major expansions and destined to become major transshipment hubs. Examples of ports/terminals under development that could attract transshipment activities in the near future include e.g. the ports of Nador West Med (Morocco)³²², the port of Cherchell (Algeria)³²³ and the port of Dakhla (Morocco)³²⁴. At the same time, if the review does not lead to a change of the list, it is proposed that no amendment of the corresponding legal act is needed.

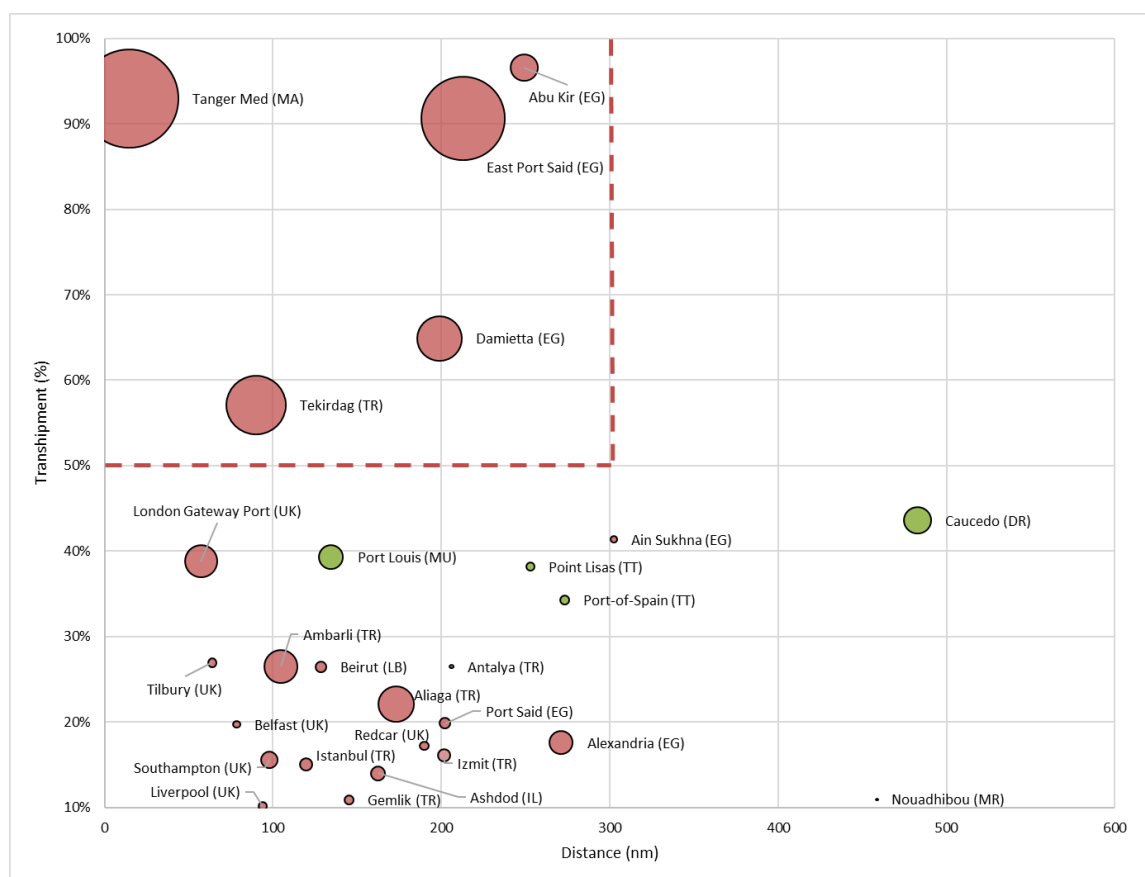
³²¹ Notteboom, T., A. Pallis and J-P Rodrigue (2022) *Port Economics, Management and Policy*, New York: Routledge. <https://doi.org/10.4324/9780429318184>

³²² Due to be fully operational in 2027.

³²³ Major ‘El-Hamdania’ megaport expansion project relaunched in September 2025, completion date currently unknown.

³²⁴ Due to be completed in 2028.

Figure 2: Illustration of the revision of the list of neighbouring transshipment ports with a 50% transshipment incidence threshold. .



Note: Vertical axis shows transshipment incidence in %, while horizontal axis shows distance to closest EU port in nautical miles (nm). Size of the bubble shows annual transshipment traffic in TEUs. Bubbles in green represent the neighbouring ports identified based on the distance to closest EU outermost regions

Source: Commission's analysis based on data from EconDB and port traffic statistics

2.2.2. RE2: Ensuring that offshore activities by ships operating in EU waters are covered, independently from their port of origin.

EU MRV and ETS elements may be amended to address the specific nature of offshore activities occurring in EU waters. Elements that may be looked at include, among others, the definition of 'port of call' or the definition of 'voyage'. This measure would ensure that vessels providing offshore services (e.g. by virtue of a contract, permit or licence or a UN/LOCODE designator) in Member States' territorial waters or Exclusive Economic Zones (EEZs) are subject to the EU ETS, independently from where they come from or where they go to after they conclude the activity. The implementation of this measure could rely on explicit permits or licences issued by Member States to precisely identify the geographical locations of the offshore activities, as in the case where a UN/LOCODE has not been formally designated for a site, and the duration of such activities. Other aspects that may need to be addressed include having clear criteria for identifying relevant offshore activities; having robust geolocation and activity data to ensure reporting accuracy and reliable verification of emissions; and making updates to Thetis-MRV to reflect the new definition and its implementation.

2.3. Assessment of policy measures

2.3.1. *Economic impacts*

2.3.1.1. Policy measure RE1

The two main economic impacts of the possible relocation of transshipment activities could be (i) lower port-related economic activities and (ii) higher import/export prices due to lower connectivity. First, if lower port traffic occurs due to the relocation of transshipment activities, it could translate into decreased gross value added and employment across port-related sectors, with broader spillover effects in the hinterland economy. Second, the relocation of transshipment activities from EU ports to non-EU ports could also have a negative impact on connectivity, because of the reduction in frequency of direct services by container ships at EU container transshipment ports. The reduction in the frequency of direct services might lead to an increase in transit time and container shipping costs, and, in turn, this can lead to higher import and export prices.

In case the relocation of transshipment activities from EU ports to non-EU ports occurs, it would likely have different economic impacts across Member States and regions. For instance, the impact on the economy might be more severe for regions and countries where port activity represents a significant share of GDP and employment. In Member States and regions whose economies are highly dependent on maritime transport services and where the number of ports is limited, the relocation of transshipment activities might have a more severe impact on connectivity and import/export prices³²⁵ than in Member States and regions with a greater number of ports.

Should RE1 effectively reduce transshipment relocation risks, it is also expected to limit the broader economic impact associated with the relocation of transshipment activities from EU ports to non-EU ports.

In relation to competitiveness impacts on EU container transshipment ports, RE1 should lead to the identification of additional “neighbouring container transshipment ports” under the ETS Directive. According to present data and assuming no major changes in ports’ activities, RE1 could lead to the identification of the port of Tekirdağ in Türkiye, which represents a yearly container transshipment volume of around 1.2 million TEU.

When considered together with the other “neighbouring container transshipment port, the scope of the current anti-evasion would cover more than 80% of the container transshipment activities taking place in non-EU Mediterranean countries.

RE1 could also help better address the risk of evasion linked to future transshipment hubs, such as the port of Cherchell in Algeria, the Port of Dakhla or Nador West Med in Morocco. By reducing the attractiveness of relocating transshipment activities to non-EU transshipment ports, RE1 should help maintain the market shares of EU container transshipment ports and contribute to preserve their competitiveness.

2.3.1.2. Policy measure RE2

Measure RE2 ensures that all ships involved in relevant offshore activities in Member States’ territorial waters or Exclusive Economic Zones (EEZs) are subject to emissions regulation, regardless of their flag or port of origin. This promotes more level playing field across the

³²⁵ In these Member States and regions that are highly dependent on maritime transport services and where the number of ports is limited, the relocation of container transshipment activities may affect trading activities and increase import and export prices, e.g. for time-sensitive commodities like electronics, perishables, and automotive parts routed through Mediterranean arcs.

sector and it would help safeguard the competitiveness of EU offshore operators based in the EU. It should be noted that the EU offshore shipping fleet is a strategic asset for the European Union, being a category of vessels that includes specialised vessels working, among others, on offshore wind installation and maintenance, cable-laying and subsea construction. These vessels provide services underpinning the EU's energy security and digital connectivity and are essential for the deployment of the EU's offshore renewable capacity and telecommunications infrastructure. Maintaining a strong and competitive EU-based offshore fleet safeguards industrial know-how, high-skilled maritime jobs and strategic autonomy, while reducing dependence on non-EU operators for critical offshore services.

2.3.2. Environmental impacts

2.3.2.1. Policy measure RE1

RE1 would result, based on data at the time of preparing this impact assessment, in the inclusion of one additional port, the port of Tekirdağ in Türkiye in addition to the four other ports on the current list or not yet added.

Under the ETS Directive calls at ports identified as “neighbouring container transshipment ports” cannot be considered as the starting or ending point of a voyage. Including these additional ports would therefore alter the scope of EU ETS³²⁶ emissions. Compared to the current list of neighbouring container transshipment ports (East Port Said and Tanger Med), the ports of Abu Qir, Damietta and Tekirdağ have lower connectivity with EU ports and shorter voyages, so emissions added to the EU ETS scope by virtue of adding these three ports to the list would be relatively small (<0.3% of EU ETS maritime emissions). This suggests that, based on existing traffic, their inclusion would have a lower effect than the currently listed ports. The two ports already in the list of neighbouring container transshipment ports between them account for more than 90% of additional emissions relating to an expanded list of neighbouring container transshipment ports. Among other potential ports for future consideration, particularly if the threshold is lowered, London Gateway would contribute most to EU ETS emissions due to its strong connectivity with EU ports.

2.3.2.2. Policy measure RE2

By covering emissions from all ships involved in relevant offshore activities in Member States' territorial waters or EEZs, the following changes in the scope of emissions under the EU ETS could occur:

- Case 1: for offshore vessels based in EU ports but performing offshore activities outside MS' territorial waters or EEZ, there would be reduction in in-scope emissions;
- Case 2: for offshore vessels performing voyages between non-EU ports and offshore sites inside MS' territorial waters or EEZs, there would be an increase in in-scope emissions.

The resulting change in covered ETS emissions would therefore depend on the frequency of each case and their weighting in terms of total emissions that would fall under those cases.

Analysis of offshore operators indicates that an absolute majority (77%) of calls by offshore ships at EU ports are operated by EU-registered companies; the share of offshore ships operated by EU companies and calling non-EU ports is also significant (42%). It may follow that the

³²⁶ For example, for a journey starting at an EU port call and ending at an EU port call via a ‘neighbouring container transshipment port’, 100% of the emissions are subject to surrender obligations in accordance with Article 3ga of the EU ETS Directive.

likelihood of the change in scope represented by case 1 is greater, and therefore a net reduction in emissions (from offshore activities) falling within EU ETS scope may occur.

2.3.3. Social impacts

Measures RE1 and RE2 should reduce potential negative social impacts from evasive behaviours.

In 2022, the port activities sector (including cargo and warehousing and port and water projects) directly employed 423 000 people³²⁷, while the maritime transport sector (including freight and passenger transport and services for transport) employed 392 800 people. Ports are vital gateways for Europe, with 74% of goods entering or leaving Europe being transported by sea and around 395 million passengers each year. Similarly, ports facilitate the exchange of goods within the EU internal market and provide crucial links for islands and peripheral regions with the rest of mainland Europe³²⁸.

The magnitude and distribution of port-related socio-economic impacts linked to the risk of evasion depend on structural and contextual factors³²⁹. Even between EU transshipment ports, the social impact of transshipment relocation can vary widely. The negative social impact is likely to be more severe for regions whose economies are highly dependent on maritime transport services via transshipment ports, because they lack alternative gateway ports.

Offshore vessels provide critical, specialised services to other important sectors, including, for example, the EU offshore wind energy sector which in 2022 employed 17 300 people, a figure that is expected to continue growing. This in turn provides opportunities for highly skilled labour. Evasive behaviour in the offshore vessels sector that leads to competitive disadvantages for EU-based operators could have wider consequential socio-economic negative impacts, including loss of employment opportunities with a knock-on effect on communities reliant on offshore vessel operations. Complementary measures to RE2, such as incentives to invest in alternative fuels for offshore vessels could also be beneficial to prevent social impacts in the long term.

³²⁷ European Commission: Directorate-General for Maritime Affairs and Fisheries, Borriello, A., Calvo Santos, A., Feyen, L., Ghiani, M. et al., *The EU blue economy report 2025*, Publications Office of the European Union, 2025, <https://data.europa.eu/doi/10.2771/2333701>

³²⁸ Rodrigue, J-P. & Notteboom, T. (2022). *Port Economics, Management and Policy*, Chapter 11 “Ports and Economic Development”, PortEconomics.eu.

³²⁹ Such as the economic structure of the surrounding region, hinterland integration (presence of rail, road, and multimodal logistics corridors), or the type of ports (e.g. gateway ports vs. transshipment ports).

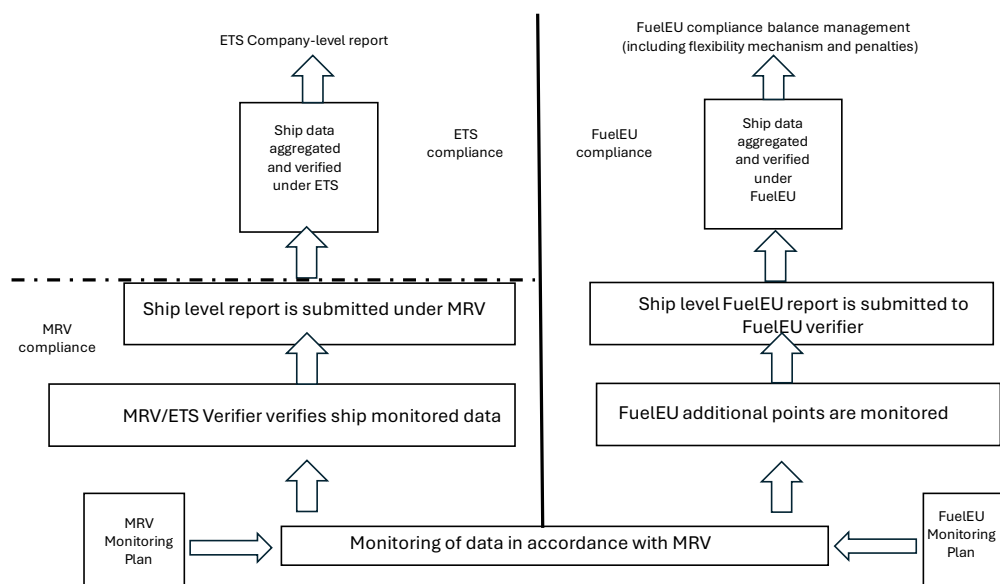
3. SIMPLIFICATION AND OTHER MEASURES TO ENHANCE ROBUSTNESS AND EFFECTIVENESS OF THE IMPLEMENTATION SYSTEM FOR MARITIME

3.1. Scoping

The co-existence of different regulatory frameworks to decarbonise shipping at EU and global level have introduced a set of parallel and sometimes overlapping requirements on shipping companies. At the EU level, the EU ETS system was extended to maritime transport activities starting in 2024 and, since 2025, a greenhouse gas intensity standard for energy used by ships was introduced through the FuelEU Maritime Regulation. The IMO introduced a system starting in 2019, mandating the monitoring and reporting of fuel consumption data, as a basis to support IMO decarbonisation measures.

The implementation of both the EU ETS maritime and of FuelEU Maritime is based on the underlying EU MRV system, established in 2015³³⁰ to prepare for the EU ETS, upon which FuelEU Maritime has also introduced additional requirements in 2023. As a consequence, the MRV system required under ETS (i.e. MRV/ETS) and the one applicable under FuelEU currently share many similarities in design, processes and involved actors, but remain formally distinct and present some overlaps and divergences, thus causing operators the duplication of compliance actions and interactions with relevant authorities³³¹. Even though synergies are currently possible, those are limited to data collection onboard the ship and only partially leveraged by shared functionalities in the IT reporting tool THETIS-MRV, acting as a “one-stop shop” for shipping companies.

Figure 3: Current MRV/ETS/FuelEU compliance cycle, main steps



Source: Own illustration

³³⁰ Through Regulation (EU) 2015/757 of the European Parliament and of the Council of 29 April 2015 on the monitoring, reporting and verification of carbon dioxide emissions from maritime transport and amending Directive 2009/16/EC (OJ L 123, 19.5.2015, pp. 55–76, ELI: <http://data.europa.eu/eli/reg/2015/757/oj>).

³³¹ Synergies are currently already possible but mostly limited to data collection onboard the ship and only partially mitigated by shared functionalities in the common IT reporting tool THETIS-MRV.

The different approaches to the regulated entity between EU MRV/EU ETS and FuelEU Maritime³³² may result into two different entities being responsible for the same ship under EU MRV/ETS and FuelEU.

The implementation of the EU ETS has also highlighted potential opportunities to increase the robustness and effectiveness of the implementation system, both in respect of the role of Administering Authorities in ensuring enforcement and of the compliance actions by shipping companies.

Summary of stakeholder views from the OPC

When asked whether the administrative costs linked to the implementation of the ETS extension to maritime transport are proportionate and reasonable, 16% (30 of 186) agreed with the statement, while 25% (47 of 186) disagreed. A further 10% (19 of 186) were neutral and 48% (90 of 186) did not know. When asked to suggest possible improvements or simplifications to streamline administrative costs, the most frequently cited view was that EU ETS rules should be aligned with IMO NZF and FuelEU Maritime to avoid double regulation (20 mentions). Closely related, stakeholders highlighted the need for standardising data collection methodologies and reporting templates across EU MRV and IMO DCS (17 mentions) and the establishment of a single EU-level digital system to simplify reporting and compliance (15 mentions). Several stakeholders stressed that clear and harmonised EU guidance is essential to reduce interpretation risks (10 mentions), while others called for simplified or tiered compliance frameworks for SMEs and small emitters (4 mentions), administrative requirements to be simplified by reducing paperwork and procedural burdens (4 mentions), and administrative fees and verification costs to be reduced and standardised across Member States (4 mentions).

When asked whether the ETS should further incentivise the uptake of renewable and low-carbon maritime fuels based on Well-to-Wake emissions, 44 respondents (23%) strongly agreed and 43 (23%) rather agreed. Nine respondents (5%) were neutral, 16 (8%) rather disagreed, 8 (4%) strongly disagreed, and 71 (37%) indicated “do not know.” Stakeholders emphasised that incentives must reflect full well-to-wake lifecycle emissions and exclude unsustainable biofuels (17 mentions). Several stakeholders also emphasised that renewable and low-carbon fuels need cost support to compete with conventional fuels (12 mentions) and that fuel incentives should remain technology-neutral to support multiple low-carbon options (11 mentions). An equal number of stakeholders highlighted the need for EU ETS rules to be aligned with FuelEU Maritime, RED III, and IMO frameworks to reduce overlap (11 mentions). Other frequently mentioned views included that ETS revenues should be reinvested to de-risk clean fuel deployment and infrastructure (8 mentions), sustainability certification should be standardised and centralised at the EU level (6 mentions), and reporting and compliance processes should be simplified, digitalised, and streamlined (4 mentions).

3.2. Policy measures

Policy measure EL1: simplification of the MRV/ETS regulatory framework for companies

³³² The definitions of the regulated entity under EU ETS/EU MRV and FuelEU Maritime are aligned. The legally non-binding FAQs of FuelEU Maritime explain that the ‘ISM Company’ distinct from the shipowner is the entity responsible for compliance with FuelEU Maritime. By contrast, under EU ETS and EU MRV, the regulated entity can be either the shipowner or the ISM Company, with the shipowner being the regulated entity by default. The ISM Company refers to the entity responsible for the compliance of a ship with the requirements of the International Management Code for the Safe Operation of Ships and for Pollution Prevention.

This measure aims at upholding coherence across existing EU and IMO frameworks (MRV/ETS/FuelEU/IMO DCS) for shipping decarbonisation through reducing existing gaps, divergences, and duplications. As a consequence, shipping companies complying with those frameworks will be able to exploit synergies, minimise undue burden, and ultimately reduce administrative compliance costs. This measure is composed by the following elements:

- Redefine the compliance process for ETS and FuelEU, to be based on one single MRV system limited to data collection, verification, and reporting distinct from further requirements in respect of EU ETS and FuelEU obligations. To this end, the additional monitoring requirements introduced by the FuelEU Maritime Regulation should be brought under the MRV Regulation, so that companies monitor and report only once in respect of the same ship. These include the requirement to monitor the following parameters: the energy provided by on-shore power supply (OPS), the energy provided by Zero-emission technology (ZET), the installation of wind assisted propulsion (WASP), the applied well-to-tank emissions factors, the date, time and position when entering and leaving the ice conditions and the distance travelled when sailing in ice conditions, and the time spent at quayside and anchorage.
- Minimise existing discrepancies and misalignments on monitoring and reporting requirements between EU MRV/ETS and FuelEU. Main elements for consideration to this end should include the following elements:

Table 4: Comparison of selected monitoring and reporting requirements under EU MRV/ETS and FuelEU Maritime

Element	EU MRV/ETS	FuelEU
Per-voyage reporting	Possible through THETIS-MRV but not mandatory	Mandatory
Derogation to per-voyage monitoring (i.e. aggregate annual monitoring)	Possible for ships that only perform intra-EU voyages and undertake more than 300 voyages each year	Not possible. All ships shall monitor on a per-voyage basis
Definition of ‘port of call’ applicable to offshore ships³³³	Offshore ships trigger a port of call when making stops to relieve crew, in addition to stops for loading/unloading cargo and embarking/disembarking passengers	Offshore ships trigger a port of call only when stopping in port for loading/unloading cargo and embarking/disembarking passengers
Timeline for reporting	Administering Authorities can anticipate the deadline of 31 March for reports submission to an earlier date, but not earlier than 28 February (Article 11(1) EU MRV).	Submission of the FuelEU report by the verifier in the FuelEU database by 31 March. It is not possible for the Administering State to set earlier deadlines
Deadline for companies to submit data to verifiers	Not foreseen. The responsibility to meet the reporting deadline for reports submission is only in respect of Administering Authorities, the European Commission, and the Flag State.	Companies shall submit data by 31 January to their verifier through the FuelEU draft report

³³³ Monitoring and reporting requirements affecting offshore ships will have to be assessed considering parallel revision of the offshore ship approach under ETS.

Reporting requirements in case of change of company during the reporting period	Under MRV the previous company is required to submit a partial emissions report at ship level, covering the emissions under MRV and ETS scope occurred during the period under which the ship was under its responsibility. The company responsible at the end of the reporting period is required to submit an end of year report which shall include the emissions under MRV scope for the entire reporting period. Both companies are responsible for ETS compliance only in respect of the ship's activities occurred over the period during which the ship was under their respective responsibility.	The previous company is required to submit a ship-specific FuelEU report, covering the energy used under FuelEU scope occurred during the period under which the ship was under its responsibility. Only the company responsible for the ship at the end of the reporting period is accountable for compliance in respect of the ship's activities occurred during the entire year.
Deadline for Monitoring Plan submission for new companies	No later than three months after each ship's first call in a port under scope (Article 6(7) of EU MRV).	No later than two months after each ship's first call in a port under scope

- Further align, and possibly merge, the relevant MRV documents into one unique template (i.e. monitoring plans, emissions reports), so that companies can submit one unique document under the revised MRV compliance cycle common to ETS and FuelEU Maritime, thus maximising the implementation of the reporting-only-once principle.
- Establish one unique verification and accreditation framework for MRV, EU ETS and FuelEU under one single legal instrument.
- Alignment of some EU MRV and IMO DCS requirements insofar definitions and monitoring and reporting parameters (e.g. distance travelled, time spent at sea, split of consumption by consumer type) without compromising the policy objectives of the EU measures.

Policy measure EL2: enhance the robustness and effectiveness of the ETS maritime implementation and enforcement system

The ETS maritime implementation since the latest (2023) revision has highlighted opportunities to further support the role of Administering Authorities as enforcers of the system. Further clarifying the role of the Administering Authority in respect of implementing the MRV system, including with respect to those shipping companies which are only active under MRV scope but not under the ETS/FuelEU scope, and establishing an *ex officio* automatic attribution for non-compliant companies³³⁴ would represent key elements to support Member States role in the system.

As far as shipping companies are concerned, a mechanism to give to those entities responsible for fewer emissions the possibility to form a pool to comply with their ETS obligations could reduce the related administrative compliance cost. Further administrative costs reduction could

³³⁴ In the current implementation framework shipping companies, which are not on the attribution list published by the European Commission have to request attribution as they start activities under scope. Establishing *ex officio* attribution on the basis of best available activity data would ensure that all companies active under MRV scope are promptly put under the responsibility of an Administering Authority.

originate from derogating small ships³³⁵ (400-5000 gross tonnage) from the obligation to monitor their emission on a per-voyage basis if they solely perform intra-EU activities over a given reporting period, regardless of the number of journeys per year and independently from pre-established schedule.

Policy measure EL3: The regulated entity in EU MRV and EU ETS is either the shipowner or the ISM Company (distinct from the shipowner)

Under EL3, the current approach to the regulated entity in EU MRV and EU ETS is maintained.

The current definition of ‘shipping company’ in the EU ETS Directive and EU MRV Regulation remains unchanged and provides for flexibility as regards the entity responsible for compliance with the EU ETS and EU MRV requirements in respect of the GHG emissions of a ship. The regulated entity is either (i) the shipowner or (ii) the company that is distinct from the shipowner and that is responsible for compliance with the International Management Code for the Safe Operation of Ships and for Pollution Prevention (the ‘ISM Code’). The entity responsible for compliance with the ISM Code is hereinafter referred to as the ‘ISM Company’.

Under EL3, an alignment of the regulated entity in EU MRV, EU ETS and FuelEU Maritime would require a change in the definition of ‘company’ in FuelEU Maritime. The definition of ‘company’ in the FuelEU Maritime Regulation should be amended (i) to refer to the definition of ‘shipping company’ under the EU ETS Directive and (ii) to clarify that the entity responsible for compliance under FuelEU Maritime must be the same as the one responsible for compliance under EU ETS and EU MRV.

The non-legally binding FAQs on FuelEU Maritime would also need to be amended³³⁶, because the FAQs explain that the ISM Company distinct from the shipowner is the entity responsible for compliance with FuelEU Maritime.

Such alignment of the regulated entity in EU MRV, EU ETS and FuelEU Maritime under EL3 means that the same Member State is responsible for the enforcement of EU MRV, EU ETS and FuelEU Maritime in respect of the emissions of a given ship, which would create synergies with the simplification elements under EL1.

Other policy measures: the challenge of using a well-to-wake approach in the ETS

Maritime emissions reported under the EU ETS scope are those occurring on-board ships, also called downstream emissions (Tank-to-Wake, TTW). Up-stream emissions from marine fuels are hence not considered under the EU ETS, except if these fuels are produced in Europe, through an installation falling under the ETS scope, such as a refinery. This situation may create wrong incentives for shipping companies, encouraging the use of marine fuels with low downstream emissions but potentially high up-stream emissions (e.g. grey ammonia).

³³⁵ Between 400 and 5000 gross tonnages.

³³⁶ https://transport.ec.europa.eu/transport-modes/maritime/decarbonising-maritime-transport-fueleu-maritime/questions-and-answers-regulation-eu-20231805-use-renewable-and-low-carbon-fuels-maritime-transport_en?mc_cid=0487626adf#general.

The Q&A was drafted by the services of the Directorate-General for Mobility and Transport of the European Commission and does not have legal effect as regards the interpretation of FuelEU Maritime. “[i]n cases when the shipowner has delegated the responsibilities to comply with the ISM Code to any other organisation or person, then that organisation or person will become the ‘ISM company’ and it is also the entity responsible for compliance with the FuelEU.”

In the current EU policy framework, this risk is mitigated by the interplay between the EU ETS and other policies. Notably, GHG Fuel intensity obligations stemming from the FuelEU Maritime Regulation are based on lifecycle accounting, comprising both upstream and downstream emissions. The interaction between the Renewable Energy Directive and the EU ETS also helps address this concern, since RED requires that fuels meet specific lifecycle GHG emissions to be qualified as renewable fuels. For instance, the zero-rating of sustainable biofuels and other renewable fuels under the ETS can only happen if these fuels comply with the sustainability and life-cycle GHG savings criteria established by the RED. Furthermore, a possible ETS support system could take the life-cycle emissions into due account.

While in theory the ETS scope could be extended to cover up-stream emissions, such a change would be very difficult to implement in practice. It would for instance lead to a risk of double counting (i.e. in relation to the upstream emissions already covered under the ETS such as in refineries or ammonia plants). It would also require additional monitoring, reporting and verification rules, and create some unclarities in terms of responsibility. Furthermore, covering upstream emissions only for maritime, would also create incoherence with the rest of the sectors covered by the EU ETS. For these reasons, the possible extension of the ETS scope to up-stream emissions is not further considered in the following sections.

3.3. Assessment of policy measures

3.3.1. Economic impacts

The simplification elements of policy measure EL1 are expected to positively impact the administrative costs for the different stakeholders involved in the MRV/ETS cycle, with shipping companies being the main beneficiaries of the resulting costs reductions.

The evaluation of the MRV Maritime system collected relevant and updated inputs from stakeholders, building on targeted questions on MRV cost components for operators³³⁷. The evaluation estimated total annual MRV compliance cost for shipping companies to be around EUR 47 million, with a median value per vessel at 3 150 euro. Respondents stressed that the costs incurred are to a considerable extent shared with those to comply with overlapping regulatory frameworks, indicating that synergies are very high in respect of FuelEU duties and costs (above 70%) and high in respect of IMO DCS ones (above 50%). This confirms the room for potential further, yet limited, synergies across systems, provided that the same regulated entity is responsible in respect of a given ship, mostly in regard to data collection and data aggregation (50% and more) and, to a smaller extent, for monitoring plan preparation, exchanges with verifiers, and use of IT systems.

Most of the elements covered under policy measure EL1 are expected to positively impact the different main cost drivers of the MRV compliance process, but the quantification of the relative contribution from each element remains particularly challenging. Still, on the basis of the ranking provided by stakeholders on the (six) different cost drivers' contribution to total MRV compliance costs, referred to above, and of their linkage to the different elements under policy measure EL1, a conservative estimate of cost reduction indicates that the full implementation of the elements under EL1 could lead to savings for recurrent MRV compliance costs incurred by companies between 10% and 20% compared to the current situation³³⁸, as described in the following table:

³³⁷ Further details in RICARDO, 2026, Support study for the evaluation of the EU Maritime MRV system in the context of the ETS Directive review (forthcoming).

³³⁸ Total MRV annual compliance cost are estimated at 47 EUR million with 3,150 EUR average cost per vessel.

Table 5: Potential cost reduction by cost driver

MRV cost driver	Total annual MRV admin cost reductions [EUR million]		Per vessel [EUR]	
	Lower bound	Upper bound	Lower bound	Upper bound
Staff time (including dedicated training)	-0.9	-1.8	-62	-124
Data collection and management (onboard and company systems)	-0.8	-1.7	-56	-111
Verification fees	-0.8	-1.6	-54	-108
IT systems / digital tools for MRV reporting (excluding THETIS MRV)	-0.8	-1.6	-53	-106
Preparation and revision of monitoring plans	-0.7	-1.4	-47	-94
Administrative coordination/ interactions with Member State authorities in charge of MRV/ETS implementation	-0.7	-1.3	-44	-88
Total	-4.7	-9.4	-315	-630

Source: own analysis based on literature review and inputs collected during the evaluation of the MRV maritime system as described above. Cost drivers are listed in order of importance, on the basis of average ranking by respondents.

Relevant cost reductions are further expected to also positively affect the administrative compliance costs incurred under FuelEU Maritime, as those have a significant MRV-related component which will be impacted by policy measure EL1³³⁹.

Policy measure EL2 is expected to drive administrative costs reduction for Administering Authorities (AA), due to efficiency gains resulting from the clearer identification of the roles and responsibilities of the AA under the MRV cycle and the association of the same shipping company to a given AA under both MRV/ETS and FuelEU, thus reducing potential divergences. A positive economic (and environmental impact) is also expected from an increase in the overall compliance rate (i.e. reduction of non-compliant shipping companies) due to the faster and clearer attribution of non-compliant companies.

Policy measure EL2 further bears potential for MRV administrative costs reduction for certain operators, in so far it could give to certain small ships the possibility to monitor and report on an annual aggregated basis, thus derogating from the general obligation to monitor relevant parameters for each voyages. In 2023, approximately a third (32%, i.e. 2 100 ships) of the small ships fleet sailed only intra-EU (Ricardo, 2025). The vast majority of these smaller vessels

³³⁹ On the basis of the compliance cost estimates under the 2021 Impact Assessment accompanying the FuelEU Maritime proposal by the Commission (SWD(2021) 635 final), the additional administrative cost reduction for shipping companies can be expected to be up to EUR 22.4 million at 2025 prices (assuming yearly average total administrative compliance cost for companies under FuelEU of around EUR 34.4 million and a reduction of 65% from MRV-cost elements on total FuelEU costs).

wouldn't be able to benefit from the present exemption rule, as they perform less than 300 voyages per year. Vessel categories with the highest share and absolute number of intra-EU voyages, such as RoPax, tug and dredgers, and passenger vessels are expected to benefit the most from such a simplification measure. A simplified data collection and management system could reduce by half the average relevant compliance cost component for operators.

A pooling mechanism to provide additional flexibility in the compliance process, as envisaged under EL 2, could further reduce the costs for those shipping companies responsible for fewer emissions. Depending on the exact design of the pooling mechanism, it could decrease the ETS compliance costs related to registry elements, for instance by centralising those through a trustee acting for multiple small emitters, or positively impact other drivers of administrative costs for companies (e.g. in terms of staff cost) by delegating data and reporting compilation to a centralised third party. Responses to the light MRV evaluation show indeed that currently larger fleets achieve lower per-vessel cost via shared systems and staff, while SMEs bear a higher cost proportional to their fleet size.

An assessment from the previous impact assessment by Pons et al. (2021)³⁴⁰ identified that a pooling mechanism might potentially lower the administrative effort by companies in the pool. However, a pooling system applied only to the ETS compliance phase would not significantly impact the MRV compliance cost, which represents the main component³⁴¹ for small emitters overall ETS participation costs, in particular when participants were already active under the MRV and ETS scope before the introduction of the pooling mechanism and therefore have already incurred into one-off costs to comply. In addition to this, even the application of a pooling mechanism to MRV compliance would only bring limited MRV cost reduction to companies, as many of those are already relying on third-party services for compliance³⁴².

The economic impacts of EL3 are mostly expected to relate to the regulatory costs for regulated entities and public authorities of Member States. With EL3, no increase or decrease in the current EU MRV and EU ETS administrative costs is expected for regulated entities and for public authorities of Member States that are responsible for the enforcement of the EU MRV and EU ETS.

As regards the overall administrative costs for regulated entities under EU MRV, EU ETS and FuelEU Maritime, EL3 is expected to contribute to a reduction in these administrative costs thanks to the synergies produced and the consequent reduction in work hours need to complete the different steps of the compliance cycle, especially when combined with EL1 and EL2.

As regards the overall costs for public authorities in respect of the combined enforcement of EU MRV, EU ETS and FuelEU Maritime, EL3 is expected to contribute to a reduction in these costs. Under the current situation, one Member State might be responsible for enforcing the EU MRV and EU ETS requirements in respect of one shipping company, while another Member State might be responsible for enforcing the FuelEU requirements in respect of the same shipping company, thus leading to some duplications. EL3 would remove such duplications and lead to a decrease in the overall regulatory costs.

³⁴⁰ Oeko's compilation based Pons et al. (2021: Study on EU ETS for maritime transport and possible alternative options of combinations to reduce greenhouse gas emissions, <https://op.europa.eu/o/opportal-service/download-handler?identifier=ba865136-353b-11ec-bd8e-01aa75ed71a1&format=pdf&language=en&productionSystem=cellar&part=>.

³⁴¹ The 2021 Impact assessment estimated annual recurrent annual ETS administrative costs per company at EUR 5,000 and one-off costs at around EUR 15,000.

³⁴² 38% SME respondents to the light MRV evaluation stated that they are already using third party support for monitoring and reporting under MRV and over 80% of these SME use third parties also for monitoring and reporting support for EU ETS, FuelEU and IMO DCS at the same time.

3.3.2. Environmental impacts

Policy measures EL1, EL2 and EL3 do not change the scope of GHG emissions covered by the EU MRV and EU ETS.

Yet, EL1, EL2 and EL3 are expected to enhance the robustness and effectiveness of the EU MRV and EU ETS. Compared to the current situation, some positive environmental impacts could derive from the increase of the compliance rates deriving from a more efficient enforcement system by administering authorities (e.g. through *ex officio* attribution of companies active under scope) and from the additional flexibilities provided to companies, in particular small emitters.

3.3.3. Social impacts

No significant impact on employment can be expected because of the implementation of policy measures EL1, EL2 and EL3.

4. MARITIME DEROGATIONS

4.1. Scoping

The EU ETS Directive provides for some derogations concerning the surrendering obligation of allowances until the end of 2030. These include:

- A temporary derogation for Ice-Class Ships (**ICS**, Article 12(3-e)), which may surrender 5% fewer allowances than their verified emissions, provided that ships have the ice class IA or IA Super or an equivalent ice class, established based on HELCOM Recommendation 25/7;
- A temporary derogation for voyages between a port of a Member State and its Outermost Region port (**OMR**, Article 12(3-b));
- The possibility for a Member State to request a temporary derogation for:
 - Voyages for passenger transport between a Member State with no land connection and other closest Member State in the context of a transnational Public Service Contract/Obligation (**PSC/O**, Article 12(3c));
 - Voyages for passenger transport between (small) island ports of a Member State with no road or rail link with the mainland and with less than 200,000 permanent residents (**SIP**, Article 12(3-d)).

The reasoning behind the different treatment of ice-class ships is that such ships, due to their design, require more fuel³⁴³ to cover the same distance when compared to non-ice class ships. As a consequence of their design, they tend to consume more fuel than comparable non-ice-class vessels in ice-free waters. This results in proportionally higher emissions that are not due to inefficiency but to essential safety and design requirements. A GHG emissions increase of around 5% is generally assumed in comparison to purely open water designs. In addition, when operating in ice-conditions, analysis shows that fuel consumption and emissions per distance travelled may be up to 60% higher during periods of ice conditions compared to open water, depending on factors such as ice thickness, ice concentration, the availability of icebreaker support, and the proportion of the voyage taking place in ice-covered waters³⁴⁴.

³⁴³ Solakivi, T., Kiiski, T. & Ojala, L. On the cost of ice: estimating the premium of Ice Class container ships. *Marit Econ Logist* 21, 207–222 (2019). <https://doi.org/10.1057/s41278-017-0077-5>

³⁴⁴ MEPC 76/INF.67, Annex titled "Effects of sailing in ice conditions on the fuel oil consumption and attained CII of ice-classed ships"

However, recent analysis shows that these impacts can vary between different vessel types. A multivariable regression analysis³⁴⁵ covering seven vessel types and using EU MRV maritime data over the period 2018–2022 showed that ice classification does not systematically correspond to higher annual mean fuel consumption across all categories. More specifically, according to this analysis, ice class has a statistically significant negative effect on fuel consumption for bulk carriers, chemical tankers, and RoPax vessels, a significant positive effect for general cargo ships and ro-ro vessels, and no clear or consistent effect for container ships and oil tankers.

The derogations for **certain voyages** stem from the particular circumstances of the routes/regions (remoteness, connectivity issues). For example, outermost regions and islands depend heavily on maritime transport for territorial continuity, economic activity, access to essential products and social and regional cohesion.

The derogations are of a time-limited nature, allowing operators in affected routes and regions sufficient time to adapt to the requirements of the system and invest in low and zero-emission technologies suitable for their specific operating conditions. This transition can already be supported by ETS revenues. For instance, Greece is leveraging specific ETS revenues to support the decarbonisation of islands through the Islands Decarbonisation Fund (IDF), which should finance a range of energy transition projects including cold ironing infrastructures in island ports, for a direct reduction of maritime emissions in the Greek islands. The temporary nature of these derogations is important as permanent derogations would reduce the ETS's environmental coverage and integrity, distort competition and operational efficiency.

The electrification of ferry routes serving small islands is increasingly recognised as a feasible and strategically important opportunity for decarbonising regional maritime transport because these routes are typically short and operate on predictable schedules, making them well suited for electrification, which has already reached a high level of technological maturity. Coupled with falling technology costs and the gradual expansion of onshore charging infrastructure, carbon pricing would create a clear business case for investment in electric ferries on selected island connections. Electrification could reduce emissions, stabilise operating costs, improve service reliability, and support local maritime industries, thereby contributing to the long-term economic resilience and connectivity of island communities. A timely and well-coordinated transition towards these low-carbon solutions is therefore essential to secure the multiple benefits of cleaner, more reliable, and cost-effective ferry services.³⁴⁶

As a basis for assessing the impact of the measures, it is important to understand the current volume of the derogations. Thetis-MRV data on verified GHG emissions covered under the EU ETS and the number of derogations in 2024 have been used in terms of different criteria.

According to the table below, in 2024, all derogations together amounted to 4.86 Mt CO₂. This corresponds to around 5% of the verified emissions for maritime transport under the EU ETS in 2024 (90 Mt CO₂). Half of the derogations were due to traffic linked to outermost regions (50.8%) and more than one third was linked to the small islands derogation (37.2%). Derogations related to ice-class ships amounted to 11,6%, while derogations for PSC/O were

³⁴⁵ Mikko Heikkilä, Tiia Grönholm, Elisa Majamäki, Jukka-Pekka Jalkanen “Effect of ice class to vessel fuel consumption based on real-life MRV data”, Transport Policy, Volume 148, 2024

³⁴⁶ RICARDO’ study on the opportunities of the green transition for shipping (forthcoming)

negligible. Considering the average price of EU allowances in 2024 (EUR 65 per allowance³⁴⁷ in 2025) and the application of the phase-in approach (surrendering obligation for 40% of the verified emissions in 2024), it can be estimated that these derogations lead to a cost exemption of around EUR 126 million in 2024 for shipping companies, EUR 64 million due to OMR and EUR 47 million to SIP. Once shipping companies have to surrender allowances for 100% of the verified emissions, the revenues forgone will amount to approximately EUR 320 million, approximately EUR (165 million due to OMR and some EUR 120 million due to SIP).

Table 6: Derogations in 2024 by ship type

Ship type [kt CO ₂]	OMR	SIP	ICS	PSC/O	Total	Share
Ro-pax ship	737	1,795	95	16	2,643	54.4%
Container ship	1,001		119		1,120	23.1%
Passenger ship	220	13	5		239	4.9%
Ro-ro ship	131		67		198	4.1%
Oil tanker	81		50		131	2.7%
Chemical tanker	72		57		129	2.7%
General cargo ship	20		76		96	2.0%
Other ship types	45		24		69	1.4%
Container/ro-ro cargo ship	46		13		60	1.2%
Refrigerated cargo carrier	58		1		59	1.2%
LNG carrier	1		42		43	0.9%
Vehicle carrier	25		5		31	0.6%
Bulk carrier	19		0		19	0.4%
Cruise Passenger ship	11		5		16	0.3%
Gas carrier	0		3		4	0.1%
Combination carrier			0		0	0.0%
Offshore						
Total	2,469	1,808	563	16	4,856	100%

³⁴⁷ German Emissions Trading Authority (DEHSt) at the German Environment Agency. (2025). German auctioning of emission allowances - Annual report 2024. In D. Lewandrowski & N. Pauly (Eds.), *German Auctioning of Emission Allowances*. https://www.dehst.de/SharedDocs/downloads/EN/auctioning/2025/2025_report_Q4.pdf?__blob=publicationFile&v=2

Share	50.8%	37.2%	11.6%	0.3%	100.0%	

Source: EMSA, Oeko's calculations

In terms of ship types, Ro-pax ships (54%) and container ships (23%) profited the most from the derogations. For all other ship types the share of total derogations was below 5% and for most types even much smaller.

In terms of ship size, more than half of the derogations went to medium sized ships (from 5 000 to 24 999 GT), while large sized ships received one third of the derogations. Very large ships (> 75 000 GT) only received 11.5% of total derogations. The number of ships that benefitted from existing derogations is also unevenly distributed among the size categories with 71% of the ships which received derogations being medium sized, 21% being large and 8% for the very large ships.

While the OMR derogation accounted for half of the total derogations in terms of tCO₂, only around 30% of the ships who received derogations, received them due to OMR. Conversely, derogations for ICS were much lower in terms of emissions (12% of the total derogation) but more than two thirds of the ships which received derogations, received them due to their ICS status.

Summary of stakeholder views from the OPC

Through the position papers as part of the OPC, 14 stakeholders (out of which 8 were from maritime industry/associations, the rest from NGOs and public authorities) supported extending derogations for routes serving outermost regions, islands, and peripheral territories. Nine stakeholders (out of which 6 were from maritime industry/associations) recommended targeted exemptions for specific vessel types, including Ro-Pax, Ro-Ro, ferries, and vessels under public service contracts, alongside compensatory mechanisms where needed.

4.2. Policy measures

Policy measure DE0: Not extending the derogations:

All present temporary derogations related to ice-class ships, outermost regions, small islands and PSC/PSO stop as from 2031.

Policy measure DE1: Extension of derogations for a limited time: Extension of existing derogations for a limited time (e.g. until 2035) within the ETS.

4.3. Assessment of the measures

4.3.1. Environmental impacts

4.3.1.1. Policy measure DE0: Not extending the derogations

Pursuant to the ETS directive, the derogations would end in 2030. Accordingly, additional 4.86 Mt CO₂ would then be covered by the ETS surrendering obligation from 2031 onwards, leading to an increase demand for EU allowances, without an increase of the cap. 2.5 Mt CO₂ would be due to the inclusion of exempted OMR emissions, while 1.8 and 0.6 Mt CO₂, respectively would be due to SIP and ICS emissions. The emissions due to PSC/O would be very small (0.02 Mt CO₂).

The end of the derogations for ice-class ships would also lead to less allowances being cancelled every year (around 0.5 Mt CO₂) per year, counterbalancing somehow the possible positive environmental impact linked to the end of the derogation for ice-class ships.

The end of the derogations would in general reinforce the contribution of the maritime transport sector to EU's climate targets. By exposing operators serving small islands, PSOs, or outermost regions to the ETS carbon price signal, it would encourage greater energy efficiency through operational measures (speed optimisation, route planning, hull maintenance), the use of renewable and low-carbon fuels, electrification or it could accelerate the renewal of older, less efficient vessels.

4.3.1.2. Policy measure DE1: Extension of derogations for limited time

The impact of extending the existing derogations (OMR, SIP, ICS, PSC/O) until 2035 would lead to around 24 MtCO₂ being exempted from the obligation to surrender EU allowances over the period 2031-2035. At the same time, it would lead to the cancellation of around 2,8 MtCO₂ allowances over the same period, as a result of the application of the cancellation mechanism for the ice-class ships derogation.

Over time, the volume of exempted maritime emissions would increase in relative importance, representing a growing share of the ETS cap increase linked to the ETS maritime extension.

From an environmental point of view, the extension of the present derogations could slow down the green transition of shipping on certain routes and hinder the achievement of the EU 2050 climate objectives. Shipping companies would continue facing no financial incentive to improve energy efficiency or adopt low-carbon solutions.

4.3.2. Economic impacts

These policy measures could have different economic impacts. They could change the compliance and operating costs for individual companies, and they could affect the revenues from the auctioning of EUAs.

4.3.2.1. Policy measure DE0: Not extending the derogations

Not extending the derogations beyond 2030 would increase the cost for shipping companies as it would increase their surrendering obligations by around 5 million EUAs. The impact on shipping companies would vary with factors such as route coverage, carbon price, distance, ship type, and fuel efficiency, but all operators currently benefiting from derogations would face higher ETS compliance costs once this end. Given these additional burdens, DE0 would likely result in slight increase transport prices for the end consumers, especially affecting small islands and outermost regions that rely heavily on maritime links. In addition, the higher compliance burden may have a detrimental effect on the viability of services on niche routes, in case companies face challenges to reduce their emissions and cannot pass through the costs.

Ending derogations would generate limited extra ETS revenues, linked to the end of the cancellation mechanism for the ice-class ships derogation. Member States could mitigate some of the economic impacts induced by the end of derogation by allocating part of their ETS revenues specifically to support the decarbonisation of maritime links serving islands and outermost regions. This targeted reinvestment could reduce cost impacts, improve the resilience of local economies and ensure that the transition contributes directly to cleaner, more efficient transport in these regions.

The competent authorities face modest additional administrative burdens, primarily related to verifying compliance through allowance surrender and enforcement activities. This is because MRV for maritime emissions is already required due to the MRV regulation.

4.3.2.2. *Policy measure DE1: Extension of derogations for limited time*

Policy measure DE1, as the opposite of DE0, would generate identical economic effects but in reverse, and no increase in ETS revenues. For ice-class ships, extending derogations would help preserve affordability on icy northern routes and contribute to limit public icebreaking costs, which in Finland alone amount to EUR 35–60 million annually. It would also allow operators serving small islands and outermost regions to continue avoiding ETS compliance costs, supporting route viability and giving more time to deploy OPS, bunkering infrastructure, and energy-efficient vessels. DE1 would further help contain short-term inflation in island economies and support regional cohesion.

However, under DE1 shipping companies would lack financial incentives to cut GHG emissions until 2035, making efficiency improvements, the use of low-carbon fuels, and electrification less attractive. This may lock operators into fossil-fuel-based fleets and delay clean-energy port investments. Overall, prolonged derogations risk slowing climate action and increasing long-term decarbonisation costs in the affected regions.

4.3.3. *Social Impacts*

4.3.3.1. *Policy measure DE0: Not extending the derogations*

Outermost regions and small islands depend on reliable and frequent maritime transport services. Changes in transport cost may hamper the connectivity of these regions and thus impact the access to essential services such as healthcare, education and employment, inducing implications for the quality of life or impact tourism flows.

At the same time, fuel prices have already fluctuated significantly in the past and the carbon price signal could have an effect comparable to the cost impact of fuel-price volatility. Based on data from the IEA on bunker fuel prices the standard deviation in the period October 2020 to September 2025 was 35%. Even before the COVID pandemic (January 2014 to December 2019) the standard deviation was 28%. Given a fuel price of EUR 500 per tonne of fuel, this is equivalent to EUR 175/140 per tonne of fuel or an allowance price of approximately EUR 56/45 per EUA. Even though the current allowance price is higher than the standard deviation of fuel prices, the difference between the lowest and highest fuel prices is higher than then current EUA price of approximately EUR 70-80 per EUA. Still, removing derogations would mean that sudden increases in fuel or carbon prices could pose a risk to stable, predictable maritime connectivity for these EU regions.

For the connectivity of small islands and outermost regions, this cost increase could undermine the affordability and frequency of maritime links. These regions already face challenges due to remoteness and limited transport options, and higher shipping costs might discourage both passenger and cargo operators from serving them regularly or at competitive rates. EU's outermost regions are more vulnerable due to significantly longer voyage legs than other intra-EU journeys and, on average, have lower GDP per capita compared to their national and wider EU averages. Increased cost for essential transport services could thus contribute to widen the GDP gap.

Since ensuring connections is essential for small islands and outermost regions, some of the transport services are conducted under public service obligations (PSO). Under these obligations contracted shipping companies have to provide a determined transport service (frequency, capacity, etc.) at a fixed price. Since the price is lower than the cost of supplying

these services, the price gap is closed through public funding pursuant to Council Regulation (EEC) No 3577/92³⁴⁸. Nevertheless, services covered by PSO may not be directly impacted but only in the longer-term if governments might have to reduce the capacity under PSO due to limited budgets.

Shipping is essential for connecting geographically isolated regions, such as islands and remote coastal communities, to their mainland and other major hubs. When it occurs, mobility poverty can perpetuate the core-periphery socioeconomic structure of these regions, leading to a lack of attractiveness, coupled with a poor organisation of transport services and thus, barriers to accessing education and jobs (Maucorps, et al., 2025). Hence, to the extent that additional cost due to the end of derogation pose a risk that service providers might reduce the frequency of their operations or increase prices for passengers and cargo – even in the context of PSOs-, this could possibly have indirect negative impacts on healthcare, education and jobs. It could also increase the pressure to migrate for work or education.

Furthermore, ice class ships are of pivotal importance in facilitating year-round maritime connectivity and supply for regions with ports that experience sea ice or adverse winter conditions. Not continuing ICS derogations could be detrimental for critical logistics and regular services when ice conditions would otherwise prevent conventional vessels from reaching these locations. However, in a recent study³⁴⁹ it was concluded that not all of the assessed ICS ship types have higher annual mean fuel consumption and thus emissions (see above).

While the supply of goods and certain services relies on maritime transport, tourism often relies more on aviation. However, maritime tourism, especially cruise, could also possibly face route changes in order to avoid ETS costs, which may negatively impact specific ports and regional communities. (In addition, ending derogations would expose ships such as Ro-pax, passenger and Ro-ro ships, “which have high average per-vessel emissions within the scope”³⁵⁰. Tourism demand is highly price-sensitive in aviation and moderate in maritime tourism, but the risk of competitive disadvantage is notable for both if cost differentials between EU and non-EU destinations grow. For instance, stakeholders foresee “an additional cost of close to EUR 30 000 for each port of call for large liners in the Caribbean Sea”, which “will reduce the competitiveness of the outermost regions’ cruise and container ship sectors compared to neighbouring territories that do not apply such requirements”³⁵¹. Martinique, for example, “is an expensive place in comparison to neighbouring islands (e.g. Sainte-Lucia, Barbados) that use weaker currencies and apply lower taxes,” leading to reduced attractiveness (Maucorps, et al., 2025).

³⁴⁸ Council Regulation (EEC) No 3577/92 of 7 December 1992 applying the principle of freedom to provide services to maritime transport within Member States (maritime cabotage) Official Journal L 364, 12/12/1992 P. 0007 - 0010

³⁴⁹ Heikkilä, M., Grönholm, T., Majamäki, E., & Jalkanen, J. (2024). Effect of ice class to vessel fuel consumption based on real-life MRV data. *Transport Policy*, 148, 168–180.
<https://doi.org/10.1016/j.tranpol.2024.01.014>

³⁵⁰ CE Delft & DLR 2021, Research for TRAN Committee – Maritime shipping, aviation and the EU ETS: challenges and impacts, Final report, European Parliament, Policy Department for Structural and Cohesion Policies, Brussels.

³⁵¹ Maucorps, A., Martín, J., Dentinho, T., Ranély Vergé-Dépré, C., Picazo Peral, P., & Fortuna, M. (2025). Research for TRAN Committee – Transport and Tourism in Outermost Regions. Brussels: European Parliament, Policy Department for Transport, Employment and Social Affairs.
[https://www.europarl.europa.eu/RegData/etudes/STUD/2025/759311/CASP_STU\(2025\)759311_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/STUD/2025/759311/CASP_STU(2025)759311_EN.pdf)

4.3.3.2. *Policy measure DE1: Extension of derogations for limited time*

If the derogations and specific rules were to continue beyond 2030, the social impacts described in the previous section would not apply. Stakeholders who currently benefit from exemptions would continue to do so, meaning that the situation in the affected regions would remain largely unchanged in terms of traffic patterns, income, connectivity, and related aspects.

5. COHERENCE WITH THE IMPLEMENTATION OF THE GLOBAL IMO MEASURE

5.1. Scoping

To address GHG emissions from international maritime activities globally, the EU has actively supported the adoption of the revised IMO 2023 Strategy as well as of IMO mid-term measures, in particular the Net Zero Framework (NZF). At the Marine Environment Protection Committee (MEPC) 83rd meeting in April 2025, the International Maritime Organization (IMO) reached an agreement on the core elements of its Net-Zero Framework .

In October 2025, the IMO's Marine Environment Protection Committee decided to adjourn discussions on the adoption of the Net-Zero Framework for one year. Whether the IMO NZF is adopted (in its entirety or partially) remains open.

This Impact Assessment acknowledges that the IMO NZF is currently the only agreed IMO mid-term measure, and that no environmentally more ambitious measures are being considered at IMO. A review of the ETS Directive in relation to an IMO mid-term measure is required by Article 3gg, with certain conditions.

This section aims to assess possible measures that would ensure coherence between the implementation of the ETS and the implementation of an IMO mid-term measure, in a way that preserves the effectiveness and environmental integrity of the EU ETS, while maximising their regulatory efficiency (e.g. avoiding any significant double burden).

Drivers to the problem

Several differences between the ETS Maritime and an IMO mid-term measure could lead to possible lack of coherence:

- **System type:** The EU framework combines a cap-and-trade Emissions Trading System with a GHG fuel intensity regulation (FuelEU). The EU ETS provides high certainty of emissions reduction since the ETS cap sets the overall volume of greenhouse gases that can be emitted by installations and operators under the system. However, the emissions reduction under the ETS will happen first in sectors where they are most cost-effective and this is why the EU ETS is combined with a GHG fuel intensity regulation at EU level to support the decarbonisation of shipping. Although no measure is yet adopted at IMO, it is unlikely that a future global measure will include a cap-and-trade system. The measures contemplated so far (such as the NZF) represented a combination of a fuel standard with an economic element.
- **GHG price formation and scope:** Under the EU ETS, every tonne of CO₂e emitted must be matched with an allowance³⁵². Additionally, the price formation in the EU ETS is market-driven and expressed in EUR. The measures considered so far by IMO, involved fixed GHG prices expressed in USD.

³⁵² The favourable treatment (zero-rating) is restricted to emissions stemming from the use of bio-sourced and other types of alternative fuels that are certified compliant with the sustainability requirements of the Renewable Energy Directive (Directive 2018/2001).

- **Enforcement:** Under MARPOL Annex VI, the primary responsibility for implementation and enforcement lies with the Administration of the flag States which ratified and implemented the amendments. Unlike the EU MRV system, the IMO framework sets only basic roles for the IMO Registry and the flag states but does not (yet) provide detailed rules for independent third-party verification. Specific guidelines on reporting and verification of the annual GFI of fuels used by ships are still under development at IMO level.
- **Scope:**
 - The IMO 2023 Strategy considers a well-to-tank (WTW) scope for GHG emissions (carbon dioxide emissions (CO₂), methane emissions (CH₄) as well as nitrous oxide (N₂O) emissions), while the EU ETS considers a tank-to-wake (TTW) scope, with a zero-rating mechanism acting as an incentive to GHG savings resulting from bio-sourced and other types of alternative fuels that are certified compliant with the sustainability requirements of the Renewable Energy Directive (Directive 2018/2001).
 - In terms of geographical scope, the IMO measures apply to 100% of fuel consumed over the calendar year, irrespective of the geographical location of port calls whereas EU ETS applies to 100% of GHG emissions that occur between two EU ports and when ships are within EU ports, but 50% of emissions from voyages starting or ending outside of the EU.
- **Timing:** while the EU ETS applies to maritime transport emissions since January 2024, the current review of the EU ETS is going to set the cap until 2040 along with the Climate Law targets. An IMO measure would not apply (and is implemented) before 2029. Once adopted, an IMO measure will only enter into force, if at least one third of the IMO Member States or Member States, which combined merchant fleets constitutes not less than 50 per cent of the gross tonnage of the world's merchant fleet, does not notify objections to the IMO within 10 months from adoption.
- **Levels of GHG emissions reductions:** The EU has legally committed to reducing economy-wide GHG emissions by at least 55% by 2030, and a 90% reduction (with a domestic target of 85% and up to 5% of international carbon credits) has been agreed for 2040, both relative to 1990 levels. Although there is no formal sectoral target for maritime transport, the sector has been included in the EU ETS, which is expected to achieve a 62% emissions reduction by 2030 compared to 2005 levels, consistent with the broader economy-wide trajectory.
- **Level of participation:** Participation to any IMO mid-term measure implementing the 2023 Strategy, generally, will depend on whether a vessel's flag State has ratified MARPOL convention and specifically Annex VI. Ships registered in the 88 states that have not ratified MARPOL Annex VI account for around 3.3% of the world's merchant fleet by gross tonnage (IMO, 2020). Although port control activities act as an important safeguard, substantial risk would arise if multiple high-volume jurisdictions decide not to implement the IMO mid-term measure, resulting in a significant number of voyages fully excluded from the system at both ends. By contrast, the EU ETS applies, irrespective of flag, ensuring consistent application on the basis of port activity rather than flag State ratification.
- **Risk of low enforceability:** Even with broad legal implementation, enforcement of the IMO mid-term measure will remain decentralised, potentially leading to inconsistencies across jurisdictions. Until the respective guidelines are adopted, there remains uncertainty

about how verification will be conducted in practice across flag States, creating potential inconsistencies in enforcement. However, enforcement in practice will also depend heavily on port States, as they hold direct jurisdiction over vessels calling at their ports.

Beyond the above-mentioned differences, the implementation of an IMO mid-term measure together with the EU ETS and EU maritime MRV, without any changes, could lead to the following inefficiencies:

- **Double administrative burden:** Ships above 5 000GT performing voyages from/to EU ports would have to comply with both the EU ETS and the IMO mid-term measure. In 2024, some 3 300 companies, operating around 13 000 active vessels were subject to compliance under the EU ETS. These figures provide therefore an upper-bound estimate of the number of entities and ships potentially exposed to both policies. Without changes, the application of the EU ETS and the IMO mid-term measure could entail some double regulation, in the sense that a share of the shipping emissions could eventually be subject to GHG pricing under both the ETS and the IMO mid-term measure. In addition, this situation could entail additional administrative burden for companies as they would have to implement two parallel monitoring, reporting, verification obligations. However, to a certain extent, companies already have two separate MRV systems, with the co-existence of the EU maritime MRV and the IMO Data Collection System. These two systems create some additional administrative burden due to e.g. differences in data granularity, verification rules or system design but they also allow for some operational synergies. EU Member States' authorities could also face some additional administrative burden linked to different enforcement rules. This administrative burden dimension is assessed further in the part on simplification.
- **Double financial burden:** to a certain extent, EU legislators intended that a double financial burden exists between the EU ETS and FuelEU. This is namely the case for the most polluting ships not in compliance with FuelEU trajectory that pay a FuelEU penalty for non-compliance in parallel to the EU ETS surrendering obligation. An IMO mid-term measure could add additional burden to ships already subject to FuelEU and ETS maritime without the relationship being clarified. The extent to which there is a double burden will depend on the environmental performance of the vessel and whether the vessel has performed activities eligible under the ETS.

Summary of stakeholder views from the OPC

In the OPC, 107 respondents provided views on the coherence between the EU ETS and a potential IMO global market-based measure for maritime transport. The most frequently cited concern was the need to avoid duplication or double administrative burdens arising from parallel EU and IMO systems (75 mentions), followed by calls for potential harmonisation between EU and IMO measures (70 mentions). 45 stakeholders supported phasing out or replacing the EU ETS with an IMO-based system once operational, while 15 emphasised retaining the EU ETS to maintain environmental ambition and ensure EU leadership on decarbonisation. 8 respondents raised concerns about competitiveness risks such as flagging out or investment diversion, and six supported mutual recognition of compliance mechanisms between the EU and IMO frameworks. A smaller group (3 respondents) called for early coordination and transitional support during any phase-out, and 2 proposed differentiated or simplified rules to reduce administrative burdens for specific vessel types. Overall, stakeholders broadly agreed that the EU should work toward coherence with an IMO global measure while ensuring high environmental integrity and avoiding duplicative costs or regulatory overlap.

5.2. Policy measures

Policy measure IMO: Deduction to avoid a significant double burden for shipping companies when complying with both the EU ETS and an IMO mid-term measure.

This measure proposes to allow for a reduction of the amount of allowances to be surrendered by shipping companies under the EU ETS on the basis of the emissions that are both covered by the ETS and subject to regulation and GHG pricing under a future IMO mid-term measure. Such a deduction would have to meet several criteria to avoid a significant double burden for shipping companies, while safeguarding the environmental credibility of the EU framework. In this context, it would have to be accompanied by the cancellation of an equivalent amount of allowances under the ETS.

This section describes possible design configurations for a potential deduction mechanism, namely in relation to:

- The metric of the deduction mechanism
- The process to determine the GFI to be considered for calculating the amount of emissions to be deducted
- Well-to-wake (WTW) or tank-to-wake (TTW) approach
- Treatment of emissions from fuels that are zero-rated under the EU ETS

5.3. Analysis of design options and their assessment

5.3.1. Metric of the deduction mechanism (Design Option 1)

The IMO mid-term measure and the EU ETS regulate different emissions scopes. They are subject to different price formation mechanisms, which could ultimately lead to different compliance costs for regulated vessels and shipping companies. To avoid significant double burden, two options are analysed regarding the possible deduction of ETS emissions, in case they are regulated and priced under the IMO global measure: with and without a minimum carbon price.

As a first option, the deduction would allow shipping companies to surrender fewer ETS allowances on the basis of the emissions (in tCO₂e) priced both under the IMO mid-term measure and the EU ETS, and independently from the carbon price signal imposed in the IMO. This option would leave to the IMO the responsibility for pricing these emissions and ensure that there is no double regulation in terms of GHG pricing.

A second option would be to allow shipping companies to surrender fewer allowances on the basis of the emissions (in tCO₂e) priced both under the IMO mid-term measure and the EU ETS, but this time with a safeguard mechanism to ensure a **minimum carbon price signal** in line with the EU ETS price. This mechanism would ensure that when GHG pricing from the IMO mid-term measure is lower than the EU ETS average yearly price, the amount of emissions to be exempted is corrected by multiplying it by the ratio between the IMO GHG price and the EU ETS annual average price. This option would still leave to IMO the responsibility for pricing these emissions but it would add a condition to safeguard a minimum carbon price level.

Table 7: Design options for the adjustment mechanism: Metric of the adjustment mechanism

Design option	Advantages	Disadvantages
1a Deduction approach: Adjust the EU ETS surrendering obligation by deducting all the EU ETS scope emissions priced under IMO mid-term measure	Simple, can be incorporated as a derogation in the legislation. It would ensure no double regulation in terms of GHG pricing. It would not involve exposure to the USD-EUR exchange rates.	Risk of excessive derogations if the IMO verification and enforcement processes are not sufficiently robust. Lower compliance costs under the IMO would weaken the incentives of the EU framework to reduce emissions.
1b Deduction as 1 a but taking into account the price difference between the ETS and IMO measure	Same as for 1a, and could prevent IMO price signal from dropping below the EU ETS price, which would weaken the price signal for investors and shipping companies.	Risk of excessive derogations if IMO verification and enforcement processes are not sufficiently robust. The correction mechanism may cause additional administrative costs.

5.3.2. Process to determine GFI to be considered to determine the deduction (Design Option 2)

Determining the amount of emissions subject to both ETS and IMO pricing could require assuming an attained GFI on voyages subject to a double burden. There are several options for obtaining this value.

The first option is to use the attained GFI when reported under the IMO via the company's Statement of Compliance (reported annually). The underlying assumption is that the global GFI also applies to voyages under the EU ETS. Since the global GFI is expected to be higher than EU-specific GFI (due to existing EU decarbonisation policies), emissions/costs eligible for the deduction may be higher, i.e., the deductions could potentially overcompensate shipping companies.

A second option is to use the FuelEU / MRV GFI (based on EU methodology). This would reflect the actual GFI attained on voyages subject to a double burden, relying only on existing EU-specific data. However, different accounting systems between Fuel EU/MRV and IMO may lead to substantial differences with the attained GFI under the IMO rules. In principle, the emissions/costs to be deducted would be smaller, avoiding overcompensation.

Finally, the third option is to simulate the equivalent IMO GFI using data reported through the EU MRV system (but using the IMO methodology to estimate the attained GFI). This would reflect only EU-specific data, and the accounting system would fully match that of the IMO, avoiding different results and overcompensation.

Table 8: Design options for the adjustment mechanism: Process to determine GFI

Design option	Advantages	Disadvantages
2a IMO NZF GFI: Use the attained GFI reported under the IMO via the company's Statement of Compliance	Simple, reduced need for additional administrative steps.	Possible over-compensation if voyages subject to EU ETS requirements operate with cleaner fuels than the vessel's annual, global average. Relying on the IMO NZF

		compliance cycle may also require timeline adjustments of the EU ETS or imply delays in deductions.
2b FuelEU Maritime GFI: Use the FuelEU / MRV GFI	Use of data already available under EU MRV to obtain results specific to voyages subject to EU ETS.	Potential differences in the GHG calculation methods under EU ETS and IMO NZF could lead to over- or underestimating the portion of IMO NZF compliance costs attributable to voyages also subject to the EU ETS
2c Simulated GFI: Simulate the equivalent IMO GFI using data reported through the EU MRV system	Precise estimates of the incurred double burden on voyages subject to both frameworks.	Distinct reporting requirements under EU MRV for FuelEU Maritime and EU ETS for voyages between ports in and outside the EU may result in misalignment of estimates. ²⁴

5.3.3. Well-to-wake (WTW) or tank-to-wake (TTW) approach (Design Option 3)

A key difference between the IMO mid-term measures implementing the 2023 Strategy and the EU ETS is that the IMO 2023 Strategy refers to Well-to-Wake (WtW) emissions, while the EU ETS only considers tailpipe emissions (tank-to-wake, TtW). There are two options for accounting for this difference in the design of the IMO deduction measure:

- deduct from the surrendering obligations emissions priced under both the EU ETS and the IMO mid-term measure, based on TtW emissions.
- deduct from the surrendering obligations emissions priced under both the EU ETS and the IMO mid-term measure, based on WtW emissions.

Table provides an overview of both options and their advantages and disadvantages.

Table 9: Design options for the adjustment mechanism: Well-to-wake (WTW) or tank-to-wake (TTW) approach

Design option	Advantages	Disadvantages
3a TTW: Only the proportion of TTW emissions falling under IMO can be deducted	Ensures better alignment with the scope of emissions under the EU ETS maritime transport extension.	Requires recalculating the attained GFI value to reflect only TTW emissions. Does not reflect the fact that some upstream emissions linked to the production of marine fuels in the EU could also fall under the scope of the ETS.
3b WTW: All emissions (on a WTW basis) falling under IMO can be deducted	Simple approach. Compatible with 3a. Ensures better alignment with the double burden perceived by shipping companies. Reflect the fact that some upstream emissions are also covered under the EU ETS linked to the production of marine fuels.	This option could lead to overcompensation as the adjustment mechanism would apply to WTT emissions, which are not necessarily subject to the EU ETS and therefore face no double burden.

5.3.4. Treatment of emissions from fuels that are zero-rated under the EU ETS (Design Option 4)

An additional aspect of the deduction closely related to the process to determine the attained GFI is how to treat emissions from fuels that are zero-rated under the EU ETS, meaning that they do not incur ETS compliance requirements. By contrast, these fuels may not be zero-rated under an IMO mid-term measure and their use may count into the attained GFI of a vessel. There are two options on how to treat compliance costs related to these fuels in the deduction.

The first option is to discount IMO compliance requirements arising from the use of fuels zero-rated under the EU ETS when determining the applicable deduction, as the absence of EU ETS requirements for these emissions means that there is no double burden.

As second option, the deduction could also account for emissions from fuels that are zero-rated under the EU ETS, meaning that these fuels would still be considered within the deductible even though they are not subject to double charging.

Table 10: Design options for the adjustment mechanism: Treatment of emissions from fuels that are zero-rated under the EU ETS

Design option	Advantages	Disadvantages
4a Discount emissions from zero-rated fuels from deductible: The portion of emissions from zero-rated fuels is not eligible for deduction	Avoid compensation for IMO compliance costs related to emissions that are not subject to a double burden.	Requires detailed information on the fuel use of a vessel to calculate the share of emissions from fuels zero-rated under the EU ETS, available from EU MRV.
4b Include emissions from zero-rated fuels in deductible: The portion of emissions from zero-rated fuels is eligible for deduction	Simple approach. Compatible with 3a. Provide additional incentives to deploy fuels that are zero-rated under the EU ETS.	Leads to overcompensation as the adjustment mechanism would cover a portion of emissions not subject to the double burden.

5.4. Economic analysis

5.4.1. Configuration of deduction design variations

Based on the deduction design variables presented above, four distinct variations of the deduction design were defined for further assessment. The variable selection of the four variations reflect their expected capacity to perform against the objective of the deduction, i.e. to reduce any significant double burden faced by shipping companies for compliance requirements under any IMO mid-term measure and the EU ETS related to emissions that fall under the scope of both systems.

Table 11: Variations of the deduction to be assessed

Variant	1. Metric	2.Process to determine GFI	3. TtW vs WtW	4. ETS zero-rated emissions
IMO0 No adjustment mechanism	n/a	n/a	n/a	n/a
IMO1-a Deduction	1b	2c Simulated GFI or 3a IMO NZF GFI	3b: WtW	4b Included

approach – Price corrected (WTW)				
IMO1-b Deduction approach – Price corrected (TTW)	1b	2c Simulated GFI or 3a IMO NZF GFI	3a: TtW	4b Included

The selection for design option 1 faces a trade-off between administrative burden and the risk of weakening the resulting carbon price signal. The deduction approach (1a) may lead to excessive pricing risk if IMO carbon pricing is lower than the EU ETS price. Based on these grounds, the price-corrected deduction approach (1b) would be the preferred option. For design option 2, option 2c or option 2a appear preferable as they avoid possible differences between the GFI calculations of FuelEU and IMO. For selecting design option 3, TtW (3a) may be preferable, because it is aligned with the EU ETS scope, however the WtW approach (3b) is chosen as it is likely to have a higher acceptability, higher deduction from EU ETS and imply less of administrative burden. For design option 4, option 4b was chosen, as including emissions related to fuels that are zero-rated under the EU ETS would be easier to implement and provide additional incentives to support their deployment.

5.4.2. Administrative costs

In addition to direct compliance costs, implementation of an IMO mid-term measure would generate additional administrative costs, as various actors, including shipping companies and administrators, would be required to undertake additional reporting, verification and compliance-related activities. In some cases, these activities would overlap with processes already required under the EU ETS or the EU maritime MRV, thereby creating a double administrative burden in case there is no potential synergies with existing processes. See the section on simplification for a comparison of the processes and options to simplify and align them.

5.4.2.1. ETS revenues

The application of the cancellation mechanism accompanying the IMO deduction measure would lead to reduced ETS revenues. The scope of this reduction will depend on the stringency of the IMO mid-measure and the use of fuels by ships subject to this measure.

5.5. Environmental impacts

The introduction of a deduction mechanism is intended to reduce the additional compliance burden created by the overlap between the EU ETS and a possible future IMO mid-term measure. By lowering the effective compliance costs for vessels subject to both systems, the mechanism aims to prevent double charging of emissions. However, this raises questions regarding its potential impact on environmental integrity. In practice, the cancellation of allowances that would accompany the deduction mechanism would address such a risk.

The deduction mechanism (with the price safeguard system) would not lead to a substantial reduction in the total carbon price faced by operators, since the reduction in ETS carbon price signal would be compensated by the carbon price signal coming from the IMO mid-term measures. Therefore, it would not weaken the economic incentive to abate emissions or invest in low- and zero-carbon technologies and operations.

Overall, the mechanism primarily affects the distribution of compliance costs across regimes, without measurable effects on total abatement levels or the strength of decarbonisation incentives.

5.6. Social impacts

Since the measures considered in this chapter are replacing EU ETS payments with IMO contributions, no social impacts are expected beyond those identified in the general report.

6. ETS OR MRV AS A SERVICE

6.1. Scoping

To help achieving the global emission reductions to meet the 1.5 degrees target of the Paris Agreement, the EU engages with countries outside the EU to promote the green transition and the development of carbon pricing and carbon markets worldwide.

The EU has been at the forefront of shipping decarbonisation, adopting in 2015 its own system to Monitor, Report and Verify emissions from maritime transport activities (EU MRV), thereby applying reporting requirements for large ships calling at EU ports already in 2018. Building on eight years of experience under the MRV Framework, the EU can share its knowledge and IT tools with third countries interested in developing their own MRV, as a first step to collect robust verified emissions data to inform policy measures to decarbonise the sector.

From 2024, the EU ETS system has applied to large ships calling at EU ports, irrespective of the flag they fly. Especially, in the event that the IMO market-based measure is not applied, to promote the adoption of consistent carbon pricing mechanisms in non-EU countries, the EU could offer the EU MRV/ETS as a service and contribute to standardised administrative procedures and stable stream of revenues to decarbonise shipping.

6.2. Policy measures

Policy measure 1 (PM1): “Offer the use of EU MRV implementation tools and expertise to non-EU countries”: it would allow third countries to use EU MRV implementation tools and procedures for the implementation of their own MRV system, where appropriate with regard to costs. Third countries could:

- Have access to the IT system THETIS-MRV developed by the European Maritime Safety Agency (EMSA) for the implementation of EU MRV requirements. The IT system could be updated with the introduction of dedicated user function for the authorities of non-EU countries, so that shipping companies could report once through the same system.
- Benefit from technical support from EU authorities, Member States, and agencies in developing their own national MRV system, including through exchange of best practices and capacity building support, with the objective of maximising synergies across EU and non-EU MRV systems.

This measure would lead to considerable resource savings for third countries, while enhancing the coherence and harmonisation of different MRV systems for maritime, thus supporting the emergence of coordinated regional approaches, which would ultimately reduce administrative burden for shipping companies operating internationally.

Policy measure 2 (PM2) “MRV/ETS as a service - Extending the MRV/ETS scope to widen carbon pricing”: to use existing infrastructure to benefit third countries from having their 50% share of maritime transport emissions from voyages to/from EEA ports directly in the ETS, with their share of revenues from carbon pricing going directly to them (‘fair share’

approach). This is an alternative to third countries establishing their own distinct MRV/ETS, by which the EU would use its tools and capabilities for the MRV/ETS implementation affecting the share of maritime transport emissions outside the current EU ETS scope i.e. the 50% not covered by EU ETS currently. As a result, the 50% revenues from the third countries' share of emissions would go directly to third countries to finance green transition.

This approach would involve amending the ETS Directive, to adjust the ETS scope to implement this approach for specific third countries not covered under the current scope. Such an extension could rely on the data currently reported under EU MRV, which requires since 2018 the reporting of 100% of emissions for extra-EEA voyages. As in the current EU MRV, emissions between two non-EEA ports and within non-EEA ports would not be covered.

Policy measure 3 (PM3) “EU ETS as a facilitator - facilitating the establishment of carbon pricing mechanisms for shipping in third countries by sharing tools or experience”:

The EU could help third countries to establish their own national ETS or GHG levy for shipping. PM1 offering the use of MRV implementation tools is included in PM3. PM3 includes sharing ETS implementation knowledge and EU experience, with the view of implementing carbon price mechanism with harmonised procedures and stream of revenues to support shipping decarbonisation. PM3 could lead to third countries who established their own ETS or GHG levy for shipping to link up with the EU maritime ETS. Each ETS would cover its respective emissions, thereby generating revenues for each separate ETS system. Emissions between two non-EEA ports and within non-EEA ports would be covered in this option as well. In the case of candidate countries, they could be fully integrated in the EU ETS, without the need to establish national ETS system for maritime before completion of accession. Emissions between two non-EEA ports and within non-EEA ports would be covered in this option as well.

6.3. Assessment of policy measures

6.3.1. Economic impacts

PM1 which aims at giving access to EU MRV tools and procedures to third countries for their own system would lead to minimal positive economic impacts. It would lead to harmonised MRV standards, easier processes for shipping companies through harmonised platforms, and knowledge sharing.

PM2 is expected to lead to positive economic impacts for EU ports, through an increased level playing field in the sector. There would also be no new monitoring requirements for shipping companies in terms of MRV. However, shipping companies would need to report separately the amounts of emissions linked to voyages between the EU and related third countries.

PM3 is also expected to lead to positive economic impacts. Candidate countries joining the ETS would lead to an increased cap and thus generate more revenues. It would also help address potential risk of evasion and carbon leakage.

6.3.2. Environmental impacts

This analysis considers emissions for Montenegro, Albania, Moldova, Ukraine and Georgia. The emissions analysis for these countries draws on port-call data for vessels above 5,000 GT within the scope of the EU ETS. Using shortest-route distances and ship-type specific CO₂ intensity curves derived from MRV data (tonnes of CO₂ per NM per DWT), all voyages were classified into three categories with the following rules:

- ‘Country ↔ World’ are treated and added as Inbound/Outbound voyage (meaning that 50% of emissions are to be considered)

- ‘Country ↔ EEA’ are subtracted from the old Inbound/Outbound totals and added to Intra-EEA voyages (100% of the emissions are to be included)
- ‘Intra country’ voyages are added to Intra-EEA voyages totals (100% of the emissions are to be included).

The results, as shown in the table below, indicate that the five candidate countries would collectively add approximately 1.13 Mton of CO₂ emissions to the EU MRV scope. Ukraine accounts for the largest share (70%), followed by Georgia (12%) and Albania (11%), while Montenegro contributes 6% and Moldova’s share is under 1%.

Table 12: Estimated CO₂ emissions (tons) for selected candidate countries, based on 2024 port-call data (MRV scope)

Route category	Montenegro	Albania	Moldova	Ukraine³⁵³	Georgia	Total CO₂ (Tonne)
Country ↔ World	19,555	59,264	1,635	1,358,488	191,467	1,630,408
Country ↔ EEA	138,739	225,613	642	341,322	107,055	813,372
Intra-Country voyages		349		43,487	1,167	45,002
Within port emissions	9,537	17,185	137	105,033	18,056	149,949
Total	167,831	302,410	2,415	1,848,330	317,745	2,638,731
%	6%	11%	0%	70%	12%	100%

Source: EMSA’s estimates and calculations

Depending on the design of the policy measure, environmental impacts may vary. Policy measure 1 of offering the use of EU MRV implementation tools to a third country is not expected to lead to significant emission reduction on the short-term.

Policy measure 2 of extending the scope of GHG emissions under the ETS to match the current MRV coverage and cover the 50% of extra-EEA emissions not covered under the current scope of ETS (i.e. voyage emissions from the candidate country ports to EEA ports) is expected to lead to positive environmental impacts. Based on 2024 estimated emissions, this approach would add to the EU ETS scope 0.41 MtCO₂ (i.e. 50% of 813,372 tCO₂) from the voyages between EEA ports and candidate country ports (see Table 12).

Policy measure 3 application to candidate countries would lead to represent an estimated increase of only 1.51% (i.e. around 1.42 Mt CO₂) to the emissions currently under EU ETS scope, resulting from the addition of emissions both from international voyages starting or ending from the ports of candidate countries (i.e. 50% of 2,443,780 tCO₂), emissions from voyages between ports of the candidate country (i.e. 45,002 tCO₂ as in Table 12) and from emissions within the ports of those candidate countries (149,949 tCO₂ as in Table 12). Overall, these figures indicate that incorporating emissions from these five countries would have a very

³⁵³ Estimated CO₂ emissions for Ukraine are based on 2019 port-call data, to adjust for the disruption of activity levels determined by the Russian war of aggression since 2022.

limited impact on the functioning of the EU ETS for maritime transport, while having a strong positive environmental impact by addressing candidate countries' fair share of emissions.

Table 13: CO₂ emissions (ktons), under EU ETS from selected candidate countries (PM3)

Route category	Emissions under EU ETS 2024	Emissions under EU ETS 2024 (with selected candidate countries)	% increase
Extra-EU voyages	50,700	51,109	0.81%
Intra-EU voyages	34,700	35,558	2.47%
Within port emissions	8,200	8,350	1.83%
Total	93,600	95,017	1.51%

Source: MRV 2024 data provided by EMSA

6.3.3. Social impacts

PM1 is not expected to lead to any social impacts. PM2 and PM3 are expected to lead to some positive social impacts. With revenues from ETS, governments could support the decarbonisation of their economy, leading e.g. to job creation, greater resilience, or reduced energy bills.

7. INCLUSION OF EMISSIONS FROM SHIPS BELOW 5000 GROSS TONNAGE

7.1. Scoping

The ETS Directive requires the Commission to examine³⁵⁴ the feasibility and economic, environmental and social impacts of including smaller vessels (400-4,999 GT) in the ETS by no later than 31 December 2026. Since 2025, the EU MRV Regulation has been expanded to cover both general cargo vessels between 400 and 4,999 GT and offshore ships of and above 400 GT as these vessel categories are the top emitters within this segment.

Vessels between 400 and 4,999 GT calling at EU ports in 2023 emitted around 19 MtCO_{2e} under the MRV scope, compared to a total of 126.7 MtCO_{2e} reported under MRV in the same year. This means that smaller vessels account for approximately 15% of total CO_{2e} emissions reported under EU MRV in 2023. Smaller vessel categories currently included in MRV³⁵⁵ represents 6.1% of total emissions, the categories currently included under MRV but only as large vessels above 5,000 GT represent 5.8% of total emissions, and categories completely exempted from MRV accounts for 2.9% of total emissions. Excluding these GHG emissions from the scope of the EU ETS (in the absence of other similar regulatory or carbon pricing measures) means that this market segment is not properly internalising its climate impacts. This is also problematic given that low and zero carbon technologies and fuels are often piloted and implemented first in smaller vessels.

³⁵⁴ The analysis for the ETS scope builds on the report from the Commission assessing the potential inclusion of additional smaller ships under the scope of the EU MRV Regulation published in March 2025: https://climate.ec.europa.eu/document/download/dc0e2810-b32c-4366-86d5-9b7ef97ad785_en?filename=Review%20of%20the%20EU%20maritime%20MRV%20regulation%20on%20the%20possible%20inclusion%20of%20smaller%20ships.pdf

³⁵⁵ Smaller (400–4999 GT) General Cargo and Offshore vessels, included in the scope from 2025. The supporting study to the Report referred to in footnote no.54 contains further details on the contribution to total emissions by vessel type.

The use of operational energy efficiency measures or the uptake of low and zero carbon fuels in smaller vessels is not being incentivised by the global policy framework as smaller vessels above 400 GT but less than 5,000 GT are excluded from relevant instruments³⁵⁶ at IMO level.

It is to be noted though that several EU Member States have already taken measures to decarbonise smaller vessels segment, including for instance taxation-related measures or voluntary ‘opt-ins’³⁵⁷ within the ‘ETS2’ for buildings, road transport and additional sectors e.g. for fishing, leisure boats or inland navigation³⁵⁸. However, these ETS2 voluntary “opt-ins” would not necessarily overlap with an extension of the EU ETS to smaller vessels considering that they presently either focus on inland navigation or exclude commercial navigation. Including smaller vessels under ETS2 would present both potential benefits and drawbacks. On the one hand, it would significantly expand the share of maritime greenhouse gas emissions subject to carbon pricing against a minimal administrative burden for shipping companies, as the compliance obligations, including reporting or verification tasks, would be placed on fuel suppliers. Furthermore, an extension under ETS2 would close the current policy gap on EU carbon pricing for smaller vessels, ensuring fair treatment across the sector while supporting the uptake of low- and zero-emission technologies in a segment which is often used to test and demonstrate new technologies before they are adopted by larger ships. On the other hand, including smaller vessels under ETS2 may bring implementation challenges with respect to bunkering activities, in terms of evasive practices and because of the need to differentiate bunkering tariffs depending on a ship’s gross tonnage.

Summary of stakeholder views from the OPC

Through the OPC, stakeholders shared views on the inclusion of smaller vessels in EU ETS Maritime provisions. Among 189 respondents, 26 (14%) strongly agreed and 31 (16%) rather agreed with the extension, 30 (16%) were neutral, 23 (12%) rather disagreed, 19 (10%) strongly disagreed, and 60 (32%) indicated “do not know”. Supporters highlighted that this vessel segment represents a significant share of emissions and is already largely covered under MRV rules. Some respondents suggested phased inclusion, simplified MRV reporting for small vessels, and using revenues generated to fund maritime decarbonisation measures. Concerns were raised regarding potential negative impacts on outermost regions, including route diversion, higher costs and competitive disadvantages.

7.2. Policy measures

Policy measure MSS1: Extension of the scope of the EU ETS to include ship categories emitting the most among small ship categories

This measure prioritises those categories of smaller vessels under the MRV with the highest contribution in terms of GHG emissions with the aim to optimise the trade-off between

³⁵⁶ Such as the Carbon Intensity Indicator and monitoring and reporting of fuel oil consumption data through the IMO Data Collection System.

³⁵⁷ Following Article 30j of the revised EU ETS Directive, Member States may opt to include under the scope of ETS2 fuel used by the shipping sector that is not already covered by ETS1 obligations (such as for inland waterway navigation and/or for small vessels not included in ETS1). However, in such a case the requirements to monitor, report and surrender emission allowances would not fall on ship operators but on fuel suppliers.

³⁵⁸ Austria would cover emissions from fuels used to propel water-borne vessels, including hovercraft and hydrofoils, but excluding commercial activities on the Danube River and on the international lakes (Constance and Neusiedl). The Netherlands would cover emissions from fuels used to propel water-borne vessels on inland waters, including hovercraft and hydrofoils, but excluding fishing vessels. Sweden intends to cover emissions from fuels used in leisure boats, excluding commercial waterborne navigation, and from fishing related fuel use. Finland would cover emissions from fuels used to propel water-borne vessels, including hovercraft and hydrofoils, but excluding commercial navigation.

bringing additional GHG emissions under ETS scope and administrative costs. The top emitting categories considered for the extension under this measure would be: general cargo, offshore vessels, tankers, RoPax ships and passenger ships, between 400 and 4 999 GT. Under this measure, a total of 5 455 new vessels would be added to the scope, corresponding to 1 171 new shipping companies brought under the EU ETS.

Policy measure MSS2: Extension of the scope of the EU ETS to all vessel types under MRV, plus fishing vessels and non-commercial yachts

This measure foresees the expansion of the EU ETS scope to all ships between 400 and 4 999 GT falling under the categories currently under MRV (i.e. all ships transporting cargo or passengers for commercial purposes as well as offshore ships), plus fishing ships and non-commercial yachts. This scenario maximises the coverage of GHG emissions among smaller vessels. Under this measure, 7 638 new vessels would be covered, representing 2 312 new companies newly subject to the ETS obligations.

7.3. Assessment of policy measures

7.3.1. Environmental impacts

Emissions under ETS scope

The extension of the EU ETS to smaller vessels under the policy measures under consideration would increase the amount of GHG emissions under the EU ETS scope, as detailed in the table below³⁵⁹. Policy measure MSS1 would capture around 11.3 MtCO_{2e} (13.2% of in-scope ETS CO_{2e} emissions³⁶⁰), while policy measure MSS2 would capture 14.6 MtCO_{2e} (17% of ETS in-scope CO_{2e} emissions)³⁶¹. MSS2 would for instance address the significant climate impact of yachts, characterised by high-carbon intensity operational profile.

Table 14: GHG emissions from vessels between 400 and 4999 GT in 2023 under the geographical scope of the EU ETS (i.e. 100% of intra-EU and at berth emissions and 50% of extra-EU emissions, considering potential derogations) and under the extension of the scope of the EU ETS to all non-exempt categories of small vessels plus fishing vessels (MSS2)

Vessel type ^[1]	In-scope GHG emissions from smaller vessels (MtCO _{2e})	Share of in-scope EU ETS emissions	Number of vessels
General cargo	3.37	3.9%	2,296
Offshore	3.13	3.6%	921
Miscellaneous - fishing	2.11	2.5%	1,065
Chemical tanker	1.94	2.3%	756

³⁵⁹ For the purposes of this analysis, the EU ETS geographical scope (100% of intra-EU and 50% of extra-EU emissions) was applied to total emissions from smaller vessels in 2023 as per Marine Benchmark data. The analysis also factored in the share of emissions subject to ETS derogations per vessel type as per THETIS-MRV data, assuming similar shares for smaller vessels would apply. A set of assumptions was required to align the categories presented in the Marine Benchmark data with those of the MRV. For instance, the MRV category “Passenger ships” was considered to comprise the analysis categories “Cruise” and “Passenger-only ferries”.

³⁶⁰ Total in-scope emissions under EU ETS for 2023 were estimated at 86 MtCO₂, considering derogations.

³⁶¹ The difference in terms of in scope EU ETS GHG emissions brought under scope between MSS2 and MSS1 is due to the exclusion under MSS1 of the types Miscellaneous – fishing (2.11 MtCO_{2e}), Yacht (non-commercial) (0.72 MtCO_{2e}), Bulk carrier (0.22 MtCO_{2e}), Refrigerated bulk (0.09 MtCO_{2e}), Container (0.08 MtCO_{2e}), Other liquids tankers (0.09 MtCO_{2e}), Ro-Ro (0.03 MtCO_{2e}).

Ferry-RoPax	1.22	1.4%	571
Yacht (non-commercial)	0.72	0.8%	896
Cruise	0.52	0.6%	217
Liquefied gas tanker	0.38	0.4%	143
Oil & Product tanker	0.36	0.4%	256
Ferry-pax only	0.32	0.4%	253
Bulk carrier	0.22	0.3%	111
Refrigerated bulk	0.09	0.1%	53
Container	0.08	0.1%	38
Other liquids tankers	0.09	0.1%	42
Ro-Ro	0.03	0.0%	20
Total	14.60	17.0%	7,638

Source: Commission analysis based on AIS data from Marine Benchmark

Note [1]: vessel categories shown in the table are the categories provided by Marine Benchmarking.

GHG emissions savings

Direct environmental impacts of measure MSS2 in terms of GHG emission reduction, fuel mix, energy efficiency were modelled in PRIMES-Maritime. Results from MSS2 (All_SV scenario)³⁶² are compared against the default policy scenario that keeps the current EU ETS scope (i.e. no ETS extension to small ships)³⁶³.

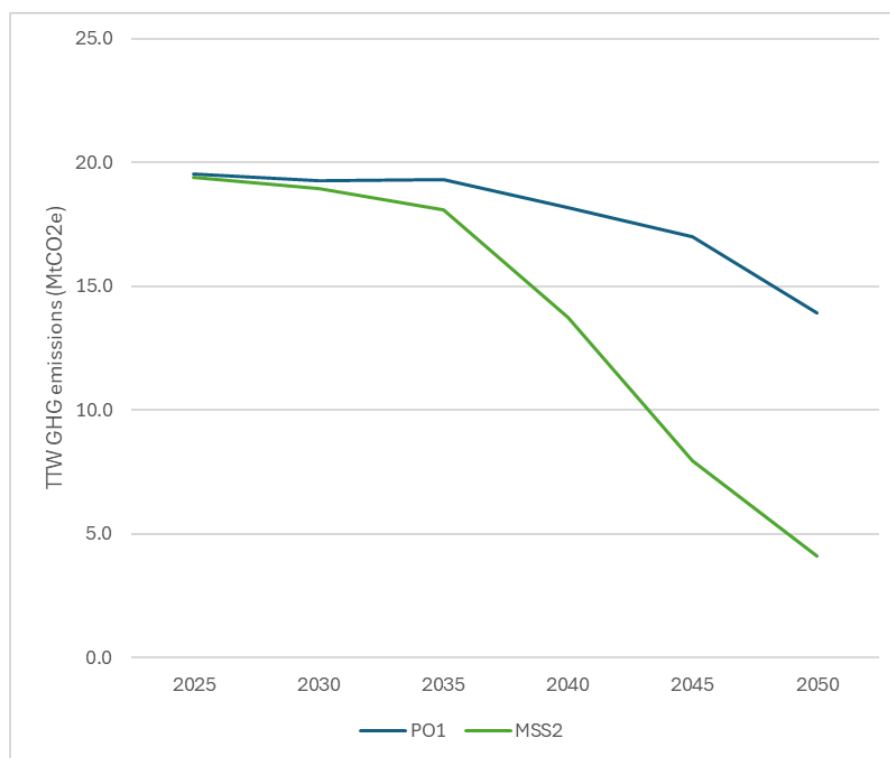
Under the default policy scenario PO1 (i.e. current EU ETS scope without changes insofar smaller vessels), GHG emissions from smaller vessels are expected to decrease by 28% over the period 2030-2050, from around 19.3 MtCO₂e in 2030 to 13.9 MtCO₂e in 2050. In the absence of smaller vessels inclusion under EU or global climate policies the main driver of such a decrease are the energy efficiency improvements in the sector, combined with the availability and therefore lower costs of low carbon fuels driven by the regulatory pressure applied in the larger vessel segment. The adoption of policy measure MSS2 would lead to a further reduction in GHG emissions, particularly from 2035 onwards, leading to 4.1 MtCO₂ of residual GHG emissions in 2050, which would amount to a 79% reduction on 2030 levels. This is mostly driven by a significantly higher uptake of low carbon and renewable fuels incentivised by the ETS price signal in the segment.

The resulting emissions trajectories and impacts on GHG emissions from smaller vessels are shown in Figure 4 and Table 15 below.

³⁶² All_SV MSS2 represents the extension of the EU ETS to smaller vessels, applied on top of the default policy scenario.

³⁶³ Impacts from measure MSS1 were not modelled in a dedicated scenario, but they are not expected to substantially deviate from those of MSS2. Impacts from MSS1 would be slightly lower (both in terms of GHG emission reductions and cost impacts) as the extension to most emitting categories in MSS1 already covers 79% of total GHG emissions that would be added for MSS2. It can be assumed that GHG emission reductions from MSS1 would be approximately 79% of those of MSS2. GHG emission savings in MSS1 are modelled alongside other measures included in PO2.

Figure 4: GHG emissions trajectory (emissions measured as MtCO₂e) for the extension to smaller vessels (MSS2) compared to the default policy scenario (PO1)



Source: PRIMES-Maritime modelling. Smaller vessels (i.e. between 400 and 5000 GT) in scope are those included in MSS2.

Table 15: Impacts from measure MSS2 on GHG emissions (in MtCO₂e) of smaller vessels

Scenario	Indicator	2030	2040	2050	Total 2030-2050
Baseline (PO1)	GHG emissions (MtCO ₂ e)	19.3	18.2	13.9	438.5
MSS2	Change wrt PO1 (MtCO ₂ e)	-0.3	-4.5	-9.8	-124.3
	% Change wrt PO1	-1.5%	-24.5%	-70.4%	-28.3%

Source: PRIMES-Maritime modelling

Energy efficiency

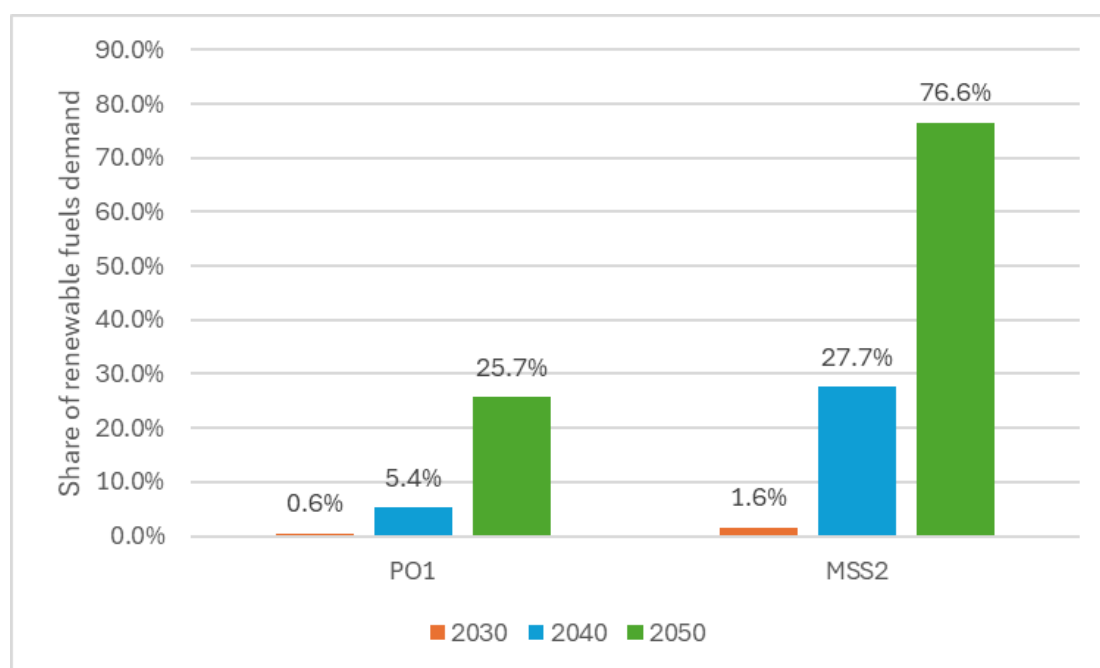
In the default policy scenario, some energy efficiency improvements are expected for smaller vessels, following technological developments for the overall fleet. Measure MSS2 is expected to lead to small additional improvements³⁶⁴ in the energy efficiency of smaller vessels (energy intensity is expected to drop by 1% in 2050 compared to PO1), driven by higher fuels costs compared to the default policy scenario. Similar trends are expected in MSS1.

³⁶⁴ These improvements are linked to the uptake of energy-saving technologies and other operational measures such as waste heat recovery systems, improved hull design, air lubrication, and optimisation tools like route planning and engine management systems.

Fuel mix

In the default policy scenario (PO1) the uptake of renewable fuels for smaller vessels would be quite limited, as smaller vessels would face no incentive in replacing traditional fossil fuels with more expansive renewable fuels. Renewable fuels would only represent 26% of the total energy demand for smaller vessels by 2050. The expansion of EU ETS to smaller vessels (under measure MSS2), due to the price signal of carbon pricing, would lead to a significantly higher uptake of renewable fuels for smaller vessels, particularly from 2040 onwards, reaching 77% of total energy demand by 2050. Similar trends would be expected for measure MSS1.

Figure 5: Trends in the demand of renewable fuels (RFNBOs, biofuels and electricity) for smaller vessels as share of total fuel use for smaller vessels under the default policy scenario (PO1) and MSS2



Source: PRIMES-Maritime modelling. Smaller vessels (i.e. between 400 and 5000 GT) in scope are those included in MSS2.

7.3.2. Economic impacts

Shipping costs³⁶⁵

Similar to environmental impacts, PRIMES-Maritime was used to model direct cost impacts from measure MSS2, while a dedicated scenario for MSS1 was not considered. Further to administrative costs, the model shows that the extension of the scope of EU ETS to smaller vessels in MSS2 is expected to represent additional costs for shipping companies responsible for smaller vessels in the form of ETS payments³⁶⁶ but also fuel costs and capital expenditure associated with decarbonisation measures within the segment, representing avoided ETS payments. Total shipping cost increases from policy measure MSS2 were estimated at 5.1% on average during the period 2030-2050, compared to the default policy scenario, as shown in the following table:

Table 16: Impact on shipping costs for smaller vessels from policy measure MSS2

³⁶⁵ Shipping costs include fuel cost, operating costs, compliance costs and capital expenditure, but exclude administrative costs, which are covered separately in sections below.

³⁶⁶ Referred below as 'ETS costs'.

Scenario	Indicator	2030	2040	2050	Total 2030-2050
PO1/default ³⁶⁷	Total shipping costs (million EUR)	23,158	28,382	33,967	707,915
MSS2	Change wrt PO1 (million EUR)	1,492	1,942	489	36,100
	% Change wrt PO1	6.4%	6.8%	1.4%	5.1%

Source: PRIMES-Maritime modelling. Smaller vessels (i.e. between 400 and 5000 GT) in scope are those included in MSS2.

It should further be noted that smaller vessels are also eligible to benefit from existing maritime derogations under ETS (i.e. OMR, PSC/PSO/ICS), which would at least partially offset the expected additional shipping costs.

Level-playing field

The extension of the ETS scope to smaller vessels would be expected to have a positive impact on the level playing field by ensuring similar regulatory requirements for vessels just above or below the 5 000 GT threshold, which might be competing for similar market segments. An analysis of vessel data segmented by size suggests that smaller vessels between 4 000 and 4 999 GT would represent 32% of the considered fleet under MSS1 and 19% under MSS2³⁶⁸. The extension of the ETS scope to smaller vessels would also address the risk of evasion consisting of using smaller vessels to avoid EU ETS obligations. By addressing this risk, policy measures MSS1 and MSS2 would avoid negative economic impacts (e.g. lack of level playing field) as well as possible negative environmental impacts (e.g. using smaller vessels instead of larger ones would result in more voyages being needed to deliver the same quantity of freight and would thus likely lead to higher emissions).

Impact on the EU maritime shipping industry

Extending the ETS to smaller vessels is expected to provide a strong and consistent incentive for the adoption of low and zero emission technologies particularly suited to this segment of the fleet. Smaller vessels operating on short and predictable routes are especially well placed to benefit from electrification, as battery-electric propulsion has reached a high level of technological maturity and aligns well with their operational characteristics. Including these ships in the ETS would enhance the economic attractiveness of clean technologies and encourage investment in supporting infrastructure such as onshore power supply. Over time, the resulting market signals are likely to accelerate fleet renewal, stimulate innovation, and strengthen industrial capabilities in advanced maritime technologies, ultimately contributing to industrial growth and job creation, reinforcing the competitiveness of shipyards and equipment manufacturers in Europe.³⁶⁹

Administrative costs for shipping companies

³⁶⁷ 'Policy Option 1' (simplified) as referred to in Section 6 represents the default policy scenario.

³⁶⁸ A detailed analysis of the share of and absolute number of vessels, by ship type and by categories by gross tonnage is available in Figure 4-2 in the supporting study to the Report referred to in footnote no.22.

³⁶⁹ RICARDO, 2026, Opportunities of the green transition for the EU maritime industry and value chain (to be published)

As for other sectors under the EU ETS, the main administrative costs of participation in the system for regulated entities are related to the MRV processes, the opening and operation of an account in the Union Registry, and the purchase and possible trade of allowances. The supporting study to the Commission report assessing the potential inclusion of additional smaller ships under the scope of the EU MRV Regulation (European Commission, 2025) estimated recurrent annual MRV-compliance administrative costs per vessel for smaller vessels at EUR 3,690, similar or slightly higher than those of vessels currently subject to MRV obligations (estimated at EUR 3,390 per vessel on average). Staff limitations and increased frequency of voyages of smaller vessels have been quoted by some shipping companies as the main reasons for higher monitoring costs. One-off costs related to MRV implementation (i.e. costs to set up the MRV system for each new vessel) were estimated at EUR 3,193 per vessel. Besides MRV processes, shipping companies controlling smaller vessels, and not already operating other vessels under EU ETS, would incur additional ETS administrative costs³⁷⁰, estimated by the previous impact assessment by the Commission (European Commission, 2021) to be around EUR 18,300 (one-off) and EUR 6,100 (annual)³⁷¹. The following table present the resulting additional administrative costs from MSS1 and MSS2:

Table 17: Additional administrative costs for shipping companies under MSS1 (PO2) and MSS2 (PO3)

Measure	Number of new vessels to MRV⁽¹⁾	Number of new companies to ETS ⁽²⁾	Total additional one-off administrative costs (MEUR)	Total additional recurrent administrative costs (MEUR per year)	Net present value of additional administrative costs (MEUR)⁽³⁾
MSS1 (PO2)	2,238	1,171	29	15	435
MSS2 (PO3)	4,421	2,312	56	30	860

Source: Commission analysis

(1) Excluding general cargo and offshore vessels, already under MRV

(2) Estimated based on analysis of shipping companies for smaller vessels not already on THETIS-MRV from (European Commission, 2025)

(3) 3% social discount rate applied for administrative costs over the period 2030-2050

Administrative and enforcement costs for public authorities

The extension of the EU ETS to smaller vessels would lead to additional administrative and enforcement costs for national authorities related to both MRV and ETS processes. A recent study (European Commission, 2025) estimated MRV related costs for authorities at 21.1 EUR/vessel for Port State Control³⁷² obligations and 186.1 EUR/vessel for Flag State³⁷³ obligations. Obligations for national authorities with regard to ETS compliance include setting up and maintaining the Union Registry for shipping companies, processing notifications, compliance auditing, and providing general support to implementation (e.g. through helpdesk).

³⁷⁰ ETS administrative costs include the costs incurred by companies to familiarise themselves with the EU ETS scheme, set up and manage their Union Registry account, and purchase or manage allowances. The ETS payments, i.e. the financial cost of the purchased EU allowances, are not considered an ETS administrative costs and are included in the ETS costs component of shipping costs previously analysed.

³⁷¹ Converted to 2024 prices with EU 27 GDP deflator 2020-2024.

³⁷² Costs incurred for vessels inspections to ensure that ships visiting national ports adhere to the MRV Regulation and relevant enforcement via a system of penalties.

³⁷³ Costs incurred for the enforcement in respect of MRV obligations for ships flying the flag of the State authority.

On the basis of recent estimates (European Commission, 2021)³⁷⁴, ETS-related one-off and annual costs per shipping company were estimated at EUR 470 and EUR 540, respectively. The resulting costs under MSS1 and MSS2 are shown in the following table:

Table 18: Additional administrative and enforcement costs for national authorities under MSS1 (PO2) and MSS2 (PO3)

Measure	Number of new vessels under MRV ⁽¹⁾	Number of new flagged vessels ⁽²⁾	Number of new companies to ETS ⁽³⁾	Total additional one-off administrative costs (MEUR)	Total additional recurrent administrative costs (MEUR per year)	Net present value of additional administrative costs (MEUR) ⁽⁴⁾
MSS1 (PO2)	2,238	316	1,171	0.55	0.74	17
MSS2 (PO3)	4,421	625	2,312	1.09	1.46	33

Source: Commission analysis

⁽¹⁾ Excluding general cargo and offshore vessels, already under MRV

⁽²⁾ This assumes that the share of vessels flagged in EU Member States compared to total vessels under MRV in 2023 (14%) also applies to this subset of vessels

⁽³⁾ Estimated based on analysis of shipping companies for smaller vessels not already on THETIS-MRV from (European Commission, 2025)

⁽⁴⁾ 3% social discount rate applied for administrative costs over the period 2030-2050

7.3.3. Social impacts

The extension of the EU ETS to smaller vessels introduces increased shipping costs for operators under both MSS1 and MSS2, depending on the emissions reduction measures implemented by shipping companies. This poses a risk that certain service providers might reduce the frequency of their operations, withdraw from or merge less profitable routes, or increase prices for passengers and cargo, therefore undermining the accessibility and affordability of essential services, particularly for vulnerable populations. In many Member States, these services are not only essential for personal mobility but also for the delivery of food, medical supplies, and other basic goods³⁷⁵. It should also be noted, however, that services to small islands and remote areas are often protected by public service obligations Public Service Contract or Public Service Obligation (PSO-PSC), which, by fixing the maximum price and minimum supply of these services already safeguard connectivity from cost pressures³⁷⁶. Additionally, EU ETS derogations for PSO-PSC, outermost regions, and small islands³⁷⁷, if extended, would further mitigate the impact.

³⁷⁴ There ETS registry and annual fees were assumed to be a good proxy for ETS-related one-off and recurrent administrative costs.

³⁷⁵ This may in particular be the case for smaller islands or remote areas, where ferries may represent the main link to the mainland, especially in adverse weather or when air connections are limited. Due to the lack of affordable alternatives, even small increases in operating costs resulting from EU ETS obligations could have a visible impact on service affordability or frequency.

³⁷⁶ In some Member States, PSO contracts also include provisions for fuel cost adjustments or direct subsidies to offset unexpected increases in operating costs, which could help cushion the impact of ETS-related fuel price rises.

³⁷⁷ Approximately 28% under MSS1 and 26% under MSS2 of voyages undertaken by smaller vessels would fall under an existing derogation. This proportion is driven predominantly by voyages between Small Island Ports (SIP), which represents a significant share in total voyages for RoPax and passenger services.



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COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT REPORT

Accompanying the documents

Proposal for a

**DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
amending Directive 2003/87/EC and Decision (EU) 2015/1814 as regards driving
competitiveness and cost-effective decarbonisation**

**REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
amending Directive 2003/87/EC as regards revised benchmark values for the heat and
fuel benchmarks period from 2026 to 2030**

**REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
amending Regulation (EU) 2015/757 and Regulation (EU) 2023/1805 to simplify and
streamline monitoring, reporting and verification and to align with revisions of the EU
Emissions Trading System**

{COM(2026) 616 final} - {COM(2026) 619 final} - {COM(2026) 620 final} -
{SEC(2026) 616 final} - {SWD(2026) 617 final} - {SWD(2026) 618 final}

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Carbon Leakage and 20 MW

1. CARBON LEAKAGE

1.1. Overview

Free allocation has been provided to ETS sectors to address the risk of carbon leakage, which occurs if industrial production relocates from the EU to jurisdictions with less stringent environmental standards. The recent introduction of the CBAM will place a carbon price equivalent to the EU ETS price on imports of certain basic products, providing an additional tool for preventing carbon leakage and, thereby, also ‘level the playing field’ in terms of the carbon costs faced by domestic production and imports entering the EU for the sectors currently covered (i.e. electricity, steel, cement, aluminium, fertilisers and hydrogen) without fully relying on free allocation for these sectors.

Considering the changes to free allocation in Phase IV, this impact assessment considers how best to revise free allocation and carbon leakage protection in Phase V of the EU ETS and whether a continuation of the current approach to free allocation remains suitable or if further reforms are appropriate.

1.2. Scoping exercise

1.2.1. *Carbon leakage prevention measures for direct emissions*

1.2.1.1. Background

Since the outset, the EU ETS has addressed the concern that an unequal carbon pricing in different jurisdictions may result in either an overall increase in global GHG emissions or a lower reduction in global emissions than in EU emissions. Allocation of free allowances has served as the main tool to prevent possible relocation of industrial production subject to EU carbon pricing to countries with less stringent climate policies, which is also referred to as carbon leakage.

While this approach helped ease the political and economic transition to a carbon market, it also introduced challenges. Uneven allocation methods across Member States led to distortions in intra-EU competition and, in sectors where allowances were passed through in product prices, companies could gain so-called windfall profits. Moreover, the environmental incentive to reduce emissions was weaker where free allocation was based on historic emissions and covered most or all a company's compliance needs.

From Phase III onwards, the share of free allowances declined as more allowances were auctioned. The methodology for allocating allowances for free changed from grandfathering (based on historic emissions) to benchmarking those rewards installations with lower specific emissions for their production by receiving more allowances for free.

The design of free allocation under Phase IV underwent significant reform to better align with climate ambition, economic fairness, and environmental integrity. The scope of this evaluation for carbon leakage prevention focuses on the key changes to free allocation that occurred at the start of Phase IV following the revision of the ETS Directive in 2018:

- Revised benchmark values for free allocation
- Updated carbon leakage list

- Establishment of a buffer to limit the application of the Cross-Sectoral Correction Factor (CSCF)¹
- Better alignment of free allocation with actual production levels

The reforms introduced indicate a strategic shift in how the system addresses carbon leakage. Rather than merely shielding the sectors indefinitely from external competition, the updated design encourages innovation while continuing to prevent relocation of emissions and production.

Because of the changes in the 2023 revision of the ETS Directive, part of the free allocation is now conditional, and this is reflected in the latest amendment of the Free Allocation Regulation ('FAR')². The conditional aspects of free allocation are now as follows:

- Free allocation to eligible installations will be reduced by 20% if operators have not implemented **energy efficiency recommendations** from energy audits or energy management systems as stipulated under the EU Energy Efficiency Directive (EED).
- The free allocation to eligible installations with product benchmarks will be reduced by 20% if a sub-installation's specific emissions are higher than the 80th percentile of emission levels for the relevant product benchmarks in their benchmark curve, unless they have a compliant **Climate-neutrality plan** (CNP) in place.
- **District heating (DH) operators** in Member States with relatively high DH emissions can obtain an additional 30% of free allowances on the condition that they have a compliant CNP in place and they make sufficient investments in the implementation of the included emission reduction measures before 2030.

Throughout the stakeholder consultation, carbon leakage was a widespread concern among stakeholders, although exposing substantial divisions between different types of stakeholders. An overall majority of respondents, mainly companies and business associations, generally advocated for maintaining and improving free allocation (with suggestions for improvements ranging from simplifications, to updating benchmarking methodologies or the carbon leakage list, or introducing conditionalities), particularly for sectors not covered by the CBAM. Conversely, NGOs generally favoured a phase-out of free allocation to fully implement the "polluter pays" principle and accelerate decarbonisation, or making free allocation conditional on taking steps towards carbon neutrality.

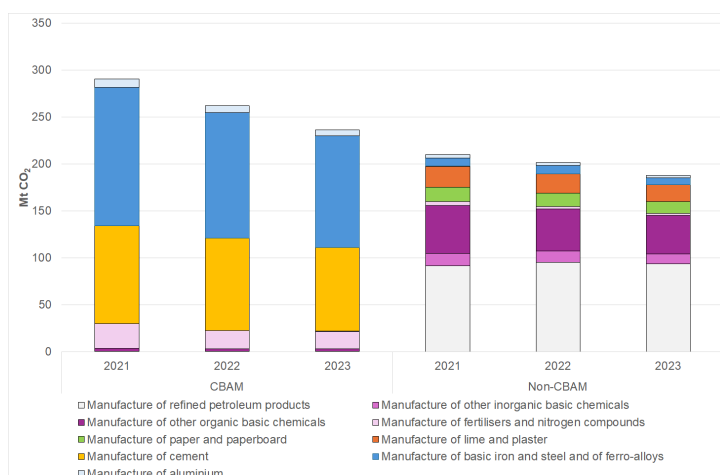
1.2.1.2. Emissions covered by non-CBAM sectors

Figure 1 provides an overview of the direct emissions covered for CBAM and non-CBAM sectors based upon provisional NIMs data, which is relied upon throughout this assessment as it provides the most comprehensive dataset on the activity level, emissions and free allocation provided to installations at the sub-installation level. This information is submitted by ETS operators as part of the process for applying for free allowances.

¹ The Cross Sectoral Correction Factor (CSCF) is used to prevent free allocation exceeding the free allocation budget and is applied to preliminary allocation to determine the final allocation.

² Commission Delegated Regulation (EU) 2024/873 of 30 January 2024 amending Delegated Regulation (EU) 2019/331 as regards transitional Union-wide rules for harmonised free allocation of emission allowances

Figure 1: Verified emissions for CBAM and non-CBAM sectors between 2021-23



Source: NIMs dataset (2014-18, 2019-23), Own illustration

The key non-CBAM sectors in terms of absolute emissions include the manufacture of refined petroleum products, manufacture of other inorganic and organic basic chemicals, the manufacture of paper and paperboard and the manufacture of lime and plaster. Indeed, these sectors account for around 40% of the average non-CBAM emissions between 2021 and 2023.

1.2.2. Carbon leakage prevention measures for indirect emissions

The ETS Directive establishes, in Article 10a(6), the principle that Member States should adopt financial measures to compensate electro-intensive industries at genuine risk of carbon leakage due to indirect carbon costs (ICC - carbon costs that are passed on through the wholesale electricity price based on the carbon cost the marginal power producer incurs), subject to State aid rules.

ICC compensation supports the business case for electro-intensive industrial processes by reducing their carbon costs. It is particularly relevant for electrified industrial processes that face an indirect carbon cost and compete with non-electrified processes that emit CO₂ directly and benefit from free allocation. Conceptually, the environmental benefit of ICC compensation is therefore a combination of:

- *Carbon leakage protection*: addressing the risk of electro-intensive industries relocating, due to indirect carbon costs, to areas with less strict climate governance.
- *Incentivising electrification*: supporting the business case for electrification relative to direct emissions, for industries that could electrify their processes.

Article 10(6) describes some key features of Member States' ICC compensation measures, including that the compensation should be based on *ex ante* benchmarks for indirect emissions per unit of production, calculated as the product of electricity consumption corresponding to the most efficient available technologies and of the CO₂ emissions from electricity production.

The Article 10(6) mandate does not contain an expiry date and is not subject to a review clause. However, Article 30(2) states that carbon leakage support measures shall be kept under review and explicitly requires the Commission to consider whether ICC measures should be further harmonised. In practice, detailed elements of Indirect Cost Compensation (ICC) governance

are elaborated and amended through the relevant State aid guidelines³, which are outside the scope of this review.

The guidelines are developed separately and cover the key characteristics such as sectoral eligibility, the methodology for calculating indirect carbon cost, the generosity of the aid (aid intensity) and conditions related to the expenditure of the aid (conditionality). The objective of the guidelines is to ensure that any State aid awarded is necessary to achieve the environmental objective of the EU ETS by reducing the risk of indirect carbon leakage and is limited to the minimum needed to achieve the environmental protection sought (proportionality of the aid) without creating undue distortions of competition and trade in the internal market⁴.

Aside from State aid, some electro-intensive installations are also eligible to receive free allocation covering indirect emissions from January 2026. To incentivise the electrification of industrial processes and reduce their emissions, the 2024 amendment of the FAR removed the rules on “exchangeability” of fuel and electricity, so that highly or entirely electrified processes covered by the EU ETS benefit from the same free allocation as processes with high direct emissions⁵. The extent to which an electrified installation benefits from this depends on the free allocation benchmarks (i.e. an installation will benefit most when it has electrified, but high direct emissions are still included in the relevant benchmark). To avoid overcompensation, Article 10a(6) of the ETS Directive states that indirect costs covered by free allocation should not also be covered by State aid. Processes not eligible to receive free allocation covering indirect emissions will remain eligible for national State aid schemes. The FAR change may affect the composition of indirect cost compensation in two ways: 1) demand for State aid may fall if a share of the indirect cost is instead compensated through free allocation; 2) the overall quantity of compensated emissions may increase, since some installations who would not have received State aid will receive free allocation.

In principle, carbon leakage risks related to ICC should dampen over time as the EU’s electricity supply decarbonises. However, ICC can still play an outsized role in the costs faced by electro-intensive industries due to the role of fossil fuels in setting *marginal* electricity prices. JRC analysis suggests that fossil fuelled power plants will continue to set the marginal price 86% of the time up to 2030⁶. It is therefore relevant to consider how carbon leakage risk related to ICC should be addressed after 2030.

At present, 15 Member States grant ICC. This impact assessment considers how the ETS Directive should address ICC post-2030, including whether ICC measures should be further harmonised. It does not quantify the specific effect of the FAR change. Further details of the

³ Guidelines on certain State aid measures in the context of the system for greenhouse gas emission allowance trading post-2021 (2020/C 317/04) supplemented by Communication 2021/C 528/01, amended by C/2026/196.

⁴ The 2021 -2025 guidelines also allow aid to exceed 75% intensity under specific circumstances. The amendment for 2026-2030 allows aid intensity of 75% or 80%, depending on the sector.

⁵ Commission Delegated Regulation (EU) 2024/873 amending Delegated Regulation (EU) 2019/331

⁶ Gasparella et al. (2023) The merit order and price-setting dynamics in European electricity markets. Report JRC134300

current ICC governance framework can be found in the annual report on the functioning of the European carbon market⁷, and State aid guidelines⁸.

1.2.2.1. Overview of sectors eligible for indirect cost compensation

The list of sectors eligible for indirect cost compensation through State aid for the period 2021-2025 was established in the ETS State aid guidelines published in 2020. This list is shown in Table 1. In early 2026, these guidelines were amended for the period 2026-2030, expanding the number of eligible sectors and changing some of the aid intensity and conditionality rules. The effect of the amendment is not considered in this assessment.

Table 1: Sectors deemed to be exposed to a genuine risk of carbon leakage due to indirect emission costs (excluding sectors that have become newly eligible as of 1 January 2025)

NACE code	Description
14.11	Manufacture of leather clothes
24.42	Aluminium production
20.13	Manufacture of other inorganic basic chemicals
24.43	Lead, zinc and tin production
17.11	Manufacture of pulp
17.12	Manufacture of paper and paperboard
24.10	Manufacture of basic iron and steel and ferro-alloys
19.20	Manufacture of refined petroleum products
24.44	Copper production
24.45	Other non-ferrous metal production
20.16.40.15	Polyethylene in primary forms
23.14.12.10	Glass fibre mats
23.14.12.30	Glass fibre voiles
20.11.11.50	Hydrogen
20.11.12.90	Inorganic oxygen compounds of non-metals

1.2.2.2. Overview of the provision of indirect cost compensation by Member State

Table 2 provides an overview of the indirect cost compensation by Member State for the year 2023. It outlines the differentiated nature of the support for indirect carbon costs across the EU.

⁷ Report from the Commission to the European Parliament and the Council on the functioning of the European carbon market in 2024. SWD (2025) 388 final.

⁸ Communication from the Commission, Guidelines on certain State aid measures in the context of the system for greenhouse gas emission allowance trading post-2021 (2020/C 317/04) and Communication from the Commission amending the Guidelines on certain State aid measures in the context of the system for greenhouse gas emission allowance trading post-2021. C/2026/196

Table 2: Indirect cost compensation by Member State

Member State	Amount paid for indirect costs incurred in 2023 (million EUR)	Number of recipients (installations)	Auction revenues in 2023 (million EUR)	Relative size of indirect costs aid compared to auction revenue
Belgium	249.9	56	739.9	33.8%
Czechia	60.4	23	771.3	7.8%
Finland	143.2	55	571.5	25.1%
France	908.8	293	2,060.1	44.1%
Germany	2,395.0	707	7,582.5	31.6%
Greece	287.0	57	1,441.8	19.9%
Italy	165.5	252	3,547.4	4.7%
Luxembourg	37.6	4	7.6	492.0%
Netherlands	147.3	48	1,261.1	11.7%
Poland	614.6	97	5,406.7	11.4%
Portugal	25.0	23	726.7	3.4%
Romania	116.7	31	571.8	20.4%
Slovakia	58.3	9	377.5	15.4%
Slovenia	25.4	16	186.5	13.6%
Spain	282.8	191	3,514.0	8.0%
Austria	N/A			
Lithuania	N/A			
Bulgaria	N/A			
Croatia	N/A			
Cyprus	N/A			
Denmark	N/A			
Estonia	N/A			
Hungary	N/A			
Ireland	N/A			
Latvia	N/A			
Malta	N/A			
Sweden	N/A			

Source: Report from the Commission to the European Parliament and the Council on the functioning of the European carbon market in 2024 pursuant to Articles 10(5) and 21(2) of Directive 2003/87/EC

1.3. Policy measures

1.3.1. Description

1.3.1.1. Carbon leakage prevention measures for direct emissions

The following three policy measures to be considered in the impact assessment include:

- CL1: Improved current approach on free allocation:

This measure represents a continuation of the current approach on free allocation but also includes several simplifications and improvements. Simplifications consist of a avoiding a general update of the carbon leakage list and streamlining of the application for free allocation and how the benchmarks are established to reduce the administrative burden. Benchmarks will continue to be set by the average performance of the 10% best performing installations, taking into account the minimum and maximum update rates and the rules for extrapolation of the trend to the mid-point of the relevant five years allocation period. However, fall back benchmarks should be differentiated to take into account the specificities of the different sectors. The rules on allocation level changes and conditionalities remain as they are currently in force.

- CL2: Conditional free allocation for investments:

This measure builds upon the improvements and simplification introduced in measure CL1 and it expands and generalises the conditionalities introduced for the period 2026-2030 (i.e. based on energy audits and climate neutrality plans for the least efficient installations and investments for district heating). A share of free allocation will be made conditional on installations developing meaningful climate neutrality plans and investing in significant emission reductions an amount equivalent to economic value of the conditional free allocation. Enforcement will take place ex-ante and ex-post. Before the allocation of (conditional) free allowances for the following period, operators will need to make binding financing decisions for the required investments. At the end of the allocation period, operators will need to demonstrate that the planned investments have been implemented leading to GHG reduction. The conditional allowances thus not allocated will be made available for free allocation to other operators. A gradual approach is necessary to enable economic actors to adjust. The share of conditional free allocation would be phased in starting with 20% in 2031, 40% in 2032, 60% in 2033, 80% in 2034 and then 100% from 2035. The impact of this measure will be assessed based on two scenarios assuming a different level of compliance with the conditionalities, namely a compliance rate of 90% (referred to as “CL2_90” in the rest of the document) and respectively 50% (“CL2_50”).

- CL3: No free allocation and partial surrender of allowances until 2034

This measure proposes an alternative to free allocation for carbon leakage protection. It replaces the current free allocation provision with a system like the approach used for phasing in the compliance obligation of maritime. Therefore, installations, instead of receiving a certain quantity of allowances for free, would be required to surrender allowances only for a part of their reported emissions. However, unlike maritime, the non-surrendered share of allowances is equivalent to allowances received for free (in the other measures) and therefore there would not be any adjustment to the cap to compensate for the partial surrender of allowances. The share of emissions that will require the surrendering of allowances will gradually increase to 100% surrender of allowances by 2034 (20% surrender in 2031, 50% in 2032, 80% in 2033, 100% from 2034). In this way, all sectors (CBAM and non-CBAM) will pay for 100% of their emissions from 2034.

- Revenue recycling variants

In the standard modelled scenarios, revenue generated by the EU ETS is recycled with 50% financing power sector investments and 50% dedicated to improving energy efficiency in covered industries. Parts of this impact assessment also consider a revised recycling structure

(CL1R, CL3R) where the 50% allocation to the power sector is instead transferred as a lump sum payment to households.

- CBAM variants

All policy measures for direct emissions target carbon leakage protection for non-CBAM sectors, while free allocation for installations covered CBAM continues to be phased out as currently planned in the ETS Directive by 2034.

However, a CBAM variant is analysed for each policy measure that considers, in addition to the specific changes for that policy measure, re-allocating 15% of the free allowances that would have otherwise been phased out to installations covered by CBAM.

- Cap variants

For deriving a free allocation budget and the resulting free allocation and cross sectorial correction factor, each policy measure has been constructed based on the ambition level determined under the measure CAP2.

In addition, a variant is analysed for CL2 based on a version of the 85% reference scenario attaining in 2035 an economy-wide GHG emissions level target consistent with a pathway towards a 90% target in 2040, but thereafter consistent with an 85% target in 2040. (CL290_9085 and CL_90C_9085). This corresponds to the CAP3 measure for the trajectory of the EU ETS from 2031-2040 (see Annex 8 – part 1, section. 2.2)

1.3.1.2. Carbon leakage prevention measures for indirect emissions

The following two policy measures are considered in the impact assessment:

- ICC1: Continued existing State-aid encouragement:

The policy measure envisages continuing the encouragement for Member States to provide indirect carbon cost (ICC) compensation in line with State aid rules, as set out in Article 10a(6) of the ETS Directive.

As with the existing Article 10a(6), the Commission may elaborate specific rules concerning ICC compensation through State aid guidelines. The guidelines currently in force apply to Member States' measures granted up to 2030.

- ICC2: Partly harmonised ICC:

In addition to the measures described in ICC1, this would consist of providing EU-level funding for ICC compensation by reserving 5% of auctioned allowances for this purpose. Providing harmonised ICC compensation through an EU-level instrument would reduce distortion in the single market and provide increased certainty to firms. Given budget constraints, a harmonised ICC fund may not be able to provide support at the maximum intensity currently permitted in the State aid guidelines. Therefore, each Member State would retain the right to provide additional compensation up to the level permitted under State aid rules.

1.4. Assessment of the measures

1.4.1. Overview

Free allocation numbers, indirect carbon costs and the impact on carbon leakage protection are affected not only by changes in the free allocation measures, but also by the broader changes to the ETS Directive, such as the level of ambition and the resulting ETS cap and linear reduction factor, the integration of removals or the inclusion of waste incineration in the scope of the EU ETS. Changes to the Market Stability Reserve may also impact liquidity. Therefore, the full impact of the measures on carbon leakage protection outlined in this chapter can only be assessed in combination with the measures on ambition, the integration of removals, MSR, cap and scope as part of the policy options, outlined in section 6 of this impact assessment.

The impact of the carbon leakage protection measures described in section 1.4 focuses on the quantitative assessments of the quantity of free allocation under the different scenarios, the sectorial distribution of the free allocation, as well as the financial value of these allowances.

In addition, GEM-E3 model runs have been completed to estimate a range of economic, social and environmental impacts resulting from different free allocation distributions across non-CBAM sectors over the 2031-40 period. The GEM-E3 model is informed by output provided by PRIMES to then assess the impact of different options for the provision of free allocation. The baseline considered under the GEM-E3 model is a free allocation budget based on the continuation of the existing legislation that assumes the ETS cap declines with an LRF of 4.4% between 2031-2040.

The modelling then compares different expectations in terms of free allocation budgets and how the allowances are distributed across industrial sectors to then provide quantitative metrics on carbon leakage rates as well as macro-economic implications. The annual share of the verified emissions that are estimated to be covered by free allocation for different industrial sectors between 2031 and 2040 is provided as a modelling input on free allocation for the GEM-E3 model runs. This modelling input has been determined based upon a comprehensive bottom-up calculation of free allocation using sub-installation data from the preliminary NIMs dataset for 2019-23 for both activity levels and emissions. The NIMs database is the outcome of the National Implementation Measure (NIM), which was specified in Article 14 of Commission Delegated Regulation (EU) 2019/331 – ‘Free Allocation Regulation’ (FAR)⁹ requiring EU Member States to inform the European Commission by providing a list of installations covered by the EU ETS and the preliminary amount of free allowances to be allocated to these installations calculated in accordance with Union-wide harmonised rules for free allocation. Table 3 provides an overview of the scenarios used for the GEM-E3 assessment, while a full explanation of the GEM-E3 model and its application in this impact assessment is outlined in Annex 4.

Table 3: Summary of GEM-E3 scenarios and policy options they address

Policy Options	Impact (Summary)
Baseline/Reference Scenario	Post-2030 greenhouse gas emissions reductions are driven by continued mitigation in both ETS and non-ETS sectors, in line with existing regulatory frameworks. Under the scenario, EU ETS emissions continue

⁹ Commission Delegated Regulation (EU) 2019/331 of 19 December 2018 determining transitional Union-wide rules for harmonised free allocation of emission allowances pursuant to Article 10a of Directive 2003/87/EC of the European Parliament and of the Council, http://data.europa.eu/eli/reg_del/2019/331/oj

Policy Options	Impact (Summary)
	to decline annually following the linear reduction pathway as currently legislated. The revenue generated via the EU ETS is recycled, with 50% allocated to financing power-sector investments and the remaining 50% dedicated to improving energy efficiency in EU ETS industries.
PO1 (CL1 & CL1R)	CL1: EU targets 85% reduction in GHG emissions by 2040, with free allocation for non-CBAM sectors based on updated product benchmarks, which is the improved current approach. The revenue generated via the EU ETS is recycled, with 50% allocated to financing power-sector investments and the remaining 50% dedicated to improving energy efficiency in EU ETS industries. CL1R: CL1 with revised recycling structure, where the 50% allocation to financing power-sector investments is instead transferred as a lumpsum payment to the households, while power investments are financed via domestic and foreign borrowing.
PO2 (CL2_50, CL2_90, CL2_50C & CL2_90C, CL2_90_9085 and CL2_90C_9085)	CL2_50 & CL2_90: EU targets 85% reduction in GHG emissions by 2040, along with a progressive share of free allocation for non-CBAM sectors which is conditional on investment in green energy/technology with two compliance variants, i.e. 50% and 90%. The emissions from the municipal waste are also considered under the EU ETS. The revenue generated via the EU ETS is recycled, with 50% allocated to financing power-sector investments and the remaining 50% dedicated to improving energy efficiency in EU ETS industries. CL2_50C & CL2_90C: CL2_50 & CL2_90 with a progressive share of free allocation for both CBAM and non-CBAM sectors. CL2_90_9085 and CL2_90C_9085 represent the same policy measures as in CL_90 and CL_90 but assessed based on the 90-85 cap pathway.
PO3 (CL3 & CL3R)	CL3: EU targets 85% reduction in GHG emissions by 2040 as it phases out the free allowance for non-CBAM sectors to ensure no further free allowances are provided to industry 2034 onwards. The emissions from the waste sector (including municipal, landfill, etc.) are also considered under the EU ETS. The revenue generated via the EU ETS is recycled, with 50% allocated to financing power-sector investments and the remaining 50% dedicated to improving energy efficiency in EU ETS industries. CL3R: CL3 with revised recycling structure, where the 50% allocation to financing power-sector investments is instead transferred as a lumpsum payment to the households, while power investments are financed via domestic and foreign borrowing.

For indirect carbon costs, the section analyses their possible evolution out to 2040 and considers how the ETS Directive's provisions concerning indirect cost compensation should evolve. This analysis is limited in its level of detail since indirect cost compensation is currently provided via State aid and granular assessment of indirect cost compensation is typically conducted through the elaboration and amendment of dedicated State Aid Guidelines.

The impact assessment also relies upon more qualitative inputs, especially with regards to stakeholder interviews and OPC responses to put the assumptions applied in the modelling into context of the experiences from industry and others.

1.4.2. *Economic impacts*

1.4.2.1. Conduct of business

1.4.2.1.1. Carbon leakage prevention measures for direct emissions

According to the legal default, no free allocation is provided from 2031. However, this is different to what was envisaged in other Union legislation¹⁰, so it was appropriate to establish a different baseline scenario for the provision of free allocation over 2031-40. The decision was taken to assume in the baseline that there will be a continuation of the current carbon leakage rules albeit with no update of the carbon leakage list or product benchmarks. In the baseline, free allocation was therefore still determined using preliminary NIMs data and applying the existing formula for free allocation (i.e. preliminary free allocation = activity level*benchmark (BM)*Carbon Leakage Exposure Factor (CLEF)*Cross Sectoral Correction Factor (CSCF)). Key assumptions taken to determine free allocation in the baseline included:

- The free allocation budget was determined based on a share of 43% of an ETS cap resulting from the continuation of the currently legislated linear reduction factor of 4.4%. The 3% buffer for free allocation is not continued post 2030.
- The level of activity was assumed to conservatively remain constant over time.
- The existing product benchmarks were updated based upon 2021/22 data to determine the top 10% of sub-installations for the 2026-30 period and these values were then further extrapolated for the 2031-40 period.¹¹
- The CLEF was not applied in the 2031-40 period, as the carbon leakage list was not updated.

To estimate the economic impact in terms of cost of the policy measures, it was necessary to calculate free allocation for Phase V of the EU ETS for the different policy measures under consideration. Each of the policy measures apply the same assumptions as outlined above in the baseline scenario except for the following key assumptions:

- The free allocation budget is set based on the assumption that the share of the ETS cap reserved for free allocation increases to 46% of the ETS cap for distribution, following any transfers to instruments to support investments, such as the Industrial Decarbonisation Bank (IDB) or the Innovation Fund (IF). The share of 46% results from the 43% from the baseline and the 3% free allocation buffer that was foreseen but not used in Phase IV. As the CSCF is projected to be triggered in all scenarios, the 3% buffer is already integrated in the free allocation budget.

The free allocation budget is higher in all the policy measures as lower LRFs were applied to the ETS cap over the 2031-40 period than in the baseline scenario (see Annex 8 – part 1, section

¹⁰ Regulation (EU) 2023/956 envisages free allocations after 2030.

¹¹ The proposed approach for updating benchmark values for Phase V for the purpose of the modelling exercise was to continue the update rate applied for the calculation of the 2026-30 benchmarks up until 2040. The BM value for 2031-35 will be based on the 2033 value and the BM value for 2036-40 will be based on the 2038 value.

2.6). Based on these assumptions a free allocation budget results under the baseline and each policy options scenarios, as outlined in Table 4

Table 4: Overview of the 2031-40 free allocation in the baseline compared to the policy measures

Scenario	2031-40 free allocation budget (M EUAs)
Baseline	1453
CL1/PO1	1,934
CL2/PO2	2,026
CL3/PO3	2,367

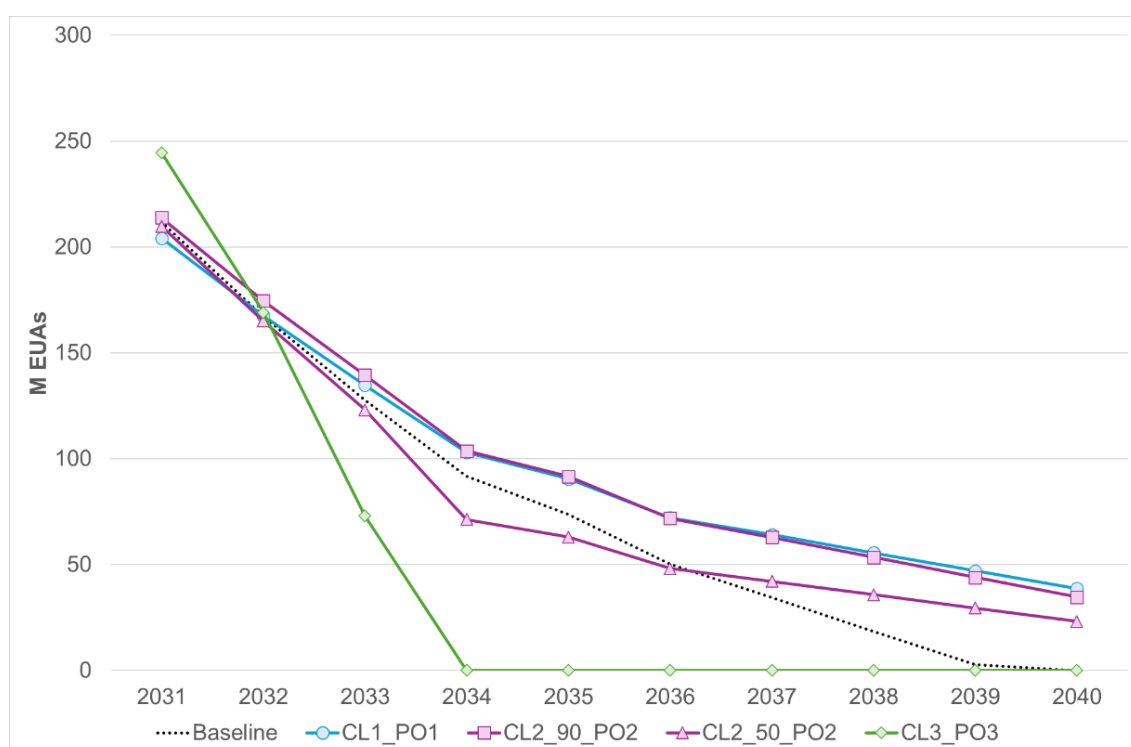
Source: Own calculation

The free allocation to be received by industry then varied further depending upon the implementation of each measure.

- Under the **improved current approach** (CL1), the methodology is the same as in the baseline. Potential simplifications or improvements under CL1 are not expected to impact overall FA values. The free allocation budget is higher in CL1 because of the different level of ambition and the different ETS cap. Also assumes existing conditionality requirements are fulfilled. The phase-out of free allocation for CBAM sectors is continued as in the baseline.
- Under the **conditional free allocation for investments** approach (CL2), the methodology is the same as outlined in CL1 but with expanded conditionality in 2031-40 with two variants to assume a range of compliance amongst ETS operators.
- Under the **no free allocation from 2034** approach (CL3), the methodology differs from the previous policy measures as free allocation is calculated based upon a share of emissions in line with schedule phase out under this policy option.

Given that each policy measures under consideration in this impact assessment involves a different distribution of free allowances across industry compared to the baseline, the economic impact is outlined for each scenario in the following sub-sections below by firstly summarising in a table the overall volume of free allowances that industry receives, and, secondly by illustrating in a figure how the volume of allowances is distributed across industry. Figure 2 provides an overview of the free allowances to be allocated under the baseline and the different policy options.

Figure 2: Total free allocation across the policy options



Source: Preliminary NIMs dataset (2019-23), Own calculation

While the economic impact of the policy measures on the conduct of business focuses primarily on changes in the allocation of free allowances across industry, the introduction of further conditionality under CL2 requires an assessment to quantify the potential positive impacts of requiring installations to make binding financing decisions of an equivalent value with the conditional free allocation to implement their climate neutrality plans. A share of free allocation will be made conditional on installations demonstrating that they have meaningful climate neutrality plans in place and that, by a certain deadline before the application for free allocation for the following period, have made binding financing decisions of an equivalent financial value with the conditional free allocation to implement their climate neutrality plans.

The estimation of free allocation volumes in this analysis over 2031-40 is a simplification as it relies upon the assumption that activity levels remain constant at 2023 levels for the entirety of Phase V.

The policy measures were designed to apply to sectors not currently covered by the CBAM. The rationale for this was that a phase out of free allocation for CBAM sectors was already legislated for under the CBAM regulation and the focus of the impact assessment was on how best to reform free allocation for the remaining sectors.

The analysis then concludes by summarising the relative changes in the volume of free allocation and its distribution across industry and then converted the allowances into a monetary value by applying an average EUA price projected for the 2031-40 period to quantify the potential economic impact on the conduct of business.

Baseline

Table 5 shows that the overall budget for free allocation between 2031-40 in the baseline. The starting point for the estimation is the free allocation budget, which is set based upon the ETS

cap and the share of it reserved for free allocation. In the baseline, the total free allocation budget is assumed to be 1,453 M EUAs over 2031-40. The preliminary free allocation was then calculated following a bottom-up approach (see discussion above) and this resulted in a total of 3,417 M EUAs over 2031-40. As the preliminary allocation exceeded the free allocation budget, the CSCF was progressively applied over the period with the value declining rapidly from 0.55 in 2034 to 0 by 2040. The application of the CSCF allows the final free allocation budget to not exceed the free allocation budget for the 2031-40 period. In a final step, the CBAM factor was applied over Phase V for sub-installations covered by the CBAM and this reduced the total free allocation over 2031-40 to 778 M EUAs in the baseline.

Table 5: Estimation of the total volume of free allowances available under the baseline for 2031-2040

	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
FA Budget	316	278	239	200	161	123	84	45	7	0
FA (Preliminary)	366	366	366	365	365	318	318	318	318	317
CSCF	0.86	0.76	0.65	0.55	0.44	0.39	0.26	0.14	0.02	0.00
FA (before CBAM phase out)	316	278	239	200	161	123	84	45	7	0
FA (after CBAM phase out)	212	167	128	92	74	50	34	19	3	0

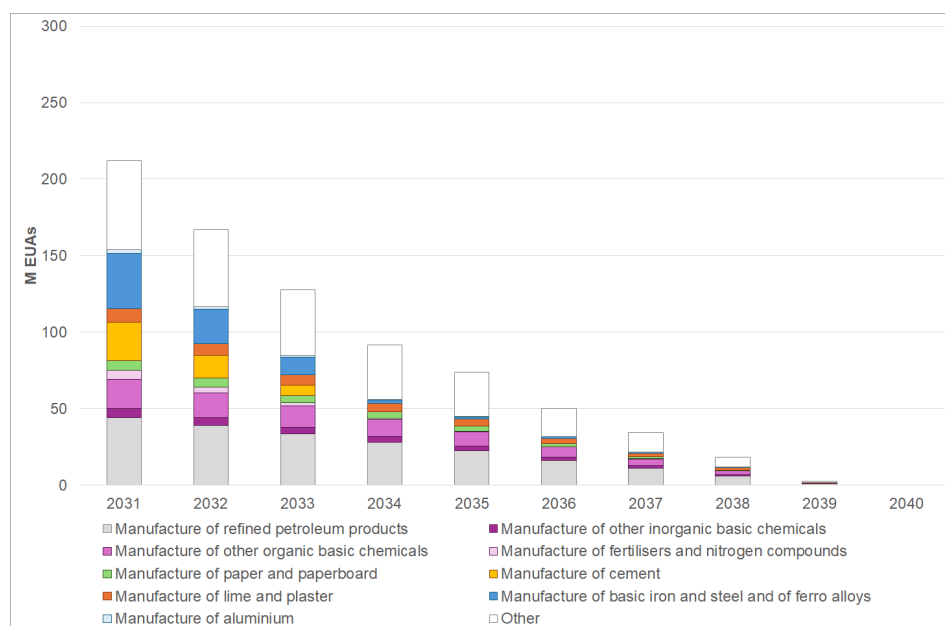
Source: Own calculation based upon preliminary NIMs data for 2019-23

Figure 3 shows how the distribution of free allocation to sectors develops over time in Phase V of the EU ETS under the baseline. The manufacture of refined petroleum products (NACE code 19.20) would receive around 202 million EUAs for free under the baseline over 2031-40. Given that the refineries sector was identified previously in the scoping exercise as the highest emitter between 2021 and 2023 after the iron and steel and cement sectors, it is to be expected that this sector would account for the largest share of allowances over the 2031-40 period as the CBAM progressively reduces free allocation in the covered sectors.¹² Indeed, although the manufacture of basic iron and steel and of ferro alloys (NACE code 24.10) received 76 million EUAs for free and the manufacture of cement (NACE code 23.51) received 47 million EUAs for free, the majority of these free allowances were distributed only up until 2034.¹³

¹² However, it is important to acknowledge that this is under the assumption that refinery output remains constant overtime. This simplification in the methodology was necessary for consistency but in reality, it is expected that the output from the refinery sector will decline over the 2031-40 period as the use of fossil fuels are expected to be progressively phased out.

¹³ The iron and steel sector continued to receive some allocation for goods that are not currently covered under the CBAM after 2034.

Figure 3: Distribution of free allocation under the baseline for 2031-40



Source: Own calculation based upon preliminary NIMs data for 2019-23

Policy Measures

The policy measures are designed with a higher free allocation budget between 2031-40, compared to the baseline scenario. The higher free allocation budget reflects the fact that the overall ETS cap is assumed to be less stringent than in the baseline. How this free allocation budget is distributed across industrial sectors however varies by the different policy measures.

CL1 (PO1)

Table 6 shows that the overall budget for free allocation between 2031-40 in CL1, which is assumed to be 1,934 M EUAs over 2031-40. The preliminary free allocation was then calculated following a bottom-up approach and this resulted in a total of 3,425 M EUAs over 2031-40.¹⁴ As the preliminary allocation exceeded the free allocation budget, the CSCF was progressively applied over the period with the value declining from 0.83 in 2031 to 0.30 by 2040. The increased volume of free allocation in CL1 compared to the baseline results in a higher CSCF over the period. The application of the CSCF allows the final free allocation budget to not exceed the free allocation budget for the 2031-40 period. In a final step, the CBAM factor was applied over Phase V for sub-installations covered by the CBAM and this reduced the total free allocation over 2031-40 to 978 M EUAs.

Table 6: Estimation of the total volume of free allowances available under CL1 for 2031-40

	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
FA Budget	305	278	252	225	197	176	156	136	115	95
FA (Preliminary)	367	366	366	366	366	319	319	319	319	319

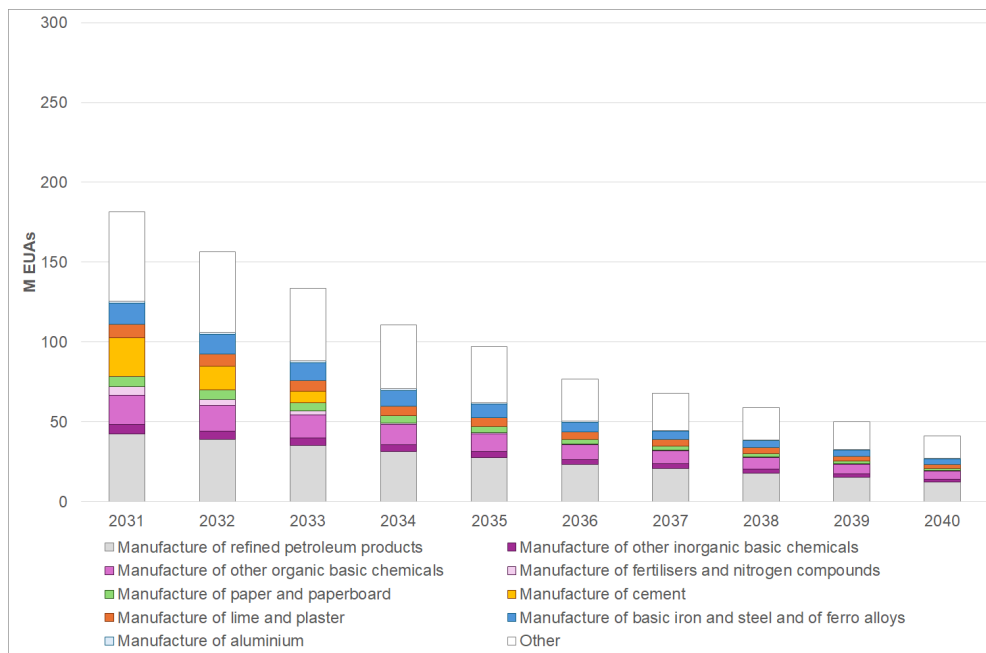
¹⁴ The preliminary allocation calculated under CL1 differs slightly from the baseline. The minor difference occurs due to the fact that process emissions are different in the baseline and policy scenarios due to the assumption of different caps. This results in minor differences in free allocation as allocation to process emission fall-back benchmarks are based on a share of verified emissions.

CSCF	0.83	0.76	0.69	0.61	0.54	0.55	0.49	0.43	0.36	0.30
FA (before CBAM phase out)	305	278	252	225	197	176	156	136	115	95
FA (after CBAM phase out)	204	167	135	103	90	72	64	56	47	39

Source: Own calculation based upon preliminary NIMs data for 2019-23

Figure 4 shows how the distribution of free allocation to sectors develops over time under CL1. The manufacture of refined petroleum products (NACE code 19.20) would receive around 266 million EUAs for free over 2031-40 and this is followed by the manufacture of other organic basic chemicals (NACE code 20.14), the manufacture of basic iron and steel and of ferro alloys (NACE code 24.10) and the manufacture of lime (NACE code 23.52) that receive 108 million EUAs, 80 million EUAs and 46 million EUAs respectively over 2031-40. In contrast to the baseline, there are considerably more allowances available for free up until the end of Phase V and this reflects the less stringent cap that also reduces the need for the full application of the CSCF.

Figure 4: Distribution of free allocation under CL1 for 2031-40



Source: Own calculation based upon preliminary NIMs data for 2019-23

CL2_90 (PO2)

Table 7 shows that the overall budget for free allocation between 2031-40 in the CL2_90 scenario, which is assumed to be 2,206 M EUAs over 2031-40. The preliminary free allocation was then calculated following a bottom-up approach and this resulted in a total of 3,306 M EUAs over 2031-40. The preliminary allocation is lower than under the CL1 scenario as the CL2_90 scenario assumes that in the 2031-40 period that an increasing share of the free allocation will be conditional. The total volume of the primary allocation is, however, like the CL1 scenario as a compliance rate of 90% is assumed in the first variant of the CL2 scenario. As the preliminary allocation exceeded the free allocation budget, the CSCF was progressively applied over the period with the value declining from 0.88 in 2031 to 0.31 by 2040. The slightly lower preliminary free allocation under the CL2_90 scenario (as well as the higher free allocation budget) compared to the CL1 scenario results in the application of a more stringent

CSCF across the period. The application of the CSCF allows the final free allocation budget to not exceed the free allocation budget for the 2031-40 period. In a final step, the CBAM discount factor was applied over Phase V for sub-installations covered by the CBAM and this reduced the total free allocation over 2031-40 to 990 M EUAs.

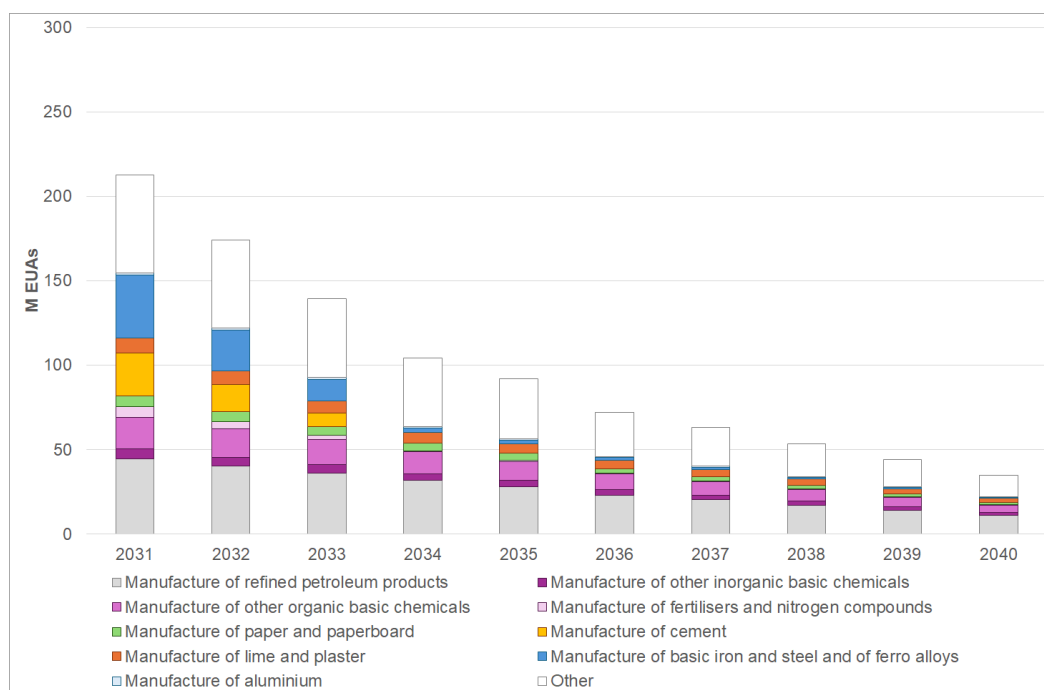
Table 7: Estimation of the total volume of free allowances available under CL2_90 for 2031-40

	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
FA Budget	320	293	267	240	212	187	163	139	114	90
FA (Preliminary)	363	360	356	349	349	306	306	306	306	305
CSCF	0.88	0.82	0.75	0.69	0.61	0.61	0.53	0.45	0.37	0.30
FA (before CBAM phase out)	320	293	267	240	212	187	163	139	114	90
FA (after CBAM phase out)	214	175	139	104	92	72	63	53	44	35

Source: Own calculation based upon preliminary NIMs data for 2019-23.

Figure 5 shows how the distribution of free allocation to sectors develops over time under the CL2_90 scenario. The manufacture of refined petroleum products (NACE code 19.20) would receive around 267 million EUAs for free over 2031-40 and this is followed by the manufacture of other organic basic chemicals (NACE code 20.14), the manufacture of basic iron and steel and of ferro alloys (NACE code 24.10) and the manufacture of lime (NACE code 23.52) that receive 109 million EUAs, 84 million EUAs and 54 million EUAs respectively over 2031-40. In contrast to the CL1 scenario, even though the preliminary free allocation is slightly lower in the CL2_90 scenario due to the implementation of conditionalities with a compliance rate of 90%, there are still more allowances available for free in the final allocation (after the application of the CSCF) up until the end of Phase V under the CL2_90 scenario and this primarily reflects the higher free allocation budget due to the higher cap as a result of including waste incineration in the ETS (in comparison to the CL1 scenario).

Figure 5: Distribution of free allocation under CL2_90 for 2031-40



Source: Own calculation based upon preliminary NIMs data for 2019-23

The introduction of further conditionalities under CL2 are expected to impact the level of investment in abatement options to accelerate rates of decarbonisation and therefore further impact the conduct of business by insisting that installations make binding financing decisions of an equivalent value with the conditional free allocation to implement their climate neutrality plans. Under CL2, the share of free allowances that are subject to conditionality increases from 20% in 2031, 40% in 2032, 60% in 2033, 80% in 2034 and then 100% from 2035 up until 2040. The value of the free allocation that is subject to further conditionalities under CL2_90 is estimated by multiplying the volume of the preliminary free allocation that is subject to conditionality each year for non-CBAM sectors by firstly the CSCF for the CL2_90 scenario, assuming an average price of EUR 150 over the period. . The expected level of investment because of the introduction of further conditionalities under CL2_90 for non-CBAM sectors only is estimated to be around EUR 90 billion over the 2031-40 period. It is important to note that this amount is not necessarily additional, as it is not possible to estimate how much from the free allocation given without any conditions would be spent on investments regardless.

CL2_90 CBAM variant

Table 8 shows that the overall budget for free allocation between 2031-40 in the CL2_90 (CBAM variant), which returns 15% of the allowances initially taken away by the application of the CBAM factor from the sectors covered under the CBAM. The starting point for the estimation is the free allocation budget, which is set based upon the ETS cap and the share of it reserved for free allocation. In the CL2_90 (CBAM variant) scenario, the total free allocation budget is assumed to be 2,206 M EUAs over 2031-40. The preliminary free allocation was then calculated following a bottom-up approach and this resulted in a total of 3,306 M EUAs over 2031-40. As the preliminary allocation exceeded the free allocation budget, the CSCF was progressively applied over the period with the value declining rapidly from 0.69 in 2034 to 0.30 by 2040. The application of the CSCF allows the final free allocation budget to not exceed the free allocation budget for the 2031-40 period. In a final step, the CBAM discount factor was applied over Phase V for sub-installations covered by the CBAM but with 15% of the allowances initially removed each year subsequently returned to these installations under the

CL2_90 (CBAM variant) scenario and this therefore increased (compared to the CL2_90 scenario) the total final free allocation over 2031-40 to 1,146 M EUAs.

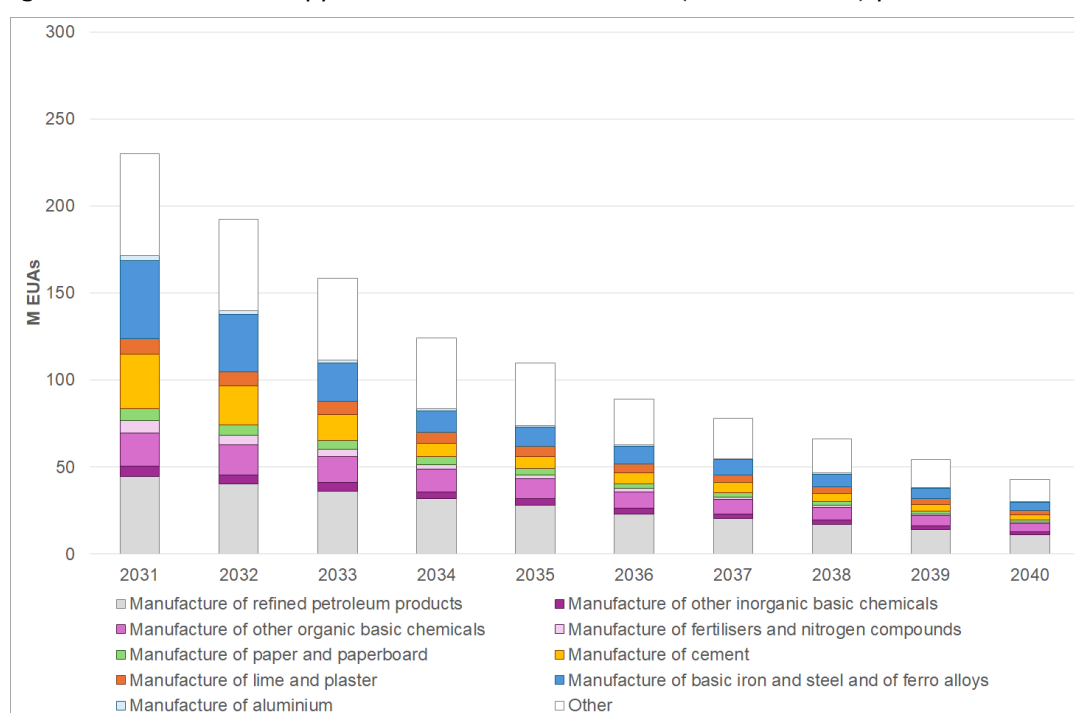
Table 8: Estimation of the total volume of free allowances available under CL2_90 (CBAM variant) for 2031-40

	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
FA Budget	320	293	267	240	212	187	163	139	114	90
FA (Preliminary)	363	360	356	349	349	306	306	306	306	305
CSCF	0.88	0.82	0.75	0.69	0.61	0.61	0.53	0.45	0.37	0.30
FA (before CBAM phase out)	320	293	267	240	212	187	163	139	114	90
FA (after CBAM phase out)	230	192	159	124	110	89	78	66	54	43

Source: Own calculation based upon preliminary NIMs data for 2019-23

Under the CL2_90 CBAM variant scenario, the manufacture of basic iron and steel and of ferro alloys (NACE code 24.10) receives 161 million EUAs for free and the manufacture of cement (NACE code 23.51) receives 100 million EUAs for free, most of these free allowances were distributed only up until 2034. These values are higher in the CL2_90 CBAM variant than in the CL2_90 scenario due to the return of 15% of the allowances that were initially taken away from both sectors due to the application of the CBAM factor.

Figure 6: Distribution of free allocation under CL2_90 (CBAM variant) for 2031-40



Source: Own calculation based upon preliminary NIMs data for 2019-23

CL2_50 (PO2)

Table 9 shows that the overall budget for free allocation between 2031-40 in the CL2_50 scenario, which is assumed to be 2,206 M EUAs over 2031-40. The preliminary free allocation was then calculated following a bottom-up approach and this resulted in a total of 2,829 M

EUAs over 2031-40. The preliminary allocation is lower than under the CL2_90 scenario as the CL2_50 scenario assumes that in the 2031-40 period that an increasing share of the free allocation will be conditional but that the compliance rate falls of 50%. As the preliminary allocation exceeded the free allocation budget, the CSCF was progressively applied over the period with the value declining from 0.92 in 2031 to 0.36 by 2040. The lower preliminary free allocation under the CL2_50 scenario compared to the CL2_90 scenario results in the application of a higher CSCF across the period. The application of the CSCF allows the final free allocation budget to not exceed the free allocation budget for the 2031-40 period. In a final step, the CBAM discount factor was applied over Phase V for sub-installations covered by the CBAM and this reduced the total free allocation over 2031-40 to 811 M EUAs.

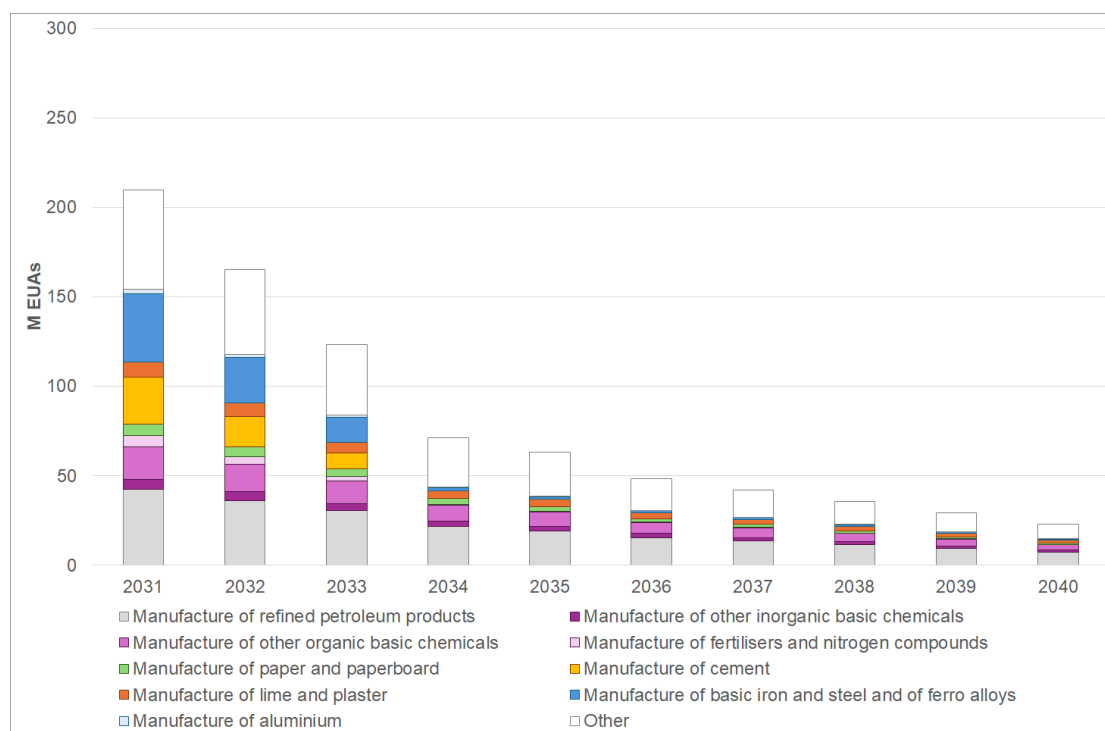
Table 9: Estimation of the total volume of free allowances available under CL2_50 for 2031-40

	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
FA Budget	320	293	267	240	212	187	163	139	114	90
FA (Preliminary)	350	333	316	282	282	254	254	254	253	253
CSCF	0.92	0.88	0.85	0.85	0.75	0.74	0.64	0.55	0.45	0.36
FA (before CBAM phase out)	320	293	267	240	212	187	163	139	114	90
FA (after CBAM phase out)	210	165	123	71	63	48	42	36	29	23

Source: Own calculation based upon preliminary NIMs data for 2019-23

Figure 7 shows how the distribution of free allocation to sectors develops over time under the CL2_50 scenario. The manufacture of refined petroleum products (NACE code 19.20) would receive around 208 million EUAs for free over 2031-40 and this is followed by the manufacture of other organic basic chemicals (NACE code 20.14), the manufacture of basic iron and steel and of ferro alloys (NACE code 24.10) and the manufacture of cement (NACE code 23.51) that receive 85 M EUAs, 84 million EUAs and 52 million EUAs respectively over 2031-40. In contrast to the CL2_90 scenario, the preliminary free allocation is lower in the CL2_50 scenario due to the implementation of conditionalities for non-CBAM sectors with a compliance rate of only 50%. However, the preliminary allocation still exceeds the free allocation budget under CL2_50, so a CSCF remains necessary, albeit the CSCF values are higher than under the CL2_90 scenario. As the conditionalities do not apply to CBAM sectors, the preliminary allocation is higher for these sectors and with the use of a higher CSCF throughout the 2031-40 period this means that the final allocation is also higher than the CL2_90 scenario after the application of the CBAM factor to phase out their free allocation up until 2034.

Figure 7: Distribution of free allocation under CL2_50 for 2031-40



Source: Own calculation based upon preliminary NIMs data for 2019-23

The value of the free allocation that is subject to further conditionalities under CL2_50 is estimated by multiplying the volume of the preliminary free allocation that is subject to conditionality each year for non-CBAM sectors by the CSCF for the CL2_50 scenario, assuming an average price of EUR150 over the period. The expected level of investment because of the introduction of further conditionalities under CL2_50 for non-CBAM sectors only is estimated to be around EUR 50 billion over the 2031-40 period.

CBAM variant

Table 10 shows that the overall budget for free allocation between 2031-40 in the CL2_50 (CBAM variant), which returns 15% of the allowances initially taken away by the application of the CBAM factor from the sectors covered under the CBAM. The starting point for the estimation is the free allocation budget, which is set based upon the ETS cap and the share of it reserved for free allocation. In the CL2_50 (CBAM variant) scenario, the total free allocation budget is assumed to be 2,206 M EUAs over 2031-40. The preliminary free allocation was then calculated following a bottom-up approach and this resulted in a total of 2,829 M EUAs over 2031-40. As the preliminary allocation exceeded the free allocation budget, the CSCF was progressively applied over the period with the value declining rapidly from 0.85 in 2034 to 0.36 by 2040. The application of the CSCF allows the final free allocation budget to not exceed the free allocation budget for the 2031-40 period. In a final step, the CBAM discount factor was applied over Phase V for sub-installations covered by the CBAM but with 15% of the allowances initially removed each year subsequently returned to these installations under the CL2_90 (CBAM variant) scenario and this therefore increased (compared to the CL2_50 scenario) the total final free allocation over 2031-40 to 993 M EUAs.

Table 10: Estimation of the total volume of free allowances available under CL2_50 (CBAM variant) for 2031-40

	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
FA Budget	320	293	267	240	212	187	163	139	114	90
FA (Preliminary)	350	333	316	282	282	254	254	254	253	253
CSCF	0.92	0.88	0.85	0.85	0.75	0.74	0.64	0.55	0.45	0.36
FA (before CBAM phase out)	320	293	267	240	212	187	163	139	114	90
FA (after CBAM phase out)	226	184	145	97	85	69	60	51	42	33

Source: Own calculation based upon preliminary NIMs data for 2019-23

Under the CL2_50 CBAM variant scenario, the manufacture of basic iron and steel and of ferro alloys (NACE code 24.10) receives 174 million EUAs for free and the manufacture of cement (NACE code 23.51) receives 121 million EUAs for free, the majority of these free allowances were distributed only up until 2034.¹⁵ These values are higher in the CL2_50 CBAM variant than in the CL2_50 scenario due to the return of 15% of the allowances that were initially taken away from both sectors due to the application of the CBAM factor.

CL3 (PO3)

Table 11 shows that the overall budget for free allocation between 2031-40 in CL3, which is assumed to be 2.367 M EUAs over 2031-40, which is higher than the free allocation budget under CL1 or CL2. The preliminary free allocation was then calculated following a bottom-up approach and this resulted in a total of 2,285 M EUAs over 2031-40. This preliminary allocation is considerably lower than under CL1 and CL2 as free allocation provision is discontinued from 2034 onwards for non-CBAM as well as CBAM sectors. Under CL3 the CSCF is only applied in 2031 and for the subsequent years the preliminary allocation is lower than the free allocation budget. In a final step, the CBAM discount factor was applied over Phase V for sub-installations covered by the CBAM and this reduced the total free allocation over 2031-40 to 487 M EUAs in CL3.

Table 11: Estimation of the total volume of free allowances available under CL3 for 2031-40

	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
FA Budget	354	326	299	270	241	218	198	176	154	132
FA (Preliminary)	390	315	243	198	198	188	188	188	188	188
CSCF	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FA (before CBAM phase out)	354	315	243	198	198	188	188	188	188	188
FA (after CBAM phase out)	245	169	73	0	0	0	0	0	0	0

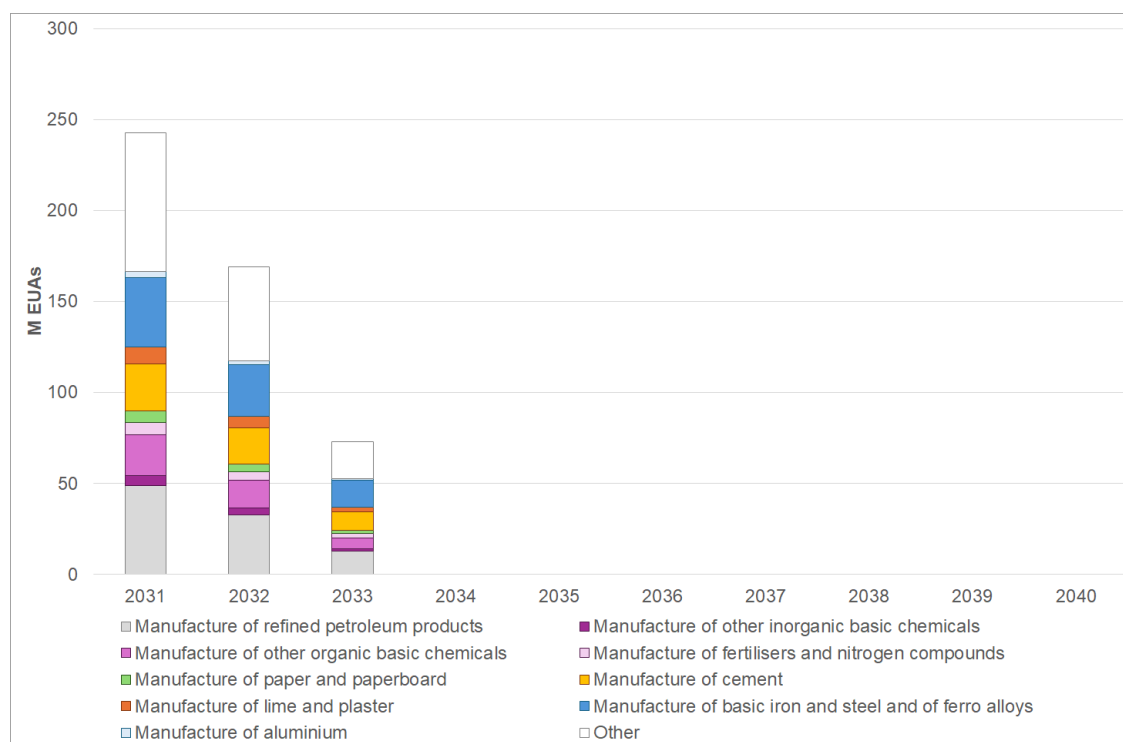
Source: Own calculation based upon preliminary NIMs data for 2019-23.

Figure 8 shows the distribution of free allocation under CL3. In contrast to the baseline, no free allocation is provided to both CBAM and non-CBAM sectors from 2034 onwards. This policy measure has a significant impact on non-CBAM sectors as they receive considerably less free

¹⁶ The Eurostat series *nrg_d_indq_n* was used for this purpose. However, this only provides consumption at 2-digit NACE level. Electricity consumption at the appropriate 4-digit and 6-digit level was estimated using production value data from the PRODCOM database as a weighting factor.

allocation over 2031-40 compared to the baseline. For example, under CL3 the manufacture of refined petroleum products (NACE code 19.20) and the manufacture of other organic basic chemicals (NACE code 2014) would only receive around 95 M EUAs and 56 M EUAs respectively. The impact is less for CBAM covered sectors such as the manufacture of basic iron and steel and of ferro alloys (NACE code 2410) and the manufacture of cement (NACE code 2351) as the phase out of their free allocation is already modelled in the baseline and policy scenarios. Both sectors receive 81 M EUAs and 56 M EUAs respectively.

Figure 8: Distribution of free allocation based under CL3 for 2031-40



Source: Own calculation based upon preliminary NIMs data for 2019-23

Summary

The economic impact of the policy measures relates to the cost of installations paying for an increasing share of their emissions as free allocation is reduced. Given that the ETS cap will progressively decline over the 2031-40 period, the availability of free allowances will become scarce in all scenarios, however the overall budget of free allocation and the timing of the phase out vary. As the ETS cap in the policy scenarios is less stringent than the baseline, free allocation is higher except for CL3.

In terms of the economic value of the free allocation provided to these sectors it will depend upon the development of the EUA price over the 2031-40 period, which is assumed at EUR 150 over the 2031-2040. The same price assumption was used for estimating the total financial value of free allocation across all policy options – see table 12.

Table 12: Overview of the 2031-40 free allowances and their economic value in the baseline scenario and the policy measures

	2031-2040
EUR/tCO₂	EUR 150.0

Baseline FA (mil EUAs)	779
Baseline FA value (bn EUR)	EUR 116.9
CL1_PO1 (mil EUAs)	977
CL1_PO1 value (bn EUR)	EUR 146.6
CL2_90_PO2 (mil EUAs)	991
CL2_90_PO2 value (bn EUR)	EUR 148.7
CL2_90_PO2 (CBAM Var) (mil EUAs)	1145
CL2_90_PO2 (CBAM Var) value (bn EUR)	EUR 171.8
CL2_50_PO2 (mil EUAs)	810
CL2_50_PO2 value (bn EUR)	EUR 121.5
CL2_50_PO2 (CBAM Var) (mil EUAs)	992
CL2_50_PO2 (CBAM Var) value (bn EUR)	EUR 148.8
CL3_PO3 (mil EUAs)	487
CL3_PO3 value (bn EUR)	EUR 73.1

Source: Own calculation based upon preliminary NIMs data for 2019-23

1.4.2.1.2. Carbon leakage prevention measures for indirect emissions

Currently, the provision of indirect cost compensation is fragmented across the EU. Under option ICC1, the economic impact in 2031-2040 will depend on whether there is a continuation of the existing State aid encouragement, on how this encouragement is implemented through the relevant State aid rules. Alternatively, it will be affected by the design of a harmonised system (ICC2).

To estimate the scale of the support that may be provided over Phase V of the EU ETS, a quantitative exercise was undertaken based on adjusting recent ICC compensation payments to account for possible developments post-2030. The estimates generated from this exercise must be considered tentative. They explore how today's ICC compensation could be affected by plausible post-2030 developments, but do not model the impacts of the policy options themselves.

Observed ICC payments amounted to EUR 4.1 billion for costs incurred in 2021-2023 on average, ranging from EUR 2.2 billion in 2021 to EUR 5.5 billion in 2023, with the variation explained mainly by increases in the carbon price over this period (see Annex 15 on the ETS Evaluation for additional backward-looking analysis of ICC compensation).

A proxy for potential **increased Member State participation** in ICC compensation was created using Eurostat data on industrial electricity consumption in ICC-relevant sectors¹⁶. This suggested that ICC compensation could increase by 18% if more Member States chose to offer compensation. It implicitly assumes that the new national schemes would adopt the average aid intensity of the existing Member State schemes. Figure 9 suggests that most of this increase would come from Sweden. However, it is important to note that the emissions factors in the

¹⁶ The Eurostat series *nrg_d_indq_n* was used for this purpose. However, this only provides consumption at 2-digit NACE level. Electricity consumption at the appropriate 4-digit and 6-digit level was estimated using production value data from the PRODCOM database as a weighting factor.

current State aid guidelines are likely to overstate the extent of indirect cost in this Member State, since the guidelines assume a single emission factor per Member State¹⁷, while Sweden has four electricity price zones, with a lot of electro-intensive industry located in Northern zones where electricity is cheaper and less carbon intensive.

The potential for **higher aid intensity** by Member States was estimated by using the ratio of ICC payments to relevant industrial electricity consumption over the period 2021-2023. Using this metric, ICC compensation would increase by a further 49% if all Member States were to provide ICC at the same intensity as Germany (the largest provider of aid in absolute terms).

Industrial electricity consumption post-2030 was estimated using a PRIMES model scenario, consistent with an 85% domestic economy-wide reduction in GHG emissions compared to 1990 levels¹⁸. By this metric, average annual electricity consumption in relevant sectors is expected to remain broadly flat in the period 2030-2040, compared to 2020-2025, with a reduction of 2%. This result is driven by an increased consumption due to electrification (especially in iron & steel) combined with reductions driven by energy efficiency improvements in other sectors (e.g. pulp & paper, non-ferrous metals).

Decarbonisation of the power supply is expected to reduce indirect carbon costs post-2030.

Applying an emission factor based on the *GHG intensity of electricity generated by fossil fuels* (in the same PRIMES scenario) is expected to reduce ICC by 14% on average. This is due to expected coal-to-gas switching in the power sector.

Applying a marginal emissions factor could reduce ICC by 58% over the 2030-2040 period due to the expected increased contribution of non-fossil sources in setting electricity prices. This estimate is based on JRC analysis of how marginal price-setting technologies per Member State may evolve up to 2030, combined with a literature-based assumption that fossil-fuel price-setting will fall to 8% of the time by 2040¹⁹.

The **carbon price** is assumed to reach an average level of EUR 150 in the period 2031-2040, compared to EUR 53 used as the basis for ICC calculation in 2021-2023 on average..

Table 13 below shows the **combined impact** of the above estimates for the period 2030-40 on average. It suggests that greater aid provision, from higher participation and/or aid intensity, could increase ICC costs by 76%. Such an increase could result from Member States choosing to offer more State aid (ICC1) or through a harmonised ICC fund (ICC2).

Regarding post-2030 effects, the greatest impact on ICC cost is expected to be a higher carbon price. This would increase both the cost of ICC compensation and the revenues from which it would be financed, although the revenue increase will be partly offset by reduction of the overall cap. On the other hand, this effect could largely be offset by electricity market decarbonisation, provided that i) this leads to a reduction in fossil fuel technologies setting the electricity price, and ii) ICC compensation rules are adjusted to reflect this.

¹⁷ In some cases, the same emission factor covers more than one Member State based on price convergence.

¹⁸ For this purpose, electricity consumption by PRIMES for the following sectors was used: iron & steel, pulp & paper, non-ferrous metals, chemicals, other industrial sectors. The influence of each sectoral projection was weighted according to Eurostat electricity consumption in the period 2021-2023.

¹⁹ JRC analysis is taken from Gasparella et al. (2023). *The Merit Order and Price-setting Dynamics in European Electricity Markets*. Science for Policy Brief JRC134300. 8% assumption for 2040 is based on analysis of price-setting in Germany in Geis et al. (2025). *Price Formation in a Highly-Renewable, Sector-Coupled Energy System*. <https://doi.org/10.48550/arXiv.2509.10092>

Table 13: Decomposition of factors that could affect the total cost of indirect carbon cost compensation post-2030

	Default emission factor		Market-based emission factor	
	% impact	EUR bn	% impact	EUR bn
ICC compensation avg. 2021-2023	-	4.1	-	4.1
increased Member State participation	+18%	4.8	+18%	4.8
higher aid intensity	+49%	6.1	+49%	6.1
<i>participation & aid intensity combined</i>	+76%	7.2	+76%	7.2
industrial electricity consumption 2031-40 avg.	-2%	4.0	-2%	4.0
decarbonisation of power supply 2031-40 avg.	-14%	3.5	-58%	3
carbon price 2031-40 avg.	+174%	11.2	+174%	11.2
<i>post-2030 effects combined</i>	+141%	9.9	+18%	4.8
<i>all impacts combined</i>	+310%	16.8	+102%	8.3

Source: European Commission analysis combining inputs from annual reports on the functioning of the European carbon market, PRIMES, Eurostat, JRC analysis, Geis et al. (2025)

The above estimates imply a level of indirect costs equivalent to 11% to 22% of total ETS revenues in the 2031-2040 period on average, which would constrain other uses of these resources.

In option ICC1, Member States would decide how best to allocate their auction share between ICC compensation and other uses. They may also use other national revenues to fund ICC.

In option ICC2, it is suggested to limit the ICC fund to 5% of total auction revenues in order to provide resources for other uses while offering the benefits of a harmonised approach to ICC to the extent it is covered by the ICC Fund (certainty to firms and reduction in distortion of the single market). Since this level of resource may not fully compensate for the indirect carbon cost faced by industry, Member States would retain the possibility option to provide additional compensation through State aid.

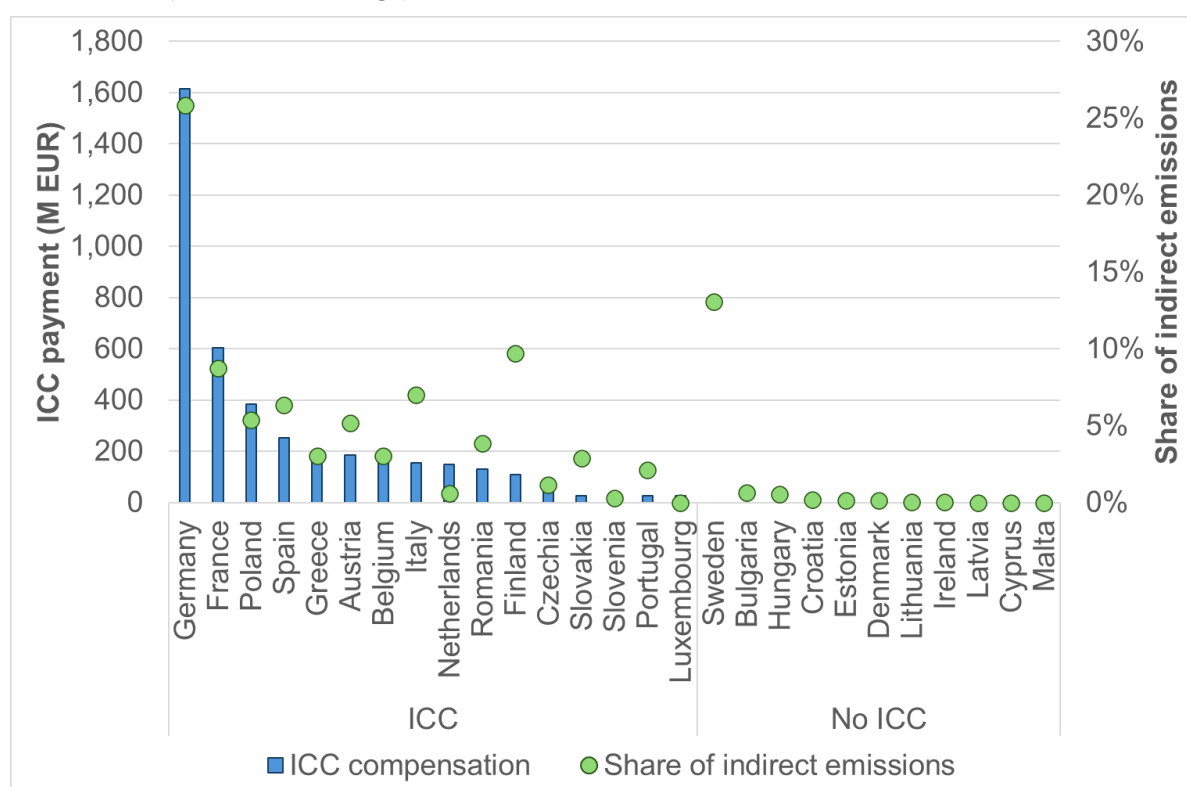
The main economic impact of ICC2 compared to ICC1 would be to provide a minimum level of compensation to electro-intensive industries regardless of where they are located in the EU, thereby reducing the extent of fragmentation of the internal market. The extent to which ICC2 is preferable over ICC1 therefore depends on the extent to which fragmented provision of ICC compensation is a problem and on how this interplays with sufficient financial resources being available for ICC. Figure 9 provides insight into this issue by comparing each Member State's share of indirect emissions (estimated using Eurostat electricity consumption data¹⁹ and emission factors from the State aid guidelines for 2021-2025) against its level of ICC

compensation paid for the period 2021-2023. Share of emissions is used as a proxy for indicating the *potential* demand for compensation within each Member State. It suggests that, in general, the Member States who do not currently provide ICC compensation have little need to do so. Member States where indirect emissions appear high relative to the compensation paid include Spain, Austria, Italy, Romania, Slovakia and Portugal. Indirect emissions also appear high in Sweden and Finland in Figure 9, but the actual indirect emissions and associated cost may be lower in these countries due to zonal electricity pricing in the Swedish case, and industrial consumers generating their own electricity in the Finnish case (especially in the pulp and paper sector²⁰).

It is important to note that offering ICC compensation is a policy choice for each Member State regarding how to use their auction revenues. While the ETS Directive encourages Member States to limit their compensation to 25% of annual auction revenues, the actual share used varies considerably (see Figure 9). Furthermore, each Member State's choice of whether to provide compensation and how much budget to allocate to it can vary year-on-year.

²⁰ Wang M (2024) Does compensating firms for indirect carbon costs work? Evidence from Finnish manufacturing

Figure 9: Comparison of indirect cost compensation and share of indirect emissions per Member State (2021-2023 average)



Source: European Commission annual reports on the functioning of the European carbon market (compensation), own calculation-based Eurostat electricity consumption and emission factors from State aid guidelines (indirect emissions)

In ICC1, each Member State retains the right to choose between ICC compensation and other revenue uses throughout the period to 2040. In ICC2, a share of ETS revenue (that would otherwise have gone to each Member State or to another EU-level instrument) is used to guarantee a certain level of ICC compensation to electro-intensive industries. Therefore, the question of whether to harmonise ICC compensation also represents a choice between providing discretionary resources to Member States vs. providing guaranteed EU-level carbon leakage protection to firms.

1.4.2.2. Administrative costs on businesses

1.4.2.2.1. Carbon leakage prevention measures for direct emissions

According to the Better Regulation Guidelines, the administrative costs consist of two different cost components:

- Business as usual costs (i.e. correspond to the costs resulting from collecting and processing information that would even be done in the absence of any legislation).
- Administrative burdens (i.e. stem from the part of the process which is done solely because of legal obligation).

The following tasks were considered as being an administrative burden on operators related to their application for free allocation:

- Learning of rules, workshops and stakeholder meetings.

- Commission Delegated Regulation (EU) 2019/3312 outlines in Article 4(2) the following particulars that accompany an application for free allocation for allocation data from 2021 onwards from the operator of an incumbent installation (requirements for new entrants are further outlined in Article 5):
 - Baseline data report
 - Monitoring methodology plan
 - Verification report
- Commission Implementing Regulation (EU) 2019/1842 outlines in Article 3(1) that operators of installations to which free allocation has been given, in accordance with Article 10a of Directive 2003/87/EC, for the trading period from 2021 to 2030 shall report annually on the activity level of each sub-installation in the preceding calendar year
- Commission Delegated Regulation – EU – 2024/873 outlines in Article 22a conditionality of free allocation on implementation of energy efficiency improvement measures, in which the operator of an installation must demonstrate that recommendations from energy audits under Article 8 of Directive 2012/27/EU⁵ have been implemented
- Commission Delegated Regulation – EU – 2024/873 outlines in Article 22b conditionality of free allocation on climate neutrality plans to be submitted by the operator of an installation.

In accordance with the EU Standard Cost Model, it was necessary to identify and classify additional administrative obligations as well as any administrative obligations that may also be eliminated by the implementation of the policy measures.

All the policy measures include within their design that the carbon leakage list will not be updated for Phase V and the formula for determining free allocation will no longer include the carbon leakage exposure factor. This simplification will eliminate administrative obligations for ETS operators in all the policy measures, with considerable time spent on administration expected to be saved

Under CL1 there are no new administrative burdens added to ETS operators as the current approach is continued albeit with the modification to the formula for determining free allocation levels because of the discontinuation of the carbon leakage list. The existing obligations for ETS operators (i.e. provision of a baseline data report, monitoring methodology plan and verification plan) would be sufficient to update the existing product benchmarks as under CL1 no change to the current definition of the product benchmarks is considered (so no further inputs into an update of benchmarks would be required and therefore CL1 is not associated with additional administrative obligations).

New administrative requirements would, however, be introduced under CL2. Under this policy measure, it is expected that the conditionalities introduced for the period 2026-2030 would be expanded to include more ETS operators in Phase V of the EU ETS. The following complementary actions have been identified because of the additional administrative obligations:

- Time spent on learning rules, workshops, stakeholder meetings
- Time spent demonstrating that all recommendations from energy audits under Article 8 of Directive 2012/27/EU have been implemented

- Time spent preparing and submitting a carbon neutrality plan

Defining the target group and the frequency of the obligated actions are required as part of the assessment of additional costs using the EU Standard Cost Model.

Given that the extension of the conditionality requirement would be subject to further assessment, for the purpose of the impact assessment a range was used to identify the target group. It was assumed that the number of ETS operators that were subject to the conditionalities as applied in 2026-30 would increase by between 20% and 40% for 2031-40.

The frequency of the required action would remain unchanged and so, for example, demonstrating that recommendations from energy audits have been implemented or the submission of climate neutrality plans would be a one-off activity at the start of Phase V.

To estimate the additional administrative cost of the complementary actions outlined above for CL2, a survey was developed and circulated to industrial stakeholders to provide information on the time spent (in person hours) on average, per year in 2021-24.

Respondents indicated that they spent on average:

- 33 person/hours on learning rules, workshops, stakeholder meetings (median value: 15 person/hours) out of 83 total responses.
- 17 person/hours on demonstrating that all recommendations from energy audits under Article 8 of Directive 2012/27/EU have been implemented (median value: 6 person/hours) out of 76 total responses.
- 19 person/hours on preparing and submitting a carbon neutrality plan out of 69 total responses.

Considering an average cost of labour across Member States of EUR 40/hour (based on Eurostat data on Labour cost for LCI by country and industry for 2024), the average administrative cost per tonne of CO₂ is EUR 0.02, which represent a very small share (approximately 0.026%) of the carbon price (assumed to be EUR 64.74, which was the average price of a EUA in 2024 and is expected to be a conservative value).

To estimate the administrative cost, it is necessary to then scale the administrative cost per tonne by projected ETS industrial emissions in 2031 (i.e. around 400 Mt) and this results in an illustrative one-off administrative cost of around 8 M EURs. This is negligible compared to the estimated value of free allocation.

The stakeholder consultation revealed very strong views from industrial associations opposing the expansion of conditionality requirements for free allocation. In interviews and position papers, the argument was consistently advanced by these stakeholders that the purpose of free allocation is to protect industry from carbon costs and that it is not an instrument to directly influence other objectives such as promoting investments in low carbon technologies. Whilst this may indeed be seen as complementary and necessary to reduce industry's exposure to the carbon price over Phase V, it was nevertheless a matter of principle for some stakeholders that the inclusion of conditionality requirements is not consistent with the original purpose of free allocation provision. However, results from the OPC also showed support for conditionality, mainly among companies and business associations from the energy sector and NGOs. Overall, making free allocation conditional on taking steps towards carbon neutrality was the fourth most frequently indicated preference (13% of all responses) to the question "on what basis

should free allocation be provided beyond 2030 for sectors not covered by the CBAM” (multiple options could be selected).²¹

Article 10a of the ETS Directive specifies that the free allocation rules shall be based on benchmarks, which account for the 10% most efficient installations, to provide incentives for reductions in greenhouse gas emissions and energy efficient techniques (by considering inter alia the most efficient techniques, substitutes and alternative production processes). It also states that free allocation shall not provide incentives to increase emissions. In this spirit, the option of placing mitigation-related conditions on free allocation is retained in this impact assessment.

In practical terms, industrial stakeholders commented frequently in both the OPC and interviews with industrial associations that any expansion of conditionality would add significant administrative burdens to ETS operators. Indeed, this view is consistent with the findings of the impact assessment that PO2 adds the highest additional administrative cost out of the policy options under consideration albeit the value is expected to be very low in comparison to the EUA price.

Given that free allocation would be phased out for non-CBAM sectors by 2034 and the time schedule for the reduction in the volume of free allowances received by ETS operators would be based on a declining share of their total verified emissions, it is to be expected that CL3 would result in a reduction in the administrative burden of businesses as they would no longer have the cost of applying for free allocation beyond 2034 and in the preceding years the input required would come from existing obligations (i.e. provision of a baseline data report, monitoring methodology plan and verification plan). It is important to add that whilst indeed the administrative costs would be lower if CL3 was adopted, this would lead to much higher carbon costs.

1.4.2.2.2. Carbon leakage prevention measures for indirect emissions

For ICC compensation, Option ICC1 would not involve significant change to the administrative cost for private sector. In this option, monitoring, reporting, verification and conditions for receiving support are elaborated in successive iterations of State aid guidelines.

Option ICC2 would create an additional administrative burden in cases where an installation receives support both from national State aid and from a harmonised EU system. ICC2 may also cover more firms than ICC1 (installations in Member States that do not offer national State aid), leading to administrative costs for these firms (but also benefits in the form of ICC compensation).

1.4.2.3. SMEs

1.4.2.3.1. Carbon leakage prevention measures for direct emissions

The SME test was applied to identify and assess the impact of the policy measures (related to direct emissions) on SMEs. In accordance with the better regulation guidelines, the SME test comprises the following components:

- Identification of affected businesses

²¹ Refer to the synopsis report documenting the stakeholder engagement strategy for the evaluation and impact assessment.

- Consultation of SME stakeholders
- Assessment of the impact on SMEs
- Minimising negative impacts on SMEs

In a first step, the businesses most likely to be affected by the policy measures were identified by using the preliminary NIMs dataset to categorise sub-installation information for selected non-CBAM sectors into different tCO₂ emission ranges. However, SMEs cannot be directly identified from the ETS data available and therefore proxy measures based on low emissions or low power consumption are adopted for the SME test.

For the non-CBAM sectors selected shown in Figure 10, the lime and refined oil sectors have the lowest shares of their total sub-installations that emit under 5,000 tCO₂ (under 20% and around 20% respectively) while the ceramics and paper and paperboard sectors have the highest shares accounting for over 60% and 50% of their total sub-installations respectively. The chemical sectors both organic and inorganic are within this range with a 34% and 36% share of their total sub-installations that emit under 5,000 tCO₂ respectively.

The distribution of emissions across the different categories highlights some further key insights:

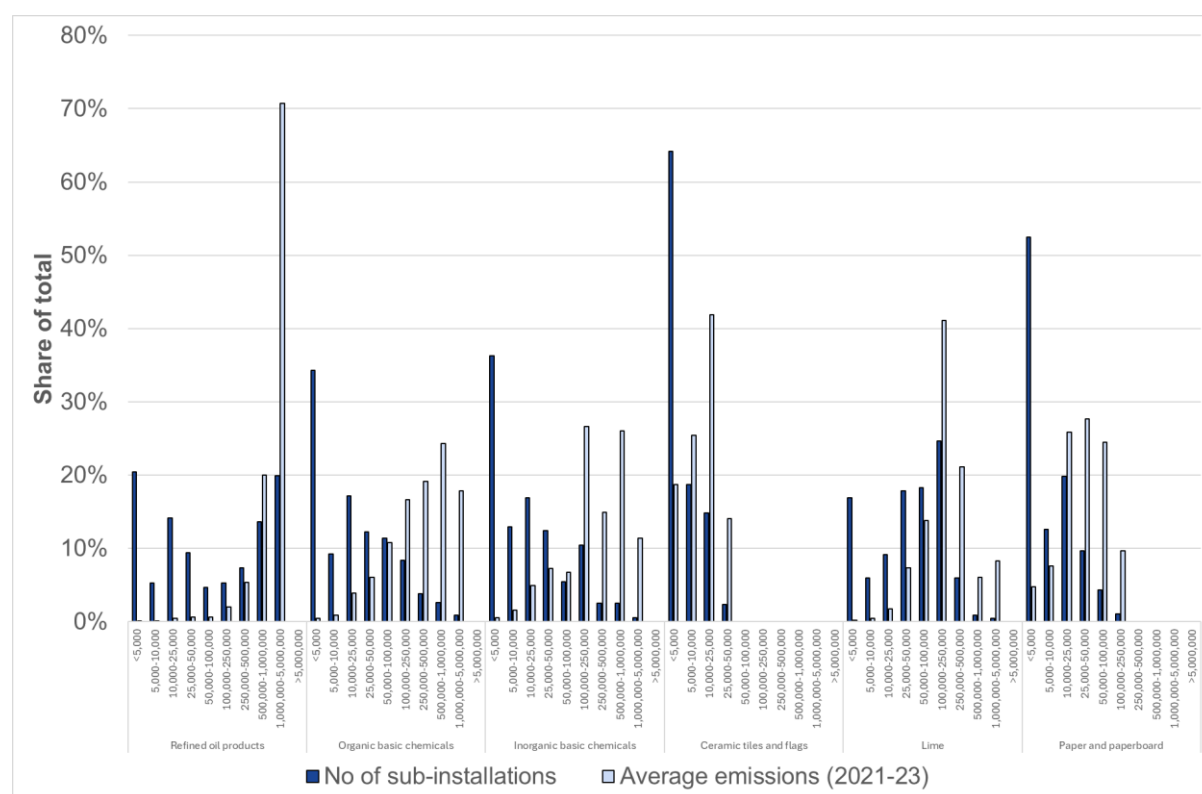
- Around 70% of the refined oil sector's average 2021-23 emissions were generated by around 20% of their total number of sub-installations that emitted CO₂ above 1,000,000t.
- Around 77% of the lime sector's average 2021-23 emissions were generated by around 32% of their total number of sub-installations that emitted CO₂ above 1,00,000t.
- Both inorganic and organic chemical sectors have a more even distribution of emission categories that contribute to their total emissions but still around 61% and 52% respectively of their average 2021-23 emissions were generated by around 7% and 5% respectively of their total number of sub-installations that emitted CO₂ above 250,000 t.
- Around 86% of the paper and paperboard sector's average 2021-23 emissions were generated by around 46% of their total number of sub-installations that emitted CO₂ below 100,000t.
- Around 81% of the ceramic sector's average 2021-23 emissions were generated by around 36% of their total number of sub-installations that emitted CO₂ below 50,000t.

The analysis of the preliminary NIMs dataset confirms that SMEs are likely to be impacted by the policy measures to phase out free allocation but that the impact on SMEs is likely to vary by non-CBAM sector.

SME stakeholders were represented by their sector associations in the stakeholder interviews as well as having the opportunity to submit their views within the OPC itself. In terms of the impact of the policy measures on SMEs within the non-CBAM sectors, the consultation exercise collected evidence that the concerns raised (i.e. increased direct carbon costs and a loss of international competitiveness) are very similar in nature to larger emitters but that the magnitude of the impact may be greater. It is to be expected that CL1 will have less of a negative impact on SMEs than CL2 or CL3 given that the non-CBAM sectors receive more free allowances under the current approach without imposing additional requirements under CL2 to comply with conditionalities or receiving less allowances under the more rapid phase out of free allocation envisaged under CL3 to align with CBAM sectors. Indeed, interviews

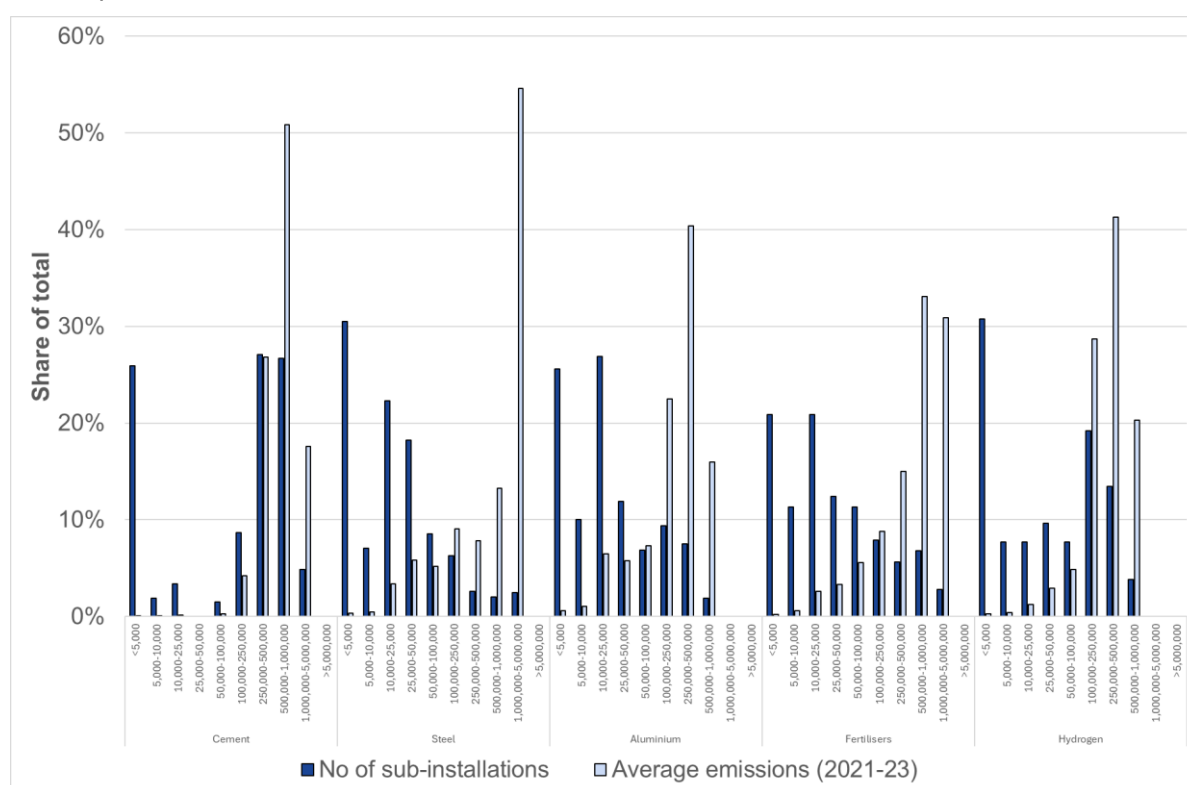
with industrial stakeholders confirmed that the introduction of further conditionalities as envisaged in CL2 would impose some additional administrative costs on operators and that these would impact SMEs more. Given the strong insistence from industrial sectors for the continuation of free allocation their view that measures to more rapidly phase out free allocation as under CL3 would increase the risk of carbon leakage and that this risk would be greater for SMEs.

Figure 10: Share of sub-installations and emissions (average 2021-23) by category size in tCO₂ for selected non-CBAM sectors



Source: Own calculation based upon preliminary NIMs data for 2019-23

Figure 11: Share of sub-installations and emissions (average 2021-23) by category size in tCO₂ for selected CBAM sectors



Source: Own calculation based upon preliminary NIMs data for 2019-23

To minimise the impact of the policy measures on SMEs, it was frequently advocated by industrial stakeholders to extend the opt-out eligibility for small emitters, subject to national measures that will achieve an equivalent contribution to emission reductions, under Article 27 of the ETS Directive. An increase in this threshold from 25,000 tCO₂/year to 50,000 tCO₂ per year was often referred to in the inputs provided under both the OPC and during subsequent interviews with industrial associations. This proposal would reduce the administrative burden for smaller emitters by:

- Simplifying monitoring requirements.
- Removing requirements for smaller emitters to hold an EU registry account.
- No requirements to fulfil third-party verification of emissions data.

The argument was made repeatedly by industrial stakeholders that such an extension of the opt out eligibility under Article 27 would significantly reduce reporting and compliance burdens on SMEs without jeopardising the overall environmental aims of the system.

Such an increase in the exclusion threshold would mean that for some sectors like ceramics, most of their emissions will be excluded from the scope of the ETS and covered by equivalent national measures instead. The assessment of these national measures however goes beyond the scope of this impact assessment.

1.4.2.3.2. Carbon leakage prevention measures for indirect emissions

Like the previous subsection, the SME test was applied to identify and assess the impact of the policy measures related to indirect emissions on SMEs.

In a first step, the businesses most likely to be affected by the policy measures were identified by using the preliminary NIMs dataset to categorise installation information for selected sectors into different electricity consumption ranges with a focus on the sectors selected that are currently eligible for indirect cost compensation under Annex I of the Guidance on certain state aid rules.²² See Figure 12 below. While it is assumed that smaller installations are more likely to be operated by SMEs, there is no specific SME threshold.

Only 3% of the refined oil sector's total number of installations annually consumed under 5,000 MWh.²³ In contrast, the share of the total number of installations that annually consumed under 5,000 MWh on average between 2021 and 2023 was much higher in the manufacture of other inorganic basic chemicals, aluminium production, the manufacture of basic iron and steel and ferro-alloys and copper production accounting for 35%, 32%, 24% and 20% respectively. Given the higher share of installations annually consuming electricity under 5,000 MWh it is more likely that any change to indirect cost compensation will have a greater impact on SMEs in these sectors relative to the other sectors that are also eligible for indirect cost compensation. It should also be noted that the manufacture of lead, zinc and tin production has a high share of installations consuming between 5,000 MWh and 10,000 MWh of electricity on average between 2021 and 2023 indicating that SMEs in this sector may also be impacted more by changes to indirect cost compensation.

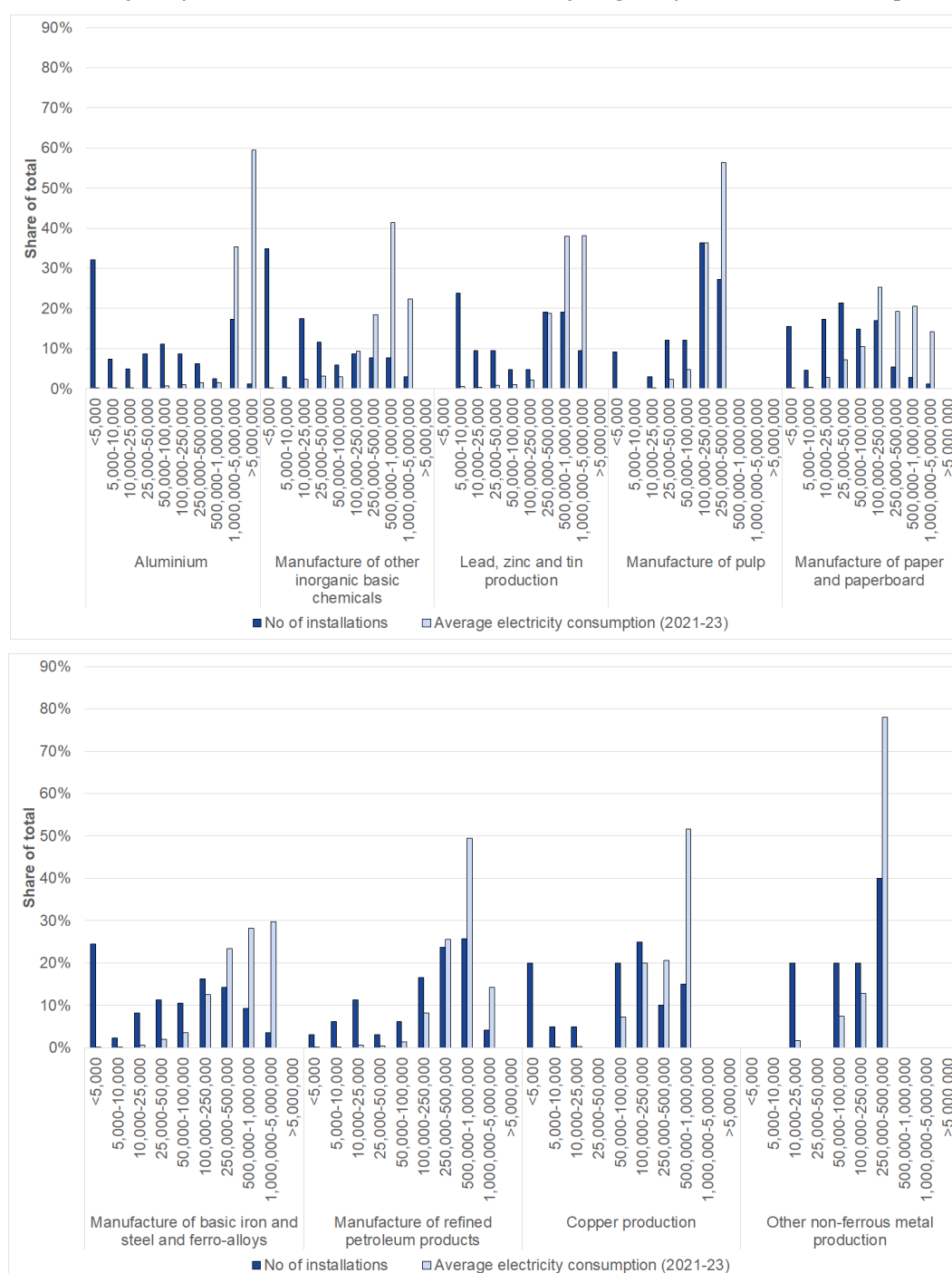
The analysis of the preliminary NIMs dataset confirms that SMEs are likely to be impacted by the policy measures related to indirect cost compensation but that the impact on SMEs is likely to vary by sector. The impact on SMEs will also depend upon the extent to which their production process is electrified, and the level of electrification varies across and within sectors.

SME stakeholders were represented by their sector associations in the stakeholder interviews as well as having the opportunity to submit their views within the OPC itself.

²² Refer to [https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:E2021X0415\(01\)\)](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:E2021X0415(01)))

²³ The 5,000 MWh threshold does not refer to any specific legislation but is how the data is presented. So it is more likely that sub-installations below this threshold are SMEs.

Figure 12: Share of installations and electricity consumption (average 2021-23) by category size in MWh/ year for selected sectors that are currently eligible for indirect cost compensation



Source: Own calculation based upon preliminary NIMs data for 2019-23

1.4.2.4. Sectoral competitiveness, trade and investment flows

1.4.2.4.1. Carbon leakage prevention measures for direct emissions

Stakeholder consultation

During the stakeholder consultation with industry, the increase in the carbon price in recent years has been highlighted by industrial associations as a key reason for the continuation of free allocation into Phase IV of the EU ETS.

There was a strong consensus during the interviews with industrial stakeholders that phasing out free allocation between 2031 and 2040 would be very likely to have a detrimental impact on their competitiveness if enabling conditions are not available to support the shift in production processes to low carbon alternatives. Although the circumstances of industry varied, there was a commonly expressed view throughout the stakeholder consultation that the carbon cost is an additional cost that puts them at a disadvantage compared to international competitors based in jurisdictions with less stringent climate policies.

In terms of assessing the impact of the policy measures, the impact will vary depending upon the volume of EUAs distributed to each sector, the stringency of conditionality upon free allocation, or if the phase out of free allowances for non-CBAM sectors is aligned with the time schedule for CBAM sectors. More broadly the impact of these policy options will depend on the success of the EU ETS and other complementary policies in decarbonising industry and facilitating decarbonisation investments, thereby reducing industries' direct and indirect carbon costs.

Industrial stakeholders during the consultation consistently argued that in many cases the unit cost of production is higher for products manufactured in the EU compared to international competitors. It was widely acknowledged that the key issue, driving such a differential in production cost in recent years, relates to dramatic shifts in the energy market following unexpected external events such as the global pandemic and subsequent geo-political volatility (i.e. illegal Russian invasion of Ukraine). The issue of competitiveness is further complicated by overcapacity in certain international markets and considerable changes in trading tariff regimes with certain key partners. While these developments are indeed very valid concerns that were expressed by industrial stakeholders, they are primarily addressed by other EU policies, and the scope of this assessment is limited to the impact of measures related to changes in the provision of support to protect against carbon leakage.

There was an acknowledgement by several industrial stakeholders during the interviews that the carbon price has not necessarily been the driving factor in the differential in the unit production cost between the EU and international competitors that has emerged in recent years. It was, however, consistently argued by several industrial stakeholders that the EU carbon cost exacerbates an already unfavourable situation for EU producers and that the carbon price will have a greater impact if levels of free allocation decline without alternative measures in place to support industry with the decarbonisation required to avoid carbon costs in the future.

An important topic in this regard is the use of allowance revenue to solely be used to support industry, which was a frequent position advocated by industrial stakeholders during the consultation. As highlighted previously when discussing impacts of the measures on competitiveness, ultimately it will require the state and private sector to work together to ensure the enabling conditions (i.e. availability of green hydrogen, infrastructure for CCUS, availability of low cost and low carbon electricity, market demand for low carbon products) are available so that the ambitious trajectories already outlined by industrial sectors for their decarbonisation are achieved.

Other measures and initiatives announced by the European Commission, such as the Industrial Accelerator Act, the European Grids Package, or the CO2 Infrastructure Package will further complement the EU ETS and drive the process of industrial decarbonisation.

The impact of phasing out free allocation on the competitiveness of industry is more nuanced. According to the stakeholders consulted, it will ultimately depend upon enabling conditions. For example, stakeholders across sectors pointed out that an increased exposure to a higher carbon price will not on its own be sufficient to make the deployment of necessary technologies

viable. Industrial stakeholders argued strongly that without complementary policies to support the deployment of abatement potentials the concern is that there will be deindustrialisation rather than decarbonisation. The main issues raised that industry believe is beyond their direct control to influence included the following:

- Availability of financial funding to support CAPEX and OPEX
- Availability of low carbon electricity at competitive prices
- Availability of green hydrogen
- Availability of biofuels
- Availability of a support infrastructure for CCS

The ability to finance investments in these areas is partly linked to the phase-out of free allocation, since alternative uses within the EU ETS determines some of the support available for decarbonization through EU-wide instruments (such as the Innovation Fund and Industrial Decarbonisation Bank) and from Member States' shares of auction revenues.

Beyond mechanisms linked to EU ETS, the argument was consistently advanced from a range of industrial stakeholders that the success of the transition to a net-zero economy will depend upon there being sufficient demand in the future for low carbon goods within the EU. If such a market is not supported then, in a worst-case scenario, industry fear decarbonising their production processes and then being out competed on price by international competitors on the EU market. In addition to the carbon leakage measures considered in this chapter, these risks are also being addressed by the introduction of the Carbon Border Adjustment Mechanism and ongoing efforts to develop lead markets in the context of the Clean Industrial Deal.

GEM-E3 model results provides insights into how alternative ETS design choices translate into heterogenous sectoral and macroeconomic impacts, relative to the baseline scenario by taking into consideration key drivers within scenario assumptions such as the different free allocation distributions across industry, as well as the different ETS coverage and cap stringency and alternative revenue recycling. The policy scenarios assessed by the GEM-E3 model are described in section 1.4.1.

Changes in the unit cost of production (Table 14) are driven by specific scenario assumptions namely: (i) different shares of free allocation, with highest shares in PO2_90, (ii) changes in carbon prices, notably in PO2 and PO3 where carbon prices are lower than the baseline, (iii) other scenario implications of waste inclusion in the EU ETS (iv) the impact arising from revenue recycling. The dominant driver of the sectoral effects varies between these four mechanisms across sectors.

Chemical products, which receive the largest share of additional free allocations, exhibit the steepest decline in unit production costs under the policy measures. Among the policy measures, PO3 shows the highest reduction in production costs relative to the baseline, despite the full phase-out of free allowances after 2034. This improvement in competitiveness is driven by the inclusion of waste emissions in the EU ETS, specifically the inclusion of landfills under PO3, relaxing the ETS constraint and thereby reducing the carbon price need to meet the EU ETS cap and hence the unit cost of production for PO3. By contrast, policy options with alternative revenue recycling (PO3R and PO1R) exhibit lower competitiveness, as redirecting revenues away from power-sector investment towards households increases domestic demand, which in turn raises both capital and labour costs. Ferrous metals and paper products publishing sectors under PO2 experiences an increase in unit production cost as higher electricity costs offsets the benefits from free allocation (which are lower compared to other sectors) and lower

labour and capital costs. It is noteworthy that when free allocation is extended to both CBAM and non-CBAM sectors, ferrous metals sector becomes more competitive compared to cases when only non-CBAM sectors received free allocation. This effect is driven by near doubling of free allocations when moving from PO2_50 and PO2_90 to PO2_50C and PO2_90C, respectively. Overall, the impact on unit production costs across policy measures and sectors relative to the Reference ranges from -0.18% to 0.19%.

Table 14: Percentage change in the unit cost of production relative to the baseline scenario (2040)

	Policy measures							
	PO1 (%)	PO1R (%)	PO2_50 (%)	PO2_50C (%)	PO2_90 (%)	PO2_90C (%)	PO3 (%)	PO3R (%)
Ferrous metals	-0.01	0.16	0.05	0.01	0.05	0.01	-0.01	0.10
Non-ferrous metals	-0.03	0.12	0.00	-0.02	-0.01	-0.02	-0.08	0.04
Chemical Products	-0.17	0.00	-0.07	-0.07	-0.12	-0.12	-0.18	-0.09
Paper products, publishing	0.04	0.19	0.03	0.05	0.05	0.06	-0.02	0.11
Non-metallic minerals	-0.03	0.13	0.00	-0.02	-0.01	-0.03	-0.05	0.08

Source: GEM-E3 model (2025)

Table 15 below shows the effects on unit cost of production when using the 90-85% cap pathway (see section 1.3.1.1), compared with the reference scenario of 85% linear trajectory. This scenario shows that for most sectors, the more ambitious cap trajectory results in some decrease in EU27 emissions and increases in the non-EU27 emissions in 2035, indicating a marginally higher production costs. The differences in the results for 2040 are marginal or 0.

Table 15: Percentage change in unit cost of production levels for variants CL290_9085 and CL290C_9085 compared to scenarios CL2_90 and CL2_90C.

	2035		2040	
	CL2_90_9085	CL2_90C_9085	CL2_90_9085	CL2_90C_9085
Ferrous metals	0.00%	0.07%	0.00%	0.00%
Non-ferrous metals	0.02%	0.04%	0.00%	0.00%
Chemical Products	0.11%	0.10%	0.00%	0.00%
Paper products, publishing	0.03%	0.00%	0.00%	0.00%
Non-metallic minerals	0.03%	0.05%	0.00%	0.00%

Source: GEM-E3 model (2025)

Production and exports respond heterogeneously across policy options relative to the baseline scenario, reflecting differences in free allocation, sectoral coverage, and revenue recycling (Tables 16 and 18). Chemical products and non-metallic minerals, which experience reductions in unit production costs relative to the baseline, face higher domestic and external demand and therefore record higher levels of both production and exports across the policy options. PO3 also exhibits higher production and export levels relative to the Reference due to lower unit cost of production. By contrast, policy options with alternative recycling (PO3R and PO1R) show lower production and export level due to reduced competitiveness. Non-ferrous metals, chemical products, and non-metallic minerals display higher production and export levels due to improved competitiveness under PO2 scenarios. On the contrary, ferrous metals become competitive leading to higher production and exports only when free allocation is extended to both CBAM and non-CBAM sectors. Overall, the impact on production and export across policy measures and sectors relative to the baseline ranges from -0.56% to 1.61% for production and -1.09% to 4.63% for exports.

Table 16: Percentage change in production levels in 2040 relative to the baseline scenario

	Policy measures							
	PO1 (%)	PO1R (%)	PO2_50 (%)	PO2_50C (%)	PO2_90 (%)	PO2_90C (%)	PO3 (%)	PO3R (%)
Ferrous metals	-0.02	-0.56	-0.08	0.21	-0.08	0.16	0.20	-0.23
Non-ferrous metals	0.26	-0.40	0.12	0.26	0.20	0.31	0.60	0.04
Chemical Products	1.15	0.74	0.60	0.69	0.95	1.03	0.66	0.44
Paper products, publishing	0.01	-0.05	-0.03	-0.04	-0.03	-0.03	0.02	-0.01
Non-metallic minerals	1.08	0.73	0.72	1.39	1.05	1.61	1.30	1.03

Source: GEM-E3 model (2025)

Table 17 below shows the effects on production levels when using the 90-85% cap pathway (see section 1.3.1.1), compared with the reference scenario of 85% linear trajectory. This scenario shows that for most sectors, the more ambitious cap trajectory results in some decrease in EU27 emissions and increases in the non-EU27 emissions in 2035, indicating a marginally lower production levels. The differences in the results for 2040 are marginal or 0 in most sectors.

Table 17: Percentage change in production levels for variants CL290_9085 and CL290C_9085 compared to scenarios CL2_90 and CL2_90C.

	2035		2040	
	CL2_90_9085	CL2_90C_9085	CL2_90_9085	CL2_90C_9085
Ferrous metals	0.00%	0.07%	0.00%	0.00%
Non-ferrous metals	0.02%	0.04%	0.01%	0.01%
Chemical Products	0.11%	0.10%	0.06%	0.06%

Paper products, publishing	0.03%	0.00%	0.00%	0.00%
Non-metallic minerals	0.03%	0.05%	0.04%	0.04%

Source: GEM-E3 model (2025)

Table 18: Percentage change in export levels in 2040 relative to the baseline scenario

	Policy measures							
	PO1 (%)	PO1R (%)	PO2_50 (%)	PO2_50C (%)	PO2_90 (%)	PO2_90C (%)	PO3 (%)	PO3R (%)
Ferrous metals	0.08	-1.09	-0.23	0.81	-0.20	0.6	0.55	-0.23
Non-ferrous metals	0.49	-0.39	0.23	0.47	0.37	0.57	0.96	0.24
Chemical Products	1.59	0.93	0.85	0.96	1.33	1.42	0.92	0.53
Paper products, publishing	-0.06	-0.50	-0.08	-0.14	-0.09	-0.14	0.07	-0.32
Non-metallic minerals	2.96	2.04	2.12	4.02	3.02	4.63	3.86	3.06

Source: GEM-E3 model (2025)

Table 19 below shows the effects on sectoral export levels when using the 90-85% cap pathway (see section 1.3.1.1), compared with the reference scenario of 85% linear trajectory. This scenario shows that for most sectors, the more ambitious cap trajectory results in some decrease in EU27 emissions and increases in the non-EU27 emissions in 2035, indicating a marginally lower export levels, with steepest decrease for non-metallic minerals. The differences in the results for 2040 are marginal or 0 in most sectors.

Table 19: Percentage change in sectoral export levels for variants CL290_9085 and CL290C_9085 compared to scenarios CL2_90 and CL2_90C.

	2035		2040	
	CL2_90_9085	CL2_90C_9085	CL2_90_9085	CL2_90C_9085
Ferrous metals	-0.66%	-0.64%	0.02%	0.02%
Non-ferrous metals	-0.47%	-0.46%	0.03%	0.03%
Chemical Products	-0.48%	-0.48%	0.08%	0.08%
Paper products, publishing	-0.03%	-0.03%	0.00%	0.00%
Non-metallic minerals	-1.84%	-1.79%	0.11%	0.12%

Source: GEM-E3 model (2025)

Table 20 shows the percentage change in GDP and the contribution of its components to this change. In all policy options, GDP in 2040 increases relative to the baseline scenario, reflecting positive macroeconomic effects driven by higher exports and/or increased private consumption, depending on the scenario. The GDP increase ranges from 0.00% under PO2_50 to 0.08% under PO3R. All scenarios with alternative recycling schemes show higher GDP growth, with PO3R in particular, with the latter achieving the highest GDP level due to the combined effect of a lower carbon price and stronger household demand stimulated by lump-sum recycling of EU ETS revenues.

In all scenarios except those with alternative recycling schemes, an improvement in EU27 competitiveness is observed, reflected in higher exports. This outcome is driven by a higher allocation of free allowances to EU ETS sectors (e.g. PO1), and/or lower carbon prices required to meet the cap because of including waste emissions in the EU ETS (e.g. PO3). In the recycling scenarios, private consumption is the main driver of GDP growth, reflecting the lump-sum transfer of EU ETS revenues to households. In these cases, exports decline due to higher labour and capital costs, which arise from increased household demand and upward pressure on factor prices. In PO2 scenarios, private consumption drops marginally.

Table 20: Percentage change in GDP and its components in 2040 relative to baseline scenario

	PO1 (%)	PO1R (%)	PO2_50 (%)	PO2_50C (%)	PO2_90 (%)	PO2_90C (%)	PO3 (%)	PO3R (%)
GDP	0.03	0.07	0.00	0.01	0.01	0.02	0.05	0.08
Investment	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01
Government consumption	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Private consumption	0.03	0.22	-0.03	-0.03	-0.03	-0.02	-0.03	0.18
Exports	0.03	-0.06	0.04	0.04	0.05	0.05	0.08	-0.03
Imports	-0.03	-0.10	0.00	-0.01	-0.01	-0.01	0.01	-0.07

Source: GEM-E3 model (2025)

Free allocation was always intended to be transitory in nature so its continuation into Phase V in all the policy measures under consideration shows an acknowledgement by the Commission that the non-CBAM sectors will require further support to decarbonise in what is a very challenging operating environment. However, the trajectory of the ETS cap means that the extent to which free allocation continues to be distributed based on the existing free allocation rules, will increasingly become less relevant if the annual amount of preliminary free allocation calculated exceeds the annual free allocation budget and the cross sectoral correction factor is applied in most years – see Table 21.

Table 21: Estimated CSCF under the different carbon leakage prevention measure of the total volume of free allowances available under the baseline and policy scenarios for 2031-40

	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
CSCF Baseline	0.86	0.76	0.65	0.55	0.44	0.39	0.26	0.14	0.02	0.00
CSCF CL1	0.83	0.76	0.69	0.61	0.54	0.55	0.49	0.43	0.36	0.30
CSCF CL2_90	0.88	0.82	0.75	0.69	0.61	0.61	0.53	0.45	0.37	0.30
CSCF CL2_50	0.92	0.88	0.85	0.85	0.75	0.74	0.64	0.55	0.45	0.36
CSCF CL3	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: Own calculation

1.4.2.4.2. Carbon leakage prevention measures for indirect emissions

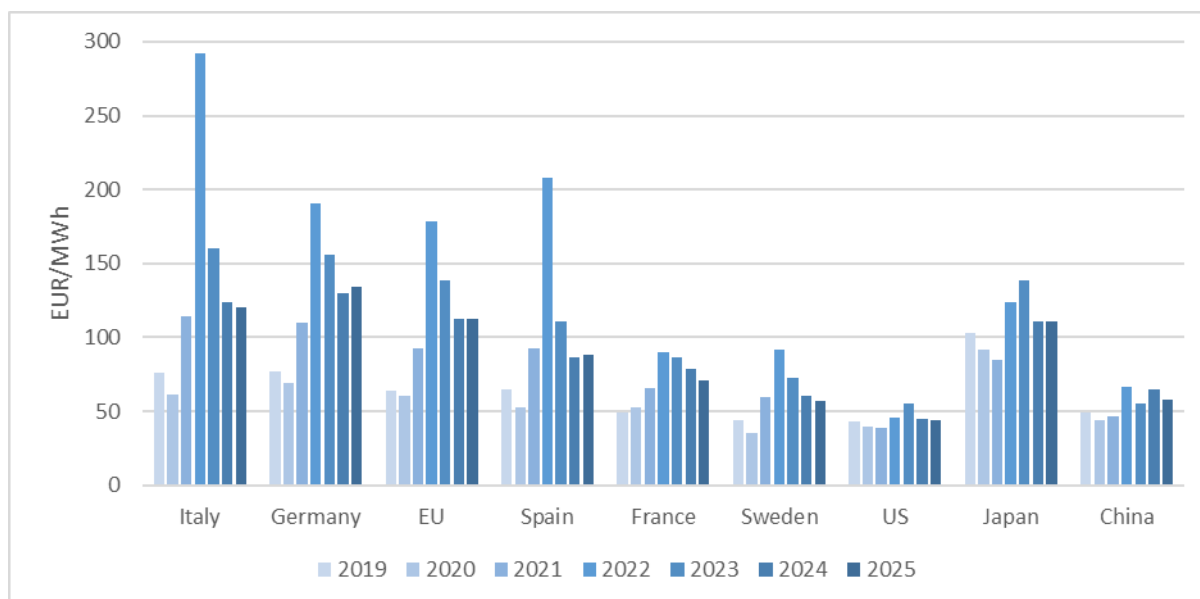
The main effect of continuing to provide ICC compensation would be to alleviate the risk of carbon leakage and incentivise electrification by compensating for some of this cost. It is therefore an important contributor to the competitiveness of electro-intensive processes within sectors, particularly for as long as direct emitting processes continue to receive free allocation and/or fossil fuels continue to act as the marginal generator, thereby exerting a greater influence on electricity prices than their generation share would suggest.

Option ICC1 would ensure that this benefit continues, subject to each Member State's decision regarding the granting of State aid.

Option ICC2 would bring additional competitiveness benefits to some installations (those who would not have received State aid under ICC1). However, this benefit would need to be weighed against the additional administrative burden associated with a standalone ICC fund.

During the stakeholder consultation with industry, the differential between electricity prices in the EU-27 with international competitors was often cited as having a negative impact on their levels of competitiveness. While industrial electricity prices in the EU are generally high compared to US and China, this gap has narrowed since the height of the energy crisis in 2022 and is smaller in Member States with a larger non-fossil share in electricity generation, as shown in Figure 13. European Commission analysis has indicated that carbon costs accounted for up to 11% of industrial energy prices in the EU on average in 2025, with fuel costs, network charges and taxes each accounting for a larger share.

Figure 13: Estimated electricity price for large industrial consumers



Source: European Commission: Derived from IEA Electricity 2026 for US, Japan and China²⁴, Others: EUROSTAT²⁵

The issue of indirect carbon costs was often raised by industry as this is often a cost that they have no direct control over and this will instead depend upon efforts to decarbonise the electricity grid in a way that also ensures the price of electricity does not become excessively high in comparison to industrial competitors. The continuation of indirect cost compensation was therefore consistently supported by industrial stakeholders during the consultation, with 74% of respondents to the OPC considering that indirect cost compensation should remain after 2030 to address the risk of carbon leakage from carbon costs passed on in electricity prices (in sectors where indirect emissions are not covered by CBAM).

Stakeholders, including in sectors not currently eligible for ICC compensation, considered it necessary to offset the high electricity costs in Europe in comparison to international competitors and it was argued that without the continuation of such support the viability of current electro-intensive production processes would increasingly become at risk of closure in the future. On this point, it is important to note that ICC compensation addresses only addresses the pass through of carbon costs to electricity consumers. Other high price drivers will need to be addressed by other means such as infrastructure improvements (e.g. the European Grids Package²⁶) or other types of State aid (e.g. the Temporary Electricity Price relief available under the Clean Industrial Deal State Aid Framework²⁷).

²⁴ Note from IEA Electricity 2026: “Values for 2025 are preliminary. The final electricity price for US is based off the final electricity for industry in Texas. The final electricity price for China is based off the final electricity for industry in Inner Mongolia. The prices for the United States and China are indicative of the average reported prices, individual industries depend on their energy consumption levels and where they are located.”

²⁵ ESTAT NRG_PC_205, band IG (150 000 MWh or over), 2025 is based only on the first semester

²⁶ Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, 'European Grids Package', COM (2025)1005 final;
Communication from the Commission, Framework for State aid measures to support the Clean Industrial Deal. C/2025/3602

Many industrial stakeholders expressed support for the harmonisation of indirect cost compensation in principle. Overall, 39% of respondents supported harmonising the system for compensating indirect carbon costs at EU level, in response to the OPC question²⁸ if indirect cost compensation will remain necessary after 2030 to address the risk of carbon leakage from carbon costs passed on in electricity prices (in sectors not covered by the CBAM). This response was mainly from sectors and sub-sectors currently not eligible for indirect cost compensation, which could indicate that respondents believed harmonisation would involve expansion of the eligible sectors. Subsequently (and separately), additional sectors were made eligible for ICC compensation in the amendment of State aid guidelines for the period 2025-2030.

A harmonised system with a common ICC Fund would not amount to State aid. The extent to which specific firms and sectors would benefit would depend on the generosity of a harmonised system compared to the support they would otherwise receive from national State aid schemes.

1.4.2.5. Impact on innovation and technological development

1.4.2.5.1. Carbon leakage prevention measures for direct emissions

The provision of free allocation limits industry's exposure to the carbon price signal. On the one hand, this may reduce the incentives within industry to abate their emissions. The historical rate of improvement in specific emissions across industry has been limited (with some notable exceptions such as the rapid reduction in emissions from nitric and adipic acid production over Phase III of the EU ETS). On the other hand, free allocation, conditioned on making investments and combined with a long-term perspective of increasing carbon prices may act as an incentive for decarbonization investments, provided a broader enabling framework is in place.

In theory, the phasing out of free allocation over 2031-40, as considered in all the policy measures, could have a positive impact on innovation and technological development by increasing the exposure of industrial producers to a rising carbon price as the ETS cap progressively declines. Given that CL3 is associated with the lowest free allocation budget and the fastest phase out, it would rationally result in the biggest impact in terms of innovation and technological development. However, the extent to which a greater exposure to the carbon price because of the implementation of the policy measures will drive the innovation required to decarbonise industry was frequently challenged by industrial stakeholders during the consultation process.

Representatives from industry were unanimous in arguing that carbon pricing alone (i.e. without revenue recycling) was insufficient to bring about the change required to decarbonise production processes unless the price was at exceedingly high levels that, very likely, would bring into question the ability of the consumer to pay for more expensive low-carbon products. It was also suggested that, in certain industries, the necessary technological innovations are not yet available commercially at scale and at a competitive price. Efforts to reduce the emission intensity could have a negative impact on the quality of their products that would not be an acceptable trade off with the standards required by their end consumers. This often leaves industrial producers with uncertainty over whether to invest in sub-optimal solutions now or to wait for technological breakthroughs later. The timing of such innovative breakthroughs will be influenced and most likely occur sooner by an accelerated phase out of free allocation, but

²⁸ Representing more than half of the 74% of respondents who supported the continuation of indirect cost compensation beyond 2030.

industry also argued strongly that the levels of financial support was considerably lower than the financial support given to the power sector and that current complementary policies, such as the ETS's Innovation Fund are not currently at the scale required to finance the investments identified by the industrial roadmaps outlining what is technologically feasible regarding decarbonisation efforts.

This is why the Clean Industrial Deal Communication announced the Industrial Decarbonisation Bank (IDB) to address the scale-up and roll-out of more mature industrial decarbonisation projects (notably in EIIs) across all MS to be funded by a dedicated part of ETS resources. With the Bank focussing on scale-up and roll-out, there is also need for continuation of the Innovation Fund (IF) (also funded by part of ETS resources) to continue supporting innovative and first of a kind technology that can address difficult to decarbonise sectors. The contribution of IDB and IF to support investments in decarbonisation and thus complementing the measures for carbon leakage protection are analysed in Annex 9.

The EU ETS will thus complement and support the objectives of the Clean Industrial Deal by providing a clear and predictable carbon price, incentivising investment in decarbonisation solutions and funding the investments which still lack the business case or where decarbonisation solutions have yet to be demonstrated, while continuing to provide carbon-leakage protection and financial support from the auction revenues with more than EUR 250 billion generated since the start of the system.

1.4.2.5.2. Carbon leakage prevention measures for indirect emissions

For several industrial sectors, electrification is crucial to decarbonise. Indirect cost compensation stimulates electrification (and hence technological development) as do the incentives to electrify from the new approach to free allocation (the removal of the exchangeability factor provides free allocation for electrified processes under 14 of the ETS benchmarks²⁹). Without ICC, companies with direct emissions may prefer to continue receiving free allocation for direct emissions rather than electrifying and having indirect carbon costs through their electricity bill (in addition to other drivers of the cost differences between electrified and non-electrified processes).

Regarding technological improvements in the electricity sector, the carbon content of electricity is often outside the control of ETS operators. However, operators can reduce it (and therefore reduce their exposure to indirect carbon costs) through investments in energy efficiency or other forms of emissions reduction, including flexibility (which may trigger additional demand for batteries and Demand-Side Response technologies) and use of renewables PPAs.

1.4.2.6. Public authorities

1.4.2.6.1. Carbon leakage prevention measures for direct emissions

The simplification measures included in all the policy measures on carbon leakage protection will reduce administrative burden also for public authorities, in particular for ETS Competent Authorities.

The policy measures have budgetary consequences for public authorities as the phase out of free allocation results in an increase of the share of the total allowances under the cap to be

²⁹ Annex 9 of SWD (2021) 601 final. Part 4/4

used for decarbonisation and, if auctioned, this generates revenues for national governments. At the same time, the decrease of the cap acts in a counterbalancing manner when compared to the baseline scenario.

A major benefit to public authorities is represented by the auction revenue derived from the auctioning of allowances. The auctioning volumes are derived from based on the estimates for the allowances distributed for free to industry and it does not consider any split between auction revenue that is accrued to EU level funds or to national treasures.

Table 12 shows the expected value of free and auctioned allowances across the policy options. The volume of free allocation across different policy options also has an impact on (cumulative) auction revenues. Table 22 presents the potential total value of auction revenues over the period 2031-2040, deducting from the estimated cap value the volumes to be allocated for free. This represents potential value to be used by public authorities (at Member States or EU level) for financing climate action and decarbonisation measures.

Table 22: Overview of the 2031-40 cumulative auction revenues

	2031-2040
Eur23/tCO₂	EUR 150.0
Baseline_Auctioned allowances (mil EUAs)	1926
Baseline_Cumulative auction revenue	EUR 288.9
PO1_Auctioned allowances (mil EUAs)	4043.7
PO1_Cumulative auction revenue (bn EUR)	EUR 606.6
PO2_Auctioned allowances (mil EUAs)	4153.5
PO2_Cumulative auction revenue (bn EUR)	EUR 623.0
PO2_CL2_CBAM variant_auctioned allowances	3987.5
PO2_CBAM variant Cumulative auction revenue	EUR 598.1
PO3_Auctioned allowances (mil EUAs)	5546
PO3_Cumulative auction revenue (bn EUR)	EUR 831.9

Source: Own calculation

1.4.2.6.2. Carbon leakage prevention measures for indirect emissions

The policy measures also have budgetary consequences for public authorities as the continuation of the encouragement to provide indirect cost compensation enables Member States to consider offsetting higher electricity prices, due in part, to the increase in carbon prices over the 2031-40 period.

Based upon the previous calculation for adjustment costs for industry (refer to Section 1.4.2.1.2), the potential scale of the financing ranges from 9 billion to 17 billion EUR annually on average over 2031-40.

Under policy measure ICC1, it is entirely up to the Member States whether they want to pay out compensation and incur some of this cost. In practice, the funding for this compensation comes primarily from each Member State's share of ETS auction revenues (though other national resources can be used), and each Member State will retain the flexibility to use these revenues for ICC or other purposes. In the existing Directive, Member States who provide ICC compensation are required to make information about the support publicly available. The resultant administrative burden for public authorities could be reduced by integrating this requirement into the broader reporting obligations on the use of auction revenues under

Regulation (EU) 2018/1999. Under policy measure ICC2, the EU-level funding for the harmonised ICC fund would come from collection of auction revenues at EU level, implying a lower share either for Member States or other EU-level ETS-funded instruments. This funding would be distributed at EU-level according to the needs of electro-intensive industries, rather than at the discretion of each Member State. Although EU-level funding is largely expected to replace State aid that Member States would otherwise have provided, some installations will receive compensation who otherwise would not have received State aid. Therefore, we expect ICC2 to have a higher cost overall in terms of allowances distributed than ICC1.

1.4.3. Social impacts

1.4.3.1. Employment

The issue of employment is directly linked to the long-term viability of industrial production in Europe. During the stakeholder interviews (and further supported by OPC results), industrial associations and businesses consistently argued that the competitiveness of EU producers would be undermined without the continuation of free allocation and by ensuring that the necessary enabling conditions are in place to enable decarbonisation rather than deindustrialisation was frequently cited by stakeholders.

The GEM-E3 model was used to estimate the impact of the implementation of policy measures on employment levels. Total economy employment impacts under the policy measures shows a slight positive impact in PO1 following production trends and slight negative impact in the rest of the scenarios. The largest employment gains occur in chemicals and non-metallic minerals sector, which also records the highest production increase by 2040. Across sectors and policy measures, the overall employment impact ranges from -0.56% to 1.76. Among the scenarios, PO1R shows the highest employment increase, driven by the volume of free allowances provided along with the alternate revenue recycling option, whereas PO3 records the lowest due to the complete phase-out of free allowances after 2034 and due to the lower production in market services.

Table 23: Sectoral employment change for ETS sectors in 2040 relative to the baseline

	Policy measures							
	PO1 (%)	PO1R (%)	PO2_50 (%)	PO2_50C (%)	PO2_90 (%)	PO2_90C (%)	PO3 (%)	PO3R (%)
Ferrous metals	0.00	-0.56	-0.06	0.30	-0.06	0.24	0.27	-0.23
Non-ferrous metals	0.27	-0.41	0.12	0.25	0.20	0.31	0.60	-0.01
Chemical Products	1.13	0.75	0.56	0.65	0.90	0.97	0.50	0.25
Paper products, publishing	0.02	0.00	-0.04	-0.05	-0.03	-0.05	0.00	-0.01
Non-metallic minerals	1.18	0.88	0.80	1.52	1.16	1.76	1.43	1.18

Source: GEM-E3 model (2025)

The table below shows the effects on sectoral employment when using the 90-85% cap pathway (see section 1.3.1.1), compared with the reference scenario of 85% linear trajectory. This scenario shows that for most sectors, the more ambitious cap trajectory results in some decrease in EU27 emissions and increases in the non-EU27 emissions in 2035, indicating a marginally lower sectoral employment rates in at that point. The differences in the results for 2040 are marginal or 0 in most sectors.

Table 24: Percentage change in sectoral employment levels for variants CL290_9085 and CL290C_9085 compared to scenarios CL2_90 and CL2_90C.

	2035		2040	
	CL2_90_9085	CL2_90C_9085	CL2_90_9085	CL2_90C_9085
Ferrous metals	-0.25%	-0.24%	0.01%	0.01%
Non-ferrous metals	-0.28%	-0.27%	0.01%	0.02%
Chemical Products	-0.31%	-0.31%	0.07%	0.07%
Paper products, publishing	-0.03%	-0.03%	0.00%	0.00%
Non-metallic minerals	-0.76%	-0.74%	0.05%	0.05%

Source: GEM-E3 model (2025)

The issue of employment is directly linked to the long-term viability of industrial production in Europe. During the stakeholder engagement (and further supported by OPC inputs), industrial associations and businesses consistently argued that the competitiveness of EU producers would be undermined without the continuation of free allocation and by ensuring that the necessary enabling conditions are in place to enable decarbonisation rather than deindustrialisation was frequently cited by stakeholders.

Continuation of ICC compensation (whether State aid or harmonised) is expected to have a positive impact on employment by protecting against carbon leakage and supporting the business case for electrification of industrial processes. While ICC is not intended to support the capital cost for electrification investments, it strengthens the business case from them by ensuring beneficiaries will not be disadvantaged in the early years when indirect carbon cost may continue to be an important influence on electricity prices.

1.4.3.2. Fundamental rights

In accordance with the Better Regulation Guidelines, the policy measures were assessed to understand if there is impact on the fundamental rights endorsed by the EU Charter of Fundamental Rights. Following a screening of the fundamental rights, the judgement was taken that the policy measures do not have a negative impact and are likely to have a positive impact on the fundamental right with regards to environmental protection under Article 37.

1.4.4. Environmental impacts

1.4.4.1. Climate

1.4.4.1.1. Free allocation: carbon leakage rates

The conventional approach for carbon leakage assessment considers the emissions that increase in one (not regulated) region whilst decreasing in another regulated region and can be expressed by the following simple formula: *Carbon leakage rate = increase in foreign emissions / decrease in domestic emissions*. However, as described in Table 25, EU27 EU ETS GHG emissions increase from baseline levels in all scenarios. Therefore, the conventional formula for carbon leakage estimation is not relevant to this analysis.

Table 25: Change in the EU 27 emissions in 2040 relative to baseline scenario (in MtCO₂eq)

	Policy options							
	PO1	PO1R	PO2_50	PO2_50C	PO2_90	PO2_90C	PO3	PO3R
Total economy	7.72	8.09	7.03	7.86	9.46	10.17	45.84	46.13
Ferrous metals	0.06	0.03	0.37	0.46	0.39	0.47	2.51	2.42
Non-ferrous metals	0.04	-0.01	0.07	0.09	0.08	0.09	0.46	0.42
Chemical Products	0.83	0.76	0.99	1.05	1.25	1.30	4.07	3.99
Paper products, publishing	0.01	0.01	0.04	0.04	0.05	0.05	0.31	0.31
Non-metallic minerals	1.00	0.86	1.82	2.43	2.13	2.65	9.99	9.81

Source: GEM-E3 model (2025)

Emissions are influenced both by the number of free allowances allocated and by the carbon price required to meet the ETS cap. In PO2—and especially in PO3—the inclusion of waste leads to the increase of the cap compared to the baseline, thus providing additional protection against carbon leakage. Overall, EU27 emissions increase across most scenarios, driven by three main factors: 1) the number of free allowances allocated in EU ETS sectors; 2) the carbon price required to meet the cap and 3) the increase in economic activity observed in all scenarios.

The only case in which EU27 emissions decline is observed in the non-ferrous metals sector under PO1 with recycling, where a reduction in activity leads to a corresponding decrease in emissions. In contrast, the chemicals and non-metallic minerals sectors exhibit the largest absolute increases in emissions, reflecting the higher number of free allowances allocated to these sectors relative to other EU ETS sectors and compared to the baseline scenario. The extension of free allocation to CBAM sectors also results in a slight increase in emissions in those sectors. At the level of the total economy, EU27 emissions increase because of higher overall activity across all scenarios. Moreover, the inclusion of waste emissions further raises emissions in EU ETS sectors, with the largest increase observed in PO3, where all waste emissions are fully covered under the EU ETS.

The lower non-EU emissions for the EU ETS sectors are on account of the competitiveness gains experienced by these sectors within the EU that overcome potential positive demand effects due to the small positive macroeconomic effects seen in the EU. The increase in free allowances and the reduction of the carbon prices result in a decline in unit cost of production for the EU ETS sectors. This results in competitiveness gains resulting to lower emissions outside EU27. This result in more pronounced in the chemicals and non-metallic minerals sectors as the have the largest competitiveness gains.

Table 26: Change in the non-EU 27 emissions in 2040 relative to the PRIMES baseline scenario (in MtCO₂eq)

	Policy options							
	CL1	CL1R	CL2_5 0	PO2_5 0C	CL2_9 0	PO2_9 0C	CL3	CL3R
Total economy	-8.36	-6.37	-4.51	-6.88	-6.95	-8.93	-4.67	-3.97
Ferrous metals	0.27	1.03	0.10	-0.16	0.19	-0.03	-0.39	0.38
Non-ferrous metals	0.00	0.28	-0.03	-0.07	-0.03	-0.06	-0.20	0.09
Chemical Products	-3.42	-1.97	-1.86	-2.10	-2.88	-3.08	-2.15	-1.25
Paper products, publishing	0.02	0.03	0.02	0.02	0.02	0.03	0.01	0.02
Non-metallic minerals	-2.79	-1.44	-2.08	-3.99	-2.91	-4.52	-3.96	-2.68

Source: GEM-E3 model (2025)

Table 27 summarises the effects regarding carbon leakage when using the 90-85% cap pathway (see section 1.3.1.1), compared with the reference 85% linear trajectory. This scenario shows that for most sectors, the more ambitious cap trajectory results in some decrease in EU27 emissions and increases in the non-EU27 emissions in 2035, indicating a marginally higher carbon leakage rates at that point. The differences in the results for 2040 are marginal or 0.

Table 27: Difference EU27 and non-EU27 emissions levels for variants CL290_9085 and CL290C_9085 compared to scenarios CL2_90 and CL2_90C.

	2035				2040			
	CL2_90_9085		CL2_90C_9085		CL2_90_9085		CL2_90C_9085	
	EU27	Non-EU27	EU27	Non-EU27	EU27		Non-EU27	
Total economy	-29.91	2.54	-30.03	2.50	-0.32	-0.44	-0.31	-0.44
Ferrous metals	-1.92	0.21	-1.93	0.20	0.00	-0.01	0.00	-0.01
Non-ferrous metals	-0.29	0.07	-0.29	0.07	0.00	0.00	0.00	0.00
Chemical Products	-4.38	1.14	-4.39	1.14	0.03	-0.20	0.03	-0.20

Paper products, publishing	-0.33	0.00	-0.33	0.00	0.00	0.00	0.00	0.00
Non-metallic minerals	-5.66	1.89	-5.74	1.85	0.03	-0.13	0.04	-0.14

Source: GEM-E3 model (2025)

1.4.4.1.2. Indirect cost compensation

In principle, ICC compensation contributes to positive environmental outcomes by avoiding carbon leakage in electro-intensive sectors and /or incentivising electrification of industrial processes that would otherwise emit GHGs directly.

The potential benefit of industrial electrification is large. There are available technologies capable of meeting 60% of European industrial process heat demand today, and 90% by 2035³⁰. However, the net benefit in terms of emissions reduction is difficult to quantify due to the variety of industrial processes concerned and the need to consider emissions that may arise from additional electricity consumption.

Failure to compensate for ICC would nevertheless be suboptimal from an environmental point of view. Since fossil fuels often constitute the marginal electricity generation technology, a carbon cost is often passed onto electricity consumers that is more than the direct carbon cost paid by electricity generators for their embedded emissions (i.e. this carbon cost is effectively paid by all consumers on the wholesale electricity market, even if a lot of this electricity is zero carbon). This in turn has the effect of discouraging electrified industrial processes and incentivising the use of processes that emit GHGs directly, on top of the fact that free allowances are available for direct emissions.

1.4.5. Summary

The assessment in the previous sections show the relative effects of the different policy measures against the baseline. On most issues, measures CL1 and CL2 show similar effects, with small relative differences between the two sets of measures. The largest impacts, in particular on carbon leakage, are driven by the changes in the overall ambition level for the EU ETS and the resulting additional free allocation. CL2 on conditional free allocation is considered the preferred option as, in addition to CL1, increases the incentives to invest in decarbonisation and therefore better complement the measures on the Industrial Decarbonisation Bank and the Innovation Fund. CL2 also better addresses the findings in the Evaluation Report (see Annex 15) that indicate that free allocation, while effective at addressing carbon leakage, has also reduced the effective carbon price and reduced the incentives to invest in decarbonisation.

As regards indirect cost compensation, both ICC1 and ICC2 have similar effects. ICC1, continuing to provide indirect cost compensation via State aid, is the preferred option due to the disadvantages of a harmonised, one-size fits all approach of ICC2, both in terms of administrative costs and the reduced flexibility that ICC2 would imply for deciding the best use of auction revenues.

³⁰ Fraunhofer ISI (2024): Direct electrification of industrial process heat. An assessment of technologies, potentials and future prospects for the EU. Study on behalf of Agora Industry.

A qualitative overview of the impacts of the policy measures across the different categories are provided below in Table 28.

Table 28: Summary of impact assessment for individual measures for carbon leakage relative to baseline

	CL1: Improved current approach	CL2_90: Conditionality (90% compliance)	CL2_50: Conditionality (50% compliance)	CL3: No free allocation after 2034
Environmental impacts				
Carbon leakage rates	++	++	+	+
Economic impacts				
Adjustment cost to operator	++	++	+	--
Administrative cost to operator	+	-	-	+++
Administrative cost to competent authorities	++	+	+	+++
Sectoral competitiveness	++	++	+	+
GDP impact	++	++	+	+
Innovation impact	+	++	+	+
Social impacts				
Employment	++	++	+	+
Fundamental rights	0	0	0	0

Table 29: Summary of impact assessment for individual measures for indirect carbon cost relative to baseline

	ICC1: State aid encouragement	ICC2: Harmonised ICC
Environmental impacts		
Address carbon leakage	+	+
Economic impacts		
Adjustment cost to operator	0	0
Administrative cost to operator	0/-	0/-
Administrative cost to competent authorities	0/-	-
Sectoral competitiveness	0/+	0/+
Reduce distortion in EU internal market	0	+
GDP impact	0/+	0/+
Innovation impact	+	+
Social impacts		
Employment	0/+	0/+
Fundamental rights	0	0

2. 20 MW THRESHOLD

Small installations with lower annual emissions incur a higher cost per tCO₂e emitted when participating in the EU ETS than larger installations. This is primarily attributable to the fixed costs associated with system participation. The ETS Directive therefore excludes installations, generally defined as those with total rated thermal capacity below 20MW. Articles 27 and 27a of the ETS Directive provide additional options to exclude some installations.

Since all emitters in the EU need to contribute to the EU's climate goals and ideally face the same carbon price, it is therefore worthwhile to explore the option of expanding the system to smaller installations which are currently excluded. Furthermore, the Commission is required to consider the feasibility of lowering the 20MW thermal capacity threshold as per Article 30(5)(b) of the ETS Directive.

2.1.Scoping exercises

A scoping exercise was conducted to identify which emissions could in principle be added to the EU ETS if the 20MW capacity threshold were to be lowered.

This identified emissions that are:

- not currently covered by EU ETS, but arise from activities that are within its sectoral scope; and
- are outside the scope of ETS2: (the emissions trading system for buildings, road transport and additional sectors).

These emissions were estimated in a two-step process. Firstly, the relevant GHG emissions beneath the 20 MW threshold were estimated using a combination of:

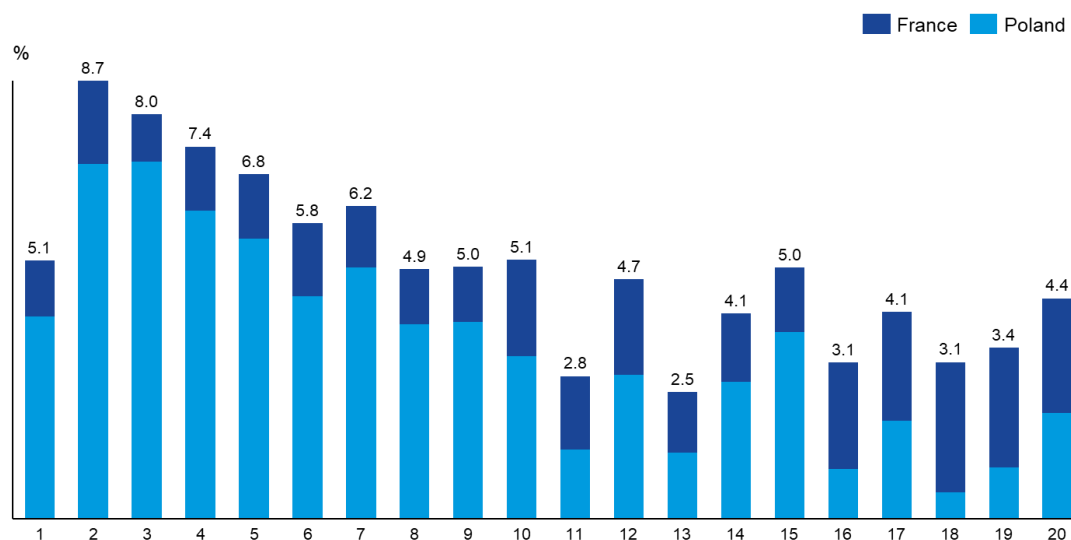
- UNFCCC (CRF) inventories³¹,
- EU ETS verified emissions³²,
- Article 14 (Governance Regulation) reports which map EU ETS verified emissions to Common Reporting Format (CRF) categories, and
- Data on Article 27/27a exclusions by Member States, which allow some small installations to be excluded from EU ETS, subject to certain conditions.

As a second step the feasibility of lowering the threshold was assessed using data from individual Member States' national Medium Combustion Plant (MCP) registries to estimate the capacity distribution in installations below 20 MW. The French and Polish MCP registries were identified to be most suitable for further analysis. Data on individual capacities per installation was converted into estimated CO₂ emissions using energy input and primary fuel values, and the resulting distribution of emissions by capacity was applied as a representative curve for the entire EU (see Figure 14 below).

³¹ European Environment Agency. *Greenhouse Gas Data Viewer*. European Union, <https://www.eea.europa.eu/data-and-maps/data/data-viewers/greenhouse-gases>. Accessed 21 August 2025.

³² Ibid

Figure 14: Proxy curve of emissions by capacity



Source: Own calculation based on MCP registries for France and Poland

2.2. Policy measures

2.2.1. Description

The measures under consideration are the maintenance of the current 20MW threshold and the lowering of the 20MW threshold.

- **T1:** Maintain current 20 MW threshold (PO1, PO2, PO3)
 - In this measure, no additional installations < 20MW in capacity would be included in the ETS, avoiding any potential additional administrative and transaction fees associated with having to be in compliance with the ETS.
- **T2:** Lower the 20 MW threshold (e.g. 0, 5, 15, 20 MW)
 - The threshold can be reduced by 20MW, 15MW, 10MW, or 5MW. In each instance, operators of installations that are less than 20MW in capacity would need to submit registration permits to have new entrant installations incorporated into the ETS.³³ Following the incorporation of these new installations, operators and competent authorities would incur additional administrative and transaction costs to ensure the new entrants remain in compliance with the ETS and receive free allocation.

³³ Department of Agriculture, Environment and Rural Affairs. *Emissions Trading Schemes: Fees, Charges and Civil Penalties*. Northern Ireland Executive. <https://www.daera-ni.gov.uk/articles/emissions-trading-schemes-fees-charges-and-civil-penalties>. Accessed 21 August 2025.

2.3. Assessment of the measures

2.3.1. Economic Impacts

2.3.1.1. SMEs

Based on results of the open public consultation (OPC), a majority of respondents opposed lowering the installation capacity threshold to expand the pool of installations covered by the EU ETS. Those respondents were mainly companies and business associations from across different sectors. In contrast, NGOs and environmental organizations were largely supportive of a potential change. Overall, a substantial share of respondents (almost three out of ten) remained neutral or uncertain.

Some stakeholders who provided specific comments considered that the administrative burden would outweigh the potential climate benefits. Others expressed concerns regarding the ability of SMEs to maintain their competitiveness within their respective industries. Several also suggested that ETS2, which covers smaller installations with a lighter approach, is a sufficient incentive for fuel mix changes and decarbonisation efforts, but this would not cover process emissions.

2.3.1.2. Administrative costs on business

There are several additional requirements that operators will have to comply with when integrating additional installations into the ETS, including setting and/or expanding the scope of the monitoring plan and verification³⁴.

T1 Maintain current 20 MW threshold

Maintaining the threshold at 20MW will have no additional financial implications for operators and competent authorities. However, a considerable number of installations and their emissions will continue to operate outside the scope of the EU ETS. This impact assessment estimates that up to 28 MtCO₂e of emissions could remain out of scope of the EU ETS as can be seen in Section 2.3.3.

T2 Lower the 20 MW threshold (e.g. 0, 5, 15, 20 MW)

Lowering the threshold carries various financial and environmental implications. Operators of new entrant installations will face additional administrative costs³⁵. These are estimated in Table 30 below.

³⁴ European Parliament and Council. Directive 2003/87/EC of 13 October 2003 Establishing a System for Greenhouse Gas Emission Allowance Trading within the Union and Amending Council Directive 96/61/EC (Consolidated Version as of 1 March 2024). Official Journal of the European Union. <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02003L0087-20240301>

³⁵ Schleich, Joachim, and Regina Betz. "EU Emissions Trading and Transaction Costs for Small and Medium Sized Companies." *Intereconomics* 39, no. 3 (2004): 121–123. Heidelberg: Springer. <https://www.econstor.eu/bitstream/10419/41807/1/388948892.pdf>

Table 30: Administrative costs paid per operator in the EU³⁶

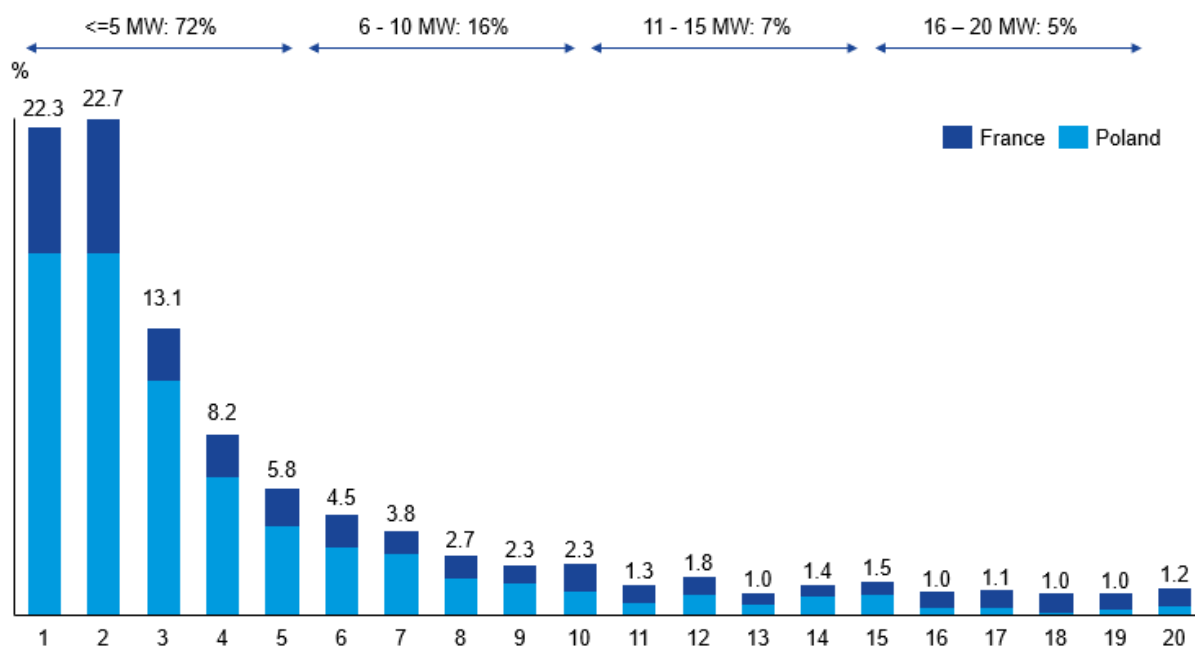
Cost	Type of cost	Used in quantification?	Amount (EUR)
Permit application fee	Non-MRV charges	No	2,164
Annual subsistence (renewal) fee	Non-MRV charges	No	4,130
Variation fee	Non-MRV charges	No	684
Permit transfer	Non-MRV charges	No	684
Revocation	Non-MRV charges	No	1,090
Surrender	Non-MRV charges	No	1,090
Allocation from new entrant reserve	Non-MRV charges	No	1,815
Preparing significant modifications to your monitoring plan	Monitoring	Yes	7,212
Monitoring in accordance with the approved monitoring plan	Monitoring	Yes	15,671
Quality assurance and quality control procedures	Monitoring	Yes	12,021
Preparing improvement reports	Monitoring	Yes	4,109
Preparing an annual emissions report and submitting it to your competent authority	Reporting	Yes	4,335
Verification	Verification	Yes	6,789
Any other costs	Other	Yes	9,052

Source: Based on Schleich & Betz (2004) and DAERA

According to the distribution derived from the French and Polish MCP registry datasets, more than 70% of installations are ≤ 5 MW (see Figure 15 below). The number of installations increases as installation size reduces (see also Figure 14 above for distribution of emissions).

Figure 15: Distribution of installations by capacity

³⁶ Department of Agriculture, Environment and Rural Affairs (DAERA). *Emissions Trading Schemes: Fees, Charges and Civil Penalties*. Northern Ireland Executive. <https://www.daera-ni.gov.uk/articles/emissions-trading-schemes-fees-charges-and-civil-penalties>. Accessed 21 August 2025.



Source: Own calculation based on MCP registries for France and Poland

The estimated total number of <20MW installations EU-wide (94,428)³⁷, combined with the distribution above indicates that most of the additional administration fees stem from installations that are less than or equal to 5MW, which is attributable to the greater number of smaller installations. Research by Peter Heindl also indicates that average transaction costs are elevated for smaller installations; these are calculated as total transaction costs divided by annual emissions³⁸. While this analysis centres on MRV costs, Heindl's findings suggest that when further costs are included, smaller installations typically have higher transaction costs than larger installations.⁴⁰

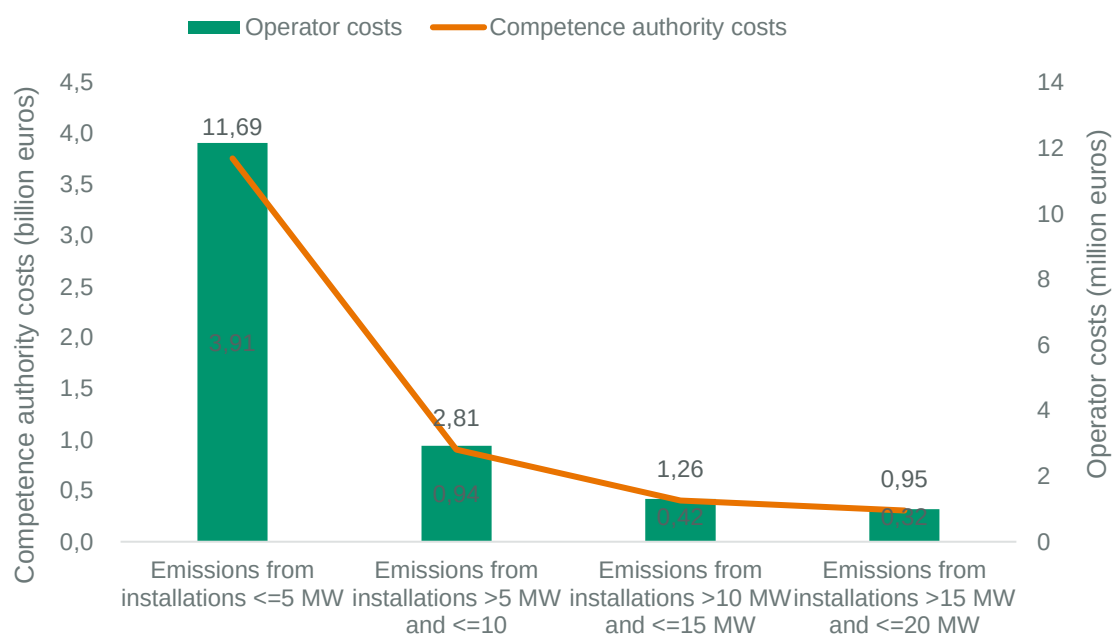
Lowering the 20MW threshold will also have significant financial implications on competent authorities. Like operator costs, competent authority costs will be greatest among the smaller installations (<=5MW). Among public authorities in Germany, there is an awareness around transactions costs being higher for smaller emitters and efforts have been made to reduce to these costs which may in effect increase the shift of the costs from operators to authorities³⁹. Overall, competent authorities across the EU may incur costs of around EUR 2.2 million if the threshold were to be lowered to 10 MW, and up to EUR 16.7 million if it were eliminated entirely.

³⁷ European Environment Agency. *Monitoring Mechanism Regulation (MMR) Reporting Tools*. Eionet Central Data Repository. <https://cdr.eionet.europa.eu/at/eu/mcp/>. Accessed 21 August 2025.

³⁸ Heindl, Peter. *The Impact of Administrative Transaction Costs in the EU Emissions Trading System*. ZEW Discussion Paper No. 15-076. Mannheim: Zentrum für Europäische Wirtschaftsforschung (ZEW), 2015. <https://www.econstor.eu/bitstream/10419/41807/1/388948892.pdf>.

³⁹ Heindl, Peter. *Transaction Costs and Tradable Permits: Empirical Evidence from the EU Emissions Trading Scheme*. ZEW Discussion Paper No. 12-021. Mannheim: Zentrum für Europäische Wirtschaftsforschung (ZEW), 2012. <https://nbn-resolving.de/urn:nbn:de:bsz:180-madoc-322019>

Figure 16: Administration fees for operators and competent authorities by installation capacity



Source: Based on Heindl (2012)

2.3.2. Social impacts

Maintaining the 20 MW threshold implies zero impact on employment, income distribution, social protection, social inclusion. Lowering the threshold may have a small negative impact on employment since participation in the EU ETS would represent an additional cost for firms. However, the overall cost would be small given the low amount of emissions that would be covered at the margin (See Section 2.3.3).

Lowering the 20 MW threshold would ensure broader participation in environmental protection and therefore contribute positively to Article 37 of the Charter on Fundamental Rights of the European Union⁴⁰. Apart from this, none of the options are expected to have an impact on fundamental rights.

2.3.3. Environmental impacts

2.3.3.1. Estimating emissions that could be affected by lowering the 20 MW threshold

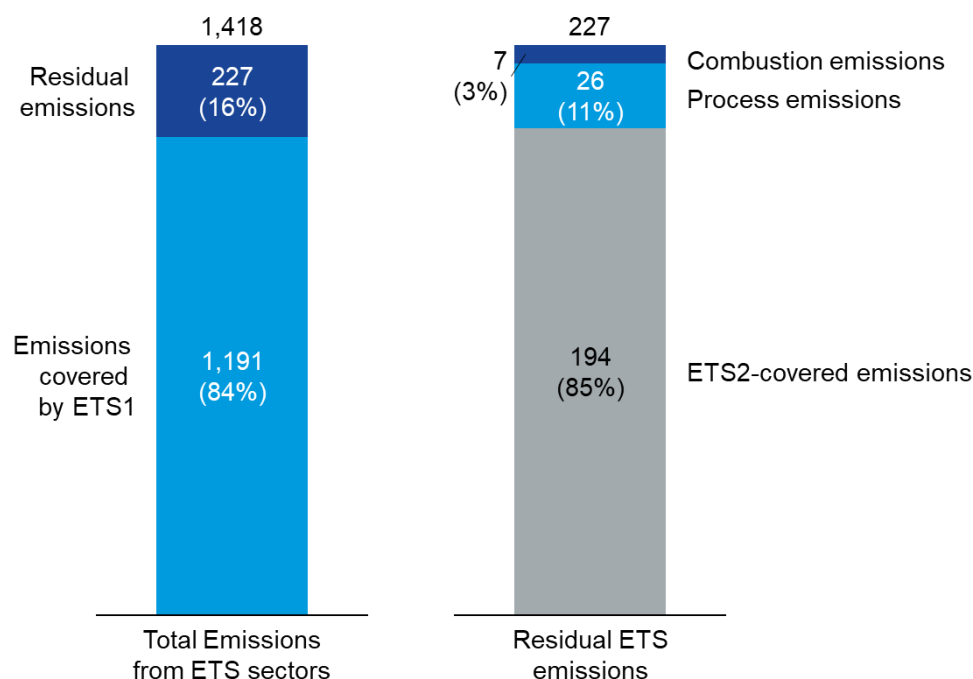
Using the average of data from the period 2021-2023, the scoping exercise identified that 226.5 Mt CO₂e of emissions from activities and gases that are not currently covered by the EU ETS but would fall within its scope if the threshold were set to zero.

However, once potential ETS2 emissions are removed, the remaining emissions that could be covered by lowering the 20 MW threshold amount to 33 MtCO₂e. Furthermore, 4.6 MtCO₂e is subtracted to account for emissions excluded from EU ETS under Article 27, since these

⁴⁰ European Parliament. *Charter of Fundamental Rights of the European Union*, 2000/C 364/01, proclaimed in Nice on December 7, 2000, https://www.europarl.europa.eu/charter/pdf/text_en.pdf.

emissions would not be impacted by lowering the 20 MW threshold.⁴¹ As a result, we can estimate that relevant emissions from <20MW installations are approximately 28 MtCO_{2e}, consisting mostly of process emissions.

Figure 17: Overview sector activities that make up the EU ETS baseline



Source: Own calculation based on data sources described in this chapter

2.3.3.2. Estimating the distribution of emissions and installation capacities below 20 MW

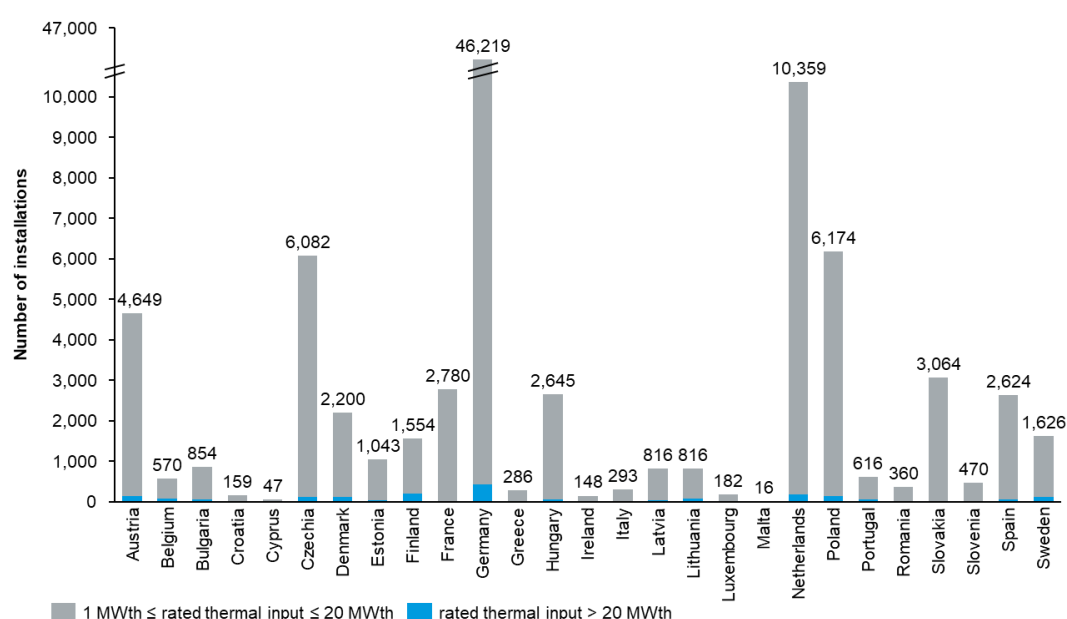
Regarding the distribution of emissions, the proxy curve derived from data on Medium Combustion Plants (MCPs) demonstrates that across the two countries from which the curve is derived, the majority of emissions stem from installations that are less than 10 MW in capacity. However, this trend is driven primarily by the Polish dataset. While both countries have more installations at the lowest capacity levels, France has more emissions in the 15-20 MW bracket, indicating that installations in this capacity bracket.

Regarding the distribution of installations, Figure 19 demonstrates the number of installations below and above the 20MW threshold for each Member State⁴².

⁴¹ These are emissions that Member States can exclude from EU ETS subject to equivalent national measures being in place

⁴² European Environment Agency. *Monitoring Mechanism Regulation (MMR) Reporting Tools*. Eionet Central Data Repository. <https://cdr.eionet.europa.eu/at/eu/mcp/>. Accessed 21 August 2025.

Figure 18: Number of installations by capacity (2019)



Source: European Environment Agency

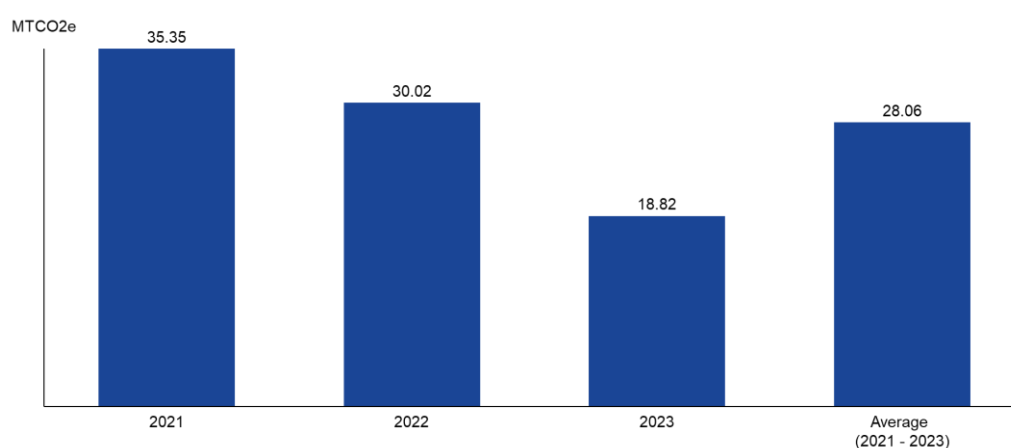
2.3.3.3. Comparing policy options

T1: Maintain current 20 MW threshold

If the 20 MW threshold is left unchanged, the relevant emissions that are outside the scope of the EU ETS & ETS2 (which are predominantly process emissions) will need to be reduced or offset by other means.

Despite not being included in the EU ETS, emissions from <20 MW installations have been decreasing year over year as observed in Figure 19, indicating that other energy and climate policies at EU-level and in Member States may have influenced industries and businesses to reduce emissions.

Figure 19: Annual emissions from <20 MW installations



Source: Own calculation based on data sources described in this chapter

T2: Lower the 20 MW threshold (e.g. 0, 5, 15, 20 MW)

According to this analysis, up to 28 MtCO₂e of emissions could be brought into the scope of EU ETS by lowering the 20 MW threshold. As Table 31 and Figure 20 below indicate, lowering

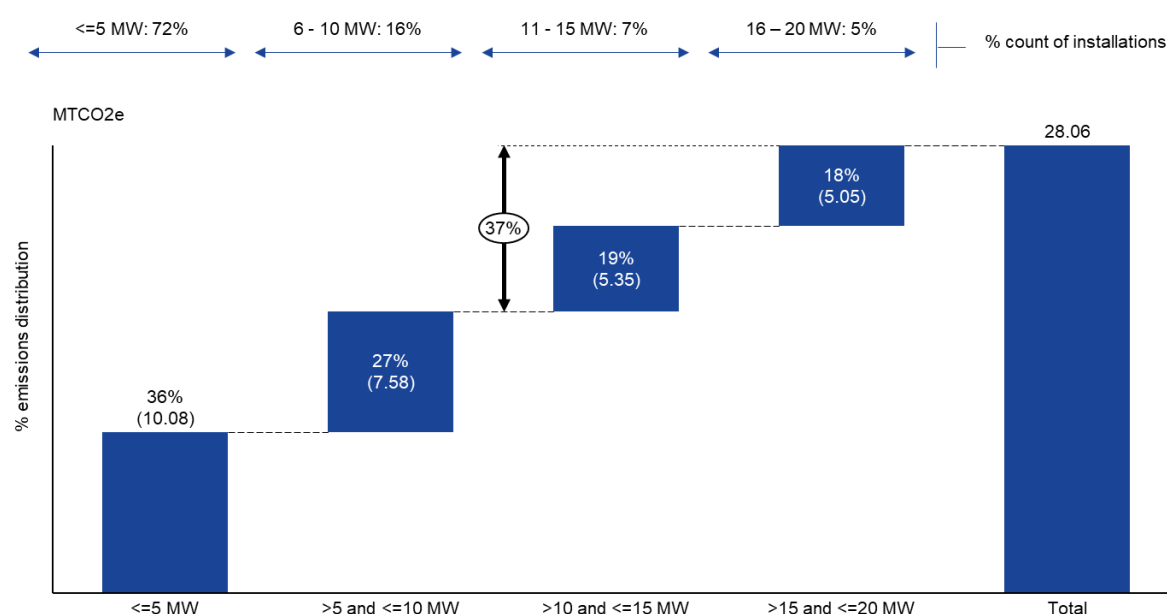
the threshold to 15 MW or 10 MW would increase coverage by 5 MtCO₂e or 10 MtCO₂e respectively. This shows that the majority of emissions (the remaining 18 MtCO₂e out of 28 MtCO₂e) occur in the smallest installations. At the bottom end, 72% of the <20 MW installations (68,000 installations) have a capacity of 5 MW or lower, while accounting for 36% of emissions.

At the top end, lowering the threshold to 15 MW or 10 MW would cover a modest fraction of the remaining emissions (18-37%). This would affect a relatively smaller share of the <20 MW installations (5-12% or 5,000-11,000 installations). However, this still represents a large number of installations in absolute terms. According to the latest available report⁴³, the EU ETS covered 8,640 stationary installations in 2022. Therefore, lowering the threshold to 15 MW would imply increasing the number of EU ETS stationary installations by over 50%.

Table 31: Estimated emissions and installation coverage from lowering the 20 MW threshold

Threshold level	Gain in emissions coverage		Gain in installation coverage	
	% of relevant uncovered emissions	MtCO ₂ e	% of relevant installations	Number of installations
≤15 MW	18%	5 MtCO ₂ e	5%	5,005
≤10 MW	37%	10 MtCO ₂ e	12%	11,615
≤5 MW	64%	18 MtCO ₂ e	28%	26,345
No threshold	100%	28 MtCO ₂ e	100%	94,428

Figure 20: Emissions by installation capacity



Source: Own calculation based on data sources described in this chapter

⁴³ European Commission: Directorate-General for Climate Action, Oudenes, M., Iersel, S. v., Bystricky, E. and Gardiner, A., Application of the European Union Emissions Trading Directive – Analysis of national responses under Article 21 of the EU ETS Directive (reported data in 2023), Publications Office of the European Union, 2024, <https://data.europa.eu/doi/10.2834/662983>

It should be noted that the distribution estimates presented in this analysis rely heavily on the distributions from only two Member States: France and Poland. A more rigorous and consistent analysis would require overcoming the difficulties encountered in obtaining data that is complete, consistent and comparable.

2.3.4. Summary

Based on the assessment presented in this section, the option of lowering the threshold is not taken further. The main reason for this is that the environmental gains from lowering the threshold would be very small compared to the substantial increase in administrative effort, in particular since most emissions from small installations will be covered under EU ETS2.

ANNEX 13: NEW SECTORS AND TECHNOLOGIES: WASTE MANAGEMENT AND CARBON CAPTURE AND UTILISATION (CCU)

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1. WASTE

1.1. Overview

The EU generates around 2.5 billion tonnes of waste per year, around 5 tonnes annually per person⁴⁴, with emissions from waste management processes responsible for approximately 6% of the EU's GHG emissions in 2023. While the waste sector as defined by the IPCC's 2006 guidelines was responsible for more than 3.5% or 109 MtCO₂eq of EU GHG emissions in 2023⁴⁵, this excludes emissions from waste incineration with energy recovery, which have been estimated to be almost similar in size⁴⁶.

The waste management sector includes a range of operations: material recovery (reuse and recycling – chemical and mechanical), composting and anaerobic digestion, and disposal (landfill and incineration) with or without energy recovery. GHG emissions primarily result from anaerobic degradation of biogenic waste streams (e.g. methane from landfills), incineration of fossil waste streams and energy and fuel use (e.g. mechanical and chemical recycling). Between 2010 and 2022 the share of waste landfilled in the EU decreased and other waste management methods like recycling, biological treatment of waste and waste incineration with energy recovery increased. Correspondingly, emissions from waste incineration have increased, while landfill emissions have decreased over this period but continue to be the largest source of GHG emissions from the waste management sector due to the high global warming potential of methane.

While the EU's environment policy framework sets out targets for waste management activities to promote circularity by boosting recycling and reducing landfilling, emissions from waste management activities are currently mainly subject to national emission reduction targets under the Effort Sharing Regulation, with landfilling and waste incineration (with energy recovery) being the main sources. Member States implement a diverse range of measures to deliver on the EU waste policy targets, but few Member States apply dedicated measures to address emissions from waste management. Denmark, Sweden and Lithuania have included municipal waste incineration (MWI) installations with energy recovery in their national implementation of the EU ETS, while Germany applies a national emissions trading system and the Netherlands implemented a carbon levy for MWI emissions.

Achieving the EU's 2050 net-zero climate target requires action across all economic sectors. These include actions related to materials and how we produce, use, re-circulate and dispose of them. Waste management and the circular economy hold considerable, mutually reinforcing potential for mitigating climate change. The introduction of additional measures linking emission reductions and circular economy policies is important to help accelerate future GHG emissions reductions while increasing circularity and improving waste management.

More than half of stakeholders in the open public consultation from different stakeholder groups, both companies and business associations as well as NGOs and environmental

⁴⁴ European Commission (2025). *Waste Framework Directive*. Available at: https://environment.ec.europa.eu/topics/waste-and-recycling/waste-framework-directive_en (Accessed: 7 November 2025).

⁴⁵ CRT source category 5A to 5D. UNFCCC EU National Inventory Document (NID) (2025). Available at: <https://www.eea.europa.eu/en/analysis/publications/annual-european-union-greenhouse-gas-inventory-2025/eu-nid-2025-1.pdf/@download/file>

⁴⁶ Counting fossil and biogenic emissions of waste incineration with energy recovery of all waste types (municipal, industrial and hazardous). See section 1.2.1.2. for more details.

organisations, supported the inclusion of MWI installations in the EU ETS. Conversely, further extensions to hazardous waste incineration (HWI) installations or landfills were more divisive.

This annex considers the impacts of a potential expansion of the EU ETS to MWI and other waste management processes in contributing to the cost-effective decarbonisation of the waste management sector, while promoting a shift to a circular economy, in line with the review clause in Article 30(7) of the ETS Directive. MWI also contributes to other policy measures under consideration in the 2026 EU ETS review, notably the generation of permanent carbon removals from the capture and storage of the biogenic carbon fraction of waste, and the coverage of downstream emissions of non-permanent Carbon Capture and Use (CCU) products.

1.2.Scope of regulated activities and emissions

Emissions from the waste management sector are currently mainly covered under the EU's Effort Sharing Regulation (ESR). However, industrial waste incineration and the co-incineration of waste, e.g. in a cement kiln, are already included in the scope of the EU ETS. In addition, some Member States have included waste incineration installations with energy or heat production as their main purpose in their national implementation of the EU ETS (Denmark, Sweden and Lithuania). This current framework has contributed to a heterogeneous coverage of emissions from waste management under the EU ETS and the ESR, which can lead to competitive distortions within the sector, between sectors and between Member States.

The main additional regulated activities and emissions considered for inclusion under the scope of the EU ETS are those identified under measures W1 (municipal waste incineration), W2 (municipal and hazardous waste incineration) and W3 (municipal and hazardous waste incineration and landfilling of non-hazardous waste).

1.2.1. Municipal waste incineration (MWI)

Regulated activity

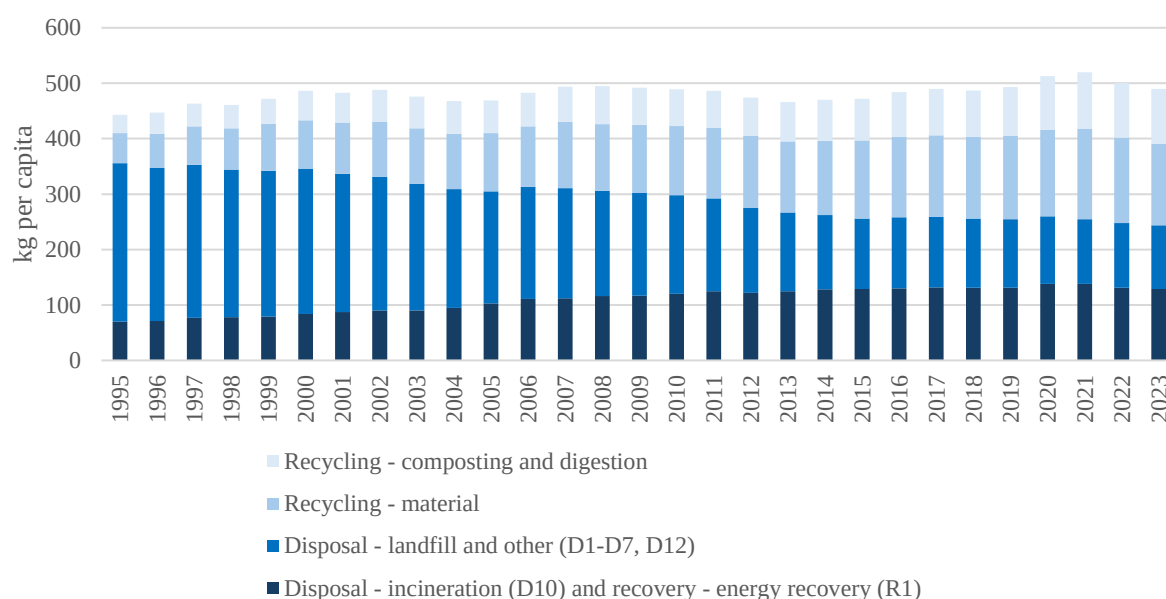
Municipal waste consists of waste from households and similarly composed waste from offices, shops and other sources, collected by or on behalf of municipal authorities and disposed of through waste management systems. It accounts for 27 % of total waste generated in the EU (excluding mining and quarrying waste and construction and demolition waste). The generation of municipal waste varies considerably between Member States, from 303 kg per capita in Romania to 803 kg per capita in Austria (2022). Municipal waste incineration (MWI) entails the combustion and conversion of this residual waste into carbon dioxide (CO₂) and water, with some remaining ashes (inorganic or inert fraction). The average amount of municipal waste incinerated in the EU has almost doubled between 1995 and 2023, from 30 million tonnes or 70 kg/capita to 58 million tonnes or 129 kg/capita⁴⁷, representing 26% of all municipal waste treated in the EU. This increase is primarily driven by an increase in total waste generated, in combination with part of decreasing landfilled volumes going to incineration⁴⁸. Figure 1 shows

⁴⁷ Eurostat (2025). Municipal waste statistics. Available at: [link](#)

⁴⁸ The combined volume of municipal waste recycled (+44 million tonnes of waste), composted (+31 million tonnes of waste) and incinerated (+31 million tonnes of waste) increased by two thirds more than the decrease in volume of municipal waste landfilled (-71 million tonnes of waste) over 1995-2024 (Eurostat), reflecting both a significant increase in overall municipal waste generated and a diversion of waste streams from landfilling to both composting, recycling and incineration.

the development of municipal waste treatment by type, showing an increase in recycling and incineration as landfilling has decreased.

Figure 1: Municipal waste per capita by treatment category in the EU (1995-2023)



Source: Eurostat

Most MWI installations in the EU operate with energy recovery (also called waste-to-energy or WtE). The Industrial Emissions Directive effectively mandates energy recovery for waste incineration⁴⁹. A total of 411 WtE plants were reported in the EEA in 2022, excluding hazardous waste incineration (HWI) plants (see Figure 2)⁵⁰. MWI incineration capacity is high overall in the EEA (with overcapacity by some estimates⁵¹) but unevenly distributed, with several Member States having limited or no incineration capacity⁵². The share of waste-to-energy installations in EU electricity generation was 1.4% in 2019, supplying electricity to some 20 million people (43 billion kWh). The share of municipal waste in district heating generation in the EU is more significant at 9.9% (2019), especially in the North, supplying around 17 million people (99 billion kWh). In some countries, like Germany, this can account for over 4% of the energy supply⁵³. In Denmark, heat recovered from waste incineration accounts for approx. 20% of supplied district heating.

⁴⁹ Article 50(5) Industrial Emissions Directive: “Any heat generated by waste incineration plants or waste co-incineration plants shall be recovered as far as practicable.”

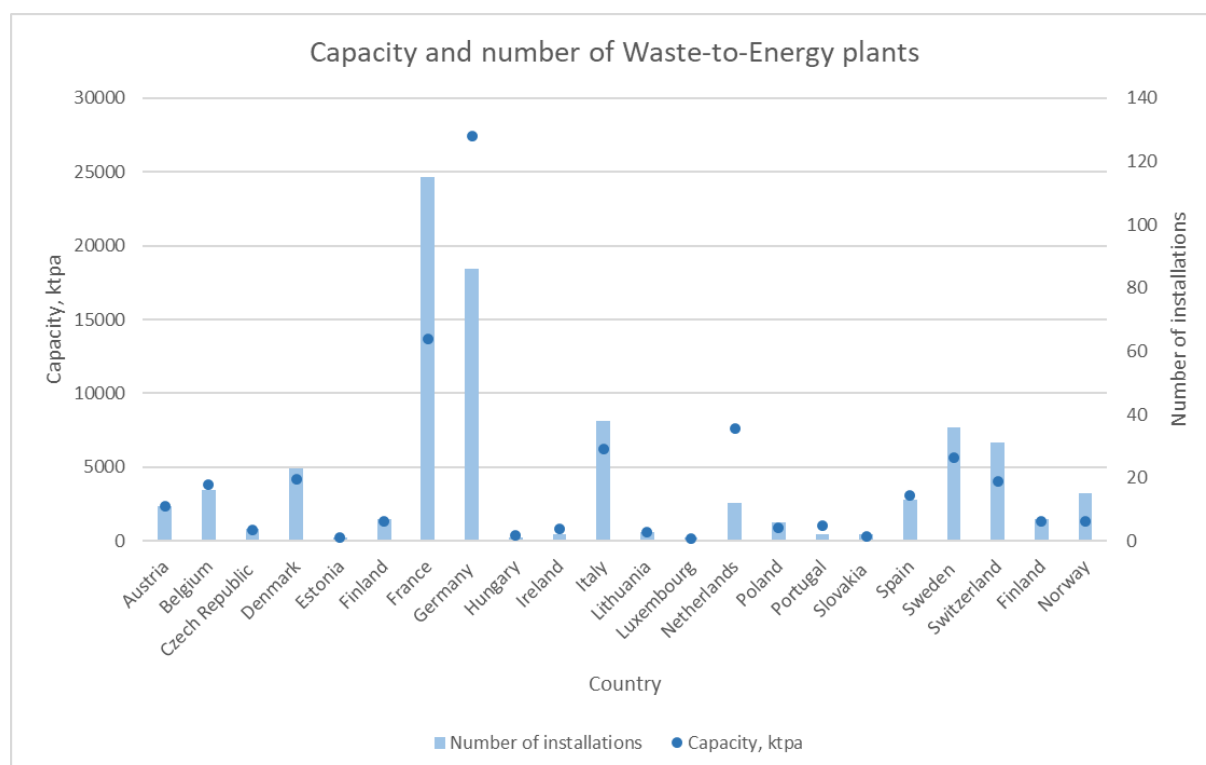
⁵⁰ CEWEP (2022). *Waste-to-Energy Plants in Europe in 2022*. Available at: <https://www.cewep.eu/waste-to-energy-plants-in-europe-in-2022/>

⁵¹ ZeroWasteEurope (2023). *Enough is enough: the case for a moratorium on incineration*. Available on : https://zerowasteurope.eu/wp-content/uploads/2023/09/zwe_sep23_report_enoughisenoughwtemoratorium-1.pdf

⁵² 8 Member States had no MWI incineration capacity in 2024 (CY, BG, EL, HR, LV, MT, RO, SI).

⁵³ P. Hockenos (2021). ‘Waste to Energy – Controversial power generation by incineration’, *Clean Energy Wire*, 26 May 2021. Available at: <https://www.cleanenergywire.org/factsheets/waste-energy-controversial-power-generation-incineration>

Figure 2: Number of Waste-to-Energy plants and volume treated by country.



Source: European Commission, based on summary data from CEWEP (2022)

Emissions

Municipal waste is mostly composed of packaging materials and bio-waste (biodegradable garden and park waste, and food and kitchen waste). The climate change impact of MWI accounted as total CO₂e emissions largely depends on the distribution between these biogenic and fossil fractions of waste input. This varies locally, regionally and from country to country depending on collection schemes, potential pre-sorting stages and local citizen habits. A tonne of municipal waste is generally estimated to be associated with emissions between 0.7 and 1.2 tonne CO₂, of which approximately half is fossil and half biogenic⁵⁴. There are also other emissions associated with the plant operations, for example, the use of burners to start-up or maintain autothermal combustion, or the generation of N₂O in the deNO_x system.

Emissions data and estimates for MWI in the EU are presented in Table 1 and explored and compared in detail in Appendix 1. MWI emissions have increased by almost 300% from 1990 to 2023⁵⁵, in parallel to the increase in volumes of waste incinerated⁵⁶.

Table 1: Emissions data and estimates for MWI in the EU-27.

⁵⁴ IPCC (2000). Emissions from waste incineration, in *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*. Published for the IPCC by the Institute for Global Environmental Strategies, Japan. Available at: https://www.ipcc-nggip.iges.or.jp/public/gp/bgp/5_3_Waste_Incineration.pdf

⁵⁵ Based on UNFCCC Inventory Data for categories 5C and 1A1a.

⁵⁶ The increase in incineration emissions is primarily driven by the increase in total municipal waste generated. The volume of plastics incinerated and the volume of plastics recycled have increased more than the volume of plastics landfilled have decreased. The EU generated 42.5 million tonnes of plastic waste in 2022, of which roughly 80% was incinerated or landfilled (JRC, 2025. *Plastic materials flows in the EU-27 and their environmental impacts*).

Source	Year of reporting	Year of emissions	Fossil emissions (MtCO ₂ e)	Biogenic emissions (MtCO ₂ e)	Data limitations
ETS MRV data	2025	2024	39.4	45.6	Only installations above 20MW.
UNFCCC Inventory Data	2025	2023	38.2	/	Includes some non-disaggregated emissions from other activities.
Internal Commission estimate	2022	2016-2018	44.3	/	Includes emissions from HWI and co-incineration.

Cap

The cap on emissions determines the ambition level of the ETS and is the maximum absolute quantity of GHGs that can be emitted by the covered activities to ensure the emission reduction target. The cap's annual trajectory is declining based on the linear reduction factor (LRF), which is set as a percentage applied to a reference value. The cap and LRF approach for MWI would need to be consistent with the overall EU ETS cap and LRF, implying an increase of the cap by the scope of MWI emissions. To determine the cap increase in order to base the system on recent, robust and verified data, the cap extension for MWI (measure W1) has been modelled to be in the range of 41.5 MtCO₂eq (EU-27) and 42.2 MtCO₂e (EEA)⁵⁷ (see Table 2), starting from the data explored in this section and taking into account differences in scope and timeframe (see Appendix 1 for details).

Table 2: Modelling of 2030 EU ETS cap extension for the inclusion of emissions from MWI.

	Waste scope and categories	EU27 (Mt)	EEA (Mt)
A	2024 ETS MRV data (MWI fossil emissions)	38.6	39.4
B	A plus gap filling for missing reporting data ⁵⁸	39.2	39.9
C	B plus margin for new capacity 2025-2030 ⁵⁹	40.5	41.2
D	C plus buffer for underestimation and uncertainties	41.5	42.2
F	Total cap 2030 (MWI only, A-D)	41.5	42.2

1.2.2. Hazardous waste incineration (HWI)

Regulated activity

Hazardous waste is waste with one or more of the hazardous properties listed in Annex III of the EU Waste Framework Directive. It covers a broad range of wastes that because of their chemical reactivity, toxic, explosive, corrosive, radioactive or other characteristics, cause danger, or are likely to cause danger, to health or the environment. In total, 10.5 million tonnes of hazardous waste were incinerated in the EU in 2022, of which 6.4 with energy recovery and

⁵⁷ This estimate uses the PRIMES model, calibrated to Eurostat energy balances and the reporting by EU Member States under the EU Governance Regulation and reflected in GHG inventory data under UNFCCC, and compared to the emissions reported under the ETS MRV obligation in 2024, to draw an average.

⁵⁸ Total missing reporting data identified from 4 installations in 3 Member States (BE, DE, HU) estimated at ~0.40 MtCO₂e in total based on combined nominal capacity and standardised fossil-based emission factor of 0.5/tonne of waste, in addition to 0.20 MtCO₂e emissions reported under the fuel combustion activity by 2 installations in LT.

⁵⁹ Estimated at 4% (EU27 only) based on extrapolation of capacity increase over the previous ten-year period (2012-2022) and desk research on planned projects by 2030.

4.1 without energy recovery⁶⁰. This has remained broadly stable over the past decade. Hazardous waste incineration (HWI) is regulated by the Industrial Emissions Directive, which sets strict operating conditions and technical requirements to protect human health and the environment. Facilities use high temperatures and advanced flue gas cleaning to destroy hazardous substances.

Emissions

Accurate data on emissions from HWI in the EU are currently not available. Based on default emission factors and cross-analysis of aggregate waste incineration emissions data in Appendix 1, the fossil fraction of HWI emissions in the EU-27 in addition to MWI emissions have been estimated to be around 3.15 MtCO₂e (See Appendix 1, Section C).

Cap

The cap-setting for HWI inclusion (measures W2 and W3) would imply an increase of the EU ETS cap by the scope of HWI emissions. In view of current limitations on HWI emissions data availability, cap-setting would ideally be based on a monitoring and reporting period to gather robust and verified emissions data with harmonised standards and rules to establish more precise data.

1.2.3. Landfilling of non-hazardous waste

Regulated activity

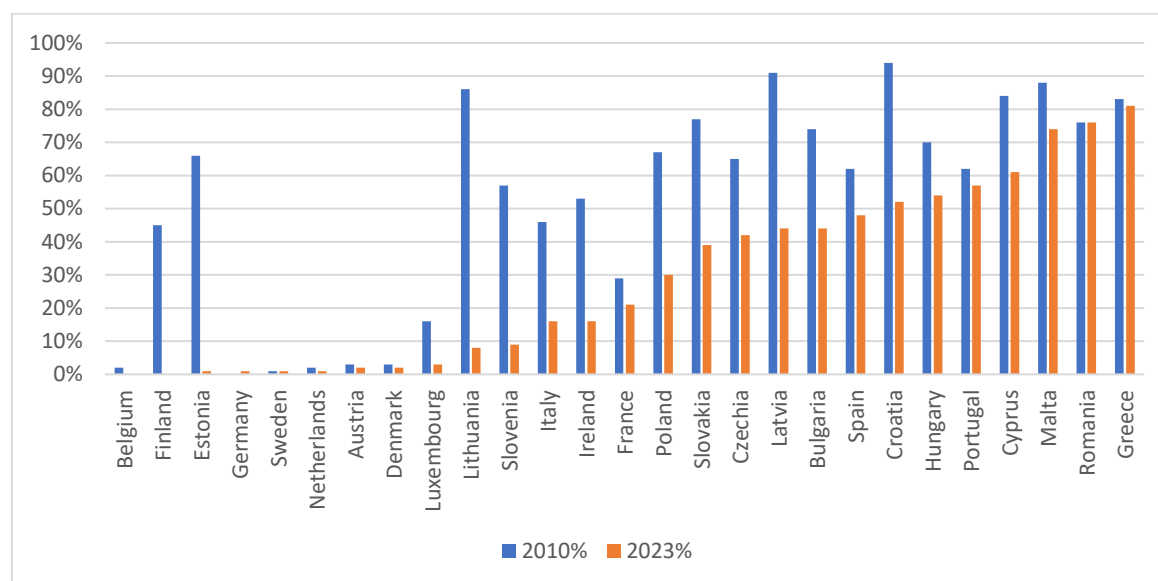
Landfilling entails the deposit of waste into or onto land. It includes specially engineered landfill sites and temporary storage of over one year on permanent sites. In 2022, 137 million tonnes of waste was disposed in landfills in the EU, of which 52 million tonnes was municipal waste, representing 23% of all municipal waste treated in the EU. The EU has seen a significant reduction in average municipal waste landfill disposal rates by 59% or 71 million tonnes from 1995 to 2023, in parallel to a substantial increase of biogenic waste going to composting and anaerobic digestion and of fossil waste going to recycling and incineration. Nevertheless, several Member States continue to be strongly reliant on landfilling for municipal waste, as illustrated in Figure 3. Across the EEA, 2,491 active landfill installations were registered in 2024⁶¹, in addition to at least 1,995 illegal or substandard landfills (2021)⁶².

⁶⁰ Eurostat (2024). Waste Statistics. Available at: [Waste statistics - Statistics Explained - Eurostat](#)

⁶¹ In the European Pollutant Release and Transfer Register (E-PRTR), which covers specific landfills defined as receiving 10 tonnes per day or with a total capacity of 25,000 tonnes or more, excluding inert waste landfills and those closed before July 16, 2001. Facilities only report if they exceed specific thresholds for pollutant releases or waste transfers.

⁶² Commission report (COM(2023)304final) on *identifying Member States at risk of not meeting the 2025 preparing for re-use and recycling target for municipal waste, the 2025 recycling target for packaging waste and the 2035 municipal waste landfilling reduction target*.

Figure 3: Share of municipal waste disposed through landfill by EU Member State (2010 vs 2023)



Source: European Commission, based on Eurostat.

Emissions

One of the primary concerns with landfilling is the emission of landfill gases, particularly methane (CH_4). Landfill gas is composed of around 45%-60% CH_4 and 40%-55% CO_2 ⁶³. However, as methane is a potent GHG with a global warming potential approximately 27 to 30 times greater than carbon dioxide (CO_2) over a 100-year period and 84 to 87 times more over a 20-year period⁶⁴, methane represents the vast majority of GHG emissions from landfills in CO_2 -equivalent. Methane is generated from the anaerobic decomposition of organic waste, including food scraps, garden waste and paper. The decomposition of waste in landfills is a long-term process that continues to release methane over time, at progressively decreasing levels, for more than 50 years after disposal (so-called ‘historic emissions’). The main factors influencing the quantity of CH_4 produced are the amount of waste disposed and the concentration of biodegradable carbon in that waste. In addition, CH_4 emissions from landfills are influenced by the amount of CH_4 recovered and utilized or flared⁶⁵. Fossil waste streams, such as plastics, represent only a minor fraction of GHG emissions from landfills.

Methane from landfills continues to account for the largest share of the waste sector’s emissions in the EU⁶⁶. At the same time, landfill emissions (for all solid waste) have decreased by 55% from 132.3 Mt CO_2e since 1990 and 25% from 99.4 Mt CO_2e since 2010, primarily due to a reduction in biodegradable waste being landfilled and a significant increase in landfill

⁶³ Alongside small amounts of nitrogen, oxygen, ammonia, sulphides, hydrogen, carbon monoxide, and non-methane organic compounds (NMOCs) such as trichloroethylene, benzene, and vinyl chloride.

⁶⁴ European Commission (2025). *Methane Emissions*. Available at : https://energy.ec.europa.eu/topics/carbon-management-and-fossil-fuels/methane-emissions_en#:~:text=On%20a%20100%2Dyear%20timescale,on%20a%2020%2Dyear%20timescale

⁶⁵ EEA (2024). Annual European Union greenhouse gas inventory 1990–2022 and inventory document 2024. Available at: <https://www.eea.europa.eu/en/analysis/publications/annual-european-union-greenhouse-gas-inventory>.

⁶⁶ EEA (2024). *Capturing the climate change mitigation benefits of circular economy and waste sector policies and measures*. Available at: Capturing the climate change mitigation benefits of circular economy and waste sector policies and measures | Publications | European Environment Agency (EEA)

methane recovery and flaring. Table 3 presents the data sources and estimates for emissions from landfilling in the EU, which are explored in further detail in Appendix 1.

Table 3: Emission estimates on landfilling of non-hazardous waste in the EU-27

Source	Emission Year	Emissions (MtCO ₂ e)	Comments
UNFCCC inventory data ⁶⁷	2023	65.3 (managed) 8.6 (unmanaged)	Scope covering emissions from historical disposal of all solid waste
Default emission factor	2022	82.2	Scope covering emissions from future disposal of all solid waste
Default emission factor	2022	31.2	Scope covering emissions from future disposal of only municipal waste

Cap

The cap-setting for the inclusion of non-hazardous landfills (measure W3) implies an increase of the existing cap by the scope of non-hazardous landfill emissions. Current EU-wide data on GHG emissions from landfills are mainly calculation-based, with constraints on accurateness in absence of comprehensive measurement-based data (see Section 1.4.3. for further discussion). The determination of the cap would therefore ideally be based on a monitoring and reporting period to gather robust and verified data based on harmonised standards and rules.

In addition, an inclusion of landfill emissions in the EU ETS would need to determine the scope of emissions under the cap, i.e. only ‘future’ emissions (resulting from waste disposed in landfills as of the date of inclusion) or also ‘historical’ emissions (resulting from the gradual decay of waste disposed in landfills prior to the date of inclusion). Based on the data explored in this section, the emissions covered would vary from 73.9 MtCO₂eq in 2022 in the latter case to 82.2 MtCO₂eq in the former case.

1.2.4. Discarded measures

Chemical recycling (W4): chemical recycling is a form of plastic waste treatment breaking plastic waste down into original chemical components, enabling to recover or convert plastic waste streams which are difficult or impossible to mechanically recycle and deliver higher quality and technical performance of recycled outputs⁶⁸. Chemical recycling is a part of the chemical sector not covered as a separate activity under the EU ETS⁶⁹. It covers a range of methods and technologies, including pyrolysis, gasification, depolymerization and solvolysis. It is an emerging technology with currently limited commercial operation in the EU, recycling less than 0.2% of plastic waste, but expected to scale-up in the future. Data on emissions from chemical recycling in the EU are currently not available. Some chemical recycling processes

⁶⁷ It is important to note the differences in scope when comparing emissions data between landfills and municipal waste incineration. Whereas landfill emissions data generally cover emissions from all solid waste, municipal waste incineration emissions cover emissions only from municipal waste.

⁶⁸ For example, a recent study comparing different waste treatment options found that chemical recycling through solvolysis of wind blades would be the most circular solution – up to 83% more resource-efficient than the other alternatives: Diez-Canamero, B. and Mendoza, J. M. F. (2023) Circular economy performance and carbon footprint of wind turbine blade waste management alternatives. *Waste Management* 164: 94–105.

⁶⁹ The bulk organic chemicals activity under the EU ETS is process specific.

are characterised by a high energy intensity, in particular pyrolysis and gasification. Their overall contribution to EU GHG emissions would be dependent on the future scale-up and application⁷⁰ of these technologies, as well as on the life-cycle carbon footprint of the recycled materials compared to virgin alternatives. From an environmental point of view, chemical recycling complements mechanical recycling for otherwise difficult or impossible to recycle waste streams, positively contributing to the waste hierarchy, while mechanical recycling technologies are in general preferable to chemical recycling technologies where mechanical recycling can produce recyclates with similar quality or performance characteristics.

Mechanical recycling (W5): mechanical recycling would in most cases establish an end of waste status, higher up the waste hierarchy than incineration or landfilling. Recycling activities are very variable, treating a variety of outputs⁷¹ and employing different technologies. Data on emissions from mechanical recycling in the EU are not available. However, mechanical recycling is primarily an energy-intensive process with the associated emissions from the power sector already covered by the EU ETS, while recycled materials generally have a better carbon footprint across the lifecycle compared to virgin products⁷². The application of the carbon price signal to these waste management processes would not be expected to cover a substantial additional volume of emissions, while under the waste hierarchy mechanical recycling is preferable compared to incineration or landfilling, thus limiting the reach of the carbon price incentive from an overall environmental perspective.

Composting and anaerobic digestion (W6): composting and anaerobic digestion are biological processes. For composting the decomposition of organic waste takes place under aerobic conditions primarily resulting in biogenic CO₂ emissions, which would be zero-rated under the EU ETS. The remaining GHG emissions from N₂O and CH₄ are relatively modest, with composting being substantially less methane-intensive than landfilling and overall accounting for only 2.8 MtCO₂e emissions from CH₄ in 2023 (compared to 76-84 MtCO₂e from landfills) and 1.7 MtCO₂e from N₂O⁷³. Anaerobic digestion is smaller than composting both in terms of volumes and associated emissions. It is a closed process by design for the recovery of methane for renewable energy, although subject to some release of fugitive methane emissions amounting to 2.0 MtCO₂e in 2023, at a more limited scale compared to composting and landfilling and with remediation possible. Under the waste hierarchy, anaerobic digestion and composting are preferable as a form of recovery and recycling contributing to the reduction of organic waste. Consequently, the application of the carbon price signal to these waste management processes would not cover substantial additional volumes of emissions, while not being coherent with the objective of the waste hierarchy incentivising these processes, limiting the reach of the carbon price incentive from an overall environmental perspective.

Carbon taxation: as an alternative to cap-and-trade systems, carbon taxation can offer predictable marginal costs and a simplified legal structure, while raising stable revenue without the complexity of allowance auctions or registries. Conversely, taxation can also be less predictable over time in view of discretionary decisions on design and levels, which

⁷⁰ For example, whether its application remains limited to recycling waste streams that can otherwise not be mechanically recycled or is expanded to cover waste streams that could also be mechanically recycled.

⁷¹ Such as paper and cardboard, flexible plastics, different dense plastics, wood materials, glass, ferrous metals, non-ferrous metals, etc.

⁷² This is, for example, applicable to the recycling of glass and metals, and for many plastics (depending on the process).

⁷³ UNFCCC EU National Inventory Document (NID) (2024). Available at: <https://unfccc.int/documents/644896>

undermines efficiency and investment predictability. Contrary to cap-and-trade systems taxation does not guarantee the achievement of emissions reductions in absence of a cap on total emissions, while carrying a higher aggregate cost due to the lack of market flexibility steering the most cost-efficient decarbonisation routes. Harmonised taxation at EU-level would carry an additional procedural complexity due to the unanimity requirement as a fiscal measure. On the other hand, national taxation reflects the current policy situation, characterised by a lack of harmonisation and risk of tax competition. Currently only one third of EU Member States have some form of taxation on waste incineration in place, of which only two apply a carbon tax (the Netherlands and Norway). With few exceptions, taxation levels are substantially below both current and projected future ETS prices, averaging EUR 19 to 29 across the EU⁷⁴. For landfilling, all but five Member States apply taxation, and levels are generally higher than for waste incineration, averaging EUR 39 to 46⁷⁵. For these reasons, this measure was discarded as an option to address emissions from the waste management sector, either harmonised at EU-level or for Member State implementation.

1.3. Carbon price signal and emission abatement

The application of the carbon price to waste incineration and landfilling can drive emissions reductions, depending on the carbon cost for operators, the carbon cost passthrough in the waste value chain and available cost-effective emissions abatement pathways at different levels of the waste value chain.

The overall carbon cost for operators depends on multiple factors including total volume of waste treated, waste composition (fossil vs biogenic fractions), the EU ETS price, the ability to pass on carbon costs to other actors, elasticities, and the availability and cost-effectiveness of decarbonisation pathways and removals generated.

The baseline assumes no EU ETS carbon cost and an average gate fee for municipal waste incinerators of EUR 100 per tonne of waste⁷⁶ (not considering separate taxes or levies on waste incineration, which could be modulated to compensate the additional carbon cost). For the inclusion of municipal waste incineration, assuming a carbon price of EUR 110 per tonne CO₂e in 2030, 1 tonne of municipal waste incinerated being associated with 0.7-1.2 tonne of CO₂ of which 50% fossil CO₂, and not integrating emissions abatement incentivised by the carbon price, the average effective carbon cost per tonne of municipal waste incinerated is estimated to range between EUR 38.5 and 66 (2030), at which level the carbon cost would add 38.5%-66% to the gate fee when fully passed through to waste suppliers. The cost would further increase in case the ETS price increases towards 2040.

For landfills, the baseline assumes no EU ETS carbon cost and generally lower gate fees than for municipal waste incineration, at EUR 50 per tonne of non-hazardous waste on average (separate landfill taxes not included, which could be modulated to compensate the additional carbon cost)⁷⁷. For landfills, assuming an emissions factor of 0.6 CO₂e for

⁷⁴ EEA (2023). Overview of taxes on the incineration of municipal waste used in EU Member States, 2023.

⁷⁵ EEA (2023). Overview of landfill taxes on municipal waste used in EU Member States, 2023.

⁷⁶ Gate fees vary significantly between Member States and regions, ranging between 80 and 120 EUR per tonne of waste.

⁷⁷ While gate fees for landfills are generally lower in the EU than for municipal waste incineration, taxation and levies on landfills are considerably higher and more prevalent than on incineration; EEA (2013). Typical charge (gate fee and landfill tax) for legal landfilling of non-hazardous municipal waste in EU Member States and regions. Last updated on 11 September 2024. Available at: <https://www.eea.europa.eu/en/analysis/maps-and-charts/typical-charge-gate-fee-and>

methane⁷⁸, the average carbon cost per tonne of landfilled waste is estimated to amount to EUR 66 on average, which would more than double the average gate fee when fully passed through to the waste supplier. The cost would further increase as ETS prices increase towards 2040.

The carbon price signal is expected to provide an economic incentive to reduce emissions from waste incineration and landfilling, mitigating carbon costs and buffering against future carbon price increases, provided cost-effective decarbonisation pathways are available. Action to abate emissions can be incentivised at installation level (see Section 1.3.2.) and in the waste value chain (see Section 1.3.1.).

1.3.1. Ability to pass-on the carbon cost and emissions abatement in the waste value chain

One of the most effective ways to ensure that no fossil carbon at stack (incineration) or methane (landfills) is emitted is source reduction or elimination. The carbon cost passthrough from waste disposal operators to waste collection authorities, notably local authorities, and other waste suppliers, such as commercial actors or recyclers, should incentivise action by waste collection authorities and other waste suppliers to reduce residual waste streams and the carbon/methane content in residual waste streams sent for disposal. The ability to do so is subject to the price elasticities in the sector, the contractual arrangements in place, and complementary policies and measures including targeted reinvestment of EU ETS revenues (see Section 1.3.4.).

Evidence indicates policy-relevant price elasticities for the demand for residual waste disposal ranging from -0.2 to -0.4, implying a 10-20% reduction potential in incineration in response to an average increase in disposal costs by EUR 50 (2030), and cross-price elasticities for diversion to recycling ranging from +0.32 to +0.45⁷⁹, implying an 16-22.5% increase potential in waste diverted from incineration to recycling. Elasticities are highest for higher price signals and for targeted weight-based or Pay-As-You-Throw waste collection systems for non-recyclable waste. Evidence on price elasticities for hazardous waste and for landfilling is more limited due to the wide variety of waste types under this category.

The carbon price incentive can improve circularity and reduce waste handling costs through improved waste prevention and separate collection. Consider a stylised example of a waste

⁷⁸ Conventional landfill with flaring. See Appendix 1 for further details.

⁷⁹ See among others: Nordic Council of Ministers (2025). Can Economic Instruments Transform Behaviour? Available at: <https://pub.norden.org/temanord2025-523/index.html>; CE Delft (2025) for ZeroWasteEurope. *Waste Incineration under the EU ETS*. Delft, CE Delft. Available at : <https://cedelft.eu/publications/waste-incineration-under-the-eu-ets/>; Meens-Eriksson, S. (2024). *Does costlier waste treatment lead to less residual waste? Evidence from Swedish municipalities*. In the Economics of Residual Waste. Umea University. Available at: <https://umu.diva-portal.org/smash/search.jsf?dswid=-8748>; Gautier, A and Salem, I (2023). *The impact of prices and pricing units on residual and organic waste: evidence from Wallonia, Belgium*. Waste Management, Volume 155, pages 99-106. <https://doi.org/10.1016/j.wasman.2022.10.027>; Finnish Environment Institute (SYKE) (2026). *Selvitys kierrätyksen edistämisen ja jätteenpolton hillinnän ohjauksineista*. Available at: <https://julkaisut.valtioneuvosto.fi/server/api/core/bitstreams/58c2facb-a2f2-4028-9bec-4e6f146ce9b9/content>; OECD (2019), Waste management and the circular economy in selected OECD countries: evidence from environmental performance reviews, OECD Environmental Performance Reviews, OECD Publishing, Paris (<https://doi.org/10.1787/9789264309395-en>; Sasao T. et al. (2021). Does Weight-based pricing for municipal waste collection contribute to waste reduction? A dynamic panel analysis in Flanders. Waste Management, Volume 128, pages 132-141. Available at: <https://doi.org/10.1016/j.wasman.2021.04.056>; Bel G., Gradus R. (2016). *Effects of unit-based pricing on household waste collection demand: A meta-regression analysis*. Resource and Energy Economics, Volume 44, 2016, Pages 169-182. <https://doi.org/10.1016/j.reseneeco.2016.03.003>.

supplier (e.g. a shopping centre) with a current total waste volume of 150 tonnes per month and a waste handling ratio of 67% recycled and 33% sent to incineration as mixed municipal waste at a gate fee of EUR 100 per tonne of waste, leading to a mixed waste handling cost of EUR 4.950 per month. If the carbon price is passed through increasing the gate fee by 40% and the shopping centre improves its waste prevention and separate collection to reduce its share of mixed municipal waste sent to incineration by one third to 22%, then the mixed waste handling cost decreases by 6.5% to EUR 4.620 per month compared to the current situation⁸⁰.

Selected circular economy measures that can steer the collection and disposal of municipal waste in line with the higher steps of the waste hierarchy, reduce emissions at disposal stage and help manage the impact of the carbon cost include:

Improved separate waste collection to improve recycling: Recycling (both of fossil and biogenic waste streams) is key to reduce emissions from waste management, with the net climate change impacts of the waste management system the lowest in Member States recycling the most⁸¹. However, separate collection of polymers and textiles (with significant impacts from incineration) that could otherwise be recycled remains overall low⁸². Depending on national variations, approximately 70% of the waste gathered as mixed municipal waste could be collected separately and recycled in a Member State with an average EU recycling rate like Finland⁸³. The greatest share of fossil CO₂ in this recyclable share comes from plastic waste, which is estimated to contain 69% of fossil carbon out of the weight of the dry material. The carbon cost passthrough from operators to waste disposal authorities is expected to incentivise action to reduce residual waste and increase recycling. Improving separate waste collection to reduce the volume of residual waste and increase the range of recyclables collected, especially those with a high fossil carbon content, can result in twofold savings by decreasing GHG emissions and by reducing disposal costs for local authorities, especially in the early years, by up to 37-56%⁸⁴. The potential depends on the current performance of local authorities, with lower performing systems having a higher reduction potential, while higher performing systems are expected to face a lower carbon cost due to the measures already in place. Early action is important, as improved separate waste collection can reduce the carbon cost in the shorter term and savings can be invested in future service improvements. In addition, improved upstream infrastructure to process and recycle the existing and other fossil streams will be necessary to achieve the requirements and could be supported through revenues from carbon pricing.

Improved biogenic waste collection and treatment: For landfills, reducing the amount of organic waste sent to landfills is one of the most effective ways to lower GHG emissions. Separate collection of biowaste (with significant impacts from landfilling) remains overall low. Through separate collection of food, paper, and garden waste, biodegradable waste can be diverted to alternative treatments such as composting, anaerobic digestion (AD), or biogas production. Implementing local or extended policies that ban biodegradable waste from

⁸⁰ While the waste additionally sent for recycling may also carry an offtake cost, waste customer costs for recycling are generally substantially lower than for disposal and part of the mixed waste reduction is also assumed to result from waste prevention.

⁸¹ Albizzati, P.F. (2024). *A model to assess the environmental and economic impacts of municipal waste management in Europe*. Waste Management 174, p. 605-617.

⁸² Sund, J.H. et al. (2025). *Comprehensive assessment of environmental and economic impacts of the entire EU waste management system*. Waste Management 204, 114910.

⁸³ Helsinki Region Environmental Services Authority (HSY) (2024). *Composition of mixed household waste in the Helsinki Metropolitan Area in 2024*.

⁸⁴ SUEZ (2025). Strategic approaches to minimising ETS costs for waste producers. Available at: <https://www.suez.co.uk/en-gb/news/list-of-publications>

landfills can further reinforce these efforts. In addition, Mechanical-Biological Treatment (MBT) can pre-treat waste before it reaches landfills by extracting recyclables and reducing organic content, which will lead to a reduction in associated methane emissions. Combining these policies can be particularly effective at reducing the amount of GHG emissions produced by landfills. However, this only affects emissions from future landfill disposal but does not address emissions from historic disposal in landfills, for which measures at installation-level are needed (see Section 1.3.2.).

Pay-as-you-Throw schemes (PAYT): PAYT schemes involve households or commercial actors paying corresponding to the amount of residual waste they produce. This can be enacted through residual waste bags costing more than recycling or biowaste bags, or through the cost of residual waste disposal being variable by weight. PAYT measures incentivise better sorting of waste through making recycling the cheaper option and have been widely used across Europe at different scales. For example, Parma in Emilia Romagna, Italy (population of 200,000), has achieved a waste separation rate of over 80% and a 65% decrease in residual waste generation 3 years after PAYT implementation. PAYT was enacted by equipping residual waste bins with transponders associated to each user and charging them for extra deliveries beyond the minimum included in their waste bill (to avoid littering). As well as door-to-door collection, the city set up eco-stations in park-and-ride-facilities, accessible 24/7 with a badge or health insurance card, with volumetric-controlled doors for residual waste to track residual waste outside of collections and prevent littering. Further selected case studies are listed in Appendix 2.

Improved recycling efficiency: the estimated recycling efficiency (i.e. the share of plastic waste being recycled out of the total input to a recycling plant) in mechanical recycling varies for each type of waste. The average recycling efficiency in conventional mechanical recycling plants ranges between 66% and 88%^{85,86}, and 71% to 93% in the 25% most advanced facilities, implying a 23% average reject rate in conventional and 15% average reject rate in modern facilities⁸⁷. Residues are generally sent to incineration and, to a lesser extent, landfills and other uses already covered by the EU ETS such as solid recovered fuel. To fulfil the ambitious recycling targets set at EU level, the improvement of the efficiency of the collection and recycling systems is imperative. This includes improvements in mechanical recycling and the further development and scaling of advanced and chemical recycling technologies. The carbon price on disposal of rejects can provide a complementary financial incentive and support from ETS revenues to optimise collection, sorting and recycling systems. The cost-passthrough is estimated to add around EUR 33 per tonne of plastic waste bale received and processed in recycling, or a 5-6% increase on the total cost for recyclers⁸⁸. The effectiveness of the carbon price cost passthrough in incentivising action to reduce residual waste and increase recycling depends not only on elasticities but also on the ability of operators to pass on the carbon cost in gate fees⁸⁸ through contractual provisions. Contracts between waste incineration or landfill operators and public or private waste suppliers establish how certain cost categories are

⁸⁵ Antonopoulos, I., Faraca, G. and Tonini, D., Recycling of post-consumer plastic packaging waste in the EU: Recovery rates, material flows, and barriers, WASTE MANAGEMENT, ISSN 0956-053X, 126, 2021, p. 694–705, JRC121522.

⁸⁶ For example 81.1% for PET (polyethylene terephthalate) packaging and 88% for HDPE (high-density polyethylene) packaging.

⁸⁷ Residues or rejects from recycling activities are generally attributable to contamination or the higher complexity in the materials of products hindering recyclability, infrastructure limitations or economic viability

⁸⁸ Gate fees are the charges levied on waste producers for disposing of waste, which can be modified to account for the carbon cost.

transferred from the operator to the local authority or other specific waste suppliers such as commercial or industrial actors. Contracts take varying formats (public service contracts with local authorities, or commercial contracts with other waste suppliers) and durations (e.g. generally ranging between 5 to 20 years for public service contracts). The carbon cost passthrough mechanism can be devised either as a lump sum in gate fees, fixing the carbon cost over a set period to allow for more predictable planning; through a modulated approach differentiating the gate fee depending on the emissions intensity of waste that is being disposed to encourage upstream actors to reduce the amount of specific waste streams sent to incineration or disposal; or based on performance-based contracts, rewarding improvements in efficiency and investment in lower-emission technologies. To facilitate the implementation of cost passthrough mechanisms in public service contracts, a transitional period could help to anticipate and prepare for the needed changes.

1.3.2. *Emission abatement at installation level*

Carbon pricing also creates economic incentives to mitigate emissions at the stage of waste disposal, with several pathways for cost and emissions abatement available to waste disposal operators:

Waste incineration

Mixed waste sorting (MWS) to reduce emissions before incineration: Sorting allows to reduce CO₂ emissions and improve overall energy efficiency of waste incineration by extracting high-carbon-content and recyclable materials, preventing their incineration⁸⁹. It can be implemented either downstream or at installation-level. A report by Eunomia Research and Consulting (ERC) estimated that MWS could save between 10.2 and 23.3 MtCO_{2e} annually across the waste management sector in the EU⁹⁰, which would represent savings of 5-10% of total EU waste management emissions (including waste-to-energy, landfilling and other activities), while another recent study found a 20% emissions reduction potential specifically for waste incineration in Sweden from the implementation of MWS⁹¹. Selected case studies are presented in Appendix 2. In terms of cost-effectiveness, cost of mixed waste sorting for MWI emissions reductions has been estimated at around 24 EUR/tonne of waste treated in the UK⁹², with cost-effectiveness increasing as the carbon content of waste increases, while costs associated with implementing Material Recovery and Biological Treatment (MRBT) systems, which combines mechanical sorting and biological processes to manage leftover mixed waste, have been estimated to range from 2 to 13 EUR/tonne of waste treated⁹³ in high-capacity (200kt) facilities, depending on regional factors such as labour and energy costs. In addition, MWS applied at installation level can also generate economic benefits for operators as the gate

⁸⁹ Mechanical-biological treatment (MBT) and advanced sorting technologies, such as mechanical separation, near-infrared (NIR) sensors, and AI-powered classification, can identify plastics for recycling or chemical recovery, reducing fossil CO₂ emissions. and advanced sorting systems can extract. Additionally, pre-drying and shredding waste enhances combustion efficiency by removing excess moisture, decreasing the need for auxiliary fuel, and further cutting emissions.

⁹⁰ Eunomia (2023). *Mixed Waste Sorting to meet the EU's Circular Economy Objectives*. Available at: <https://eunomia.eco/reports/mixed-waste-sorting-to-meet-the-eus-circular-economy-objectives/>

⁹¹ IVL Swedish Environment Research Institute (2025). Comparing high-quality recycling and downcycling of plastics. Available at: <https://ivl.diva-portal.org/smash/get/diva2:1936329/FULLTEXT01.pdf>

⁹² SUEZ (2025). Strategic approaches to minimising ETS costs for waste producers. Available at: <https://www.suez.co.uk/en-gb/news/list-of-publications>. Exchange rate used: 1 GBP = 1.15 EUR.

⁹³ ZeroWasteEurope (2023). *Nothing left behind: modelling Material Recovery and Biological Treatment's contribution to resource recovery and fighting climate change*. Available at: https://zerowasteurope.eu/wp-content/uploads/2023/04/ZWE_Apr23_Study_MRBT_costs_study.pdf.pdf

fee is received for the initial volume of residual waste, while recyclable fractions subsequently sorted out can be sold to the recycling industry. While these studies have different geographical and sectoral scopes, the results and the case studies in Appendix 2 indicate MWS is a cost-effective abatement option for municipal waste incineration.

Fuel switch and alternative feedstocks during incineration: Compared to other sectors, a fuel switch is not a general decarbonisation pathway for the municipal waste incineration sector. A secondary pathway to reduce incineration emissions involves replacing auxiliary fossil fuel by biofuels or other renewable alternatives⁹⁴. However, these emissions generally represent only a low ratio of total emissions from a waste incinerator. Fuel switching in hazardous waste incinerators could be more relevant, as auxiliary burners need to be lighted with a higher frequency to maintain the 1,100C temperature requirement in the secondary chamber. No detailed information was available on the costs associated with fuel switching and alternative feedstocks.

Process optimisation during incineration: Process optimisation enables plants to deliver a higher amount of energy, as power, heat or both, when burning the same amount of municipal solid waste. Examples include improved combustion efficiency by optimising oxygen supply and temperature, advanced monitoring and control systems to optimise combustion efficiency and minimise excess air, and upgrading boilers, heat recovery systems and turbines to maximise energy output per unit of waste. These result in a lower carbon intensity per kWh of energy produced or delivered, reducing the carbon cost.

Carbon capture, utilisation and storage (CCU/S) to sequester emissions after incineration: Carbon capture provides a twofold contribution to GHG reductions in the incineration sector by preventing the release of carbon of fossil origin and by removing carbon of biogenic origin, generating negative emissions. CCU/S can capture up to 90% of residual CO₂ before emission at stack⁹⁵, and either permanently fixate or store it (CCS) or use it in downstream industrial applications (CCU). Experience from Member States who have already applied a carbon price on waste incineration indicates growing interest in carbon capture at incineration facilities (see Appendix 2 for selected case studies). The business case for cost-effective carbon capture implementation in MWI is driven by the investment and operational cost of carbon capture technologies, the carbon price, and additional factors:

- the cost of **carbon capture** in waste-to-energy installations has variously been estimated to range from EUR 40-75/tonne of CO₂⁹⁶ (CAPEX) to EUR 76-127/tonne of CO₂⁹⁷ (total CAPEX and OPEX), which is lower than for most other hard-to-abate industrial sectors⁹⁸, to EUR172/tonne of CO₂⁹⁹ (total CAPEX and

⁹⁴ These could be for example hydrogen, hydrogenated vegetable oil (HVO) or biomass co-firing.

⁹⁵ There are several carbon capture methods suitable for incineration plants. Post-combustion capture is the most practical for existing facilities, using chemical solvents, adsorbents, or membranes to extract CO₂ from exhaust gases. Oxy-fuel combustion involves burning waste in an oxygen-rich environment instead of air, producing a high-purity CO₂ stream that is easier to capture. While pre-combustion capture is less common in incineration, it can be applied in waste gasification processes.

⁹⁶ JRC (2024). Carbon capture, utilisation and storage in the European Union.

⁹⁷ Eunomia Research & Consulting for Viridor (2021). CCUS Development Pathway for the EfW Sector. Exchange rate applied: 1 GBP = 1.15 EUR. The lower costs in this range relate to WtE facilities that are in closer proximity to CCUS clusters as they can benefit from shared infrastructure.

⁹⁸ Capture costs are primarily determined by the characteristics of the CO₂-rich stream. The high concentration of CO₂ in flue gases enhances the efficiency and cost-effectiveness of capture compared to other industrial sources.

⁹⁹ Oxford Institute for Energy Studies (2024). Carbon capture from energy-from-waste (EfW): A low-hanging fruit for CCS deployment in the UK? Exchange rate applied: 1 GBP = 1.15 EUR.

OPEX), which is comparable to other industrial sectors. These costs expected to come further down as technologies mature and become more widely adopted^{100,101,102} and exclude the potential to generate biogenic carbon removals and negative emissions, which is significant in the sector compared to other industrial sectors. Taken into account the potential to also generate and integrate carbon removals, a positive business case for carbon capture is expected by the mid-2030s.

- the integration of carbon removals under the EU ETS, allowing to generate **revenue from removals from the biogenic fraction of MWI emissions**, supporting the business case for carbon capture implementation.
- implementation of **waste heat recovery** to offset the loss in heat output from the operation of carbon capture technology, minimising the reduction in heat available for supply to district heating networks (where applicable)¹⁰³. In addition, innovation in advanced solvent systems can contribute to reduce energy requirements of solvent regeneration in the future.
- a **predictable timescale and financial support to plan and invest** in carbon capture technology, with other abatement options offering pathways to reduce the carbon cost in the shorter-term until the implementation of carbon capture over time. Financial support and a transition period could complement the economic incentive of the carbon price. Financial support is currently already available under the Innovation Fund and the Modernisation Fund.
- waste incineration infrastructure is generally modern and technically advanced, with long operational lifespans, making it well-suited for CCUS retrofitting. In the UK – with a similar market structure as the EU27 – 60-65% of 57 installations, covering 74-78% of total emissions from the sector, have been found to be CCUS compatible¹⁰⁴. Further **development of smaller modular units** and the implementation of **CCS-readiness mandates**¹⁰⁵ requiring new MWI installations to be designed for compatibility with carbon capture technology, addressing

¹⁰⁰ Global CCS Institute (2021). *Technology Readiness and Costs of CCS*. Available at : <https://scienceforsustainability.org/w/images/b/bc/Technology-Readiness-and-Costs-for-CCS-2021-1.pdf>

¹⁰¹ Carbon Clean (2021). [https://www.carbonclean.com/en/press-releases/breakthrough-industrial-carbon-capture-solution#:~:text=CycloneCC%20has%20a%20footprint%20that,and%20storage%20\(CCUS\)%20undeniable](https://www.carbonclean.com/en/press-releases/breakthrough-industrial-carbon-capture-solution#:~:text=CycloneCC%20has%20a%20footprint%20that,and%20storage%20(CCUS)%20undeniable)

¹⁰² JRC (2024). Carbon capture, utilisation and storage in the European Union.

¹⁰³ The operation of carbon capture technology is energy intensive. An estimate of the energy demand required, depending on the size and configuration of the installation, is around 3.6-3.9 GJ/tCO₂ or 1MWh/tCO₂ (thermal input, usually from medium pressure steam to run the stripper) and in the range of 100-250kWe/tCO₂ (electrical or power input, to run all equipment such as pumps, fans, etc). This can reduce the heat and/or power output available for supply by a waste-to-energy installation to a district heating or energy network. The loss in heat output can be fully recovered by means of carbon capture technology selection and waste heat recovery through heat integration and installation of heat pumps. Conversely, full recovery of heat output results in a significant (up to 50%) reduction in power output, as alternative capture technologies and heat pumps consume power.

¹⁰⁴ Oxford Institute for Energy Studies (2024). Carbon capture from energy-from-waste (EfW): A low-hanging fruit for CCS deployment in the UK?

¹⁰⁵ For example, the UK has implemented the CCS Readiness Requirement that mandates that all new combustion power stations with a capacity of 300 MW or more must be designed to allow future retrofitting of CCS technology, to make new infrastructure compatible with future decarbonisation technologies.

practical constraints in retrofitting smaller existing plants due to footprint restrictions¹⁰⁶.

- **further development of a harmonised EU regulatory framework** for industrial carbon management, including CO₂ transport, access to storage locations (CCS), demand for recycled carbon (CCU), and the creation of a single European market for CO₂.

Landfills

Landfills covered by the Industrial Emissions Directive must apply Best Available Techniques (BAT). In addition, a BAT Reference Document (BREF) and BAT conclusions for landfills are currently under development. Emissions abatement pathways include:

Biofilters and biocovers to reduce emissions: Biofilters and biocovers¹⁰⁷ are passive techniques that can be used to mitigate landfill gas (LFG) emissions. Biofilters and biocovers can function independently of active gas collection systems and can be used for areas of landfills no longer connected to such systems. Biocovers utilising substantial amounts of aged compost have demonstrated methane oxidation rates between 30% and 40%, while methane oxidation rates in biofilters can reach up to 19%¹⁰⁸. For example, the Fakse landfill biocover project in Denmark covered over 5,000 m² with biocovers, with field tests showing a 30% reduction in methane emissions. The cost of biofilters and biocovers is overall limited and depends on the local availability of materials. Costs include installation, as well as ongoing maintenance, such as watering oxidizing materials in dry climates and monitoring their effectiveness over time. The United States Environmental Protection Agency (EPA) estimates that, on average, the capital cost for a biocover is approximately EUR 16.7 per hectare.

Quality landfill management: Effective landfill (cover) management plays a key role in reducing methane emissions. Using impermeable covers helps prevent rainwater infiltration while enhancing methane capture. Additionally, implementing a leachate collection and management system reduces moisture levels and anaerobic conditions within the landfill, thereby limiting CH₄ production.¹⁰⁹ Enhanced landfill management practices can improve waste decomposition and maximise gas collection efficiency. Key strategies include compacting waste to minimize empty spaces where methane can accumulate and using alternative daily cover materials that support gas capture. Additionally, routine monitoring and maintenance of gas collection systems are crucial to ensuring long-term effectiveness.¹¹⁰

Landfill gas (LFG) capture and utilisation: Capturing LFG involves collecting methane produced during waste decomposition and repurposing it, for biogas production, electricity

¹⁰⁶ According to literature sources, the footprint for a carbon capture plant could range between 270-1,600 m²/tCO₂. See for example: Realmonte, G., Drouet, L., Gambhir, A. et al. An inter-model assessment of the role of direct air capture in deep mitigation pathways. *Nat Commun* 10, 3277 (2019). <https://doi.org/10.1038/s41467-019-10842-5>

¹⁰⁷ A biofilter comprises a porous material layer topped with organic matter, such as compost, designed to oxidise methane present in LFG. LFG is directed from gas vents through flexible tubing into the biofilter, where methanotrophic bacteria convert methane into carbon dioxide which is a significantly less potent GHG. Alternatively, a biocover involves placing a porous material layer directly on top the landfill, covered by an oxidising layer of mature compost. As fugitive LFG permeates this cover, methane oxidation occurs.

¹⁰⁸ EPA (2025). *Apply Biofilters or Biocovers*. Available at : <https://www.epa.gov/lmop/apply-biofilters-or-biocovers>

¹⁰⁹ Kurniawan T. A. et al. (2024). 'Landfill mining: A step forward to reducing CH₄ emissions and enhancing CO₂ sequestration from landfill'. *Journal of Hazardous Materials Advances*. Available at: <https://doi.org/10.1016/j.hazadv.2024.100512>

¹¹⁰ See footnote 65

generation or heat generation in industrial processes. LFG capture not only mitigates the release of methane into the atmosphere but can also provide sustainable energy alternatives, with efficient energy recovery generating substantial savings¹¹¹. Alternatively flaring systems can burn excess methane if energy recovery is not feasible, converting CH₄ to CO₂ which has a lower global warming potential. LFG capture efficiency varies, with well-managed, modern sites achieving 70-90% efficiency¹¹². The abatement potential of landfill gas capture and utilisation was also explored during the stakeholder consultation, confirming these results. The overall Levelized Cost of Electricity (LCOE) for electricity production from biogas in the EU was analysed to be 80 EUR/MWh (2018)¹¹³ and between 40-60 EUR/MWh specifically for LFG capture and utilisation projects (2020)¹¹⁴, making it a competitive renewable energy source with an LCOE within the range of onshore wind and (substantially) below fossil power sources. Selected case studies on LFG projects are presented in Appendix 2.

1.3.3. Complementary measures and revenue use

Complementary policies and measures and the targeted reinvestment of EU ETS revenues can provide key complementary incentives for abatement, in particular by reducing the amount of non-recyclable plastics at production level and by increasing recycling of fossil-based waste streams, in particular plastics, through upstream improvements in product design, improving producer responsibility for waste treatment, and expanding recycling capacity. The EU already has several policy frameworks that promote such measures. A recent report by the Joint Research Council¹¹⁵ found that an ambitious circular economy scenario based on strengthened reduce, reuse and recover levers has a substantial potential for reducing GHG emissions across selected energy-intensive sectors, with up to 75-84 Mt CO₂-eq emissions reductions in plastics by 2050 through the reduction of virgin plastics, strengthened eco-design, lifetime extension measures and improved waste management to deviate plastic towards recovery and recycling. Selected complementary measures that can support the carbon price incentive include:

Strengthened Extended Producer Responsibility (EPR): Extended Producer Responsibility (EPR) schemes shift the accountability for the environmental impacts of products across their entire lifecycle to producers, who contribute financially to waste collection, treatment, and

¹¹¹ Integrity Council for the Voluntary Carbon Market (2025). *Landfill Gas Capturing*. Available at: <https://icvcm.org/landfill-gas-capture/>

¹¹² See for example Giordano, R. (2024). *Landfill gas collection efficiency: Categorization of data from existing in-situ measurements*. Waste management, volume 175, pages 83-91. Available at: <https://doi.org/10.1016/j.wasman.2023.12.042>; and Oonk, H (2012). *Efficiency of landfill gas collection for methane emission reduction*. Greenhouse gas measurement and management. Volume 2, 2012 - Issue 2-3. Available at: <https://doi.org/10.1080/20430779.2012.730798>

¹¹³ Motola V., et al. (2022). *Clean Energy Technology Observatory: Bioenergy in the European Union – 2022 Status Report on Technology Development, Trends, Value Chains and Markets*, Publications Office of the European Union, Luxembourg, 2022, doi:10.2760/577104, JRC130730

¹¹⁴ Unece KIT DFIU-TFTEI Technical Secretariat (2020). *Background informal technical document on techniques to reduce methane emissions in Europe from landfill gases, the natural gas supply system and biogas facilities*. Available at: https://unece.org/sites/default/files/2022-07/TFTEI_methane_background_document-december_2020.pdf?utm_source=chatgpt.com

¹¹⁵ WALKER, A., ALBIZZATI, P.F., MILIOS, L., PINERO MIRA, P., BESLER, M. et al., *Capturing the Potential of the Circular Economy Transition in Energy-Intensive Industries - Summary Report*, Publications Office of the European Union, Luxembourg, 2025, <https://data.europa.eu/doi/10.2760/4604362>, JRC142938

disposal, encouraging recyclability and reparability of products¹¹⁶. Extending and optimising EPR schemes can improve the recyclability of products, decrease the amount of non-recyclable plastics being sent to disposal, reduce the amount of carbon content in and emissions from waste, ensure that producers share the cost of managing fossil carbon emissions and generate revenue to support recycling capacity. Under the Packaging and Packaging Waste Directive, EU Member States set an EPR scheme for plastics (p-EPR) by 31st December 2024. An overview of Member States' EPR schemes can be consulted on the sector organisation's website¹¹⁷. One example is Fost Plus in Belgium, an industry-funded non-profit EPR-scheme to manage packaging waste collection and recycling, including a take-back obligation for industry and eco-modulation with higher rates for difficult or non-recyclable packaging. The system achieved a 71% plastic packaging recycling rate in 2024, above the EU target, while having reduced the volume of non-recyclable packaging on the Belgian market by more than half since 2019. From 2025, textile waste (which in most cases has a fossil component) must also be separately collected and EPR schemes will be set up for textile and footwear products. Some countries have further extended EPR schemes to other fractions (such as toys, electronics, etc). Factors that can further strengthen the impact of EPR schemes are to use (part of) the revenues to support waste management service improvements, making EPR schemes sufficiently responsive to cover the ETS carbon cost, and extending and aligning EPR-schemes at EU-level to the scope of waste streams covered under the EU ETS¹¹⁸.

Mandatory recycled content policies: Mandatory recycled content policies reduce (virgin) fossil-based waste streams and incentivise recycling. The EU has mandatory recycled content policies, primarily through the Packaging and Packaging Waste Regulation (PPWR) and the Single-Use Plastics Directive (SUPD), requiring minimum recycled content for plastics, like 25% in PET bottles by 2025 and 30% by 2030, with broader packaging rules targeting virgin material reduction and recyclability by 2030. Recent developments also set mandatory recycled content for vehicles (25% by 2036) and focus on improving end-of-life vehicle management and producer responsibility to boost circularity.

1.4. Monitoring and Reporting

When expanding the ETS to cover waste sector emissions, the development of an effective MRV framework, balancing the need for robustness with practical feasibility, would be an essential element of a potential inclusion of waste incineration facilities and landfills in the EU ETS. The MRV process should be in line with the rules applied in other ETS sectors. It should also build on the existing MRV obligation for installations for the incineration of municipal waste exceeding 20 MW in place since 2024. In the ETS, the monitoring and reporting of GHG emissions needs to follow the EU MRR. As a first step, operators of installations need to submit a monitoring plan to the Competent Authority for check and approval before the start of

¹¹⁶ EPR-schemes can be applied through compensation models, where producers are made financially and/or operationally responsible for the management of their products' waste after consumer use, e.g. through a Producer Responsibility Organization (PRO), or cost application models, where the net carbon cost of waste management is (partially) transferred to producers through fees based on the carbon intensity of their products, potentially linked to the ETS-price.

¹¹⁷ European (2025). Overview of Member States' EPR Schemes: <https://www.europen-packaging.eu/publication/overview-of-member-states-epr-schemes/>

¹¹⁸ Under the UK ETS consultation on incineration (closed in August 2024), it has been estimated that around 20-30% of the fossil waste (wt/wt) is under this plastics-EPR scope, and therefore, Local Authorities could recover those payments. See: Joint consultation (2024). 'UK Emissions Trading Scheme Scope Expansion: Waste.' Available at : <https://assets.publishing.service.gov.uk/media/6669a60c9d27ae501186db79/ukets-scope-expansion-consultation-waste.pdf>

operation. Thereafter, operators carry out monitoring during the calendar year according to the approved monitoring plan. In case of significant changes to the monitoring methodology, operators submit an updated monitoring plan for approval. Operators then submit a verified annual emission report (AER) to the Competent Authority that needs to be verified by an independent accredited verifier. In case of a full integration into the EU ETS, operators then surrender allowances before 30 April and where needed, operators submit a report on improvements to the monitoring methodology before 30 June. Competent Authorities are in charge of enforcing penalties in case of non-compliance.

As of the start of 2024, installations for the incineration of municipal waste exceeding 20 MW are included in the EU ETS with an obligation for monitoring, reporting and verification only. Under the current EU ETS MRR, municipal waste incineration (MWI) installations, like any other combustion installation, can monitor emissions either by a calculation-based or a measurement-based approach, and the MRR does not contain special provisions for the monitoring of emissions from MWI. In case of an extension of the EU ETS to MWI, an update of the MRR would be needed to further define MWI-specific implementing rules (i.e. definitions, monitoring and reporting methods to be used, the detailed provisions of each method such as frequency of sampling, etc.). This was also frequently raised as an important condition for inclusion in the EU ETS by different stakeholders, both companies and business associations as well as NGOs, in the OPC.

Drawing on the feedback from the stakeholder consultation, the experience from the start of monitoring and reporting under the EU ETS as of 2024, and the UK's approach towards voluntary MRV for waste incineration as of 2026¹¹⁹, a tiered system that incorporates both measurement-based and calculation-based methodologies, along with simplified provisions for smaller emitters, can provide a scalable and proportionate MRV system for the inclusion of the waste incineration sector. A tiered approach allows different levels of methodological rigor depending on plant size and technical capacity, while allowing to consider the different uncertainty levels of each methodology and various technical, operational, and administrative considerations related to the variable nature of waste inputs and the need to differentiate between fossil and biogenic carbon. It will also be important to further align the MRV with existing legislative frameworks such as the Industrial Emissions Directive to avoid duplication (for example, measurement equipment such as stack flow and CO₂ volumes) and minimise administrative costs. Standard methodologies and harmonised guidance, flexible tiered methodologies and support mechanisms to ensure an accurate and manageable implementation across the sector, reducing the financial and logistical challenges for operators, for medium and small-size facilities. It must be noted that the inclusion of hazardous and clinical waste facilities may require a tailored approach, given that some measurement-based methods cannot or should not be applied (see section 1.4.1. below).

Contrary to waste incineration, there are currently no established harmonised (measurement-based) MRV protocols in place or available in literature for methane emissions from landfills, and uncertainty in the quantification of methane emissions from waste remains high. Differently to emissions from incineration, methane generation at landfills is a biological activity, with emissions being diffuse, distributed over longer timeframes and site-specific. These issues should be addressed by advancing MRV robust, harmonised MRV methodologies prior to considering carbon pricing to avoid unintended consequences. This process is expected

¹¹⁹ Department for Energy Security & Net Zero (2024). *MRV Options for Inclusion of Energy from Waste Plants and Waste Incinerators within the UK ETS*. Available at: <https://assets.publishing.service.gov.uk/media/66a24709a3c2a28abb50d725/uk-ets-waste-MRV-report.pdf>

to be complex and would need to take into account the different waste streams received across a large number of disposal sites, the decay period of biogenic waste in landfills and whether to cover only future emissions or also emissions from the decay of past disposal, and the different designs and LFG-capture possibilities of each site. While MRV approaches for landfilling could be based on calculations or measurements, the use of standardised emission factors can substantially over- or underestimate actual emissions and research gaps remain among others on the determination of national Degradable Organic Carbon values, classification of waste fractions and interactions with pre-treatment processes. A measurement-based approach would contribute to increasing the accuracy of emissions data compared to the current data reported under the ESR and UNFCCC EU national inventory reports, which in turn would be important to ensure the environmental integrity of the EU ETS, but is more complex to develop and consistently apply.

Appendix 3 discusses different measurement- and calculation-based methodologies available for waste incineration and landfill sites. The data on expected costs is sourced from the UK but is expected to be relatively transferable to the EU context.

1.4.1. Threshold for inclusion

The current thermal input threshold for inclusion in the EU ETS is 20MW. However, unlike power generation and industrial process installations, the thermal input of a waste incinerator does not consistently correspond to its emissions or its scale of operation due to the varying composition of residual waste, affecting its energy content and fossil-carbon share. Reliance on a 20MW threshold could therefore lead to inconsistencies, where some installations with low throughput but high-calorific waste would be covered, while others with high throughput but lower-calorific waste may fall out of the scope. Similar considerations would apply for landfills. An inclusion of waste sector activities into the EU ETS therefore needs to carefully consider the potential threshold for the sector, considering the nature of waste as a feedstock, environmental integrity ensuring accurate, fair and effective coverage of emissions, avoidance of disproportionate impacts on small operators and minimising threshold effects leading to diversion to installations just below the threshold. These concerns were also consistently highlighted during the stakeholder consultation by both business and NGO stakeholders from the waste sector. Three options for threshold setting for the waste incineration sector are explored below and the estimated impacts on installations and emissions covered are summarised in Table 4:

- **Thermal input threshold:** The EU ETS MRV obligation for MWI since 2024 as well as the German national emissions trading system covering waste incineration currently apply the general threshold of 20 MW. While no exact data is available on the share of installations and emissions falling below this threshold, an approximation can be made on the basis of the municipal waste-to-energy installations in the EEA not reported under the MRV obligation in 2024 (see Appendix 1 for details), on the basis of which 53 installations were identified with total fossil-based emissions of maximum 1.05 MtCO₂e¹²⁰ or an additional 2.7% on top of the total reported emissions under the EU ETS MRV. However, as

¹²⁰ Estimate based on the combined nominal capacity of these installations (CEWEP data) and a standardised 0.5 fossil emission factor. The result is likely an overestimate as the figure is based on nominal capacity instead of actual volumes incinerated, which is generally lower.

highlighted above, any thermal threshold carries several intrinsic challenges and inconsistencies in terms of coverage in the waste sector.

- **No threshold:** Several stakeholders, both businesses and NGOs from across the waste management sector, proposed the 20 MW thermal input threshold to be eliminated, and all incineration and energy from waste activities included in principle. However, smaller incinerators would be expected to fall under the small or ultra small emitters provisions in Articles 27 and 27a in the EU ETS and therefore could opt-out of the inclusion of the scheme and the surrender of allowances, although still subject to a monitoring plan. Out of 411 municipal WtE installations in the EU in 2022¹²¹, 58 had a nominal capacity of 50.000 tonnes of waste or less per year, which (assuming a 50% fossil-based fraction) would each be expected to produce 25.000 or less tonnes of CO₂e on annual basis. If their thermal threshold is below 35 MW, these would fall under the hospital and small emitter opt-out clause under Article 27. If producing less than 2.500 tonnes of CO₂e on annual basis, they would fall under the ultra-small emitter opt-out clause under Article 27a of the EU ETS Directive.
- **Volume-based threshold:** An alternative approach could be based on waste capacity or waste throughput (tonnes per year), more closely reflecting the specific characteristics of the sector. This approach was suggested by several stakeholders from the sector in the stakeholder consultation. The design of the UK ETS scheme expansion to waste is also proposing an alignment of entry criteria with the existing environmental permitting framework. As a result, the waste sector would be expected to use tonnage-based thresholds, specifically three tonnes per hour of non-hazardous waste or ten tonnes per day of hazardous waste. A similar approach could be followed under the EU ETS¹²², which would result in 15 municipal WtE installations falling below this threshold, with maximum fossil-based emissions of 0.15 MtCO₂e¹²³ or an additional 0.5% on top of the total reported emissions under the EU ETS MRV given the limited capacity of these installations (see Appendix 1). This is expected to be a slight overestimation due to being based on nominal instead of actual incineration volumes. The disadvantage is that a volume-based threshold is not necessarily associated with the total emissions and their impact, as this will depend on the volume and composition of waste that is combusted in each facility.

¹²¹ CEWEP (2022).

¹²² The Industrial Emissions Directive applies the same thresholds, see Annex I, point 5.2.: “Disposal or recovery of waste in waste incineration plants or in waste co-incineration plants: (a) for non-hazardous waste with a capacity exceeding 3 tonnes per hour;”. This equates to a capacity of 26.280 tonnes per year. In terms of thermal input, assuming a calorific value of respectively 10 GJ/tonne of (unprepared) or 7.5 GJ/tonne of (prepared) leftover MSW, 3 tonnes per hour would imply respectively 30.000 or 22.5000 MJ/hour, or 8.33 or 6.25 MW (MJ/sec).

¹²³ Estimate based on the combined nominal capacity of these installations (CEWEP data) and a standardised 0.5 fossil emission factor. The result is likely an overestimate as the figure is based on nominal capacity instead of actual volumes incinerated, which is generally lower.

Table 4: Options for threshold for inclusion of waste incineration installations in the EU ETS and estimated impact on installations covered and emissions excluded

Threshold	Examples	Estimated installations excluded (N)	Estimated emissions excluded under the threshold (N and %)
20MW (cf. EU ETS, German ETS) (~71.500 tpa)	EU ETS for stationary installations; German ETS for MWI installations	≤ 53	≤ 1.05 MtCO ₂ e (2.7%)
No threshold		0	0
Volume-based threshold of 3tph (~ 26.280tpa)	Industrial Emissions Directive threshold for environmental permit for MWI; UK ETS threshold for voluntary MRV for MWI	≤ 15	≤ 0.15 MtCO ₂ e (0.5%)

Source: Commission desk research.

1.4.2. Simplified MRV for small and ultra-small emitters

As indicated above, the current EU ETS Directive provides two opt-out provisions to the allowance surrendering requirements for smaller emitters:

- Article 27 EU ETS Directive allows for the exclusion of small installations subject to equivalent measures. Member States may exclude installations which have reported emissions of less than 25.000 tonnes of carbon dioxide equivalent and, where they carry out combustion activities, have a rated thermal input below 35 MW, excluding emissions from biomass. Hospitals may also be excluded if they undertake equivalent measures. These emitters are known as Hospital and Small Emitters (HSE).
- Article 27a EU ETS Directive allows for the exclusion of installations emitting less than 2.500 tonnes. Member States may exclude installations that have reported emissions of less than 2.500 tonnes of carbon dioxide equivalent, disregarding emissions from biomass. These emitters are known as Ultra Small Emitters (USEs).

1.5. Coherence with other policy frameworks

In line with the review clause in Article 30(7) of the EU ETS, the assessment of a potential inclusion of the waste management sector into the EU ETS should consider the alignment with the objectives of Waste Framework Directive. The long-term goal of the EU's waste framework is to transition to a circular economy, where waste is kept to a minimum, and unavoidable waste is used as a resource as far as possible. It aims to protect the environment and human health by emphasising the importance of proper waste management, recovery and recycling techniques to reduce pressure on resources and improve their use. Effective municipal waste management requires well organised separate collections of various materials, appropriate infrastructure for sorting, treatment, incineration and/or landfill, and a viable market for the recycled output.

To this end, the EU has established a comprehensive regulatory framework to advance the transition to a more circular economy, increase recycling and reduce landfilling. It has set targets for Member States to ensure that a certain share of municipal waste, of packaging waste and of other specific waste streams is prepared for re-use and recycled. By 2025, 50% of plastic, 65% of packaging waste and 55% of municipal waste must be prepared for re-use or recycled, the latter further increasing to 65% by 2035. The EU has also set a target for Member States to

reduce the share of waste sent to landfill to 10% by 2035. The current targets are set by the Waste Framework Directive, the Packaging and Packaging Waste Regulation, and the Landfill Directive. In addition, the Waste Shipment Regulation establishes strict controls over the shipping of waste within the EU and between the EU and non-EU countries, thereby preventing illegal waste trafficking and minimizing the risk of environmental harm¹²⁴. The Commission has announced a new Circular Economy Act to be adopted in 2026, which will accelerate the circular transition, stimulating the single market and demand for secondary materials and circular products, supporting investment in recycling capacity, reducing the landfilling and incineration of used raw materials, and rolling-out upstream producer-oriented policies such as eco-design requirements.

In addition, the Industrial and Livestock Rearing Emissions Directive (Directive 2010/75/EU or ‘IED 2.0’) regulates pollution from large industrial sites, including waste incineration plants and landfill sites, to reduce emissions to air, water, and soil. The IED 2.0 sets conditions and criteria for the granting of environmental permits to the concerned installations by national permitting authorities, including emission limits, operational standards and promoting Best Available Techniques (BATs) as the most environmentally effective and economically and technically viable way for the prevention and control of emissions, encouraging innovation.

These regulations have driven improvements in waste prevention, recycling and alternative treatment methods. The overall recycling performance for municipal waste has increased by more than 10 percentage points between 2010 and 2022, from 38% to 48.7% for the EU-27 (see figure 4). However, implementation varies significantly across Member States and national regulatory and fiscal measures differ widely in scope, enforcement and impact. Recent reports by the EEA and the European Court of Auditors (ECA)¹²⁵ show that many EU Member States are not on track to meet the recycling targets for municipal waste and packaging waste, with 10 Member States at risk of missing both targets in 2025 nor to meet the 10% landfilling target, with 13 Member States having recorded landfilling rates of over 50% in 2021 (see figure 5). Specifically for plastic waste, a major source of incineration emissions, the EU generated 42.5 million tonnes of plastic waste in 2022, of which only around 20% was recycled while the remaining 80% was incinerated or landfilled (45% was not separately collected and 33% – three fifths of the 55% separately collected – was not sent to recycling¹²⁶). At the same time, separate waste collection mostly remains at a very low level, bio-waste is not yet collected separately in many Member States and fees for the Extended Producer Responsibility are often insufficient to cover the costs. Member States with the highest recycling rates and highest increases in recycling are generally those with the strongest additional regulatory policies discouraging landfilling and prioritising recycling, including (high) volume-based landfill

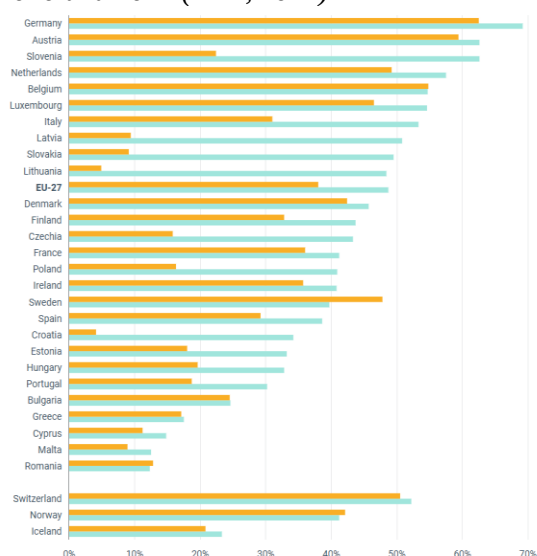
¹²⁴ All exports of plastic waste from the EU to non-OECD countries will be prohibited and subject to strict notification and consent procedures to OECD countries as of November 2026, exports of hazardous and other specific wastes to non-OECD countries will be prohibited as of May 2027, and exports of other non-hazardous waste for recovery to non-OECD countries generally restricted unless explicitly requested by the country and it shows ability to treat it sustainably, and passes audits.

¹²⁵ ECA (2025). Special Report 23/2025. Municipal Waste Management. Available at : https://www.eca.europa.eu/ECAPublications/SR-2025-23/SR-2025-23_EN.pdf; EEA (2023). Briefing no. 28/2022. Many EU Member States not on track to meet recycling targets for municipal waste and packaging waste. Available at:

¹²⁶ JRC (2025). Plastics materials flows in the EU-27 and their environmental impacts.

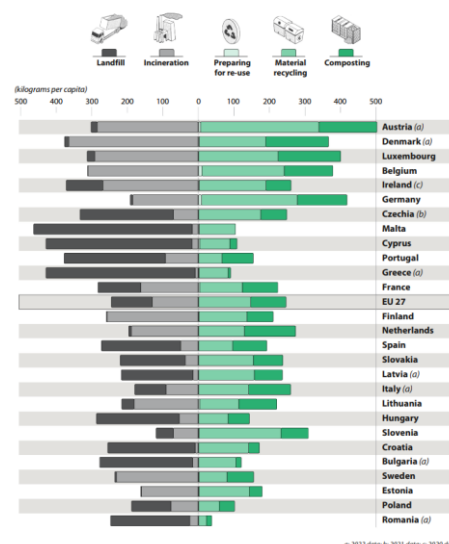
and/or incineration taxes¹²⁷ (e.g. DK, LV, SE, NL), bans or restrictions on biodegradable waste being landfilled (e.g. AT, BE, NL, SI), or some form of carbon pricing (DK, LT, NL, SE)¹²⁸. Recommendations in the ECA report are to focus, among others, on making recycling practices more viable and on harmonising landfill and incineration taxes. Applying EU-wide carbon pricing to waste management activities can further support action on the EU's waste policy framework by providing such harmonised economic incentive towards recycling and to reduce waste disposed through processes lower on the waste hierarchy.

Figure 4: Municipal waste recycling rates in 2010 and 2022 (EEA, 2024)¹²⁹.



Source: EEA

Figure 5: Municipal waste per capita and treatment methods (in kg, 2023)¹³⁰.



Source: ECA, based on the Eurostat dataset env_wasmun

Outside of the EU, the UK Government has established a voluntary monitoring, reporting, and verification (MRV) period for waste incinerations installations under the UK ETS as of 1 January 2026, with a decision on the full inclusion of the sector foreseen in the future. The scope of the MRV for waste incineration would apply to installations processing three tonnes or more per hour of non-hazardous waste or ten tonnes or more per day of hazardous waste, with clinical waste incinerators included and high-temperature hazardous waste incinerators exempted.

¹²⁷ Volume-based landfill taxes (present in 22 Member States) ranged from 5 to 110 EUR/tonne of waste landfilled in 2023, while volume-based incineration taxes (present in only 10 Member States) ranged from 5-80 EUR/tonne of municipal waste incinerated. See EEA (2023). *Technical note accompanying the EEA briefing 'Economic instruments and separate collection – key instruments to increase recycling'*. <https://www.eea.europa.eu/en/analysis/publications/economic-instruments-and-separate-collection/technical-note-accompanying-the-eea-briefing-economic-instruments-and-separate-collection-key-instruments-to-increase-recycling>

¹²⁸ Only few Member States apply some form of emissions-based pricing on incineration. Denmark and Sweden have included municipal waste incineration (MWI) installations in their national implementation of the EU ETS, while Germany included waste incineration installations in its national emissions trading system and the Netherlands implemented a carbon levy for emissions from MWI.

¹²⁹ EEA (2024). *Waste Recycling in Europe*. <https://www.eea.europa.eu/en/analysis/indicators/waste-recycling-in-europe>

¹³⁰ ECA (2025). *Special Report 23/2025. Municipal Waste Management*. Available at : https://www.eca.europa.eu/ECAPublications/SR-2025-23/SR-2025-23_EN.pdf;

1.6. Policy measures

1.6.1. *Description of the policy measures*

Drawing from the analysis in this annex, this section assesses the concrete policy measures considered for the extension of the EU ETS to waste management activities. The measures are assessed for their environmental, economic and social impacts, specifically the environmental integrity, the alignment with waste hierarchy, the feasibility of robust monitoring and reporting of emissions as well as internal market effects and potential distortions of competition– as prescribed for the review clause. Timewise, the expansion of the EU ETS to waste management regardless of the level has been fixed at ‘from 2030 onward’ to ensure predictability and sufficient preparation time for the waste sector (considering the time for the co-decision process for the review and the time needed to implement its outcomes).

The measures under consideration are:

- W1: Inclusion of non-hazardous waste incineration installations in the EU ETS.
- W2: Inclusion of all waste incineration installations in the EU ETS.
- W3: Inclusion of all waste incineration installations and landfills of non-hazardous waste in the EU ETS.

1.7. Assessment of Policy measures

1.7.1. *Environmental impacts*

1.7.1.1. Climate impact

1.7.1.1.1. W1 ‘EU ETS expansion to non-hazardous waste incineration’

W1 extends the EU ETS carbon price to municipal waste incineration (MWI) compared to the baseline, which would ensure that emissions from the combustion of municipal waste, providing an economic incentive to reduce emissions cost-effectively, while also harmonising the polluter-pays-principle between Member States, between sectors and within the waste management sector.

First, the inclusion of non-hazardous waste incineration in the EU ETS would be an important step towards increasing accountability for fossil carbon emissions from municipal waste streams, notably plastics. The existing environmental policy framework on waste incineration does not specifically address GHG emissions from waste incineration, with incineration policies and taxes mainly focused on the activity and waste volumes instead of its carbon content, while few Member States have taken national measures under the Effort Sharing Regulation. Reported emissions from MWI above 20 MW under the EU ETS MRV obligation amounted to 85 Mt CO₂ in 2024 for the EEA, of which 39.4 MtCO₂e (47%) fossil-based emissions, and 45.6 MtCO₂e (53%) biogenic-based emissions which would be considered zero-rated under the EU ETS. This is significant and equivalent to total GHG emissions from Finland or to two thirds of all ETS aviation emissions in 2024. If included as a separate sector, the fossil fraction of MWI emissions would be the 7th largest out of 27 sectors under the EU ETS.

The carbon price is projected to drive both cost-effective emissions reductions and carbon removals or negative emissions from municipal waste incineration through a combination of waste prevention and reduction at source, pre- and post-collection sorting and recycling of

waste, and carbon capture and process optimisation at installation-level (see Section 1.3.). These were also the most frequently raised justifications in the stakeholder consultation by the majority of respondents supporting MWI inclusion, arguing inclusion in the EU ETS will contribute to incentivise recycling higher up the waste hierarchy (over one third of responses), as well as incentivising CCUS uptake (nearly one fifth of responses) and the potential to generate removal credits from biogenic CO₂ (nearly one tenth of responses). The price signal of the cost passthrough can incentivise improved pre-collection sorting and residual waste reductions in the range of 10-20% (3.6-7.2 Mt CO₂eq) and increased recycling in the range of 16-22.5% on the basis of existing price elasticities for the residual waste disposal demand. Increased recycling generates a dual benefit through the reduction of GHG emissions in the waste management sector and by providing recycled materials displacing more carbon intensive virgin materials. Combined with complementary circular economy policies and measures, an ambitious circular economy scenario has a substantial potential for up to 75-84 Mt CO₂-eq emissions reductions from plastics by 2050⁴⁵. Carbon capture likewise offers a dual benefit of reducing fossil emissions and generating biogenic carbon removals and negative emissions. The risk of *emissions* leakage due to potential waste diversion to landfilling would be limited by the design of W1 as emissions from organic waste – the main source of methane emissions from landfills – would be zero-rated, substantially restricting incentives to divert organic waste to landfills in avoidance of the carbon cost, where they would be responsible for increased methane emissions. Conversely, the environmental risk of (fossil) waste diversion to landfills is further assessed in section 1.7.1.2.1.

Second, extending the EU ETS to non-hazardous waste incineration installations would harmonise the application of the polluter-pays principle within the waste incineration sector, addressing the current heterogeneous coverage of emissions from waste incineration depending on the waste type and Member States' classification of installations. In addition, an extension would support a level playing field for the application of the polluter-pays between sectors, notably with the co-incineration of waste in industrial installations (e.g. cement kilns) and power generation already in EU ETS. Finally, an extension would also harmonise the application of the polluter-pays principle between Member States, addressing competitive distortions resulting from the current differentiated carbon pricing of waste-to-energy installations in selected Member States (Denmark, Sweden, Lithuania, Germany, the Netherlands). Nearly one third of respondents in the OPC who supported an inclusion of MWI into the EU ETS substantiated their support to ensure a level playing field between sectors and maximise cost-effectiveness of emission reductions, while it was also raised by multiple stakeholders in position papers and during the interviews. On the other hand, W1 carries a risk of uneven distribution of the carbon price incentive across the EU, given the diverse range of incineration shares across Member States. A 'three-speed Europe' can be observed in terms of incineration rates, with a share of Member States having high incineration capacity and low to zero landfilling, a share of Member States transitioning from landfilling to incineration, and another share of Member States remaining heavily reliant on landfilling and having no or almost no incineration capacity. Under W1, the carbon price would not directly affect waste management in the latter Member States.

1.7.1.1.2. W2 - EU ETS expansion to non-hazardous and hazardous waste incineration'

In addition to W1, under W2, the carbon price signal is also applied to hazardous waste incineration (HWI). A detailed analysis of cost-effective emissions reductions under W2 was not possible due to data limitations on current HWI emissions. HWI emissions were approximated in Section 1.2.2. to amount to around 3.15 MtCO₂e (2022). The establishment

of the cap increase and modelling of cost-effective emissions reductions under the LRF would ideally require more accurate MRV data to be collected prior to inclusion. However, the cost-effective emission reduction potential for HWI is expected to be more limited compared to W1 in view of these waste streams more regularly originating from products with limited recycling potential and a lack of viable alternatives for the hygienic and environmentally sound disposal of non-recyclable hazardous waste in view of strict regulatory requirements.

There was no majority for the inclusion of installations for the incineration of hazardous waste in the EU ETS among stakeholders in the OPC, with a relative majority of just over one third against, versus one third in favour and one third uncertain. The main arguments against inclusion of HWI were the stricter regulatory requirements and more limited alternatives in safely handling hazardous waste and potential risks to public health and safety compared to MWI, the public-service role and lack of control over upstream hazardous waste production, and limited fuel-switch options due to the need for destruction at high temperatures. One of the most frequently raised grounds in favour of including HWI installations was to uphold the polluter pays principle by enhancing coherence and a level playing field between incineration activities, and that some MWI installations hold permits also for some hazardous waste fractions (the other main argument being to incentivise cleaner technologies and cleaner consumer choices).

1.7.1.1.3. W3 'EU ETS expansion to non-hazardous and hazardous waste incineration as well as non-hazardous landfills'

Methane emissions from landfills are responsible for the largest share of emissions from EU waste management, with many Member States still seeing high landfill rates, despite an overall decrease over the past decades. Landfills are a persisting source of methane (CH₄), which is a more potent GHG than CO₂¹³¹. Contrary to MWI, EU and national regulatory frameworks are currently in place to reduce landfills and landfill emissions (Landfill Directive and national bans on landfilling of organic and combustible waste) which, when implemented effectively, have been successful in several Member States in reducing emissions from non-hazardous landfills.

The uncertainty in the quantification of methane emissions from landfills remains high. Reported emissions based on reference values range from 74 MtCO₂eq (based on 'historical emissions', i.e. emissions in a given year resulting from historical and current waste disposed in landfills) to 82 MtCO₂eq (based on 'future emissions', i.e. all emissions expected over the lifetime of the waste disposed in a given year), depending on the methodology used (see Section 1.2.3.). Under both approaches, emissions exceed those from aviation currently under the EU ETS. The assessment of abatement options for landfills suggests a relatively high potential for cost-effective emissions reductions, for which the carbon price could be an important incentive (see Section 1.3.). The establishment of the cap increase and modelling of cost-effective emissions reductions under the LRF would ideally require more accurate and harmonised MRV data to be collected prior to inclusion. Emissions from non-hazardous landfilling are projected to continue to gradually decrease by 2040 if the existing regulatory framework is fully enforced and implemented, in line with the trend over the previous decades (albeit at a below-potential rate so far due to slow progress towards the landfill target in some Member States), with the benefit of ETS inclusion being to increase certainty and provide complementary incentives to

¹³¹ European Commission (2025). *Methane emissions*. Available at: https://energy.ec.europa.eu/topics/carbon-management-and-fossil-fuels/methane-emissions_en#:~:text=On%20a%20100%2Dyear%20timescale,on%20a%2020%2Dyear%20timescale.

achieve these reductions in view of the current slow progress towards the landfill target in some Member States.

An extension of the carbon price to emissions from landfills would have to consider whether to include only emissions from future waste disposal or also emissions from waste disposed prior to the application of the carbon price. A significant proportion of landfill emissions are expected to be a result of waste disposed of in the past as the emissions are produced by the ongoing anaerobic decay of organic material deposited years or decades earlier. The scope of coverage needs to consider not only the environmental impact of the scope, but also the feasibility of establishing a robust MRV, economic costs and abatement options. Extending the carbon price to historical emissions from landfills would provide a more extensive coverage of the polluter-pays-principle compared to applying the carbon price only to future emissions from landfills. The MRV and economic considerations are assessed in the subsequent sections.

1.7.1.2. Other environmental impacts

1.7.1.2.1. W1 ‘EU ETS expansion to non-hazardous waste incineration’

By incentivising waste reduction and increased recycling, the extension of the carbon price signal to MWI will contribute to the environmental policy framework objectives to reduce environmental (non-GHG) pollution (e.g. Industrial Emissions Directive, Landfill Directive) and to move waste higher up the waste hierarchy (e.g. Waste Framework Directive, Packaging and Packaging Waste Regulation).

First, action is needed at different levels to move waste up the waste hierarchy, from upstream improvements in product design to facilitate recyclability and increase recycled content, to waste prevention and effective sorting at consumption level, and separate waste collection and expanding recycling capacity. Extending carbon pricing to GHG emissions from waste incineration can provide an important complementary financial incentive supporting the circular economy by making waste prevention, recycling and reuse more financially competitive through the application of a carbon price on waste management processes further down the waste hierarchy. By internalising the carbon footprint of non-hazardous waste incineration, W1 would incentivise more efficient material flows through improved separate waste collection, sorting and material recovery. The most frequently cited argument among OPC respondents in support of MWI inclusion was to incentivise recycling higher up the waste hierarchy. On the other hand, W1 carries a risk of waste diversion to landfills, especially for fossil waste streams, which would contradict the waste hierarchy. The risk would not be uniform across the EU and is crucially dependent on the effective enforcement and implementation of the existing regulatory framework. Landfilling is currently the cheapest disposal route in Member States where bans or high taxation are not in place. Higher compliance and operational costs for municipal waste incineration may further incentivise some operators or waste producers to look for cheaper treatment or disposal routes, chiefly landfilling, where strict regulatory or fiscal policies closing the gap are not in place. This concern was also consistently raised in the public consultation by almost half of the respondents who oppose MWI inclusion, while several respondents supporting MWI inclusion also linked their support to addressing potential unintended consequences in terms of landfill diversion. Their views were divided, however, on the appropriate approach to achieve this, whether regulatory (e.g. stronger enforcement or advancing implementation of targets under the Landfill Directive), fiscal (taxation or levies) or carbon pricing (inclusion in the EU ETS). Experience of landfill development across the EU also confirms that mitigating the risk of landfill diversion is crucially dependent on effective implementation and enforcement of the waste policy framework to discourage landfilling. Member States effectively banning or

(heavily) taxing landfilling of waste have generally achieved low landfilling levels, effectively deterring diversion and directing waste up the waste hierarchy. This evidence also holds for Member States currently already applying carbon pricing to municipal waste incineration, with landfill rates having continued to decrease in Denmark, Germany, Lithuania and Sweden since inclusion of the incineration sector in the ETS.

Second, by incentivising waste reduction, extending carbon pricing under W1 will further contribute to reduce non-GHG air pollutant emissions from MWI. The average net (non-GHG) environmental life cycle costs of overall waste management in the EU-27 have recently been estimated at 162 EUR/tonne of waste, with incineration and landfilling one of the main cost drivers¹³², with Member States with high recycling rates having lower environmental life cycle costs than those with high disposal rates. MWI is a substantial source of particulate matter (PM_{2.5} and PM₁₀) and polycyclic aromatic hydrocarbons (PAHs), which contribute to respiratory and heart problems, and sulphur dioxide (SO₂) and nitrogen oxides (NO_x), which contribute to acid rain and local smog. Typical emission factors for modern EU plants are roughly 1.07 kg NO_x per tonne of waste, 0.087 kg SO₂ per tonne, and 0.03 kg PM per tonne, alongside trace emissions of heavy metals (lead, mercury) and highly toxic persistent organic pollutants (dioxins, furans) measured in nanograms per tonne of waste. These pollutants are regulated by the IED and adopted BREF conclusions. However, pollutants can concentrate in the resulting ash and residues, and total emissions remain notable due to the scale of incineration capacity. Changes in the emission to air of different pollutants (see Figure) by EU incineration facilities varied between 2010 and 2022, showing either increasing or decreasing trends, with a more stable path since 2017¹³³. The potential for additional environmental costs reduction at EU27 level through increased recycling and reduced disposal has been estimated at EUR 8.4 billion annually¹³⁴.

The risk of waste diversion to HWI is limited given the technical and operational differences, smaller capacity and higher incineration cost due to higher temperatures and 2-3 times higher gate fees, and strict regulatory requirements. Still, there are MWI installations with permits to also incinerate hazardous waste fractions (generally low-hazardous fractions that can be incinerated at ‘standard’ temperature), for which a risk of waste misclassification under W1 cannot be fully ruled out but can be limited through careful boundary setting under the scope and MRR framework.

The risk of waste diversion to exports to third countries is considered to be limited. Member States exported 11.4 million tonnes of waste outside of the EU in 2024 (excluding mineral and metal waste)¹³⁵. From November 2026 and May 2027, the EU will enforce stricter rules on plastic and hazardous waste exports under the Waste Shipment Regulation; waste export to non-OECD countries would be generally prohibited (with some exceptions) (see also Section 1.5.).

¹³² Albizzati, P.F. (2024). *A model to assess the environmental and economic impacts of municipal waste management in Europe*. Waste Management 174, p. 605-617.

¹³³ EEA (2025). Pollutant emissions from waste incineration (Indicator). Available at: <https://www.eea.europa.eu/en/european-zero-pollution-dashboards/indicators/pollutant-emissions-from-waste-incineration-indicator>

¹³⁴ Albizzati, P.F. (2024). *A model to assess the environmental and economic impacts of municipal waste management in Europe*. Waste Management 174, p. 605-617.

¹³⁵ Eurostat (2025). Trade in waste by type of material and partner. Available at: https://ec.europa.eu/eurostat/databrowser/view/env_wastrdmp__custom_19587397/default/table

1.7.1.2.2. W2 - EU ETS expansion to non-hazardous and hazardous waste incineration'

In addition to the assessment of the impacts under measure W1, W2 addresses any residual risk of waste diversion and waste misclassification to HWI under W1. The risk of diversion to landfills is considered overall smaller than for W1, as landfilling or improper treatment of hazardous waste is either prohibited or strictly controlled under EU and national legislation. Hazardous waste export to facilities outside the EU ETS is likewise considered unlikely for the same reasons.

In terms of reducing environmental pollutant emissions and incentivising waste management higher up the waste hierarchy, the additional impact of W2 is expected to be more limited compared to the impact of W1 as there is generally lower flexibility in treatment options for materials that cannot be safely recycled, recovered, or treated by other means compared to municipal waste due to stricter regulatory requirements. However, data on treatment on hazardous waste in the EU indicates that while the amount of hazardous waste disposed through landfills and incineration (without energy recovery) has substantially increased between 2004 and 2022, the amount of hazardous waste recycled and recovered has remained constant¹³⁶, suggesting room for improvement.

1.7.1.2.3. W3 'EU ETS expansion to non-hazardous and hazardous waste incineration as well as non-hazardous landfills'

Compared to W1 and W2, the additional extension of the carbon price signal to landfilling under W3 would further contribute to incentivising waste management higher up the waste hierarchy and to reducing environmental pollutant emissions.

First, W3 would further support waste diversion up the waste hierarchy and contribute to address the risk of diversion to landfills down the waste hierarchy under W1, by providing a level playing field, but continues to carry a risk of possible waste diversion albeit more nuanced:

- to illegal landfilling, which is considered to be a significant problem in the EU.
- shifts of plastic waste away from incineration to landfilling, and of biogenic waste from landfilling to incineration, to avoid the carbon cost.

While overall relatively few stakeholders provided their view in the OPC on whether additional waste management activities should be included in the EU ETS if waste incineration is to be covered, more than one third of those called for appropriate measures to address landfill emissions, both to ensure a level playing field with incineration (if covered) and to address the climate impact of methane emissions. However, views were divided on the concrete approach, with diverse suggestions ranging from strengthening the Landfilling Directive to advance the ban on landfilling, introducing a carbon tax on landfilling, or the inclusion of landfilling in the EU ETS.

Second, W3 would support the reduction of air and groundwater contamination from landfills by disincentivising landfilling in favour of waste reduction and alternative waste management processes. Landfills that are covered by the Industrial Emissions Directive are subject to rules that aim to prevent soil pollution. Landfilling impacts local air quality through other landfill

¹³⁶ Eurostat (2025). *Treatment of waste by waste category, hazardousness and waste management operations*. Available at: https://ec.europa.eu/eurostat/databrowser/view/env_wastrt__custom_18786621/default/table

gas constituents (e.g., non-methane VOCs and ammonia) and soil/groundwater quality through leachate formation¹³⁷. As biodegradable waste decomposes, leachate containing nutrients, heavy metals, and organic contaminants can percolate into surrounding soil and, if not managed with engineered liners and collection systems, contaminate groundwater and local ecosystems. One study estimated that 0.2 m³ of leachate can be generated by one tonne of landfilled solid waste, depending on the type of waste and seasonal climate.¹³⁸

1.7.2. *Economic impacts*

1.7.2.1. Cost of compliance

1.7.2.1.1. W1 ‘EU ETS expansion to non-hazardous waste incineration’

Under W1, the overall carbon cost to operators depends on multiple factors including total volume of waste treated, the share of fossil-based emissions, the carbon price, actions to reduce emissions at installation level and cost passthrough and actions to reduce emissions in the waste value chain. The cost is expected to vary between countries or even regions in the same country. The effective carbon cost for the fossil fraction per tonne of municipal waste has been estimated in section 1.3.1. to range from EUR 38.5 to 66 in 2030 at a carbon price of EUR 110 per tonne CO₂e. The cost is expected to increase over time with the increasing ETS price until 2040. While operating costs vary considerably depending on installation type, size and location, evidence from the application of the EU ETS price to municipal waste incinerators with energy recovery in Sweden and Denmark indicates the carbon cost (in 2025) represented 10-20% of total operating costs.

One of the most effective cost abatement pathways is source reduction and diversion to recycling. The carbon cost passthrough from operators to waste suppliers and waste collection authorities can incentivise improved pre-collection sorting and residual waste reductions in the range of 10-20% and increased recycling in the range of 16-22.5% on the basis of existing price elasticities for the residual waste disposal demand (see Section 1.3.1.), supporting the circular economy. Circular economy activities already represent around 1-2% of EU GDP¹³⁹. In 2021, recycling, reuse and related circular economy activities accounted for 4.3 million jobs across the EU (an 11% increase since 2015) and generated approximately 299 billion EUR in gross value added, alongside the 121.6 billion EUR in private investment¹⁴⁰. Evidence shows that the higher the separate collection of recyclables and, consequently, of recycling, the higher the amounts of jobs created within the waste management system, with an overall potential for (additional) job creation in collection, transport and recycling estimated at 206.100 FTE

¹³⁷ EEA (2024). Leachate pollution from landfills (Signal). Available at: <https://www.eea.europa.eu/en/european-zero-pollution-dashboards/indicators/emission-from-waste-management-facilities#:~:text=Key%20messages:%20EU%20legislation%20has,of%20waste%20generation%20is%20essential.>

¹³⁸ CleanLeachate (2010). Combined anode and cathode process to treat landfill leachate. Available at: <https://cordis.europa.eu/project/id/262335>

¹³⁹ OECD (2025). The Circular Economy in Cities and Regions of the European Union. Available at: https://www.oecd.org/en/publications/the-circular-economy-in-cities-and-regions-of-the-european-union_e09c21e2-en.html

¹⁴⁰ European Commission (2023) 306 final. Communication on a revised monitoring framework for the circular economy. Available at: https://www.europarl.europa.eu/RegData/docs_autres_institutions/commission_europeenne/com/2023/0306/COM_COM%282023%290306_EN.pdf

annually in the EU27 in one study¹⁴¹, and a potential to create up to 2.5 million additional jobs by 2030 in another study¹⁴². The recycling sector delivers economic security, added value, employments, and a potential for long-term competitiveness for the EU economy by reducing reliance on imported virgin materials, reducing volatility of input costs, improving resource productivity, and strengthening innovation. At installation level, cost-effective abatement options include improved Mixed Waste Sorting in the short-term and CCUS in the medium- to longer term by the mid-2030s, with the integration of carbon removals under the EU ETS further providing the MWI sector with a potential for compensating allowance costs through removals from the biogenic fraction of waste, representing around 50% of all waste incinerated, supporting the business case for cost-effective emissions abatement (see Section 1.3.2.). Complementary policies and measures and the targeted investment of EU ETS revenues to support the rollout of CCUS and complementary measures in the waste value chain play an important role to contribute manage operational costs for operators and local authorities (see Section 1.3.3.). Annual EU ETS revenues from the inclusion of MWI are expected to be significant and average around 4.75 billion EUR over 2031-2040, assuming an average carbon price of EUR 150.

Almost a quarter of stakeholders in the OPC, from across different stakeholder groups, signalled that the EU ETS expansion to non-hazardous waste incineration can contribute to significant reductions in GHG emissions if complementary circular economy policies are effectively implemented. Some stakeholders across OPC responses, position papers and interviews also highlighted the importance of passing through the carbon costs to waste producers, following the Polluter Pays Principle (PPP), including through the extension of the EPR schemes to those producers which manufacture non-recyclable products, for example textiles.

1.7.2.1.2. W2 - EU ETS expansion to non-hazardous and hazardous waste incineration'

Under W2, the carbon price would be further extended to hazardous waste incineration (HWI) installations. Similar to W1, the overall carbon cost to the remaining installations would depend on the total volume and composition of hazardous waste incinerated, the carbon price, action taken to reduce emissions at operator level, and the cost passthrough and actions to reduce emissions throughout the waste value chain. Overall, operational cost increases due to the carbon price are expected to be comparatively higher to that of non-hazardous waste incineration installations given the higher fossil content of hazardous waste (90% compared to 50% for municipal waste) and more restricted alternatives due to regulatory constraints.

The treatment and sorting of hazardous waste are strictly regulated by health and safety regulations, implying more limited abatement options compared to W1 in terms of incentivising increased recycling, while incentives to reduce hazardous waste at source are expected to be heterogeneous depending on the specific product/waste stream and applicable regulatory requirements. Abatement options at installation-level are equally expected to be less cost-effective compared to W1, with Mixed Waste Sorting less technically, economically and regulatorily viable and CCUS application showing a more limited potential for biogenic carbon removal generation due to the higher fossil emission fraction.

¹⁴¹ Albizzati, P.F., et al. (2024). *A model to assess the environmental and economic impacts of municipal waste management in Europe*. Waste Management 174, p. 605-617.

¹⁴² OECD (2025), "The Circular Economy in Cities and Regions of the European Union", <https://doi.org/10.1787/e09c21e2-en>

A relative majority of stakeholders opposed the expansion of the EU ETS to HWI, mainly questioning the extent to which carbon pricing could be effective in reducing emissions from a process that has very few alternatives. They argued that fuel-switch options are limited due to the need for destruction at high temperatures, while applying the added cost pressure would not remove the need for the removal of hazardous waste as the production of such waste is not within their control and those installations have a public-service requirement in safely handling hazardous waste and potential risks to public health and safety.

1.7.2.1.3. W3 ‘EU ETS expansion to non-hazardous and hazardous waste incineration as well as non-hazardous landfills’

Under W3, like W1, the overall carbon cost to installations would depend on the emissions, the carbon price, action taken to reduce emissions at operator level, and the cost passthrough and actions to reduce emissions throughout the waste value chain. With total emissions from landfills being substantially larger than those from MWI, the economy-wide carbon cost will be higher, but will also be distributed among a larger number of installations compared to W1 or W2. The average carbon cost per tonne of non-hazardous waste landfilled has been estimated in Section 1.3.1. to amount to EUR 66 in 2030, assuming a carbon price of EUR 110 per tonne CO₂e and 1 tonne of municipal waste being associated with 0.6 tonnes of fossil CO₂ emissions. This cost is expected to increase over time with the increasing ETS price until 2040. From an economic perspective, the associated costs would also depend on whether only future emissions would be covered under the scope of extension, or also historical emissions. Overall costs would be higher over time in the latter case, as operators would also be liable for historical emissions resulting from disposal before the start of application of carbon pricing. While evidence on price elasticities for non-hazardous landfilling is limited, the combination of the existing regulatory framework with the increase in the cost of landfilling would be expected to further drive a reduction of organic residual waste streams disposed in landfills. In addition, the assessment of abatement options for landfills in Section 1.3.2. indicates a high cost-effective abatement potential compared to W1 and W2, with biogas production from landfill gas capture providing additional economic opportunities for operators.

Similarly to W1 and W2, complementary upstream measures and policies to prevent and reduce the amount of biodegradable waste that is landfilled play an important role to increase waste prevention, diversion to recycling or composting. However, upstream interventions mainly affect future emissions, while abatement at installation level is needed to address historical emissions from waste that has been landfilled in the past.

1.7.2.1. Administrative efforts

1.7.2.1.1. W1 ‘EU ETS expansion to non-hazardous waste incineration’

Extending the scope of the EU ETS to waste incineration relies on the existing system under the EU ETS. For both options W1 and W2, one-time administrative costs, regularly occurring administrative costs and costs for disclosure and sanctioning can be identified for competent authorities and for the operators. However, the existing system, processes and infrastructure (such as the Registry) can be used, limiting costs.

W1 builds on the already implemented MRV requirements for MWI, including the developed monitoring plans, data collection and reporting infrastructure. Additional monitoring and reporting costs under W1 may result from a review of the MRV rules to further specify the harmonised monitoring and reporting standards and protocols for the sector. As with the inclusion of any sector, being subject to the ETS entails third-party verification of emissions

reports. Depending on the MRV protocol followed, other third-party cost may arise from periodic sampling if required, laboratory analysis (e.g., radiocarbon testing or waste composition studies), and the integration of IT systems for emissions tracking and record-keeping. For many facilities, particularly those without existing carbon accounting systems, these obligations necessitate specialist staff training and potentially, engagement of external consultants. The administrative burden for a specific operator will vary according to plant size, complexity and the MRV methodology adopted.

There are a range of methods available for monitoring emissions from waste incinerators, which have different associated costs. The estimated costs associated with these methods have been assessed in Section 1.4 and Appendix 3. Overall, the technical implementation and cost related to MRV, while additional, are expected to be manageable under W1 in light of the already applicable MRV obligation and other reporting obligations and experience already in place, for example under the Industrial Emissions Directive (IED), and the possibility to establish a tiered system that incorporates both measurement-based and calculation-based methodologies, along with simplified provisions for smaller emitters, providing scalable and proportionate MRV system minimising administrative costs. The threshold for inclusion may need to be modulated to alternative mechanisms based e.g. on tonnage instead of thermal capacity, to adjust to the specificities of the waste sector, as indicated by multiple sector stakeholders during the consultation.

1.7.2.1.2. W2 - EU ETS expansion to non-hazardous and hazardous waste incineration'

While largely building on W1, W2 may may require a tailored approach since some analytical methods cannot or should not be applied for hazardous waste given the regulatory and practical restrictions on the application of some measurement-based methods for these waste streams (e.g. radiocarbon and the waste analysis might not be possible due to the health and safety implications of these waste inputs). Calculation-based methodologies and simplified requirements could be developed for these installations to limit administrative efforts, especially when small.

1.7.2.1.3. W3 'EU ETS expansion to non-hazardous and hazardous waste incineration as well as non-hazardous landfills'

W3 would require dedicated monitoring and reporting rules to be developed in addition to W1 and W2 and tested prior to inclusion of landfilling in the EU ETS. The detailed administrative effort could not be estimated as dedicated rules would need to be developed under the ETS framework given the current absence of established MRV measurement protocols providing standardised and harmonised methodologies for methane emissions from landfills. The administrative and operational cost of MRV would be dependent on several factors, including the approach selected (calculation-, i.e. reference value, or measurement-based, i.e. ground-based and/or satellite monitoring), the scope of emissions covered (future emissions only or also historical emissions) and the characteristics of each landfill site (size, waste composition, weather conditions, gas capture efficiency, etc.) (see sections 1.4. and Appendix 3 for further details). In view of the above, the choice of monitoring methods needs to consider both the balance between accuracy, technical complexity and economic costs, as well as the suitability of each method to the different possible scope of emissions covered for landfills.

1.7.2.2. SMEs

1.7.2.2.1. W1 ‘EU ETS expansion to non-hazardous waste incineration’

Stakeholder consultations and an internal study by the Commission indicate that the waste management sector has a comparatively higher share of medium-sized enterprises compared to other sectors under the EU ETS. The administrative and financial burden resulting from MRV compliance requirements for SMEs can be addressed through simplified MRV provisions for smaller installations to provide a scalable and proportionate system to keep compliance proportionate to emissions, avoiding placing an excessive burden on low-emitting sites while still ensuring a basic level of emissions accountability. In addition, W1 is modulated by the applied activity threshold. Under the EU ETS Directive, combustion installations are included in the scope of the system if they are above the threshold of 20 MW rated thermal input. Even if another threshold is set, e.g. based on waste management volume, or if no threshold would be set, smaller installations could still opt-out under the existing small- and ultra-small emitter provisions in the Directive. Several interviewed stakeholders, both business associations and NGOs, emphasised the importance of maintaining a level playing field across all MWI operators regardless of size by reducing the threshold. They argued that retaining the 20 MW threshold could create unintended incentives for operators to divert waste to smaller facilities under the threshold, thereby avoiding carbon pricing obligations.

1.7.2.2.1. W2 - EU ETS expansion to non-hazardous and hazardous waste incineration’

Due to data limitations no detailed assessment could be conducted for HWI in addition to W1.

1.7.2.2.2. W3 ‘EU ETS expansion to non-hazardous and hazardous waste incineration as well as non-hazardous landfills’

No detailed assessment on the additional impact of W3 could be conducted due to the limited information on landfill operations available. The assessment in section 1.2.2. indicates that there is a substantial share of smaller and substandard landfills in the EU, however the impact would depend on the scope of coverage and thresholds applied for inclusion of landfills under the EU ETS.

1.7.3. *Social impacts*

1.7.3.1. Employment

A quantitative assessment of the impact of employment is undertaken at the policy option level.

1.7.3.2. Income distribution, social protection, and social inclusion (of particular groups)

A quantitative assessment of the impact on income distribution, social protection and social inclusion is undertaken quantitatively only at the policy option level.

1.7.3.3. Fundamental rights

All options assessed are aligned with Article 37 of the Charter of Fundamental Rights of the European Union¹⁴³ (the Charter)¹⁴⁴ (environmental protection). They are designed to incentivise decarbonisation in the waste sector as well as encourage a transition to a circular economy model. Although the measures differ in scope (broadening progressively), they all involve the inclusion of certain Waste sector emissions in the ETS. This inclusion increases the cost of emitting these emissions, thereby strengthening the carbon price signal and encouraging emissions reductions. As a result, these measures are expected to contribute to more effective environmental protection.

The design of these measures must also ensure full compliance with Article 36 of the Charter of Fundamental Rights, which recognises access to services of general economic interest. Waste management is widely regarded as an essential public service, fundamental to safeguarding public health, environmental protection, and the functioning of the circular economy across the EU.

1.7.3.4. Implications for municipalities

The carbon price is expected to be (at least partially) passed through by operators to waste disposal authorities, often local authorities, through the gate fees. The subsequent cost passthrough to citizens i.e. in the form of increased taxes or levies, will crucially depend on how the initial cost passthrough incentivises municipalities, other waste generators, and third parties to reduce waste streams and/or the carbon content in waste streams, e.g. through improved separate waste collection, waste collection fees or taxation modulated for the carbon content of waste streams, or higher penalties for illegal waste disposal, as assessed in sections 1.3.1. Nearly one fifth of stakeholders opposing MWI inclusion in the OPC expressed concerns over the expected impact and perceived lack of alternatives for customers, notably local authorities. Stakeholders interviewed further specified their concerns that bringing the waste sector under the EU ETS could create operational and financial challenges for the continued delivery of these services as the additional costs associated with participation in the EU ETS (allowance purchases, MRV obligations, and administrative requirements) may place pressure on municipal budgets and waste operators. This could, in turn, affect the affordability and accessibility of waste management services for households and businesses. Evidence from Member States already applying a carbon price for municipal waste incineration (DE, SE) indicates that current pricing¹⁴⁵ corresponds to limited, manageable increases in average annual household waste management fees in the order of EUR 10 (DE) to EUR 13 (SE), of which a substantial share can furthermore be avoided through improved prevention, separation and recycling of waste, alongside complementary measures and financial support through ETS revenues to support local authorities and/or households in implementing these measures and lower or avoid fees passed through to households. The extension of the EU ETS cap with the waste sector is expected to generate significant EU ETS revenues averaging EUR 4.75 billion annually for municipal waste incineration, or double to triple this amount in case of an

¹⁴³ CHARTER OF FUNDAMENTAL RIGHTS OF THE EUROPEAN UNION (2000/C 364/01)

¹⁴⁴ “A high level of environmental protection and the improvement of the quality of the environment must be integrated into the policies of the Union and ensured in accordance with the principle of sustainable development”.

¹⁴⁵ At EU ETS carbon price of EUR 75/tonne of CO₂ (Sweden, 2025) and national ETS carbon price of 62/tonne of CO₂ (Germany, 2026).

extension to all waste incineration and non-hazardous landfills, which could be reinvested to support complementary circularity policies and measures in waste reduction and recycling.

At the same time, including the waste management sector in the EU ETS offers significant opportunities to further incentivise circularity and recycling, both minimising environmental impacts from natural resource use and financial costs for waste management for local authorities. While the waste recycling rate in Europe has steadily increased due to EU binding recycling targets, separate collection of waste was progressing slower than required and most waste was still disposed of through incineration or landfill operations in 2022, carrying substantial financial burdens on local authorities in the form of gate fees and additional taxation, and consequently on taxpayers. Including waste management into the EU ETS would contribute to incentivise ambitious waste management policies to increase recycling and discourage landfills and incineration.

Overall, an extension of the carbon price to waste management activities needs to balance the environmental integrity and the costs associated to waste management as a public service. This may warrant targeted safeguards, transitional measures, or financial support mechanisms to prevent unintended social or economic impacts while still achieving the overarching climate objectives of the EU ETS.

1.7.4. Summary

A summary comparison of the measures is provided in the table below. Measure W1 is rated as compared to the baseline of no inclusion of waste management activities, with each subsequent measure designed and rated as an extension to the preceding measure. In addition, a summary of the key costs and benefits of the measures under the preferred policy option is included in Annex 3, Section 2.

Criterion	W1: Inclusion of non-hazardous waste incineration	W2: Inclusion of all waste incineration	W3: Inclusion of all waste incineration plus non-hazardous landfill
Environmental (Climate)	+ Substantial increase of scope of economy-wide GHG emissions accounted for and priced. Incentive and resources to support sectoral decarbonisation through improved circular economy incentives and carbon capture for residual emissions (mid-decade). Secondary decarbonisation benefit from improved circularity reducing GHG emissions from waste disposal and generating recycled materials displacing more carbon-intensive virgin materials. Significant potential for permanent carbon removal generation from biogenic emissions, supporting economy-wide decarbonisation (<i>synergy with integration of removals in ETS</i>). Enabling condition for promoting the use of captured CO₂ as feedstock for non-permanent CCU products (<i>synergy with CCU product incentives in ETS review</i>).	0 Limited additional environmental benefit from further extension to HWI (small scope and limited abatement incentive).	+ Substantial increase of scope of economy-wide GHG emissions accounted for and priced, complements existing emission reduction trajectory already in place under regulatory policy framework for landfilling. Higher overall GHG emissions reductions mainly driven by landfills, compared to lower incineration emissions reductions than W1/W2.
Environment	+	0	+

(Other environmental impacts)	Additional contribution to air pollutants reduction. Additional incentive for circular economy for materials, supporting the business case for waste prevention, separate collection, sorting and recycling. Risk of landfill diversion for organic waste streams limited due to zero-rating in incineration. For fossil waste streams depending on effective regulatory or fiscal policy framework in place.	Limited additional benefit for waste hierarchy from further extension to HWI in view of strict regulatory requirements in place.	Additional contribution to ground pollution reduction. Additional incentive supporting increased separate collection and alternative treatment of organic waste streams. Contributes to address risk of landfill diversion for organic waste streams through carbon pricing of methane. For fossil waste streams depending on effective regulatory or fiscal policy framework in place.
Economic (Cost of compliance)	+ Effective carbon cost reduced due to biogenic share plus opportunities for permanent carbon removals from biogenic emissions. Cost-effective abatement options available at installation level and value chain, complementary policies and targeted support mechanisms are key enabling conditions for investment and planning predictability, decarbonisation support, and reinforced circular economy policies. Contribution to circular economy growth. Supporting level playing field for industrial installations and power plants by harmonising carbon price signal	- High additional carbon cost for further extension to HWI due to higher emission intensity, limited carbon removal potential and restricted alternatives.	+/- Higher cost of compliance compared to W1 and higher cost-effective abatement potential for landfills, in particular for emissions from historical disposal. Overall cost of compliance dependent on scope of inclusion, with higher cost and operational constraints if emissions from historical disposal also covered.

	with co-incineration and electricity and district heating production.		
Economic (Administrative effort)	+ Limited additional costs compared to baseline (already applicable), building on already established MRV process and infrastructure, and tiered system with simplified provisions for smaller operators balancing robustness and administrative burden and costs.	- Possible additional HWI-specific MRV cost due to regulatory restrictions. Possibility for simplified MRV or exclusions and opt-outs of the system.	- MRV methodology to be developed and implemented for landfills from scratch. No cost estimate: depending on method and scope (historical emissions). Complex and lengthy development process (especially if based on comprehensive measurement-based approach). Simplified approach based on reference values possible. Development needs to balance robustness with administrative burden and costs.
Economic (SMEs)	0 Comparatively high share of medium-sized enterprises. Simplified MRV, opt-out provisions and potential exclusions under threshold for small emitters reduce impact on SMEs.	0 Same as for W1.	Comparatively high share of medium-sized enterprises but impact dependent on scope of GHG emissions included, threshold applied and other factors.

Appendix 1: Data on emissions from waste incineration and landfilling in the EU

A. Data on emissions from municipal waste incineration

Data prior to 2024 (UNFCCC GHG Inventory, internal Commission estimates) do not provide disaggregated data per type of waste (municipal, hazardous, industrial) or per type of incineration (with or without energy recovery). Since 2024, accurate MRV data have been collected specifically for municipal waste incineration (with and without energy recovery) above the EU ETS threshold.

EU ETS monitoring, reporting and verification data

From 1 January 2024, installations for the incineration of municipal waste above the EU ETS threshold are required to monitor and report emissions under the EU ETS¹⁴⁶. In 2025, emissions data from the first year (2024) of the monitoring and reporting of emissions by municipal waste incineration (MWI) installations under the EU ETS became available. The total 2024 emissions from MWI (excluding hazardous waste incineration) from the reporting data provided by 19 countries (18 Member States¹⁴⁷ and Norway) for 395 installations amounted to 85.0 MtCO₂eq (Figure 6)¹⁴⁸. Of this total, approximately 47% or 39.4 MtCO₂eq were fossil-based emissions and 53% or 45.6 MtCO₂eq biogenic emissions¹⁴⁹. In case of an extension of the EU ETS to waste incineration, only the former would be expected to fall under the scope of the EU ETS as biogenic emissions are zero-rated under the EU ETS. The 2024 MRV data provides the most recent and accurate report of emissions from MWI in the EU.

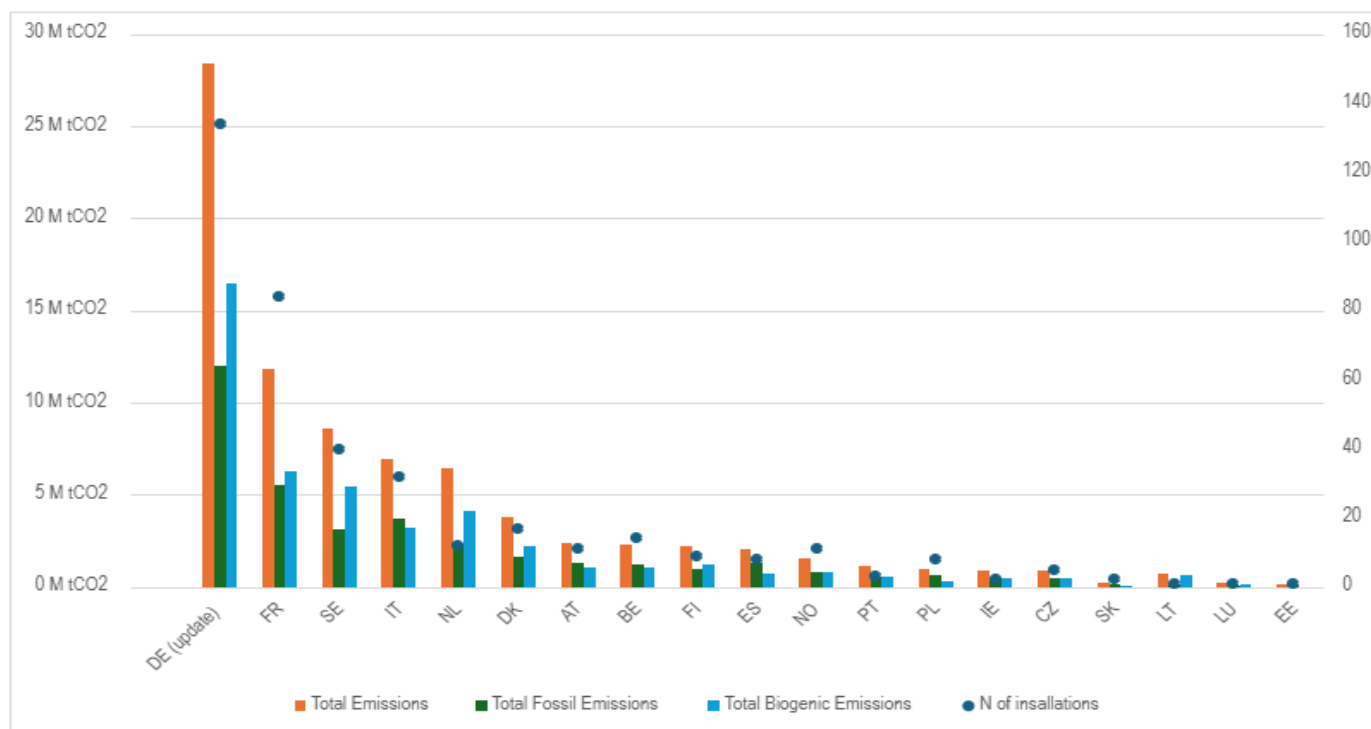
¹⁴⁶ Installations carrying out combustion activities and having a total rated thermal input exceeding 20MW (as well as incinerating predominantly municipal waste).

¹⁴⁷ AT, BE, CZ, DE, DK, EE, ES, FI, FR, IE, IT, NL, LT, LU, PL, PT, SE and SK.

¹⁴⁸ Reporting data from 4 installations in 3 Member States (BE, DE, HU) was missing at the time of writing. Based on desk research, this are projected to add approximately a further 0.40 MtCO₂e, based on nominal capacity and assuming a standardised 50% fossil emissions factor and bring the total number of MWI installations above the 20MW threshold in the EU to 400. In addition, 2 installations in LT were reported under the fuel combustion activity, representing 0.20 MtCO₂e fossil emissions. The remaining 8 Member States had no significant MWI incineration capacity in 2024 (CY, BG, EL, HR, LV, MT, RO, SI).

¹⁴⁹ 38.6 MtCO₂eq and 44.8 MtCO₂eq for the EU-27.

Figure 6: Emissions and number of installations reported under the scope of the EU ETS MRV obligation for combustion of fuels in installations for the incineration of municipal waste (2024).



Source: European Commission

Data limitations: No data on emissions from hazardous waste incineration; no data on emissions from MWI installations below 20MW (not covered under the MRV obligation). Reported data may not be exhaustive and require further finetuning as results cover only the initial year of reporting.

UNFCCC Inventory Data

Emissions from waste incineration (all types) without energy recovery are reported separately in the UNFCCC National Inventory Report under category 5C1 and amounted to 2.07 MtCO₂e in 2023. Emissions from waste incineration with energy recovery are not separately reported but are reported as part of emissions from fuel combustion. Category 1A1a (Electricity and Heat Production - Other Fuels (CO₂)), which amounted to 36.1 MtCO₂e in 2023, mainly covers the fossil part of municipal solid waste incineration with energy recovery whose main economic activity is power and heat production. Biogenic CO₂ generated by the combustion of organic waste is

not accounted for in the national total. Combined the reported fossil part of emissions from MWI in the UNFCCC inventory would amount to 38.2 MtCO₂e in 2023, within the same range as the EU ETS MRV reported emissions.

Data limitations: No disaggregated data on municipal waste incineration without energy recovery; no data on emissions from hazardous waste incineration; no data on biogenic fraction of emissions.

Internal Commission Estimates

In 2022, during the legislative process on the 2023 revision of the EU ETS, the European Commission internally estimated the scope of the fossil part of emissions from all waste incineration in the EU using data reported by Member States under the Governance Regulation (2016-2018) (for overall waste combustion in the relevant sectors), EU ETS emissions reporting under Article 21 of the ETS Directive and the average share of municipal waste in the total waste combusted (67%), which were further validated through technical discussions with Member States and cross-checks with other available data sources. The data are presented in Table 5. The resulting estimates of the emissions from the combustion of the fossil fraction of municipal and hazardous waste combined are in the range of 44.2 MtCO₂eq. Taking into account the difference in scope (these estimates also include installations below the 20MW threshold (see Section 2 below), hazardous waste incineration with energy recovery (see Section 3 below), and co-incineration installations already covered under the EU ETS), these estimates indicate a similar order of magnitude as the reported 2024 MRV data for MWI installations above 20MW only.

Table 5: Internal Commission estimates (2022) for fossil emissions from all types of waste incineration (municipal, hazardous and industrial) in the EU27.

	EU ETS	Non-EU ETS	Total
Total fossil emissions from all waste incineration (municipal, industrial, hazardous)	22,369	40,636	63,005
Fossil emissions from incineration of municipal and hazardous waste	12,928 ¹⁵⁰	31,332	44,260
Fossil emissions from incineration of industrial waste	9,441	9,304	18,746

Data limitations: No disaggregated emissions from municipal and hazardous waste incineration installations, from installations above and below the 20MW threshold, and from incineration and co-incineration installations.

B. Estimates of emissions from municipal waste incineration installations below the 20MW threshold

¹⁵⁰ Installations for the incineration of municipal waste already covered by the EU ETS (waste-to-energy installations included as part of national implementation of the EU ETS in certain Member States (DK, SE) reported at 4.8 MtCO₂e in 2024 MRV data and co-incineration in industrial installation such as cement kilns)

Data on the share of installations below the 20 MW threshold are not readily available, as these were not subject to the monitoring and reporting obligation under the EU ETS as of 2024. Emissions from municipal waste installations below the 20MW threshold can be approximated based on the nominal capacity of municipal waste-to-energy installations not reported under the MRV obligation^{151,152}. On this basis, 53 installations (EEA) were identified with total fossil-based emissions of maximum 1.05 MtCO₂e¹⁵³, or an additional 2.7% on top of the total reported emissions under the EU ETS MRV, given the limited capacity of these installations.¹⁵⁴ Moreover, this figure is an overestimate as approximated emissions are based on nominal instead of actual incineration volumes, which are generally lower. On the other hand, this figure does not cover any MWI installations without energy recovery, although no evidence was found on such installations and these would be expected to represent only a minor share of emissions given the limited total emissions of this subsector (2.07 MtCO₂e in 2023 for all types of waste incineration without energy recovery combined).

C. Estimates on emissions from hazardous waste incineration

As identified in Section A, detailed data on emissions from hazardous waste incineration in the EU are currently not available. Emissions from hazardous waste incineration can however be estimated based on the volume of hazardous waste treated and the default emission factor of hazardous waste incineration on the one hand, and by cross analysing the data sources on total waste incineration in Section A.

The volume of hazardous waste incinerated amounted to 10.5 million tonnes of waste in 2022 according to Eurostat, of which 6.3 million tonnes with energy recovery and 4.1 million tonnes without energy recovery¹⁵⁵. However, these data cover both incineration in dedicated hazardous waste incineration installations, as well as co-incineration in industrial installations (e.g. cement or lime kilns) and fractions of low-hazardous waste incinerated in municipal waste incinerators. The former is currently already covered by the EU ETS, while the latter would be covered under the inclusion of MWI under the EU ETS in line with the existing scope of the MRV obligation for MWI¹⁵⁶. Considering only hazardous waste incinerated in dedicated hazardous waste incineration installations, the volume amounted to only 3.5 million tonnes of waste (Industrial Emissions Portal).

¹⁵¹ Source: desk research based on the EU E-PRTR database and installations listed by the sector organisation CEWEP (2017, Interactive Map of Waste-to-Energy Plants. Available at: <https://www.cewep.eu/interactive-map/>).

¹⁵² The thermal input is determined by the calorific value of the waste and the mass throughput being fed into the furnace at any given moment. Approximating a throughput (capacity) value for waste incineration installations equivalent to the 20 MW thermal input threshold, assuming a net calorific value of 7.5 MJ/kg and 85% annual availability, results in a 20 MW thermal input corresponding to approximately a throughout of 71.500 tonnes per year (upper threshold).

¹⁵³ Based on the combined nominal capacity of these installations (CEWEP data) and a standardised 0.5 fossil emission factor.

¹⁵⁴ No data are available on the number and capacity of hazardous waste incineration installations below 20 MW.

¹⁵⁵ Eurostat

¹⁵⁶ Guidance on interpretation of Annex I of the EU ETS Directive from December 2024: https://climate.ec.europa.eu/document/download/edc93136-82a0-482c-bf47-39ecaf13b318_en?filename=policy_ets_gd0_annex_i_euets_directive_en.pdf

HWI generally has a higher fossil emission intensity (90%) compared to MWI. Combining the volume of HWI with the 0.9 fossil-based emission factor results in an estimated total fossil fraction of emissions from HWI ranging from ~3.15 MtCO₂e (dedicated HWI only) to ~9.5 MtCO₂e (all hazardous waste incinerated through various types of incinerators) of which ~5.7 MtCO₂e fossil emissions from HWI with energy recovery and ~3.8 MtCO₂e fossil emissions from HWI without energy recovery, with the additional coverage in case of an extension of the EU ETS to HWI in addition to MWI expected to be closer to the first (3.15 MtCO₂e).

D. Data on emissions from landfilling

UNFCCC Inventory Data

Member States collectively reported 65.3 Mt CO₂e emissions in 2023 from all solid waste disposed in ‘managed waste disposal sites’ and a further 8.6 Mt CO₂e from ‘unmanaged’ waste disposal sites or illegal activities. Municipal waste represented around two fifths of all solid waste landfilled in the EU27 (52 out of 137 million tonnes of solid waste landfilled in 2023), but no detailed information is reported on the corresponding share of emissions. Landfill emissions have decreased by 55% from 132.3 Mt CO₂e since 1990 and 25% from 99.4 Mt CO₂e since 2010, primarily due to a reduction in biodegradable waste being landfilled and a significant increase in landfill methane recovery and flaring. A smaller number of emissions are also emitted from sectors such as ‘uncategorised waste disposal sites’ and ‘open burning of waste’. The data reported in the UNFCCC GHG inventory cover historical emissions resulting from the decay of waste disposed in the past¹⁵⁷.

Estimates using emissions factors

Emissions from landfilling can also be estimated using data on the tonnes of waste landfilled in the EU, combined with an emission intensity factor. In 2022, 137 million tonnes of solid waste was disposed in landfills in the EU. Using an indicative value of 0.6 tonne CO₂e/tonne of residual waste treated in conventional landfill with flaring¹⁵⁸, which can be considered the technological level in the middle between landfills without flaring and any type of energy recovery at all on one end and highly engineered landfills with methane capture and energy recovery on the other, the resulting estimate of landfill emissions for solid waste in 2022 would be 82.2Mt CO₂ eq.

¹⁵⁷ The First Order of Decay method used by Member States to calculate the emissions in the national inventory reports in accordance with the 2006 IPCC Guidelines is considered to account relatively accurately for the fact that the degradable organic components decay slowly over decades (see section 1.4.3 on methodologies). While the methodology can be considered to be relatively accurate, the calculation relies on the quality of activity data, emission factors and other parameters used by each Member State for their inventories, which results in inconsistencies and carries a risk of imprecise estimation.

¹⁵⁸ Based on a study by Prognos and CE Delft which was assessed against a range of emissions factors for the flaring technique. Prognos and CE Delft (2022). CO₂ reduction potential in European waste management. Emission factors used in national inventory reports and assessed in literature display a wide range of variation. For example, emission factors used in national inventory reports vary widely between countries, ranging from 0.8 to 2.0 tonne CO₂/tonne of mixed solid waste landfilled depending on the presence and type of methane capture, local conditions and waste composition, among others, while emission factors in literature display an even wider range from less than 0.2 to more than 2.6 depending on the methodology used.

52 million tonnes of the 137 million tonnes of solid waste were municipal solid waste, which translates into an estimated 31.2Mt CO₂ eq for municipal waste landfill emissions in 2022. This estimate covers a different scope of emissions compared to the UNFCCC inventory data, providing an estimate of ‘future’ emissions from the waste disposed in a landfill in a given year (assuming all incorporated emissions are released in one year) but not considering emissions resulting from past disposal in landfills.

Appendix 2: Selected case studies on emissions abatement options for waste incineration and landfilling

Mixed Waste Sorting (MWS)

- **Case Study 1** – The **IVAR IKS facility in Forus, Norway**¹⁵⁹, has operated a fully automated sorting plant (equipped with near-infrared (NIR) and visual spectrometer (VIS) technologies, differentiating between various polymers and material types) since 2019, designed to process residual household waste of approximately 325.000 citizens. The recovery of recyclables increased from 28% to 82% following the implementation of MWS. The facility reduces annual CO₂ emissions by approximately 33.000 metric tons.
- **Case Study 2** – **Omrin's Ecopark De Wierde in Heerenveen, the Netherlands**¹⁶⁰, is a public waste management company with an advanced AI-driven separation plant processing over 311.000 tonnes of household waste annually, achieving a 78% waste separation rate, which significantly outperforms the EU average of 49%.
- **Case Study 3** – The **Site Zero facility in Motala, Sweden**, is currently the world's largest and most advanced plastic sorting plant, using near-infrared (NIR) sensors to separate 12 different types of plastic, compared to only four types previously. In its first full year of operation (2024), the facility doubled the sorting efficiency to 95% compared to 47% previously, and approximately 42.4% of all plastic packaging received at the facility was successfully converted into recycled raw material.

Pay-As-You-Throw (PAYT) schemes

- **Case Study 1** - The County of Aschaffenburg, Germany, has implemented a weight-based PAYT system, resulting in one of the highest recorded rates of recyclables collection (86%) and one of the lowest recorded rates of residual waste generation (55 kg per capita per year) in the EU. The Aschaffenburg model has been replicated in other Germany counties, in Italy and in Belgium.

¹⁵⁹ Circular Economy Knowledge Hub (2022). *Waste sorting plant to advance mixed municipal waste management*. Available at: <https://knowledge-hub.circle-economy.com/article/12719?n=Waste-sorting-plant-to-advance-mixed-municipal-waste-management>

¹⁶⁰ Grayparrot AI (2025). *How Omrin uses Greyparrot Analyzer to maximise yield*. Available at: <https://www.greyparrot.ai/resources/case-studies/omrin-greyparrot-analyzer->

- **Case Study 2** – Bergen, Norway: by changing their model of waste collection from curbside collection to underground collection hatches with a PAYT element, residual waste collected reduced by 9% and plastic recycling collected increased by 28% 6 years into the scheme.
- **Case Study 3** – Bassano del Grappa, Veneto, Italy: a PAYT was piloted as part of the EU-funded LIFE-REthinkWASTE project. Residents receive a personalised bill based on the amount of unsorted waste they generate and was combined with a KAYT (know-as-you-throw) information campaign to encourage proper sorting. The scheme resulted in a 27.8 % reduction in residual waste between 2018-2022.
- **Case Study 4** – Chastre, Belgium: the first municipality to introduce smart bins equipped with microchips in Belgium, in 2016, whereby any household producing waste above a certain quota got a surplus tax of up to EUR 600 added to their basic local tax. This amounted to residual waste per person dropping from 135kg to 74kg.

Carbon Capture

Case Study 1 – In Norway, the world’s first commercial incineration plant equipped with full-scale CCS technology is set to become operational in 2026. The **Oslo Klemetsrud** plant aims to capture and store approximately 400,000 tonnes of CO₂ annually, of which around 60% is expected to be biogenic.¹⁶¹

- **Case Study 2** – In Sweden, the **Filbörnaverket waste-to-energy-plant** aims to capture and store its emissions by 2030. The project has been awarded support from the Innovation Fund.

Case Study 3 – In the Netherlands, the **Twence plant** introduced a first pilot for carbon capture in 2014, with a subsequent development to upscale the solution. It targets a CCU concept, converting the captured carbon into sodium bicarbonate which could be used to abate the acid gases in the flue gas, and since 2020, the plant has been supplying some nearby greenhouse infrastructure¹⁶². The AVR-Duiven plant has been successfully capturing CO₂ via an MEA chemical absorption process and supplying to nearby greenhouses in the form of liquid CO₂ since summer 2019 in the range of 60kton of CO₂ every year ¹⁶³.

- **Case Study 4** – In the UK, waste management company **Viridor** has announced plans to invest up to GBP 1 billion in CCS technologies across seven sites, aiming to capture approximately 0.9 million tonnes of CO₂ annually at its Runcorn WtE facility.

¹⁶¹ SLB Capturi (2025). *Oslo CCS*. Available at: <https://capturi.slb.com/projects/oslo-ccs>

¹⁶² SLB Capturi (2025). *Twence CCU*. Available at : <https://capturi.slb.com/projects/twence-ccu>

¹⁶³ AVR (2025). *CO₂ – capture plant*. Available at: <https://www.avr.nl/en/optimal-process/co2-capture-plant/>

Landfill gas capture and utilisation (LFG)

- **Case Study 1 - Granges landfill: renewable gas production from landfill biogas (France):** In June 2025, Veolia and Waga Energy inaugurated a renewable natural gas facility at the Granges landfill in Burgundy, eastern France. The project's primary objective is to capture methane generated by decomposing waste and upgrade it into quality biomethane, thus reducing GHG emissions while displacing fossil natural gas. The facility can treat up to 600 m³ of raw biogas per hour and inject the upgraded gas into the local distribution network operated by GRDF (France gas distributor) via a dedicated pipeline. Since it began operating in early 2025, the plant has produced enough renewable gas to supply more than 3000 households annually and is expected to avoid around 3.300 tonnes of CO₂ equivalent emissions each year. The project has significantly improved the site's overall energy efficiency and environmental performance by replacing a combined heat and power unit with direct biomethane injection.
- **Case Study 2 – Can Mata controlled landfill: large-scale biomethane injection from landfill biogas (Spain):** In June 2023, PreZero, Waga Energy, and Nedgia commissioned Spain's largest landfill biomethane injection project at the Can Mata controlled landfill near Barcelona. The project is designed to fully upgrade landfill biogas into grid-quality renewable gas, thereby maximising methane recovery while reducing GHG emissions. The facility produces around 70 GWh of biomethane per year, sufficient to supply approximately 14000 households, or fuel around 200 municipal buses, avoiding more than 17.000 tonnes of CO₂ equivalent annually. The project pioneered an innovating financing model, based on a long-term biomethane purchase agreement support by 2.4 million EUR from the EU Innovation Fund.

Appendix 3: MRV methodologies for waste incineration and landfilling

A. Measurement-based methodologies

Waste incineration installations: Most (if not all) MWI installations already apply a measurement-based approach (continuous emission monitoring system (CEMS)) for the monitoring obligations under the Industrial Emissions Directive (IED) on the concentration of air pollutants (NO_x, SO_x, etc.), providing experience in the application of measurement-based approaches for the monitoring of GHG emissions. The specific requirements for measurement-based monitoring of GHG emissions would depend on the tier levels applicable in accordance with Annexes II and VIII of the MRR. Category A installations are expected to achieve at least Tier 2, while Categories B and C are expected to meet Tier 4¹⁶⁴. Most waste incinerators (64%), especially WtE installations, would be expected to fall within Category B, with an estimated 35% of installations falling within Category A¹⁶⁵. However, among the latter, some installations, such as hazardous waste incinerators or smaller installations, may fall below the threshold for opt-outs of small installations (see section 1.4.3. below for details). Table 6 outlines the requirements by category.

Table 6: Summary of the Tier Requirements (maximum permissible uncertainty) by category (for a measurement-based methodology).

	Tier 1 ±10%	Tier 2 ±7.5%	Tier 3 ±5%	Tier 4 ±2.5%
Category A				
Category B				
Category C				

- **Radiocarbon analysis (C14 method):** For large WtE plants treating MSW, the most reliable MRV method is radiocarbon (C14) analysis. Radiocarbon analysis, also known as the C14 method, measures the ratio of carbon isotopes in flue gas to differentiate between fossil and biogenic carbon. Fossil-derived CO₂ contains no C14, whereas biogenic sources do. The costs associated with C14 implementation depend on installation costs, annual operating costs and sampling and analysis

¹⁶⁴ However, if an operator can demonstrate to the competent authority that meeting the required tier is technically infeasible or would result in unreasonable costs, they may apply a lower tier, specifically, one tier lower for Category C installations and up to two tiers lower for Categories A and B if Tier 1 is the minimum applied.

¹⁶⁵ Article 19 of the EU ETS MRR establishes the categories of installations. Category A installations have annual emissions ≤ 50,000 tonnes of CO₂e, Category B installations have annual emissions between 50,000 and ≤ 500,000 tonnes of CO₂e, and Category C installations have annual emissions > 500,000 tonnes of CO₂e. Based on publicly available data by sector organisation CEWEP on the number and capacity of WtE installations in the EU and assuming that 1 tonne of waste would produce around 1 tonne of CO₂ of which 50% fossil-based, 270 out of 423 (64%) installations have a capacity between 100.000 and 1.000.000 tpa, i.e. between 50.000 and 500.000 tonnes of CO₂ (Category B); 150 (35%) have a capacity below 100.000 tpa, i.e. below 50.000 tonnes of CO₂ (Category A); and 3 (1%) have a capacity above 1.000.000 tpa, i.e. above 500.000 tonnes of CO₂ (Category C).

costs. An analysis done in the UK for the future inclusion of waste incineration in the UK ETS estimated cost ranges at EUR 34.900 – 93.000 for installation, EUR 11.600-23.300 for annual operating costs and EUR 465-755 per sample lab analysis¹⁶⁶. However, smaller operators may find this method difficult to implement due to the infrastructure, costs and expertise required, as the method requires regular sampling of flue gases and laboratory analysis, which can be costly and technically demanding. C14 testing is generally also unsuitable for use in clinical or hazardous waste incineration facilities due to the small sample volumes and hazardous/radioactive materials handled.

- **Manual sorting and sampling method:** Manual sorting can serve as a supporting or indicative tool, although not typically used as a primary MRV method¹⁶⁷. Incineration facilities would likely be subject to more frequent reporting, either quarterly or annually, depending on the volume of emissions. Stakeholders in the UK preparatory report have suggested that each sample uses approximately one week's worth of work to physically sort the waste, costing around EUR 700 - EUR 1,400 per sample. Manual sorting and sampling is labour-intensive and susceptible to subjectivity and sampling error. Due to these limitations, it is not recommended as a standalone method for regulatory MRV purposes but can serve as a supportive tool.
- **Selective Dissolution Method:** The selective dissolution method is a laboratory-based approach that uses chemical processes to dissolve specific components of waste, helping to distinguish between fossil and biogenic content. This technique remains largely experimental and is not yet widely adopted in operational or regulatory settings. It may apply to certain waste types where more established methods, such as radiocarbon analysis or balance calculations are unsuitable.

Landfills: Satellite-based monitoring and ground-based monitoring provide two measurement-based methods available for landfilling.

- **Satellite-based monitoring:** Satellite-based monitoring is an emerging monitoring approach for methane emissions from landfills. Since 2017, the TROPOMI instrument, capable to detect (among others) methane emissions, has been in orbit by the European Space Agency and the Netherlands Space Office. The data generated have been used to develop detection, identification, and monitoring systems of methane emissions from landfill sites¹⁶⁸. Recent satellite-based analyses of methane emissions from landfill sites have found little correlation with reported or modelled emission estimates at landfill

¹⁶⁶ Exchange rate used: GBP 1 = EUR 1.16

¹⁶⁷ The manual sorting and sampling method approach involves physically sampling the incoming waste stream and manually separating it into fossil and biogenic fractions based on visual or material characteristics.

¹⁶⁸ Schuit, B. J., et al. (2023) Automated detection and monitoring of methane super-emitters using satellite data, *Atmos. Chem. Phys.*, 23, 9071–9098, <https://doi.org/10.5194/acp-23-9071-2023>, 2023.

sites¹⁶⁹, highlighting the potential of satellite observations to accurately detect and monitor methane emissions from the waste sector. For example, in 2022, a study published by SRON Netherlands Institute for Space Research, Harvard University, and GHGSat Inc¹⁷⁰ found high emission rates in the studied landfills, with emissions above the reported in the national inventories (1.4 to 2.6 times higher). Since 2025, the European Space Agency has also been conducting a real-world case study of the Las Dehesas landfill (Spain) combining ground surveys, sensor-equipped aircraft and satellites to assess methane leaks and the impacts of repairs and changed management practices with the aim to inform satellite-guided pathways to reduce or avoid emissions, mirroring successes targeting oil and gas facilities. Satellite measurements would be accurate, could be regularly conducted to monitor trends, and would be suited to monitor historical emissions from landfills. However, while an accurate measurement method, it would in the current phase of development still be technically and economically challenging to consistently implement across the EU given the number of landfill facilities but subject to further development could be considered when establishing or updating future MRV protocols for landfill.

- **Ground-based monitoring:** Ground-based measurement based on a tracer gas dispersion method (TDM) can provide high accuracy and high sensitivity. It involves releasing an inert tracer gas from the landfill and measuring its concentration downwind alongside the target gas, usually methane. By comparing the ratio of methane to the tracer gas and using a dispersion model, the total emission rate of the target gas from the entire landfill can be calculated. This method is effective for quantifying whole-site emissions, including fugitive ones. However, it is very labour- and time-intensive and scaling this methodology up to an entire landfill, let alone hundreds of landfill sites across the EU, is challenging.

B. Calculation-based methodologies

Waste incineration installations: A calculation-based methodology could be used as an alternative to direct measurement for monitoring emissions in some circumstances. This approach estimates emissions by combining activity data (such as the quantity and type of waste incinerated) with emission factors derived from laboratory analysis or established default values. These emission factors could also be updated with analytical methods, where possible and applicable. Whilst a measurement-based method is preferable, the calculation-based approach is acknowledged as potentially more practical for smaller or resource-limited sites, especially where direct measurement is technically challenging or prohibitively expensive. It may be relevant for hospital and small emitters (HSEs) or for waste types such as clinical and hazardous waste, where physical sampling is restricted. In the UK, a simplified MRV framework is

¹⁶⁹ Dogniaux, M., Maasakkers, J.D., Girard, M. et al. Global satellite survey reveals uncertainty in landfill methane emissions. *Nature* 647, 397–402 (2025). <https://doi.org/10.1038/s41586-025-09683-8>

¹⁷⁰ Maasakkers J. et al. (2022). ‘Using satellites to uncover large methane emissions from landfills’, *ScienceAdvances* (8; 32). Available at: <https://doi.org/10.1126/sciadv.abn9683>

proposed for small, known as hospital and small emitters (HSE), and ultra-small emitters (USE). These are allowed to utilise emission factors provided by the Competent Authority, with HSE sites further exempt from needing to justify why higher MRV tiers cannot be applied and automatically allowed to use Tier 1, which has a maximum uncertainty of $\pm 10\%$. This tiered flexibility is intended to keep compliance proportionate to emissions. The calculation-based methodology could be implemented according to the standard methodology set out in Article 24 of the mass-balance methodology set out in Article 25 of the EU ETS MRR:

- **(Mass-) Balance Method:** The balance method calculates fossil CO₂ emissions by assessing the known composition of incoming waste and applying emission factors based on the types and quantities of materials incinerated. It relies on accurate input data and is often supported by operational records, sampling, or modelling. This method is particularly suitable for medium to large facilities that have access to reliable waste composition data or can estimate it with a reasonable degree of certainty. While less precise than C14 testing, it offers a more cost-effective and scalable solution. Similarly, a customised balance method based on detailed waste characterisation could serve as a tailored MRV method for clinical and hazardous waste incinerators given the variability of waste types and their higher fossil content. It works using continuous real time data from the distributed control system (DCS), emissions data from the CEMS complemented with pre-established values from literature or the software supplier. Installation of this system is estimated to cost around EUR 58,200 per line, with annual operating costs of about EUR 17,400. One example of the use of emission factors is Germany, where emissions factors are applied estimated for the biogenic content of each waste code and/or the energy content. However, this is unlikely to be consistently accurate for all waste inputs received at the different MSWI due to the heterogeneous nature of the waste processed at incinerators. Given the variable nature of MWS, an individual or country-based approach would be recommended rather than a generic EU-wide waste code value.
- **Default emission factors:** Using default emission factors involves applying standardised values based on typical waste compositions and combustion technologies, often aligned with international methodologies such as those from the IPCC. This tiered approach is particularly useful for smaller facilities or those with relatively low emissions, where the cost and complexity of higher-tier methods may not be justified. It offers a simplified, consistent reporting pathway with minimal administrative burden. However, its accuracy is lower than other methods, and periodic and local validation may be required to ensure continued reliability. Waste incinerators without energy recovery, often smaller in scale, could follow simplified MRV approaches such as default emissions factors or a lower-tier balance method.

Landfills: The IPCC Guidelines¹⁷¹ establish two methods to calculate methane emissions from landfills. Method A is based on theoretical gas yield and assumes that all the methane is released in the same year the solid waste is disposed of. Method B, which is the first order decay model based on kinetics, provides a more accurate estimate for the actual annual emissions. However, method B is more difficult to apply given the amount of necessary data that is required (waste disposal, rate of decay, etc). The methods provide substantially different estimates for methane emissions from landfills:

- **Default emission factors:** This calculation-based method deploys default emissions factors with the assumption that all methane is released within the same year of disposal of the waste, thus including expected future decay emissions into one emissions estimate. It is a simpler method which requires limited inputs with default values and country-based quantities and data (to be provided by each MS or operator). This method could be the simplest approach. However, available emission factors vary widely depending among others on the presence and type of methane capture, local conditions and waste composition, ranging from less than 0.2 (with capture, low estimates) to more than 2.6 (without capture, high estimate based on satellite-based measurements) and the methodology used¹⁷².
- **First-Order of Decay (FOD) method:** The FOD method estimates landfill emissions by using a mathematical model that treats the decomposition of waste as a first-order reaction, based on two main parameters: the ultimate methane generation potential and the methane generation rate constant, summing the emissions from each year's waste input using a separate equation for each year's waste. Consequently, this method covers historical emissions, reflecting the gradual decay and emissions of waste in landfills. It offers a more robust emissions profile but is more complex to implement consistently, as it requires country-specific data which may not be readily or accurately available. It is a standard method for estimating LFG emissions and is used in various models, such as the IPCC Guidelines and the U.S. EPA's LandGEM model.

¹⁷¹ IPCC (2000). 'CH₄ emissions from solid waste disposal', in IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. Published for the IPCC by the Institute for Global Environmental Strategies, Japan. Available at: https://www.ipcc-nggip.iges.or.jp/public/gp/bgp/5_1_CH4_Solid_Waste.pdf

¹⁷² See for example the factors provided in Department for Energy Security and Net Zero (2023). *Greenhouse gas reporting: conversion factors 2023*. Available at : <https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2023> or CEWEP (2022). *Waste-to-Energy Climate Roadmap*. Available at : <https://www.cewep.eu/wp-content/uploads/2022/06/CEWEP-WtE-Climate-Roadmap-2022.pdf>

2. NON-PERMANENT CARBON CAPTURE AND UTILISATION (CCU)

2.1. Overview

Carbon capture and utilisation (CCU) refers to technological processes or practices that make use of captured carbon dioxide (CO₂) as a feedstock for the manufacture of products in various applications, such as (but not limited to) organic chemicals and plastics, synthetic fuels or building materials. As part of the CCU process, the CO₂ molecule is chemically converted in complex organic (i.e. carbon based) molecules or in mineral carbonates. CO₂ may also be used as is (without chemical conversion) in the food and drinks sector (i.e. for greenhouses, beverages) or other applications, such as a refrigerant or for fire extinguishers.

In contrast, carbon capture and storage (CCS) refers to the capture of CO₂ and its transfer for permanent storage in dedicated geological storage sites, permitted under Directive 2009/31/EC (CCS Directive)¹⁷³. Some CCU applications also have the potential to permanently store captured CO₂ in products, also known as permanent CCU. Commission Delegated Regulation 2024/2620¹⁷⁴ supplements the ETS Directive regarding the requirements necessary for considering that emissions are permanently chemically bound in products, i.e. constituting a permanent CCU. In addition, this Regulation also lists several products that are considered to meet these requirements, namely mineral carbonates in construction products, such as aggregates, cement and other binders, concrete, tiles, bricks or other masonry products. The safeguards provided by this regulatory framework regarding CCS and permanent CCU ensure that emissions that are captured and permanently stored can effectively be considered as not emitted without endangering the integrity of the EU ETS. Therefore, ETS operators receive a derogation from the obligation to surrender emission allowances for those reported emissions that are captured and permanently stored, either through CCS or permanent CCU.

As noted in recital (97) to Directive (EU) 2023/959¹⁷⁵, until all stages of the life of a product in which captured carbon is used are subject to carbon pricing, in particular at the stage of waste incineration, reliance on accounting for emissions at the point of their release from products into the atmosphere would result in emissions being undercounted. Therefore, unless permanently stored, all other captured emissions are priced in the EU ETS, which ensures the integrity of the EU ETS. However, this approach creates the potential that some emissions may be double counted in the EU ETS in case products produced with captured emissions end up being combusted in another ETS installation. The potential integration of waste incineration in ETS 1, assessed in the previous section, would increase the risk of this double counting of emissions.

¹⁷³ Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide, <http://data.europa.eu/eli/dir/2009/31/oj>

¹⁷⁴ Commission Delegated Regulation (EU) 2024/2620 of 30 July 2024 supplementing Directive 2003/87/EC of the European Parliament and of the Council as regards the requirements for considering that greenhouse gases have become permanently chemically bound in a product. Official Journal of the European Union, L 2620, 4 October 2024. Retrieved from https://eur-lex.europa.eu/eli/reg_del/2024/2620/oj/eng

¹⁷⁵ Directive (EU) 2023/959 of the European Parliament and of the Council of 10 May 2023 amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union and Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading system (Text with EEA relevance), <http://data.europa.eu/eli/dir/2023/959/oj>

The European Commission published in February 2024 a Communication on Industrial Carbon Management (ICM) in the EU¹⁷⁶. This strategy acknowledges the importance the CCU can play in the production of advanced synthetic fuels, chemicals or polymers and its contribution to the circular economy model. As the production of chemicals and materials still relies heavily on fossil-based feedstocks, CCU can contribute to emission reductions, energy security and the autonomy of the EU by replacing the fossil feedstock with captured CO₂, (and renewable or low carbon H₂). This is further emphasised in the European Chemicals Industry Action Plan¹⁷⁷, which emphasises that the use of alternative, clean carbon sources like biomass, recycled waste and CCU are essential for achieving net zero and ensuring the clean transition of the EU chemicals industry.

Non-permanent CCU is an important technology for addressing emissions from hard-to-abate sections, providing an alternative carbon feedstock for economic sectors that require CO₂. However, the current EU ETS framework, in particular EU ETS covering stationary installations, maritime and aviation, does not fully address the unique characteristics of non-permanent CCU products, such as different carbon sources and variable storage durations for the captured carbon and the captured emissions being re-emitted at various points in the value chain. Therefore, in accordance with Article 30(5)(c) of the ETS Directive, this assessment analyses how to best recognise in the EU ETS CO₂ in captured non-permanent products, ensuring that all emissions under the scope of the ETS Directive are effectively accounted for and double counting is avoided.

The potential inclusion of waste incineration as part of this review of EU ETS, assessed in section 1 of this Annex, allows re-assessing the current accounting approach, i.e. considering all captured CO₂ as emitted unless proven that it is permanently stored, and assess alternative accounting options that recognise the environmental and economic benefits of non-permanent CCU products, while maintaining the integrity of the EU ETS.

In the open public consultation, most respondents, including a majority of companies/businesses and business associations (mainly from the energy sector and manufacturing industry), agreed that surrender obligations should be adjusted where emissions are captured and used in products without permanent storage, in order to recognize the potential climate benefits of capture and use (84 respondents, i.e. 34% strongly agreed and 55 respondents, i.e. 23% somewhat agreed). However, most NGOs and environmental organizations (strongly) disagreed with this option due to the higher integrity offered by the current system, despite its potential for double counting of emissions. Nonetheless, there was broad support across all stakeholder groups (including from both companies/businesses and business associations and NGOs) for introducing restrictions or conditions when adjusting surrender obligations for the capture and use of non-permanent carbon (e.g.: minimum emission savings, displacement of fossil carbon, avoiding double counting/pricing of the same emissions), where 47 respondents (19%) and 83 (34%) somewhat agreed.

The EU ETS framework covering stationary installations, maritime and aviation, does not fully address the unique characteristics of non-permanent CCU products, such as different carbon sources and variable storage durations for the captured carbon and embedded in a production.

¹⁷⁶ Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Towards an ambitious Industrial Carbon Management for the EU

¹⁷⁷ Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - A European Chemicals Industry Action Plan, [Eur-Lex - 52025dc0530 - En - Eur-Lex](#)

Non-permanent CCU applications represent a form of carbon re-use, where emissions resulting from some economic activities that would have otherwise been released directly into the atmosphere are captured and permanently used or stored or captured and utilised as a useful input for the manufacturing of other products. However, the carbon embedded in non-permanent CCU products (by definition) will be released into the atmosphere either during use or at the end-of-life of the respective product. As highlighted in Article 30(5)(c) of the ETS Directive, addressing non-permanent CCU is fundamentally a carbon accounting challenge, by which it is meant measuring and reporting emissions and surrendering the corresponding quantity of ETS emission allowances. This assessment is focused on several options for accounting for non-permanent CCU in the EU ETS, assessing the most effective approach for regulating and accounting for the capture and use of carbon in a manner that maintains the integrity of the EU ETS i.e. reduces net emissions and ensures emissions are accounted for in a fair and equal manner. However, in addition to a pure accounting exercise, recognising non-permanent CCU also has economic impacts for ETS operators, providing additional pathways for abating their emissions and contributing to achieving the objectives of the ETS Directive in a more efficient and effective manner.

The measures addressing non-permanent CCU in the EU ETS are described and assessed in section 2.3. The assessment of the environmental and economic impacts has been done based on the following criteria:

Whether they provide a level playing field for non-permanent CCU. To produce CCU fuels or chemicals, the current EU ETS rules require payment for the emissions captured and embedded in any product that does not meet the permanence criteria. This situation leads to a lack of level playing field between the traditional petrochemicals, for which no payment is required in the ETS when using virgin fossil carbon, and alternatives based on CCU.

Whether they ensure accounting effectiveness and a cost-efficient reduction of emissions. With the integration of waste incineration into the ETS, virgin fossil feedstock would be subject to carbon pricing at the point where the carbon is released from the product, potentially levelling the playing field. However, without a change in the CCU rules, the emissions embedded in non-permanent products would be paid twice: once when captured (unless they meet the permanence requirement) and a second time at the end of life when incinerated. This leads to a double counting/pricing of emissions, which results in an inefficient reduction of emissions.

Whether the changes of the ETS accounting of emissions in non-permanent CCU products leads to excessive administrative burden.

Ensuring a level playing field between non-permanent CCU products and CCS and permanent CCU products will be assessed in the impact section.

2.2.Scoping

Non-permanent CCU is a broad concept and covers a wide range of products that could be potentially manufactured via the CCU process. Assessing the impact of the different potential accounting approaches for non-permanent CCU cannot be done in abstract, and such assessment needs to consider the characteristics of the respective products, in particular their use and end-of-life treatment. This can ultimately allow to ascertain if the final release of the emissions from the non-permanent CCU products will be covered by the EU ETS and thus if accounting further downstream, instead of at point of capture, would lead to accounting loopholes. Therefore, this section focuses on identifying the potential non-permanent CCU products that need to be kept in mind when considering how CCU could be reflected in the ETS, and the associated accounting approach.

It is important to underline that the EU ETS is a system that sets an overall cap and requires the surrendering of allowances for “fossil” resulting from activities within the scope of the EU ETS Directive. “Fossil” emissions effectively means the emissions resulting from source streams that are not considered to be zero-rated under specific provisions of the ETS Directive or its secondary legislation. Zero-rated source streams include biomass that is certified as meeting the sustainability criteria or of the Renewable Energy Directive¹⁷⁸ (RED) emissions, or e-fuels that are certified as meeting the 70% emissions savings. The emissions resulting from zero-rated source streams are also considered to be zero-rated, which means that they do not require the surrender of emission allowances. Emissions resulting from the combustion of non-sustainable biomass would not be zero-rated and treated the same way as fossil emissions.

For this assessment, carbon capture and utilisation and the accounting of emissions in the ETS refers exclusively to the treatment of fossil emissions that are captured and stored or utilised. Emissions that are zero-rated receive the same treatment in the ETS regardless of whether they are released directly in the atmosphere or captured, stored or utilised in non-permanent products, i.e. they do not require the surrender of emission allowances. The EU ETS does not give credits for the capture of emissions that are already zero-rated, and the certification of carbon removals (permanent or temporary) is done under a different legal framework, namely under the Carbon Removals and Carbon Farming Regulation (CRCF).¹⁷⁹ The options for integration of carbon removals in the EU ETS are analysed separately in Annex 8.

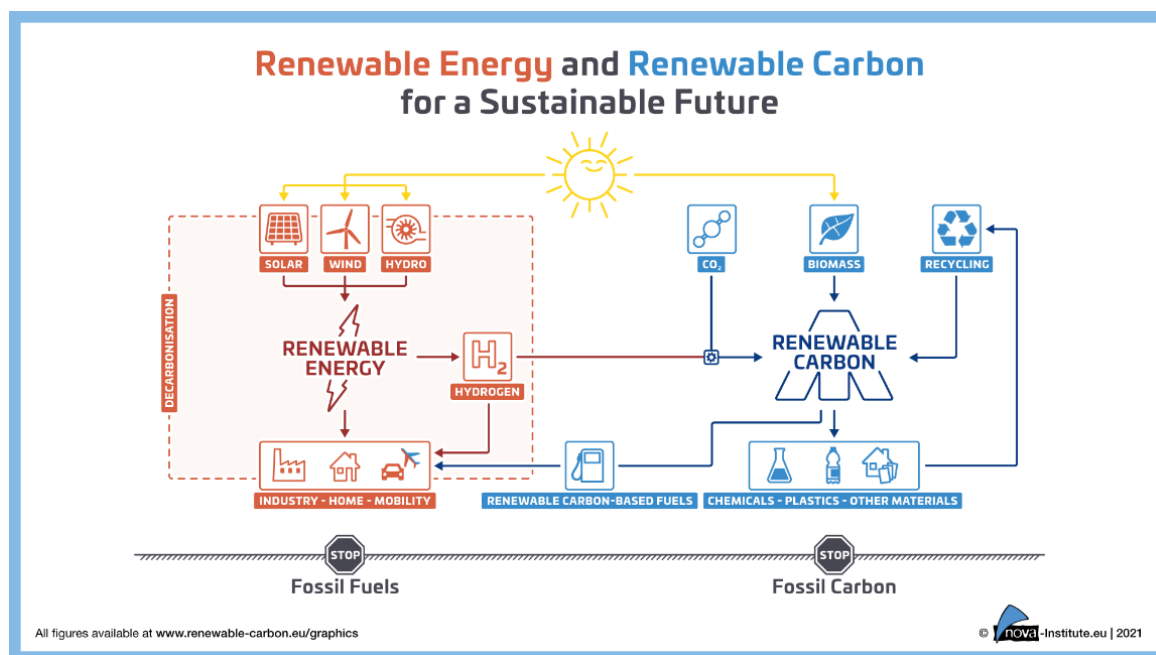
2.2.1. Description of importance and potential for CCU market, products

As mentioned in the overview, CCU is recognised as a potential solution for reducing emissions for sectors where there are very few other decarbonisation options, such as the chemicals or the cement sectors, but also some transport modes such as aviation and maritime. In this context, some stakeholders argue that CCU provides the opportunity to provide a source of “renewable carbon”, which when matched with an adequate supply of renewable energy can significantly reduce the emissions of hard to abate sectors.

¹⁷⁸ Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (recast), <http://data.europa.eu/eli/dir/2018/2001/oj>

¹⁷⁹ Regulation (EU) 2024/3012 of the European Parliament and of the Council of 27 November 2024 establishing a Union certification framework for permanent carbon removals, carbon farming and carbon storage in products, <http://data.europa.eu/eli/reg/2024/3012/oj>

Figure 7: Concept of Renewable Carbon

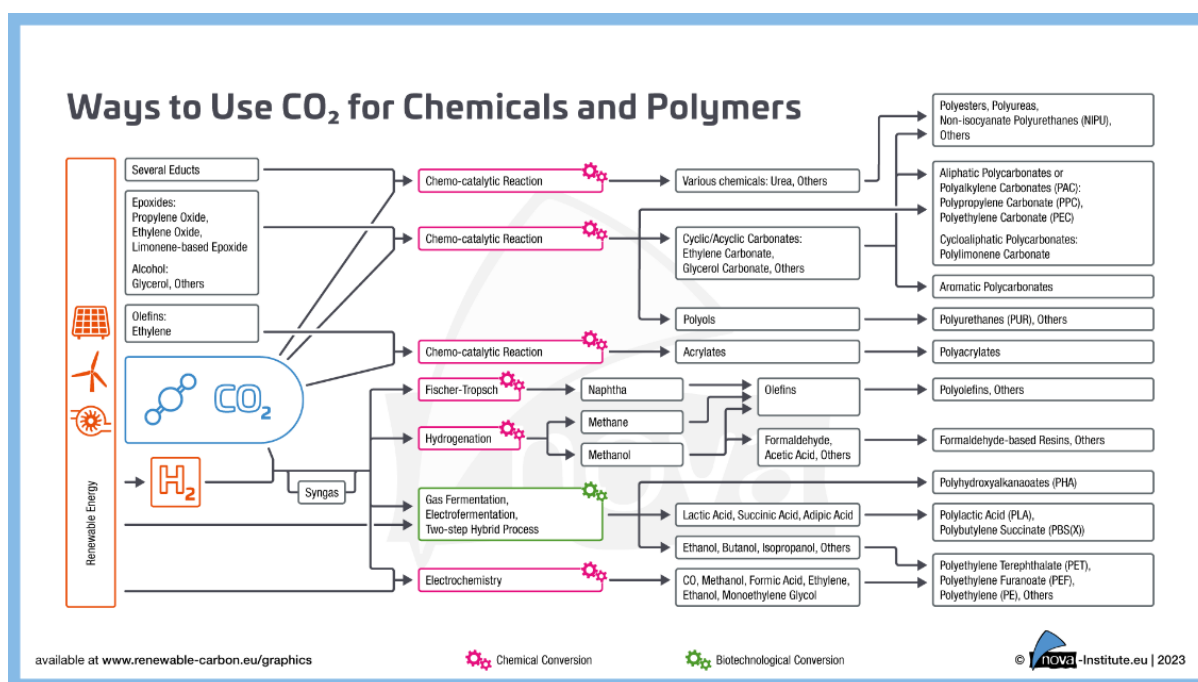


Source: Nova Institute

As emphasised in the European Chemicals Industry Action Plan, this is particularly important for the chemicals sectors, which requires significant amount of carbon feedstock (estimated at over 120 Mt/C/year for the EU-27) and more than 90% of it is derived from fossil sources¹⁸⁰. Therefore, the chemical conversion of CO₂ presents an important potential to produce a wide variety of chemicals without relying on fossil feedstocks. Figure xx provides an overview of the different CO₂ conversion technologies and the range of resulting CCU products, as well as their technology readiness levels.

¹⁸⁰ Nova Institute, The fossil fuel trap: Why defossilising chemistry is essential – and feasible!, <https://renewable-carbon.eu/news/the-fossil-fuel-trap-why-defossilising-chemistry-is-essential-and-feasible/>

Figure 8: Overview CCU technology pathways for chemicals and polymers



Source: Nova Institute

A 2023 report¹⁸¹ identified that in 2022, the total production capacity of novel CO₂-based products of about 1.3 Mt/a with an outlook by 2030 expected to exceed 6 Mt/a of CO₂-based products. A 2024 evaluation of a number industry studies and reports on the future of the plastics or chemicals sectors¹⁸² identified that the use of CO₂ as feedstock in CCU applications amounted by 2050 to an average 17% of the share of feedstock for plastics and 33% for chemicals in general (exceeding the predicated share of biomass for materials).

This makes it clear that CCU plays currently a small role as an industrial technology, but it presents an important potential for the development of new production methods that are inherently better suited to a low carbon, net-zero economy. Against this background, this assessment considers the role the EU ETS can play in providing a level playing field for CCU applications to develop and compete with traditional fossil-based production methods

2.2.2. Identification and description of accounting approaches

‘Upstream’ ‘downstream’, and ‘midstream’ in the context of this assessment refer to the different stages in the CCU value chain, i.e., ‘upstream’ representing the initial carbon capture stage and ‘downstream’ is the stage where the emission eventually occurs, such as at the point of combustion of a fuel or other end of life treatment of a product. ‘Midstream’ represents an accounting point somewhere in the middle of the value chain. In the illustrations below, a +1, 0 or -1 indicate where emissions or removals reported across the different steps of the CCUS chain. In the case of permanent storage, the sum of the emissions at each stage should add up to 0, while in the case of non-permanent CCU, the sum of the emissions at each stage should

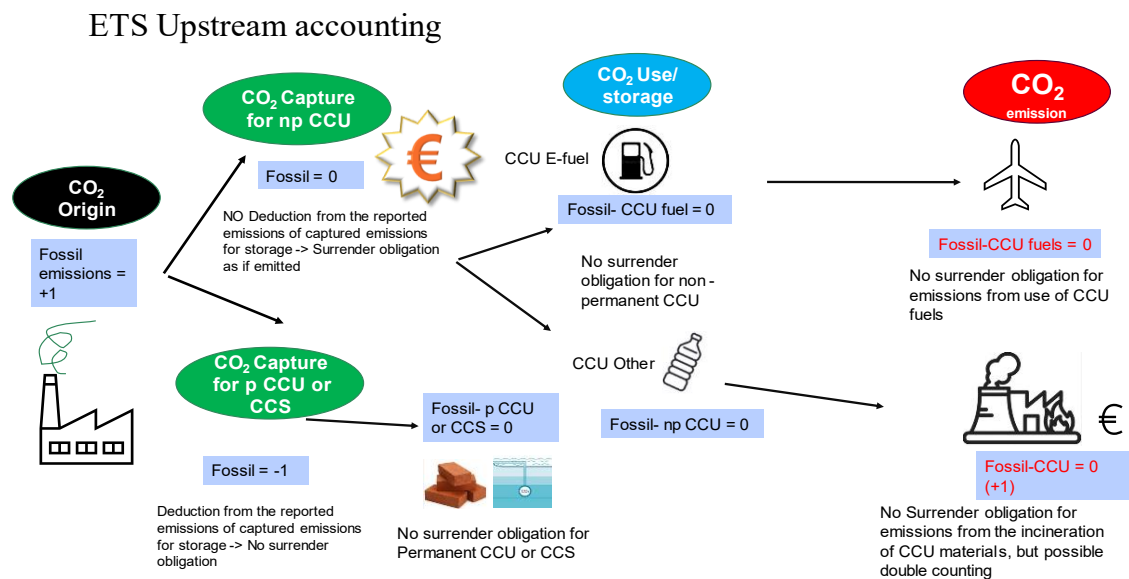
¹⁸¹ Pauline Ruiz, Pia Skoczinski, Achim Raschka, Nicolas Hark, Michael Carus, Carbon Dioxide (CO₂) as Feedstock for Chemicals, Advanced Fuels, Polymers, Proteins and Minerals

¹⁸² Harrandt, J., Carus, M., vom Berg, C., 2024: Evaluation of Recent Reports on the Future of a Net-Zero Chemical Industry in 2050

add up to +1. A lower value would represent under-counting of emissions, and a higher one would represent double counting of emissions.

‘Upstream accounting’, in the context of the EU ETS, refers to accounting for emissions at the point of capture of emissions that result from activities within the scope of the ETS Directive. Captured CO₂ that is not designated for CCS or subject to the exemption for permanent CCU products, still requires the surrender of emission allowances, i.e. it is priced at the point of capture. Captured carbon would then be utilised in the value chains of non-permanent CCU products, such as for the production and use of plastics or e-fuels. Upon combustion of e-fuels, the priced carbon is emitted into the atmosphere.

Figure 9: Simplified illustration of upstream accounting in ETS context

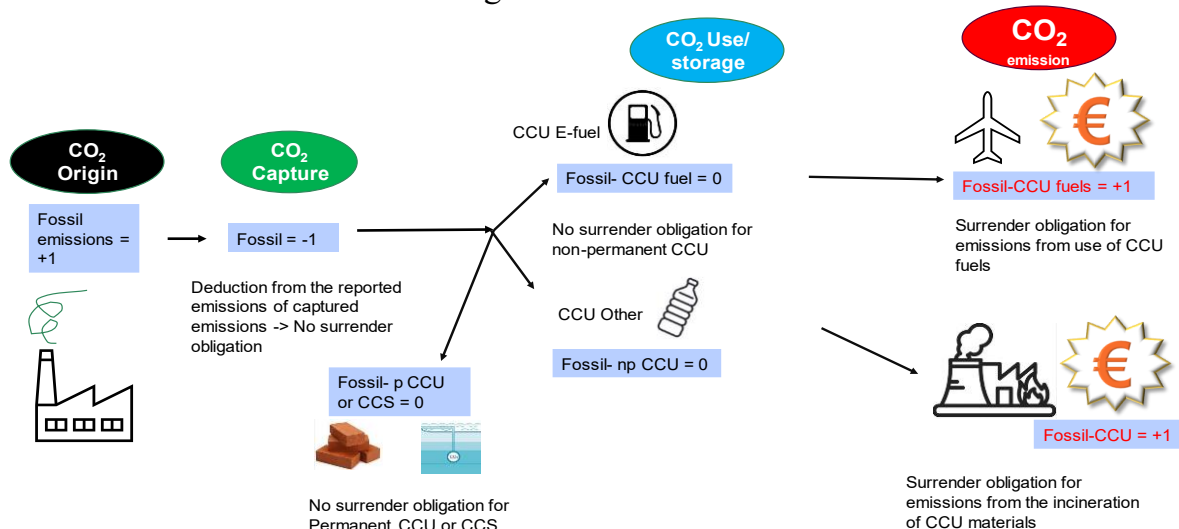


Source: Own illustration

‘Downstream accounting’ refers to reporting of emissions at the point where the captured carbon is released back into the atmosphere, such as during product use or disposal. In this approach, the ‘final emitter’ pays, meaning the point of surrender obligation is shifted downstream in the CCU value chain. The EU ETS installation capturing its emissions and transferring the resulting CO₂ to another EU ETS installation will not be required to surrender emission allowances for that CO₂, regardless of if it intended for non-permanent CCU applications or permanent geological storage or any type of CCU application storage site. The emissions embedded in non-permanent CCU products are accounted and priced downstream at the end of life when combusted and the CO₂ is released.

Figure 10: Simplified illustration of downstream accounting in ETS context

ETS Downstream accounting

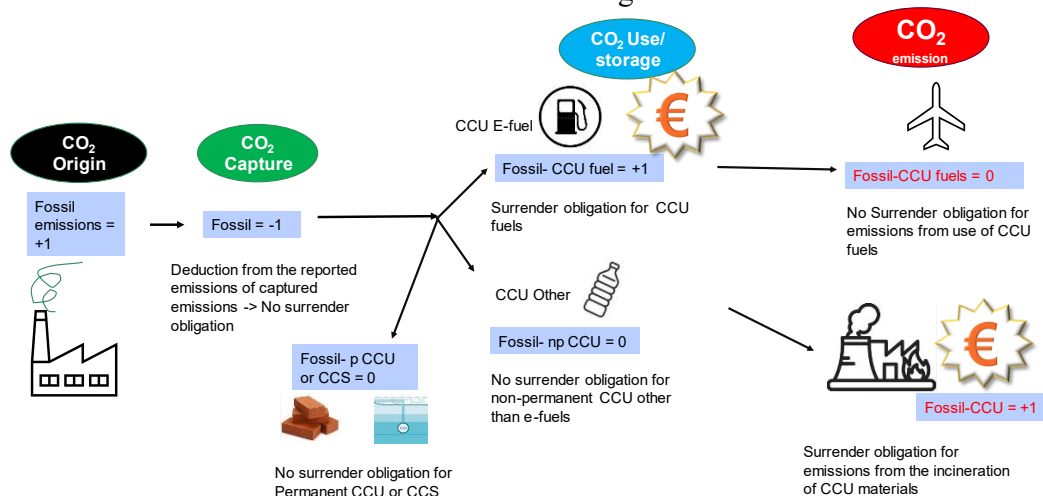


Source: Own illustration

‘Hybrid downstream and midstream accounting’ represents a version of the downstream accounting, where the point of accounting can be enacted somewhere in the middle of the value chain for a particular CCU product. The hybrid midstream is particularly relevant for e-fuels, where the zero-rating for qualifying e-fuels can be maintained by moving the point of accounting and pricing midstream. In the case of e-fuels, the midstream accounting point is either the producer of e-fuel, similar to a refinery or organic chemicals producers, or as a distributor placing e-fuels on the EU market for final consumption. For the other CCU products, the downstream accounting is applied as described in the ‘downstream accounting’ measure, hence the ‘hybrid’ designation.

Figure 11: Simplified illustration of hybrid downstream and midstream accounting in ETS context

ETS Downstream and midstream accounting



Source: Own illustration

These concepts underpin the suggested policy measures articulated for the treatment of non-permanent CCU in the EU ETS in the below chapter.

2.2.3. Identification of potential non-permanent CCU products and their normal use or end-of-life treatment

The main CCU products or applications outlined below, as well as their normal use or end-of-life treatment.

Table 7: Overview of product lists by normal use or end-of-life treatment

Direct Utilization of CO ₂	Incineration during normal use or at the end-of-life	Recycling or landfilling	Other
Dry Ice	PCC (except used as mineral fertiliser)	Plastics	Solid Carbon
Greenhouses	Plastics	Plasterboard	Other carbonates
Food & Drink	Sodium Carbonate (soda ash)	Refractory Products	PCC used as mineral fertiliser
	E-fuels	Caustic Calcinated Magnesite	Other organic chemicals

2.2.4. Identification of potential loopholes for downstream accounting

To understand the implications of the carbon accounting policy measures to be assessed, the end-of-life pathways and emissions profile for each non-permanent CCU product was examined. The goal of this exercise was to determine which non-permanent CCU products are likely to be inert or to re-emit CO₂ at their end of life based on their typical waste management process. Should a non-permanent CCU product meet its end of life outside of the and re-emit those captured of emissions, the product is considered to evade the accounting of ETS system and undermine its environmental effectiveness. This evasion is referred to as ‘loopholes’.

An assessment of the risk loopholes was performed to determine which potential non-permanent CCU products are likely to be inert or to re-emit the embedded CO₂ at the end of life based on their typical waste management process. Furthermore, in-case of re-emission, it is important to assert whether that emission would occur within or outside the scope of the EU ETS, either currently or in the future, considering the possible extension to include waste incineration. This forms the basis of analysing the impacts of the different proposed CCU measures and whether the double- or under-counting of ETS emissions occurs.

Three waste management processes – recycling, incineration and landfill - were examined for several specific non-permanent CCU product, Direct CO₂ use applications and e-fuels were also considered. The following conclusions were determined:

- **Direct utilisation of CO₂** in sectors such as horticulture, food and drinks or refrigeration, will result in direct, and in most cases immediate, emission in the atmosphere of the utilised CO₂. As these sectors fall outside the scope of the EU ETS, this **re-emission of the CO₂ would not be covered by the EU ETS**.
- **E-fuels**, which are produced from hydrogen and CO₂, will results in the **CO₂ being emitted during fuel usage (combustion)**. The amount of CO₂ released during combustion can be considered equal to the amount of CO₂ used to create the fuel (excluding any emissions associated with the energy required for the production, which are not considered here). The use of fuels, including e-fuels, already falls largely **within to scope of the EU ETS and ETS 2**.

- The potential **CCU products** analysed that have a **high incineration rate** (either from the outset or at the end of several recycling cycles) are assumed to **re-emit** any embedded CO₂. However, some industrial wastes are co-incinerated as fuel for some ETS activities, and therefore these emissions are covered by the EU ETS. Furthermore, for the purpose of this assessment, it is assumed that the scope of the EU ETS is expanded to include waste incineration, in which case it can be **assumed that most emissions from the incineration of waste will fall within the scope of the EU ETS**.
- The potential **CCU products that are landfilled** are considered **generally inert**. Emissions from landfill result from the digestion (aerobic or anaerobic) of biodegradable waste. Synthetic organic materials, unless specifically designed to be bio-degradable, breakdown very slowly in landfill conditions with half-lives estimated ranging in hundreds to thousands of years.¹⁸³ However, the current IPCC guidance on emissions from solid waste disposal sites includes only the reporting of CH₄ (methane) emissions from landfills, as the CO₂ released from landfills is considered of biogenic origin. Some emissions could occur if landfill conditions become very acidic, landfill fires or in case of illegal dumping, which may not be accounted in inventories
- For potential **CCU products** that have a **high recycling rate, the fate of the embedded CO₂ depends on the recycling process**. Mechanical recycling process do not alter the chemical composition of the material and therefore, from the CO₂ re-emission point of view, they can be considered inert. In some cases, such as plasterboard, the recycling process requires high enough temperatures that result in the release of the CO₂. In other cases, where novel recycling processes are applied, the fate of the embedded CO₂ will depend on the nature of the product and of the recycling process and it cannot be determined in advance with precision. Products that after the recycling process, due to degradation or contamination, are not recyclable anymore are assumed to be either landfilled or incinerated, and therefore the likely emission fate outlined for those two end-of-life treatments.
- There are **some CCU applications** that, like the direct CO₂ utilisation, will result in the **re-emission of at least some the embedded CO₂ outside of the scope of the EU ETS**. This category includes primarily the products such as urea or PCC used as fertilisers or soil additives, where they break down and get dissolved in the water stream or re-emitted in the atmosphere. IPCC guidance on agricultural liming considers in its the default method that all embedded CO₂ in fertilisers is released¹⁸⁴. However, it does acknowledge a high uncertainty level as high as 50% and the exact rate of re-emission is influenced by local conditions, in particular soil acidity.

This assessment shows the possible non-permanent CCU product categories that will eventually result in the release of the embedded CO₂, where that emission would occur and whether it would fall within or outside of the scope of the EU ETS, assuming also its extension to include waste incineration.

¹⁸³ Degradation Rates of Plastics in the Environment, Ali Chamas, Hyunjin Moon, Jiajia Zheng, Yang Qiu, Tarnuma Tabassum, Jun Hee Jang, Mahdi Abu-Omar, Susannah L. Scott, and Sangwon Suh, *ACS Sustainable Chemistry & Engineering* **2020** 8 (9), 3494-3511, DOI: 10.1021/acssuschemeng.9b06635

¹⁸⁴ IPCC 2006 Guidance, Volume 4, Chapter 11, Section 11.4.1 **CHAPTER 11**

It is important to note that to date, apart from PCC, urea and some applications making direct use of CO₂, CCU technologies are largely at the research or piloting stage. The products researched in this section represent *potential or possible* products that could be produced via CCU. However, it is not possible to say which of those products will likely be produced at scale, which will depend on specific technological, financial and commercial considerations for each product. Therefore, the risks identified for the CCU products in this section are theoretical, as currently there are no or very few CCU products commercialised.

2.3. Policy measures

2.3.1. Description of the policy measures

The following policy measures to be considered for non-permanent CCU in the impact assessment include:

CCU0: Represents no change compared to the baseline based on upstream accounting and the current scope of the EU ETS as regards waste incineration.

CCU1: Maintain upstream accounting/pricing after integration of waste incineration

Upstream accounting is the status-quo accounting mechanism of the EU ETS premised upon the “emitter pays” principle, where carbon is accounted for at the point of the initial activity generating emissions. Upstream accounting was the most frequently identified accounting approach (44%) by respondents in the OPC when asked what accounting approach should be applied to non-permanent CCU technologies in the ETS to ensure the integrity and effectiveness of the EU ETS.

- **CCU2:** Downstream accounting (final emitter pays), conditional on integration of waste incineration:

Downstream accounting moves the point of accounting/pricing downstream to where the emission occurs. The capture operator (e.g. cement plant) is not required to surrender allowances for any CO₂ captured, as the final emitter, the user of synthetic fuels or the waste incinerator that incinerates non-permanent CCU products, would have to surrender allowances for these emissions. Downstream accounting, in various forms (with or without a ‘chain of custody’ approach) was the second most frequently identified approach (38%) by respondents in the OPC, mainly from companies and business associations from the manufacturing industry.

- **CCU3:** Hybrid downstream & midstream accounting, conditional on integration of waste incineration:

This approach is a variation to the previous downstream accounting option that seeks to offer an accounting approach that can accommodate the emissions profiles of e-fuels. In this approach, downstream accounting on waste incineration would take place to ensure that the emissions resulting from most non-permanent CCU products that meet their end-of-life downstream are accounted for. Additionally, a zero-rating for qualifying e-fuels would be maintained, and to ensure emissions from e-fuel production are accounted for, the point of accounting/pricing would move midstream and placed on either the producer or distributor of e-fuels. The difference between the two options as the midstream point of accounting is that midstream accounting at the point of production would cover only e-fuels produced in the EU, while midstream accounting at the point of distribution would cover both domestic and imported e-fuels. The producer or distributor of e-fuels would be included in the EU ETS as an

operator and would be required to surrender allowances for the fossil CO₂ used in e-fuels, which would enable to continue zero-rating these fuels when used in the ETS.

2.3.2. *Description of discarded measures*

- Life Cycle Assessment (LCA) based partial non-surrender obligation or carbon tracking:

LCA approaches fundamentally concern the evaluation of a non-permanent CCU product's life-cycle emissions through life-cycle analysis. LCA approaches and associated partial surrender obligations could be conceived as a sub-option for both upstream and downstream accounting, where instead of altering the point of an allowance surrender obligation, the extent of the surrender obligation is altered instead with emission factors based on life-cycle assessments that identify the climate benefit of non-permanent CCU products¹⁸⁵. In other words, partial emission factors would be applied instead of full pricing or full exemption. A life-cycle assessment approach to non-permanent CCU technologies in the ETS was supported by only a small share of OPC respondents (11%), mainly on the grounds that this would provide for the most accurate accounting method, LCA can represent an “outside of the box” solution for some, moving beyond the upstream-downstream paradigm, forgoing the need to assess as well whether a non-CCU product will be incinerated at its end of life or not. Additionally, LCA measures represent alternatives to the approach of addressing CCU through the avoidance of double counting, particularly in case of a decision not to integrate waste incineration into the EU ETS. More so, LCA approaches may provide incentive for CCU over the use of virgin fossil feedstock if the non-permanent CCU application is recognised to have, and is rewarded for, lower life-cycle emissions. LCAs in principle could be done, requiring clear and favourable rules for carbon footprint accounting to create incentives for CCU-based products.

However, there is no consensus on an appropriate methodology for conducting LCA for non-permanent CCU applications¹⁸⁶. In essence, the comparison of non-permanent CCU applications with a fossil fuel baseline may sound simple in principle, but in practice, can also involve a range of uncertainties and assumptions, being highly dependent on chosen baseline scenarios and associated assumptions¹⁸⁷. More so, it may not even be the case that a non-permanent CCU product displaces a fossil fuel baseline. A wide range of outcomes can be achieved when applying substitution with credits to deal with allocation in LCA approaches.

Fundamentally, LCA measures would require putting in place a certification infrastructure to be able to make such assessments, which would be complex and create a disproportionate administrative burden for uncertain benefits. The overall lack of consensus on methodological approach inherently raises a degree of uncertainty with regards to exactly how the associated monitoring, reporting, verification and accreditation (MRVA) would function in the first place.

¹⁸⁵ Technopolis (2024, July). Issues and Options for EU Emissions Trading after 2030, Final Task 2 Report – Analysis of issues, policy topics and policy options for the 2030-2040 timeframe (Report No. CLIMA/2022/OP/0012). European Commission, Directorate-General for Climate Action. <https://www.technopolis-group.com/report/issues-and-options-for-eu-emissions-trading-after-2030/>

¹⁸⁶ Technopolis (2024, July). Issues and Options for EU Emissions Trading after 2030, Final Task 2 Report – Analysis of issues, policy topics and policy options for the 2030-2040 timeframe (Report No. CLIMA/2022/OP/0012). European Commission, Directorate-General for Climate Action. <https://www.technopolis-group.com/report/issues-and-options-for-eu-emissions-trading-after-2030/>

¹⁸⁷ Vermeulen, H., Lockwood, T., & Lawaetz, R. (2025, June). *Pricing it right: Accounting for non-permanent CCU while safeguarding the EU ETS*. CONCITO & Clean Air Task Force. <https://concito.dk/files/media/document/Pricing%20it%20right.pdf>

Furthermore, LCA approaches are generally not compatible with the existing ETS MRVA framework, which was not designed to incorporate life-cycle assessments. Introducing LCA based approaches for CCU would introduce an unlevel playing field for CCS, which is based on incorporating the entire CCS chain in the scope of the ETS Directive (capture, transport and storage) and monitoring and reporting any emissions associated with each step.

In the context of CCU fuels, a “strict LCA approach is not seen as implementable for the ETS MRVA” according to FuelsEurope. For the chemical sector as well, there can be a wide range of LCA approaches that can lead to different results, and no clear way to harmonise LCAs for different chemicals and their products in what is inherently a complex industry. Practically, the tracking of the carbon molecules across the value may be unfeasible. Chemicals could be processed through many different stages and intermediaries and used as a feedstock for various end-use products. In practice, both upstream and downstream actors would have difficulties in compiling LCAs for their products due to uncertainties of the value chains.

Even though LCA has been standardised by the European Committee for Standardisation in ISO 14040/14044, the standard does not prescribe the exact methodological choices to be made regarding factors such as: selection of the functional unit, system boundaries (i.e., different “cradles” in a “cradle-to-gate” system), background processes, or environmental impact assessment methods. The lack of consensus on LCA for non-permanent CCU applications could also lead to sub-optimal decisions¹⁸⁸. As discussed above, with LCA approaches there is an inherent trade-off between the accuracy of an LCA approach versus the costs and administrative burdens of the associated MRV; the greater the accuracy the more costly the MRV system. Every LCA approach heavily depends on adequate data, the provision of which from stakeholders can incur additional costs.

Finally, the established approach of the EU ETS is based on Scope 1 direct emissions. Integrating an LCA approach that revolves around Scope 3 logic would increase the risk of double counting. Under the downstream accounting scenario, if again there is no comprehensive coverage of all end-of-life pathways for non-permanent CCU, then the same concerns about loopholes can arise again. More so, LCA has also been criticised for not being able to account for emission timing, i.e. the time interval between the capture of CO₂ and its subsequent emission¹⁸⁹. To this end, some stakeholders have suggested adding “timeframes”, where different blocks of time are used to denote the emissions from different components (Cembureau, stakeholder interview, July 28, 2025), although how exactly this would work was not detailed.

Given the limited feasibility and technical complexity, specifically the lack of consensus on methodological approach for applying an LCA to non-permanent CCU activities, the lack of certification structure and ease of integrating an LCA approach in the existing EU ETS MRVA framework, this measure is not assessed in detail as a policy measure in the impact assessment.

2.4.Assessment of the measures

This section assesses each of the three policy measures proposed for accounting non-permanent CCU in the ETS, as outlined in the previous section. These alternatives are considered

¹⁸⁸ Müller, L. J., Kästelhön, A., Bachmann, M., Zimmermann, A., Sternberg, A., & Bardow, A. (2020). A guideline for life cycle assessment of carbon capture and utilization. *Frontiers in Energy Research*, 8, 15. <https://doi.org/10.3389/fenrg.2020.00015>

¹⁸⁹ Cabrera, G., Dickson, A., Nimubona, A.-D., & Quigley, J. (2022). Carbon capture, utilisation and storage: Incentives, effects and policy. *International Journal of Greenhouse Gas Control*, 117, 103756. <https://doi.org/10.1016/j.ijggc.2022.103756>

regarding their economic, social and environmental impacts, drawing on the findings of the scoping exercises and stakeholder feedback.

2.4.1. Quantitative assessment

The modelling foresees that all industrial and power installations pay ETS price, disregarding whether emissions are captured and used for CCU later, that is equivalent to the upstream accounting. The options included in the assessment are:

- (i) The current CCU (CCU0) accounting in EU ETS follows the rule: the EU ETS installation capturing the CO₂ is required to surrender an allowance if the captured carbon is subsequently used to produce RFNBOs or other CCU in non-permanent goods. This is equivalent to the upstream accounting.
- (ii) Midstream accounting (CCU3): The point of accounting/pricing is moved mid-stream. In the context production or distribution of e-fuels, this captures producers/distributors of e-fuels. They will be required to surrender allowances for the fossil CO₂ used in e-fuels.

The scope of CCU analysis in the current assessment is focused on two categories:

- (i) on CCU in non-permanent materials + waste incineration
- (ii) on CCU for synthetic fuels production

The implementation of CCU in non-permanent materials proved challenging due to the limited availability of detailed statistics on the end-of-life treatment of products in Eurostat balances, as well as the scarcity of product-specific data on the potential share of recycled CO₂ content. Furthermore, the analysis was constrained by the lack of national-level data from ETS installations in the waste incineration sector. In agreement with the client, this route was therefore excluded from the assessment.

The EU ETS impact assessment scenarios align with the regulatory requirements for renewable fuels of non-biological origin (RFNBOs) and recycled carbon fuels¹⁹⁰, which determine the eligible sources of carbon feedstock for synthetic fuel production. In line with the Delegated Act¹⁹¹, and Directive (EU) 2018/2001¹⁹², recycled carbon fuels must achieve at least 70% greenhouse gas savings and use fully renewable electricity.

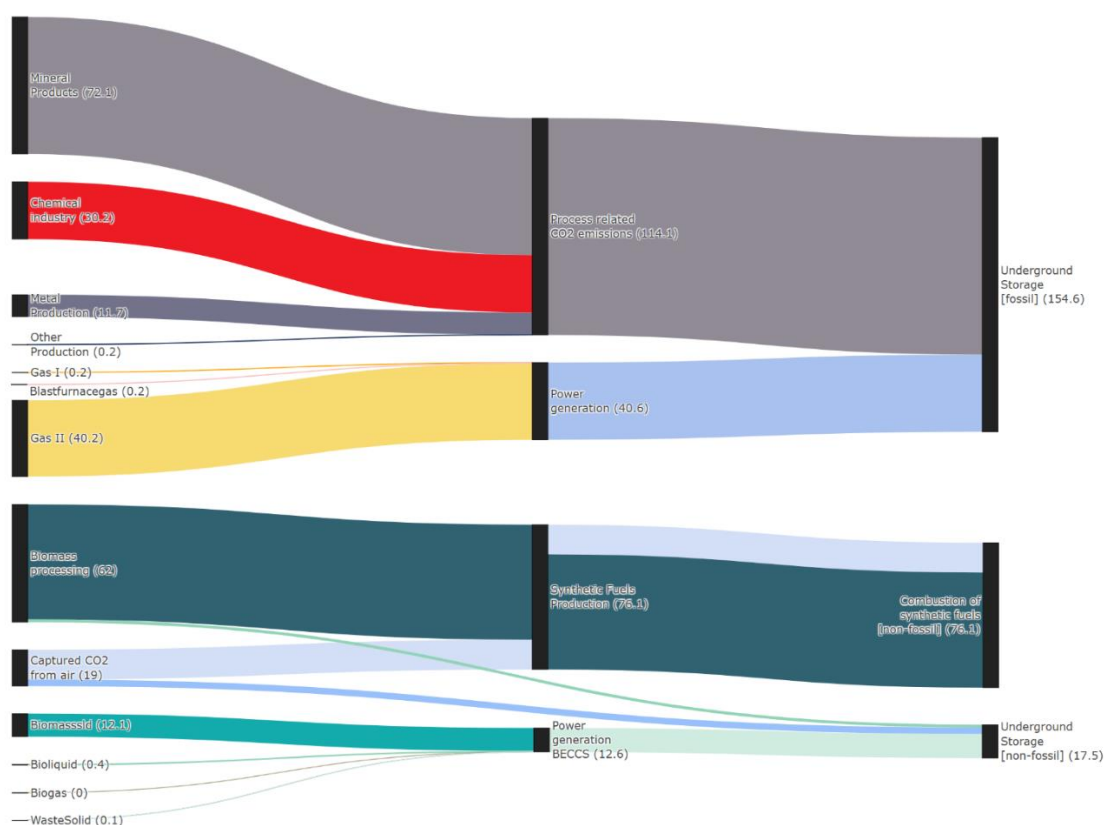
To reflect these provisions, the analysis assumes that CO₂ from electricity generation can be used only until 2035, and CO₂ from industrial processes only until 2040. Over time, the supply of capturable fossil CO₂ is expected to decline, with eligible sources increasingly limited to residual emissions from hard-to-abate sectors. Consequently, the model does not invest in infrastructure for fossil CO₂ use but instead prioritises CO₂ captured from biomass processing, particularly from biofuel production, refer to Figure 12.

¹⁹⁰ The term is used in the Commission Delegated Regulation (EU) 2023/1185 to describe synthetic fuels produced with the fossil captured carbon feedstock.

¹⁹¹ Commission Delegated Regulation (EU) 2023/1185

¹⁹² In RED III Directive (EU) 2023/2413, the Article 27 is revised and requirement to the electricity used production of renewable fuels of non-biological origin are provided in the paragraph 6.

Figure 12: CO₂ flows in PO2 scenario for 2040



Source: PRIMES

Additionally, a recent JRC study¹⁹³ computed the technical feasibility of capturing CO₂ in the EU industrial sectors, suggesting that a total of 210-290 Mtpa are available for capture in the iron and steel, cement and petrochemicals sectors together depending on the capture technology deployed, while in waste-to-energy plants the capturable amount would lie between 60 and 120 Mtpa.

2.4.2. Environmental impacts

The creation of a non-permanent CCU product prevents the immediate release of CO₂ into the atmosphere but results only in a delay of days to years when that emission is eventually released into the atmosphere, compared to permanent storage which stores the CO₂ for hundreds to thousands of years.

The EU ETS is fundamentally an emission accounting system that monitors and reports as accurately as possible the emissions resulting from the activities within its scope, which then leads to a corresponding compliance obligation for the respective ETS regulated entities. Therefore, the accurate accounting of emissions is essential for the EU ETS meeting its objectives.

Non-permanent CCU poses an accounting challenge for the EU ETS, as captured emissions by an ETS installation and used for non-permanent CCU products will eventually be released in the atmosphere at a relatively short period of time somewhere down the value chain. As these

¹⁹³ Bottom-up modelling of CO₂ availability and capture feasibility in EU industrial facilities – JRC145042

delayed emissions are still relevant on climate change timescales, they cannot be treated the same as emissions that are permanently stored and will need to be reported as emitted sooner or later.

Therefore, the effective accounting of emissions is the principal criterion to determine the environmental impacts of recognising non-permanent CCU in the EU ETS. Effective accounting means that emissions should be counted at least once (no undercounting), but also no more than once (no double counting). Effective accounting also ensures accurate pricing of emissions, which is essential for the EU ETS achieving its objectives.

It is important to also note that non-permanent CCU products enables the substitution of fossil carbon in sectors that require a carbon feedstock, supporting the reduction of scope 3 emissions for the chemical industry. However, CCU applications are very energy intensive and they provide LCA GHG emissions reduction only if the energy used for the capture of the CO₂ comes from renewable sources and the utilisation process is done with green H₂. The ETS is feedstock agnostic and does not provide any restrictions on the type of energy used for a particular process, but it requires that all emissions associated with the production process are monitored, reported and surrender the corresponding number of allowances. This ensures that although no specific renewable energy requirements are set, any development of CCU applications will be done within the constraints set by the ETS cap and the carbon price signal, prompting ETS installations to make use of CCU applications only when it results in overall emissions reductions. Some academic stakeholders emphasized the importance of ensuring permanence if surrender obligations are adjusted to accommodate for non-permanent CCU, emphasizing the risk of mitigation deterrence and noting that potential changes to the ETS accounting framework should be carefully weighed against the avoid adverse effects on the environmental integrity of the current ETS¹⁹⁴. Comparatively, business associations and individual businesses emphasized the importance of recognizing the role that non-permanent CCU plays in the EU's climate-neutrality pathway, particularly to address residual emissions.

2.4.2.1. CCU1 – ‘Upstream accounting’:

Upstream accounting provides the highest assurance in terms of integrity of the ETS system, as all captured emissions are considered as emitted unless proven that they are stored permanently. It is virtually guaranteed that all captured emissions resulting from ETS activities would be accounted for at least once, e.g. by the operator of a cement plant with a carbon capture facility, but possibly also by the waste incinerator (if any). Therefore, under the upstream accounting there is **no risk of undercounting of emissions**. This was also corroborated by OPC responses, with one of the main justifications for those supporting upstream accounting being the high environmental integrity by providing for a full coverage of emissions without risk of undercounting.

The upstream accounting is the approach that is currently in force in the EU ETS. It was included to avoid emission leakage out of the ETS when carbon is transferred to non-ETS installations¹⁹⁴, as a significant share of potential downstream emissions would occur outside the scope of the EU ETS. Therefore, without an upstream accounting system, these emissions resulting from ETS activities would bypass the ETS carbon price.

¹⁹⁴ Vermeulen, H., Lockwood, T., & Lawaetz, R. (2025, June). *Pricing it right: Accounting for non-permanent CCU while safeguarding the EU ETS*. CONCITO & Clean Air Task Force. <https://concito.dk/files/media/document/Pricing%20it%20right.pdf>

2.4.2.2. CCU2 and CCU3 – ‘Downstream’ and ‘Hybrid downstream and midstream accounting’

The most frequently cited concern in the OPC responses in relation to moving the surrender obligation downstream, both by proponents and opponents, was the risk of emission leakage associated with this accounting approach, for example in the event that CCU products such as plastics may avoid incineration, assuming that the waste sector is included within the scope of the EU ETS.

Firstly, in order to ensure the integrity of the EU ETS, the downstream and midstream accounting options require the extension of the scope of the ETS Directive to include the CCU value chain from the point of capture to the point of utilisation.

Currently, the scope of the EU ETS includes only the activities of CO₂ capture and CO₂ transport for the purpose of geological storage. Therefore, CO₂ capture and CO₂ transport for CCU purposes would also need to be included in the scope of the ETS Directive.

Furthermore, similarly to the inclusion in the EU ETS of geological storage sites permitted under the CCS Directive, CCU installations would also need to be included in the scope of the ETS Directive. This ensure that CO₂ does not need to be transferred outside the boundaries of EU ETS to be utilised in a product, keeping therefore intact the CO₂ chain of custody from the point of capture until the CCU product is placed on the market. In addition, any emissions associated with the CCU process (energy related or process emissions) will also be covered by the EU ETS, ensuring that any CCU processes are less emission intensive than traditional manufacturing processes.

Secondly, implementing downstream accounting in a manner that provides assurance of the integrity of the EU ETS would require identifying potential gaps or loopholes, specifically cases in which the end-of-life of non-permanent CCU products is met by end-of-life treatments other than municipal waste incineration, such recycling and landfill.

To determine the extent of potential loopholes, an analysis was conducted for a set of potential non-permanent CCU products to assess whether the CO₂ is re-emitted or remains inert when that product meets its end of life via recycling, landfill or incineration and, in case of re-emission, whether that emission would occur within or outside the scope of the EU ETS – see section 2.2.4.

The results of the analysis found that most of the potential CCU products are not likely to lead to any significant loopholes as regards the integrity of the EU ETS. Non-permanent CCU products that are either incinerated via waste incinerators, and the resulting emissions fall within the scope of the EU ETS or the CO₂ embedded in the product remains inert throughout the products waste management process (recycling or landfilling). In addition, CO₂ used to produce e-fuels will also not represent a loophole risk, as their combustion will mostly occur within the scope of the EU ETS, in sectors such as maritime and aviation. Furthermore, e-fuels are subject to specific certification requirements and are easily tracked across the value chain. However, to avoid undercounting of emissions used to produce e-fuels would necessarily mean that it is not possible anymore to zero-rate the emissions from the combustion of these fuels.

However, a small number of potential CCU products present a clear potential risk of loopholes to EU ETS accounting. They include:

- The direct use of CO₂ in applications such as greenhouses, food and drinks or refrigeration.

As the CO₂ is not chemically converted it will immediately be released as a greenhouse gas without the need of special conditions such as high temperature or acidic environments. Furthermore, the use of CO₂ in such applications will happen outside of the scope of the EU ETS and will not be subject its monitoring, reporting and compliance obligations.

- CCU products used as fertilisers (PCC as mineral fertiliser or urea)

As these products are used in agricultural applications and when the embedded CO₂ will eventually be released it will happen outside of the scope of the EU ETS.

There are additional loophole risks in some cases, but they are however not well defined and influenced by many variables:

- CCU products that risk emitting during the recycling

Some products (plasterboards, used oils, some organic chemicals) there may be a risk of loopholes depending on the type of recycling process used and whether that recycling is or not part of the EU ETS. Some forms of recycling may involve sufficiently high temperatures to release the embedded CO₂. However, it is also possible that such processes would be covered anyway by the EU ETS.

- In addition, it is possible that some emissions from the end-of-life treatment of non-permanent that would normally fall within the scope of the EU ETS may nevertheless be emitted outside the scope of the system. This can happen in the following cases:
 - Waste incineration in installations that are excluded from the scope of the EU ETS due to small size and or the specific nature of waste they treated (hazardous, medical, etc)
 - Export of waste for treatment outside of the EEA
 - Illegal dumping of waste
 - Exports of non-permanent CCU products, which would also result in waste to be treated outside of the EEA.

While these are potentially important risks, there are already measures in place that limit the export of waste outside of the EEA or that address the problem illegal dumping. In addition, as novel non-permanent CCU products are not yet produced at any significant volumes, these risks represent only a potential for future loopholes.

Therefore, it will be necessary to provide for a regular assessment of on-going of the risks of loopholes based on the actual scale-up of non-permanent CCU products, as well as the development of environmental and waste management legislation. Based on this assessment it would be possible to exclude specific products that have a high risk of creating loopholes, introduce additional safeguards or requirements, or add correction factors to account for the risk of loopholes.

2.4.3. Economic impacts

2.4.3.1. Conduct of business

The CCUS sector has for the moment a small economic weight, and it is not yet possible to separately identify value chains linked only to CCU. JRC analysis¹⁹⁵ identified 186 key companies worldwide with activity in CCUS, out of which 45 (24%) are European or are active in the field through their European subsidiaries and that overall revenue recorded for the CCUS value chain amounted to only 95 million EUR in 2021.

Despite the limited economic role played by the CCUS sectors, it is important to consider the potential for its development and to role it can play in a low carbon, net-zero economic. Therefore, the economic impacts of the proposed measures are relevant mostly in terms of the incentives it sets for the development of this sector.

2.4.3.1.1. CCU1 – ‘Upstream Accounting’:

As regards CCU1, accounting for emissions upstream places the ETS burden on the emitter/capture operator, meaning they would have to consider as emitted and surrender allowances for any captured emissions, unless stored permanently¹⁹⁶. As a result, this measure will have the following impact on the conduct of businesses:

- It does not incentivise ETS emitters to invest in carbon capture for CCU

Installing carbon capture capacity on existing industrial installations represents a significant investment, both in terms of capital investments and operating costs¹⁹⁷. The JRC estimates that, according to the literature review, the capture costs for hard-to-abate sectors lie between 40-90 EUR per tonne of CO₂, varying based on the concentration and purity of the CO₂. In addition, the JRC’s own capture cost estimate¹⁹⁸ suggests that around 200 Mtpa of CO₂ can be captured at a cost lower than 100 EUR per tonne mostly from cement, waste-to-energy and certain petrochemical facilities.

Under upstream accounting, ETS installations that do carbon capture will be able to reduce their compliance obligations only if the captured emissions are permanently stored (either in geological storage or permanently chemically bound in products), while any CO₂ captured for other use purposes will have to be reported as emitted and thus caused an additional cost. Capture only for geological storage may be not an economical or practical option available to all installations that might benefit from carbon capture to reduce their emissions. This can be due limited number of operational storage sites, lack of proximity to those storage sites or limited CO₂ infrastructure (pipelines or shipping terminals, as truck or rail; transport is possible but for low volumes and higher costs). In fact, a recent JRC study¹⁹⁹ suggests that the chemical and waste-to-energy sectors see their capturable CO₂ amounts decreased the most when

¹⁹⁵ Clean Energy Technology Observatory, *Carbon capture utilisation and storage in the European Union – Status report on technology development, trends, value chains and markets – 2023*, Publications Office of the European Union, 2023, <https://data.europa.eu/doi/10.2760/882666>

¹⁹⁶ Verbist, F., Meus, J., Moncada, J. A., Valkering, P., Delarue, E., & others. (2024). Implications of the EU ETS on the level-playing field between carbon capture storage & utilisation. *International Journal of Greenhouse Gas Control*, 136, Article 104165. <https://doi.org/10.1016/j.ijggc.2024.104165>

¹⁹⁷ Clean Energy Technology Observatory, *Carbon capture utilisation and storage in the European Union – Status report on technology development, trends, value chains and markets – 2024*, Publications Office of the European Union, 2024, <https://data.europa.eu/doi/10.2760/0287566>

¹⁹⁸ Bottom-up modelling of CO₂ availability and capture feasibility in EU industrial facilities – JRC145042

¹⁹⁹ Bottom-up modelling of CO₂ availability and capture feasibility in EU industrial facilities – JRC145042

considering the characteristics of each individual facility, while the iron and steel, cement and refining sectors are more likely to deploy capture. Therefore, upstream accounting limits in practice the economic options available to ETS installations to reduce their capture costs and achieve their emission reduction goals. Investments in carbon capture will be done only when and where economic conditions are in place for sending captured CO₂ to geological storage site, while carbon capture for utilisation is disincentivised.

A 2024 JRC study²⁰⁰ estimated that by 2050, the European CO₂ pipeline network necessary for CCS could reach up to 9 000 km and requires investment of between EUR 9.3 billion and EUR 23.1 billion study. This shows the costs implied by a system of transporting captured CO₂ either to geological storage sites and/or CCU users for the decarbonisation of hard to abate industries requires significant investments in infrastructure to ensure the connection of emitters with relevant solutions without any direct revenues. A system allowing for more localised solutions, including CCU, would reduce these infrastructure costs.

- It increases the cost of CO₂ feedstock and reduces its availability for potential CCU producers

As shown previously, the upstream accounting may reduce the incentives to invest in carbon capture for industrial emissions, except when the captured CO₂ can be permanently stored. This in turn reduces the availability of CO₂ as alternative carbon feedstock for e-fuels or synthetic chemicals. As ETS installations have no incentives to capture CO₂ for CCU, e-fuels or synthetic chemicals producers need to source CO₂ from non-ETS emitters, which limits the available volumes. Furthermore, as any CO₂ captured for non-permanent CCU would still require the payment of the ETS price for the emitter installation, this would further increase cost of this feedstock. Under this scenario, non-permanent CCU actors may rely on cost pass-through, passing the costs of the ETS down the value chain by incorporating the price of an ETS allowance into the carbon feedstocks they would sell to non-permanent CCU application developers. However, the combination of low volumes and high price for a key feedstock for non-permanent CCU products will make them uncompetitive.

The upstream accounting is beneficial for the e-fuel market, because it enables the zero rating of the emissions from the combustion of e-fuels and considering them as sustainable fuels. For producers, this allows them to sell the e-fuels at a premium and, for consumers, it allows them to use e-fuels to reduce their emissions. One fifth of respondents in the open public consultation, who expressed support for upstream accounting did so specifically for CCU fuels as, in their view, this would help to ensure regulatory stability with the current framework that also follows an upstream approach to accounting (i.e. to align with EU ETS and RED rules and remain coherent with the RED RFNBO Delegated Act).

However, despite the advantages for the e-fuel market of the upstream accounting, due to the lack of investment in carbon capture, e-fuel producers have difficulties in sourcing sufficient CO₂ feedstock for their operations.

- It leads to reduced supply of captured CO₂ to replace virgin fossil carbon in non-permanent CCU products, if capturing for permanent geological storage (CCS) is the only option for emitters.

Under the upstream accounting, capturing emissions for non-permanent CCU applications does not change the compliance obligations of ETS installations. As in the long-term the emission

²⁰⁰ JRC, Shaping the future CO₂ transport network for Europe, Shaping the future CO₂ transport network for Europe

space for ETS covered sectors will be limited only to the hardest to abate emissions. Therefore, installations will seek to permanently store their hard to abate emissions and, if that is not possible, will not invest in carbon capture at all and therefore discourage the development of non-permanent CCU applications.^{201, 202, 203}

This view is supported by a wide range of stakeholders in the OPC across companies and business associations and academia, who considered that CCU and CCS are treated unequally under the EU ETS as currently there is a well-developed accounting framework in place for CCS, including for its transport and for liability for the risk associated with storage.

- It leads to a lack of level playing field between non-permanent CCU products and the traditional virgin carbon equivalent products

Under the current EU ETS rules, the activities of bulk organic chemicals production or refining of fuels covers only the emissions from the combustion of fuels and the process emissions, i.e. scope 1, direct emissions. However, scope 3 emissions represent 60-80% of the overall LCA emissions of the chemical sector and the majority of which is represented by the eventual emission of the embedded carbon in their products²⁰⁴, is not considered as an ETS emission and it is not priced. To the contrary, under the upstream accounting, the embedded carbon in a non-permanent CCU product would be priced.

As a result, the upstream accounting would make non-permanent CCU products uncompetitive with their virgin fossil carbon equivalent. Non-permanent CCU applications may still be developed with an upstream accounting approach if commodity prices are high enough to cover the ETS allowance cost for capture operators or if non-permanent CCU products are sufficiently subsidised or supported through other means.

The combination of scarce and expensive feedstock and a level playing will make very difficult to create a business case for non-permanent CCU products.

Even with high levels of public support, this may result in the needed investments in CCU applications not materialising. It enables e-fuels producers to meet the certification requirements for sustainable e-fuels and allows e-fuels user to zero-rate those emissions

It is important to note that in the case of production of e-fuels, upstream accounting is currently necessary for to be able to certify these e-fuels as meeting the 70% GHG emissions savings required under the Renewable Energy Directive (for RFNBOs) and the Gas Directive (for LCFs). Therefore, without any adjustments in the respective regulatory framework, upstream accounting provides e-fuel producers a clear way of meeting the conditions necessary for the certification of e-fuels.

²⁰¹ CO₂ Value Europe. (2025, June). *CO₂ Value Europe position: The 2026 ETS revision must advantage CCU over fossil feedstocks*. https://co2value.eu/wp-content/uploads/2025/06/CO2-Value-Europe-position-on-EU-2026-ETS-revision_June-2025.pdf

²⁰² Vermeulen, H., Lockwood, T., & Lawaetz, R. (2025, June). *Pricing it right: Accounting for non-permanent CCU while safeguarding the EU ETS*. CONCITO & Clean Air Task Force. <https://concito.dk/files/media/document/Pricing%20it%20right.pdf>

²⁰³ Verbist, F., Meus, J., Moncada, J. A., Valkerig, P., & Delarue, E. (2024). Implications of the EU ETS1 on the level-playing field between carbon capture storage & utilisation. *International Journal of Greenhouse Gas Control*, 136, Article 104165. <https://doi.org/10.1016/j.ijggc.2024.104165>

²⁰⁴ Christopher vom Berg, Michael Carus, Making a case for Carbon Capture and Utilisation (CCU), <https://doi.org/10.52548/VYKR3129>

However, the upstream accounting allows the users of e-fuels to consider that their generation results in no emissions (or zero-rated emissions), which enables sectors like aviation or maritime transport to rely on such e-fuels for the decarbonisation of their activities.

- Double counting of emissions downstream

Upstream accounting of emissions has the potential to double count emissions when a CCU product is combusted. Emissions that have been priced upstream can be zero rated downstream, but this is only possible when it can be proven that a particular source of emissions has already been priced. This is possible for e-fuels, which are subject to a specific certification and tracking regime. Double counting occurs for CCU products end up incinerated in the general waste stream that is subject to carbon pricing. This concerns PCC used in paper, certain plastics and soda ash. This double counting of emissions increases the overall cost for businesses and reduces economic efficiency for these non-permanent CCU products.

Considering the 14 unique Eurostat waste categories, data shows that around 5% of the overall annual waste reported in 2022 went directly to incineration and energy recovery, 9% to landfill, and the remaining 86% to recycling. However, this Eurostat data represents waste treatment in the first instance of the products end-of-life and does not consider the lifecycle and associated timeline of products that may be recycled multiple times and eventually incinerated, nor does it relate to whether non-permanent CCU products are inert or re-emit under recycling or landfill. Furthermore, if most of the non-permanent CCU products considered in this analysis are recycled, materials cannot be endlessly recycled, and they will eventually sufficiently degrade that they would have to be either incinerated or landfilled. If eventually incinerated, the materials initially sent for recycling can still pose a risk of double-counting.

By volume recycled, paper and cardboard wastes, plastic wastes, and mineral waste from construction and demolition, are the top three recycled Eurostat product groupings. For plastics, most recycled plastics are recycled once or twice before final disposal²⁰⁵, and as noted in this assessment, the average landfill and incineration rates for plastic wastes in Europe was ~40% and ~60% respectively. For mineral waste, the largest category by volume of waste treated, most waste is landfilled, with an average landfill rate of 91%, and incineration is not generally relevant. For paper and cardboard wastes (the second-most voluminous category), Eurostat data suggests that beyond recycling, the next most popular form of waste treatment is incineration in energy recovery. Research suggests that most paper can be recycled approximately 5-7 times before final disposal²⁰⁶. Across all non-permanent CCU products considered, an average incineration rate of only 21.4% is observed.²⁰⁷

The theoretical magnitude of potential double counting is determined by the likelihood of CCU products replacing traditional one. PCC represents one of the few existing CCU applications and is replacing natural carbonates in applications, such as fillers for paper production. Another

²⁰⁵ Ritchie, H. (2018, September). *FAQs on plastics*. Our World in Data. <https://ourworldindata.org/faq-on-plastics>

²⁰⁶ Obradovic, D., & Mishra, L. N. (2020). Mechanical properties of recycled paper and cardboard. *Journal of Engineering and Exact Sciences (JCEC)*, 6(3), 429–434. https://www.researchgate.net/publication/346288278_Mechanical_Properties_Of_Recycled_Paper_And_Cardboard/fulltext/63cad96b6fe15d6a57343d2d/Mechanical-Properties-Of-Recycled-Paper-And-Cardboard.pdf

²⁰⁷ Eurostat. (2025). *Treatment of waste by waste category, hazardousness and waste management operations (ENV_WASTRT)* Data set. European Commission. https://ec.europa.eu/eurostat/web/products-datasets/-/env_wastrt

potential CCU product category that may lead to double counting is that of polymers or plastics, replacing fossil-based virgin plastics.

Currently, the actual risk of double counting is minimal, mostly limited to quantities of PCC used as filler in paper and other products that end up eventually incinerated. However, as carbon capture and CCU applications will play an increasingly important role in decarbonising (and de-fossilising) hard to abate sectors, this risk is expected to grow and become significant with time. The theoretical potential for double counting of emissions, even when looking only at these two CCU products, can be as much as all the emissions from the incineration of more than half of the share of plastics and from all the volume of paper being disposed.

The primary method of avoiding double counting of emissions that have already been accounted upstream is to zero-rate the emissions from CCU products. This is already the established practice for emissions from biomass (as biomass emissions are accounted in the land sector) and from e-fuels, if they are certified to meet minimum sustainability requirements. However, the zero-rating of biofuels and e-fuels is enabled by a certification system that can identify and trace along the value chain fuels with specific characteristics.

Such a system would be difficult to apply to the zero-rating of CCU products in the waste stream sent for incineration. Furthermore, it is not possible to distinguish between virgin fossil carbon and captured and recycled fossil carbon, unlike biogenic emissions that can be distinguished from fossil-based carbon via isotope analysis at the point of combustion. Thus, it is technically unfeasible to avoid double counting by measurement at the point of incineration. Therefore, avoiding the double counting of emissions under the upstream accounting, would require determining the proportion of captured carbon eventually entering an ETS-regulated MWI would require a tracking or mass balance recycling of CCU based products based on a certification process from the upstream creation of the non-permanent CCU product through its end-of-life pathway or the trading of GoOs representing quantities of CCU products. However, as shown previously, such systems would be administratively complex and costly to implement.

Furthermore, while the LCA effects of using CCU products are not assessed here, it is important to also highlight upstream accounting also disincentivizes projects that can use captured CO₂ as an alternative feedstock, perpetuating the use of virgin fossil fuels and chemicals.

As a result, in the upstream accounting a risk of double counting of emissions will negatively affect business conduct by increasing the compliance obligations of businesses.

2.4.3.1.2. CCU2 and CCU3 – ‘Downstream -’ and ‘Hybrid Downstream and midstream accounting’

As regards CCU2, the accounting of emissions moves the burden of the reporting and paying for the captured emissions downstream, at the end of life of the product. This can be either where the product is consumed (in the case of fuels) or where the product is disposed of (e.g. waste incineration). This measure assumes that this downstream activity falls within the scope of the EU ETS. This measure will have the following impact on the conduct of businesses:

- It improves the business case and incentivises ETS emitters to invest in carbon capture based on the demand for fossil-replacement carbon feedstocks for CCU

The downstream accounting provides ETS emitters with more options for reducing their compliance obligations by having the possibility of choosing between capturing emissions for storage or for utilisation (or for both), and optimising their strategy based on their individual

circumstances. As the availability of and access to geological storage sites is limited, CCS may not be economically viable for some installations, or even unfeasible. As shown previously, in a CCS only scenario, the required CO₂ transport infrastructure would need investments of up to 23 billion EUR by 2050. Incentivising CCU allows to reduce these investment costs, as CCU producers can be located in the proximity of emitters and would not require the transport of CO₂ over large distances

The capture for non-permanent CCU products allows ETS emitters to both reduce their ETS costs and sell the captured CO₂ as a feedstock to other installations, therefore making a costly waste product into a business opportunity.

- It incentivises the production of non-permanent CCU products by improving the availability of CO₂ feedstock

By incentivising the capture and use of emissions, the downstream accounting increases the availability and may over time reduce the cost of CO₂ as a feedstock to be used for non-permanent CCU products. More investments in carbon capture and the capturing of higher CO₂ volumes will reduce the cost of the CO₂ feedstock due to economies of scale, better utilisation of capital and competition between the different capture installations. It therefore supports the production of synthetic fuels or chemicals, as CCU producers are able to secure sufficient CO₂ feedstock to make their business viable.

- It levels the playing field between CCU products and traditional fossil products.

The downstream accounting approach ensures that non-permanent CCU products are treated the same way as their fossil fuel equivalent in terms of emissions accounting, where loopholes are avoided. Only the combustion and process emissions from their production are reported and priced in the ETS for both type of products, while the emissions embedded in the product will be reported and paid for downstream when those emissions are realised, i.e. at the point of incineration.

It is important to note that to ensure this level playing field, the activity “production of synthetic fuels and chemicals” would need to be specifically covered by the EU ETS, which is currently not the case.

The most frequently cited reason in the OPC for supporting downstream accounting options was to provide a clear incentive for CCU based carbon over virgin fossil-based carbon. By moving the surrender obligation downstream to the final emitter rather than upstream with the capture installation, CCU use can be incentivised as there is an incentive to transfer CO₂ downstream as they would no longer need to surrender allowances for such non-permanent storage and re-use.

- It avoids the double counting of emissions

Downstream accounting addresses the risk of double counting that results from the upstream accounting system if waste incineration is part of the EU ETS scope. If the capture operator is not required to surrender allowances for any CO₂ captured, the final emitter, which can be the user of synthetic fuels or the waste incinerator that incinerates non-permanent CCU products, would have to surrender allowances for these emissions.

This was also one of the most frequently cited justifications for respondents to the OPC supporting downstream accounting. However, with the downstream accounting there is the risk of loopholes in the accounting system in case the downstream emission occurs outside of the scope of the EU ETS and therefore it is not priced, undermining the integrity of the EU ETS.

Respondents provided further justification for downstream accounting contributing to the avoidance of double counting, with 34 responses highlighting that the avoidance of double-counting is a key advantage of such an accounting approach. Respondents often explained that by moving the surrender obligation downstream, double counting of CO₂ emissions from further up the value chain would be avoided. This category also captures the further benefit of the downstream approach (i.e. aligning with the principle of single carbon pricing) that was frequently expressed by the respondents regarding the provision of better incentives for the use of CCU as a result of moving the surrender obligation downstream. Given that the capture installation avoids the cost of surrendering allowances under this downstream accounting approach, it can offer captured CO₂ at lower prices to producers of carbon-based products further downstream.

- It creates potential loopholes where emissions are not accounted for and paid for

As shown in the section on the environmental impacts, downstream accounting can create loopholes resulting in emissions within the scope of the EU ETS being under-reported and therefore avoiding the associated carbon price. Although, this represents primarily a potential negative environmental impact (see section 2.3.4.2), it does reduce the compliance costs for individual operators that capture their emissions as they would have to surrender less emission allowances compared to the upstream accounting under CCU1.

- ‘Downstream accounting’ weakens the business case for e-fuels and, if no adjustments in the regulatory frameworks, creates challenges in the certification of sustainable e-fuels

Downstream accounting presents a weaker business case to produce CCU fuels, as downstream accounting means that the fuel user would be required to report and price the resulting combustion emissions. In this case, there would be no incentive for fuel user to purchase and use e-fuels, which are still significantly more expensive than fossil fuels.

Furthermore, the current regulatory framework under the RED and the Gas Directive require upstream accounting for the CO₂ used to make CCU fuels. Without any regulatory adjustments, the downstream accounting approach will make it impossible to meet the required 70% GHG emissions savings for the fuels to qualify as sustainable renewable or low carbon fuels.

Correspondingly, the need for a differentiation of accounting approaches was often advocated among respondents to the OPC, making a key distinction between CCU fuels and CCU materials. One fifth of respondents who expressed support for upstream accounting did so specifically for CCU fuels as, in their view, this would help to ensure regulatory stability with the current framework that also follows an upstream approach to accounting (i.e. to align with EU ETS and RED rules and remain coherent with the RED RFNBO Delegated Act).

- It increases the compliance obligations for downstream installations, such as waste incinerators and e-fuel users

As mentioned in the previous paragraphs, under the downstream accounting fuel users would have to report and pay for the emissions resulting from the use of e-fuels the same way they would for traditional fossil fuels. Given the cost differential between the different fuels, this would disincentivize fuel users in using e-fuels and continue the use of fossil fuels. While this will not in itself increase the compliance obligations of fuel users, it will reduce their available decarbonisation options, especially for sectors that cannot be (easily) electrified, such as aviation and maritime.

Unlike fuels users, which may have a choice between which fuel type to use, waste incinerators are required to process any unrecyclable waste that is sent to them for treatment. Therefore, the

downstream accounting may increase the compliance obligation of waste incinerators if included in the EU ETS, as they would be paying for emissions that originate from other ETS installations that were then captured and embedded in CCU products. This concern was also specifically expressed by respondents from the waste sector in the OPC, outlining that as they are not responsible to produce the non-recyclable waste, they would have no control over their obligation to surrender allowances. However, this would be no different from the compliance obligation resulting from the combustion of virgin fossil waste. It can be assumed that non-permanent CCU products will replace at least to some degree virgin fossil equivalent products and therefore the net effect in terms of increased compliance obligations for waste incinerators will be limited.

However, waste incinerators are now in addition to the downstream point of accounting potentially also upstream capturers of emissions if they install carbon capture. As an ETS installation with high emissions and limited abatement possibilities, waste incinerators would benefit from the same incentives as all other ETS emitters to capture their emissions and send the CO₂ either for geological storage or for CCU. This would incentivise the closing of the emissions loop, which gradually can support the demand for carbon feedstock in the economy without the use of virgin fossil fuels.

The measure CCU3 seeks to maintain the advantages identified for the downstream approach and address the challenges it creates for the e-fuel business case. Therefore, the measure retains the downstream accounting for all non-permanent CCU products other than e-fuels, for a midstream accounting would apply. Therefore, most impacts identified previously are the same and are not repeated.

Midstream accounting for e-fuels means that the accounting and pricing of emissions that are captured for e-fuels will be done by the producer or distributor of e-fuels (instead of the capturer or the user). Midstream accounting by the producer effectively covers only domestic EU production of e-fuels and additional regulations or restrictions would be required for imported e-fuels. Midstream accounting by the distributor would cover e-fuels that are either domestically produced or imported. The obligation for accounting for fossil CO₂ embedded in e-fuels would be therefore for the entity placing the e-fuels on the market, similar to how fuels are regulated in ETS2. Therefore, the hybrid downstream and midstream accounting would have the following impact on businesses:

- It provides the most flexibility to all actors in the CCUS chain to optimise their business strategy

The hybrid downstream and midstream accounting would incentivise the capture of CO₂ and provide flexibility for operators to decide whether the CO₂ should be stored or utilised in different types of products or applications depending on their particular circumstances (location, access to CO₂ infrastructure and storage, access to green H₂, etc.) and the comparative costs and benefits between storing emissions, or producing different synthetic chemicals, plastics or e-fuels.

For e-fuel producers this option gives more clarity on the costs and trade-offs available for sourcing different CO₂ feedstock for their production process. Fossil CO₂ may be more available and cheaper to capture, but it requires the surrendering of emissions of allowances, while biogenic or atmospheric CO₂ may be more expensive to source, but do not require an ETS payment. If the midstream accounting obligation is set for the distributor of e-fuels, the e-fuel producer does not pay directly the ETS price, reducing their production costs. The distributor will be able to balance sourcing e-fuels with cheaper production costs, from fossil CO₂ which require the surrender of emission allowances for the embedded fossil CO₂, with

sourcing e-fuels with higher production costs with CO₂ from biogenic or atmospheric sources that would not lead to an ETS compliance obligation. It enables e-fuels producers to meet the certification requirements for sustainable e-fuels and allows e-fuels user to zero-rate those emissions

The midstream approach places a compliance obligation on e-fuels producers or distributors, as they would need to pay the carbon price for any fossil CO₂ embedded in e-fuels, either at the point of product or at the point of distribution. While in theory this increases their costs, the costs would not be higher compared to the upstream accounting, under which the capturer would have passed through any compliance costs it was bearing. To the contrary, the costs for e-fuel producers could be lower in the midstream approach, as they benefit from the increased investments in capture and improved availability of CO₂ feedstock due to the incentives for capture and non-permanent use under this measure.

The midstream accounting can be considered to meet the same requirements for effective carbon pricing under the RED and Gas Directive rules and will enable e-fuel producers to meet the 70% GHG emissions savings obligation required to certify the produced e-fuels as sustainable renewable or low carbon fuels. Furthermore, as accounting of emissions is done at the level of the producer or distributor of e-fuels, the users can consider these e-fuels as generating zero emissions and are therefore incentivised to use them to reduce their emissions.

2.4.3.1.3. SMEs

While carbon capture requires expensive investments that make sense only for large installations, many technology providers in the field of CCU that look to commercialize recently developed technology are small, start-up businesses. Therefore, measures CCU2 and CCU3 seek to level the playing field for these new entrants to allow new CCU products to compete with CCS.

Furthermore, these measures have been designed to be implementable based on the established MRVA system that can ensure the accounting integrity of the EU ETS, while not imposing excessive administrative burdens on operators. For this reason, the measure based on LCA accounting has been discarded as overly complex and costly to implement.

Stakeholders consulted as a part of the OPC questionnaire emphasize the importance of ‘administrative proportionality’ for non-permanent CCU policy measures. Especially amongst business associations, emphasis was placed on implementing an accounting approach that prioritizes simplicity and continuity for SMEs to effectively implement non-permanent CCU measures.

2.4.3.2. Administrative costs on business

In interviews, stakeholders highlighted that there are currently no tailored MRV methodologies for non-permanent CCU, hindering project developers from demonstrating emissions reductions or accessing support mechanisms such as the Innovation Fund. This in turn creates uncertainty for developers in the long-term. To unlock CCU's potential, stakeholders identified that ETS rules must be updated to recognize non-permanent CCU applications that lead to verifiable fossil carbon replacement or climate benefits, regardless of permanent storage. Uniform EU MRV methodologies for non-permanent CCU across its lifecycle (fuels, plastics, chemicals, fertilizers, construction materials) are needed. They also identified the importance of equal access to financing instruments (Innovation Fund, CCfDs) that reflects non-permanent CCU's climate value and resource efficiency. An overview of the impact of the specific administrative obligations under each of the respective policy measures is detailed below.

2.4.3.2.1. CCU1 – ‘Upstream accounting’

From an administrative perspective, for emitters the upstream accounting approach would represent the continuation of the system currently in place. The capture of emissions for any non-permanent CCU would need to be reported as emitted. From that point onwards the captured CO₂ does not require any further monitoring or reporting obligations from the ETS point of view. In fact, CO₂ transport for CCU and CCU activities are currently outside of the scope of the EU ETS and would continue to be so under this measure. However, in case an installation will capture some CO₂ for permanent storage and some for non-permanent CCU, this will imply additional monitoring and reporting costs, as the different destinations for the CO₂ receive different regulatory treatment and therefore, they need to be reported separately. The most frequently cited reason for OPC respondents supporting upstream accounting for non-permanent CCU technologies in the ETS, was its administrative simplicity as compared to more complex tracing methodologies. However, incorporating waste incineration into the scope of the EU ETS along with upstream accounting will lead to the double counting of emission (see section 2.4.2. on environmental impacts). In order to avoid or mitigate the risk of double counting, which means also double pricing of the emissions, complex monitoring and certification solutions would be required.^{208, 209}

Therefore, avoiding double counting would require either a full value chain coverage by the EU ETS to enable the tracking of the ‘chain of custody’ of CCU products (in practice not feasible due to the design constraints of the ETS) or alternative systems, such as a Guarantees of Origin (GoOs) system for CCU products that could be used by waste incinerators for a share of their compliance obligations, or a conservative carbon correction factor that would downrate the emissions of waste incinerators based on the estimated non-permanent CCU products placed on the market likely to end up in waste incineration. Regardless of the tracking or certification put in place, it would create higher transaction and administrative costs across the system, as it would require detailed information on the proportion of captured carbon utilized in a product and estimates how these products are used and discarded. Several energy intensive industry stakeholders articulated that this additional administrative burden and cost would have the effect of reducing captured CO₂ use by EU ETS covered entities.

2.4.3.2.2. CCU2 and CCU3 – ‘Downstream -’ and ‘Hybrid Downstream and midstream accounting’

In terms of administrative costs, the downstream accounting will result in a simplification in the current rules applicable for the reporting of emissions in case of the capture of CO₂. Emitters that capture CO₂ will be able to report it as captured (and deduct it from their overall emissions) the amount of CO₂ that has been captured and transferred to another ETS installation, regardless of the purpose, be it for CCS, permanent CCU or non-permanent CCU. This contrasts with the current situation where CO₂ captured for different purposes has different regulatory treatments.

²⁰⁸ Technopolis (2024, July). Issues and Options for EU Emissions Trading after 2030, Final Task 2 Report – Analysis of issues, policy topics and policy options for the 2030-2040 timeframe (Report No. CLIMA/2022/OP/0012). European Commission, Directorate-General for Climate Action.
<https://www.technopolis-group.com/report/issues-and-options-for-eu-emissions-trading-after-2030/>

²⁰⁹ Vermeulen, H., Lockwood, T., & Lawaetz, R. (2025, June). *Pricing it right: Accounting for non-permanent CCU while safeguarding the EU ETS*. CONCITO & Clean Air Task Force.
<https://concito.dk/files/media/document/Pricing%20it%20right.pdf>

It is important to note that to achieve these benefits, in addition to the downstream accounting of non-permanent CCU products, it will also be necessary to extend the scope of the ETS by generalising the scope of the CO₂ capture and CO₂ transport activities, as they are currently limited only to the capture and transport of CO₂ for geological storage. The ETS MRVA system for the CCS value chain relies on the physical transfer of CO₂ from one regulated entity to another, which results also in the transfer of the liability for that CO₂, i.e. the requirement to monitor, report and surrender allowances for any emissions associated with that CO₂. To ensure the level playing field for CCU and CCS applications, it will be necessary to include in the scope of the ETS the entire CCUS value chain, including the CCU activity itself (but excluding anything from the point of putting the product on the market and up to the end-of-life treatment).

On one hand, this extension of scope will create some new administrative costs for CCU installations due to the ETS requirements (GHG permit, monitoring plan, etc). However, these costs would not be any different than the costs imposed by any certification scheme, if required to prove for their products' particular environmental claims. On the other hand, this allows CCU installations to fully participate in the ETS CO₂ value chain, i.e. their reception of CO₂ allows the transferring ETS installations to deduct that CO₂ from their reported emissions, which would not be possible without their inclusion in the ETS. Furthermore, as regards CO₂ transport infrastructure, their monitoring and reporting obligations will be simplified, as they would not need to keep track separately of CO₂ transported for different purposes.

As noted in the previous section, the downstream accounting relies on the integration of waste incineration in the EU ETS. However, once included in the EU ETS, there is no difference between the administrative costs for waste incinerators in the upstream accounting (CCU1) or downstream accounting scenario. Waste incinerators would continue to monitor and report emissions in the same manner, and therefore administrative costs would be the same for them under downstream accounting (CCU2 or CCU3).

The hybrid midstream accounting for e-fuel producers or distributors will rely on ensuring that midstream point on the value chain is part of the EU ETS. This will require an extension of the ETS scope to include e-fuel producers or distributors, which will result in some additional administrative burden (requirement for a GHG permit and monitoring plan). However, many fuel distributors are already part of ETS 2 starting as of 2027 and e-fuel producers must comply with a demanding certification process and the RED or Gas Directive. Therefore, if ensuring that regulatory requirements resulting from the midstream accounting measure are streamlined and take due accounting of the obligations already in place for these economic operators, the resulting administrative burden will be marginal.

The administrative impact of dealing with any potential loopholes will depend on the formulation of the measures taken to mitigate the risk of loopholes. Relying on complex value chain assessment and the verification of individual claims of companies will be similar to undergoing an LCA approach and, as shown in the section on discarded measures, would impose significant administrative costs. However, if the measures to mitigate costs is done on the basis of the existent ETS MRVA systems the costs, if any, would be minimal. This can take the form of an ex-ante assessment or the determination of a positive list of products considered not to lead to loophole risks (or negative list of products considered to do so), meaning that producers only need to demonstrate that their process results in a listed product, which is easily checked by verifiers. Alternatively, correction factors in the surrender obligation could be introduced, if an assessment determines that a given percentage of emissions is not accounted in the EU ETS, but the loopholes cannot be attributed to specific products. Such a correction factor could be applied universally when determining the amount surrender obligation of

companies undertaking the CCU and, while it would increase the compliance costs of companies, it would not result in any additional administrative burden.

2.4.4. Social impacts

2.4.4.1. Employment

Integrating non-permanent CCU into the EU ETS can influence employment through creating new incentives for more CCU companies to enter the EU market. Policy measures that provide predictable, streamlined, and equal treatment of non-permanent CCU products compared to CCS, such as downstream accounting (CCU1) are more likely to enable near-term investment and job creation in the CCU industry. Additionally, adding flexibility to compliance obligations through policy measures such as mid-stream accounting (CCU3) can support EU ETS covered entities to streamline ETS compliance costs, enabling companies to direct these revenues to maintaining employment levels. Absent such support for CCU, weaker demand for non-permanent CCU products may delay investment decisions and moderate job growth in the CCU industry.

A further quantitative assessment of the impact of employment is undertaken at the policy option level.

2.4.4.2. Fundamental rights

Fundamental rights afford basic legal protection for political, social, and procedural rights to individuals and legal entities. The Charter of Fundamental Rights of the European Union²¹⁰ (the Charter) is an instrument of primary EU law that enshrines the fundamental rights people enjoy in the EU. All measures were assessed having regard to the relevant EU instrument and it was concluded that they maintain full respect for human and fundamental rights, and none will have any negative impact in this regard.

The measures will have a positive impact on Article 37, which states the following with regards to environmental protection

“A high level of environmental protection and the improvement of the quality of the environment must be integrated into the policies of the Union and ensured in accordance with the principle of sustainable development”.

All the measures assessed under the non-permanent CCU thematic area adhere to Article 37 as they aim to enhance the carbon price signal by considering how to fully address the unique characteristics of non-permanent CCU products, such as carbon sources and storage durations. Adjustments to the EU ETS directive are needed to ensure the level playing field for CCU technologies while ensuring that emissions are effectively accounted for and priced. The policy measures outlined in section 2.3. will consider how to incorporate non-permanent CCU into the EU ETS, resulting in a stronger price signal and more effective environmental protection.

2.4.5. Summary

A summary comparison of the measures is provided in the table below. Measures are rated as compared to the baseline of no non-permanent CCU accounting mechanism.

²¹⁰ European Parliament, Council of the European Union, & European Commission. (2000). *Charter of Fundamental Rights of the European Union*. https://www.europarl.europa.eu/charter/pdf/text_en.pdf

Table 8: Comparison of non-permanent CCU policy measures

Criterion	CCU1 ('Upstream accounting)	CCU2 ('Downstream accounting)	CCU3 ('Midstream accounting)
Economic / Conduct of business	-/+ Places non-permanent CCU applications that use recycled CO ₂ at a competitive disadvantage with the traditional fossil based equivalent products.	-/+ Incentivises capture of CO ₂ and provides the flexibility for operators to decide whether CO ₂ should be stored or utilised in different applications. Shifts the burden of accounting and pricing to the final emitter, disincentivized production of producing CO ₂ feedstocks for e-fuels fuels, a key non-permanent CCU application.	+ /++ Incentivises capture and use of CO ₂ and provides the flexibility for operators to decide whether CO ₂ should be stored or utilised in different applications, including both e-fuels and chemicals.
Economic / Conduct of business Double counting	- With integration of MWI emissions can be double counted, accounted for and priced both upstream at capture and downstream at MWI.	+ Lowers risk of double counting, as emissions accounted for at final emitter stage Does not offer an accounting approach that aligns with e-fuels produced from CO ₂	+ Lowers risk of double counting, as emissions accounted for at final emitter stage Combination of zero rating of e-fuels and downstream accounting allows for accounting approach conducive with all non-permanent CCU products
Economic / Administrative costs on business	-/+ Most straight forward accounting approach. Requires additional mechanisms to account for double pricing and leakage from the EU ETS system.	-/+ If waste incineration is integrated into the EU ETS, downstream accounting has limited additional administrative burdens. Requires additional mechanism to identify and providing systems to avoid loopholes.	-/+ Maintains limited additional administrative burden of downstream accounting. Fuel supplier or distributor may face increased costs to meet compliance demands but could be offset by discounted CO ₂ purchase costs.
Environmental / Climate Undercounting	++ Creates certainty that all non-permanent CCU emissions would effectively be accounted for by the EU ETS.	+ Some risk for non-permanent CCU products whose end-of-life treatment is not met by waste incineration to create loopholes.	+ Some risk for non-permanent CCU products whose end-of-life treatment is not met by waste incineration to create loopholes.

2.5. Conclusions

The three measures outlined in Section 2.3 represent different accounting options that seek to adapt the ETS framework to the specificities of non-permanent CCU products. They all present advantages and disadvantages and choosing a preferred accounting model represents a balancing act between the different trade-offs.

As shown previously, upstream accounting (CCU1) provides the highest integrity and assurance that all emissions resulting from ETS activities are accounted and priced.

However, in the case of integration of waste incineration in the EU ETS, upstream leads to double counted emissions, in particular for CCU plastics. Furthermore, upstream accounting rewards only the capture of emissions for geological storage. As the capturing of CO₂ by ETS emitters for CCU application is currently much less likely than from zero-rated emitters, upstream accounting effectively restricts the development of alternative technologies that make use of the capture carbon instead of virgin fossil carbon. Both factors restrict the efficiency and effectiveness of the EU ETS in achieving its objectives.

The hybrid downstream and midstream accounting (CCU3) effectively addresses the issues outlined in the previous paragraphs and it enables investments in carbon capture and non-permanent use. This in turn contributes to reduction in costs of CO₂ feedstock and helps the business case for CCU products. It is important to recall that numerous sectors and services rely on carbon, so they cannot be “decarbonised”. The use of captured CO₂ as a feedstock can provide a source of carbon for producing fuels, chemical and materials and ensure that these sectors can eventually be de-fossilised. As noted previously, the transition to alternative source of carbon is therefore, an important part of reaching the EU’s climate targets.

The combination of the downstream and midstream accounting encompassed in measure CCU3 also best addresses the specificities of e-fuels, as one particular type of CCU products with an existing regulatory framework already in place, and of other potential CCU products, such as synthetic chemicals or plastics.

The measures CCU2 and CCU3 provide important benefits, in particular as regards the incentivisation of carbon capture, ensuring the level playing field for novel and traditional products and providing flexibility to operators on what to do with captured CO₂. However, the trade-off of moving away from the upstream accounting of emissions is that it creates the risk for undercounting of emissions in cases when emissions captured and embedded in CCU products are released in activities outside the scope of the EU ETS.

In case of such loopholes associated with clearly identifiable CCU products or applications, the risk can be best addressed by applying the upstream accounting as a derogation to a general rule or setting additional requirements or limitations to the use of such products in order to minimise the risks. Nevertheless, addressing all possible loopholes risks is not feasible in practice without severely restricting the use of non-permanent CCU applications, limiting therefore their development. Given the low volumes of CCU products currently being produced, these risks are only hypothetical at this stage. Therefore, it is preferable to adopt an approach that regularly assesses the effective risk posed by non-permanent CCU to the integrity of the ETS and introduces corrective mechanisms if and when such risks start having a material impact.

ANNEX 14: LINKING

Article 25 ETS Directive encourages the conclusion of linking agreements with third countries, in particular those with compatible mandatory greenhouse gas emissions trading systems and with absolute emission caps.

Article 30 (6) tasks the European Commission to analyse how linking the EU ETS to other systems can be established “without impeding the achievement of the climate-neutrality objective and the Union climate targets.” To carry out this analysis, the Commission has commissioned an analysis and will publish a report. This annex summarises the findings of the forthcoming report and draws conclusions relevant for the present review of the ETS.

1. WHY AND WHY NOT TO LINK?

Economic theory dictates there are gains to be made from linking ETSs, primarily as a result of the increased market size. These include increased cost effectiveness, market liquidity and stability, as well as a reduction of carbon leakage. These benefits become increasingly valuable in the European context of a carbon market with a declining cap, headed for significant emission reductions in the next decade and alignment with climate neutrality thereafter.

The benefits of linking can only be realised fully in case of a so-called ‘full, bi-directional link’ whereby allowances from one jurisdiction can be used to meet compliance obligation in the other, and vice versa. Opening one’s market to the allowances of another requires trust, legal clarity, as well as a deep degree of harmonisation in order to ensure a level playing field between compliance entities in the two jurisdictions. Stakeholder responses to the Open Public Consultation conducted under the ongoing Review also emphasised the importance of linking. Most respondents supported pursuing further linking between the EU ETS and other ETSs and emphasised economic benefits, with top motivations being reducing carbon-leakage risk, improving cost-effectiveness via price convergence, and supporting market liquidity.

This risk of a distorted level playing field impacting competitiveness is a key risk associated with linking, but there are others. For instance, harmonisation to the lower of the two sets of rules risks compromising the environmental and economic integrity of the linked system. Furthermore, without constant management and close oversight, diverging policies in the linking parties can further distort the level playing field. Linking with multiple systems increases complexity and the need for coordination.

Where jurisdictions are too dissimilar in their journey to climate neutrality, one of the two systems ends up being a permanent net buyer, de facto outsourcing its emission reductions to the other system, who sees their most cost-effective abatement options being counted towards the former’s target. Recalling the need to assess linking “without impeding the achievement of the climate-neutrality objective and the Union climate targets”, this is particularly important. Finally, diverging price levels may also discourage potential linking partners as the fungibility of allowances implies price alignment.

2. WITH WHOM TO LINK?

It follows that linking partners need to be chosen with care and that, in reality, only few jurisdictions can be regarded as realistic candidates for the EU ETS, given its advanced state and elaborate acquis. At present, the EU ETS is linked to the Swiss ETS and negotiations with the UK ETS have recently been launched. The EEA EFTA States are integrated in the EU ETS,

and in the future a possible enlargement of the European Union may lead to the integration of further countries.

Other ETSs currently in operation around the world are less similar in design as well as price level and stage of decarbonisation, such that considerable obstacles would need to be overcome in order to agree on a Linking Agreement and establish a successful link. For instance, examples of design elements that are assessed in the report include the absence of an absolute cap (explicitly mentioned in Article 25, albeit not a binding prerequisite), the process of cap setting, and the global trend towards more intensity-based systems, the impacts of diverging MRV and enforcement regimes, the distinction between volume-based and price-based approaches to market stability, carbon leakage frameworks and, finally, approaches to revenue use.

The EU ETS itself is also subject to reform, which is relevant for linking because the changes reflect not only the sectoral scope, but also key building blocks related to carbon leakage (free allocation, CBAM), market stability, and the integration of domestic removals (and non-integration of international credits). Moreover, ETS2 will start in 2028, which has implications even if a linking partner is primarily interested in linking with the EU ETS. Where a prospective linking partner is unwilling or unable to implement similar rules, the level playing field is once more at risk of distortion to the detriment of the covered industries. In such instances, it is important to agree on strong rules for enforcement, dispute settlement mechanism as well as for how the linking can be suspended and terminated.

3. CONCLUSION

The answer to the question in Article 30(6) ETS Directive how linking the EU ETS to other systems can be established without impeding the achievement of the climate-neutrality objective and the Union climate targets crucially depends on the climate ambition and the ETS-design of the other jurisdiction. Only where ambition and design are relatively aligned can linking be considered as a serious option. Given the substantial resources needed to negotiate, establish and maintain a link over time, such considerations need to be weighed before embarking on linking talks.

Finally, it is important to recall that there are other, less far-reaching forms of carbon market cooperation that can deliver important benefits. Recognition of prices paid under other schemes for instance can help facilitate trade and reduce payments under a carbon border measure. This requires understanding and trust of underlying rules, in particular those related to MRV and carbon leakage, that can only be established through close cooperation. Several multilateral fora exist to foster such cooperation and the EU, as well as several of its Member States, play a constructive role.



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COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT REPORT

Accompanying the documents

Proposal for a

**DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
amending Directive 2003/87/EC and Decision (EU) 2015/1814 as regards driving
competitiveness and cost-effective decarbonisation**

**REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
amending Directive 2003/87/EC as regards revised benchmark values for the heat and
fuel benchmarks period from 2026 to 2030**

**REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
amending Regulation (EU) 2015/757 and Regulation (EU) 2023/1805 to simplify and
streamline monitoring, reporting and verification and to align with revisions of the EU
Emissions Trading System**

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GLOSSARY

Term or acronym	Meaning or definition
BECCS	Bioenergy with carbon capture and storage
CCfD	Carbon contract for difference
CCS	Carbon Capture and Storage: a set of technologies aimed at capturing, transporting, and permanently storing CO ₂
CCUS	Carbon capture, utilisation, and storage
CBAM	Carbon Border Adjustment Mechanism
CDR	Carbon Dioxide Removal
CHP	Combined Heat and Power: a combined heat and power unit is an installation producing both electrical energy and heat
CO _{2e}	Carbon dioxide-equivalent: a measure used to compare quantities of different greenhouse gases in a common unit based on their global warming potential over a given period
CRCF	Carbon Removals and Carbon Farming framework, established under Regulation (EU/2024/3012)
CSFC	Cross-sectoral correction factor: a factor by which free allocation of emission allowances is reduced uniformly across all industry sectors, if the demand for free allocation exceeds the total amount of available free allowances
DACCS	Direct Air Capture with Carbon Storage
E-fuels	Liquid fuels produced based on hydrogen obtained from electricity via electrolysis.
EEA	European Economic Area
EIB	European Investment Bank

ESR	Effort Sharing Regulation
ETS Directive	Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC
EU ETS	European Union Emissions Trading System covering stationary installations, aviation and maritime transport
ETS2	Emissions Trading System covering Buildings, Road Transport and Additional Sectors in accordance with Chapter IVa of the ETS Directive
EUA	European Union Allowance: the tradable unit under the EU ETS, giving the holder the right to emit one tonne of CO ₂ e
GDP	Gross Domestic Product
GEM-E3	General Equilibrium Model for Energy-Economy-Environment interactions
GHG	Greenhouse gas
GT	Gross Tonnage
ICC	Indirect carbon cost
IF	Innovation Fund
IMO	International Maritime Organization
JRC	Joint Research Centre of the European Commission
JRC-GEM-E3	Joint Research Centre variant of the GEM-E3 model
LDC	Least developed countries

LRF	Linear Reduction Factor: a factor by which the ETS cap is reduced yearly
MS / MS EU	Member State(s) of the European Union
MSR	Market stability reserve
MtCO ₂	Million tonnes of CO ₂
MW	Megawatt
NECP	National Energy and Climate Plan
NIMs	National implementation measures under Article 11 ETS Directive
NZF	Net-Zero Framework
OPC	Open Public Consultation
PRIMES	Price-Induced Market Equilibrium System model
PRIMES-TREMOVE	Integrated transport component of PRIMES model
SAF	Sustainable Aviation Fuel
SME	Small and medium-sized enterprise
SWD	Staff working document
TNAC	Total number of allowances in circulation

1 INTRODUCTION: PURPOSE AND SCOPE OF THE EVALUATION

1.1 Overview of the EU ETS

1.1.1 *How the EU ETS functions*

The EU ETS is a classic “cap & trade” system. It achieves its environmental goal by definition – the aggregate emissions of many covered entities cannot exceed an absolute ceiling of (annual) emissions without breaking the rules of the system. The main difference to “command & control” systems is that the individual participant in the system does not get an individual (legally binding) target for their emissions, and thereby implicitly the amount of required emission reductions. Instead, the overall target must be achieved jointly by all participants. The distribution of efforts among participants (who reduces emissions and by how much) is determined through a market interaction based on the various emitters’ marginal abatement costs. This gives companies the flexibility to cut their emissions in the most cost-effective way.

Compliance with the system is achieved by surrendering units of “rights to emit”. In the EU ETS they are called “EU allowances”, or EUAs, with a value equivalent to the emission of one metric tonne CO₂e. These rights can be freely traded. Hence each actor (in the EU ETS they are operators of stationary installations, shipping companies and aircraft operators¹) can decide whether to emit a certain amount of greenhouse gases (GHGs) and cover them with allowances, or whether to reduce their emissions so that they will have to purchase fewer allowances or is even able to sell allowances in case of a surplus.

Since economically rational actors tend to optimise their profits, either by reducing their costs or by increasing their product prices (if the latter is possible), the following foreseeable effects are at the heart of the ETS:

- (i) Operators will try to reduce their emissions to bring down their costs. This can be done either by making the production per unit of product less GHG intensive, or by reducing the production level for that GHG intensive good. The latter will be incentivised if their consumers find ways of using less of that GHG intensive good, either by making more efficient use of that good, or by completely substituting it.
- (ii) The consumer in turn also sees an incentive for such changes, because it will ideally be an economically rational actor, who wants to avoid the increased costs brought along by the price of GHG emissions.

Several production processes have “indirect” embedded emissions, referring to the emissions that occur upstream. The most common example is the indirect emissions embedded in the electricity consumed during the production of industrial goods. These production processes can also incur indirect carbon cost, since the carbon price paid by the direct emitter (e.g. a power plant) is passed on to the electricity bill of the consumer (e.g. an industrial installation).

As this illustrates, in an optimally functioning ETS virtually all possibilities for emission reductions are driven by the CO₂ price:

- producing the same goods more GHG efficiently,

¹ In addition to the traditional EU ETS covering large industrial installations and aviation, the 2023 Directive introduces a new emissions trading system (EU ETS 2) for emissions from fuels used in buildings and road transport. This significantly broadens the scope of carbon pricing in the EU. Starting in 2024, the EU ETS also covers emissions from maritime transport. These additional sectors are not part of this evaluation given that they have only recently become part of the system.

- producing a smaller quantity of those GHG intensive goods, as the demand may decline (induced by behavioural change of the end users or replaced by imported goods, that may cause carbon leakage), or
- producing other – less GHG intensive – goods.

1.1.2 How to implement the EU ETS

It is important to note that some practical issues must be solved for putting in place a successful cap & trade system such as the EU ETS. Those elements have been regulated by the ETS Directive and secondary legislation, and are therefore of particular interest for this evaluation and further improvement of the EU ETS:

- A robust system for monitoring emissions and reporting (M&R) emissions to the competent authority is the core of any market-based measure. The M&R system is accompanied by requirements to have the emissions verified by an independent and competent third party (“the verifier”), who in turn should be under some form of legal control (usually accomplished by accreditation). Accreditation and Verification (A&V) rules are therefore also required. M&R and A&V rules are collectively referred to as the Monitoring, Reporting, Verification and Accreditation (MRVA) system. Effective enforcement options (penalties) will also be essential.
- For efficiency reasons allowances exist in a purely electronic form. All allowance transactions, including issuance, transfers, surrender, and cancellation, are recorded in the ETS Union Registry.
- At least one allocation system is required, so that market participants can receive the allowances that they need for compliance. In the EU ETS, auctioning was established as the default method of allocation of allowances from Phase III onwards. Detailed rules were established to ensure that auctions take place in an open, transparent, harmonised and non-discriminatory manner. However, free allocation is still granted to address the risk of carbon leakage. To make this allocation fair, EU-wide rules (based on ex-ante benchmarks) have been put in place.
- As from January 2018, emission allowances are classified as financial instruments by the revised Directive on Markets in Financial Instruments (MiFID2).² This classification constitutes an important element in safeguarding the carbon market from market abuse and other types of market misconduct regulated under the Market Abuse Regulation (MAR). Anti-money laundering safeguards are extended to all segments of the carbon market.

1.1.3 The EU ETS and its legislative history

The EU ETS is currently in its fourth phase of implementation. It has undergone a series of significant reforms, primarily due to changes in the level of ambition, but also in response to the key lessons learnt from challenging and often unanticipated problems.

In **Phase I (2005-2007)**, most allowances were allocated for free with each Member State developing a National Plan³. Phase I was primarily used for testing price formation in the carbon market and to establish the infrastructure necessary for monitoring, reporting and verification (MRV). The cap during this pilot phase was based on estimates, due to insufficient data the emissions of installations. Therefore, the total allocation of allowances exceeded

² Directive - 2014/65 - EN - MIFID II - EUR-Lex

³ National allocation plans - European Commission (europa.eu)

emissions in Phase I, and this led to a collapse in the carbon price in 2007 to zero (as these allowances could not be banked for use in Phase II).

Phase II (2008 – 2012) expanded the scope in terms of covered greenhouse gases (GHGs), sector (aviation) and countries, and lowered the cap on allowances with respect to 2005. Moreover, Phase II reduced the number of free allowances to around 90%.

Phase III (2013-2020) introduced a single EU-wide cap instead of the previous system of national caps; it prioritised auctioning as the main allocation method; it harmonised allocation rules; and it included additional sectors and GHGs.

The **Market Stability Reserve (MSR)** was introduced with Decision (EU) 2015/1814⁴ and began operating in 2019 with the purpose of addressing the surplus of allowances that have been building up the ETS market since 2009 and ensuring resilience against market shocks through a flexible supply of allowances. The supply is controlled by absorbing or reducing the number of allowances in the reserve, which reduces or increases the total number of allowances in circulation (TNAC) available in the market.

Phase IV (2021-2030), through the revised 2018 Directive, established a more ambitious linear reduction factor for GHG emissions, which was increased from 1.74% to 2.2% per from 2021, to achieve a 43% reduction in GHG emissions in the ETS sectors by 2030, compared to 2005 levels. New rules for free allocation and provisions for carbon leakage were also established.

- The provision of free allocation for sectors deemed at risk of carbon leakage was revised to be more targeted and effective.
- The benchmarks applied for the free allocation were revised to be more ambitious
- An Innovation Fund to provide financial support for projects in the areas of renewable energy sources and carbon capture and storage, as well as a Modernisation Fund for the modernisation of energy systems in lower-income Member States, were also established.
- The ambition of the ETS was enhanced further in a revision to the ETS Directive in 2023 that increased the ETS reduction target to 62% below 2005 levels, together with other changes to support the increased ambition.

1.1.4 The EU ETS evaluation and review proposal of 2015

In October 2014, the European Council agreed on the 2030 policy framework for climate and energy. In this framework, the European Council endorsed a binding EU target of an at least 40% domestic reduction in greenhouse gas emissions by 2030 compared to 1990 levels.

The framework established that a well-functioning, reformed EU ETS with an instrument to stabilise the market in line with the Commission's proposal will be the main European instrument to achieve this target and set out a framework of measures in the system. The Commission was invited to implement this framework in concrete policy measures as soon as possible by a revision of the ETS Directive.⁵

⁴ Decision (EU) 2015/1814 of the European Parliament and of the Council of 6 October 2015 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and amending Directive 2003/87/EC

⁵ European Council (23 and 24 October 2014). Conclusions on 2030 Climate and Energy Policy Framework (europa.eu)

An evaluation of the ETS Directive⁶ was carried out in the first quarter of 2015, which provided inputs and supported the review of the ETS Directive. In July 2015, the European Commission proposed a reform of the EU ETS for the 2021-2030 period, following the guidance set by the October 2014 European Council meeting. After its adoption by Council and Parliament, the revised Directive (EU) 2018/410⁷ entered into force on 8 April 2018 and set the framework for the fourth trading period (phase) from 2021 to 2030, in line with the EU's 2030 climate and energy framework.

The Directive was further revised in 2023 under the “Fit for 55” package of legislative proposals, in view to achieve climate neutrality in the EU by 2050, including the intermediate target of at least 55% net GHG emissions reductions by 2030. The current evaluation focuses on the ETS Directive in its version after the 2018 review to evaluate the situation before and after the implementation of the new rules of the fourth phase. The 2023 revision is not included in the current evaluation, as there isn't sufficient data for the assessment (minimum of 3 years-worth of data required by the EU Better Regulation Guidelines⁸).

Regarding the MSR, the evaluation focuses on changes following the establishment of the policy instrument in Decision (EU) 2015/1814. The key provisions and subsequent implementing measures of relevance are highlighted for every design element of the ETS within this evaluation report. The rationale for the interventions across different design elements of the ETS are then outlined in detail before the evaluation responds to the specific questions set in the corresponding evaluation matrix (provided in Appendix III).

1.2 Scope

The scope of this evaluation is focused on the ETS Directive in its version after the 2018 review, as outlined in the 2015 impact assessment. It addresses for the most part the changes that have been introduced for Phase IV of the EU ETS. The evaluation of the individual ETS components, in addition to the relevant provisions in the ETS Directive, includes also the various implementing or delegated acts adopted following the 2018 review of the ETS Directive that are providing the detailed rules (see Appendix III for each individual ETS component evaluated).)

The key aim of this evaluation is to provide an evidence-based assessment of the extent to which the EU ETS:

- Is *effective* in meeting its objectives and delivering the expected results.
- Is *efficient*, in terms of cost-effectiveness and proportionality of costs versus benefits.
- Is *relevant*, in terms of responding to needs.
- Is *coherent* internally and with other EU interventions and international obligations.
- Has *EU added value* compared to action by Member States alone.

As part of the REFIT programme, this evaluation should also assess the potential for simplification and burden reduction, particularly as part of the *efficiency* analysis.

⁶ EVALUATION OF THE EU ETS DIRECTIVE Carried out within the project “Support for the Review of the EU Emissions Trading System”, [EU ETS Directive Evaluation 2015](#)

⁷ Directive (EU) 2018/410 of the European Parliament and of the Council of 14 March 2018 amending Directive 2003/87/EC to enhance cost-effective emission reductions and low-carbon investments, and Decision (EU) 2015/1814 ([europa.eu](#))

⁸ Better regulation: guidelines and toolbox ([europa.eu](#))

The interventions assessed as part of this evaluation include the overall EU ETS⁹ and the Market Stability Reserve. In addition, the following ETS components that support the implementation of the overall system are evaluated individually, mainly in relation to their effectiveness and efficiency, with the detailed findings presented in Appendix III:

- Provision of free allocation to address the risk of carbon leakage.
- Monitoring, Reporting, Verification, and Accreditation (MRVA).
- Monitoring, Reporting, Verification system for maritime (MRV maritime).
- Auctioning.
- Union Registry.

The Innovation Fund and the Modernisation Fund, established by the 2018 review of the ETS Directive, are evaluated separately¹⁰.

Where results from the analysis in Appendix III are relevant for answering evaluation questions for the EU ETS as a whole, reference is made here to the more detailed sections, instead of repeating those findings. The relevance and EU added value are evaluated only at the aggregate level.

This evaluation is based on a literature review, stakeholder interviews and own analysis. However, no specific economic modelling was carried out for this report, but it refers to the ex post economic modelling and econometric analysis available within the existing literature. For additional details on the methodology, see Appendix II.

2 WHAT WAS THE EXPECTED OUTCOME OF THE INTERVENTION?

2.1 EU ETS

2.1.1 Point of comparison for the EU ETS

As mentioned, in July 2015, the European Commission proposed a reform of the EU ETS for the 2021-2030 period, accompanied by an impact assessment¹¹. That proposal led to the revised EU ETS 2018 Directive¹², which entered into force on 8 April 2018 and set the framework for the fourth trading period (phase) from 2021 to 2030, in line with the EU's 2030 climate and energy framework.

The key element of the revised Directive was a more ambitious linear reduction factor for GHG emissions. The proposal determined that to achieve the EU's target to reduce GHG emissions by at least 40% domestically by 2030, the sectors covered by the EU ETS would need to reduce their emissions by 43% by 2030, compared to 2005 levels.

To achieve this target, the linear reduction factor was increased from 1.74% to 2.2% per year from 2021.

⁹ Criteria of coherence is assessed only for the EU ETS in general, while the other criteria are assessed also for the specific components.

¹⁰ Evaluation of the Innovation Fund's operation (SWD(2026) 199) and Evaluation on the operating rules of the Modernisation Fund (SWD(2026) 197)

¹¹ SWD (2015) 135 final, Impact Assessment accompanying the Proposal for a Directive of the European Parliament and of the Council amending Directive 2003/87/EC to enhance cost-effective emission reductions and low carbon investments

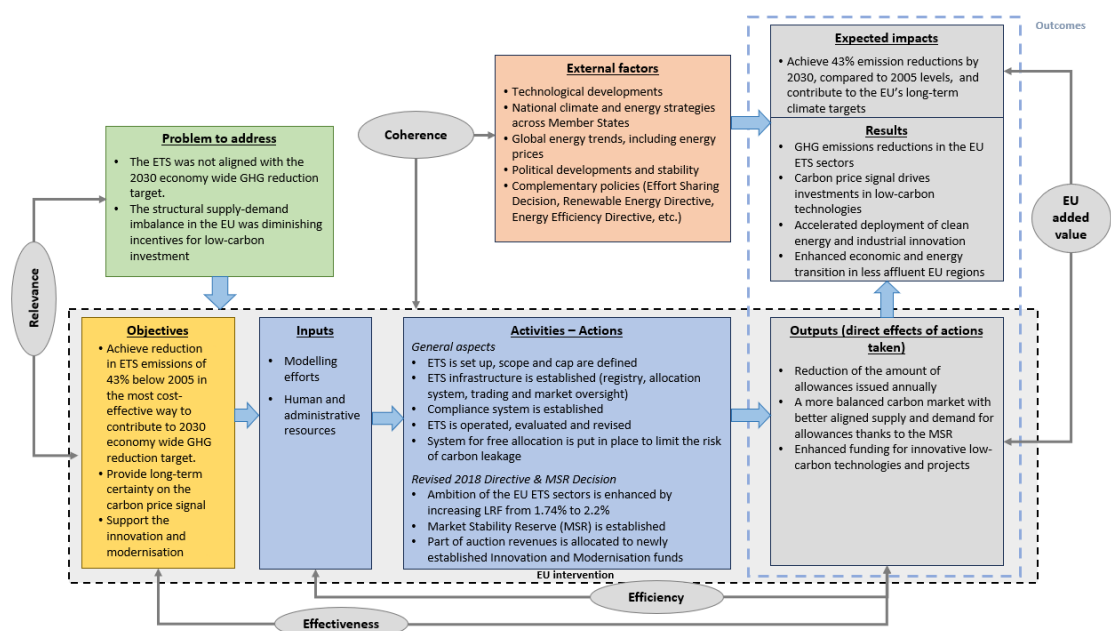
¹² DIRECTIVE (EU) 2018/410 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 14 March 2018 amending Directive 2003/87/EC to enhance cost-effective emission reductions and low-carbon investments, and Decision (EU) 2015/1814

The auctioning of allowances remained the general rule in Phase IV, with the share of allowances to be auctioned set at 57%, i.e. the same as in Phase III.

2.1.2 Description of the intervention and its objectives for the EU ETS as a whole

Figure 1 provides an overview of the intervention logic for the EU ETS overall. The policy intervention to be evaluated refers to the operation of the EU ETS in general and in relation to key overarching changes following the revision to the ETS Directive in 2018. The extent to which the EU ETS as a whole has delivered the expected outcomes outlined in the intervention logic below will be the subject of the evaluation. Each element of the intervention logic diagram is discussed further in the following subsections.

Figure 1: Intervention logic (EU ETS)



Source: Own illustration

2.1.2.1 Problem to address

The main problems to address for the EU ETS overall include the fact that:

- The ETS was not aligned with the 2030 economy wide GHG reduction target.
- There remained a structural supply-demand imbalance in the EU ETS, which was one of several factors¹³ contributing to a low carbon price signal and therefore reducing the incentives for low-carbon investments. This point is addressed in greater detail in Section 2.2.2 on the intervention logic for the MSR.

2.1.2.2 Objectives

Following the previous evaluation in 2015, three specific objectives for the EU ETS overall were outlined in a proposal for amending Directive 2003/87/EC to enhance emission reductions and low carbon investments:¹⁴

¹³ Other factors including weak or no complementary policies, lower general political importance of climate policies leading to less confidence in the market.

¹⁴ EUR-Lex - 52015PC0337 - EN - EUR-Lex

- *Specific objective 1*: “Revise the ETS Directive in a manner to ensure emissions in the EU ETS are reduced by 43% below 2005 levels by 2030.” In so doing, this ensures that the EU ETS contributes to the EU's climate objectives in the most cost-effective manner.
- *Specific objective 2*: “Promote low-carbon innovation and establish, for industrial sectors, appropriate provisions to address the potential risk of carbon leakage in the absence of comparable climate policy measures in other major economies.” This includes more targeted rules on free allocation that are discussed in more detailed in the intervention logic for carbon leakage (refer to Appendix III, Section 8.3)
- *Specific objective 3*: “Implement further ETS-related aspects of the 2030 climate and energy policy framework.” The system should support innovation and the modernisation of energy systems and industrial processes, thereby contributing to the transition towards a low-carbon economy.

2.1.2.3 Actions

Actions to support the functioning and strengthening of the EU ETS can be grouped into general system aspects and those introduced by the policy intervention.

2.1.2.3.1 General aspects

- The EU ETS is established, with its scope and emissions cap defined to set the framework for emissions trading.
- A supporting infrastructure is in place, including the registry, allocation system, trading mechanisms, and market oversight arrangements.
- A compliance system is implemented to ensure that regulated entities meet their obligations through monitoring, reporting, and verification of emissions.
- The system is operated, evaluated, and revised regularly to improve effectiveness and respond to evolving circumstances.
- A system of free allocation is in place to mitigate the risk of carbon leakage.

2.1.2.3.2 Specific aspects under the revised 2018 Directive & MSR Decision

- The ambition of the EU ETS is increased by raising the linear reduction factor (LRF) from 1.74% to 2.2%, thereby accelerating the annual reduction in the emissions cap.
- The Market Stability Reserve (MSR) began operating in 2019 with the purpose of improving the stability and resilience of the carbon market by addressing the structural imbalance between supply and demand of allowances.
- A share of auction revenues is allocated to the newly established Innovation Fund and Modernisation Fund to support the deployment of innovative low-carbon technologies and the modernisation of energy systems in lower-income Member States.

2.1.2.4 Inputs

The inputs identified as necessary for the policy intervention include:

- Modelling efforts to estimate the LRF level for the ETS cap as well as the key design parameters for the operation of the MSR.
- Human and administrative resources dedicated to monitoring, management and administration of the Innovation and Modernisation funds.

2.1.2.5 Output

The outputs as a direct consequence of policy intervention include:

- An increased pace of reduction in the annual volume of allowances issued, in line with the increased LRF.
- A more balanced and resilient carbon market, with improved alignment between the supply and demand of allowances through the functioning of the MSR.
- Increased financial support for the development and deployment of innovative low-carbon technologies and projects, enabled by the Innovation Fund and the Modernisation Fund.

2.1.2.6 Results

Following the outputs from the policy intervention it is expected that this will lead to the following results:

- A sustained reduction in GHG emissions from sectors covered by the EU ETS.
- A more robust and predictable carbon price signal that encourages investments in low-carbon technologies.
- Accelerated deployment of clean energy solutions and industrial innovation, supported by targeted funding mechanisms, facilitated by the Innovation Fund.
- Enhanced economic and energy transition in less affluent EU regions, facilitated by the Modernisation Fund.

2.1.2.7 Expected Impacts

Because of the results from the policy intervention, it is expected that the following impacts will occur:

- Achievement of a 43% reduction in GHG emissions by 2030 in sectors covered by the EU ETS, compared to 2005 levels.
- Significant contribution to the EU's long-term climate objectives.

2.1.2.8 External factors

External factors that may impact the expected impact of the policy intervention include:

- Technological developments that can accelerate or delay the availability and cost-effectiveness of low-carbon solutions.
- National climate and energy strategies implemented by Member States, which can complement or interact with the EU ETS.
- Global energy trends, including fluctuations in energy prices, which may impact fuel switching, investment decisions, and competitiveness.
- Political developments and overall stability in the EU and internationally.
- Complementary EU-level policies, such as the Effort Sharing Regulation (ESR), Renewable Energy Directive (RED), and Energy Efficiency Directive (EED), which jointly influence emissions reductions in the EU.

2.2 Market Stability Reserve

The Market Stability Reserve (MSR) was introduced at a period when the EU ETS was considered to fall short of its potential to reduce emissions. With the economic crisis of 2010, the inflow of offsets from the Clean Development Mechanism and the initially generous cap in the ETS, cumulated allowance supply exceeded allowance demand. In consequence, EUA prices lingered under 10 EUR until the reform in 2018. Much has changed since then. In recent years, price levels have increased considerably and were approximatively 65 EUR per EUA (ICAP Status Report 2025) on average over 2024, i.e. in ranges where the carbon price has an

actual effect on decarbonisation. Part of this success story is the MSR. However, it is difficult to establish the direct impact of the MSR on the rise in ETS price compared to other reform elements, in particular the strengthening of the cap. Therefore, this evaluation of the MSR aims to disentangle, as much as the available data permits, the different effects of the MSR and its consecutive reforms in the period 2013 to 2024.

The evaluation of the MSR has at its centre the evaluation of effectiveness, i.e. if the instrument has achieved its objectives as expected. The findings on effectiveness are complemented by an analysis of the MSR's efficiency, looking at the instrument's costs and benefits, and coherence, analysing how it interacted with other EU and Member State policies. The evaluation of relevance and EU added value happen at the level of the overall EU ETS as the MSR is mainly a design element of the EU ETS strengthening the system to enforce its place as cornerstone of the EU's climate policy.

The purpose of the MSR evaluation is to provide a record of the developments of the past twelve years and extract lessons learned for the future of the EU ETS, as well as for other jurisdictions with ETSs that are considering introducing an instrument like the MSR.

2.2.1 Point of comparison of the MSR

The MSR has evolved through distinct policy reforms and been implemented in consecutive steps that enhanced the mechanism over time until today. Concrete thinking around measures to address the imbalance of cumulated supply and demand in the EU ETS evolved in 2013/14 with expert consultations and an Impact Assessment discussing potential options. This led a year later to the adoption of the MSR. A comprehensive EU ETS reform in 2018 adjusted the way the MSR was planned to work. The MSR then entered into force in 2019. In 2021, the Commission conducted a review of the instrument. Insights from the review were used for a new reform as part of the Fit for 55 package that was adopted in 2023. This section describes the outcome of the 2014 Impact Assessment, the initially adopted MSR and its different reforms. The first expert consultations on the MSR took place in October 2013 with an announcement in January 2014 that the Commission proposes an MSR to be introduced at the start of Phase IV in 2021 to address the supply-demand imbalance in the EU ETS (see EC Memo/14/39).

The Impact Assessment concluded that a structural measure that not only attends to the historical surplus, but also to future demand-supply imbalances is necessary, as the TNAC was expected to grow further over Phase III. Accordingly, Option 1 was concluded to be probably insufficient. A combination of a permanent retirement and the introduction of an MSR together, as proposed by Option 3, was deemed the adequate solution to address both the historical surplus and future imbalances.

2.2.1.1 Initial MSR

The MSR was established by the MSR Decision (EU) 2015/1814 in 2015. The adopted version was closest to Option 2d from the 2014 Impact Assessment, choosing an MSR start year of 2019, the middle ground between the two modelled sensitivities of 2017 and 2021. The MSR Decision did not foresee the retirement of allowances, as proposed by the Impact Assessment.

The adopted MSR Decision implemented some modifications on the exact MSR parameters. The upper threshold decreased from 1,000 to 833 million allowances in circulation. The intake rate was set at 12% which leaves the minimum intake at 100 million allowances, which was equivalent to 10% at an upper threshold of 1,000 million allowances (Article 1 (5)). Release

rate and volume were set at the values of Option 2d from the Impact Assessment (Article 1 (6)).

2.2.1.2 2018 reform

Following co-decision, the ETS Directive and MSR Decision were amended in 2018 by Directive (EU) 2018/410. This first major revision of the MSR took place in the process of setting the rules for Phase IV of the EU ETS. The reform enacted a doubling of the MSR intake rate from 12% to 24% as well as the release volume from 100 to 200 million allowances for the initial period of 2019 to 2023 (Article 2(1)) to increase the effectiveness of the mechanism in its initial years.

The 2018 reform also introduced a mechanism to invalidate allowances stored in the MSR as favoured in the 2014 Impact Assessment. Article 2(2) states that from 2023 allowances in the MSR above a volume of the auction volume of the previous year will be retired. This provision brought the implemented MSR closer to Option 3 from the Impact Assessment as it introduced a permanent retirement of allowances (however, it differs substantially in terms of the volume of retired allowances, as the invalidation mechanism applies not only to the 900 million backloaded allowances, but to the entire volume held in the reserve, including unallocated allowances and those absorbed by the MSR via the intake mechanism). The invalidation mechanism was novel as it enacted an endogenous change to the allowance supply in the EU ETS.

2.2.1.3 MSR Review 2021

The Commission conducted a review of the MSR in 2021 (SWD(2021) 601 final) including a legal review of its effects until 2021 and an impact assessment of future design options. The MSR Review is based on a 2021 Vivid Economics study.

The legal review assessed how the TNAC had developed over Phase III and what events and shocks influences the balance of demand and supply in the EU ETS. It also reviewed the effect of the MSR on EU ETS resilience as well as the competitiveness of firms regulated under the EU ETS.

The MSR Impact Assessment of 2021 assessed how the decreases in demand induced by the phase-out of coal-fired power plants as well as the COVID-19 pandemic are addressed by the MSR under different design options for its future refinement. It corrected all scenarios to reflect net demand from aviation and linking with the Swiss ETS in the TNAC calculation.

2.2.1.4 Fit for 55 reform

The Fit-for-55 package, as adopted by Directive 2023/959, reformed the MSR in three ways: First, the period for the application of the increased intake rate of 24% was extended to 2030 (Article 5) to boost MSR effectiveness beyond the introduction period.

Second, a buffer zone for MSR intake was established to reduce threshold effects: For a TNAC between 833 and 1096 million allowances, the MSR takes in the number of allowances exceeding 833 million (Article 5). The buffer zone ensures a gradual increase in volume intake. With the previous parameters, intake increased from zero for a TNAC slightly below the threshold to approx. 200 million allowances (24% times, for example, 834 million allowances) for a TNAC slightly above the threshold (here: 834 million allowances). Under the adjusted rules, the intake at a TNAC of 834 million allowances is only one million allowances and from there increases smoothly. At a TNAC of 1096 million allowances, the existing rule is again in force.

Lastly, the invalidation mechanism has been reformed to invalidate all MSR holdings above 400 million EUAs from 2024 (Article 5a) to increase clarity and stringency of the allowance retirement. The reform entered into force in 2024.

2.2.1.5 MSR point of comparison

Because of the number of reforms of the MSR, the baseline for evaluation is difficult to determine. The years 2014 to 2017 can be compared to the assessment of Option 2d (with MSR start in 2017 and 2021). With the reforms from 2018 and 2023, the MSR has considerably changed.

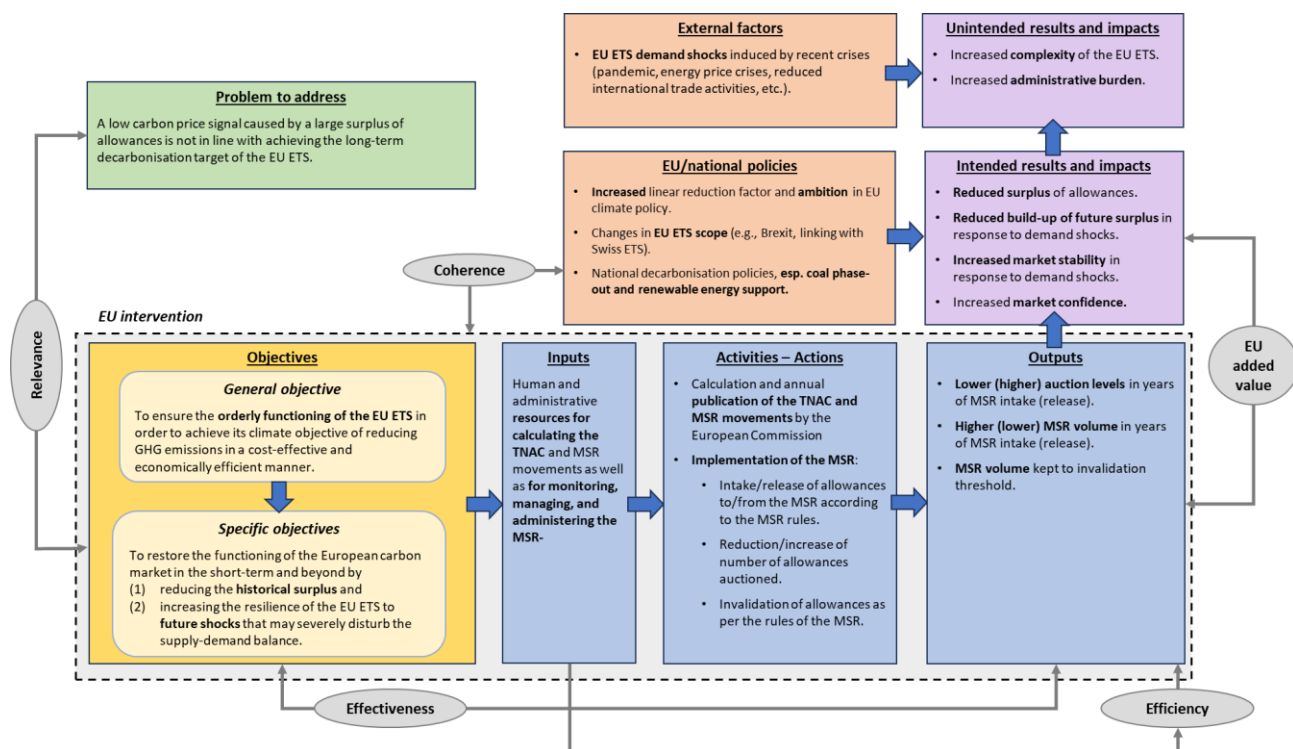
Similarly, the mechanism for permanent retirement envisioned in Option 3 of the 2014 Impact Assessment differs largely from the one implemented in 2023 and further adjusted in 2024. Option 3 consists of retiring 500 million allowances from the 900 million allowances backloaded. That means that instead of returning 300 and 600 million allowances to the auction volumes in 2019 and 2020, only 400 million EUA would have been released, and 500 million EUAs are permanently retired. In contrast, the invalidation mechanism in place does not establish a fixed number of EUAs that would be retired and in practice led to a higher volume of invalidated allowances since it was implemented.

Therefore, it must be concluded that there is no appropriate point of comparison in the 2014 Impact Assessment for evaluating the MSR functioning in the years 2018 to 2024. Instead, the evaluation will draw upon other existing analyses, particularly the MSR Review of 2021, as points of comparison. From the 2021 MSR Review, the MSR0 scenario can serve as point of comparison for the 2019 implemented MSR that is based on the 2018 reform. The MSR1 scenario comes closest to the Fit for 55 reform, although it does not depict a reform of the invalidation mechanism or the introduction of the buffer zone. The reduced upper threshold in this scenario is less problematic as it at least partially matches a downward adjustment of the TNAC in the entire analysis.

2.2.2 *Description of the intervention and its objectives for the MSR*

Figure 2 provides an overview of the intervention logic to justify the introduction of the Market Stability Reserve. The extent to which the intervention delivered the expected outcomes will be the subject of the evaluation. Each element of the intervention logic diagram below is further discussed in the following subsections.

Figure 2: Intervention logic diagram (MSR)



Source: Own illustration

2.2.2.1 Problem to address

The MSR was adopted to address the large surplus of allowances in the EU ETS prevalent in Phase III. The problem arose in the context of the economic downturn following the crisis of 2010 which reduced the demand for allowances with demand being significantly below allowance supply and the allowance surplus banked by market participants building up (EU COM 2014, p.8ff.).

As a result before the adoption of the MSR Decision in 2015, the EU ETS was perceived as not adequately functioning with allowance prices too low to drive decarbonisation. Alongside the low prices, confidence in the market and the instrument as such was low in the public debate. The initial attempt to drive down the allowance surplus by backloading allowances had not had a sufficient impact.

2.2.2.2 Objectives

The problem to address directly translates into the **general objective of the MSR of ensuring the orderly functioning of the EU ETS** to achieve its climate objective of reducing GHG emissions in a cost-effective and economically efficient manner. This points to two specific objectives: To reduce the historical surplus and to increase resilience of the EU ETS to future shocks and demand and supply imbalances.

The **first specific objective** of reducing the excessive surplus that had structurally built up in the years of the economic crisis and its aftermath can be operationalised as reducing the total number of allowances in circulation (TNAC). The TNAC is the difference between the cumulative supply of allowances since the beginning of the EU ETS reduced by the allowances placed in the Market Stability Reserve and the cumulative number of allowances that left the market because they were used to settle surrender obligations. The TNAC represents the

number of allowances held by market participants, both compliance entities and financial actors.

The **second specific objective** of enhancing future resilience of the EU ETS market consists of three parts. First, the MSR should prevent the build-up of future surpluses (from a 2014 perspective). In other words, the MSR should intervene at an early stage in case supply significantly exceeds demand, for instance because of another economic crisis. Second, the MSR should ensure market stability in reaction to shocks. Climate policy needs to function in an environment of economic crises and other shocks. The objective of the MSR is to prevent these shocks from having a destabilising effect on the EU ETS market. Third, the MSR should increase the confidence in the EU ETS and strengthen long-term market expectations. This objective is driven by the notion that by adopting the MSR the EU signals to the market and the general public that it considers the EU ETS as a key instrument for driving decarbonisation in the EU.

2.2.2.3 Inputs

Establishing the MSR and improving upon its design has required human and administrative resources, e.g. for legal and economic analysis.

Operating the MSR requires human and administrative resources for monitoring, managing, and administering the reserve. While it did not create additional data needs to calculate the TNAC, and derive the MSR movements from it, a process for the annual communication of the TNAC and the MSR intake needed to be established.

2.2.2.4 Actions

The intervention relied on two types of actions. The first set of activities concerned the adoption of the regulatory framework around the establishment and operation of the MSR. This included the formal MSR decision as well as its subsequent amendments. The first amendment to the MSR introduced a mechanism to invalidate allowances in the MSR as well as the temporary increase of the intake rate of 24% instead of 12% from 2019 to 2023 in the 2018 reform of the ETS Directive. The second amendment was part of the Fit for 55 package that reformed fundamental MSR parameters (smoother intake rules for the buffer zone of a TNAC between 833 and 1096 million allowances and prolongation of the 24% intake rate until 2030) as well as the invalidation threshold that capped the MSR volume at a fixed level of 400 million allowances.

The second set of activities concerns the implementation of the MSR. It consists of the calculation and annual publication of the TNAC and the corresponding MSR movements (i.e. intakes, releases, or invalidations), if any. Based on this calculation, the actual implementation of the MSR can take place that involves moving allowances from the auction volume of a year to the MSR or vice versa, which would then have an impact on the auction volumes for the 12-month period starting in September. It also involves invalidating allowances placed in the MSR if its volume exceeds a certain threshold.

2.2.2.5 Output

An output of an intervention refers to direct outputs of the activities undertaken. In this sense, the MSR has three outputs:

- First, the volume of auctioned allowances in years of MSR intake are lower than in a counterfactual scenario without the MSR. They are higher in years in which allowances are released from the MSR.

- Second and accordingly, the MSR volume increases or decreases in response to intake or release of allowances.
- Third, the MSR volume is limited to the invalidation threshold in any given year.

2.2.2.6 Intended results and impacts

There are several intended results from this output.

- Most importantly, the MSR should achieve a reduction of the historical surplus of allowances.
- In case of demand shocks, there would be only a limited build-up of a new surplus as the MSR would automatically remove allowances from the auction volumes.
- Overall, the market would be more stable and resilient in reaction to future demand shocks and the overall confidence in the market would be strengthened.

2.2.2.7 Unintended results and impacts

The MSR potentially led to unintended results and impacts:

- It increased the complexity of the functioning of the EU ETS, making assessments of future developments regarding supply and demand of allowances as well as allowances prices more challenging.
- Similarly, it potentially increased the administrative costs for the EU Commission and for EU ETS authorities in Member States.

2.2.2.8 External factors

The main external factor relevant for the MSR is the occurrence of external demand shocks. For the MSR evaluation, external demand shocks are assessed with a similar approach to “intended” demand shocks induced by complementary EU or national policies like the phase-out of coal-fired power plants or renewable energy support policies. This builds on a categorisation developed in the 2021 MSR Impact Assessment and the underlying Commission study.

Like the COVID-19 pandemic in 2020/21, the energy price crisis induced by the Russian invasion of Ukraine in February 2022 and reduced international trade activities in response to a global economic downturn have had significant influence on industrial emissions and electricity demand and in consequence on the demand for EU ETS allowances.

2.2.2.9 EU/national policies

The MSR works in the context of the broader EU climate policy. It is significantly influenced by increased ambition, e.g. through the 55% reduction target until 2030 which translated into a more stringent cap reduction in the EU ETS through an increased linear reduction factor. The cap reform reduced the allowance supply and in consequence the TNAC that drives MSR movements.

The MSR is also impacted by other changes in the EU ETS design, especially changes regarding the EU ETS scope. This includes the departure of the United Kingdom and its installations, the scope expansion to include the maritime sector as of 2024 and the linking with the Swiss ETS. These events influenced supply and demand of the allowances under the EU ETS.

Complementary EU or national policies like the German coal phase-out or renewable energy support policies caused another category of EUA demand shocks interacting with the MSR. These effects are assessed in this evaluation.

To a limited extent, the MSR was also used as vehicle for releasing 27 million allowances to the market to replenish the Innovation Fund to compensate for its contribution to financing the REPowerEU amendment of the Recovery and Resilience Facility, potentially impacting the intended results of the MSR.

3 HOW HAS THE SITUATION EVOLVED OVER THE EVALUATION PERIOD?

Following the 2018 review, the ambition of the ETS cap was enhanced further in a revision to the ETS Directive in 2023 that increased the ETS reduction target to 62% below 2005 levels and made free allocation in some circumstances conditional to additional efforts (i.e. implementing energy audit recommendations or developing and implementing carbon neutrality plans).¹⁵ Within this revision, the adoption of the Carbon Border Adjustment Mechanism (CBAM) is taken into account by outlining the phase-out schedule of free allocation for sectors covered by the CBAM (i.e. steel, cement, fertilisers, hydrogen and aluminium) up until 2034. An accompanying targeted review of the MSR prolonged the 24% intake rate until 2030 and included the fine-tuning of certain elements of the mechanism, amongst which introducing a buffer mechanism for intakes, to address potential threshold effects when TNAC is close to the upper threshold.

4 EVALUATION FINDINGS (ANALYTICAL PART)

4.1 To what extent was the intervention successful and why?

4.1.1 EU ETS

4.1.1.1 Effectiveness

The effectiveness of the EU ETS in achieving its objectives is evaluated based on the following questions examined under points 4.1.1.1.1 to 4.1.1.1.6.

4.1.1.1.1 What were the overall emissions reductions associated with the EU ETS sectors?

Since its inception in 2005, emissions from stationary installations, including both power and industrial facilities, have decreased by around 50% in 2024 (see Figure 3). Between 2018 and 2023, emissions from regulated entities under the EU ETS (covering combustion plants, industry, and aviation) dropped substantially, with most of the reduction driven by the power sector. According to the European Environment Agency (EEA)¹⁶, emissions from stationary installations (thus excluding aviation) fell by 16.7% in 2023 compared to 2022, which represents the largest annual emissions reduction in the scheme's history.

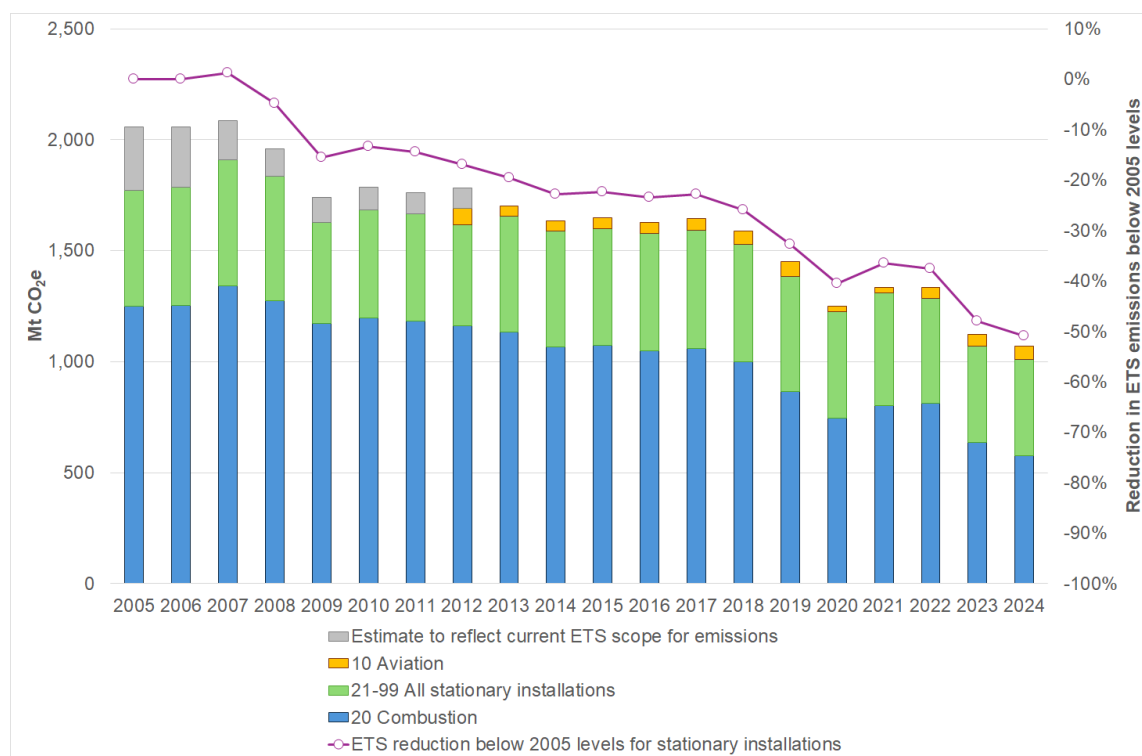
Focusing only on energy-intensive industries (i.e. stationary installations excluding combustion), emissions fell by 17.1% between 2005 and 2024. At the same time, the EEA found that the combined GVA of energy-intensive industries remained broadly stable while emissions fell, indicating a positive decoupling from economic activity within the sectors.¹⁷

¹⁵ Directive - 2023/959 - EN - EUR-Lex

¹⁶ EEA Greenhouse gas emissions under the EU Emissions Trading System, <https://www.eea.europa.eu/en/analysis/indicators/greenhouse-gas-emissions-under-the>

¹⁷ EEA Briefing 01/2026: Zero-pollution, decarbonisation, and circular economy in energy-intensive industries, ISBN: 978-92-9480-753-3 - ISSN: 2467-3196 - Doi: 10.2800/4884883

Figure 3: Comparison of the development of total EU-27 emissions within the EU ETS, disaggregated by activity



Source: Own illustration based on information from EU Emissions Trading System (ETS) data viewer (EEA)

The power sector has thus been the primary contributor to decarbonisation. This reflects the fact that free allocation for the power sector has largely been phased out since 2013. Therefore, the carbon price is fully transmitted to the wholesale electricity price. For example, when the marginal producer setting the market price is a fossil fuel power plant, it is expected that the market price also includes the carbon cost of that fuel.¹⁸ Evidence of the full cost pass-through of carbon prices to wholesale power prices in Belgium, Germany, Italy, the Netherlands, Scandinavia and the United Kingdom for the period 2008-18 has recently been provided in a study by Bai and Okullo (2023).¹⁹

The power sector has witnessed a sharper decrease in emissions since the start of the EU ETS. The increase between 2020 and 2022 was initially most likely due to the rebound effect following the COVID-19 crisis, but it also reflected the impact of the energy crisis following Russia's illegal invasion of Ukraine (refer to Section 4.1.1.1.2).

The overall trend of declining emissions in the EU power sector demonstrates the transition to clean power, which according to Ember²⁰ reached a tipping point in 2025 with wind and solar

¹⁸ European Commission, 2025. "Trends in carbon intensity and the macroeconomic role of the EU Emissions Trading System - Economy and Finance", https://economy-finance.ec.europa.eu/trends-carbon-intensity-and-macroeconomic-role-eu-emissions-trading-system_en

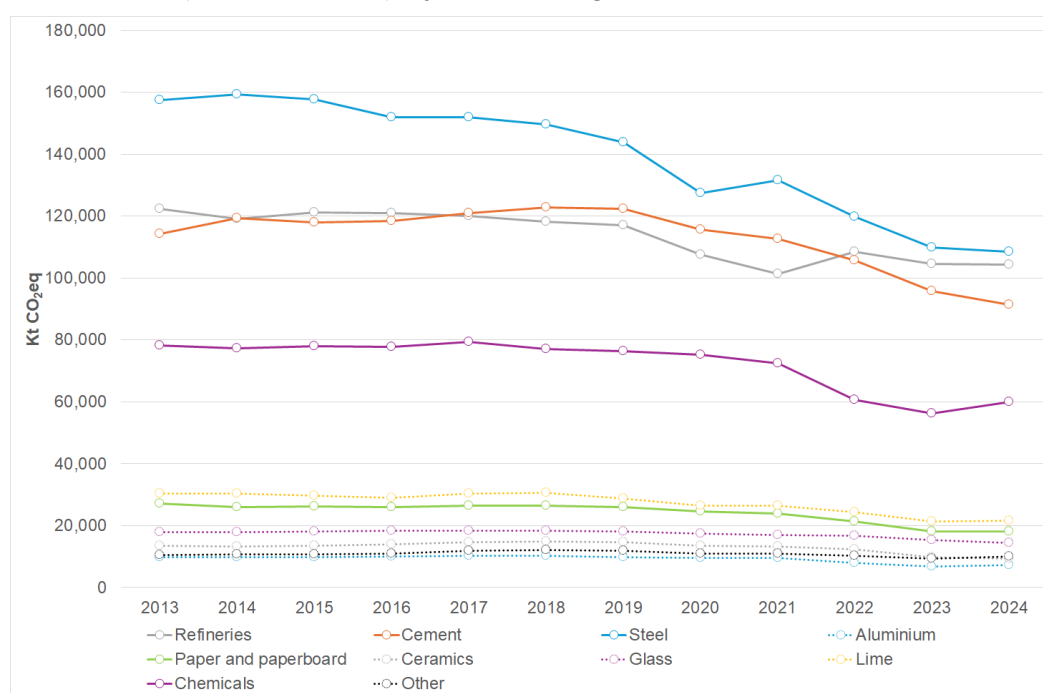
¹⁹ Bai, Yiyi & Okullo, Samuel J., 2023. "Drivers and pass-through of the EU ETS price: Evidence from the power sector," *Energy Economics*, Elsevier, vol. 123(C).

²⁰ Ember Report, 2026. "European Electricity Review", <https://ember-energy.org/app/uploads/2026/01/EMBER-Report-European-Electricity-Review-2026.pdf>

power generating more electricity than fossil sources for the first time. Indeed, wind and solar accounted for 30.1% of EU electricity in 2025 (841 TWh), whereas all the fossil power sources in the EU accounted for 29% (809 TWh). Between 2020 and 2025 the share of EU power from wind and solar has increased by more than 10 percentage points and this is in stark contrast to electricity generation from fossil fuels, which has declined by almost 8 percentage points over the same period.²¹

Emissions reduction from industry (excluding combustion) was mainly driven by the following sectors: production of steel (including activities preliminary to steel production, namely metal ore roasting or sintering, production of ferrous metals, production of coke); production of cement clicker; refining of mineral oil. The more recent decline in industrial emissions is primarily due to lower levels of activity (see also Section 8.3.4) but also reflects, to a lesser extent, improvements in the performance of installations in terms of their specific emissions.

Figure 4: Development of total EU-27 emissions within the EU ETS, breakdown of all stationary installations (excl. combustion), by most emitting activities



Source: Own illustration based on information from EU Emissions Trading System (ETS) data viewer | Maps and charts | European Environment Agency (EEA)

Feedback from the Open Public Consultation strengthens the validity of the findings. A clear majority of respondents judged the EU ETS to be delivering on its main objective of reducing GHG emissions. About half of the respondents²² considered it moderately effective, nearly one-fifth very effective, while only a small share viewed it as ineffective.

²¹ Ibid

²² Question: “How effective do you think the ETS Directive has been in achieving its objective to reduce greenhouse gas emissions?”

4.1.1.1.2 To which extent can the emissions reductions (if observed) be attributed to the application of the Directive?

In an ideal situation, we would expect to see the following if the application of the Directive was effectively reducing emissions aligned with the cap trajectory.

- Emissions from ETS sectors would reduce
- Activity levels from ETS sectors would decouple from emissions

Such a decoupling of activity from emissions would be a clear indication of the effectiveness of the Directive. While we have observed emission reductions this has, however, not been accompanied by increased levels of activity in recent years (refer to Section 8.3.4.1). It is therefore necessary to try and understand the role of the carbon price signal in influencing the lower levels of activity as opposed to external factors beyond carbon pricing.

The starting point for any evaluation into the extent to which the emission reductions observed in the previous section can be attributed to the application of the Directive should involve an initial assessment of the relative exposure of each of the ETS covered sectors to the carbon price signal.

Relative exposure of each of the ETS covered sectors to the carbon price signal

The relative exposure to the carbon price signal reflects both the provision of free allocation to shield against the carbon cost and the cost of abatement to avoid the carbon cost.

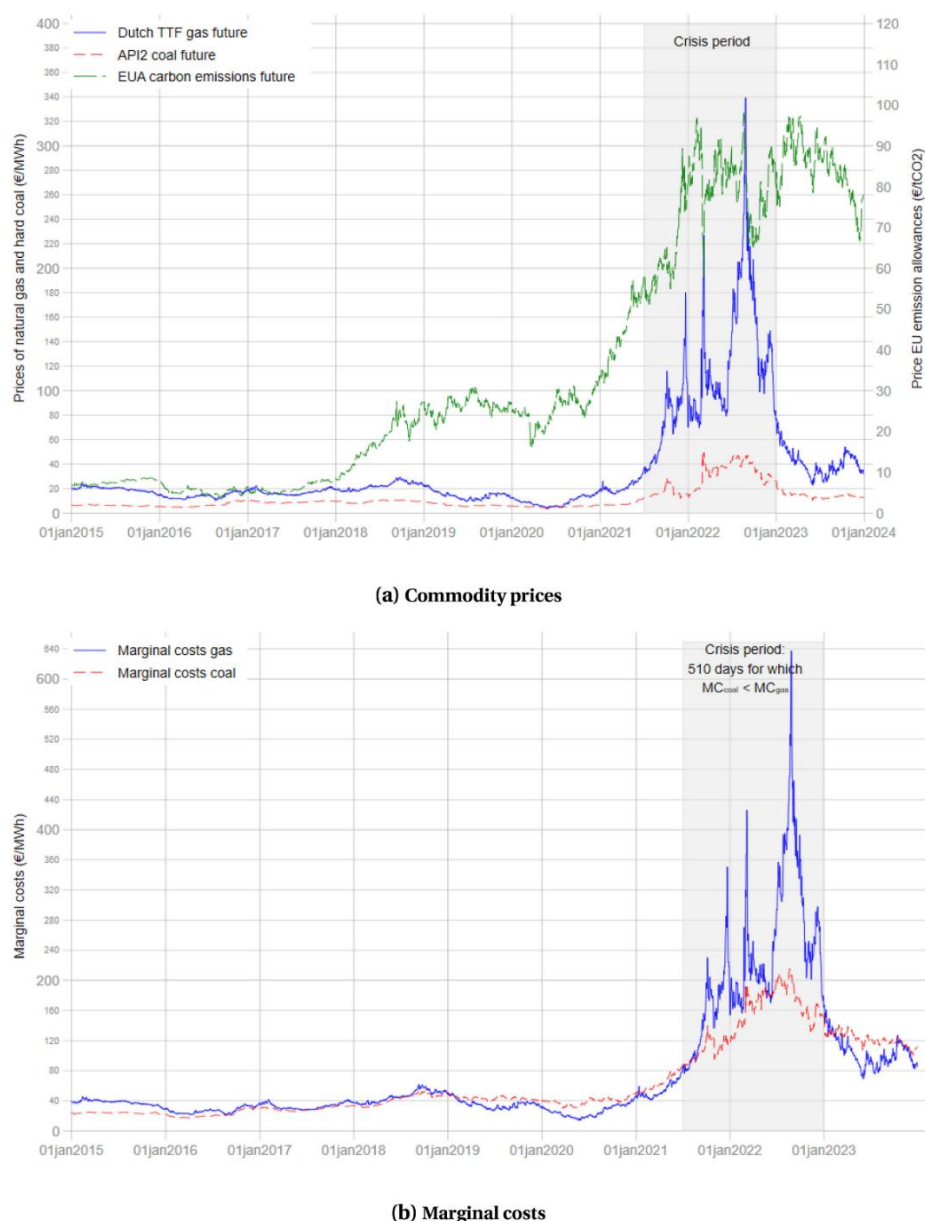
Free allocation to the power sector has been very limited since the start of Phase III with most generators required to purchase allowances to cover their verified emissions. The power sector has therefore been exposed to the carbon price signal, and this has provided an incentive for the uptake of abatement options (i.e. switching from fossil fuels to renewables and using technologies like nuclear and hydropower in electricity generation) to avoid the cost of compliance.

Emission reductions in the power sector have taken place at a faster rate in comparison to industrial sectors. This resulted from a combination of policy support, market structure, and technical opportunities. EU and national policies promoting renewable energy, including the RED and national support schemes like feed-in tariffs, premiums, auctions, and, more recently, PPAs, have been decisive in scaling up wind and solar capacity. These structural shifts were reinforced by the functioning of the wholesale power markets. Because the costs of emissions allowance are reflected in the marginal cost of production, electricity generators can pass most of the carbon price through to electricity price.

Indeed, Liebensteiner & Kimani (2026)²³ show evidence of fuel switching from coal to gas in the power sector (i.e. the marginal cost of coal was higher than the marginal cost of gas) from the start of 2019 until mid-2021 driven in part by an increase in the price of EU allowances following reforms to the EU ETS (see Figure 5). However, the energy crisis following Russia's illegal invasion of Ukraine temporarily reversed this trend between 2022 and 2023 as the marginal cost of natural gas increased significantly and Liebensteiner & Kimani (2026) argue that this is likely to have resulted in a switch back from gas to coal and an increase in GHG emissions. Fuel switching from coal to gas started again post 2023 following the end of the peak of the energy crisis related to Russia's illegal invasion of Ukraine.

²³ Mario Liebensteiner, Alex Mburu Kimani (2023)

Figure 5: Development of prices and marginal costs in the EU power sector



Source: *Environmental and health costs of Europe's shift from gas to coal amidst the energy crisis*²⁴

An important indicator of industry's exposure to the carbon price signal is to examine the ratio of free allocation to verified emissions.²⁵ At the start of the third phase of the EU ETS, this ratio was very high for all industrial ETS sectors (even higher than the level of reported emissions for some sectors) and, combined with a very low EUA price, resulted in emission trends remaining relatively flat across industrial sectors. However, from the interviews with industrial stakeholders, there was a consensus that free allocation has been effective in

²⁴ Liebensteiner, Mario and Kimani, Alex Mburu (2023)

²⁵ The exact ratio is difficult to calculate for certain sectors such as the iron and steel sector due to the transfer of waste gases from the blast furnace impacting the balance as the waste gas may be emitted elsewhere under other economic activities. For this reason, the balance between verified emissions and free allocation from the EEA Data viewer are not presented

preventing carbon leakage, although many suggested that the effectiveness of free allocation has declined following the Phase IV reforms to free allocation rules (especially with regards to the reduction of the BM values).

Better targeted benchmarks in Phase IV and provisions to better align free allocation with actual levels of production indicate that the selected benchmarks for Phase IV (2021-25) are in most cases lower than the average emissions for 2021/22 and this indicates that the benchmarks have been set to incentivise further improvements in performance over Phase IV.

As the share of emissions covered by free allocation has declined in Phase IV due to more ambitious benchmarks this results in many industries suggesting that they are now facing a shortage in allowances. However, approximately 80-90% of the verified emissions of industry have nevertheless remained covered by free allocation at the start of Phase IV of the EU ETS²⁶. Therefore, it is highly unlikely that, despite a considerable increase in the EUA price and changes to the provision of free allocation in Phase IV, it is unlikely that they alone are responsible for the observed reduction in industrial emissions (refer to work undertaken in Section 8.3.4.1). Indeed, it is more likely that the emission reductions observed are primarily driven by a decline in levels of activity across industrial sectors in response to a range of external and unexpected events, unrelated to the ETS. Understanding the factors underlying the decline observed in activity is important for any evaluation to assess the effectiveness of the Directive.

While free allowances continue to protect industry from a high share of the direct cost of carbon, the extent to which the rising EUA price could have been passed through indirectly via electricity prices may have had a downward effect on the international competitiveness of European producers. Carbon leakage protection measures have, to a certain extent, offset this impact via indirect cost compensation (although ICC does not cover all sectors and is applied differently in the Member States that implement it).

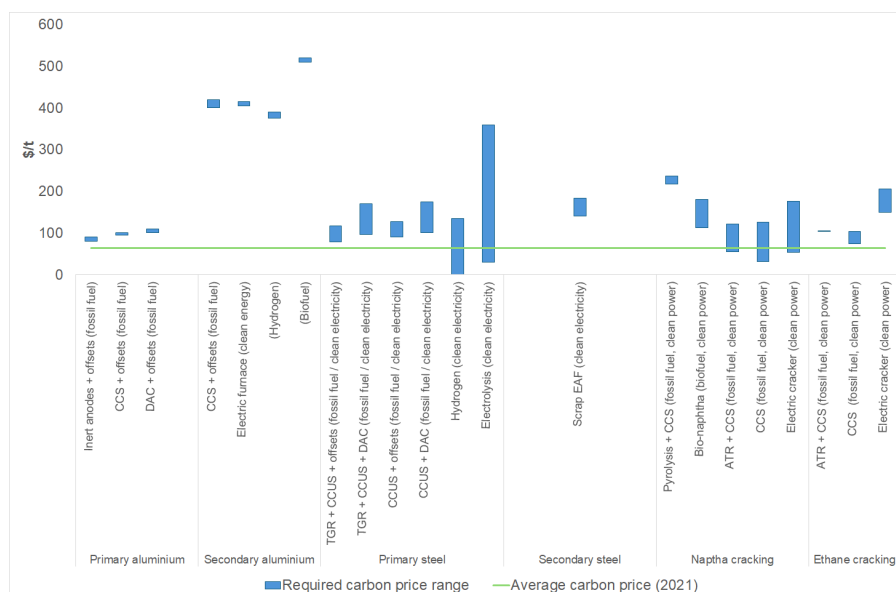
Based upon extensive interviews with industrial stakeholders during the consultation period, it was frequently explained that the reduction in activity levels has been the primary driver of the observed recent emission reductions. This can be attributed largely to the increase in energy prices observed since the start of Phase IV of the EU ETS as a result of several external events. However, industrial stakeholders indicated that the unilateral nature of the carbon cost has most likely also contributed to a difficult situation in terms of their recent competitiveness.

Several studies highlight that the EU ETS has largely failed to incentivise breakthrough innovations in these sectors. Carbon prices have remained below the threshold needed to make transformative technologies commercially viable. For example, the various carbon abatement options in the chemical industry can reach up to EUR 500 t/CO₂²⁷. According to modelling by BloombergNEF, the upper estimates of the required carbon price necessary to make a new-build net-zero technology financially viable exceeded the average EU carbon price in 2021 across a range of different abatement options in the aluminium, chemical and steel sectors (see Figure 6)

²⁶ Own calculations

²⁷ Lennard Rekker, Michaela Kesina, Machiel Mulder, 2023, “Carbon abatement in the European chemical industry: assessing the feasibility of abatement technologies by estimating firm-level marginal abatement costs”, <https://doi.org/10.1016/j.eneco.2023.106889>.

Figure 6: The estimated required carbon price range to make selected abatement options financially viable in the aluminium²⁸, chemicals²⁹ and steel sectors³⁰ compared to the average EU carbon price in 2021



Note: The average carbon price is based upon the annual average EUA auction price in 2021 accessed via the EEX and converted from EUR to USD using an average conversion exchange rate of 1.18 provided by OFX.³¹

Source: Own illustration based BloombergNEF data

There remains, however, a lot of uncertainty with regards to the marginal abatement cost of technological potentials across industry and this was reflected by a reluctance from stakeholders during interviews to provide an exact marginal cost per tonne of abatement. However, several stakeholders provided an indicative range of expected marginal abatement costs or explained the abatement options available in more detail.

- *Eurofer* noted that “with regards to the abatement costs per tonne for abatement potentials such as hydrogen steel, DRI and CCUS the numbers remain uncertain and potentially out of date now as it does not take into account impact of the recent energy crisis, but figures ranged from 100 to 200 EUR per tonne of abatement.” However, it was also added that a “comparison between the EU carbon price and the abatement costs does not reflect the business reality of investment decisions, which is heavily impacted by the international competition, both on the existing carbon intensive technologies, but also on the low carbon ones as well as on whole value chains.”
- *Cement Europe* stated that “at a minimum, the EUA price would need to reach levels of at least 200 EUR otherwise the cement sector simply does not have the business case

²⁸ For abatement options in the aluminium sector carbon price refers to what is required to make a new build net zero technology competitive with existing BAU technologies. A range of abatement prices are provided without specifying the year(s) of the required carbon price range.

²⁹ For abatement options in the steel sector carbon price refers to what is required to make a new build net zero technology competitive with existing BOF or scrap EAF capacity. 2050 values assume that all technologies have reached NOAK costs.

³⁰ For abatement options in the chemicals sector carbon price refers to what is required to make a new build net zero technology competitive with new build BAU technology. 2050 values are provided without a further explanation on how they were derived.

³¹ Yearly average rates - OFX (UK)

for deep decarbonisation without other funding options. So, the implication that arises is that the ETS as currently designed is not sufficient to drive the transformation required with additional reform and most likely without complementary policies to address issues that are beyond the control of the cement sector to influence directly.”

- *Fertilisers Europe* outlined several options, but all are currently associated with challenges undermining their potential uptake:
 - CCS: Is regarded as the most realistic measure that could become more financially viable with the carbon price rising but there are issues regarding complementary policies that are preventing the uptake of CCS in the fertiliser sector such as planning for CCS plants and the legislative requirements for such plants being set too high from day one.
 - Biomethane: While biomethane potentially could run within the existing production process the cost of biomethane is very high and in insufficient volume to make a shift at scale.
 - Electrification of ammonia production: The increase in production costs (potentially as high as four times the current cost production) is prohibitive and current provision of subsidies insufficient.
- *European Aluminium* highlighted the use of an inert anode as an important abatement option for reducing direct emissions but made clear that while technically possible this is not currently available at scale and is unlikely to be a viable option before 2035 and were not prepared to speculate on the cost of abatement. CCS and CCU would represent a fall-back option to the use of an inert anode, but these technologies are expensive to deploy. European Aluminium also refers to the uncertainty currently among their members in deciding upon their investment strategy. Should more money be invested in CCS ready smelting process now or should investment be delayed until the use of inert anodes or even direct air capture are available at scale?
- *Cefic* presented the key technologies that would help the chemical sector to reduce GHG emissions. These include:
 - Alternative energy carriers and sources: such as electrification, hydrogen as energy carrier, steam & heat from biomass and Small Modular nuclear Reactors (SMRs)
 - Circular carbon feedstock to close the carbon loop: using waste, CO₂ and bio-based feedstock.
 - Other solutions: Hydrogen from alternative production routes; process optimisation; CO₂ capture and storage.

Cefic declined to provide more detail on the marginal abatement costs for each of the proposed technologies as “it is extremely complex as it depends on the location where the technology project is implemented (i.e. country of implementation) and specificities of the project itself.”

An important benefit of including a large number or relatively diverse portfolio of sectors within the coverage of the EU ETS, all with different abatement costs, is that the emissions trading system can self-optimize which emissions can be abated most efficiently in the short-term and medium-term, while sectors with higher abatement costs (or complex abatement solutions) can plan the necessary measures for the long-term.

Despite the increase in the carbon price in recent years, the marginal cost of many abatement options remained higher across industrial sectors and therefore was insufficient to drive transformative change. Free allocation rules granted to emissions intensive, and trade exposed industries have historically lowered the price signal, thus reducing the incentive to invest in

decarbonisation technologies. Moreover, compared to the power sector, industry was not supported by other policies that encouraged the shift towards low carbon production. Indeed, industrial stakeholders were keen to emphasise that enabling conditions beyond the carbon price needed to also be delivered to encourage investments in low carbon technologies. The impact of changes to the free allocation in Phase IV, including the effects on incentives for abatement, are the focus of the evaluation for the topic of carbon leakage and further assessment on this is provided in Section 8.3.

Given that emissions were reduced over time in both the power and industrial sectors and both were exposed (albeit to different extents) to the carbon price signal, the following subsections summarises evidence from the literature that aimed to attribute the role of the EU ETS to the emission reductions observed.

Impact of the EU ETS on emission reductions in the power sector

The decline in emissions from the power sector must be considered in the broader context of reduced industrial activity. The more recent downturn in industrial output, driven by the energy crisis, high input costs, and weaker demand in energy-intensive sectors, contributed to a temporary reduction in electricity demand and, therefore, in power sector emissions (see Section 8.3.4 for more details).

Beyond these cyclical factors, emissions reduction in the power sector has been driven by a combination of the ETS price signal and a set of supporting policies³². The record drop in 2023 (-16.7% year-on-year) was driven largely by the accelerated deployment of renewable energy sources in the power sector facilitated by a robust carbon price. The increased uptake in renewable energy sources has been encouraged by different forms of public support schemes, including at the national level. Among the key support schemes, feed-in tariffs and feed-in premiums (including contracts-for-difference) have been implemented to expand renewable energy generation³³. Country evidence shows that explicit coal phase-out policies also played a crucial role in emissions reduction via fuel switching. In Germany, for example, auctions for compensated closures retired 10GW of coal capacity between 2020 and 2022 at low cost, while cancelling free allowances³⁴. These policies, combined with the increase in EUA prices, strengthened incentives for fuel switching from coal to gas, and made low-carbon investment more attractive. A recent econometric post-assessment of the ETS³⁵ applies a Bayesian structural time-series model to monthly emissions in 24 Member States, constructing a counterfactual path that controls for fuel prices, demand, weather, renewable generation and an index of overlapping policies and measures. The study attributes a 19% reduction in emissions from the power sector during Phase III to the ETS, net of other drivers.

Impact of the EU ETS on emission reductions in industrial sectors

The decline in emissions from the power sector must be considered in the broader context of reduced industrial activity. The more recent downturn in industrial output, driven by the energy

³² REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL on the functioning of the European carbon market in 2023, SWD(2024) 264 final

³³ European Commission, 2023. “The Development of Renewable Energy in the Electricity Market”, https://economy-finance.ec.europa.eu/system/files/2023-06/dp187_en_energy%20markets.pdf

³⁴ Silvana Tiedemann, Finn Müller-Hansen, 2022. “Auctions to phase out coal power: Lessons learned from Germany”, <https://doi.org/10.1016/j.enpol.2022.113387>.

³⁵ Ethan Eslahi, Anna Creti, María-Eugenia Sanin, 2025. “Mission accomplished? A post-assessment of EU ETS impact on power sector emissions reduction”, <https://doi.org/10.1016/j.ecolecon.2025.108784>.

crisis, high input costs, and weaker demand in energy-intensive sectors, contributed to a temporary reduction in electricity demand and, therefore, in power sector emissions (see Section 8.3.4 for more details).

While the energy crisis is likely to have played an important role in driving the emission reductions that have occurred in recent years across industry, there is evidence of the carbon price also influencing emission reductions. Overall, according to a study by the European Investment Bank³⁶, the observed emissions reduction in regulated entities within the manufacturing sector can be directly attributed to the application of the ETS Directive, especially to the Phase IV revision. The study reveals that the effect of the ETS prices on carbon efficiency and emissions reduction is more pronounced for sectors transitioning away from free allocation and into auctioning. Sectors that lost their carbon leakage status in Phase IV tended to improve their carbon efficiency to a larger extent and tended to have lower direct emissions compared to those that retained carbon leakage status. This suggests that when sectors bear the direct cost of their emissions, the incentives for them to reduce emissions is higher. A 2023 study³⁷ confirms that the emissions reduction experienced in Phase III of the ETS is attributed to increasing stringency in the Directive, which led to companies purchasing more EUAs due to a significant reduction in free allocation and stricter enforcement of rules. Incentives to decarbonise within the EU ETS are enhanced when companies are required to purchase allowances instead of receiving them for free. The linear reduction factor, which tightens the path of the emissions cap, further enhances this effect by increasing stringency and allowance scarcity.

Evidence shows that higher ETS prices have fostered carbon efficiency and emissions reductions within the EU manufacturing sectors. More specifically, the study by the European Investment Bank estimates the elasticity of carbon efficiency and emissions with respect to ETS prices on a panel of manufacturing sectors from 2012 to 2022. Using a difference-in-differences design, the authors conclude that a 1% increase in ETS prices leads to an improvement of carbon efficiency by 0.04% and a decrease in emissions of 0.05% in regulated sectors. This suggests a positive correlation between rising ETS prices and environmental performance. Moreover, the increase in the EUA price during Phase III of the ETS had a statistically significant and substantial impact on the emissions reduction compared to Phase II. More specifically, a study by Bordignon & Gamannossi degl'Innocenti³⁸ employs a quasi-experimental econometric approach based on panel data from 2008 to 2020 to estimate that, for each additional allowance bought, there was a decrease in emissions of approximately 0.5 tonnes of CO₂-eq. The study conservatively estimated of a total emission emissions reduction in CO₂-eq is of 422 Mt, which represents 22.5% of the average yearly EU ETS emissions or 4.3% in Phase II. CO₂-eq. The significant reduction is attributed to a tightening of ETS regulation.

The empirical literature provides growing support for a causal contribution of the EU ETS to emissions reductions in covered sectors, with increasingly robust identification strategies applied over time. Evidence based on long-run aggregate data is provided by Klimko and

³⁶ European Investment Bank, 2024. “A positive trade-off: Emissions reduction and costs under Phase IV of the Emissions Trading System”, https://www.eib.org/attachments/lucalli/20240297_economics_working_paper_2024_05_en.pdf

³⁷ Bordignon, M., & Gamannossi degl'Innocenti, D. (2023). Third Time's a Charm? Assessing the Impact of the Third Phase of the EU ETS on CO₂ Emissions and Performance. <https://doi.org/10.3390/su15086394>

³⁸ Ibid

Hasprová (2025)³⁹, who analyse annual EU27 data covering the period 2005-2022, spanning all four trading phases. Using ordinary least squares (OLS) regressions, the authors relate total ETS-covered CO₂e emissions to macroeconomic variables, including GDP, total and corporate investment, the average EUA market price and a time trend. Their results show a statistically significant negative relationship between allowance prices and emissions, as well as a negative role for corporate investment, suggesting that the ETS price signal and capital adjustment are important drivers of emissions reductions over time. While this approach does not employ a counterfactual or quasi-experimental design and therefore does not allow phase-specific causal estimates, it provides consistent econometric evidence that the ETS has been an important explanatory factor behind the decline in ETS-covered emissions between 2005 and 2022.

Stronger causal identification for the EU ETS prior to Phase IV is provided by the European Central Bank (2023)⁴⁰, who use sector-level panel data covering the period 2000–2016, covering the first three trading phases. Their empirical strategy combines fixed-effects panel regressions with a difference-in-difference-in-difference design, exploiting variation across time, sectors and regions. Specifically, they compare emissions trends in ETS-regulated industries within the EU to the same industries in non-EU regions and to unregulated sectors, therefore constructing a credible counterfactual for emissions developments in the absence of the ETS. The authors estimate an average treatment effect of approximately six percentage points, indicating that emissions declined significantly faster in regulated EU sectors following the introduction and tightening of the ETS than in comparator groups. Although the analysis does not extend into the fourth trading period, it provides robust causal evidence that the ETS accelerated emissions reductions beyond what would have happened in absence of the intervention due to global trends, sectoral restructuring or other contemporaneous policies alone.

Direct causal evidence for the fourth trading period is provided by Willemaers (2025)⁴¹, who focuses specifically on the Phase IV reforms affecting free allocation. The study uses installation-level data from the EU Transaction Log covering the period 2015-2023, capturing both the end of Phase III and the first years of Phase IV implementation. The empirical strategy exploits the exogenous, policy-driven reduction in free allocation that occurred between 2020 and 2021 following benchmark updates and a narrower carbon-leakage list. Treatment intensity is defined as the installation-specific loss of free allocation, and causal effects are estimated using a continuous difference-in-differences design with installation and year fixed effects, complemented by an event-study analysis to test for parallel pre-trends. The results show that a 10% reduction in free allocation is associated with roughly 3.5% lower verified emissions in the post-2021 period. This finding provides quantitative evidence that the tightening of effective carbon constraints in Phase IV translated directly into lower emissions at the installation level, strengthening the causal attribution of observed reductions to the Phase IV design of the EU ETS.

³⁹ Klimko, Hasprová, 2025. “The impact of the EU ETS on Greenhouse Gas Emissions in the EU from 2005 to 2022”, *ECONOMICS AND ENVIRONMENT*11(92)

⁴⁰ ECB Working Paper Series No 2764 / January 2023, Benefits and costs of the ETS in the EU, a lesson learned for the CBAM design <https://www.ecb.europa.eu/pub/pdf/scpwps/ecb.wp2764~3ff8cb597b.en.pdf>

⁴¹ Arthur Willemaers, 2025. “Cutting Free Allocation Cuts Emissions: Evidence from Phase IV of the EU ETS” (Working Paper). 2025. {hal-05400137}

An additional study by the European Central Bank (2026)⁴² compares the effects of a weaker carbon price signal pre-2017 and of the stronger carbon price signal following the regulatory reforms analysed in this evaluation. The study is based on a sample of over 5000 EU ETS installations, representing approximately 90% of the total verified emissions in the EU ETS. The study concludes that a weak carbon price signal generates little meaningful firm-level response, with the pre-2017 EU ETS emissions largely unchanged among regulated firms. However, the rise in carbon prices after 2017, due to the reform of the EU ETS and the start of the MSR operations resulted in firms exposed to carbon pricing reducing their emissions, while maintaining output and therefore implying efficiency gains rather than output contractions. Thirdly, ECB study finds that the market for corporate control emerges as a channel through which firms realize these efficiency gains, with the high-exposed manufacturing firms significantly increased their acquisitions of green targets after 2017.

Feedback from respondents in the OPC was mostly aligned with the findings. Many respondents⁴³ pointed to the rise in carbon price in recent years (13% of respondents) and the tightening of the cap for Phase IV (26% of respondents) as concrete evidence of the system's effectiveness, and several respondents also cited observed emission reductions – particularly in the power sector – as proof that the ETS can drive abatement. At the same time, some stakeholders (7% of respondents) argued that a portion of power-sector cuts stemmed from complementary renewable-energy and coal-exit policies rather than the ETS alone, and a few industry respondents felt that, although prices have risen, they were not high or predictable enough to drive transformative investment. More details on the OPC responses are in the Synopsis Report.

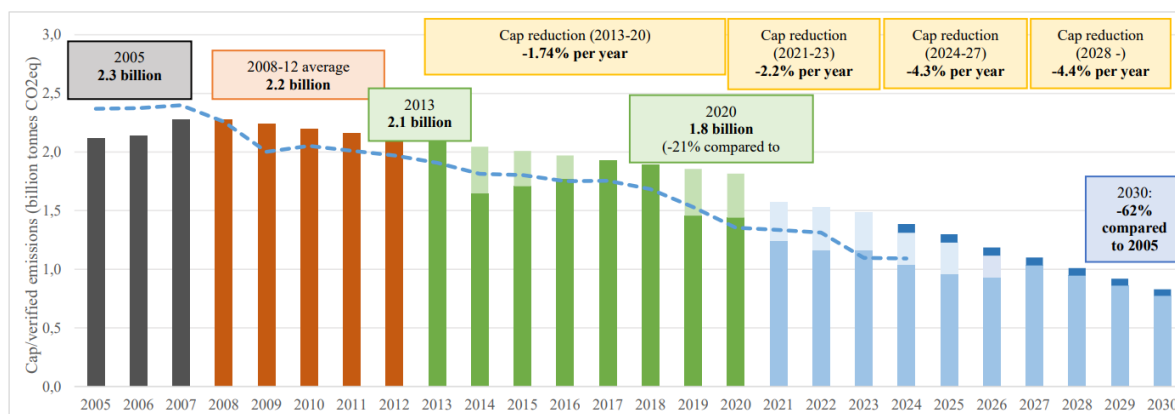
4.1.1.1.3 How do the observed effects correspond to the objectives of the Directive?

The objective of the ETS Directive is to reduce emissions in a cost-effective way, incentivising firms to invest in low carbon solutions and reducing emissions by putting a price on them. The improvement in carbon efficiency and reduction in emissions is identified as key objective of the ETS. Figure 7 shows the development of verified emissions in relation to the EU ETS cap over time. It shows a consistent downward trend in terms of emissions reductions. Verified emissions were lower than the annual cap in each year of Phase II of the EU ETS but this mainly reflected the onset of the economic recession of 2008/09 that mean that levels of activity were lower than anticipated when the cap was initially set. Therefore, policy interventions (i.e. such as the backloading of allowances or the introduction of the market stability reserve) subsequently managed the balance between the supply and demand of allowances, which increased levels of scarcity as the number of allowances in circulation was lower than verified emissions. Such scarcity has strengthened the carbon price signal over Phase III and especially into Phase IV and provides further incentives for long-term investments in low carbon technologies.

⁴² European Central Bank Working Paper Series, No 3253 (2026), “Climate Regulation, firm emissions and green takeovers”, [Climate regulation, firm emissions, and green takeovers](#)

⁴³ Question: “Please provide specific examples or evidence to support your assessment of effectiveness of the ETS Directive and MSR Decision”, 218 respondents

Figure 7: Evolution of the EU ETS cap from 2005 up until 2030 compared with verified emissions⁴⁴



Note: Emissions cap in the EU ETS compared with verified emissions. The figure considers the 2023 revision of the ETS Directive, i.e. rebasing of the cap in 2024 and 2026, including the maritime transport sector in the EU ETS from 2024 and the linear reduction factor of 4.3% in 2024-2027 and 4.4% from 2028. Aviation is not included. Due to changes in scope, the 2005-2007 figures are not directly comparable with the latest ones.

From 2021, the EU ETS no longer covers installations in the UK, only electricity generators in Northern Ireland. From 2024, verified emissions in the figure also include the maritime sector, hence the 2024 and 2023 emissions are not comparable. Legend: bars (cap), light shaded bars in 2014-2016 (allowances backloaded from auctions), light shaded bars from 2019 (feeds of allowances to the Market Stability Reserve), dark shaded bars from 2024 (maritime scope extension), dashed line (verified emissions).

Source: Own illustration

Evidence from the literature supports the argument that the ETS has been successful in enhancing carbon efficiency in regulated sectors. A study by Dechezleprêtre & al, (2023)⁴⁵ conclude that the EU ETS has been successful in reducing carbon emissions, and at the same time did not impact negatively economic performance and output. Instead, the study finds that the EU ETS led to a statistically significant increase in revenue and fixed assets of regulated firms, and it had no significant impact on profits or employment. This suggests that the system induced investment, which might have increased productivity. Phase IV has effectively accelerated sectors' reduction of carbon emissions⁴⁶. The more stringent rules in Phase III contributed to reduced emissions, while having an insignificant negative impact on capital, labour productivity, and output⁴⁷.

In terms of investments incentives, a study by Bounou & Dufau (2024)⁴⁸ shows that firms in regulated sectors immediately reacted to the Phase IV announcement in the 2015 proposal by increasing their R&D spending, which boosted output competitiveness despite a reduction in

⁴⁴ REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL on the functioning of the European carbon market in 2024, SWD(2025) 388 final

⁴⁵ Antoine Dechezleprêtre, Daniel Nachtigall, Frank Venmans, 2022. "The joint impact of the European Union emissions trading system on carbon emissions and economic performance", <https://doi.org/10.1016/j.jeem.2022.102758>.

⁴⁶ European Investment Bank (2024)

⁴⁷ Bordignon, M., & Gamannossi degl'Innocenti, D. (2023)

⁴⁸ Whelsy Bounou, Bastien Dufau, 2024. "EU ETS Phase IV and Industrial performance", <https://doi.org/10.1016/j.econlet.2024.111596>.

employment, which has been explained as substitution of labour with more productive capital. Lin & al (2019)⁴⁹ confirms that the EU ETS is consistent with the Porter Hypothesis, which states that environmental regulation can lead to increased efficiency and reduced costs. More specifically, the study finds that the innovation compensation effect generated by the EU ETS compensates the additional cost imposed on regulated entities, as observed in the pulp-and-paper sector. This outcome is in line with the overarching ETS objectives of reducing emissions while ensuring economic viability.

The ETS played a role in accelerating the phase-out of coal and has supported incremental innovation, such as improving energy efficiency and increasing patent activity in covered sectors⁵⁰. Some studies show a modest increase – up to 10% – in patenting in ETS-covered sectors compared to others, particularly for technologies that were near market-ready⁵¹. However, the price signal has not been strong or stable enough to drive transformational change, particularly in sectors like steel, cement, or chemicals that require innovation and infrastructure change. While there were examples of the carbon price driving rapid abatement (i.e. the improvements in the specific emissions of adipic acid production), energy intensive production such as hot metal for steel remains very limited. This likely reflects the high share of free allocation that remains available to industry as well as the carbon price not yet reaching a level that would make the more innovative abatement solutions financially viable. For additional details on the effectiveness of the carbon leakage prevention measures, see Appendix III, Section 8.3.4.1.

In addition, the impact of the Innovation Fund and Modernisation Fund in incentivising low carbon solutions is assessed in a separate evaluation (SWD(2026) 199) and SWD(2026) 197).

4.1.1.1.4 Has the revised ETS Directive been successful in improving the functioning and the resilience of the carbon market by addressing the surplus of allowances (which was identified in Phase III) by strengthening the MSR and increasing the LRF?

A surplus of allowances in the carbon market weakens the carbon price signal. The revision of the ETS Directive addressed this issue by strengthening the MSR rules and increasing the LRF, which defines by how much the cap of allowances reduces over time. The effect of these reforms has been increasingly visible. The carbon price rose steadily from around EUR 5/tCO₂ in 2017 to over EUR 80/tCO₂ in 2021, reaching levels that begin to reflect the external cost of emissions more accurately. Although the MSR has helped address some volatility, in Phase III, ETS allowances prices still fluctuated based on external shocks and trading behaviour, which weakened the long-term credibility of the price signal.⁵² Nearly two thirds of all OPC respondents⁵³ consider the MSR moderately to very effective in addressing the structural

⁴⁹ Weiming Lin, Jianling Chen, Yi Zheng, Yongwu Dai, 2021. “Effects of the EU Emission Trading Scheme on the international competitiveness of pulp-and-paper industry”, <https://doi.org/10.1016/j.forpol.2019.102021>.

⁵⁰ Nguyen, P.-V. and Pellerin-Carlin, T., 2021. “The EU ETS: from cornerstone to catalyst”, <https://institutdelors.eu/en/publications/the-eu-ets-from-cornerstone-to-catalyst/>

⁵¹ R. Calel, A. Dechezleprêtre, 2016, Environmental policy and directed technological change: evidence from the European carbon market

⁵² Europea Court of Auditors, Special Report 18 2020, The EU’s Emissions Trading System: free allocation of allowances needed better targeting

⁵³ Question: “How effective has the MSR Decision been in addressing the structural surplus of allowances that had accumulated in the EU ETS since 2009 (n=282)”

surplus of allowances in the EU ETS, including a majority of both private sector respondents and NGO respondents.

According to the European Investment Bank (2024)⁵⁴, the reforms introduced to address the oversupply of allowances have been successful in increasing the carbon price and thus increasing compliance with the EU ETS and reduction in carbon emissions.

A more detailed analysis on addressing the surplus of allowances via the implementation of MSR is provided in Section 4.1.2.

4.1.1.1.5 Has the EU ETS MRVA system supported the overall effectiveness of the EU ETS?

The detailed evaluation of the MRVA system presented in Appendix III, Section 8.4 concludes that the MRVA system ensured robust, transparent, consistent, and accurate monitoring and reporting of greenhouse gas emissions from industrial installations and aircraft operators. It examines four main aspects: the accuracy, completeness, and transparency of emissions data, the system's ability to prevent errors and misreporting, the effectiveness of the verification and accreditation processes in ensuring reliable data and compliance with EU ETS rules; the extent to which Member States have improved MRVA procedures and how these improvements have influenced overall compliance; and finally, how well the MRVA system has adapted to emerging challenges and what further enhancements could strengthen its effectiveness.

The MRVA system delivers high harmonisation and accuracy with standard methods used almost universally. The MRVA system ensures that nearly all emissions from activities listed in Annex I of the ETS Directive are monitored and reported, with only marginal delays or omissions. Clarity and consistency of reported data under the EU ETS MRVA remain high, supported by established inspection procedures, though their scope and frequency vary across Member States. Strict approval procedures and harmonised templates ensure a consistent and non-arbitrary application of monitoring methodologies across the EU ETS.

Verification under the EU ETS ensures that operators apply EU-approved methodologies and emission factors, and that emissions data are independently verified for accuracy. The EU ETS verification system ensures stringency and independence through robust accreditation, annual oversight, and consistently high compliance, though emerging capacity pressures because of the expansion of ETS activities pose risks to the quality of verification. Annual verifier audits provide comprehensive on-site coverage and effectively identify discrepancies, but recent findings suggest room for greater consistency across verifiers. There is a high level of confidence in the system's integrity and robustness, and competent authorities report that verified data are dependable enough to be used directly for compliance assessments, surrendering the right number of allowances and international greenhouse gas inventories, demonstrating institutional trust in verification outcomes. The accreditation framework under the AVR remains proportionate and robust.

Overall, the MRVA framework has proven adaptable to the evolving policy and operational challenges that arose over the evaluation period.

⁵⁴ European Investment Bank (2024)

4.1.1.1.6 Has the EU ETS auctioning system supported the overall effectiveness of the EU ETS?

The EU ETS auction system has been evaluated for its effectiveness in allocating emission allowances transparently and equitably across the EU. It operates in an open manner with well-defined rules and publicly available procedures, providing transparency and predictability for participants. The EEX, the appointed auction platform, manages auctions consistently and effectively for all member states and the EEA countries. To date over 3000 auctions were conducted with minimal cancellations, illustrating its reliability. The ETS auctions raised over 169 billion EUR in auction revenue during the period of the evaluation (and over 250 billion EUR in total to date). Auction volumes were calculated accurately, adhering to regulatory requirements. Results are published promptly, providing comprehensive information to stakeholders. Equitable access to allowances is ensured for all eligible parties, including SMEs, although many opt to use intermediaries in the secondary market. The system's regulatory framework, bolstered by MiFID II and MAR, prevents market manipulation and abuses, maintaining the integrity of the EU ETS. The EEX offers training and support for smaller emitters to encourage participation, contributing to the stable and competitive nature of the auctions. Overall, the auctioning system has successfully achieved its objectives and ensured a balanced distribution among different market participants.

4.1.1.1.7 Has the EU ETS registry system supported the overall effectiveness of the EU ETS?

The Union Registry has been evaluated for its effectiveness to maintain a reliable and secure IT system for tracking the creation, allocation, surrender and reversal of allowances. From 2018 to 2023, the Union was operational 99% of the time and encountered only minor technical interruptions due to scheduled upgrades, and some unexpected technical difficulties in 2020 causing temporary unavailability. The Registry effectively provides accurate, up-to-date, and publicly accessible information crucial for ETS reporting, ensuring transparency and accountability and supporting compliance monitoring, market integrity, and informed decision-making. However, a challenge is the limited availability of Legal Entity Identifiers (LEIs) for financial supervisory purposes, though these are being gradually integrated. The technical rules and requirements sufficiently support account holders and representatives.

Ensuring adequate security has been in focus, with a framework developed to protect data confidentiality and system integrity. Yearly IT Security Plans address potential risks through mitigation strategies. Although historical security measures have been effective, evolving risks, particularly the risks of cyber-attacks and issues like inadequate financial or human resources, underline the need to strengthen the security of the infrastructure and to revise the operating model. Studies and security plans have identified vulnerabilities, recommending additional security measures to adapt to the growing IT risks and market changes.

4.1.1.2 Efficiency

The efficiency of the EU ETS in achieving its objectives is evaluated based on the following questions:

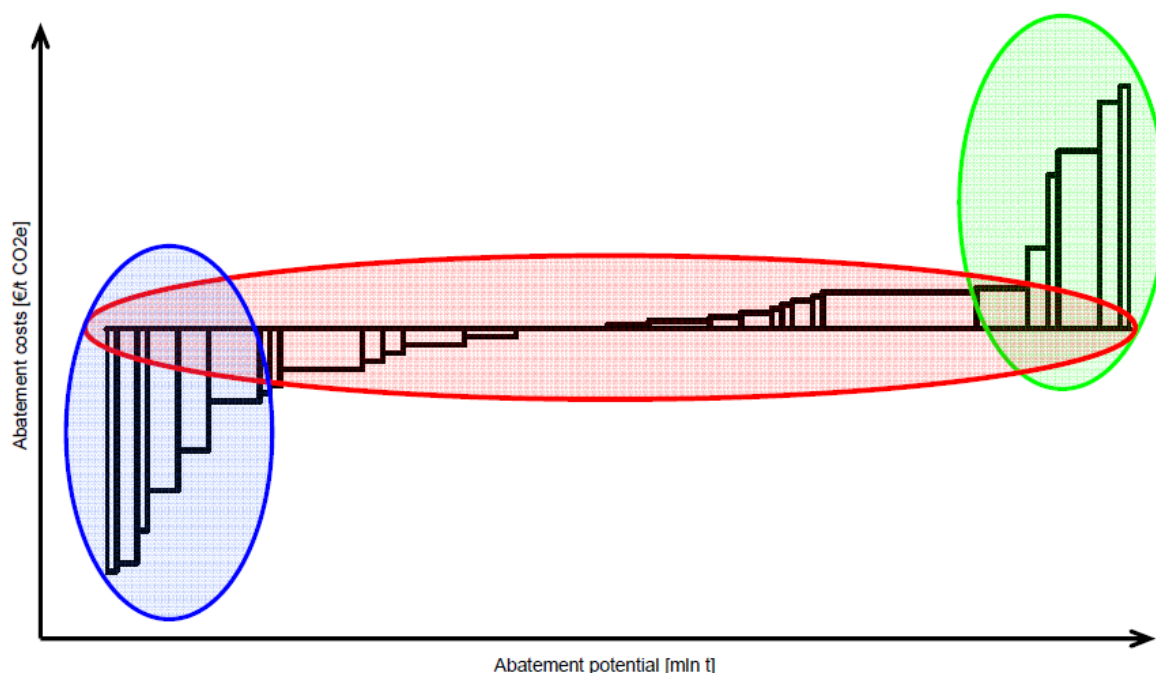
4.1.1.2.1 To what extent has the Directive been successful in achieving its objectives compared to alternatives, e.g. command and control measures, taxation?

From an efficiency perspective, the ETS Directive has generally been more successful in delivering cost-effective GHG emissions reductions than other regulatory approaches (namely,

command and control measures, and carbon taxes) and, in several respects, compares favourably with carbon taxation.

Figure 8 illustrates this relationship using a stylised marginal abatement cost curve. The central segment of the curve, where abatement options are more mature and cost-competitive, is well suited to market-based instruments, such as cap-and-trade systems or carbon taxes which equalise marginal abatement costs across the emitters. On the other hand, the left-hand side of the curve shows “locked” low or cost-saving potentials that are hindered by non-price barriers and usually require complementary regulatory measures, efficiency standards, or targeted incentives. At the opposite end, on the right-hand side, sit innovation-intensive or infrastructure-dependent options that require technology-specific support and long-term investment frameworks. The figure also helps to visualise how different policy instruments operate: a cap-and-trade system fixes the total quantity of emissions (i.e. how far an economy moves along the x-axis) and allows the market to determine the corresponding carbon price; a carbon tax fixes the price per tonne and allows the level of abatement to adjust accordingly; command-and-control measures prescribe fixed measures that do not necessarily correspond to the lowest points on the curve, which might result in overall higher costs.

Figure 8: Marginal Abatement Cost Curve



Source: Öko-Institut⁵⁵

Cap-and-trade systems such as the EU ETS combine the advantages of quality control with market flexibility. The Directive sets a total cap on emissions from covered sectors and distributes allowances, which firms may trade, ensuring that reductions occur where they are cheapest. In theory, according to Stavins (2022)⁵⁶, if taxes and trading are designed

⁵⁵ Öko-Institut, 2010. “Greenhouse gas emissions trading and complementary policies. Developing a smart mix for ambitious climate policies”. [Developing an ambitious climate policy mix](#)

⁵⁶ Stavins, Robert N., 2022. “The Relative Merits of Carbon Pricing Instruments: Taxes versus Trading”. *Review of Environmental Economics and Policy* 16, no. 1 (2022): 1-21. <https://www.journals.uchicago.edu/doi/abs/10.1086/717773>.

equivalently, they yield the same marginal incentives and aggregate abatement costs. In practice, experience shows that emissions trading has instead achieved larger cost savings compared to command-and-control rules, as in the US SO₂ programme⁵⁷, and that the EU ETS itself has delivered substantial reductions at moderate cost once early design flaws were corrected. Chen & al (2020)⁵⁸ similarly finds that cap-and-trade can reduce emissions more effectively than a carbon tax when allowance prices are robust, while rewarding firms that develop or adopt cleaner technologies.

The efficiency of the EU ETS has been shaped by its market design. Initial over-allocation of permits and price volatility limited abatement incentives in the initial phases. Recognising these shortcomings, the EU gradually improved the ETS. From Phase III onwards, substantial reforms were introduced to improve market functioning and to ensure the credibility of the price signal. Notably, the system moved from decentralised allocation to a centralised EU-wide cap, tightened the supply of allowances, introduced benchmarking for free allocation based on the most efficient installations, and made auctioning the default method for allocating allowances. The 2018 revision of the EU ETS reinforced this outcome by tightening the emissions cap, integrating the MSR to address surplus and price volatility (see Section 4.1.2), and further shifting from free allocation to auctioning and better targeting the allowances still allocated for free, thus improving the carbon price signal and allocative efficiency. The system has also induced innovation and emissions reduction in power generation and industrial processes, an outcome that rigid standards rarely achieve and that carbon taxes have encouraged only when rates were high and predictable⁵⁹.

Carbon taxes retain certain advantage, namely offering predictable marginal costs and a simpler legal structure and avoiding the price volatility sometimes seen in allowance markets. Taxes can also raise stable revenue without the complexity of allowance auctions or registries. However, they do not guarantee emissions reduction, and their rates are often diluted for competitiveness or equity reasons, which undermines efficiency. Command-and-control measures remain important where market failures or information problems prevent efficient market responses, but they are widely recognised as inferior as a primary climate instrument because they do not have the cost-minimising potential of trading or taxing⁶⁰.

Overall, the existing evidence from both theoretical and empirical studies suggests that the EU ETS has delivered significant efficiency gains compared with prescriptive regulation and has matched, and often exceeded, the cost-effectiveness of taxation. By aligning abatement across

⁵⁷ The sulphur dioxide (SO₂) allowance-trading programme established under Title IV of the 1990 Clean Air Act Amendments (CAAA) was the world's first large-scale pollutant cap-and-trade system. The stated purpose of the Acid Rain Program was to reduce total annual SO₂ emissions in the US by ten million tons relative to 1980, when total US emissions were about 26 million tons. In a departure from conventional environmental regulation, the legislation did not prescribe how power plants would reduce their SO₂ emissions. Instead, with a phase-in beginning in 1995 and culminating in 2000, the statute capped aggregate SO₂ emissions at the nation's 3,200 coal plants and created a market for firms to buy and sell government-issued allowances to emit SO₂. By 2007, annual emissions had declined below the programme's nine-million-ton goal (a 43% reduction from 1990 levels), despite electricity generation from coal-fired power plants increasing more than 26% from 1990-2007 (EPA 2012; EIA 2011). (Stavins, Robert N. "The U.S. Sulphur Dioxide Cap and Trade Programme and Lessons for Climate Policy." Vox. August 12, 2012.)

⁵⁸ You-hua Chen, Chan Wang, Pu-yan Nie, Zi-rui Chen, 2020 "A clean innovation comparison between carbon tax and cap-and-trade system", Energy Strategy Reviews, <https://doi.org/10.1016/j.esr.2020.100483>.

⁵⁹ Ibid

⁶⁰ Stavins, Robert N. (2022)

firms and providing flexibility over time, the Directive has reduced emissions at lower aggregate cost, while also stimulating technological change

4.1.1.2.2 To what extent are the costs resulting from the implementation of the Directive proportionate to the changes/effects it has achieved?

Cost of free allocation

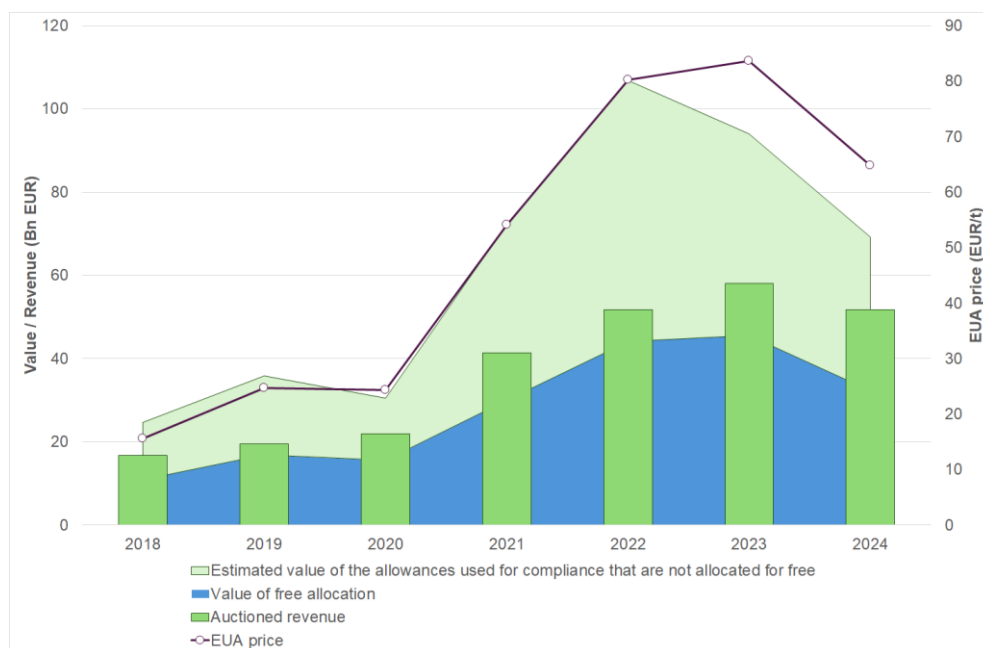
The EU ETS has created significant value in the form of allowances by placing a price on the right to pollute. The blue area in Figure 9 provides an estimation of the value of free allocation by multiplying the volume of total free allocation (includes volumes for free allowances allocated under Article 10a(1), Article 10a(7) and Article 10c) for each year by the average annual EEA price. The overall value of the free allocation provided is estimated to be around EUR 195 billion over the 2018-24 period.

The light green shaded area in Figure 9 shows an estimated value for the allowances used for compliance that were not allocated for free, and this was calculated by subtracting the total verified emissions for the EU-27 by the total free allocation for the EU-27 and then multiplying the difference by the average carbon price for the relevant year based on EEX report data.

Over the 2018-2024 period, the value of allowances that were assumed to be used for compliance and not allocated for free is estimated to be around EUR 238 billion. The value of the allowances used for compliance that were not allocated for free was then subsequently compared with actual annual data on auctioning revenues from the EEX platform (i.e. refer to the green bars in Figure 9). In practice, operators may not always go to the market for allowances as this will depend on whether they are long or short of allowances and whether they need allowances to cover their emissions (this will vary depending upon the uptake of abatement options as well as external events impacts activity and therefore emissions). The increase in revenues for the auctioning of allowances in recent years has been driven by the strengthening of the carbon price signal over the period.

In a counterfactual situation whereby all the allowances were auctioned, the value of allowances that were assumed to be used for compliance and not allocated for free over the 2018-2024 period would increase to around EUR 433 billion. This valuation assumes that operators do nothing to reduce their exposure to the carbon price, which is unlikely to be the case so the estimation should be viewed as the maximum potential value.

Figure 9: Estimation of the value of allowances compared to actual revenues from auctioning



Source: EEA EU ETS Data viewer (2025), EEX market reports, Own calculation.

While free allocation helps shield European industry from competitiveness impacts, it also distorts the carbon price signal by reducing the effective carbon cost faced by firms.^{61,62} Sectors with higher pass-through capacity firms may pass the notional cost of allowances to consumers while still receiving them for free, leading to windfall profits rather than actual emissions reductions or innovation. A report by CE Delft⁶³ identified cost pass through to be the largest driver of windfall profits, with an estimated EUR 26-46 billion after adjusting for market share losses. This study shows that in almost all sectors, the additional profits from cost pass through largely outweighed any loss in profits due to reduced market share. The iron and steel, refineries and cement sectors accrued respectively EUR 16 billion, EUR 12 billion, and EUR 7 billion of windfall profits from carbon cost pass through⁶⁴.

Although cost pass through helps internalise the cost of carbon, windfall profits arising from free allocation do not necessarily contribute to decarbonisation. Free allocation is considered to be the primary cause of windfall profits under the ETS. As the system matures, a reduction in free allowances, combined with increased auctioning and the full implementation of the EU CBAM is expected to reduce these undue rents and improve the system's effectiveness, while still shielding industries from international competition. The extent to which the cost of free allocation is considered proportionate will ultimately depend on whether free allocation prevented the relocation of industry due to carbon pricing. There is not yet firm evidence of

⁶¹ Nguyen, P.-V. and Pellerin-Carlin T. (2021)

⁶² Scotti, F., Flori, A., Crescenzi, R., & Pammolli, F., 2025. "Demand-pull and technology-push environmental innovation: a policy mix analysis on EU ETS and EU Cohesion Policy". *Climate Policy*, 25(2), 153–170. <https://doi.org/10.1080/14693062.2024.2366894>

⁶³ Additional profits of sectors and firms from the EU ETS 2008-2019, Delft, CE Delft, May 2021

⁶⁴ However, the cost pass through rates applied in the CE Delft study were based on a range of literature sources that are not accepted by industrial sectors who argued strongly during the stakeholder consultation that their ability to pass through costs were very limited.

carbon leakage occurring at a large scale (refer to Section 8.3.4.1) and industrial stakeholders have also frequently noted during interviews undertaken for the evaluation of the importance of free allocation in limiting the relocation of industry due to carbon pricing.

Costs and benefits for different stakeholders - Member States, industry sectors and SMEs

The distribution of costs and benefits under the EU ETS varies across Member States, industry sectors, and firm sizes. Member States bear administrative costs related to the operation of national registries, MRV systems, enforcement, and the allocation and auctioning of allowances. At the same time, Member States receive most of the revenues from the auctioning of allowances, which governments can reinvest in climate and energy programmes. Regulated industries face compliance obligations, as they must monitor emissions, surrender allowances, and bear the cost of purchasing permits if free allocation is insufficient. Energy-intensive or trade-exposed sectors often benefit from free allocation, and/or cost compensation for indirect carbon costs, helping to mitigate the competitiveness risks and to reduce the cost imposed on firms. Larger companies can take advantage of economies of scales to spread additional costs, including reporting costs caused by MRV compliance, across greater output, hedge against allowance price volatility, and invest in efficiency or fuel-switching technologies to reduce their emissions and thus the cost of complying with the Directive. SMEs typically face proportionally higher compliance costs because MRV compliance may need to be outsourced and capital for low-carbon investment is generally scarcer. SMEs might gain from ETS flexibility and provisions for smaller firms. SMEs can choose the lowest-cost abatement options, bank or sell surplus allowances if they reduce emissions below their cap, and, in some cases, obtain free allocations or apply for EU or national funds (e.g., Innovation Fund) financed by auction revenues. These elements offer opportunities to offset part of the administrative burden, although access depends on sector eligibility and the firm's capacity to engage with support mechanisms. At EU level, the European Commission bears administrative and analytical costs associated with the period review of benchmarks and the preparation of the carbon leakage list, as well as for the maintenance and security of the Union Registry. The 2018 revision increased these responsibilities by expanding the scope of benchmarking and carbon leakage assessment.

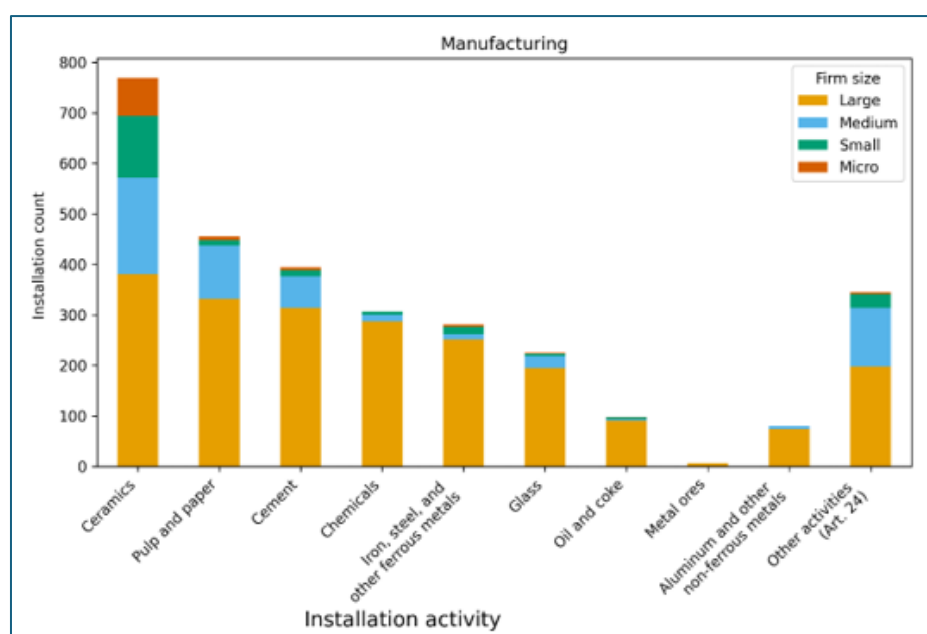
Evidence from the Open Public Consultation (available in Annex 2 of the Impact Assessment) shows that most respondents consider the overall cost of implementing the EU ETS to be moderate or good compared with the environmental and market outcomes, although a sizeable minority, especially smaller operators and energy-intensive industries view administrative requirements as burdensome. These perceptions are echoed in the targeted operator survey on free allocation, which found that, compared with Phase III, most installations reported either slightly or significant higher administrative costs when applying for free allocation in Phase IV. The increase was most frequently mentioned by combustion, lime/dolomite, ceramics, and other energy-intensive sectors. Across company sizes, most respondents reported an increase in administrative and compliance costs, but larger installations (>500), which are the most represented size in the survey in terms of responses, more often indicated that costs had increased significantly, while micro-operators (<10 employees) were more likely to either report a slight increase or being unsure.

In addition to the public consultation, analysis of SME coverage by EU ETS was conducted using the Orbis database (a commercial database that contains economic and financial data on around 600 million companies worldwide) and an ETS matching tool developed by the

European Commission⁶⁵. This analysis identified companies in the database that are operators of ETS installations, and identified which of these were SMEs, using the official European Commission definitions⁶⁶. Micro enterprises have fewer than 10 employees and a turnover, or a balance sheet total not exceeding EUR 2 million; small enterprises have fewer than 50 employees and a turnover, or a balance sheet total up to EUR 10 million; and medium-sized enterprises have fewer than 250 employees, with a turnover not exceeding EUR 50 million or a balance sheet total not exceeding EUR 43 million. The Orbis database has known limitations (in particular under-representation of small firms and uneven representation across countries) but was nevertheless considered the best tool available for conducting analysis of the corporate structure of ETS operators (as opposed to the size of their installations).

The analysis identified 7,685 operators of stationary ETS installations and found that 26% of these were SMEs. Most of these were medium-sized enterprises (19%) rather than small (6%) or micro (2%). It also found that the ceramics sector had the highest proportion of SMEs, in particular micro and small enterprises, as Figure 10 shows.

Figure 10: Number of ETS operators per sector and company size identified in Orbis analysis



Source: Own calculation

To improve the proportionality and reduce compliance costs across stakeholder groups, the 2018 ETS Directive introduced targeted interventions addressing administrative and financial burdens. Article 10(4) requires that auctioning rules guarantee full, fair, and equitable access for SMEs and small emitters and ensure that participation remains cost-efficient and does not impose undue administrative costs. Article 27a(1) further allows Member States to exclude very small installations from the ETS, namely those emitting less than 2500 tonne/CO₂-eq annually, or operating for less than 300 hours per year, provided that adequate measures are in

⁶⁵ European Commission, “Matching the EU Transaction Log to the Orbis database” https://single-market-economy.ec.europa.eu/single-market/chief-economist-business-intelligence-unit/analytical-work/single-market-industry-and-competitiveness/matching-eu-transaction-log-orbis-database_en

⁶⁶ Commission Recommendation of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises. ELI: <http://data.europa.eu/eli/reco/2003/361/oj>

place, and thus avoiding disproportionate compliance costs. Introduced prior to the 2018 revision, Article 27(1) continues to allow Member States to exclude installations emitting less than 25,000 tCO₂e per year provided they are subject to equivalent national emission reduction measures.

The Orbis analysis mentioned above was undertaken in 2025, after the 2018 revision. This implies that the SMEs identified are either operating installations with capacities above the thresholds of Art 27 / Art 27a, or that the Member States where they are located have chosen not to exercise the exemptions permitted by these articles.

Overall, the provisions introduced by the 2018 revision aim to streamline administration, enhance cost-effectiveness, and ensure that the burden of participating in the EU ETS better reflects each stakeholder's capacity and exposure to competitive pressure.

4.1.1.2.3 Has the monitoring, reporting and verification of greenhouse gas emissions covered by the EU ETS been carried out cost effectively and are there any apparent options for simplification with a view to reduce administrative burden on relevant stakeholders?

The detailed evaluation of the MRVA system presented in Appendix III, Section 8.4. concludes that MRVA costs are not perceived to have increased significantly between Phase III and Phase IV although reported costs associated with MRVA are higher than previously identified. Based on a standard cost methodology, total costs for all operators of stationary installations range from EUR 0.2 – 0.9 billion per year. When expressed as cost per tonne of emissions, this gives a range of 0.2 to 0.8 euro/tonne CO₂.⁶⁷ These costs per tonne CO₂ are higher than in the 2016 administrative cost study,⁶⁸ which gave an average of EUR 0.16 per tonne CO₂. This cost increase can be explained by inflation, increases in labour costs and the inclusion of some costs for free allocation in the estimates. However, it is also possible that some efficiencies, for example through implementing standard tools, more harmonisation between Member States and improving guidance, may have been offset by additional requirements in some areas such as those related to the requirement of the operator to demonstrate compliance of biomass fuels with sustainability and greenhouse gas savings criteria laid down in the Renewable Energy Directive. Even though some stakeholders indicated that the requirements related to metering for stationary installations have become more cost intensive, there is no clear reason for that emanating from the regulation. Compared to 2016 the rules on measurement of fuel consumption or material production have not changed significantly. However, these costs remain small per unit of emissions.

Aircraft operators generally face smaller MRVA costs per unit of emissions than operators of stationary installations, except for verification fees. The relatively more straightforward monitoring and reporting requirements for the aviation sector contribute to lower costs and fewer days staff-time for MRVA activities. Based on 378 active aircraft operators, total costs ranged from EUR 12 – 20 million. With total emissions of the aviation sector of 54 MtCO₂ in 2023⁶⁹, the costs range from EUR 0.2 - 0.4 per tonne CO₂. The fact that verification fees are similar to those for stationary installations is in itself not strange but the fact that the number of days spent on the verification also shows an increase is surprising as the rules in 2023 have not changed significantly since 2016.

⁶⁷ Based on total emissions from stationary installations in 2023 taken from Article 21 reporting.

⁶⁸ Evaluation of EU ETS Monitoring, Reporting and Verification Administration Costs, 2016

⁶⁹ Data provided under Article 21 reporting

While the reported costs for competent authorities responsible for administering MRV procedures are higher than previous studies, with total cost estimates based on survey results are in a range of 7 – 13 million euro,⁷⁰ these are small relative to MRV costs for operators of stationary installations.

MRVA costs identified as an issue by both stationary installations and aircraft operators but, for most responding to the survey, they still represent a relatively small proportion of the overall ETS compliance costs. The difference in costs between different types for stationary installations reflect the complexity of the industrial process covered and the level of emissions. Installations in the chemicals, oil refining, and cement sectors generally incur per installation costs above the average. This is likely attributable to the greater complexity of processes and/or higher emission levels typically associated with these sectors. The MRVA requirements for installations in these areas account for both the complexity and scale of operations to ensure accurate emissions reporting and uphold environmental integrity. Using a standard cost approach, the cost per tonne of CO₂ for refining and cement sectors are on the lower side because of the higher emissions. Minerals and glass and pulp and paper report relatively high costs per tonne of CO₂. In pulp and paper, there are a high percentage of installations that use biomass (50% and 29% respectively)⁷¹, which adds complexity to the MRV processes due to the need to demonstrate compliance with the sustainability and greenhouse gas savings criteria laid down in the RED II Directive.

Smaller installations bear relatively higher costs per unit of emissions than the larger installations, despite efforts to simplify requirements for these installations. The smallest installations report relatively high equipment costs. The costs per tonne of CO₂ decrease as the size of the installation increases, with small installations reporting particularly high costs per tonne. This was also found in the 2016 report on administrative costs, with Category A installations facing costs per tonne CO₂ around 50 times that of Category C.^{72,73} In the current study, the difference between these two categories is about the same or narrower depending on the approach taken in the estimates. Over the years several measures were taken to simplify the monitoring requirements for the smaller installations whilst ensuring the environmental integrity and robustness of monitoring and reporting. Installations of low emissions can apply less strict monitoring requirements in accordance with Article 47 of the MRR. Category A installations are not required to meet the highest tiers. Conditions have been included in legislation to allow to waive site visits for smaller and simple situations with low verification risks. All these measures, including the increased use of templates, IT systems and guidance, have facilitated the implementation of MRV and made the system more effective. Nevertheless,

⁷⁰ There are 31 competent authorities, 27 Member States plus Iceland, Liechtenstein, Northern Ireland and Norway. The competent authority in Liechtenstein is not very active as only two installations were included in the EU ETS in the period 2021-2023. In the fourth trading period these installations are no longer in the EU ETS.

⁷¹ European Commission: Directorate-General for Climate Action, 2024. “Application of the European Union Emissions Trading Directive – Analysis of national responses under Article 21 of the EU ETS Directive (reported data in 2023)”, Publications Office of the European Union, <https://data.europa.eu/doi/10.2834/662983662983>

⁷² Category A includes installations with emissions lower than 50 000 tonnes of CO₂eq. A sub-set of this category are installations with emissions below 25 000 tonnes of CO₂eq, called installations with low emissions. Category B includes installations with emissions more and equal to 50 000 and less and equal to 500 000 tonnes of CO₂eq. Category C includes installations with emissions higher than 500 000 tonnes of CO₂eq

⁷³ Evaluation of EU ETS Monitoring, Reporting and Verification Administration Costs, 2016

smaller installations still report higher costs: to some extent because of the use of biomass, or because smaller installations do not always have simple monitoring requirements or robust MRV procedures.

Stakeholders in the EU ETS feel that efficiency in the MRVA system could be improved and brought forward ideas, through the survey, interview and the reality check workshop. Most of these suggestions for improvement related to the free allocation process as allocation benchmark rules are perceived to be complex and require often additional costs.

The options for improvements and streamlining related to the MRV of emissions identified by respondents to the survey and OPC broadly fall into the following categories:

- Changes to the requirements for site visits for verification.
- Changes to deadlines of reporting and less frequent verifications.
- Greater harmonisation on interpretation of materiality risk.
- Harmonising EU ETS/RED/Waste Framework Directive requirements.
- Standardised opt-out provisions
- Less strict MRV requirements for installations that have stable emissions and strong compliance records.
- Relaxing requirement on monitoring accuracy.
- Further simplifications for small installations.
- More timely provision of guidance and templates.
- More streamlining with the Industrial Emissions Directive (IED).
- Greater consistency in templates and IT tools across jurisdictions.
- Better alignment between EU ETS and CORSIA.
- Simplification of procedures for competent authorities.

While potentially providing some efficiencies, many of the options have implications for environmental effectiveness or legal/practical implications that need more consideration. The MRVA system has already been streamlined and simplified as it has developed, motivated by increasing cost efficiency but also improving equal treatment. Nevertheless, there are likely still further opportunities for improving efficiency that could be considered. Both survey and consultation results from the ETS and MSR evaluation indicate that Phase IV reforms strengthened traceability and consistency, but stakeholders felt that it did not totally deliver on simplification, leaving administrative burden a key concern for future MRVA improvements.

From the suggested improvements no options stand out as priorities for regulatory change within EU ETS, but some need more consideration as to whether they might be incorporated in regulatory change in future or whether other actions, such as clarified guidance or additional training, are needed. These include:

- Simplifications in the requirements for installations emitting less than 50 kilotons CO₂ with very simple monitoring methodologies and low inherent and control risks. Most simplifications are already accommodated in the Monitoring and Reporting Regulation and low risks in simple and small installation often require less extensive verification approaches.
- Simplification of uncertainty requirements smaller source streams and allowing a wider application of default values for the emission factors and calorific value for certain fuels. Generally, the current MRR already allows simplification on uncertainty assessment and the application of default values for commercially standard fuels. But further research may reveal additional opportunities for simplification.

- Further streamlining procedures or reporting requirements between IED, EU ETS and other legislation, regarding the reporting requirements to avoid overlap in reporting data.
- Simplification through digitalisation. Digital technology is already being used to improve efficiency and accuracy but there is still untapped potential. Various tools have been developed and implemented to help improve efficiency of the MRVA system and increase the accuracy of reported data. Templates have been developed by the European Commission for monitoring plans, emission reports, verification reports and improvement reports (for installations and aviation).⁷⁴ Additionally, the European Commission has developed an IT tool called ETS Reporting Tool MRV (ERT), designed to facilitate the submission of monitoring plans, emission reports, verification reports, and improvement reports. This tool helps streamline reporting to reduce administrative burden and improve the accuracy of reporting and increase compliance of installations. The ERT is a web-based platform offering advanced features for all stakeholders and applies to sectors covered by the EU ETS.⁷⁵ In the survey, around half of the competent authorities responding have implemented the ERT. Of those that have more than half reported that it had improved efficiency and quality of reporting significantly or slightly. Fewer competent authorities in the survey reported having developed their own IT system but those that had reported that it had improved efficiency

4.1.1.2.4 Has the auctioning system been an efficient way of allocating ETS allowances?

The auctioning system for ETS allowances is considered a more efficient way of allocating allowances, especially when compared to free allocation. Auctioning provides a market-based approach that ensures allowances are allocated to those who value them most, reducing risks like over-allocation and windfall profits. Additionally, auctioning generates revenues for governments that can be utilized for climate change mitigation and adaptation efforts. It has shown effectiveness in reducing emissions more significantly than free allocation, due to stronger incentives for companies to invest in abatement measures. Another advantage is the reduction of market manipulation and enhancement of transparency, essential for a functional emissions trading scheme. Despite administrative and financial resources required for auctioning, such as selecting the auction platform and managing procedures, it is less resource-intensive compared with tasks associated with free allocation, like setting benchmarks and reporting activity levels. The differences in auction clearing prices compared to secondary market prices have been minor, indicating competitiveness of the auctioning process. Overall, auctioning has successfully adapted to changing requirements and increased revenues for environmental initiatives. Though SMEs face participation barriers due to costs, they can access allowances through intermediaries or the secondary market.

4.1.1.2.5 Has the Registry system been operating in a cost-efficient way?

The Union Registry displays robust operational efficiency supplemented by security measures. However, it faces ongoing challenges due to evolving cybersecurity threats and resource limitations. Recommendations have been made to enhance security measures and reconsider

⁷⁴ European Commission, “Monitoring Reporting and Verification”. https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/monitoring-reporting-and-verification-eu-ets-emissions_en#tab-0-1

⁷⁵ Ibid

its business model to better align with financial market frameworks to ensure the integrity of the European carbon market.

The Registry system's cost efficiency can also be evaluated based on the fees charged by Member States and the annual costs of operating and maintaining the Registry incurred by the Central Administrator (European Commission). Overall, the Registry system has significant variations in fees across Member States and insufficient resources to protect the confidentiality and integrity of the system by the Central Administrator. Different studies proposed a new operating model to address these issues, with an estimated investment of EUR 32.8 million per year. This investment represents only 0.00016% of the assets held in the Union Registry and would ensure the integrity and security of the system and integrity of the European carbon market.

4.1.1.3 Coherence

4.1.1.3.1 To what extent is the Directive coherent with other EU policies, such as those related to renewable energy, energy efficiency, state aid, etc.?

The EU ETS has evolved to improve coherence both across EU instruments and within its own regulatory architecture, although some tensions remain. Externally, complementary EU-level policies such as the Renewable Energy Directive (RED) and the Energy Efficiency Directive (EED) have contributed significantly to decarbonising the power sector, which is one of the ETS's main coverage areas, by reducing fossil fuel-based electricity generation and overall energy demand. While these outcomes align with the broader objective of emissions reduction, in practice these overlapping policies have also undermined the ETS price signal by reducing demand for ETS allowances, especially prior to the reform of the ETS cap adjustment mechanism. This exposed to a degree of external incoherence, where complementary policies aimed at a common goal (emissions reduction) operated in ways that were not fully integrated with the market logic of the ETS.

The 2018 revision addressed overall coherence through the integrated modelling that underpinned the 2030 climate and energy framework. The Impact Assessment supporting Directive (EU) 2018/410 used modelling to test combined policy scenarios for GHG reductions, renewable energy, and energy efficiency, ensuring that the ETS cap and trajectory and allowance supply mechanism were consistent with parallel objectives in the RED and EED. The scenario identified as the most coherent, which combines a 40% GHG emissions reduction target with moderate renewables and energy efficiency measures, was found to deliver the targets at the lowest macroeconomic cost in terms of GDP.

The introduction of the MSR in 2019 helped to address the long-criticised waterbed effect by allowing allowance supply to respond to changes in demand, including those induced by overlapping policies like RED and EED. In principle, this enables real emissions reductions by cancelling unused allowances. Moreover, by linking the volume of auctioned allowances to the total number of allowances in circulation (TNAC) and introducing automatic invalidation of persistent surpluses, the post-2018 system allows the effective supply of allowances to adjust to market conditions and to policy-driven changes in demand.

However, as argued by Willner & Perino (2022)⁷⁶, the MSR has introduced new layers of complexity: while it responds effectively to unforeseen shocks, its interaction with anticipated

⁷⁶ Willner, M., & Perino, G., 2022. "Beyond Control: Policy Incoherence of the EU Emissions Trading System". *Politics and Governance*, 10(1), 256-264. <https://doi.org/10.17645/pag.v10i1.4797>

policy changes can dampen abatement incentives in the short term and complicate predictability. Overall, coherence has improved since 2018, but the system's dynamics have become more intricate, underscoring the importance of maintaining transparency in the MSR functioning and periodically reviewing its parameters to ensure continued effectiveness and coherence.

In the Open Public Consultation, respondents were asked to express their view on the external coherence of the EU ETS and MSR. Most respondents agreed that the EU ETS and MSR were coherent, to varying extents. Nevertheless, feedback from the stakeholder consultation stressed that, despite reforms such as the MSR and updated free allocation rules, ensuring both internal and external coherence remains a continuing challenge, particularly in relation to interactions with other EU climate and energy policies, and international frameworks.

4.1.1.3.2 To what extent are the various elements of the Directive (such as free allocation, carbon leakage, innovation support) coherent with one another?

Internally, the Directive has made efforts to balance environmental integrity with competitiveness and fairness. A key example is free allocation, which, while a deviation from the polluter-pays principle, remains justified as a transitional measure to address the risk of carbon leakage. Although free allocation might weaken the carbon price signal by preventing operators from being fully exposed to the carbon price, more targeted allocation based on updated benchmarks and declining free allocation shares have improved its internal coherence. In this way, free allocation can be understood not as a contradiction to the ETS logic, but as a pragmatic safeguard that supports the broader policy goals of EU climate leadership and industrial resilience. Similarly, the MRVA framework enforces internal coherence by ensuring that emissions are measured accurately, transparently, and homogeneously across all sectors and Member States. This high level of data integrity is essential to maintain trust in the cap-and-trade system, as it ensures that allowances correspond to real-world emissions, and that policy adjustments are based on verifiable outcomes. In this sense, the MRVA is not just a technical pillar to the ETS, but a central element that enables the system to effectively meet its climate objectives effectively.

Auctioning and the use of auction revenues are key elements supporting internal coherence. Auctioning reflects the polluter-pays-principle and ensures that carbon costs are internalised by operating firms, while the revenues generated complement free allocation. These revenues finance instruments such as the Innovation Fund (Article 10a(8)), which supports investment in industrial decarbonisation and low-carbon technologies, the Modernisation Fund (Article 10d), which supports the modernisation of energy systems and the improvement of energy efficiency of the lowest-income Member States. Together, these mechanisms support a coherent package of incentives for innovation and decarbonisation, and safeguards to support competitiveness, therefore reinforcing the objective of cost-effective emissions reduction of the ETS.

4.1.1.3.3 To what extent is the Directive coherent with international climate policies and obligations?

In terms of alignment with international objectives, the EU ETS is explicitly framed as a central instrument for achieving the EU's commitments to the Paris Agreement, including its NDCs (Nationally Determined Contribution). While the EU ETS is the central tool for reducing emissions in power, industry, aviation – which together account for around 40% of EU's total GHG output – its scope during the evaluated period did not cover emissions from maritime,

buildings and road transport, land use, and agriculture. Indeed, the ETS alone was not designed to deliver on its own the EU's full climate ambition, including the 2030 target of at least 55% emission reductions and the goal of climate neutrality by 2050. Additional policies such as the Effort Sharing Regulation, the introduction of the maritime sector in the EU ETS, and a newly approved second ETS (EU ETS 2), which will cover buildings and road transport from 2028, have been developed or are already in place. Together, these instruments are intended to form a more comprehensive and coherent policy framework capable of supporting the EU's 2030 targets and the longer-term objective of climate neutrality by 2050.

4.1.2 Market Stability Reserve

4.1.2.1 Effectiveness

The evaluation of the effectiveness of the MSR focuses on how successful the instrument has been in achieving and progressing towards its objectives. It uses where possible quantitative analysis complemented by qualitative assessments from existing studies and academic literature as well as stakeholder interviews. The evaluation focuses on two aspects of effectiveness: whether the MSR achieved its objectives, considering effectiveness in a broad sense; and, evaluating effectiveness in a narrow sense, it compares the expected effects of the instrument against the actual effects and developments in the EU ETS. Expected effects are those identified in the MSR Impact Assessment (IA) from 2014 for the years 2013 to 2017. For the years following the 2018 reform, the evaluation draws from the 2021 MSR Review. For a detailed outline of MSR reforms and a discussion of the suitable points of comparison, see Section 2.2.

In addition, the invalidation mechanism introduced in 2018 and reforms under the Fit for 55 package is also evaluated, as well as the price developments over the evaluation period together with price drops related to shocks and other events, assessing the role of the MSR for long- and short-term price changes. Closely related to the development of price is the question of how the MSR has been able to increase confidence in the allowance market, the EU ETS as instrument and the regulatory commitment of the EU and the Member States to a strong carbon market. This question is evaluated in the same subsection.

4.1.2.1.1 Achievement of objectives

4.1.2.1.1.1 Approach of evaluating achievement of objectives

Effectiveness in a broad sense evaluates whether the MSR has achieved its stated objectives. The first specific objective of the MSR is to reduce the excessive historical surplus that built up before the adoption of the MSR. The starting year of the evaluation is 2012, i.e. the base year of the 2014 IA, which featured a calculated TNAC at the end of the year of 1,750 million EUA. Of these, 917 million EUAs, i.e. the volume above the MSR's upper threshold of 833 million, can be considered as excess historical surplus. The MSR was effective in achieving its first objective if it reduced the TNAC by this volume.

The second specific objective of the MSR is to mitigate the build-up of any new surplus caused by supply and demand imbalances. For the effectiveness evaluation, an undesired build-up is defined as any increase of the TNAC from 2013 onwards. The second objective targets supply and demand imbalances in general, i.e. not just situations in which supply exceeds demand in response to unforeseen events or shocks but also situations of exceptional scarcity in which demand exceeds supply. As there is not yet a situation of the latter type of imbalance in the market, the evaluation focusses on the build-up of TNAC between 2013 and 2024 and how the MSR was able to mitigate this.

To assess the effects of the MSR on the TNAC and the achievement of the second objective, the actual TNAC is compared to an ex-post baseline, a simplified hypothetical counterfactual scenario without the MSR constructed after the fact. For this purpose, the operational MSR intakes⁷⁷ of each year are added to the reported TNAC, re-adding the supply that has been reduced because of the MSR (see Figure 11 below). This approach, however, neglects any dynamic effects of the MSR on the allowance demand, i.e. the verified emissions, and in turn on MSR intake and allowance supply in individual years. A strengthened EUA price or increased scarcity in the market would be expected to result in reduced emissions and hence allowance demand. This then would increase the TNAC and MSR intake. In consequence, the ex-post baseline overestimates the TNAC in the absence of the MSR and hence MSR effectiveness. However, this dynamic effect on allowance demand is unlikely to be dominant, and the ex-post baseline can be considered the robust way to assess the effect of the MSR on the TNAC.

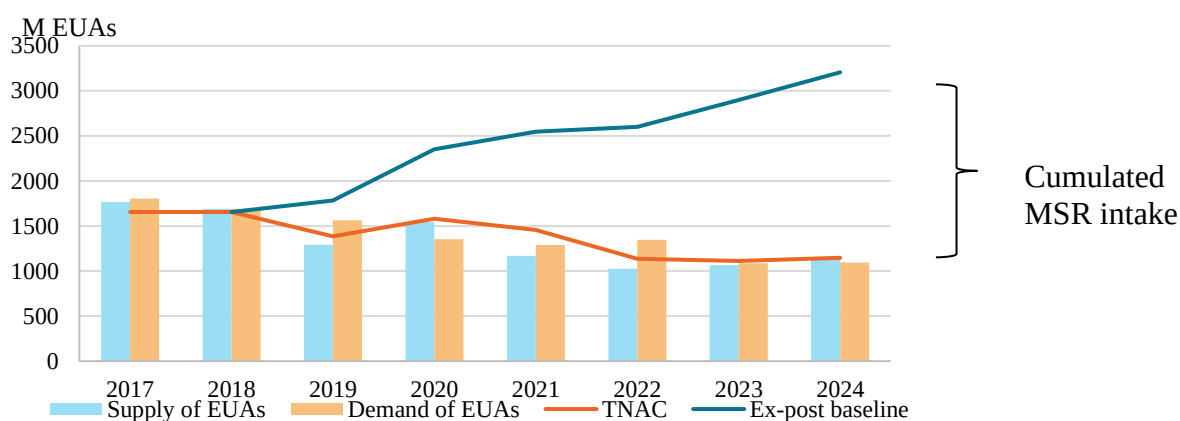
4.1.2.1.1.2 Development of demand, supply, and TNAC

As the objectives of the MSR focus on the number of allowances in circulation, this section starts with a description of demand and supply of allowances in each year after the baseline year 2012 to assess how the TNAC, which is the accumulation of supply and demand imbalances over time, has developed. For each year, main regulatory and economic events that influenced supply or demand are explained. Figure 11 shows the annual figures for demand and supply of allowances and the development of the TNAC⁷⁸. It also presents the ex-post baseline as point of comparison of the MSR effects. Between 2012 and 2018, before the start of the MSR operations in 2019, the TNAC decreased from 1,750 to 1,655 million EUA (in part due to backloading). From the start of the MSR to the end of 2024, TNAC decreased to 1,148 million EUA.

⁷⁷ The official MSR intake as published in the annual TNAC Communications refer to an intake from September of a year $t+1$ to August in $t+2$ for a TNAC in year t . We use the term operational MSR intake as the intake for a calendar year.

⁷⁸ Note that the evaluation focuses on emissions from and allowances used by stationary installations only as the TNAC is based on these, leaving aside allowance supply and verified emissions for aviation.

Figure 11: Demand, supply⁷⁹, and TNAC from 2017 to 2024.



Source: Own illustration

There are no official TNAC announcements for the period 2013-2016 and so this period is not included in the figure above. However, apart from 2013, verified emissions for stationary installations were higher than or at least at par with allowance supply in the EU ETS. That means, even before the MSR went into force, the number of banked allowances in the EU ETS was decreasing. In 2018, the TNAC was 95 million EUA lower than in 2012 after the following developments:

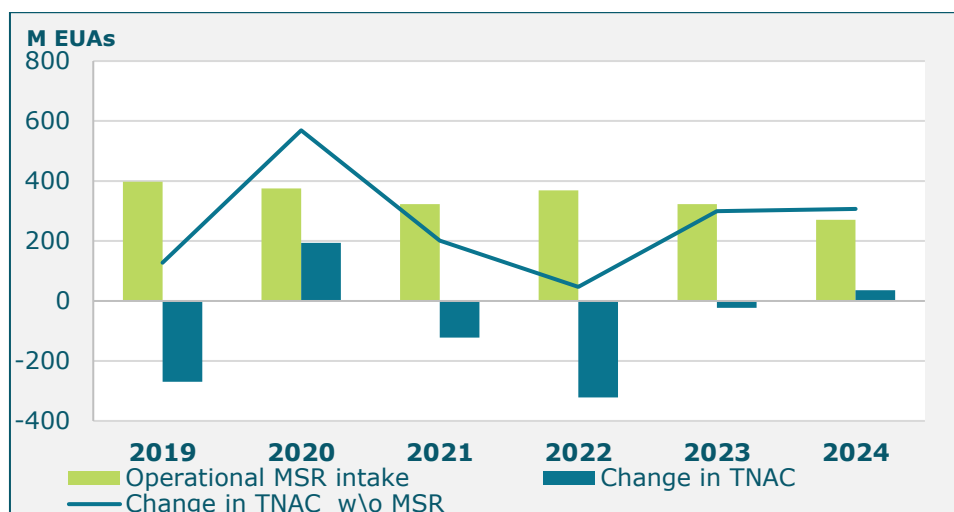
- One of the major contributors to the decrease in TNAC was the backloading of 900 allowances between 2014 and 2016. It is reasonable to assume that 2018 TNAC levels would have been above 2012 levels in the absence of this intervention. While the backloading of allowances did not have a noticeable effect on allowance prices, it was effective in reducing the surplus of allowances in the market.
- Another element that contributed to TNAC reduction was the decrease of offset inflow in the EU ETS. The rules for offset use for EU ETS compliance became considerably more stringent from Phase II (2008-2012) to Phase III (2013-2020). In Phase III, newly generated carbon credits were required to originate only from projects in least developed countries. Credits from industrial gas projects were excluded altogether, although carbon credits issued until 2012 could still be used for compliance in 2013 and 2014. (ICAP Status Report 2024) Hence, offset supply spiked in 2012 with 493 million credits, was still considerable in 2013 and 2014 (129 and 247 million credits, respectively) and dropped below 30 million credits for each year between 2015 and 2020.

In 2017, demand exceeded supply by 39 million EUA. In 2018, the difference between allowance supply and verified emissions was marginal. By then, allowance supply had dropped sufficiently to be at par with verified emissions without any additional cap adjustments. Verified emissions were relatively stable in this period, indicating the absence of any major demand shocks but also low progress on decarbonisation.

⁷⁹ Ex-ante supply is decreasing over time following the cap reduction. Ex-post supply reflects adjustments for e.g. MSR intake, Brexit from 2021, and scope expansion to the maritime sector from 2024.

The MSR started operating in 2019. Figure 12 below presents the operational MSR intake, the resulting change in TNAC as well as a hypothetical change in TNAC in the ex-post baseline scenario without the MSR. The latter is the sum of change in TNAC and MSR intake.

Figure 12: MSR intake; actual and ex-post baseline changes in TNAC



Source: Own illustration

This shows that in its first year and including an MSR intake of 367 million EUAs, allowance demand, i.e. verified emissions, exceeded supply by 269 million. It is very likely that the TNAC would have increased in the absence of the MSR (ex-post baseline scenario).

The pandemic year of 2020 brought an unanticipated demand shock which contributed to adding 194 million EUA to the TNAC, even in the presence of the MSR. This is caused by the restrained economic activity and a drop in verified emissions from 1,562 to 1,352 Mt EUA from 2019 to 2020. At the same time, EUA supply to the market increased from 1,293 to 1,546 Mt EUA when the suspended UK auctions and free allocations in 2019 were compensated for in 2020.⁸⁰ In total, the TNAC thus increased in 2020 despite an MSR intake of 376 million EUA. Part of this increase in TNAC occurred due to the shift of supply from 2019 to 2020, i.e. the TNAC decrease in 2019 would have been lower in the absence of this effect.

The following years 2021-2023 saw again a decline in TNAC (blue bars), with the help of MSR intakes above 300 million EUA per year (green bars). The years 2021 and 2022 featured similar levels of verified emissions as 2020. Here the economic recovery after the pandemic increased emissions but the withdrawal from UK entities from the EU ETS reduced them. Allowance supply was below verified emissions with the help of the MSR, leading to a considerable TNAC decrease. The Russian invasion of Ukraine in February 2022 and the energy price crisis led then to another economic downturn accompanied by a drop in verified emissions in 2023 and 2024. At the same time, verified emissions were at par with allowance supply, leading to marginal changes in 2023 and 2024, respectively.

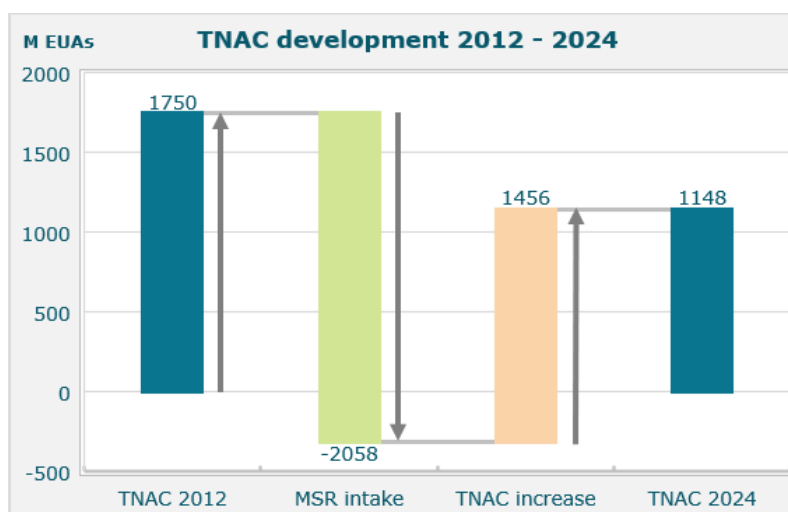
⁸⁰ DG CLIMA, 2020. “Lifting the suspension of UK-related processes in the Union Registry of the EU ETS, news article 31 January 2020”, https://climate.ec.europa.eu/news-your-voice/news/lifting-suspension-uk-related-processes-union-registry-eu-ets-2020-01-31_en

4.1.2.1.1.3 Conclusion on historical surplus (until 2012) and new surplus (added between 2013 and 2024)

Considering the base year for this evaluation is 2012, the starting volume of TNAC is 1,750 million EUA. Given this starting value, everything above the MSR upper threshold of 833 million EUA was assessed as being excessive historical surplus. Hence, there was an excess historical surplus of 917 million EUA in 2012. Since the MSR started operating in 2019, its total operational intake until 2024 was 2,058 million EUA. This volume exceeded, together with the 900 million EUA from backloading in 2014 to 2016, the excess historical surplus by far. It can be concluded that the MSR successfully achieved its first objective of reducing the historical surplus in the allowance market.

The second objective of the MSR targets new surplus that built up between 2013 and 2024. From the perspective of 2012, this can be considered as future surplus. We can define additional surplus as any increase in TNAC, resulting from an imbalance of demand and supply over the evaluation period. Figure 13 below shows how in aggregate the MSR intake of 2,058 million EUA exceeded the initial TNAC of 1,750 million EUA. However, the TNAC would have increased by 1,456 million EUA in a simplified ex-post baseline scenario, leading to an actual TNAC in 2024 of 1,148 million EUA. In other words, the MSR intake did not fully cover the new demand-supply imbalance that built up between 2013 and 2024, as the TNAC of 1,148 million EUA in 2024 was still above the targeted level of 833 million EUA. While the significant drop in TNAC since 2012 is a success, it did not fully tackle subsequent demand-supply imbalances. In consequence, the MSR achieved its second objective albeit only partially.

Figure 13: Aggregate development of TNAC between 2012 and 2024



Source: Own illustration

Part of this overall success needs to be attributed to the backloading of 900 million allowances between 2014 and 2016 that were later transferred to the MSR and subsequently invalidated. The backloaded allowances consequently did not return to the market, as initially planned. Without this measure, the build-up of new surplus would have been higher.

Looking at individual years, apart from 2020 and 2024 since the MSR entered into force, the operational MSR intake exceeded the reduction in TNAC. It is hence likely that without the MSR, the TNAC would have increased in these years, so the demand-supply imbalance would

have increased. With the MSR, TNAC levels decreased, although the target level of 833 million has not been reached yet.

In a counterfactual baseline, allowance supply was still above verified emissions between 2019 and 2024. It is likely that emissions reductions induced by climate policy measures (e.g. an increase of renewable capacity) and unanticipated demand shocks (e.g. economic downturns) reduced verified emissions by more than the amount that the Linear Reduction Factor has reduced the cap over the same period. When supply exceeds demand in a given year, by construction the MSR only removes a part of the imbalance (i.e. 24% with the current intake rate) as long as it is outside the buffer zone. Once the TNAC is between 833 and 1096 million EUA, all new surplus is transferred to the MSR which ensures per construction full effectiveness. Above the buffer zone, the MSR is by design delayed in its effectiveness and as long as TNAC builds up the MSR can only be partially effective in addressing demand-supply imbalances.

4.1.2.1.1 Comparison of actual outcome to baseline assessment

4.1.2.1.1.1 Approach for evaluating actual versus expected MSR effects

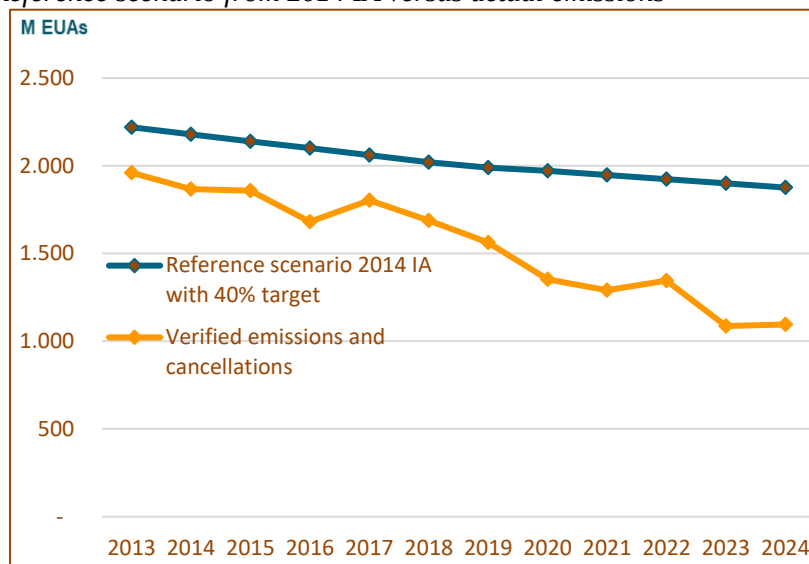
The second part of the effectiveness evaluation analyses if the effects of the MSR occurred as expected when the mechanism was designed in the early 2010s and whether unforeseen developments or unintended effects leading to a higher or lower TNAC or to the MSR behaving in a different way have since occurred. For this, actual EU ETS data should in theory be compared to a baseline describing a scenario set up before the adoption of the instrument.

The main baseline should in general come from the impact assessment of a policy. In this case, the Commission undertook an impact assessment for the MSR in 2014. It modelled different scenarios and options for the adoption of the MSR described in Section 2.2. The next section compares actual market outcome in the period from 2014 to 2017 to the assessment of Option 2d in the IA (with MSR start in 2017 and 2021). Because of the substantive reforms between 2018 and 2023, the design of the MSR has changed considerably. This makes it impossible to identify a suitable point of comparison in the 2014 IA to evaluate the MSR performance in the years 2018 to 2024. Instead, the evaluation will draw upon other existing analyses, particularly the MSR Review in 2021, as points of comparison. Section 4.1.2.1.2.3 compares the market outcome of 2021 to 2024 to the scenario in the 2021 MSR Review which hence serves as an alternative point of comparison.

4.1.2.1.1.2 Comparison of actual outcome to baseline from 2014 Impact Assessment

While the scenarios modelling the MSR options from the 2014 IA are not helpful for evaluating the MSR that has been implemented in 2019, the IA offers several important insights on the expected effects of the MSR and thus helps evaluating its conception and identifying where assumptions in 2013/14 did not turn out to be valid. One example is the reference scenario used in the IA.

Figure 14: Reference scenario from 2014 IA versus actual emissions



Source: Own illustration

The reference scenario from the 2014 Impact Assessment presents a scenario that fully implements all existing policies, including backloading, renewable energy targets, emission reduction targets for 2020 (20%) and 2030 (40%) and the implementation of the Energy Efficiency Directive. It depicts a world without the MSR that is more ambitious regarding the implementation of climate policies compared to the 2014 IA baseline scenario (IA 2014, p. 8ff.). The reference scenario is hence a better point of comparison for the evaluation than the baseline scenario, as it is closer to the actual EU climate policy ambition in the evaluation period.

Figure 14 compares the emissions profile under the reference scenario with the actual verified emissions (incl. a small number of voluntary allowance cancellations which are accounted for together). It is striking that the emissions path from the reference scenario significantly overestimates emissions in the EU ETS. In 2024, emissions were around 45% below the expectations in the reference scenario. That means, emission reductions were much higher than expected. This likely results from a combination of three types of unanticipated developments: First, the expectation of increased ambition of the EU ETS in the lead up to the adoption of the European Climate Law and the Fit for 55 package led to a stronger signal for emissions reductions through an increased EUA price already in 2018 (see subsection on prices below). The expectation was then confirmed when the higher linear reduction factors were implemented in 2021 and 2024. Second and related to increased ambition, other climate policies to decarbonise the EU ETS sectors, especially in the power sector, reduced emissions more than expected. Third, political and economic events like Brexit, the COVID-19 pandemic and the energy price crisis reduced emissions significantly. Note that even in years of high economic activity (e.g. in 2015 or 2018), emissions declined more than expected. The 2021 MSR Review calculates that the annual cap decline rate between 2013 to 2019 was 1.95%, compared to a decline of verified emissions of 3.57%, attributing this mainly to policies inducing a decrease in emissions from electricity and heat (Vivid 2021, p.35). In a way, this positive development of unexpected emissions reduction contributed to the fact that there is still a remaining demand-supply imbalance in the EU ETS.

It is important to underline that the objective of the MSR is to strengthen and stabilise the EU ETS but not necessarily to increase its ambition. If the MSR contributed to strengthening

confidence into the EU ETS and supporting EUA prices, it led to lower verified emissions thereby potentially reducing its own activity. Because emissions levels decreased and are below the allowance supply even in 2024, TNAC levels are still above the MSR upper threshold of 833 million EUA and hence the MSR only partially achieved its second objective. For the 2014 IA, it can be concluded that the reference scenario underestimated the problem to be addressed by the MSR and in consequence expected a more pronounced MSR effect.

Figure 3 in the 2014 IA shows the expectation that both allowance supply and demand will decline at a relatively low rate in the reference scenario with demand exceeding supply from 2022 and the total surplus accordingly increasing slowly until 2022 and decreasing afterwards (see 2014 IA, p. 9). The focus of the MSR design was in consequence on the excess historical surplus and not on future demand-supply imbalances. However, both demand and supply decreased at a faster rate than expected. The latter materialised through an increase of the Linear Reduction Factor from 1.74 to 2.2 in the 2018 reform and to 4.3/4.4 in the Fit for 55 reform. Both effects increased the relevance of future demand-supply imbalances compared to the excess historical supply. The starting point for the 2014 IA did not consider these unexpected developments.

As a result of the overestimation of verified emissions in the reference scenario, the actual TNAC was higher than in the modelled scenarios from the 2014 IA – in the range of 15% to 20% for the years 2014 to 2016. For 2017, TNAC is around 1,450 million EUA if the MSR is implemented in Phase III (2017) and 1,550 million EUA if in Phase IV (2021) in the Option 2d scenario that serves as a point of comparison for this evaluation. When the MSR started operating in 2019, the actual TNAC was 1,655 million EUA. This was even though the implemented intake rate at 24% was higher than what was proposed by Option 2d (100 million EUA if TNAC is above 1,000 million EUA, i.e. $\leq 10\%$). The observed TNAC remained high despite the relatively low prices between 2013 and 2017 which imply a low incentive to reduce emissions and in consequence high verified emissions. Both reduce the TNAC at a given level of allowance supply. These were the circumstances under which the MSR became operational in 2019.

Note that MSR elements can take effect long before they become operational as each reform changes expectations of EUA prices and in consequence mitigation behaviour. The MSR likely had an effect before it entered into operation in 2019. This effect was however not considered in the quantitative analysis of the 2014 IA. The modelled Option 2d with a start in 2021 should have display effects already in 2017 due to the anticipation of market participants. It is likely that the verified emissions and TNAC in 2017 were influenced by this anticipatory effect.

4.1.2.1.1.3 Summary of findings on MSR effectiveness from Vivid study for 2018-2024

As explained in the point of comparison analysis of the MSR above, the years 2018 to 2024 cannot be compared to the 2014 IA as the 2018 reform fundamentally changed the instrument compared to what was assessed in the IA. In the absence of a point of comparison, this evaluation draws on the conclusions from the 2021 MSR Review (SWD(2021) 601 final) based on a 2021 Vivid Economics study.

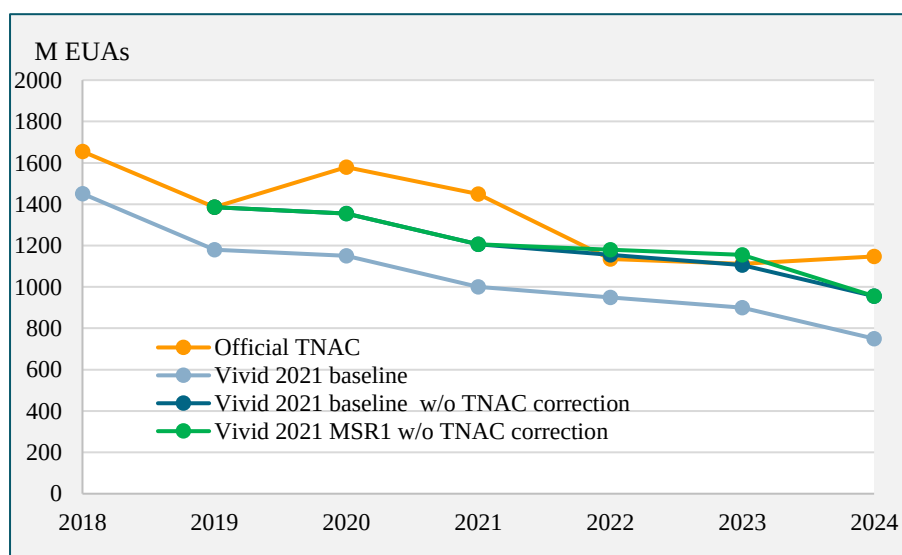
The 2021 MSR Review has two elements. First, a backward-looking perspective for the years 2018-2020 for which the review assessed how the MSR has performed drawing on the conclusion of the legal review (Annex 7 of SWD(2021) 601 final) as well as Section 3.2 in the study by Vivid Economics. In essence, the MSR Review confirmed the finding that the MSR successfully addressed the historical surplus, already in its first years of intake in 2019 and

2020. In line with this assessment, it identifies the overestimation of verified emissions as an obstacle to the reduction of TNAC to the target levels and hence to MSR effectiveness.

Second, the 2021 MSR Review has a forward-looking section modelling future scenarios of MSR developments given political and economic events and shocks. Chapter 4 and 5 of the Vivid Economics (2021) study discuss future risks for the MSR and design options to improve the functioning of the MSR which feed into an impact assessment of future MSR design in Annex 8 of the official MSR Review. The forward-looking analysis from the 2021 MSR Review can serve as alternative point of comparison for the evaluation of the years 2021 to 2024: the baseline scenario represents the MSR as implemented in 2019 based on the outcome of the 2018 reform.

The 2021 MSR Review raises the point that an inadequate TNAC calculation interferes with the MSR effectiveness (see Vivid 2021, 54ff.). It highlights that the net demand from aviation and linking with the Swiss ETS overestimates the TNAC, i.e. the number of allowances that are available to the market is lower than the calculated and published TNAC. In consequence, the Review infers that the MSR intake was higher than it would have been with a corrected TNAC. The study authors hence correct the TNAC start value in 2019 for the baseline scenario for their impact assessment (see Vivid 2021 baseline). As the official TNAC has not yet been corrected, the current analysis adjusted the modelling results from the 2021 MSR Review by adding a constant term that reflects the 2019 TNAC correction conducted by Vivid Economics (labelled as “w/o TNAC correction”).

Figure 15: TNAC 2018 to 2024: Official data versus baseline and MSR1 from 2021 MSR Review



Source: Own illustration

The baseline and the MSR1 scenario in the 2021 MSR Review can serve as alternative points of comparison for the MSR evaluation (see Subsection 2.2 above for a detailed description of the modelled scenarios). Figure 15 presents the official TNAC and the modelled TNAC for the years 2018 to 2024. For the years 2020 and 2021, the effect of the COVID-19 pandemic leading to reduced verified emissions is visible. In consequence, the model results underestimate the TNAC significantly.

A similar phenomenon can be observed for 2024. In response to the energy price crisis and the induced economic downturn, as well as high levels of electricity from renewable energy sources, verified emissions decreased significantly in 2023 and 2024. This led to an increase

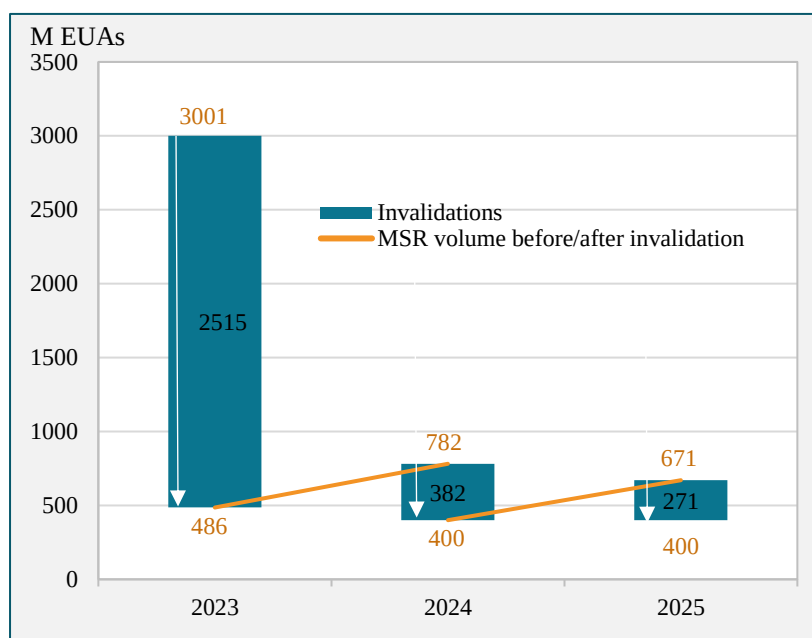
in the TNAC that was unexpected from the perspective of the 2021 MSR Review. The model results match the actual TNAC in 2022 and 2023. In 2022, the economic recovery after the pandemic matched expectations of such recovery. Note that the modelling results lead to the dynamic effects of an increased TNAC in 2022 and 2023 in the MSR1 scenario (green line) compared to the 2021 MSR Review baseline (blue line). Because market entities anticipate an MSR reform to be implemented in 2024, prices increase even before that reflecting this anticipation, leading to earlier emissions reductions and in consequence a higher TNAC.

4.1.2.1.2 Effectiveness of invalidation mechanism

As described previously, the 2014 Impact Assessment did consider introducing an MSR together with a permanent retirement of an absolute number of allowances from the backloading volume in Option 3. However, the in 2015 adopted MSR did not include comparable design features and opted for a cap-neutral mechanism, limited to shifting allowance supply over time. Only in 2018, when the EU ETS required further strengthening, the adopted reform of the MSR included an invalidation mechanism, restricting the MSR volume to the auction volume of the previous year and invalidating all allowances above that threshold, starting in 2023. With the Fit for 55 reform, the threshold was then changed from a dynamic threshold to the fixed level of 400 million allowances that cap the MSR volume.

Option 3 in the 2014 IA is not a useful point of comparison for the implemented invalidation mechanism. The substantial difference is that the permanent retirement proposed in the IA envisioned a retirement of a fixed number of allowances (500 million EUA) at a fixed point in time (in 2019 and 2020) (IA 2014, p.37). The introduced mechanism in turn implemented an automatic, rule-based process for retirement without prescribing volume and timing (apart from the start year 2023). Accordingly, the scenarios in the 2014 IA cannot be compared to the actual invalidations. At the time of adoption in 2018, there was no impact assessment estimating the number of allowances that would be invalidated given the new mechanism. Only the 2021 MSR Review conducted by a consortium around Vivid Economics modelled scenarios for the impact of the invalidation mechanism that can serve as point of comparison for the evaluation. It analysed two concrete configurations in four scenarios: the scenarios *Baseline* and *MSR1* modelled the 2018 configuration of the invalidation mechanism, and *MSR2* and *MSR3* modelled invalidation above an MSR volume of 700 million EUA starting in 2024.

Figure 16: MSR volume and respective invalidations



Source: Own illustration

Figure 16 presents the MSR holdings before and after invalidations and the respective invalidation volumes in the three operational years of the invalidation mechanism. 3,167 million allowances were invalidated so far in 2023, 2024, and at the beginning of 2025. In 2023, the 2018 configuration of the invalidation mechanism was still in force setting the volume of invalidated allowances to the auction volume in the EU ETS in 2022. For 2024 and 2025, the new configuration had been adopted, invalidating all allowances above an MSR volume of 400 million EUA. Complementing the invalidation volumes, the graph shows how the MSR volume increases throughout the years as a result of additional MSR intake.

For 2023, the 2021 MSR Review estimated a lower invalidation of around 2,100 million EUA (against the 2,515 million EUA actually invalidated). The gap can likely be attributed to the expectation of an economic recovery after the COVID-19 pandemic that would have led to higher emission levels, a lower TNAC and in consequence less MSR intake and invalidations. Another part of the explanation might be that the 2023 configuration of the invalidation mechanism had an unintended self-amplifying effect: A high TNAC in 2021 led to more MSR intake in 2022. This in turn reduced auction levels and led to a higher invalidation volume.

The invalidations in 2024 and 2025 are in all scenarios of the 2021 Vivid study between 200 and 350 million EUA. Invalidations above a fixed MSR volume of 700 million EUA led to slightly lower invalidations compared to the 2018 configuration. Actual invalidation in 2024 was higher than in the modelled scenarios as the adopted 400 million EUA maximum MSR volume is more ambitious than the modelled 700 million EUA maximum.

While the exact figures of invalidation differ between actual market outcome and the 2021 MSR Review, the invalidation mechanism works as expected. It follows the set rules for a process of automatic invalidations which left by design no leeway for political or other interferences. The design as rule-based mechanism that, for instance, did not rely on further political approval before an invalidation takes place led to an effective mechanism that works as planned.

It is more difficult to assess the effectiveness of the invalidation mechanism in terms of achieving its set objective, mainly because the invalidation mechanism has no official standalone objective but must be evaluated as part of the MSR. In terms of the MSR objectives of reducing the historical surplus and preventing the build-up of future surplus, it can be pointed out that the invalidation mechanism did not have any direct effect on allowance supply up until now. The invalidation mechanism only reduces the allowances in the reserve and consequently the allowance supply in times in which the TNAC reaches the lower threshold of 400 million EUA. Only then, it limits the number of allowances that is released from the reserve and reinjected into the market and shortens the reinjection period. The invalidation mechanism will not have any direct effect on the number of allowances in the market before that. Note that the absence of direct effects, i.e. invalidations, until now does not mean that the invalidation mechanism has not been effective, as short-term direct effects were never intended.

There has been, however, an indirect effect of the invalidation on today's prices and abatement behaviour, which is difficult to assess quantitatively. The invalidation reduces cumulative allowance supply that will be available over the next decades in the EU ETS. This increases overall scarcity in the market leading to higher prices both in the future and today, if market actors have a sufficiently long planning horizon. However, this effect is relatively low compared to adjustments of the linear reduction factor (LRF), i.e. the general ambition of the EU ETS, which has a more immediate impact on the supply of allowances. Bocklet et al. (2019)⁸¹ find that the increase of the LRF from 1.74 to 2.2 had a 4.5 times stronger effect on the overall allowance supply than the invalidation mechanism in the 2018 reform. However, the invalidation of 3,167 million allowances between 2023 and 2025 is equivalent to 23.4% of the allowances supply in Phase III (2013 to 2020) and hence not negligible.

The introduction of the invalidation mechanism induced a fundamental shift. While the 2015 MSR was potentially cap-neutral in the long-term (by allowing to shift the allowance supply across time for use in a later period), the invalidation of allowances meant an endogenous adjustment of allowance supply and a reduction of allowances available in the EU ETS. One of the strongest effects from the introduction of the invalidation mechanism was probably the one signalling that the EU was committed to a stringent and ambitious instrument, automatically, i.e. without the need of further political approval, invalidating excess allowances that could potentially weaken the market. As discussed above, the 2018 and the Fit for 55 reform were effective in providing a strong signal. Especially the 2018 reform showed that “*the doctor cared for the patient*” as some interviewed stakeholders put it. However, the reduction of EU ETS auction volumes was rated by 36% of stakeholders as the most important MSR feature contributing to the MSR's effectiveness compared to 11% that consider the invalidation mechanism to be the most important MSR feature.

4.1.2.1.3 Evaluation of price developments and market confidence

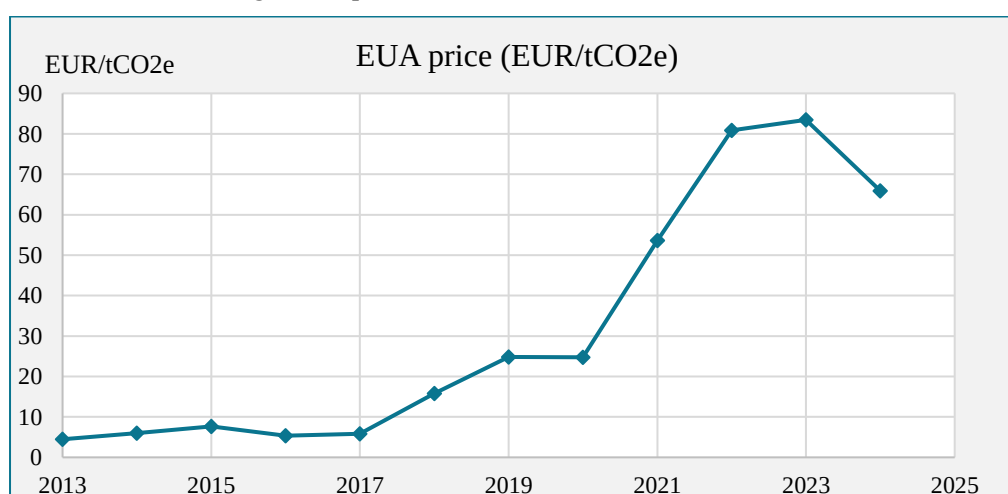
4.1.2.1.3.1 Annual price levels

While the emphasis of the MSR's second specific objective of enhancing future resilience of the EU ETS market is on preventing the build-up of new surplus, as discussed in the previous subsection, it also points to stabilising price developments and increasing confidence in the market. This subsection takes a closer look at these components of EU ETS resilience.

⁸¹ Johanna Bocklet, Martin Hintermayer, Lukas Schmidt, Theresa Wildgrube, 2019. “The reformed EU ETS - Intertemporal emission trading with restricted banking”, <https://doi.org/10.1016/j.eneco.2019.104486>.

Figure 17 shows the development of EUA prices over the evaluation period. Two periods can be distinguished. Between 2013 and 2017, EUA prices remained under EUR 10 . Hence, neither the discussions around the design of the MSR, the adoption of the MSR Decision in 2015 nor the backloading of allowances from 2014 to 2016 did lead to noticeable price increases that could be interpreted as an indicator of increasing confidence. Forward-looking market participants adjust their behaviour based on their expectations of future prices. If the market expected a price increase for 2019 (when the MSR became operational) already at the time when the MSR was announced or adopted, this would have had also an effect on prices at that time, i.e. in 2015. The reason is that EUAs can be banked, so it makes sense to buy them at a lower price in 2015 if prices are expected to increase in 2019. However, neither verified emissions nor price levels reacted strongly to the initial announcement of the MSR in January 2014 or its adoption in March 2015. This indicates that the market might not have expected the 2015 MSR to have a substantial effect. This can be partially explained by the fact that the initial MSR only shifted the supply of allowances to the future by reducing auction levels in the short run and increasing them at a later stage. The overall allowances supply did not change. This only changed with the introduction of the invalidation mechanism in 2018 which was further strengthened by the Fit for 55, reform, proposed in 2021.

Figure 17: Annual average EUA prices



Source: Enerdata

Another explanation why the MSR adoption in 2015 had no significant effect is the potential short-sightedness of market participants. Quemin and Trotignon (2021) modelled rolling horizons in the context of the EU ETS and concluded that a horizon of a 12 years can explain best the market behaviour between 2008 and 2017.⁸² Similarly, Bocklet and Hintermayer (2020) find that a planning horizon of ten years explains best the EUA prices in Phase III.⁸³ While these horizons might suggest that an introduction of the MSR five years after its initial announcement can be foreseen even by shortsighted market participants, the exact mechanisms of myopia are not fully understood. Furthermore, carbon market analysts generally observe short-sighted behaviour from market participants in the carbon market.

⁸² Quemin & Trotignon, 2021. "Emissions trading with rolling horizons", *Journal of Economic Dynamics and Control*, Volume 125, April 2021, 104099.

⁸³ Bocklet & Hintermayer, 2020. "How does the EU ETS reform impact allowance prices? The role of myopia, hedging requirements and the Hotelling rule". *EWI Working Paper*, 20/01.

Only with the 2018 reform that increased the Linear Reduction Factor and adjusted the MSR including the adoption of the invalidation mechanism, prices began to increase significantly. In 2018, price levels reached EUR 15.8 per tCO₂e, almost tripling compared to the EUR 5.8 per tCO₂e in 2017. Prices further increased to EUR 24.9 per tCO₂e in 2019, holding this level with an average of EUR 24.8 per tCO₂e during the pandemic year of 2020. Linked to the proposal of the Fit for 55 reform, prices increased substantially in both 2021 and 2022 to 53.7 and EUR 80.8 per tCO₂e, respectively. They remained high in 2023 with an average of 83.5 EUR per tCO₂e. Prices dropped to EUR 65.9 per tCO₂e in 2024, likely because of the economic downturn and, at the same time, record renewables that led to lower verified emissions in 2023 and 2024.

The 2018 reform and the Fit for 55 reform proposed in 2021 had a significant effect on EUA prices. Academic research using EU ETS modelling shows that the price increases can mainly be explained by the increased Linear Reduction Factor with the MSR reforms having only a small fundamental effect (see for instance Bocklet et al. (2019)⁸⁴ and Wildgrube (2023)⁸⁵). However, several stakeholders mentioned in interviews that they perceive the MSR as part of a package, which increased confidence and strengthened market prices in the EU ETS.

The Vivid Economics (2021) study also confirms that the MSR and backloading helped restore EUA prices from low historical levels induced by a historical build-up of allowance supply. This is in line with the results from the open public consultation in which respondents frequently referred to the MSR and its effectiveness in addressing the structural surplus in the EU ETS as key factor for the increase of the carbon price (mentioned several times, especially by NGOs) as well as for the increase of market liquidity and mitigation of price volatility (mentioned especially by companies and business associations). The Vivid study acknowledges that the price increases cannot be only attributed to the MSR but to the broader set of EU ETS reform elements in 2018 (the study was completed before the Fit for 55 reform proposal).

4.1.2.1.3.2 MSR and price shocks

Part of the MSR's objective to increase the resilience of the EU ETS is how the MSR interacts with allowances prices in the presence of shocks and crises. During the five operational years that are subject of this evaluation, the MSR had several opportunities to prove its effectiveness in improving the resilience of the EU ETS against crises and shocks. We identify at least there major economic and policy shocks:

1. Brexit and the shift of UK's share of EUA supply from 2019 to 2020
2. COVID-19 pandemic in 2020/21
3. Energy price crisis in 2021 to 2023

The evaluation focuses on assessing if the MSR contributed to mitigating price crashes. For this, we need to look at price changes with higher frequency. We can potentially rely on the legal definition of undesired price developments from Article 29a of the ETS Directive. It refers to price increases in which the average price over a period of six months is 2.4 times higher than the preceding two-year reference period. The mechanism, however, looks at unexpected price increases instead of price crashes. The latter seems to be more short term in character. For the purpose of this evaluation, a price crash is defined as any substantial decrease of auction

⁸⁴ Bocklet, Hintermayer, Schmidt, and Wildgrube, 2019. "The reformed EU ETS - Intertemporal emission trading with restricted banking". *Energy Economics*, page 104486.

⁸⁵ Wildgrube, 2023. "Fit for 55? An assessment of the effectiveness of the EU COM's reform proposal for the EU ETS". *Zeitschrift für Energiewirtschaft* 47, 52–65 (2023).

clearing prices within a one-month period. Section 4.1.1.1.2 presents more granular price graph showing such price drops.

The shift of supply of UK EUA from 2019 to 2020 did not lead to any visible repercussions on the EUA primary market. This probably indicates that, while supply of UK EUA was paused by the end of 2018 as a result of Brexit negotiations, there was confidence in the market that a transition would be handled carefully in case the UK would leave the EU ETS. In particular, a potential market disruption could have been caused by a temporary over- or undersupply of allowances in the EU ETS if UK entities still had to surrender allowances but supply of UK EUAs ceased or if surrender obligations phased out but UK EUAs were still supplied to the market. These scenarios seem to have been assessed as unlikely by the market participants. The shift of supply in itself is not problematic. Even short-sighted market participants would anticipate an increase in the following year and keep their market behaviour unchanged. From 2021 onwards, the exit of the UK from the EU ETS was permanently implemented with an adjustment of the supply of allowances (see Decision 2020/1722) and of the MSR intake (see Commission Notice 2020/C 428 I/01). From this moment, surrender obligations for UK entities also ceased.

The COVID-19 pandemic led to a price drop from EUR 24.64 per tCO₂e on 24 February 2020 to a low of 14.60 EUR/EUA on 23 March 2020, clearly related to the first lockdown and the uncertainties around the economic implications of the pandemic. Prices recovered by June 2020 and increased steadily over the remainder of the pandemic, reaching the milestone of EUR 50 per tCO₂e in May 2021.

The energy price crisis from 2021 to 2023 saw significant price drops within a month on two occasions after a period of sustained price increases after the announcement of the Fit for 55 reform proposal. Most notably, the auction price decreased from EUR 97.51 per tCO₂e on 8 February 2022 to EUR 57.91 per tCO₂e as a result to the Russian invasion of Ukraine on 24 February 2022. The price recovered over the summer to see another price drop from EUR 97.50 per tCO₂e on 22 August 2022 to EUR 65.21 per tCO₂e on 9 September 2022 related to high gas prices after the shutdown of the Nord Stream 1 pipeline in late August and its final closure in September 2022.⁸⁶ In the power sector high gas prices tend to induce a shift to coal-fired power generation, leading to higher emissions and hence higher demand and EUA prices. In August/September 2022, the expectation of market participants seems to have been rather a downturn of industrial production in response to the high gas prices, leading to lower emissions and EUA prices. This price drop was potentially exacerbated by speculations around potential political interventions to relieve pressure from high energy prices by increasing allowance⁸⁷ The Commission requested the European Securities and Markets Authority (ESMA) to conduct an in-depth enquire into the trading of emission allowances. This enquiry did not find any major issues as regards the transparency and integrity of the trading emission allowances that ETS prices reflect market fundamentals⁸⁸.

A second related price drop took place between 16 November and 15 December 2023 where prices decreased from EUR 79.00 to EUR 66.60 per tCO₂e. Analysts attributed this price drop

⁸⁶ See for instance <https://www.politico.eu/article/gazprom-announces-nord-stream-stoppage/>.

⁸⁷ Carbon Pulse, 2022. “Euro Markets: EUAs slide to six-month low amid prospect of additional supply”, 5 September 2022, <https://carbon-pulse.com/171157/>.

⁸⁸ European Securities and Markets Authority, 2022. “Final Report on EU emission allowances and derivatives thereof”, ref ESMA70-445-38, 28 March 2022.

to be predominantly caused by additional auctioning to finance REPowerEU.⁸⁹ The REPowerEU strategy was designed to reduce energy dependence from Russian imports and mitigate the economic downturn caused by high energy prices since the Russian war of aggression on Ukraine starting in February 2022.⁹⁰ To contribute to finance the REPowerEU amendment of the Recovery and Resilience Facility (RRF),) the EU decided in Regulation (EU) 2023/435 to frontload the sale of EUAs from 2027-30 to 2023-26, thereby increasing auction levels in the EU ETS in the short-term. This was implemented in the secondary legislation amending the EU ETS Auctioning Regulation 1031/2010 adopted on 17 October 2023 which financed REPowerEU mainly frontloading allowances from the Innovation Fund and Members States' auctioning volumes, with only a very small amount taken from the MSR to partly replenish the Innovation Fund.⁹¹ For 2023, the additional auction volume was 38.4 million EUA. While this is a relatively low share of the total supply of allowances of 1,064 million, the confusion between the initial proposal and the adopted legislation and the signalling effect around the potential market intervention led to a significant price drop. In other words, the price drop was not caused by the actual intervention leading to a change of fundamental price drivers but rather the perceived increase in regulatory uncertainty. Several position papers submitted as part of the open public consultation expressed that they see using the MSR as financing tool as undermining the EU ETS's effectiveness and credibility, potentially distorting price signals. This perception stems from the initial proposal instead of the actual adopted legislation.

The three instances of unanticipated price drops in the context of the pandemic and the energy price crisis in February and November 2022 as well as in November 2023 happened at short notice. The frequency of MSR intervention is too low to immediately react. The MSR is constructed in a way that it reduces supply starting from September for a demand-supply imbalance in the previous year, i.e., if a demand shock occurs in January, the MSR starts reacting 21 months later. However, market participants can anticipate that the rule-based MSR will react at that time through an automatic mechanism that does not depend on a further decision by the regulator. As such, the MSR contributes to stabilising the market in the event of a shock even when its actual intake of the ensuing surplus is not immediate.

Note that while the years since the start of operations of the MSR in 2019 have experienced several economic and political turbulences, both the 2022 and the 2024 ESMA Market Report on EU carbon markets⁹² did not identify any relevant problems regarding the functioning of the EU ETS, with historical and intraday volatility at low levels and even declining from 2022 to 2023. The 2022 ESMA report points out the EUA markets resemble markets for energy commodities in terms of volatility, which by nature also reacted to the economic and political developments described above.

4.1.2.1.3.3 MSR and market confidence

The discussion of price drops in the previous subsections shows that EUA prices are also driven by factors beyond market fundamentals. There are a number of intangible factors that we bundle, analyse and evaluate here under the umbrella of market confidence.

⁸⁹ For instance, Homaio: <https://www.homaio.com/post/why-did-eua-prices-fall-so-much-at-the-end-of-2023-and-the-beginning-of-2024>

⁹⁰ https://ec.europa.eu/commission/presscorner/detail/en/ip_22_7717

⁹¹ <https://veyt.com/articles/title-eua-sale-for-repowereu-reaches-eur2-bn/>

⁹² Market Report on EU carbon markets – 2024, ESMA50-43599798-10379

Stephan Salant raised in an academic paper from 2016 that the EU ETS was ailed by regulatory uncertainty and potential policy interventions depressing prices.⁹³ Confidence in the instrument has much improved since then, which ultimately shows in increased allowance prices. Most stakeholders interviewed for this evaluation confirmed that confidence in the market increased as a result of the package of reform elements. While the individual effect of the MSR on confidence cannot be assessed, stakeholders perceive the MSR as an integral part of the reform package.

There is however a second element of how the MSR influenced confidence in the market. Stakeholders raised in the conducted interviews that the MSR is complex and not fully understood by market participants. This might lead to reduced relevance of market fundamentals compared to intangible factors when market developments become more difficult to assess. The efficiency evaluation in Section 4.1.2.2 will further assess the topic of complexity.

4.1.2.1.4 Response to evaluation questions on effectiveness

1a. Did the MSR reduce the total number of allowances in circulation as expected?

Yes, the MSR reduced the TNAC, and its high level caused by historical demand-supply imbalances as expected. It did this quicker than expected as the intake rate was higher than envisioned by the 2014 Impact assessment. Stakeholders confirm this assessment: 64% find in the OPC that the MSR has been moderately or very effective in addressing the structural surplus in the EU ETS that has been accumulating since 2009.

1b. Has the MSR mitigated the build-up of a new surplus?

The MSR could mitigate the build-up of a new surplus but could not fully absorb it. Due to a substantial build-up of new surplus in the evaluation period between 2013 and 2024, the TNAC is still at a level of 1,148 million EUA, substantially above the target value of 833 million EUA. The underlying reason for this is that verified emissions declined at a faster rate than expected and allowance supply did not decrease at the same rate.

1c. For shocks between 2019 and 2024, has the MSR contributed to mitigating price crashes?

Over the evaluation period, the EUA prices increased significantly as a result of different reforms improving the EU ETS. Stakeholders perceive the elements of the EU ETS reform as blended package. The MSR was one important element of reform among others that strengthened the EU ETS.

In the six years in which the MSR is now operating, the market saw a number of price drops. The MSR mechanism is constructed in a way that it reacts only delayed to shocks and other events. Hence no direct link between price drops and the effect of the MSR can be established. However, as the MSR strengthened confidence in the EU ETS, it had an overall strengthening effect on allowance prices.

1d. Has the MSR increased confidence into the EU ETS as main driver for long-term decarbonisation in the EU?

While the individual effect of the MSR on confidence cannot be assessed, stakeholders perceive the MSR as an integral part of the reform package that led to a strengthening of the market.

⁹³ Salant, 2016. "What ails the European Union's emissions trading system?" *Journal of Environmental Economics and Management*, Vol. 80, November 2016, p. 6-19.

The MSR potentially increased the complexity of market fundamentals (discussed in Section 4.6). There is a risk that this reduced the relevance of market fundamentals in the behaviour of market participants.

4.1.2.2 Efficiency

The evaluation of efficiency complements the analysis of whether a measure achieved its objectives by comparing its costs and benefits and their distribution among different stakeholders. The ex-post evaluation assesses if costs and benefits occurred as expected, highlighting unanticipated developments and drawing conclusions on how small adjustments of the measure can reduce its costs or raise its benefits with a particular focus on potential simplification and burden reduction. Note that while the previous section analysed the effectiveness of the invalidation mechanism separately from the effectiveness of the general MSR to disentangle effects, the efficiency evaluation analyses the costs and benefits of the MSR as a single tool. Ideally, the efficiency evaluation would aim to quantify costs and benefits. In the case of the MSR, this is a difficult endeavour due to the nature of the MSR and how it works. The MSR has a direct, quantifiable effect only on allowance supply. How it affects allowance prices and how these prices translate into different implied costs and benefits for market participants is much more difficult to quantify. Like this evaluation, the 2014 Impact Assessment and the 2021 MSR Review have only been able to quantify the MSR efficiency to a very limited extent.

As explained in detail in Section 2.2.2 since its adoption in 2015 the MSR underwent substantial reforms adjusting its configuration (e.g. by a higher intake rate) and introducing the invalidation mechanism. These changes were not foreseen by the initial IA conducted in 2014. Hence, analogously to the evaluation of effectiveness, the efficiency evaluation can only use the 2014 IA as point of comparison for the period of 2013 to 2017, relying on other sources for the period 2018 to 2024. The information of MSR efficiency provided in the 2014 IA is limited even for the evaluation between 2013 and 2017.

4.1.2.2.1 Anticipated costs

Direct costs for the implementation of the MSR have been low. The main task is to prepare the annual TNAC Communication. The Commission estimates the effort for this process to be around 15 working days, including the calculation of TNAC figures by DG CLIMA, the legal review and supporting IT services. Similarly, the additional direct effort for Member States is negligible. However, as an interviewee from the public sector pointed out, there is some cost related to the uncertainty around annual auction levels and hence revenues. As discussed in the effectiveness evaluation, the MSR has likely had some effect on EUA prices, especially around the 2018 reform. There is, however, a high level of uncertainty on the exact impact on prices. The 2014 IA anticipated a cost-shifting effect from future to present of the MSR with higher EUA prices in the short run over the MSR intake period and lower prices when these allowances are reinjected into the market. This is confirmed by other modelling efforts, e.g. in Bocklet et al. (2019). As discussed above, while the fundamental effect of the MSR on prices induced by cost-shifting and the invalidation of allowances is generally considered low, a substantial price effect was likely induced by the reform packages (in 2018 and for Fit for 55) including the MSR boosting confidence into the EU ETS.

Higher prices will increase costs for compliance entities under the EU ETS, potentially increasing costs for consumers of manufactured goods, electricity and heat, creating incentives for decarbonisation in the sectors covered by the ETS. However, in aggregate, these additional costs are balanced out as they generate auction revenues that can and have been redistributed.

This happened through Member States as well as through EU ETS-related programmes at EU level like the Innovation Fund, the Modernisation Fund and indirect cost compensation programmes at Member State level. As pointed out by the 2021 MSR Review (p. 44f.), higher prices mainly affect emission-intensive trade-exposed sectors. Within these sectors, firms that can abate emissions at lower costs might even benefit from price increases as they can strengthen their competitiveness. Similarly, firms that were able to bank unused allowances allocated for free to them, benefited from higher prices.

One ambiguous aspect regarding the MSR evaluation is whether it improved the efficiency of how allowance supply in the EU ETS is distributed throughout the years. Leaving the invalidation mechanism aside, the MSR shifts allowance supply from the present to the future. From the viewpoint of economic theory, this decreases the efficiency of the EU ETS as it limits the flexibility of firms to bank allowances now and to shift their abatement across time, determining the abatement path that minimises their costs. Bocklet et al. (2019) estimate that the MSR in its post-2018 reform configuration could add between 1-2% to the present value of total costs if the LRF of 2.2% was continued until allowance supply drops to zero.

The modelling exercise is, however, based on the strong assumption that regulated entities have perfect foresight and are rationally optimising their abatement behaviour over decades.⁹⁴ The 2014 IA, in turn, points out that experts considered the efficiency of the EU ETS to be low in the consultation year. Several experts stated that the carbon price signal at the beginning of Phase III was watered down, leading to inefficiently high prices in the long run. If the price dilution was caused by a limited foresight of market participants and a lack of confidence into the EU ETS, the MSR improved efficiency. Beyond this qualitative argument on the dilution of the price signal, the analysis of the 2014 IA is of limited value for the MSR efficiency evaluation in the current evaluation. This is because the 2014 IA measured efficiency as decrease in surplus and not as function of overall abatement costs.

The ambiguity of the effect of the MSR on intertemporal efficiency has already been discussed by the 2021 MSR Review (p. 51). The authors point out that TNAC increases can stem from an excess, therefore inefficient, surplus in the market but similarly from more complex market dynamics related to anticipatory banking reflecting an expectation of future scarcity in the market or of the effect of complementary policies. If TNAC increases come from the latter two, the MSR potentially decreases the efficiency of the EU ETS, as pointed out above.

4.1.2.2.2 Unanticipated costs

One category of interviewed stakeholders, academics, indicated that the MSR has induced unanticipated challenges by introducing uncertainty around annual auction volumes, increasing the complexity of EU ETS price formation and reducing the overall transparency of the EU ETS. This uncertainty would likely cause some additional costs for regulated entities, authorities and other stakeholders like academics, but such indirect costs are difficult to pinpoint and quantify. While the 2014 Impact Assessment lists the lack of simplicity as one of the weaknesses of the proposed MSR (p. 56f.), the complexity of the mechanism was not analysed and likely not fully understood when designing the instrument. The number of academic publications analysing the effect of the MSR are witness to this. Furthermore, the implemented MSR with the reforms of the intake rate and the introduction of the invalidation

⁹⁴ This assumption has been subsequently challenged, for instance in Quémén & Trotignon (2021).

mechanism is slightly more complex than the options from the 2014 IA. Various stakeholders identified several features of the MSR that are complex, among others:

- TNAC is a new concept describing the private holdings of allowances. The TNAC increases when allowance supply exceeds verified emissions in a given year. Allowance supply, however, directly depends on the MSR.
- The level of the intake rate appears arbitrary and its effect on intake difficult to qualify. The intake rate started at 12% and is now at 24% of TNAC. It is not intuitive if 12% leads to a high or low intake level and if 24% are substantially different.
- MSR release will likely happen in the 2030s. The exact release period, however, depends on technological developments and complementary policies driving verified emissions. There is a high degree of uncertainty around the timing of release and hence future allowance supply.
- The initial invalidation mechanism with the dynamic threshold of the previous year's auction volume made invalidation volumes opaque. This has been corrected by the Fit for 55 reform setting a fixed threshold of 400 million EUA, increasing predictability of invalidation volumes.
- The overall level of invalidations and hence the overall number of allowances in the system depend on several factors and are hard to predict, creating uncertainty around allowance supply.

It is overall manageable to understand these features. However, in aggregate, the functioning of the EU ETS becomes more complex. As one of the academic MSR experts interviewed for the evaluation pointed out: *“The big drawback of the MSR is that it created a regulatory regime that the affected people do not understand.”* Those taking the time to understand the MSR face unanticipated high one-off costs. As another interviewee from the public sector put it: *“I must admit that analysing the MSR mechanism, both in the context of the concept, legislation, implementation process and then effects, took a lot of time, energy and reflection within our team.”*

Regulated entities are dealing differently with this increased complexity. Bigger companies have their own departments dealing with trading allowances. These companies had to adjust their EU ETS models to include the newly introduced MSR rules, likely hiring new or training existing staff. Smaller entities usually do not trade allowances themselves but rely on intermediaries. They will likely face a higher service fee in consequence of the MSR introduction.

4.1.2.2.3 Anticipated and unanticipated (co-)benefits

The main anticipated benefits of the MSR can be derived from its objectives. The reduction of the historical and new excess allowance surplus is the most direct benefit. While more difficult to quantify, support for the stabilisation of prices in times of low-price levels as well as of the signal the MSR provided in terms of confidence into the EU ETS and credibility of the commitment of the EU to this instrument are important benefits. These benefits are discussed in more detail in the evaluation of the MSR effectiveness in Section 4.1.2.1.1

This section focuses on whether the MSR has led to any benefits beyond those intended by the MSR objectives.

By construction, the MSR is meant to have limited effects outside the EU ETS context, and hence potential co-benefits. Neither the 2014 Impact Assessment nor the 2021 MSR Review mention specific co-benefits.

To the degree that the MSR contributed to price increases in the EU ETS, this generated additional revenues for EU Member States which invested them to a large share into climate-related programmes. Furthermore, the higher price led to increased decarbonisation efforts, fostering the development of low-carbon technologies and generating a positive environmental impact. The invalidation mechanism de facto lowered the number of allowances and therefore emissions.

A hard-to-quantify unanticipated co-benefit of the MSR is that it increased interest in and availability of data on the EU ETS. The annual TNAC Communications that are released in May help market participants and other stakeholders assessing the market situation, especially the development of verified emissions and allowance supply over time. Similarly, the adoption of the MSR inspired an array of research and active discussions on EU ETS market dynamics in general.

4.1.2.2.4 Lessons learned and recommendations

A lesson learned on efficiency, that the Commission already applied in the Fit for 55 reforms, is that mechanisms like the MSR should be implemented with least complexity, decreasing the cost for regulated entities, authorities and other stakeholders that comes with understanding how the MSR changes the functioning of the EU ETS and the EUA price formation. A number of the position papers that were received as part of the open public consultation, call for an increase in transparency of MSR related data and predictability of the MSR movements, indicating that there might be still room for improvement, for instance finetuning MSR parameters. Note that there is a trade-off between a mechanism that is rule-based and a mechanism that can flexibly react to changes in market conditions.

Overall, the MSR had mostly indirect costs and benefits for regulated entities under the EU ETS. This is highlighted by the results of the open public consultation on this matter: While 39% responded that the MSR is moderately or very efficient, another 35% did not know how to answer. One potential reason for the significant number of “Do not know” answers could be that these respondents are not aware of the costs and benefits of the MSR. This, in turn, reflects on the unanticipated complexity of the mechanism.

One way to leverage the benefits of the MSR is to improve the presentation of data from the TNAC Communications. For example, a small straightforward improvement would be to publish the Excel tables providing data from all years of TNAC Communications. This would ease the accessibility of TNAC data and support regulated entities, market participants as well as researchers in working with MSR data.

4.1.2.3 Coherence

The evaluation of coherence assesses how well the MSR is functioning in a harmonised way with other elements of the EU ETS (internal coherence), other EU climate and energy policies as well as policies at Member State level (external coherence). Neither the 2014 Impact Assessment nor the 2021 MSR Review, or other studies have identified obstacles to the internal coherence of the MSR.⁹⁵ This is also confirmed by the open public consultation. Question 3a

⁹⁵ Pahle et al. (2023) are pointing out a future issue of internal coherence, not relevant for a backward-looking evaluation. They find that the invalidation mechanism can cause a price spiral if the EU ETS cap becomes tighter in the light of the EU’s 2050 net-zero target. If market participants expect a tighter market in the future, they will increase abatement efforts now, banking allowances in response to an expected future scarcity. If this additional banking leads to TNAC levels that trigger MSR intake and invalidation of allowances, this will further increase the scarcity of allowances in the EU ETS, potentially inducing further banking.

of the evaluation matrix, *Is the MSR aligned to other elements of the EU ETS?* can therefore be affirmed and the evaluation focus will be on external coherence.

Coherence is mainly evaluated for the overall EU ETS (in Section 4.1.2.3) but there are some aspects that are particularly relevant for the evaluation of the MSR as individual feature of the EU ETS.

4.1.2.3.1 MSR and complementary policies

The 2014 Impact Assessment discusses the coherence of the MSR with complementary policies. Complementary policies are defined as a subtype of overlapping policies whose primary or secondary objectives are aligned with the assessed policy. In the context of the EU ETS, overlapping policies are all other climate or energy policies that directly or indirectly aim to reduce emissions (the 2014 IA mentions renewable energy, energy efficiency policies and policies to reduce the use of carbon-intensive fuels). As with the discussion of efficiency, the 2014 IA focusses on the static reduction of the allowance surplus. It hence falls short of identifying and analysing the intricacies of how the MSR interacts with complementary policies. Since the initial IA, there has been a large body of academic literature analysing the interaction between the EU ETS, the MSR and complementary policies. This has been reviewed and extensively discussed in the final report for Task 1 of the DG CLIMA project on *Issues and Options for EU Emissions Trading after 2030*, published in 2024.⁹⁶

On the one hand, the invalidation mechanism of the MSR increases the coherence between EU ETS and complementary policies. Without it, any complementary climate or energy policy covering EU ETS sectors reduces demand for allowances, thereby reducing EUA prices and de-incentivising decarbonisation which leads to higher emissions and demand for allowances. From a theoretical point of view, the net effect of complementary policies on emissions is zero. This is the so-called waterbed effect. The MSR in its original design could not have fixed the waterbed effect as it only adds a shift of allowances and hence abatement efforts over time. With the adoption of the invalidation mechanism in 2018, however, it permanently removes allowances, thereby mitigating or even overcoming the waterbed effect.

On the other hand, the literature review discusses dynamic effects of how the MSR and the invalidation mechanism work (p.23f.). While several research papers find that the MSR works as expected in the context of unanticipated shocks caused, for instance, by economic crises, the MSR has unintended effects in reaction to anticipated shocks which are often related to complementary policies like coal-phase outs or renewable energy support. If the market expects that in the future complementary policies will reduce emissions and hence the carbon price, abatement efforts today will also decrease. This in turn leads to a lower TNAC and less MSR intake and invalidation. In the worst case, this effect can overcompensate the initial emissions reduction induced by the complementary policy, leading to overall higher emissions. This effect can occur in interaction with EU or Member State-level climate or energy policies.

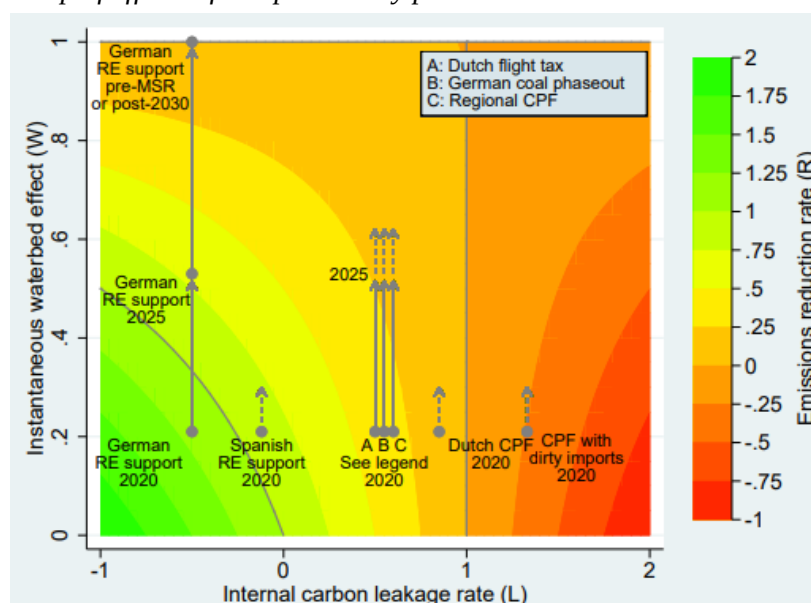
A recent paper by Perino et al. (2025)⁹⁷ maps overlapping climate policies regarding additional emission reduction effects, assuming the MSR threshold of 833 million EUA is reached in

⁹⁶ DG CLIMA, 2024: “Issues and Options for EU Emissions Trading after 2030. Final Task 1 Report – Integrated reporting on literature review”, interviews with experts/stakeholders and stakeholder survey, online: <https://op.europa.eu/en/publication-detail/-/publication/67267406-313b-11f0-8a44-01aa75ed71a1/language-en>

⁹⁷ Perino, Ritz and van Benthem, 2025. “Overlapping Climate Policies”, *Economic Journal*, <https://doi.org/10.1093/ej/ueaf021>

2030. In Figure 18, the x-axis is the internal carbon leakage rate, i.e. the shift of emissions from one jurisdiction to another, including carbon-intensive imports, at a fixed EUA price. Internal carbon leakage is measured between -1 and 2. At a rate of 1, all emissions reduced by the complementary policy are 1:1 replaced by new emissions somewhere else. Above 1, total emissions increase, e.g. through carbon-intensive imports. Below 0, the complementary policy incentivises emission reduction elsewhere as with the German renewable energy (RE) support that decreases investment costs for RE. The y-axis is the waterbed effect, i.e. the overall effect on emissions covered by the EU ETS with an endogenous EUA price. For instance, the German RE support pre-MSR had a waterbed effect of one. All emission reduction achieved led to lower EUA prices and higher emissions elsewhere under the EU ETS. The German coal phase-out or a regional carbon price floor (CPF), in turn, had in 2020 a low waterbed effect of 0.2 as allowances were invalidated through the MSR. The main finding of the paper is that the waterbed effect crucially depends on the timing of overlapping policies, as illustrated for the German renewable support pre-MSR, 2020, 2025 and post-2030. It is worth mentioning that Germany's voluntary cancellation related to its coal phase out considers of the MSR's intakes and only cancels what the MSR does not. Germany and the Commission communicate transparently and timely on this.

Figure 18: Map of effects of complementary policies in the EU ETS



Source: Perino et al. (2025)

4.1.2.3.2 Alignment to other EU climate or energy policies and lessons learned

As discussed in Section 4.1.2.1,1 the MSR has been successful in strengthening the EU ETS. As the EU ETS is the cornerstone of EU climate policy, the adoption of the MSR is coherent as part of the broader climate policy mix. However, the MSR potentially enables other EU climate and energy policies to interfere with the EU ETS's environmental integrity and effectiveness. A number of interviewed stakeholders across sectors mentioned as negative example for this the use of MSR allowances for financing the REPowerEU programme. As discussed previously, although this in fact never happened and there was only a frontloading of allowance supply outside the MSR, the proposal undermined confidence into the EU ETS. From a coherence point of view, it can be added that, even if that did not happen in this case, a potential scenario arose in which the MSR as an allowance reserve could be used for adjusting auction volumes and generate additional revenue in response to political considerations not

directly related to the ETS. As an interviewed industry representative put it: “*Such interventions need to be thought through carefully because they create uncertainty.*”

4.1.2.3.3 Alignment to policies at Member State level

While the paper by Perino et al. (2025) outlines how the timing of individual complementary policies at Member State level depends on its interaction with the MSR, and in particular with the invalidation of allowances, this subsection looks specifically at the interactions between the MSR and the German coal-phase out, going beyond the academic perspective, and including a consideration on administrative effort and concrete implementation challenges.

The German coal phase-out is an interesting case because it is the only Member State policy that used Article 12(4) of the ETS Directive. This provision allows Member States to cancel EUAs they would have auctioned otherwise, so that the additional emission reduction effect achieved by the closure of electricity generation capacity stays intact. Member States can withdraw allowances up to the average verified emissions of closed power plants over a period of five years preceding the closure.

Beyond the invalidation of a fixed number of allowances, the German government intended to implement the coal phase-out as neutral regarding the EUA price, i.e. without any waterbed effect, as experts from the public and academic sector interviewed for the evaluation explained. This led to complicated modelling efforts as price neutrality also needed to take into account the interference of the policy with the MSR intake. As a result, Germany failed in its attempt to withdraw allowances for phased-out capacities in 2021.⁹⁸

Another academic expert highlighted, however, that this failure was irrelevant. As long as the coal phase-out happens when the TNAC is still above 833 million, the MSR will invalidate allowances that reduced demand in response to the policy. This is the combined effect of the introduction of the upper buffer zone with one-for-one MSR intake between a TNAC of 833 and 1096 million allowances and the fixed invalidation threshold of 400 million. Article 12(4) will only become relevant once the TNAC falls under 833 million allowances.

4.1.2.3.4 Lessons learned and recommendations

The evaluation of coherence between the MSR and the EU ETS on the one hand and complementary policies on the other raises the broader question of which role complementary policies should play next to the EU ETS to support decarbonisation. The EU ETS sets a price signal, adjusting the marginal costs of low- versus high-carbon technologies or activities to account for damages from climate change and to make polluters pay for the external costs of their decisions. The absence of climate change damages from the polluters’ decision making is not the only market failure hindering decarbonisation and requiring government intervention. For instance, infrastructure like smart grids and EV charging networks are public goods and would not be provided adequately without government intervention. This requires a climate policy portfolio where the EU ETS is a central but not the only policy for the low carbon transition and brings the issue of the coherence of the whole portfolio to centre stage.

Overall, the interactions of the MSR and complementary policies are more complex than initially foreseen, especially through the interaction with the invalidation mechanism adopted in 2018 which leads to changes in expectations of market participants. However, the new upper

⁹⁸ See also Carbon Pulse, 2025: “Ahead of German elections, government faces scrutiny over coal phaseout as EUA cancellations lag”, 21 February 2025, <https://carbon-pulse.com/371265/>

buffer introduced by the Fit for 55 reform largely mitigates the problem of the waterbed effect and hence improves coherence.

As in the evaluation of the MSR efficiency, the discussion of coherence circled back to the topic of complexity and makes the assessment of the effects of complementary policies difficult. The main recommendation for future adjustments of the MSR is hence to consider possible simplifications as well as to increase transparency by providing data and guidance material. The latter helps assessing interactions with complementary policies and hence understanding coherence issues, ideally even before future complementary policies are adopted.

A majority of interviewed stakeholders across different sectors criticised the proposal for financing the REPowerEU programme from MSR allowances, even if the adopted intervention relied on allowances frontloaded from the Innovation Fund and Member States' auctioning. The MSR could potentially be strengthened by adding safeguards that prohibit any arbitrary use of the allowances stored in the MSR, to avoid any uncertainty of possible unanticipated political interventions in the future.

Lastly, although this is a forward-looking assessment based on a number of underlying assumptions, rather than a backward-looking assessment covered by this evaluation, the potential price spiral identified by Pahle et al. (2023) indicates that the MSR parameters need to be carefully adjusted to be fit for a future market that could in the long run be characterised by a potential scarcity of allowances. Among a series of potential ETS adjustments to address future scarcity, removing the invalidation mechanism could contribute to preventing such a price spiral from materialising.

Note that the points on which the coherence of the MSR can be improved are less important than addressing issues of overall EU ETS coherence. In the open public consultation, only 7% of respondents to the open question of how to improve coherence refer to the topic of market stability and MSR. Topics like external coherence, international cooperation and free allocation, competitiveness and carbon leakage received more attention from the respondents.

4.2 How did the EU intervention make a difference and to whom?

4.2.1 What is the EU-value added of the EU ETS?

The EU added value refers to the extent to which the objectives and impacts of the ETS Directive could not have been achieved by Member States acting independently. Evidence from literature confirms that coordinated, supranational implementation has delivered greater effectiveness, efficiency, and equity than would not have been possible through national action alone. Across environmental, economic, and administrative dimensions, the EU ETS demonstrated strong added value.

The fact there has been little to no analysis in the literature with regards to replacing the EU ETS with alternative national schemes indicates that the added value of implementing the ETS and the EU level is widely accepted. It is unlikely, and there is no evidence from the literature to suggest, that greater effectiveness, efficiency and equity could have been achieved through national action alone.

A central pillar of the EU ETS added value concerns the creation of a harmonised carbon market that preserves the integrity of the single market and ensures a level playing field for regulated sectors operating in different Member States. The 2018 revision further reinforces this harmonisation by establishing EU-wide benchmarks and phasing out National Allocation Plans, and by implementing uniform carbon leakage criteria across the EU. By establishing

common rules on cap setting, emissions monitoring, allowance allocation, and compliance, the ETS Directive avoids competitive distortions that would arise from uncoordinated national systems. Identical installations across different Member States receive the same treatment under fully harmonised benchmarks and allocation rules, something that national legislation alone cannot achieve⁹⁹.

Without EU level coordination, Member States would face a “prisoner dilemma” dynamic: fearing the competitive disadvantage of setting ambitious caps, they would collectively set weaker targets. Harmonised MRVA procedures and the establishment of a central EU registry have also substantially reduced the risk of carbon leakage within the EU and improved transparency and compliance across jurisdictions¹⁰⁰¹⁰¹.

The EU ETS was also able to deliver emissions reduction at a lower cost than it would have been possible under parallel national policies. Pre-implementation modelling estimated that reaching the EU’s Kyoto targets without a common EU-wide system would have been at least 20% more expensive¹⁰². The pooling of abatement potential across countries allows for more efficient emissions reductions where they are cheapest, and the move from 28 separate National Allocation Plans (NAPs) to a single cap-setting and auctioning system has simplified administration for regulators and firms. Centralised software development, EU-wide state aid guidelines, and streamlined verification systems have generated substantial economies of scale, strengthening the system’s efficiency compared to any conceivable patchwork of national trading systems¹⁰³.

Moreover, the EU ETS, as set up during the period under evaluation, covered approximately 40% of EU emissions, including electricity generation, heavy industry, and aviation. Its cross-border reach, which extends to EFTA countries, enables the system to regulate emissions in sectors that naturally transcend national boundaries, such as energy networks and industrial supply chain¹⁰⁴¹⁰⁵.

A major area of EU added value stems from the EU ETS’s ability to stimulate low-carbon innovation and investments, which would be far more limited under national systems. While the literature remains limited and incomplete there has been evidence to show that the EU ETS has increased innovation activity in low carbon technologies among regulated entities compared to a counterfactual scenario.¹⁰⁶ Regulated firms under the EU ETS have been shown to increase low-carbon innovation by up to 30%, with a statistically significant 15% in revenues

⁹⁹ EVALUATION OF THE EU ETS DIRECTIVE, 2015, https://climate.ec.europa.eu/system/files/2016-11/review_of_eu_ets_en.pdf

¹⁰⁰ Antoine Dechezleprêtre, Caterina Gennaioli, Ralf Martin, Mirabelle Muûls, Thomas Stoerk, 2021. “Searching for carbon leaks in multinational companies”, <https://doi.org/10.1016/j.jeem.2021.102601>.

¹⁰¹ EVALUATION OF THE EU ETS DIRECTIVE, 2015

¹⁰² Delbeke, J, Hartridge, O, Lefevere, J, Meadows, D, Runge-Metzger, A, Slingenberg, Y, Vainio, M, Vis, P, & Zapfel, P, 2006. “*EU Energy Law*”. Volume 4. *The EU Greenhouse Gas Emissions Trading Scheme*. Netherlands.

¹⁰³ EVALUATION OF THE EU ETS DIRECTIVE, 2015

¹⁰⁴ Griet Verhaeghe, Volker Mauerhofer, 2023. “National progress towards supranational climate & energy goals due to policies & their mixes? Insights from Northern & Western Europe”, <https://doi.org/10.1016/j.jenvman.2023.119304>.

¹⁰⁵ Antoine Dechezleprêtre, Caterina Gennaioli, Ralf Martin, Mirabelle Muûls, Thomas Stoerk (2021)

¹⁰⁶ Raphael Calel & Antoine Dechezleprêtre, (2016). “Environmental Policy and Directed Technological Change: Evidence from the European Carbon Market,” *The Review of Economics and Statistics*, MIT Press, <https://ideas.repec.org/a/tpr/restat/v98y2016i1p173-191.html>

and 8% increase in fixed assets over the 2005-2012 period¹⁰⁷. These outcomes are not only driven by the carbon price signal, but also by the financial architecture enabled at the EU level. The 2018 revision of the EU ETS has established dedicated funding mechanisms that pool ETS auction revenues from Member States into central funds, namely the Innovation Fund and the Modernisation Fund¹⁰⁸. These funds are then redistributed based on need and ambition, supporting capital intensive decarbonisation projects that single Member States would not be able to finance alone. Programmes such as NER300 and the Innovation Fund enable the scaling of technologies like green hydrogen, CCS, and industrial electrification.

Feedback from the stakeholder consultation broadly confirms the findings. 45% of respondents¹⁰⁹ emphasised the EU's added value in harmonising implementation across Member States, avoiding a fragmented patchwork of national schemes and ensuring a common price signal.

4.2.1.1 To what extent could the changes brought by the Directive have been achieved by national or individual Member States' measures only?

Across all dimensions, the evidence suggests that the Member States acting independently would face significant barriers to replicate the outcomes of the EU ETS. National systems would likely experience:

- Inconsistent carbon pricing and ambition levels¹¹⁰
- Increased administrative and monitoring burdens¹¹¹
- Fragmented investment signals and diminished innovation incentives¹¹²¹¹³
- Higher risks of carbon leakage and intra-EU competitiveness distortion¹¹⁴¹¹⁵

The ETS's harmonised framework mitigates these challenges, thanks to collective cap setting, regulatory consistency and shared financial tools.

4.2.1.2 What would be the most likely consequences of stopping or downscaling the existing ETS Directive?

A further point to consider when evaluating the EU added value of the ETS Directive is what would be the consequence of downscaling or discontinuing the EU ETS. Stopping or significantly downscaling the EU ETS would likely reverse many of the environmental and economic benefits achieved to date. Empirical evidence shows that the ETS has contributed to speed up emissions reductions more than the EU had envisaged: 2.1% on average every year,

¹⁰⁷ Ibid

¹⁰⁸ ECB 2023. "Benefits and costs of the ETS in the EU, a lesson learned for the CBAM design", ECB Working Paper Series No 2764 / January

¹⁰⁹ Question: "Please provide an explanation to support your view, in particular explaining which particular elements of the ETS you would signal out in terms of adding value or not adding value (n=220)"

¹¹⁰ Griet Verhaeghe, Volker Mauerhofer, 2023. "National progress towards supranational climate & energy goals due to policies & their mixes? Insights from Northern & Western", <https://doi.org/10.1016/j.jenvman.2023.119304>.

¹¹¹ EVALUATION OF THE EU ETS DIRECTIVE, 2015

¹¹² Antoine Dechezleprêtre, Caterina Gennaioli, Ralf Martin, Mirabelle Muûls, Thomas Stoerk (2021)

¹¹³ EVALUATION OF THE EU ETS DIRECTIVE, 2015

¹¹⁴ Antoine Dechezleprêtre, Caterina Gennaioli, Ralf Martin, Mirabelle Muûls, Thomas Stoerk (2021)

¹¹⁵ EVALUATION OF THE EU ETS DIRECTIVE, 2015

compared to 1.6% targeted in the period 2005-2016. The pace accelerated further to 2.5% in the third stage after 2013, following the ETS reform.¹¹⁶

According to the EEA (2024a), while external costs from energy-intensive industries, the majority of which are linked to impacts on human health, fell by 23% from 2012 to 2021, they still amounted to over EUR 73 billion in 2021. Across all the energy-intensive sectors, carbon dioxide (CO₂) was responsible for 58% of these external costs.

The EU ETS and the resulting carbon price has contributed to internalising the external cost of climate change for those activities that fall within the scope of the system. While there are different methods of estimating the external costs of climate change, on study on the external costs of transport¹¹⁷, based on an analysis of the relevant literature, estimated a central value for short- and medium- run climate change costs of EUR₂₀₁₆ 100 t/CO₂ (or approximately EUR₂₀₂₃ 120 t/CO₂). Based on the evaluation of the carbon price, in particular since 2021 (see Figure 17), it can be said that the EU ETS resulted in internalising a significant (at least half to two thirds, depending on the price level) share of the external cost associated with the effects of climate change, especially for the power sector (see Figure 5) which did not benefit from free allocation and could pass through the resulting carbon costs. Therefore, a discontinuation of the ETS would have had a considerable impact in terms of increased external costs associated with these sectors.¹¹⁸

Moreover, discontinuation would weaken low carbon investments signals, and it would reduce ETS revenues that are used for innovation and investment to modernise the energy systems in Europe through the Innovation and Modernisation Funds, both necessary for reducing electricity prices, as well as investments by Member States to support the green and socially fair transition. Employment in affected firms¹¹⁹ would go down and climate-related jobs in sectors such as clean tech, verification, consulting, and innovation support¹²⁰. In addition, the intervention would also damage the Union's credibility as a stable economic environment, potentially discouraging future investments in consideration of the unreliable regulatory framework.

From an economic standpoint, halting the EU ETS would have led to what can seem like a double-faced outcome. On one hand, it can be estimated that a discontinuation of the ETS in 2023 would have led to a loss of approximately EUR 93 billion¹²¹ in allowance value held by companies and the financial sector for compliance and for their investment strategy as allowances are traded financial instruments. On the other hand, companies would not have been subject to compliance worth approximately EUR 44 billion that were paid in auctions in 2023¹²². If able to do so, companies may have passed on these compliance costs to the consumers.

¹¹⁶ ECB (2023)

¹¹⁷ European Commission: Directorate-General for Mobility and Transport and CE Delft, 2020. "Handbook on the external costs of transport – Version 2019 – 1.1", Publications Office

¹¹⁸ European Environment Agency (EEA), 2026. "Zero-pollution, decarbonisation, and circular economy in energy-intensive industries", online: <https://www.eea.europa.eu/en/analysis/publications/zero-pollution-decarbonisation-and-circular-economy-in-energy-intensive-industries>

¹¹⁹ Antoine Dechezleprêtre, Caterina Gennaioli, Ralf Martin, Mirabelle Muûls, Thomas Stoerk (2021)

¹²⁰ EVALUATION OF THE EU ETS DIRECTIVE, 2015

¹²¹ The value was estimated considering the TNAC in 2023 according to C/2021/3415 and the average EUA price in 2023 ([7a7780d7-8f18-42e0-aff9-5ade23e63d7e](https://www.eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:7a7780d7-8f18-42e0-aff9-5ade23e63d7e) en)

¹²² Based on primary market auction report from EEX for 2023.

However, the consequence on elimination the compliance costs must be carefully considered. Most allowances are purchased by the energy sector, which passes on the price to consumers. If the price is not passed on any longer, removing the cost of compliance should in the short run lead to lower energy bills, rather than increasing companies' budgets. In the long run, the reduction in energy costs would be outweighed by the increase in cost from an increase in fossil fuel dependency, while Renewable Energy Sources (RES) generally offer lower wholesale electricity prices. Removing the compliance obligation removes the carbon price incentive for RES: (i) it benefits non-marginal producers, especially those with no emissions, such as RES and improves their business case and development and (ii) incentivises fuel switching, in particular from coal to gas. Together, these two factors have been major abatement channels in the ETS and are the cause of most of the system's 50% emission reductions achieved thus far. Thus, in reality, the impact will be negative overall from both perspectives.

At an international level, dismantling the EU ETS would undermine the EU's credibility in international climate diplomacy and weaken the EU's position on shaping global carbon pricing mechanisms and border adjustment instruments¹²³.

The strongest argument against stopping or downscaling the EU ETS remains in the long-term costs of inaction, which would dwarf any short-term gain induced by reduced compliance costs. The cost of climate change has both a social and economic dimension. From a social perspective, inaction increases risks related to health, extreme climate events, degradation of soil, and pollution of air. The economic and industrial cost is represented by the risk of remaining locked in high-carbon technologies, which are strongly reliant on imports of fossil fuel. Such reliance, especially in an increasingly complex geopolitical scene, undermines domestic competitiveness and will increase uncertainty.

4.3 Is the intervention still relevant?

4.3.1 *Relevance of the EU ETS and how well its objectives (still) correspond to the EU climate policy objectives?*

The EU ETS covers approximately 40% of total EU-27 emissions¹²⁴ from “around 10,000 installations in the energy sector and manufacturing industry as well as aircraft operators flying within the EU and departing to Switzerland and the United Kingdom”.¹²⁵

The objectives that were previously set in the 2015 proposal¹²⁶ by the Commission included the revision of the ETS Directive to ensure that emissions in scope are reduced by 43% below 2005 levels by 2030 so that it contributed to the EU's overall GHG reduction target for 2030 in the ‘most cost-effective manner’. By 2024, EU ETS emissions have already reduced by approximately 50% compared to 2005 levels. However, since emissions from industry remained stable, it can be argued that the ETS is still relevant in supporting with the delivery of the EU climate policy objectives, as further emissions reductions in ETS covered sectors are needed to achieve the 2050 climate target.

¹²³ ECB (2023)

¹²⁴ Based upon a calculation of total EU-27 emissions in 2023 from the EEA greenhouse gases — data viewer | Maps and charts | European Environment Agency (EEA) compared to EU-ETS emissions for the same year from the EU Emissions Trading System (ETS) data viewer | Maps and charts | European Environment Agency (EEA).

¹²⁵ Refer to Scope of the EU ETS - Climate Action - European Commission, https://climate.ec.europa.eu/eu-action/carbon-markets/eu-emissions-trading-system-eu-ets/scope-eu-ets_en

¹²⁶ COM(2015) 337 final

The CO₂ price signal from the setting of a cap-and-trade scheme under the EU ETS allowed for the identification and realisation of abatement across the EU Member States where it was more economically efficient to do so. The targets were therefore originally set so that the contribution of ETS sectors to the overall GHG reduction target was higher than for non-ETS sectors. The exact share was informed by macroeconomic modelling to determine the most efficient split between ETS and non-ETS sectors to achieve the overall target for 2030. The ETS target has subsequently been updated to a 62% reduction below 2005 levels by 2030 to align with the enhanced ambition of the EU economy-wide climate target for 2030 of reaching a 55% reduction below 1990 levels in GHG emissions by 2030.¹²⁷

The prevention of carbon leakage and the encouragement of innovation were also set as further objectives (see Section 8.3.3.2) and these are both very much aligned with the EU climate policy objectives as the EU aims to support a competitive industry as it decarbonises, by providing financial support and using the price signal of the EU ETS to drive innovation. As long as certain industrial sectors remain high emitters of CO₂ and assuming that comparable levels of carbon pricing do not exist in key trading partners, then carbon leakage will remain a valid concern in the context of the EU ETS. The achievement of these objectives is assessed in detail in Section 8.3 of this evaluation on the topic of carbon leakage.

4.3.1.1 Is EU ETS (a cap-and-trade system) still relevant as an effective and efficient instrument for achieving the EU climate policy goals and priorities?

The 2015 evaluation of the EU ETS concluded that a cap-and-trade system was an effective and cost-efficient instrument for achieving emissions reduction, since it targets directly major emitters and ensures that overall emissions stay within the cap. More recent literature reinforces this view, clarifying the comparison with a carbon tax. Chen & al (2020)¹²⁸ show that, although both carbon pricing instruments stimulate clean innovation, cap-and-trade generally induces larger investment in low-carbon technologies and achieves larger emissions reductions, provided that the carbon price resulting from the cap-and-trade system are set appropriately. At the same time, Stavins (2022)¹²⁹ emphasises that a carbon tax and a cap-and-trade system differ in terms of price volatility, revenue certainty, and administrative complexity. These findings, which are aligned with the conclusions provided by the 2015 evaluation, suggest that the EU ETS remains relevant as a cap-and-trade system, especially giving its proven capacity to deliver emissions reduction and stimulate innovation (see Section 4.1.1.2 on Efficiency), while ongoing design adjustments, such as the Market Stability Reserve are needed to address the practical limitations of a cap-and-trade system compared with a carbon tax.

4.3.1.2 How well adapted is the Directive to subsequent technological or scientific advances, or any other unexpected external influences such as the recent economic crisis?

The ETS is inherently flexible by design, since it does not mandate how operators must reduce emissions but instead ensures operators can adopt the most efficient technologies and processes available. This ensures that the system remains relevant when facing technological improvement, with increasing allowances prices continuing to incentivise the uptake of increasingly ambitious abatement options. Moreover, the reforms introduced in the 2018

¹²⁷ 'Fit for 55': Council adopts key pieces of legislation delivering on 2030 climate targets - Consilium

¹²⁸ Chen et al, 2020. "A clean innovation comparison between carbon tax and cap-and-trade system", Energy Strategy Reviews, <https://www.sciencedirect.com/science/article/pii/S2211467X20300365>

¹²⁹ Stavins, Robert N. (2022)

Review of the Directive have strengthened further this adaptability. The update of product benchmarks has allowed free allocation rules to better reflect technological progress and to align more closely with actual production levels (see Section 8.3 on carbon leakage), while the MSR enhances resilience by addressing allowance surpluses arising from economic crises or sudden technological shifts (see Section 4.1.2 on MSR).

4.3.1.3 Can the Directive be easily adjusted to new needs, in particular a new GHG target for the EU?

As stated in the 2015 evaluation, the EU ETS is relevant as an instrument that can be easily adjusted to new needs, and more specifically to a new GHG target. In principle, only Article 9 needs to be amended in order to adjust the Linear Reduction Function to respond to changes in GHG reduction ambition. At the same time, market interventions need to be kept to a minimum to ensure a predictable market functioning and a reliable long term price signal to build investment decisions on.

Feedback from the OPC¹³⁰ confirms that the stakeholders see the EU ETS as continuing to address needs that clearly warrant EU level action. Almost half of respondents, both from companies/businesses and NGOs, judged the Directive's objectives to remain relevant to a very large extent, and a further quarter considered them relevant to a large extent. Only a small minority of respondents viewed the instrument as only slightly or not at all relevant, and a few were undecided. These results suggest broad consensus that the ETS remains an appropriate and necessary EU-level tool for achieving climate policy goals in covered sectors.

5 WHAT ARE THE CONCLUSIONS AND LESSONS LEARNED?

5.1 EU ETS

In conclusion, the EU ETS is very much aligned to the broader climate policies of the EU with ETS sectors making a greater contribution to the achievement of EU 2030 GHG reduction target as it was more economically *efficient* for it to do so than for non-ETS sectors. There was evidence to suggest that the EU ETS has been *effective* in driving the overall emission reduction trend observed in the EU.

During the evaluation period, total emissions from stationary installations declined significantly, consistent with and exceeding the trajectory required to meet the 43% reduction below 2005 levels by 2030 set by the 2018 revision of the Directive. The strengthened CO₂ price signal under Phase IV has likely incentivised higher levels of overall abatement as reforms were undertaken to address the structural imbalance in the demand and supply of allowances that previously undermined the performance of the EU ETS in Phase III. The uptake of abatement options is likely to have been higher in the power sector than for industrial sectors and this is, in part, due to the further complementary measures that have been in place to support with the decarbonisation of electricity generation across the EU, as well the absence of free allocation that minimised the impact of the carbon price for the industrial emitters.

The *external coherence* of the EU ETS with the wider policy framework has been considerably improved following the introduction of the MSR addressing the long-criticised waterbed effect by allowing allowance supply to respond to changes in demand, including those induced by overlapping policies like RED and EED. Reforms to the EU ETS, such as reforms to free

¹³⁰ Question: "To what extent do the needs/problems addressed by the EU ETS Directive (cost-effective emissions reductions in the covered sectors to support the EU climate targets) continue to require action at EU level? (n=295)"

allocation, in recent years have started to address previous issues identified with regards to the *internal coherence* of different design elements. For example, the setting of more ambitious benchmarks for the provision of free allocation helps to enhance the impact of the CO₂ price signal to provide greater incentives for decarbonisation whilst striking a balance in protecting industry from the risk of carbon leakage. Evidence from the literature supported the argument that the implementation of the revised ETS Directive in 2018 has provided considerable EU added value to Member States and it has likely resulted in more cost-effective mitigation than would have been provided than if action only occurred at the national level.

As regards the prevention of carbon leakage, earlier studies found little evidence of carbon leakage, largely because the EU ETS in its early stages was designed to minimise such risks. However, the carbon price increases, and free allocation has been reduced, more recent analyses find small but increasingly significant evidence of carbon leakage. At the same time, the high level of protection from carbon leakage and levels of free allocation in the first phases of the ETS resulted in windfall profits and reduced incentives to invest in decarbonisation.

The revision of free allocation rules for Phase IV balanced the need for carbon leakage protection and the need to encourage the reduction in emissions. This was done by developing a more targeted carbon leakage list, more ambitious benchmarks, and the introduction of adjustments to allocation to better consider changes in activity levels. As a result, the overall volume of free allowances that has been provided to industry has declined in Phase IV compared to Phase III, but it continues to cover a significant share of the industrial emissions.

The MRVA system delivers high harmonisation and accuracy with standard methods used almost universally. The MRVA system ensures that nearly all emissions from Annex I activities are monitored and reported, with only marginal delays or omissions. The verification system ensures stringency and independence through robust accreditation, annual oversight, and consistently high compliance, though emerging capacity pressures because of the expansion of ETS activities pose risks to the quality of verification. There is a high level of confidence in the system's integrity and robustness, although the efficiency of the system could be improved. In line with the REFIT programme, a number of options for simplification and reduction costs for the MRVA programme have been identified (see Section 8.4.4.2), in particular in terms of increased use of harmonised and simplified reporting, use of default values, increased use of common IT tools by Member States.

The EU ETS auction system operated in an open manner, providing transparency and predictability for participants. Over 3000 auctions were conducted with minimal cancellations, illustrating its reliability, which resulted in raising over EUR 169 billion in auction revenue during the period of the evaluation (and over EUR 250 billion in total to date). The system's regulatory framework, bolstered by MiFID II and MAR, prevents market manipulation and abuses, maintaining the integrity of the EU ETS. Overall, the auctioning system has successfully achieved its objectives and ensured a balanced distribution among different market participants.

The Union Registry has provided a reliable and secure IT system for tracking the creation, allocation, surrender and reversal of allowances, with only minor technical interruptions due to scheduled upgrades. The Registry effectively provides accurate, up-to-date, and publicly accessible information crucial for ETS reporting. Although historical security measures have been effective, evolving risks, particularly cyber-attacks, and issues like inadequate financial and human resources, necessitate to strengthen the security of the infrastructure and to revise the operating model. Studies and security plans have identified vulnerabilities, recommending

additional security measures to adapt to the growing IT risks and market changes and recommendations have been made to enhance security measures and reconsider its business model to better align with financial market frameworks to ensure the integrity of European carbon market. Overall, the Registry system has insufficient resources to protect the confidentiality and integrity of the system. Different studies proposed a new operating model to address these issues, with an estimated investment of EUR 30-40 million per year. This investment represents only 0.00016% of the assets held in the Union Registry and would be justified ensuring the integrity and security of the system and integrity of the European carbon market.

Overall, the evaluation confirms that the ETS has successfully achieved its objectives so far and it has been a key instrument in delivering on the EU climate objectives. However, the evaluation also points to areas of improvements, such as better balancing the need to prevent carbon leakage with ensuring continued incentives for investments in decarbonisation, ensure a more efficient MRVA system and enhance the security measures for the Union Registry.

5.2 MSR

The MSR was adopted in 2015 as an instrument with two objectives. First, it aimed to reduce excess allowances in the EU ETS that built up over Phases II and III, as a result of (i) a decrease in demand for allowance due to the 2010 economic crisis and a number of complementary policies, and (ii) an increase in allowance supply through the inflow of international credits into the EU ETS. Second, the MSR aimed to mitigate the build-up of new demand-supply imbalances in order to sustainably strengthen the resilience of the EU ETS.

Since the initial Impact Assessment from 2014, the MSR underwent a number of changes and reforms. The configuration adopted in 2015 was slightly deviating from the parameters assessed in the 2014 IA. In 2018, the intake rate was doubled to increase the effectiveness of the mechanism at reducing the surplus, and an invalidation mechanism was added that introduced a rule-based volume cap for the allowances held in the MSR. This MSR configuration entered into force in 2019. Starting in 2021 with adoption in 2023, the Fit for 55 reform further refined the MSR design. As a results, the 2014 IA can only serve to a limited degree as point of comparison and only for the period from 2014 to 2017, i.e. before the MSR started operating. The MSR Review that the Commission undertook in 2021 is a useful complement for the evaluation.

Effectiveness: The MSR was effective in reducing the historical demand-supply imbalance in the allowance market. The MSR mitigated the build-up of a new imbalance from 2013 but did not fully absorb excess allowances. There is still a demand-supply imbalance. It was hence only partially effective in achieving its second objective to enhance future resilience of the EU ETS market. It was effective in mitigating price crashes resulting from the shocks related to the COVID-19 pandemic and the energy price crisis. Most notably, the MSR credibly signalled the commitment of the EU to the EU ETS, thereby boosting confidence in the market.

Efficiency: The operation of the MSR has few direct costs and large benefits. The evaluation of efficiency concludes however that the MSR induces additional complexity to the EU ETS that is connected with indirect costs for Member States, regulated entities, and other stakeholder engaging in modelling, price forecasts or any other assessment of the functioning of the EU ETS.

Coherence: The evaluation of MSR coherence concludes that the MSR is largely coherent with complementary policies as it addresses the waterbed effect. In some instances,

counterintuitive interactions with complementary policies have occurred, such as REPowerEU and voluntary cancellation, but these have been effectively addressed.

In sum, while the MSR added complexity to the EU ETS regarding the calculation of allowance supply in a given year as well as the interaction with complementary policies, the evaluation attests to the instrument's positive effect on reducing demand-supply imbalances in and increasing overall confidence into the EU ETS, thereby making it more resilient to future shocks.

6 APPENDIX I. PROCEDURAL INFORMATION

See Annex 1 on Procedural Information

7 APPENDIX II. METHODOLOGY AND ANALYTICAL MODELS USED

This Evaluation has not carried out economic modelling but has studied the literature for ex post economic modelling and econometric analysis, supplemented by stakeholder interviews and own analysis. The details are given in Appendix III as well as the body of the Evaluation.

For the EU ETS as an instrument to attain a certain ambition level cost-effectively, it is extremely challenging to dis-entangle the impacts of the carbon price, which was rather low over much of the period, from the impacts of financial crisis, the COVID-19 Pandemic, and the energy price crisis due to the Russian invasion of Ukraine, taking part against the background of a secular shift from manufacturing to Services in Western economies, and the rise of the Chinese economy. All of these elements have a very large impact on the economy as a whole.

Nevertheless, in so far as academic literature has been available, it has been cited in the body of the Evaluation. It needs to be emphasised here that all econometric or ex post modelling literature suffers from the uncertainties inherent to dis-entangling the impacts of climate policy from much larger economic crises or megatrends. While general conclusions can be drawn, full quantification is unreliable, and these past results should not be extrapolated to the future. For this reason, the evaluation has taken a pragmatic approach, using external knowledge and a well-circumscribed analysis of available data, with the necessary caveats.

For assessing the effectiveness and efficiency of the EU ETS as a whole, the Evaluation cited economic studies in the literature and drew conclusions from available data about emissions per sector, carbon prices and energy prices.

For the Market Stability Reserve a “Baseline” was retro-actively constructed by arithmetically calculating what the surplus (TNAC) in the market would have been without an MSR active. While this leaves out the dynamic impacts of the MSR on price and on reductions, it provides a straightforward way to show its impacts. The Baseline from the Impact Assessment in 2014 is too outdated to use, given that policy intensity has been higher and economic developments since 2020 have been dramatically different. The Reference Scenario from 2014 is more relevant but possesses similar drawbacks. The analysis based on the straightforward counterfactual Baseline has been further strengthened by considering the way the carbon market has responded to recent shocks, consulting stakeholders as well as literature.

The analysis on carbon leakage used academic literature as well as stakeholder interviews to get external views on the effectiveness of carbon leakage measures so far, as well as the possible occurrence of carbon leakage in the past. The extent of free allocation for different sectors, how this changed from Phase III and Phase IV, and the impact thereof on carbon costs, was estimated based on the emissions and activity data submitted by operators, as part of the application for free allocation for 2026-2030. The administrative costs for the monitoring, reporting, verification, as well as free allocation processes were determined based on data collected from operators, verifiers and competent authorities via a dedicated survey.

8 APPENDIX III. EVALUATION MATRIX AND DETAILED EVALUATION OF THE EU ETS COMPONENTS (BY CRITERION)

8.1 EU ETS Evaluation Matrix

8.1.1 Effectiveness

Table 1: ETS Evaluation Matrix – Effectiveness

	Sub-questions	Judgment criteria	Indicators and approach	Data sources
2a	What were the overall emissions reductions associated with the EU ETS sectors?	If the quantitative assessment shows that emissions have declined over the 2018-23 period, then emission reductions have occurred.	Quantitative assessment: Show overall emission reduction between 2014 up until 2023 based upon NIMs data and compare with EUTL values.	EUTL NIMs Build upon the work already undertaken for carbon leakage evaluation.
2b	To which extent can the emissions reductions (if observed) be attributed to the application of the Directive?	If the carbon price has increased to levels that incentivise realisation of abatement potential and sectors are more exposed to the carbon price signal then the ETS has driven, at least in part, the emission reductions observed.	Quantitative / qualitative assessment - Show the balance of allowances compared to verified emissions based on EUTL data and discuss ETS and non-ETS factors that could drive the observed trend. - Show carbon price development based on EEX data. - Refer to work undertaken for carbon leakage chapter to outline the share of emissions covered by free allocation. - Show CO₂ cost impact on electricity prices	EUTL EEX Literature review Interviews

			• Refer to work undertaken for carbon leakage chapter to outline the support provided for indirect cost compensation. • Refer to work undertaken for carbon leakage on specific emission improvements of product BMs. • Refer to interviews to add insight on role of ETS on the changes in specific emissions observed and how the carbon price is influencing abatement. Qualitative assessment: • Literature review of studies that assess the role of ETS in driving emission reductions.	
2c	How do the observed effects correspond to the objectives of the Directive?	If the emission levels are in line with the ETS cap, then the observed effects correspond to the objectives of the Directive. If there is no evidence of carbon leakage, then the observed effects correspond to the objectives of the Directive with regards to a ‘high level of environmental protection.’ If there is evidence of investments in low carbon technology, then that the observed effects correspond to the objectives of the Directive.	Quantitative assessment: • Compare the emission levels over the 2014-23 with the ETS cap. • Show evidence of carbon leakage (refer to more detailed analysis under carbon leakage) • Show effect on investments (refer to more detailed analysis under carbon leakage) Qualitative assessment: • Refer to ongoing studies from EEA to validate quantitative results.	Progress on climate action - European Commission Carbon Market Report EEA trends and projections report
2d	Has the revised ETS Directive been successful in improving the functioning and the resilience of the carbon	If the surplus of allowances has been reduced since the start of Phase III, then the MSR reforms and increasing the LRF has been successful.	Refer to more detailed chapters of the evaluation: • Refer to effectiveness under the MSR chapter.	More detailed work in subsequent chapters.

	market by addressing the surplus of allowances (which was identified in Phase III) by strengthening the MSR and increasing the LRF?			
2e	Has the EU ETS MRVA system supported the overall effectiveness of the EU ETS?	The MRVA system ensured accurate, complete and transparent emissions data, as well as prevented errors or misreporting.	Quantitative assessment: - MRVA survey results assessment Qualitative assessment: - Assessment of Member States Article 21 reports	Survey results Article 21 Reports
2f	Has the EU ETS auctioning system supported the overall effectiveness of the EU ETS?	The auctioning system operated in an open, transparent and predictable manner and ensured the reliable allocation of emission allowances to market participants and the transfer of auction proceeds to the auctioneers.	Quantitative assessment: - Auction bidder participation rates, number of cancellations, etc. Qualitative assessment: - ESMA assessment of the functioning of the carbon market	ESMA report EEX reports Article 10(4) reports
2g	Has the EU ETS registry system supported the overall effectiveness of the EU ETS?	The Union Registry ensured maintained a reliable and secure IT system for tracking the creation, allocation, surrender and reversal of allowances.	Refer to more detailed chapters of the evaluation: Refer to effectiveness under the Registry Section in Annex III.	More detailed work in subsequent chapters.

8.1.2 Efficiency

Table 2: ETS Evaluation Matrix – Efficiency

Sub-questions	Judgment criteria	Indicators and approach	Data sources

3a	To what extent has the Directive been more or less successful in achieving its objectives compared to alternatives, e.g. command and control measures, taxation?	Cap and trade is more efficient than alternatives such as regulation of carbon taxes.	Qualitative assessment Outline the theoretical differences and explain the rationale in favour of cap and trade.	Literature review
4a	To what extent are the costs resulting from the implementation of the Directive proportionate to the changes/effects it has achieved?	If the administrative costs associated with the implementation of the Directive are relatively low, then the costs are proportionate to the changes/effects it has achieved.	Quantitative assessment: - Calculate the total free allocation volume, auctioned allowance volume and verified emissions to all installations in the EU ETS for the years 2014-23 based on EUTL. - Then calculate absolute value based on an average annual carbon price based on EEX. - Show the value of free allocation. - Compare with a counterfactual scenario whereby all allowances would have been auctioned. - Compare value estimated with information to be collected on administrative costs for free allocation application from the survey and insights from interviews and literature review.	EUTL EEX
4b	Has the monitoring, reporting and verification of greenhouse gas emissions covered by the EU ETS been carried out cost effectively and are there any options for simplification are apparent with a view to reduce administrative burden on relevant stakeholders?	The cost of reporting remains proportionate to achieving the objective of accurate reporting.	Quantitative assessment: Cost of reporting assessed based on MS reporting and survey results	Survey results Article 21 reports

4c	Has the auctioning system been an efficient way of allocating ETS allowances?	Cost of the auctioning process lower than other allocation methods (i.e. free allocation). Auction clearing prices do not significantly deviate from the secondary market	Quantitative assessment: - Auction clearing prices vs secondary market Qualitative assessment: - ESMA assessment of the functioning of the carbon market	ESMA report EEX reports Article 10(4) reports
4d	Has the Registry system been operating in a cost-efficient way?	Registry fees Adequate resources available to operate the Registry securely	Refer to more detailed chapters of the evaluation Refer to effectiveness under the Registry Section in Appendix III.	More detailed work in subsequent chapters.

8.1.3 Coherence

Table 3: ETS Evaluation Matrix – Coherence

	Sub-questions	Judgment criteria	Indicators and approach	Data sources
5a	To what extent is the Directive coherent with other EU policies, such as those related to renewable energy, energy efficiency, state aid, etc.?	If the other climate policies fully support the environmental integrity of the EU ETS and does not impact the ETS cap, then other EU policies are coherent with the Directive. However, overlap may impact the cost of achieving the EU ETS target.	Qualitative assessment: Build upon the previous evaluation and look for more recent examples of coherence assessments in the literature.	Literature review
5b	To what extent are the various elements of the Directive (such as	If the various elements of the EU ETS hinder the achievement of the objectives of the ETS Directive,	Qualitative assessment: Review of literature to look at the coherence of free allocation on prevention	Literature review

	free allocation, carbon leakage, innovation support) coherent with one another?	then the design elements are not fully coherent with one another.	of carbon leakage whilst continuing to provide support for innovation. Review literature to discuss the coherence of the MSR with the EU ETS.	
5c	To what extent is the Directive coherent with international climate policies and obligations?	If the 2030 ETS target is aligned to a trajectory of climate neutrality by 2050 then the Directive is coherent with international climate policies and obligations.	Qualitative assessment: Refer to Article 4 of the Paris Agreement that requires ‘achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century’ and compare this with the 2030 target set for the ETS and whether this is aligned with decarbonisation by 2050.	Literature review

8.1.4 EU added value

Table 4: ETS Evaluation Matrix – EU added value

	Sub-questions	Judgment criteria	Indicators and approach	Data sources
4a	What is the EU-value added of the Directive? To what extent could the changes brought by the Directive have been achieved by national or individual Member States’ measures only?	If the changes brought by the ETS Directive would most likely be more expensive to implement at the national level, then there is added value of implementation at the EU level.	Qualitative assessment: - Build upon argumentation from previous evaluation and add new relevant insights and reflect more recent changes as examples of the EU added value. - Look also at literature assessing impact of national measures. - Refer to more detailed work on EU added value of rule harmonisation for free	Literature review

			allocation, MRVA and resilience provided by the MSR.	
4b	What would be the most likely consequences of stopping or downscaling the existing ETS Directive?	If the list of potential impacts is likely to be very detrimental then the EU provides a lot of added value that would be at risk if national emission trading systems replaced the EU ETS.	Qualitative assessment: Build upon argumentation from previous evaluation and add new relevant insights and reflect more recent changes as examples of the EU added value.	Literature review

8.1.5 Relevance

Table 5: ETS Evaluation Matrix - Relevance

	Sub-questions	Judgment criteria	Indicators and approach	Data sources
1a	How well do the objectives of the EU ETS (still) correspond to the EU climate policy objectives? Is the updated objective from the 2018 ETS revision of GHG emissions to be reduced ‘in the most economically efficient manner’ ¹³¹ still relevant?	If the ETS accounts for a considerable share of the emission reduction effort to meet the EU wide targets, then we can argue that the ETS remains relevant.	Quantitative assessment - Compare EU climate target for 2020 and 2030 with verified emissions in the EU ETS. - Share of EU emissions covered by EU ETS 1 and evolution over time. - Number of installations covered by the EU ETS	EUTL NIMs

¹³¹ Refer to para 31 in DIRECTIVE (EU) 2018/ 410 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL - of 14 March 2018 - amending Directive 2003/ 87/ EC to enhance cost-effective emission reductions and low-carbon investments, and Decision (EU) 2015/ 1814. “This Directive seeks to contribute to the objective of a high level of environmental protection, in accordance with the principle of sustainable development, in the most economically efficient manner, while providing installations

1b	Is EU ETS (a cap-and-trade system) still relevant as an effective and efficient instrument for achieving the EU climate policy goals and priorities?	Cap and trade is more efficient than alternatives such as regulation of carbon taxes.	Qualitative assessment: Refer to discussion provided in detail under efficiency for the EU ETS overall.	Literature review
1c	How well adapted is the Directive to subsequent technological or scientific advances, or any other unexpected external influences such as the recent economic crisis?	If the update of benchmarks have taken account of technological progress and the alignment of free allocation with actual production levels and the introduction and reforms of the MSR has helped the functioning of the ETS in response to unexpected external events, then the changes in the 2018 Directive have helped the ETS to adapt and stay relevant.	Qualitative assessment: - Outline that the ETS is inherently flexible by design but argue that reforms have improved resilience and refer to the following chapters for a more detailed level of argumentation. Refer to more detailed chapters of the evaluation: - We will refer to more detailed discussion of updating product benchmarks in carbon leakage and alignment of free allocation to actual production levels. - We will refer to more detailed discussion of functioning of the MSR to respond to external shocks.	More detailed work in subsequent chapters.
1d	Can the Directive be easily adjusted to new needs, in particular a new GHG target for the EU?	The ETS Directive can be easily adjusted via a change to the LRF to reflect any updates of EU economy-wide ambition.	Qualitative assessment: Discuss how the LRF was changed in the ETS 2018 Directive to reflect enhanced ambition of EU with 2030 targets.	Review of EU legislation.

adequate time to adapt, and providing for more favourable treatment of particularly affected persons in a proportionate manner to the maximum extent compatible with the other objectives of this Directive.”

8.2 MSR Evaluation Matrix

8.2.1 Relevance

Refer to evaluation matrix for the EU ETS overall.

8.2.2 Effectiveness

Table 6: MSR Evaluation Matrix - Effectiveness

	Sub-questions	Judgment criteria	Indicators and approach	Data sources
1a	Did the MSR reduce the total number of allowances in circulation as expected?	- Assessing the development of TNAC from 2013 to 2024. Success: TNAC significantly decreased as expected. - Qualitatively discussing the effect, the effect of EU ETS reform milestones (announcements, adoption, implementation) as well as external factors (economic development, pandemic, energy crisis). - Discussing the MSR effect versus other EU ETS reform elements. - Explaining the realities of the lack of a clear baseline to compare the MSR effectiveness given the number of MSR changes.	TNAC	- TNAC Communications: TNAC, annual allowances supply and verified emissions - Baseline from Impact Assessment and MSR Review - EUA price data
1b	Has the MSR mitigated the buildup of a new surplus?	- Analysing the effects of the MSR on the TNAC during the pandemic 2020/21, the energy crisis 2021/2022 and potential shocks induced by complementary policies (e.g. coal phase-out). - Building upon and potentially update the 2021 IA. - Success: The MSR reduced a buildup of the TNAC compared to a scenario without it. - Discussing the MSR effect and the effect of individual MSR elements versus other EU ETS reform elements.	TNAC	- TNAC Communications: TNAC, annual allowances supply and emissions - Economic activity, energy and EUA price data - MSR Review (2021)

1c	For shocks between 2019 and 2024, has the MSR contributed to mitigating price crashes?	- Analysing the effects of the MSR on the EUA price level during the pandemic 2020/21, the energy crisis 2021/2022 and potential shocks induced by complementary policies (e.g. coal phase-out). - Building upon and potentially update the 2021 IA, incl. the categorisation of shocks. - Success: No building up of a surplus in the period of operations of the MSR. The price level remained stable in times of crises. Shocks have not induced price crashes. - Discussing the effect of the MSR and its individual elements versus other EU ETS reform elements, highlighting that it is impossible to clearly delineate the MSR effect in reality. Using results from existing academic modelling to compare the size of individual effects.	Changes in price level (indicating a healthy demand-supply balance)	- EUA price level - Economic activity, energy and EUA price data - Academic modelling
1d	Has the MSR increased confidence into the EU ETS as main driver for long-term decarbonisation in the EU?	- Assessing how the proposal for the MSR and the invalidation mechanism has been perceived by media, in communications of industry associations, etc. at different reform milestones. Success: positive perception of the MSR/invalidation mechanism in the public opinion. - If possible, discussing the part of price increases attributable to EU ETS fundamentals versus the role of increased confidence.	- Price level (indicating confidence into the system) - Perception of the EU ETS	- EUA price data - Media articles, press releases - Interviews

8.2.3 Efficiency

Table 7: MSR Evaluation Matrix - Efficiency

	Sub-questions	Judgment criteria	Indicators and approach	Data sources
2a	What costs were identified by the 2014 IA?	• Discussing direct and indirect costs for EU administration, MS, and stakeholders, as analysed within the 2014 IA. Discussion of level of these costs. • Direct costs: Low for the EU administration, no direct costs for MS and stakeholders for the implementation of the MSR. • Indirect costs: (as identified in 2014 IA) • Judgement criteria: The 2014 IA had a correct estimation of the identified costs.	Types and level of costs identified in the 2014 IA	• 2014 Impact Assessment
2b	What costs were induced by the MSR that were not foreseen in the 2014 IA?	• Discussing unforeseen direct costs and how they are distributed among stakeholders • Qualitative discussion of indirect costs, e.g. increased complexity in forecasting EUA prices, increased complexity for invalidating allowances alongside a coal phase-out, etc., that appeared within the actual circumstances of MSR implementation. • Judgement criteria: Beyond the 2014 IA no other costs occurred in a significant scale.	Additional cost types and their respective levels	• 2021 Impact Assessment • Academic papers • Targeted interviews
2c	Which of these costs could have been avoided by choosing a different MSR design?	• Analysing potential design choices of the MSR within the fundamental principles of an allowance reserve (threshold parameters and values, speed of reaction). Discussing recent changes like the introduction of the buffer zone to avoid threshold effects. Success: The MSR design is optimal in terms on reducing costs.	Alternative MSR design features	• 2021 Impact Assessment • Academic papers and modelling, policy reports

2d	Did the MSR lead to co-benefits besides the targeted benefits that could not have achieved by other measures?	- Beyond the intended benefits of the MSR (i.e. the reduction of the historical surplus and the increased resilience to future shocks, there are possibly unexpected co-benefits that need to be considered in an evaluation of the MSR efficiency. - Possible co-benefits: further transparency through the publication of the TNAC and its calculation, increased flexibility of the EU ETS through creating a reserve (for reinjecting, invalidation or other purposes), etc. - Judgement criteria: The MSR generated co-benefits that improve its efficiency beyond the original assessment in 2014.	Additional benefits	- Academic papers - Targeted interviews

8.2.4 Coherence

Table 8: MSR Evaluation Matrix - Coherence

	Sub-questions	Judgment criteria	Indicators and approach	Data sources
3a	Is the MSR aligned to other elements of the EU ETS?	- Analysing how other elements of the EU ETS, especially those adjusted in recent reforms (e.g. LRF; 2030 reduction target), might counteract the functioning and objectives of the MSR and vice versa. - E.g., if allowances from the MSR are released in 2030, this might increase emissions and jeopardise the 2030 climate target. - Success: No significant interference between the MSR and other EU ETS elements.	Potential interference between MSR and other EU ETS elements	2014 and 2021 Impact Assessments - Academic papers and modelling, policy reports
3b	Is the MSR aligned to other EU climate or energy policies?	- Analysing how EU climate or energy policies might counteract the functioning and objectives of the MSR and vice versa. - Success: No significant interference and ideally synergies between the MSR and other EU climate or energy policies.	Potential interference between MSR and other EU ETS elements	2014 and 2021 Impact Assessments - Academic papers and modelling, policy reports - Targeted interviews

3c	Is the MSR in line with to climate or energy policies at Member State level?	- Analysing how climate or energy policies at Member State level counteract the functioning and objectives of the MSR and vice versa. - Particularly, this concerns renewable energy policies, energy efficiency policies and coal-phase outs. - Success: No significant interference and ideally synergies between the MSR and climate or energy policies at Member State level.	Potential interference between MSR and climate or energy policies at Member State level	2014 and 2021 Impact Assessments - Academic papers and modelling, policy reports - Targeted interviews

8.2.5 EU Added value

Refer to evaluation matrix for the EU ETS overall

8.3 Carbon Leakage Prevention Evaluation

8.3.1 Introduction

Since the outset of the EU ETS, the allocation of free allowances has served as the main provision for the prevention of carbon leakage, which refers to the possible relocation of industrial production that is subject to EU carbon pricing to countries with less stringent climate policies. Consequently, there is a concern that such unequal carbon pricing may result in either an overall increase in global GHG emissions or a lower reduction in global emissions than in EU emissions.

Already since the start of the EU ETS, the free allocation of allowances was the main instrument used to limit carbon costs and protect against leakage. While this approach helped ease the political and economic transition to a carbon market, it also introduced challenges. Uneven allocation methods across Member States led to distortions in intra-EU competition, and in sectors where allowances were passed through in product prices, companies could gain so-called windfall profits without corresponding environmental benefit. Moreover, the environmental incentive to reduce emissions was often weakened, particularly where free allocation covered most or all of a company's compliance needs.

From Phase III onwards, the share of free allowances declined considerably as more allowances were instead auctioned. The methodology for allocating allowances for free also changed from grandfathering (i.e. based upon historic emissions) to benchmarking that rewarded firms with relatively lower specific emissions for their production by receiving more allowances for free. These reforms to free allocation raised concerns amongst industry about the risk of carbon leakage with less of their emissions covered by free allowances than in previous phases of the EU ETS. However, this potential impact was offset initially by the structural surplus of allowances at the start of Phase III that undermined the price signal of the EU ETS reducing the carbon costs that firms were subject to and, even then, many firms were able to bank their own surplus allowances for later use to hedge themselves against future carbon costs.

In response, the design of free allocation under Phase IV has undergone significant reform to better align with climate ambition, economic fairness, and environmental integrity. The scope of this evaluation for carbon leakage prevention focuses on the key changes that occurred at the start of Phase IV to free allocation following the revision of the ETS Directive in 2018:

- *Revised benchmark values for free allocation:* The introduction of more stringent product benchmarks for free allocation, based on the average performance of the top 10% most efficient installations. This approach strengthens the incentive to improve efficiency and invest in low-carbon technologies, as allowances are increasingly allocated based on demonstrated best performance rather than historical emissions.
- *Updated carbon leakage list:* Phase IV revised the method for identifying sectors at risk of carbon leakage. A quantitative carbon leakage list now applies more rigorous criteria, based on emissions intensity and trade exposure, to determine sectors and sub-sectors that are deemed at a higher risk of carbon leakage. As a consequence of the update to the carbon leakage list, the number of sectors and sub-sectors deemed at risk of carbon leakage was lower than in previous carbon leakage lists and therefore the support in the form of additional free allowances was better targeted.

- *Establishment of a buffer to limit the application of the Cross Sectoral Correction Factor (CSCF)*¹³²: If the preliminary allocation of free allowances exceeds the free allocation budget, then the CSCF is applied to reduce the allocation of free allowances by an equal percentage across all installations. The CSCF buffer was introduced to limit the need to apply the CSCF by increasing the number of free allowances that can be made available (up to 3% of allowances that are allocated for auctioning may be used to increase the maximum amount available for free allocation) if the preliminary allocation may exceed the free allocation budget for a given year.
- *Better alignment of free allocation with actual production levels*: the number of free allowances an installation receives is adjusted regularly to reflect actual production levels, rather than being fixed for long periods based on past output. This ensures that free allocation is now more aligned to actual production and that the demand and supply of allowances is more balanced. It also strengthens the economic rationale of the ETS by ensuring that allowance distribution better reflects real-world activity.

The reforms introduced in the latest ETS phase indicate a strategic shift in how the system addresses carbon leakage. Rather than merely shielding the sectors indefinitely from external competition, the updated design encourages innovation while continuing to prevent relocation of emissions and production.

8.3.2 Point of comparison

Provisions of relevance from the 2018 ETS Directive

In the revision to the ETS Directive in 2018, several important reforms were made to the determination of harmonised rules for the free allocation of allowances under Article 10a that will be the focus of this evaluation.

- Harmonised allocation rules for free allocation:

Article 10 (1) provides that the Commission is empowered to adopted “Union-wide and fully harmonised rules for the allocation of allowances”. On this basis, Delegated Regulation (EU) 2019/331 was adopted on 19 of December 2018 and further elaborates on the harmonised allocation rules outlined in Article 10a of the ETS Directive.

- Revised benchmark values for free allocation:
Article 10a, paragraph 2 was updated as follows:
 - “For the period from 2021 to 2025, the benchmark values shall be determined on the basis of information submitted pursuant to Article 11 for the years 2016 and 2017. On the basis of a comparison of those benchmark values with the benchmark values contained in Commission Decision 2011/278/EU (*), as adopted on 27 April 2011, the Commission shall determine the annual reduction rate for each benchmark, and shall apply it to the benchmark values applicable in the period from 2013 to 2020 in respect of each year between 2008 and 2023 to determine the benchmark values for the period from 2021 to 2025”
 - “Where the annual reduction rate exceeds 1,6 % or is below 0,2 %, the benchmark values for the period from 2021 to 2025 shall be the benchmark values applicable in the period from 2013 to 2020 reduced by whichever of

¹³² The Cross Sectoral Correction Factor (CSCF) is used to prevent free allocation exceeding the free allocation budget and is applied to preliminary allocation to determine the final allocation.

those two percentage rates is relevant, in respect of each year between 2008 and 2023.”

- “By way of derogation regarding the benchmark values for aromatics, hydrogen and syngas, these benchmark values shall be adjusted by the same percentage as the refineries benchmarks in order to preserve a level playing field for producers of those products....In order to promote efficient energy recovery from waste gases...the benchmark value for hot metal, which predominantly relates to waste gases, shall be updated with an annual reduction rate of 0,2 %.”

Implementing Regulation (EU) 2021/447 was adopted on the 12th of March 2021, which determined the revised benchmark values for free allocation of emission allowances for the period from 2021 to 2025.¹³³

- Establishment of a buffer to prevent the application of the CSCF:
Article 10a, paragraph 5 is replaced by the following:
 - “In order to respect the auctioning share, set out in Article 10, for every year in which the sum of free allocations does not reach the maximum amount that respects the auctioning share, the remaining allowances up to that amount shall be used to prevent or limit reduction of free allocations to respect the auctioning share in later years. Where, nonetheless, the maximum amount is reached, free allocations shall be adjusted accordingly. Any such adjustment shall be done in a uniform manner.’

The following paragraph was subsequently inserted:

- By way of derogation from paragraph 5, an additional amount of up to 3 % of the total quantity of allowances shall, to the extent necessary, be used to increase the maximum amount available under paragraph 5.
- Better alignment of free allocation with actual production levels:
Article 10a, paragraph 20 was replaced by the following:
 - “The level of free allocations given to installations whose operations have increased or decreased, as assessed on the basis of a rolling average of two years, by more than 15 % compared to the level initially used to determine the free allocation for the relevant period referred to in Article 11(1) shall, as appropriate, be adjusted. Such adjustments shall be carried out with allowances from, or by adding allowances to, the number of allowances set aside in accordance with paragraph 7 of this Article”

Implementing Regulation (EU) 2019/1842 was adopted on the 31st of October 2019, which outlined the rules for the further arrangements for the adjustments to free allocation of emission allowances due to activity level changes.¹³⁴

In the revision to the ETS Directive in 2018, several important reforms were made to the transitional measures to support certain energy intensive industries in the event of carbon leakage under Article 10b that will be the focus of this evaluation.

- Updated carbon leakage list:

¹³³ Implementing regulation (EU) 2021/447, available at: https://eur-lex.europa.eu/eli/reg_impl/2021/447/oj

¹³⁴ Implementing regulation (EU) 2019/1842, available at: eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R1842

Article 10b, paragraph 1, was replaced as follows:

- “Sectors and subsectors in relation to which the product resulting from multiplying their intensity of trade with third countries, defined as the ratio between the total value of exports to third countries plus the value of imports from third countries and the total market size for the European Economic Area (annual turnover plus total imports from third countries), by their emission intensity, measured in kgCO₂, divided by their gross value added (in EUR), exceeds 0,2, shall be deemed to be at risk of carbon leakage. Such sectors and subsectors shall be allocated allowances free of charge for the period until 2030 at 100 % of the quantity determined pursuant to Article 10a.”

Delegated Decision (EU) 2019/708 was adopted on the 15th of February 2019, which determined the sectors and subsectors deemed at risk of carbon leakage for the period 2021 to 2030.¹³⁵

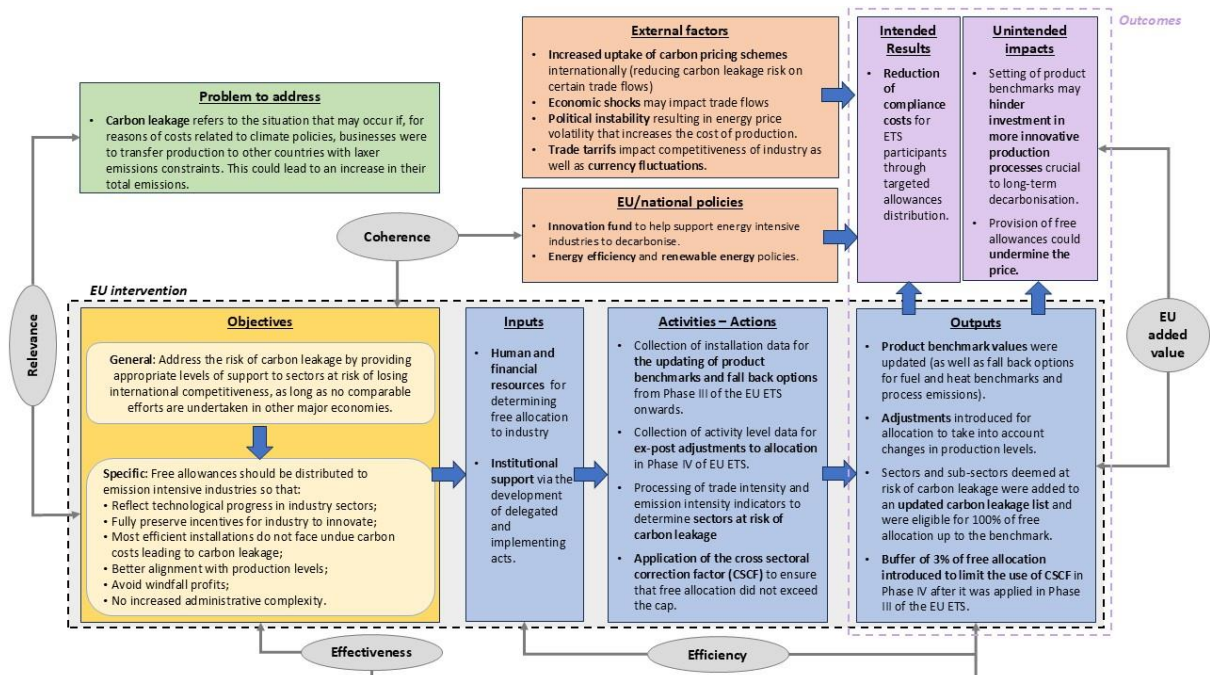
The reforms to free allocation outlined above following the revision to the ETS Directive in 2018 were all intended to better target free allocation to sectors at risk of carbon leakage. The next section explains further via an intervention logic diagram how the collective policy interventions were intended to be implemented in theory before subsequently evaluating whether this materialised in practice based on recent empirical evidence.

8.3.3 Intervention logic

Figure 19 provides an overview of the intervention logic to justify the provision of free allocation in order to prevent the occurrence of carbon leakage. The intervention logic diagram focuses on the point of comparison, which as explained in the previous section, refers to the reforms made to the provision of free allocation following the revision to the ETS Directive in 2018. The extent to which the policy intervention delivered the expected outcomes will be the subject of the evaluation responding to the questions set in the corresponding evaluation matrix. Each element of the intervention logic diagram below is further discussed in the following subsections.

¹³⁵ Official Journal of the European Union, Volume 62, 8 May 2019, available at: eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L:2019:120:FULL

Figure 19: Intervention logic diagram (carbon leakage)



Source: Own illustration

8.3.3.1 Problem to address

The prevention of carbon leakage, which refers to the possible relocation of industrial production that is subject to EU carbon pricing to countries with less stringent climate policies. Therefore, there is a concern that such unequal carbon pricing may result in either an overall increase in global GHG emissions or a lower reduction in global emissions than in EU emissions. As a consequence, unequal carbon pricing across jurisdictions abroad presents a competitive challenge for European producers covered by the EU ETS.

Carbon leakage poses economic risks, including the potential decline of industrial activity, jobs and market share, and also undermines the climate objectives of the EU ETS. Addressing this concern is central to the EU's overall climate strategy and becomes increasingly relevant as the ambition of the EU ETS progressively increases over time.

8.3.3.2 Objectives

The primary instrument to protect emission intensive industries against the risk of carbon leakage was free allocation. Through free allocation, a portion of allowances is allocated for free to carbon intensive sectors exposed to the risk of carbon leakage, in order to prevent relocation of activity to areas without a carbon price.

Indeed, the **general objective** of the provision of free allocation is to prevent the risk of carbon leakage by shielding emissions-intensive and trade-exposed industries from the full cost of

compliance of the EU ETS. The design of the policy intervention is underpinned by the following two **specific objectives**¹³⁶:

- the more targeted provision of free allowances to continue “effective protection for sectors exposed to a significant risk of carbon leakage”.
- to incentivise “the uptake of low carbon technologies” to reduce their exposure to the carbon price in the longer term.

A common critique of free allocation in the EU ETS is that it reduces the incentive for emissions-intensive industries to decarbonize by shielding them from the full carbon price. This can delay or reduce incentives for these industries to shift to lower-emission technologies, as they face less financial pressure to cut emissions. In theory, however, the EU ETS still encourages decarbonisation because companies can sell any surplus allowances if they lower their emissions below allocated levels, thereby earning a profit. Furthermore, reforms to how free allocation is provided (i.e. the introduction of benchmarking) ensures that incentives remain to reward firms for taking early action to reduce their emissions by securing more allowances that they can sell in the future. Nonetheless, critics argue that this profit potential is often not strong enough to overcome the benefit of maintaining current, higher-emission processes when firms receive allowances at low or no cost.

The extent to which the objectives above address the identified problem are defined as the relevance of the policy intervention. The ambition of the EU ETS has been raised further in Phase IV to align with the goal of achieving climate neutrality by 2050, set by the European Green Deal. As a consequence, concerns regarding carbon leakage have continued to grow in recent years as the price signal has strengthened in response to, in part, the enhanced levels of ambition of the EU ETS.

8.3.3.3 Inputs

Implementing the reforms for the more targeted provision of free allocation in Phase IV required significant **human and financial resources** from the Commission, Member States, and relevant institutions. The use of these resources is discussed in the next subsection providing examples of the subsequent actions.

8.3.3.4 Actions

With significant human and financial resources from the Commission, Member States and other relevant institutions, the following actions were undertaken:

- The *updating of the product benchmarks and fall-back options* by taking into account more recent NIMs data¹³⁷ on emissions and activity levels for installations (that needed to be collected, verified and processed) to make the

¹³⁶ COMMISSION STAFF WORKING DOCUMENT IMPACT ASSESSMENT REPORT Accompanying the document DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union, Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and Regulation (EU) 2015/757, <https://eur-lex.europa.eu/legal-content/EN/AUTO/?uri=celex:52021SC0601>

¹³⁷ Data collected/submitted to the COM in accordance with Art. 11 of the ETS-D and FAR Art. 14.

necessary adjustment to the product benchmark values and fall-back options that were applied previously in Phase III.¹³⁸

- *Determining whether the CSCF needed to be applied* to ensure that final free allocation did not exceed the EU ETS cap even with the establishment of the additional buffer. This involves further resource to compare the cap and auctioning share with the total preliminary allocation before multiplying it by the CSCF to calculate the total final allocation that was subsequently approved and published by the Commission. The establishment of an additional buffer also required resources to design, review and approve.
- Setting rules for the Activity Level Changes Regulation (ALCR)¹³⁹ and to then adjust allocation to reflect changes in activity levels. This required resources to maintain free allocation levels that were more aligned to actual production levels.
- The *determination of the carbon leakage list* involved detailed assessments of trade intensity and emissions exposure across industrial sectors and required dialogue with key stakeholders. The methodology for the first level quantitative assessment was revised with a single carbon leakage indicator (i.e. emission intensity * trade intensity) used to determine the sectors and sub-sectors at significant risk of carbon leakage and this required considerable resources to design, review and approve. The eligibility criteria for a second level assessment at a more disaggregated level was also revised to reflect the use of a single carbon leakage indicator.

8.3.3.5 Output

The actions described above resulted in the following outputs:

- *Updated benchmark values* for Phase IV (2021-25) were calculated based upon NIMs data, which was collected by the Commission in 2019, related to the emissions and activity levels of all sub-installations. The benchmark values from Phase III were adjusted downwards to reflect the technological improvements observed in the NIMs dataset.
- *No application of the CSCF*: In Phase III, the application of the CSCF resulted in a reduction in free allocation of approximately 6% in 2013 and 18% in 2020.¹⁴⁰ In Phase IV (2021-25) the CSCF was not applied and remained at 1 because of the preliminary allocation not exceeding the available quantity of free allowances.
- *Rules for aligning allocation better to activity levels*: Rules were set for adjustment to allocation levels in Phase IV to be more aligned with actual production.

¹³⁸ The key activities involved the collection of detailed emissions and activity data from industrial installations to establish benchmark values. These benchmark values, which represented the average emissions of the top 10% most efficient installations, were used as the basis for calculating free allocation. For Phase III of the EU ETS, 52 product benchmarks and two fall-back values were established. The fall-back options are benchmarks for heat and fuel consumption for product and processes covered by the product benchmark. The collection of benchmark data was organised on a voluntary basis and based on a methodology set out by the European Commission.

¹³⁹ Implementing regulation (EU) 2019/1842, available at: https://eur-lex.europa.eu/eli/reg_impl/2019/1842/oj/eng

¹⁴⁰ EU ETS Cross Sectoral Correction Factor

- *More targeted carbon leakage list:* Sectors and sub-sectors that met the criteria for significant risk of carbon leakage were added to a carbon leakage list and were eligible for 100% of the quantity of free allowance determined pursuant to Article 10a of the ETS Directive. The resulting carbon leakage list was more targeted due to the use of a single carbon leakage indicator to determine the carbon leakage risk status of sectors and sub-sectors.

8.3.3.6 Intended results

The policy intervention intended to provide emission-intensive and trade-exposed sectors with a degree of protection from the full cost of carbon pricing under the EU ETS. By providing a targeted allocation of free allowances to sectors at significant risk of carbon leakage, it aimed to limit compliance costs and prevent relocation of industry. At the same time, it was expected that the use of benchmarks and gradual adjustments to allocation rules would preserve incentives for emissions reductions and innovation. In this way, the intervention sought to balance competitiveness and climate objectives.

8.3.3.7 Unintended impacts

Free allocation can result in lower carbon prices, which could undermine the strength of the EU ETS price signal and the efficiency of the system. The updated benchmark values for Phase IV, better alignment of allocation to production levels and a revised carbon leakage list all help to ensure that free allocation is better targeted and this offsets the unintended impact of free allocation on the lowering of carbon prices.

Another unintended impact of the provision of free allocation, albeit better targeted, is that it may still delay investments in more innovative production processes as installations that continue to receive free allowances are not fully exposed to the carbon cost. However, the allocation of free allowances based upon benchmarking has helped to mitigate this unintended impact by linking the allocation of free allowances to performance in terms of the emission intensity of production for benchmarked products. However, even with the use of product benchmarks, innovation can still be disincentivised if a product benchmark fails to take into account new technologies within its product boundary. This has already been acknowledged and started to be addressed by the Commission with some product benchmark definitions being modified - most notably those related to hydrogen and steel production.¹⁴¹

8.3.3.8 External factors

The effectiveness of carbon leakage provisions has been influenced by external developments. At the international level, the increase in the international uptake of carbon pricing schemes could reduce the impact of carbon leakage on certain domestic industries and trade flows. According to ICAP,¹⁴² 36 ETS systems are currently in force at a global level, and 22 systems are under stages of development and consideration. Industrial influences include macroeconomic shocks, which can impact trade flows; geopolitical instability, which could result in energy price volatility and increase costs of production for emissions intensive industries; trade tariffs and currency fluctuations can impact trade flows and the competitiveness of EU industries.

¹⁴¹ REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL on the functioning of the European carbon market in 2023, SWD(2024) 264 final

¹⁴² [Emissions Trading Worldwide: 2024 ICAP Status Report | International Carbon Action Partnership](#)

8.3.3.9 EU/national policies

The intervention interacts with several related EU and national policies. At the EU level, instruments such as the Innovation Fund, established by the Directive 2003/87/EC, promotes financial support for emission-reducing investments and can support emission intensive industries' efforts to decarbonise. Likewise, the Energy Efficiency Directive (Directive (EU) 2023/1791) and the Renewable Energy Directive (Directive (EU) 2023/2413) aim to reduce overall energy demand and increase the share of renewables, thereby indirectly reducing emissions and the demand for ETS allowances.

Member States' National energy and climate plans (NECPs) outline how each Member State plans to achieve its climate goals by 2030. NECPs include information on energy efficiency and innovation, which could affect industrial emissions. Member States' energy strategies and renewable targets can affect emissions reduction. The coherence and interplay between these policies are essential to ensure that carbon leakage provisions remain effective while supporting the Union's wider climate policy objectives.

8.3.4 *Evaluation findings*

8.3.4.1 Effectiveness

The effectiveness of free allocation as measure for reducing the risk of carbon leakage is evaluated on the basis of the following questions:

- EQ1: Has free allocation been an effective measure in Phase IV to protect against carbon leakage considering the targets of the enhanced emissions reduction?

In recent years, industrial producers in Europe have been operating in an increasingly uncertain and volatile environment following a succession of unforeseen external events that included the supply chain impacts of the COVID-19 pandemic, the spike in energy prices following the illegal invasion of Ukraine by Russia and the imposition of higher trade tariffs by the United States. Over the same period, the EUA price has risen sharply reaching in excess of EUR 80 early into Phase IV of the EU ETS. As a consequence, the cost of compliance for European producers that do not have banked allowances from previous phases of the EU ETS has increased considerably. During interviews with a range of industrial stakeholders there was an acknowledgement that carbon pricing was not the main driver influencing the competitiveness of EU industry, however, it was strongly argued that the additional unilateral costs associated with the increased EUA price has exacerbated what was already a very challenging situation for European producers.

The risk of carbon leakage depends upon two factors:

- Exposure of EU producers to the carbon cost.
- Extent of comparable carbon pricing in third countries.

EU industrial producers have not yet fully decarbonised, so they remain exposed to the carbon cost and, comparable carbon pricing in third countries has overall not yet materialised. The provision of free allocation to industry was therefore continued into Phase IV of the EU ETS, still as a transitional measure, to reduce compliance costs to protect European industry from the risk of carbon leakage. There was a consensus from the interviews with industrial stakeholders that free allocation has been effective in preventing carbon leakage, although many suggested that the effectiveness of free allocation has declined following the Phase IV reforms to free allocation rules (especially with regards to the reduction of the product benchmark values).

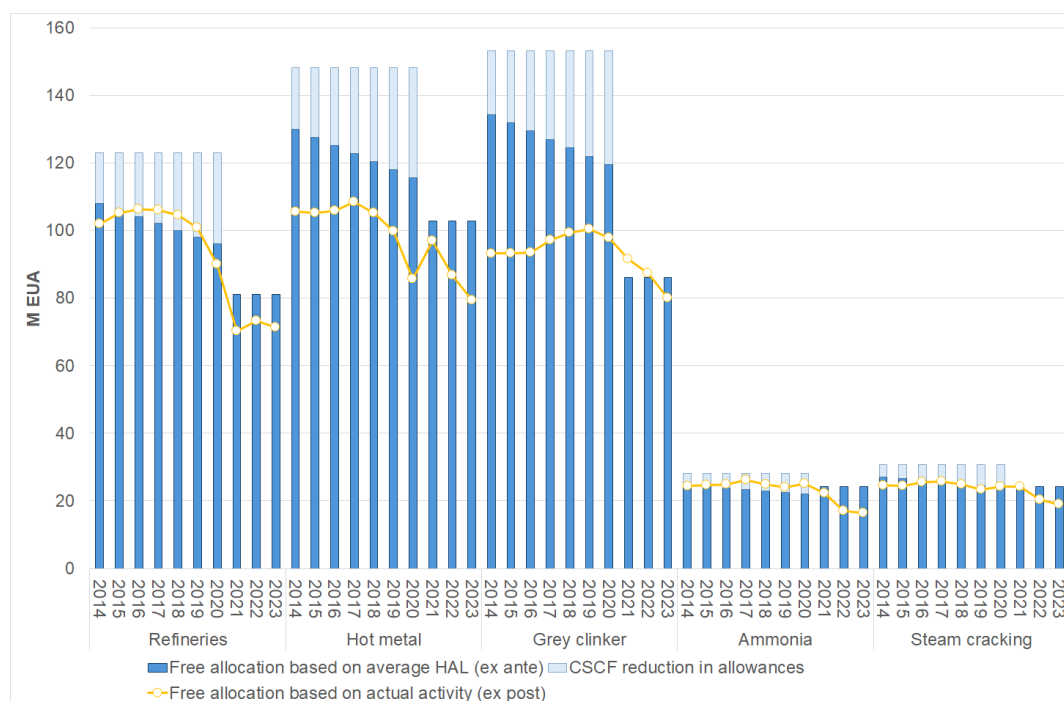
In terms of the volume of free allocation, it is the case that overall levels have been reduced in Phase IV compared to Phase III because of the reforms to free allocation that were implemented (i.e. mainly related to the reduction in the product benchmark values).

Figure 20 shows that there is a considerable reduction in the level of free allocation provided at the start of Phase IV for the most emission intensive product benchmarks compared to previous levels of free allocation provided in Phase III. This reduction in free allocation in Phase IV compared to Phase III reflects the fact that 1) the product benchmark values have been reduced and 2) the historical average activity level used to determine the volume of free allocation in Phase IV was significantly lower. This represents a cost to industrial stakeholders as a consequence of the reforms to free allocation that were implemented from Phase IV of the EU ETS onwards as a greater share of their verified emissions were not covered by free allowances. Industrial stakeholders consistently argued in interviews that the reforms to free allocation in Phase IV have reduced the effectiveness of free allocation to protect against carbon leakage based upon the logic that overall volumes of free allocation are now lower and that the carbon price is significantly higher. However, the impact of the reforms to free allocation in Phase IV is likely to be offset by the allowances banked by industrial producers from Phase III.

As part of the evaluation, levels of free allocation were recalculated based on actual activity data from the NIMs dataset and this shows that in practice the number of allowances provided to industry were considerably higher based upon the historical ex-ante values (prior to the economic recession of 2008/9) used to determine free allocation levels in Phase III. Therefore, the number of allowances available between 2013 and 2020 (even after a reduction following the application of the cross sectoral correction factor)¹⁴³ was still in many cases higher than the free allocation that was recalculated based on actual activity levels. It is evident from this quantitative analysis that the exposure to the carbon price has increased across industrial sectors due to the revision to free allocation lowering volumes in Phase IV, but it is still very likely that, in the short term, at least some of these impacts can be offset by the volume of free allowances that were banked from the previous phase.

¹⁴³ The values were based on the update of the CSCF according to Annex II Commission Decision (EU) 2017/126 of 24 January 2017 amending Decision 2013/448/EU as regards the establishment of a uniform cross-sectoral correction factor in accordance with Article 10a of Directive 2003/87/EC of the European Parliament and of the Council. This is likely to over-estimate the impact of the application of the CSCF as in practice volumes of free allocation prior to 2017 were not retrospectively changed considering this decision.

Figure 20: Comparison of the free allocation provided to sub-installations¹⁴⁴ via emission intensive product benchmarks with ex-ante¹⁴⁵ and ex-post activity¹⁴⁶ levels



Source: Preliminary NIMs dataset (2025), COM publication on average HAL to determine free allocation volumes in Phase III [f0360f59-5fd0-4d08-933b-eb12cd2cfc9a_en](#), Own calculation.

During the interviews with industrial stakeholders, the starting point for many of the discussions was to first reach an understanding concerning the carbon cost of production and how this has developed over time. The difference between the benchmark value of a product and the average specific emissions associated with the production of each benchmarked product will, in theory, determine the additional carbon cost. The argument consistently advanced by the industrial stakeholders was that the emissions not covered by free allocation for the production of benchmarked products has increased due to the reduction in the benchmark values in Phase IV and that the cost of compliance has increased considerably due to the sharp rise of the EUA price in recent years and that therefore free allocation is less effective than in the past at protecting industry from the risk of carbon leakage.

Table 9 provides an overview of the estimated carbon cost per unit of output for a selection of benchmarked products because of the 2016/17 average specific emissions¹⁴⁷ being higher than the benchmark value set for the 2021-25 period. The difference is the specific emissions not

¹⁴⁴ Sub-installations were only included if NIMs data on historic activity level was available for both the 2014-18 and 2019-23 to ensure a consistent dataset across the period.

¹⁴⁵ The ex-ante free allocations for Phase III and Phase IV were estimated by multiplying the relevant product benchmark by the corresponding average historical activity level for 2008-09 (based on aggregated production data published by the COM (refer to [f0360f59-5fd0-4d08-933b-eb12cd2cfc9a_en](#)) and 2014-18 (based on aggregated historical activity levels from the NIMs dataset) respectively and this was then subsequently multiplied by the annual CSCF across each year of the time period.

¹⁴⁶ The ex-post free allocations for Phase III and Phase IV were estimated by multiplying the aggregated historical activity levels from the NIMs dataset with the corresponding product benchmark over the 2014-23 period and this was then subsequently multiplied by the annual CSCF across each year of the time period.

¹⁴⁷ Average specific emissions for 2016/17 were estimated based on the values previously calculated by the COM using the NIMs dataset (refer to [policy_ets_allowances_bm_curve_factsheets_en.pdf](#))

covered by free allocation and this amount was therefore subject to a carbon cost (based on an EUA price assumption of EUR 80). Industry often cited higher average specific emissions during the interviews in order to argue higher carbon costs per tonne but it is likely that the carbon cost were actually lower than those outlined in Table 9, as the preliminary NIMs data assessed for this evaluation shows that there has in fact been further improvements in average specific emissions across the benchmarked products since the 2016/17 values were published by the Commission.

Table 9: Carbon cost per tonne (assuming an EUA price of 80 EUR) across selected benchmarked projects based upon a comparison of the 2021-25 BM value with average 2016/17 specific emissions

BM	BM Unit	BM (2021-25)	2016/17 AVG	Diff.	Carbon cost (EUR/t or CWT)
Refinery products	t CO ₂ e/CWT	0.0228	0.033	0.0102	1
Hot metal	t CO ₂ e/t	1.288	1.520	0.232	19
[Primary] Aluminium	t CO ₂ e/t	1.464	1.681	0.217	17
Grey cement clinker	t CO ₂ e/t	0.693	0.818	0.125	10
White cement clinker	t CO ₂ e/t	0.957	1.097	0.14	11
Lime	t CO ₂ e/t	0.725	1.034	0.309	25
Dolime	t CO ₂ e/t	0.815	1.177	0.362	29
Sintered dolime	t CO ₂ e/t	1.406	1.525	0.119	10
Float glass	t CO ₂ e/t	0.399	0.514	0.115	9
Bottles & jars (colourless glass)	t CO ₂ e/t	0.29	0.481	0.191	15
Bottles & jars (coloured glass)	t CO ₂ e/t	0.237	0.391	0.154	12
Ammonia	t CO ₂ e/t	1.57	1.972	0.402	32
Steam cracking	t CO ₂ e/t	0.681	0.891	0.21	17

Source: *policy_ets_allowances_bm_curve_factsheets_en.pdf*, Own calculation.

In the interviews, industrial stakeholders often cited higher carbon costs per unit of production (often referring to different categories of products than those benchmarked or simply by referencing different average specific emissions). These inputs were intended as transparent calculations based on a set of assumptions by industrial associations to helpfully provide a scale

of the carbon cost. Several sector examples are provided below with an explanation for the main reasons for differences with the previous calculation using a different approach outlined in Table 9:

- *Eurofer* estimated carbon cost for crude steel production of around EUR 25 to 30 per tonne based upon an average emission intensity of 1.8 tCO₂ per tonne of primary crude steel to argue that around 0.36 to 0.45 tCO₂ per tonne of output were fully exposed to the carbon price. The cost price for a tonne of crude steel varies and a value was not provided during the interview but based on secondary literature the carbon cost share could represent around 5 to 7% based on a cost price of EUR 458 per tonne for crude steel produced via the integrated route.¹⁴⁸ The value provided by Eurofer is considerably higher than the value calculated in Table 9 and this is primarily driven by the fact that a higher specific average emission was assumed for crude steel than what was published as an average 2016/17 for specific emissions for hot metal production.
- *Fertilisers Europe* based their estimation of the carbon cost on the average specific emissions of ammonia production of 2 tCO₂ per tonne of output and suggested that the carbon cost was EUR 50 per tonne of ammonia (if 0.5 tCO₂ per tonne of output was above the benchmark and subject to a carbon price of EUR 100). Given that the price of ammonia per tonne is around EUR 400 per tonne it was argued that the carbon cost component accounted for a 12.5% share of the product price in Phase IV. The value provided by Fertiliser Europe is considerably higher than the value calculated in Table 9 and this reflects a higher carbon price assumption and specific average emissions that are assumed to be higher than what was published as an average 2016/17 for specific emissions for ammonia production.
- *Cement Europe* estimated the carbon cost of production based on the average performance of a clinker installation being 0.820 tCO₂ per tonne of clinker output. Given that the cost price for a tonne of cement is around EUR 80 to 90 , making further assumptions on both the ratio of clinker in cement (i.e. 75%) and the carbon price (i.e. 70 EUR per tonne). Cement Europe estimated that the carbon cost accounted for between 6 and 15 % of the total cost price a tonne of cement, which was cited as being around EUR 80 to 90 . The value provided by Cement Europe is not directly comparable with the calculation above in Table 9 as it refers to cement rather than cement clinker but again their higher value is driven by an assumed higher average specific emission than what was published as an average for 2016/17
- *Eurometaux* provided information on the full carbon cost exposure without free allocation citing a much higher average specific emission value for primary aluminium production than what was published as an average specific emission value for 2016/17 as shown in Table 9. The low carbon cost calculated for primary aluminium reflects that the average 2016/17 specific emissions are only slightly higher than the benchmark value, so it is assumed that a very low share of emissions is exposed to the carbon price. In contrast, the calculation provided by Eurometaux does not consider the share of emissions currently covered by free allocation. They stated during the interview that primary aluminium production emits around 2 tCO₂ per tonne of aluminium. Assuming an ETS price of 70 EUR/t, the ETS increases the cost of producing primary aluminium

¹⁴⁸ Refer to https://www.eurofer.eu/assets/news/eu-technical-report-on-production-costs-from-the-iron-and-steel-industry-in-the-eu-and-third-countries/production_costs_from_the_iron_and_steel_industry_-_final_online.pdf

in Europe by 140 EUR/t. This is equivalent to 6% of the global price for a tonne of aluminium set at the London Metal Exchange (currently 2600 \$/t = 2222 EUR/t).

- *Fuels Europe* did not provide an estimate of the carbon cost directly but instead stated that the sector has experienced a consistent shortage (around 30%) in the number of allowances to cover their verified emissions.

The industrial stakeholders that were interviewed frequently praised the role of free allocation in partly offsetting the full carbon cost, which in their opinion cannot be passed through due to exposure to international competition. While the ability to pass through costs is likely to vary across industrial sectors, all the industrial stakeholders argued that free allocation was necessary to offset the impact of a unilateral carbon cost that is simply not faced by international competitors.

A key question then arises, has the reduction in free allocation that has been observed in Phase IV led to carbon leakage? If carbon leakage was to have occurred, in the short term, it is likely that the following trends would have materialised:

- Activity levels would have reduced (as production re-located outside of the EU).
- Imports would have increased.
- Exports would have declined.

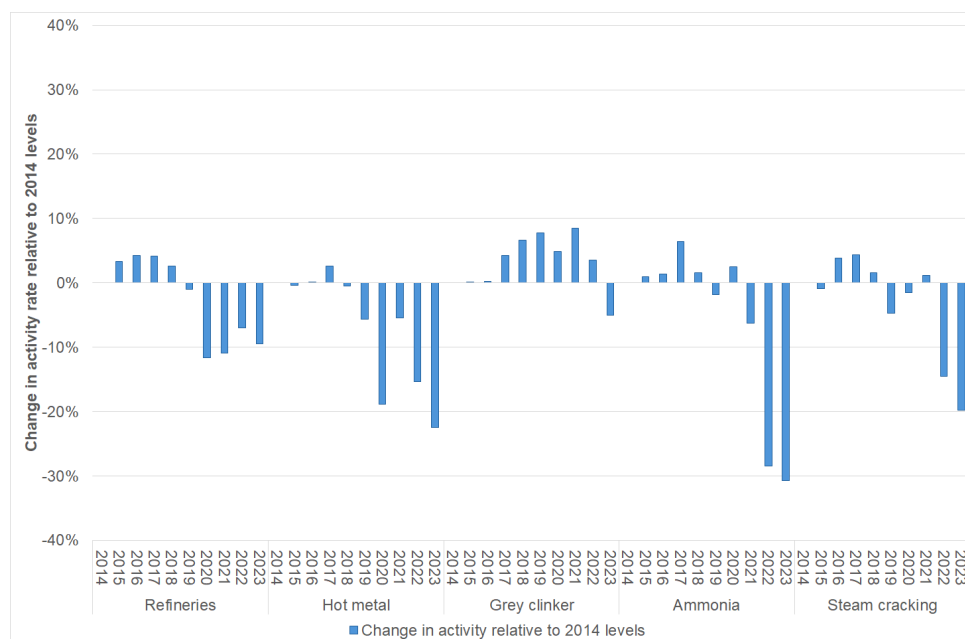
To evaluate the effectiveness of free allocation in preventing carbon leakage, it is necessary to start by outlining the development of the key trends in activity and trade to establish if there is evidence of industrial production re-locating outside of the EU.

To assess changes in activity levels across European industry, the preliminary NIMs dataset provides the most comprehensive and consistent dataset at the sub-installation level and is attributed to the benchmark used by each to apply for free allocation. Figure 21 shows that levels of activity have decreased in the most emission intensive benchmarked products. Given that reforms to free allocation only took effect after 2021, the considerable decline in activity observed in 2020 indicates that other factors beyond carbon pricing have most likely driven this trend (i.e. reduced demand and supply chain issues associated with the COVID-19 pandemic, increase in energy prices (especially natural gas) following the illegal Russian invasion of Ukraine in 2022), as well as the impact in international trade tariff regimes and issues related to overcapacity globally in certain commodities. Indeed, industrial stakeholders confirmed that carbon pricing was not likely to be the main driver of the reduced levels in activity observed in recent years but nevertheless they strongly argued that the increased carbon cost because of free allocation volumes declining, and the EUA price rising have exacerbated an already challenging situation in terms of their international competitiveness.

Given that the NIMs data was only preliminary at the time of the evaluation, it was not possible to estimate statistically whether carbon leakage had occurred based on, for example, econometric approaches. Such an exercise should be conducted when the final NIMs data is available. As an alternative, a more descriptive analysis was undertaken with considerable efforts made to engage with industrial stakeholders in order to better understand the driving factors responsible for the observed changes in activity and trade patterns. It was evident from this descriptive analysis that imports in certain emission intensive goods have increased over the time period (i.e. for example increased imports were observed for cement clinker, urea, unwrought aluminium and hot rolled wide strip and cold rolled steel) and that could, in theory, provide evidence to support claims of carbon leakage via the short term-competitiveness channel. However, it was evident from the stakeholder interviews that the carbon price was not

driving the increase in these imports alone with external factors also influencing the changes observed in trade patterns.

Figure 21: Change in activity levels relative to 2014 levels for selected emission intensive product benchmarks¹⁴⁹



Source: Preliminary NIMs dataset (2025), Own calculation.

- EQ2: Did a revision of the carbon leakage list (CL list) for 2021-2030 increase the effectiveness of the measure by changing the methodology to a single indicator of carbon leakage?

The purpose of the carbon leakage list is to determine, which sectors and sub-sectors are deemed to be at risk of carbon leakage and are therefore eligible for 100% of the calculated free allocation (i.e. the carbon leakage exposure factor used in the formula for determining free allocation is set at 1).¹⁵⁰ The carbon leakage exposure factor has been set at 1 for sectors and sub-sectors that have been deemed at risk of carbon leakage in both Phase III and IV. Sectors and sub-sectors that were not deemed to be at risk of carbon leakage continued to receive free allowances but were not eligible for the full 100% of the calculated free allocation. During Phase III the carbon leakage exposure factor for sectors and sub-sectors deemed to not be at risk of carbon leakage declined from 0.8 in 2013 to 0.3 by 2020 and the carbon leakage exposure factor has remained constant at 0.3 for Phase IV (2021-25).

The carbon leakage risk status of the sectors and subsectors has been defined based upon a set of rules that have changed over time.

In Phase III a sector or sub-sector was deemed to be at risk of carbon leakage¹⁵¹ if:

¹⁴⁹ Sub-installations were only included if NIMs data on historic activity level was available for both the 2014-18 and 2019-23 to ensure a consistent dataset across the period.

¹⁵⁰ The formula for calculating final free allocation is benchmark * activity level * carbon leakage exposure factor * cross sectoral correction factor.

¹⁵¹ In Phase III of the EU ETS the carbon leakage list was updated several times (i.e. in 2013-14 and 2015-2019 and then extended to 2020).

- Direct and indirect costs induced by the implementation of the directive would increase production cost, calculated as a proportion of the gross value added, by at least 5%; and
- The sector's trade intensity with non-EU countries (imports and exports) was above 10%

A sector or sub-sector was also deemed to be exposed if:

- The sum of the direct and indirect additional costs was at least 30%; or
- The non-EU trade intensity was above 30%.

In Phase IV the carbon leakage list was determined by a single indicator of carbon leakage risk, which is outlined and further explained below:

- Carbon leakage indicator = trade intensity * emission intensity
With
Trade intensity = (imports + exports) / (imports + turnover)
Emission intensity = (direct emissions + indirect emissions) / GVA

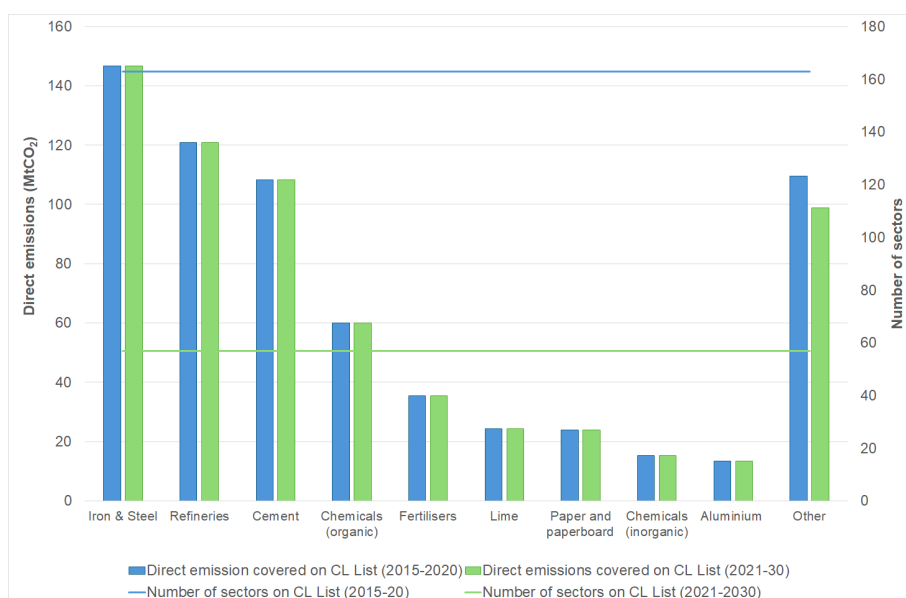
In terms of the overall impact of the change in methodology, Figure 22 shows that the adoption of a single based indicator reduced the number of sectors at the NACE 4-digit level covered on the 2021-30 carbon leakage list declined by around 65% compared to the 2015-20 carbon leakage list. However, the direct emissions (2014-18 average based on NIMs dataset and aggregated to the NACE 4-digit level) covered only declined by around 2%. This suggests that the changes to the methodology have increased the effectiveness of the measure by removing many sectors that previously only qualified based upon the trade intensity threshold alone but had only a limited impact on the direct emissions covered. The intentional setting of a low threshold for the carbon leakage indicator to determine sectors at significant risk of carbon leakage ensured that free allocation was still better targeted in Phase IV compared to Phase III by ensuring that those sectors with minimal CO₂ costs were no longer eligible for free allocation support.

Although the change to the carbon leakage list in Phase IV has led to a more targeted allocation (in terms of the number of sectors and subsectors deemed at risk of carbon leakage, the European Court of Auditors concluded in their own review of free allocation provision that it could have been better targeted.¹⁵² Indeed, the review criticised the carbon leakage list for not establishing different degrees of carbon leakage risk for the various sectors included in it, instead treating them all equally. Furthermore, lessons learnt from the implementation of the carbon leakage list in Phase III outlined that stakeholders indicated that for the carbon leakage list of 2015-20 the workload for applications was substantial, although at the time it was regarded as proportional to the scale and significance of the task.¹⁵³ Given the limited reduction in the emissions not covered under the subsequent update to the carbon leakage list in 2021-30, and the significant resources that remained necessary to update the list, the impact of such changes appears misaligned between outcome (i.e. better targeting of allocation) and administrative effort.

¹⁵² Refer to [Emissions Trading System: targeting free allocation of allowances](#).

¹⁵³ Refer to SWD(2019) 22 final, <https://edz.bib.uni-mannheim.de/edz/pdf/swd/2019/swd-2019-0022-en.pdf>

Figure 22: Comparison of carbon leakage lists for Phase III and IV in terms of their coverage of both direct emissions and the number of sectors¹⁵⁴



Source: Decision - 2010/2, Decision - 2014/746, Own illustration.

- EQ3: Has free allocation been effectively calculated to prevent the occurrence of carbon leakage?

Since the start of Phase III, free allocation has been calculated based upon product benchmarks and fall-back options with the intention of both better targeting free allocation and to provide stronger incentives for improved performance than under the previous allocation approach (i.e. grandfathering of allowances based on historical emissions). How the benchmark values are set is of critical importance for the effectiveness of free allocation to prevent the occurrence of carbon leakage. If the ex-ante benchmarks are set too high compared to actual performance, then the incentive to improve performance will be reduced, however, alternatively if the ex-ante benchmarks are set too low and beyond technological limits (a concern that was frequently raised during stakeholder engagement with industry), then the effectiveness of free allocation to protect against carbon leakage will be reduced.

Table 10 provides an overview of how the benchmark values were updated for use in the first half of Phase IV (i.e. 2021-25). Given that these values were set ex-ante a useful exercise is to compare how the benchmarks compared with actual developments based upon published information from the European Commission on the setting of the 2021-25 benchmarks. A key takeaway from Table 10 is that 29 out of the 52 benchmarks were updated for the 2021-25 period by applying the maximum limit to the annual update rate used for the calculation. In

¹⁵⁴ The number of sectors refers only to the NACE 4-digit level. If multiple sub-sectors within a NACE 4-digit code are included at a higher level of disaggregation within the carbon leakage lists, they are only counted once. For example, 63 sectors and sub-sectors were on the 2021-30 carbon leakage list, but this included several sub-sectors with the same NACE 4-digit code. Given that the NIMs data only matches installations to a 4-digit NACE code it also means that the direct emissions covered in the calculation may be slightly over-estimated when only certain sub-sectors within a NACE 4-digit code are deemed at risk of carbon leakage.

some cases, the difference between the annual update rate calculated¹⁵⁵ and the annual update rate applied¹⁵⁶ was considerably higher. This means that in practice these benchmarks could have been set more ambitiously (i.e. the update of these benchmarks for 2021-25 were not based on the average of the 10% best performers) than they were if the actual rate of improvement was applied rather than a maximum limit being applied. As a consequence, this may have resulted in the installations covered by these benchmarks receiving more allowances than if actual update rates of improvement were applied and this may have reduced the incentive for driving emission reductions.

Table 10: Comparison of benchmark values set in Phase III and IV of the EU ETS

BM Description	BM Unit	BM (2013-20)	2016/17 AVG of the 10% most efficient installations	Annual update rate calculated	Annual update rate applied	Total update from Phase 3	BM (2021-25)
Refinery products	t CO ₂ e/CWT	0.0295	0.0255	-1.5%	-1.5%	-23%	0.0228
Coke	t CO ₂ e/t	0.286	0.144	-5.5%	-1.6%	-24%	0.217
Sintered ore	t CO ₂ e/t	0.171	0.163	-0.5%	-0.5%	-8%	0.157
Hot metal*	t CO ₂ e/t	1.328	1.331	0.02%	-0.2%	-3%	1.288
EAF carbon steel	t CO ₂ e/t	0.283	0.209	-2.9%	-1.6%	-24%	0.215
EAF high alloy steel	t CO ₂ e/t	0.352	0.266	-2.7%	-1.6%	-24%	0.268
Iron casting	t CO ₂ e/t	0.325	0.299	-0.9%	-0.9%	-13%	0.282
Pre-bake anode	t CO ₂ e/t	0.324	0.317	-0.3%	-0.3%	-4%	0.312
[Primary] Aluminium	t CO ₂ e/t	1.514	1.484	-0.2%	-0.2%	-3%	1.464
Grey cement clinker	t CO ₂ e/t	0.766	0.722	-0.6%	-0.6%	-10%	0.693

¹⁵⁵ Based on performance data for the years 2007 and 2008, annual reduction rates were determined for each benchmark for the 9-year period from 2007/2008 to 2016/2017.

¹⁵⁶ In accordance with Article 10a(2) of Directive 2003/87/EC, the applied reduction over the 15-year period should not be lower than 3% and not be higher than 24%.

White cement clinker	t CO ₂ e/t	0.987	0.973	-0.2%	-0.2%	-3%	0.957
Lime	t CO ₂ e/t	0.954	0.746	-2.4%	-1.6%	-24%	0.725
Dolime	t CO ₂ e/t	1.072	0.881	-2.0%	-1.6%	-24%	0.815
Sintered dolime	t CO ₂ e/t	1.449	1.441	-0.1%	-0.2%	-3%	1.406
Float glass	t CO ₂ e/t	0.453	0.421	-0.8%	-0.8%	-12%	0.399
Bottles & jars (colourless)	t CO ₂ e/t	0.382	0.323	-1.7%	-1.6%	-24%	0.290
Bottles & jars (coloured)	t CO ₂ e/t	0.306	0.265	-1.5%	-1.5%	-23%	0.237
Continuous filament glass fibre products	t CO ₂ e/t	0.406	0.290	-3.2%	-1.6%	-24%	0.309
Facing bricks	t CO ₂ e/t	0.139	0.094	-3.6%	-1.6%	-24%	0.106
Pavers	t CO ₂ e/t	0.192	0.140	-3.0%	-1.6%	-24%	0.146
Roof tiles	t CO ₂ e/t	0.144	0.130	-1.1%	-1.1%	-17%	0.120
Spray dried powder	t CO ₂ e/t	0.076	0.050	-3.7%	-1.6%	-24%	0.058
Mineral wool	t CO ₂ e/t	0.682	0.595	-1.4%	-1.4%	-21%	0.536
Plaster	t CO ₂ e/t	0.048	0.048	-0.0%	-0.2%	-3%	0.047
Dried secondary gypsum	t CO ₂ e/t	0.017	0.008	-6.1%	-1.6%	-24%	0.013
Plasterboard	t CO ₂ e/t	0.131	0.119	-1.1%	-1.1%	-16%	0.110
Short fibre kraft pulp	t CO ₂ e/Adt	0.120	0.000	-11.1%	-1.6%	-24%	0.091

Long fibre kraft pulp	t CO ₂ e/Adt	0.060	0.001	-11.0%	-1.6%	-24%	0.046
Sulphite pulp	t CO ₂ e/Adt	0.020	0.000	-11.1%	-1.6%	-24%	0.015
Recovered paper pulp	t CO ₂ e/Adt	0.039	0.000	-11.1%	-1.6%	-24%	0.030
Newsprint	t CO ₂ e/Adt	0.298	0.007	-10.9%	-1.6%	-24%	0.226
Uncoated fine paper	t CO ₂ e/Adt	0.318	0.011	-10.7%	-1.6%	-24%	0.242
Coated fine paper	t CO ₂ e/Adt	0.318	0.043	-9.6%	-1.6%	-24%	0.242
Tissue	t CO ₂ e/t	0.334	0.139	-6.5%	-1.6%	-24%	0.254
Testliner and fluting	t CO ₂ e/Adt	0.248	0.071	-7.9%	-1.6%	-24%	0.188
Uncoated carton board	t CO ₂ e/Adt	0.237	0.009	-10.7%	-1.6%	-24%	0.180
Coated carton board	t CO ₂ e/Adt	0.273	0.011	-10.7%	-1.6%	-24%	0.207
Carbon black	t CO ₂ e/t	1.954	1.141	-4.6%	-1.6%	-24%	1.485
Nitric acid	t CO ₂ e/t	0.302	0.038	-9.7%	-1.6%	-24%	0.230
Adipic acid	t CO ₂ e/t	2.79	0.320	-9.8%	-1.6%	-24%	2.120
Ammonia	t CO ₂ e/t	1.619	1.604	-0.11%	-0.2%	-3%	1.570
Steam cracking	t CO ₂ e/t	0.702	0.693	-0.15%	-0.2%	-3%	0.681
Aromatics*	t CO ₂ e/CWT	0.0295	0.0072	-8.4%	-1.5%	23%	0.0228
Styrene	t CO ₂ e/t	0.527	0.419	-2.3%	-1.6%	-24%	0.401
Phenol/acetone	t CO ₂ e/t	0.266	0.244	-0.9%	-0.9%	-14%	0.230
Ethylene oxide &	t CO ₂ e/t	0.512	0.314	-4.3%	-1.6%	-24%	0.389

ethylene glycols							
Vinyl chloride monomer	t CO ₂ e/t	0.204	0.171	-1.8%	-1.6%	-24%	0.155
S-PVC	t CO ₂ e/t	0.085	0.073	-1.5%	-1.5%	-23%	0.066
E-PVC	t CO ₂ e/t	0.238	0.103	-6.3%	-1.6%	-24%	0.181
Hydrogen*	t CO ₂ e/t	8.85	4.09	-6.0%	-1.5%	-23%	6.84
Synthesis gas*	t CO ₂ e/t	0.242	0.009	-10.7%	-1.5%	-23%	0.187
Soda ash	t CO ₂ e/t	0.843	0.789	-0.7%	-0.7%	-11%	0.753
Heat benchmark	t CO ₂ e/TJ	62.3	1.6	-10.8%	-1.6%	-24%	47.3
Fuel benchmark	t CO ₂ e/TJ	56.1	34.3	-4.3%	-1.6%	-24%	42.6

Note: Pursuant to Article 10a(2) of Directive 2003/87/EC, specific provisions apply for the update of the benchmark values for aromatics, hydrogen, syngas, which are adjusted by the same percentage as the refineries benchmark and also for the hot metal benchmark, which is updated with an annual reduction rate of 0.2%.

Source: policy_ets_allowances_bm_curve_factsheets_en.pdf

Figure 23 provides a summary of how selected product benchmark values that were applied in Phase III (2013-20) and Phase IV (2021-25) compared with estimates for the 2016/17 and 2021/22 average specific emissions respectively of all sub-installations covered.¹⁵⁷ The provisional results show that the selected benchmarks for Phase IV (2021-25) are in many cases lower than the specific average emissions for 2021/22 and this indicates that the benchmarks have been set to incentivise further improvements in performance over Phase IV. In many cases, the distance between the product benchmark values and specific average emissions were higher in Phase IV than in Phase III.¹⁵⁸

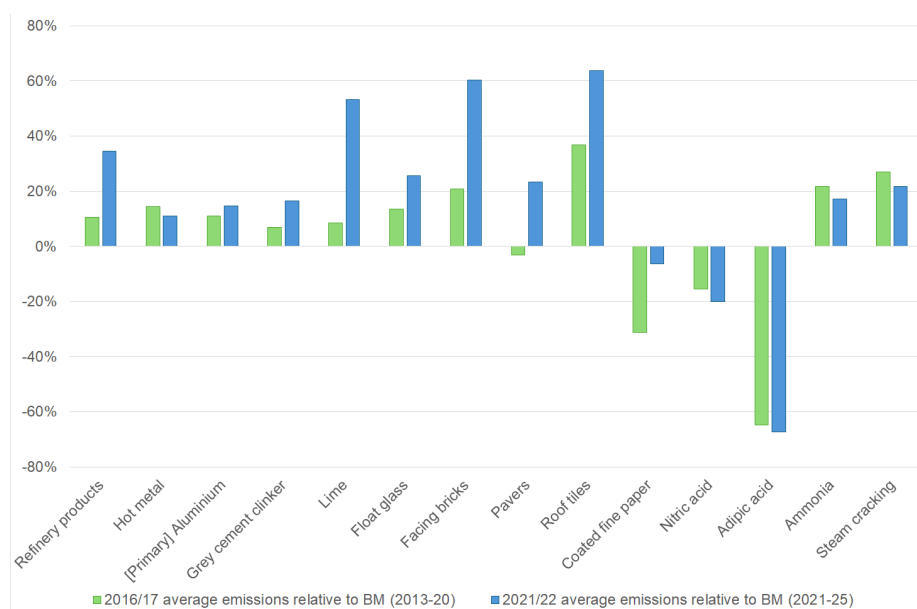
Evaluating the effectiveness of how the updated benchmark values were calculated will ultimately depend upon whether the level of performance required is technically feasible. A concern raised frequently by industrial associations during the stakeholder interviews was in

¹⁵⁷ Only preliminary information from NIMs 2019-23 dataset was available at the time of writing the evaluation and therefore the results are provisional and should be updated following the finalisation of the NIMs dataset for 2019-23.

¹⁵⁸ The Phase III product benchmark values were compared with average 2016/17 specific emissions data provided in a Commission publication (refer to DG CLIMA, 2021. "Update benchmark values for the years 2021-2025 of phase 4 of the EU ETS", <https://climate.ec.europa.eu/system/files/2021>). Phase IV product benchmark values for 2021-25 were also taken from policy_ets_allowances_bm_curve_factsheets_en.pdf and were then compared with average specific emissions for 2021/22 that were provisionally estimated based upon preliminary NIMs data for 2019-23 for all the sub-installations covered by a product benchmark.

relation to the setting of benchmark values that go beyond what is achievable. The main issue that emerged was to do with the extrapolation of the benchmark values based on annual rates of improvements with the concern raised that such an approach may result in the setting of benchmark values that are simply not possible in practice. Given the abatement potential identified in various industry roadmaps for decarbonisation pathways up until 2050, these technical limits are unlikely to be reached based on the extrapolated values used for the 2021-25 benchmark values, but concerns have been raised more for the viability of future benchmark setting.

Figure 23: Comparison of the average specific emissions in relation to the benchmark for selected products in Phase III and IV



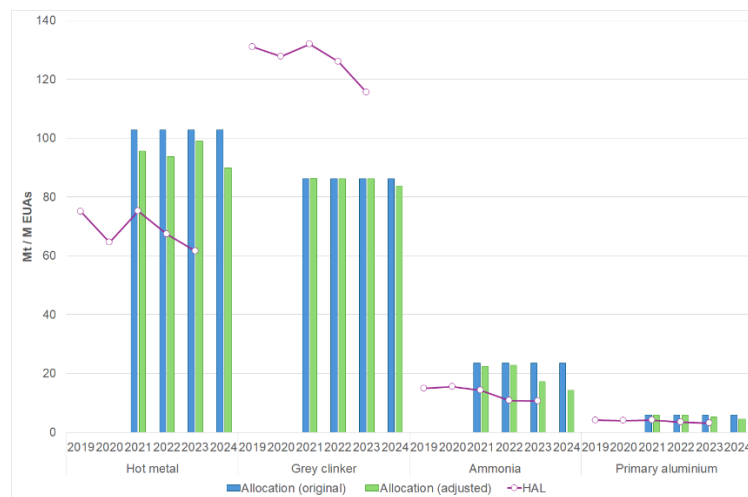
Source: *policy_ets_allowances_bm_curve_factsheets_en.pdf*, own calculation based upon preliminary NIMs dataset 2019-23

During the interview process, further views were put forward regarding the effectiveness of the setting of the benchmark values.

- Eurometaux criticised the fact that fallback benchmarks group all sectors together under one fallback benchmark value for fuel and heat, regardless of the differences in technologies that can be used in the sectors covered. This leads to inaccurate values, and today, the heat and fuel fallback benchmarks do not adequately reflect the reality of some of the sectors that rely on these benchmarks for the allocation of free allowances to their installations. These fallback benchmarks are currently based on the abatement potential of sectors that can widely use biomass to reduce their emissions. However, some of the sectors covered, such as copper and other non-ferrous metals, cannot rely on biomass to reduce emissions. This is because (1) the use of biomass is not suitable for production processes in every sector, especially those processes that require high-temperature heat, and (2) the supply of biomass is inherently constrained, and not equally available in every Member State.
- EULA also suggested limitations with the current application of the fall-back options expressing how the current benchmarking approach lacks flexibility to consider the issue of process emissions that cannot easily be mitigated without technologies such as CCS that have not so far been economically viable based on the existing carbon price.

In addition to the setting of more ambitious benchmarks in Phase IV, reforms were made to better align free allocation with actual levels of production. Figure 24 shows for selected product benchmarks a simplification for illustrative purposes of the adjustment to free allocation to better align with levels of production over Phase IV. Preliminary NIMs data for 2019-23 on activity levels were used to ascertain at the sub-installation level whether an increase or decrease above or below the 15% threshold had occurred. The original allocation of free allowances was then compared to the adjusted volume of free allowances that consider changes from the previous two-year rolling average¹⁵⁹. The outcome of this exercise demonstrates how the effectiveness of free allocation has been improved by this better alignment with actual levels of production. Activity levels have declined and rebounded in most industrial sectors after the COVID-19 pandemic and were then further impacted by the energy price crisis triggered by the illegal Russian invasion of Ukraine. The adjustment to allocation because of these externalities further improved the resilience of the EU ETS and ensured that free allocation was better targeted in Phase IV compared to Phase III.

Figure 24: Estimation of the impact of dynamic allocation on the provision of free allocation to selected benchmarks in Phase IV



Source: Own calculation based upon preliminary NIMs dataset 2019-23

Evidence of actual adjustments in response to changes in activity levels beyond the simplified quantitative exercise presented above have been reported by competent authorities. For example, the competent authority in Germany (i.e. DEHSt) reported that levels of free

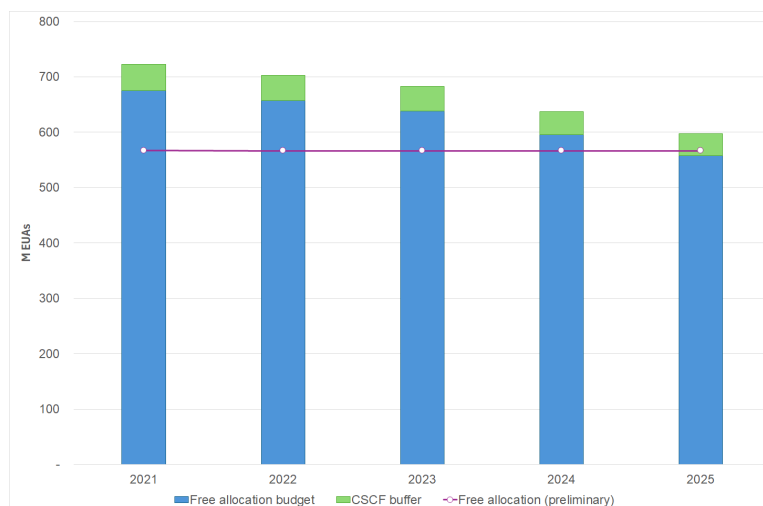
¹⁵⁹ Article 5 of Regulation (EU) 2019/1842 outlines the conditions for adjusting allocation to reflect changes in activity levels. The calculation is a simplification as for each year the allocation is adjusted if the two-year rolling average of the activity level of a sub-installation is 15 % higher or lower than the historical activity level (i.e. 2014-18 average) used to set the original free allocation. The preliminary NIMs dataset for 2019-23 is used to compare the activity level data for the sub-installations with their average historical activity level for 2014-18, which is matched to each sub-installation from the NIMs dataset for 2014-18. In circumstances where the 15% threshold is exceeded, free allocation is recalculated for a sub-installation based upon the previous rolling two-year average activity level and this is multiplied by the corresponding benchmark, carbon leakage exposure factor and cross sectoral correction factor. The original and adjusted allocation was then aggregated for all sub-installations covered by a product benchmark to estimate the potential impact of the intervention.

allocation declined across many industrial sectors in 2024 with the declines in activity observed after the energy price shock of 2022 fully reflected in the two-year rolling average.¹⁶⁰

A consensus emerged from the stakeholder interviews with industrial associations that the better alignment of free allocation with levels of activity change was regarded as a welcome improvement. The main critique of the reform from industry, however, related to the setting of an activity threshold that was often seen as a disincentive for an installation to incrementally increase their production as any change up to 15% would be subject to the full carbon price. Indeed, this point was made repeatedly by industrial stakeholders in the context of their own production process. However, the 15% a threshold level for activity level changes represents a balance between ensuring that the free allocation level reflects the actual production level, with minimising the administrative burden for operators and competent authorities of reporting, verifying and approving adjustments to free allocation based on small changes in activity levels. Furthermore, it can be said that this provision provides industrial installations a buffer of free allocation for a production decrease of less than 15%, as the allocation levels are not adjusted.

As part of the effective implementation of free allocation provision, the cross sectoral correction factor (CSCF) ensures that volumes of free allocation do not exceed the ETS cap. In Phase III it was necessary to apply the CSCF in all years between 2013 and 2020 to reduce free allocation volumes and so a CSCF buffer was introduced at the start of Phase IV to reduce the likelihood of the CSCF needing to be applied. However, Figure 25 illustrates mainly that because of the introduction of more ambitious benchmarks at the start of Phase IV, the resulting reduction in free allocation volumes meant that it was not necessary to apply the CSCF.

Figure 25: Free allocation (preliminary) volumes in 2021-25 compared to the free allocation budget and CSCF buffer



Source: Own calculation based upon NIMs dataset 2019-23¹⁶¹

¹⁶⁰ Emissions Situation in EU ETS 1 in 2024 - Stationary Installations, “Aviation and Maritime Transport Subject to Emissions Trading in Germany”, https://www.dehst.de/SharedDocs/downloads/EN/publications/2024_VET-Report.pdf?__blob=publicationFile&v=2

¹⁶¹ Based upon the ETS cap, the free allocation budget for each year is calculated as 43% of the ETS cap and a further 3% of the ETS cap is added each year as a further CSCF buffer. The preliminary free allocation for 2021-25 was taken directly from the total annual provisional values provided in the NIMs database.

- EQ4: Has the indirect cost compensation been an effective measure to support the sectors under EU ETS to prevent occurrence of carbon leakage?

Effectiveness in compensating installations at risk of carbon leakage

Under the EU ETS, firms incur two types of carbon costs: direct costs from purchasing allowances for their emissions, and indirect costs passed through in electricity prices, as power generators must also cover their emissions. These indirect costs can be significant, especially for energy-intensive sectors. To address the risk of carbon leakage brought by indirect costs, the ETS Directive encourages Member States to compensate selected sectors through State aid. This compensation is optional at the MS level, creating heterogeneity in application and raising questions about its efficiency.

Governance of indirect carbon cost compensation is split between the ETS Directive and the relevant State aid guidelines¹⁶². The ETS Directive (Article 10a(6)) provides general guidance to Member States. It encourages them to provide compensation to sectors and subsectors at genuine risk of carbon leakage due to significant indirect costs passed on in electricity prices, in accordance with State aid rules, and outlines that they should seek to use no more than 25% of their auction revenues for this purpose. The Directive also specifies that the aid should be based on benchmarks for indirect emissions per unit of production corresponding to the most efficient available technologies and on the CO₂ emissions of the relevant electricity production mix.

The State aid guidelines themselves identify eligible sectors, benchmarks, emissions factors and conditions for granting the aid. State aid guidelines governing indirect carbon cost (ICC) compensation were first adopted in 2012 for the period 2013-20. New guidelines for the post-2021 period were adopted in 2020 and amended in 2025¹⁶³. Therefore, it is the guidelines, rather than the ETS Directive itself, that define which sectors are at risk of carbon leakage due to indirect carbon cost.

Article 10a(6) was amended in the 2018 amendment of the ETS Directive. The main changes introduced were:

- To introduce a ‘soft’ cap on ICC compensation (Member States shall seek to use no more than 25% of their annual auction revenues).
- To introduce reporting requirements for Member States and a requirement for the Commission to assess ICC compensation in its annual report on the functioning of the European carbon market¹⁶⁴. Member States are report on the amount of ICC provided per sector and subsector, on why aid exceeds 25% of revenues (if applicable), on electricity prices for industrial consumers, and whether they have considered other measures to lower indirect carbon costs.
- To amend other elements. For example, the invitation to Member States to provide ICC compensation changed from ‘may’ to ‘should’, and the sectors eligible were changed from those ‘determined to be exposed to a significant risk of carbon leakage’ to those ‘exposed to a genuine risk of carbon leakage’ due to indirect costs ‘actually incurred’.

¹⁶² Guidelines on certain State aid measures in the context of the system for greenhouse gas emission allowance trading post-2021 (2020/C 317/04)

¹⁶³ These guidelines are communications 2012/C 158/04, 2020/C 317/04 and C/2026/196 respectively.

¹⁶⁴ COM(2024) 538 final

The amount of aid provided depends on the limits set out in the State aid guidelines (where the aid permitted is a function of activity level, carbon price, sectoral efficiency benchmarks and emission intensity of the power sector). It also depends on the preferences of Member States regarding whether to operate a State Aid scheme, how much budget to allocate to it, and which sectors to cover. Total ICC compensation has risen over time, from EUR 0.5bn for costs incurred in 2017, to EUR 1.8bn for costs incurred in 2019, EUR 2.3 bn in 2020, EUR 3.1 bn in 2022 and EUR 5.5 bn in 2023. The increase is mainly due to increases in the EUA price over the same period (which generate both the need for compensation and the resources to fund it). It is also partly due to increases in budget and participation by Member States (though this can vary year-on-year). Reports from Member States include justifications for exceeding 25% of auctioning revenues where applicable. Member States typically attribute this to the level of carbon prices, with some also attributing it to a high historical national share of low-carbon electricity generation compared to their share of electro-intensive industries (i.e. more demand for compensation relative to available auction revenues).

The total payments for indirect costs incurred in 2022 were equivalent to 16% of the 2022 auction revenue collected by 15 Member States. However, five Member States (Austria, Belgium, France, Luxembourg and Romania) provided aid in excess of the recommended 25% limit.¹⁶⁵ This demonstrates that Member States differ in their prioritisation of ICC payments. However, each Member State's share of national ETS auction revenues is not necessarily correlated to the size of its electro-intensive industries.

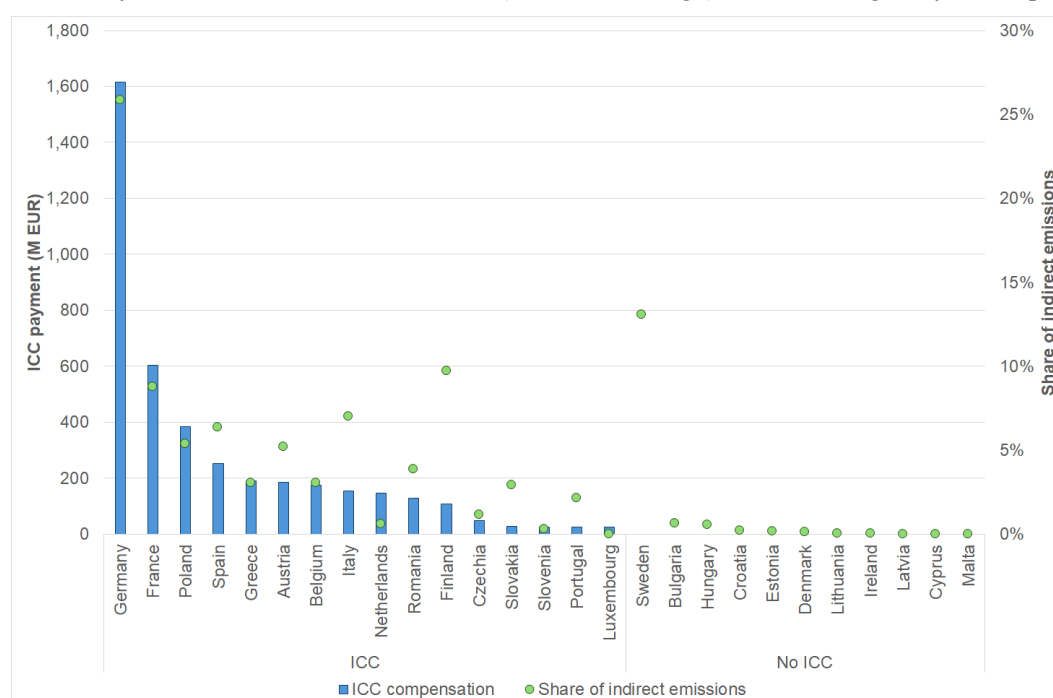
Reports from Member States are used by the Commission to assess ICC payments as part of the annual report on the functioning of the European carbon market. The level of detail possible in this assessment is limited due to differences between Member States in the level of detail and topics covered. This in turn is not surprising, given the low level of precision in the Article 10a(6) reporting provisions. In order to estimate how the potential need for ICC payments are distributed across Member States, Eurostat data on the electricity consumption of each Member State by NACE activity was combined with Prodcom data on sold production to provide a simplified comparison of each Member State's ICC payment relative to its share of EU27 indirect emissions in relevant sectors (a rough metric for their *potential* to provide ICC compensation if they wished).

The outcome of this exercise is illustrated in Figure 26 below. It indicates that Germany provides the most aid and has greatest need, while Italy and Spain provide relatively little compared to their industry size.

While the figure suggests that Finland and Sweden have a substantial need for compensation, this may be misleading. In the case of Sweden, the high share shown in the figure replicates the State aid guidelines, which use a national emission factor to represent. However, the Swedish electricity market is split into four zones, with much of industry represented in Northern zones where electricity is both cheaper and less carbon intensive. In the case of Finland, the exposure of industry to indirect carbon costs may be lower than shown in the figure since a proportion of Finnish industries tend to generate their own electricity, so will not be exposed to indirect carbon cost passed on through marginal electricity pricing to the same extent as firms reliant on traded electricity.

¹⁶⁵ REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL on the functioning of the European carbon market in 2023, SWD(2024) 264 final

Figure 26: Indirect cost compensation (2021-23 average) of each Member State compared to their share of the total EU indirect emissions (2021-23 average) that were eligible for ICC payments



Note: No information on PRODVAL for NACE code 19.20 (i.e. refined petroleum products) so excluded from the graph and calculation of indirect emissions but ICC payments to sector are represented by the blue bar.

Source: Eurostat (2025), Own calculation.

Effectiveness of reporting and conditionality framework in guiding expenditure by beneficiaries

Both the ETS Directive and State aid guidelines include reporting requirements for Member States. These are summarised in Table 11 below. As the table shows, the reporting requirement under the ETS Directive is more qualitative, open to Member State interpretation and intended for a public audience. On the other hand, the reporting requirements from the State aid guidelines are more specific.

Table 11: Reporting Requirements for Member States providing State aid for Indirect Carbon Cost Compensation

ETS Directive	State aid guidelines
Article 10a(6) <u>Member States</u> shall make available to the public, in an easily accessible form, within three months of the end of each year: - Total amount of compensation provided per benefitting sector & subsector. - The reasons for exceeding 25% of auction revenues (if applicable).	2020/C 317/04. Point 60 <u>Member States</u> report annually to the Commission using the standard form, including: - name of each beneficiary & aided installation. - sector(s) in which beneficiary is active (NACE-4 code). - year for which aid is granted and year paid.

• Information on electricity prices for large industrial consumers benefitting from ICC compensation. • Whether due consideration has been given to other measures to sustainably lower ICC costs in the medium to long term. Commission • Assessment, in the annual report on the functioning of the European carbon market, of effects of ICC compensation on the internal market. • where appropriate, recommend any measures that may be necessary.	• actual output for each aided installation. • actual electricity consumption for each aided installation (if aid is given using a fallback benchmark). • EUA forward price used to compute aid amount • Aid intensity • National CO₂ emission factor

From 2021 onwards, the State aid guidelines for ICC compensation include the requirement that beneficiaries of the aid take action to improve their environmental performance by either i) implementing recommendations of an energy audit (provided the pay-back time does not exceed three years); ii) covering at least 30% of their electricity consumption from carbon-free sources; or iii) investing at least 50% of the aid amount in projects leading to substantial reductions in the installation's greenhouse gas emissions. Member States are not required to report on how these conditions are implemented, although in several cases documentation of the Member States' implementation rules is publicly available.

Commercial stakeholders were also consulted for this evaluation. Their observations included that due to the functioning of the electricity market based on marginal pricing, indirect costs paid by EU industry in the electricity price are not linked to the actual emissions of the electricity consumption but to the emissions of the marginal electricity producer, which they expect to remain largely fossil-based beyond 2030. While this may be true, the design of the State aid guidelines already takes this into account since their emissions factors are based on CO₂ intensity of electricity produced from fossil fuels in the relevant geographical zone (the long-term implications of this are explored in Annex 12 of the Impact Assessment). The guidelines also provide Member States with the option of instead using an emissions factor based on market-based modelling, though only two Member States currently make use of this.

Stakeholders also pointed out that financial compensation is typically only allowed for 75% of eligible costs and is not implemented (at all or to the full extent) in several Member States, which leaves local industries exposed to indirect costs without protection. Limiting the aid intensity to 75% is an intentional feature of the guidelines, designed to limit negative effects on competition and maintain an incentive to reduce indirect emissions (e.g. by improving energy efficiency).

Stakeholders from sectors that at that point were not eligible for ICC compensation (such as glass and ceramics) stressed how their inclusion would help their sectors to switch to electrified processes. These sectors have since become eligible in the 2025 amendment to the State aid guidelines.

8.3.4.2 Efficiency

The efficiency of free allocation as a measure for reducing the risk of carbon leakage is evaluated on the basis of the following questions:

- EQ1: Are the current carbon leakage provisions only applied to those (sub-)sectors where it is necessary?

Based upon the quantitative assessment undertaken in the previous section on effectiveness, the change to a single metric for determining the carbon leakage list in Phase IV resulted in free allocation becoming more targeted in comparison to Phase III. The removal of many sectors and sub-sectors from the carbon leakage list that previously only qualified for free allocation on the basis of trade intensity alone represents an improvement in overall effectiveness.

- EQ2: Is the increased amount of free allocation due to the carbon leakage provisions cost-efficient, in particular with a view to reduced auctioning revenues for MS? Is there evidence for significant cases of windfall profits, which would prove inefficiency in this regard?

Evidence of windfall profits

The EU ETS aims to internalise the cost of carbon into economic decisions, particularly by creating a price signal that influences both producers and consumers. A key component of this mechanism is cost-pass-through, which occurs when firms factor the carbon price into product prices, even if they receive emission allowances for free. This is grounded in standard economic theory: if a company uses a free allowance to comply with emission rules, it gives up the opportunity to sell it, meaning the opportunity cost of that allowance is equal to its market value. Firms seeking to recover all costs, including opportunity costs, are thus incentivised to pass those costs to consumers through higher prices.

It should be noted that cost-pass through itself is not a flaw, but rather a design feature of the EU ETS. By raising the prices of carbon-intensive goods, the ETS aims to steer consumption toward cleaner alternatives. This makes the ETS more efficient by ensuring that the carbon costs are reflected throughout the economy. The potential issue, however, arises when firms receive allowances for free and still raise prices. This results in altered consumer behaviour, but also in windfall profits.

Windfall profits occur when companies can pass through carbon cost and consequentially raise prices based on the market value of emission allowances they receive for free. The CE Delft report¹⁶⁶ quantifies windfall profits by estimating the additional profits companies earned through the EU ETS, primarily as a result of receiving free emission allowances. The core component of the methodology focused on calculating the value of cost-pass through for carbon allowances. These profits were calculated by multiplying verified emissions by the estimated cost pass through rate and the annual EUA price. To reflect real-world conditions, the analysis also adjusts for potential loss in market share due to higher prices, by comparing firm-level profits under a cost pass through scenario to a counterfactual scenario with no pass-through. Additional sources of windfall profits identified by the CE Delft report include profits from the overallocation of allowances and the use of cheaper international offsets for compliance, which, however, is no longer allowed in the EU ETS. Cost pass through was identified to be the largest driver of windfall profits, with an estimated EUR 26-46 billion between 2008 and 2019, after adjusting for market share losses. The study shows that in almost all sectors, the additional profits from cost pass through largely outweighed any loss in profits due to reduced market share. The iron and steel, refineries and cement sectors accrued respectively up to 16

¹⁶⁶ CE Delft, 2021. “Additional profits of sectors and firms from the EU ETS 2008-2019”, Delft

billion EUR, 12 billion EUR, and 7 billion EUR of windfall profits from carbon cost pass through.¹⁶⁷

1. Evidence on cost pass-through of EU ETS carbon costs in industry is very limited, especially when compared to the extensive literature for the power sector. The only systematic, multi-sector econometric evidence available remains the ex-post study by Cludius et al. (2020)¹⁶⁸, which is now relatively dated and covers mainly Phases II and III of the EU ETS (roughly 2008–2014). Using product-level price data for more than 50 product–country combinations across six industrial sectors (cement, iron and steel, refineries, fertilisers, petrochemicals and glass), the study applies econometric cost-price models to identify whether changes in EUA prices are reflected in product prices. The analysis finds statistically significant evidence of carbon cost pass-through in around 60% of the cases examined, with results most robust for cement, iron and steel, and refineries. Indicative pass-through rates are estimated to range from about 20-40% for bulk cement products, rising to 90-100% for Portland cement, 55-85% for most steel products, and 80-100% for refinery products, while results for fertilisers, petrochemicals and glass are more mixed and less robust due to data and modelling limitations. Importantly, the authors stress that these rates are indicative rather than precise, reflecting substantial heterogeneity across products and countries and the inherent difficulty of estimating pass-through in industrial markets with opaque pricing, limited high-frequency data and complex market structures.

2. For the power sector, a small number of empirical studies provide more systematic evidence, albeit with important limitations. In particular, Bai and Okullo (2023)¹⁶⁹ analyse carbon cost pass-through in electricity markets using futures price data for seven European power markets (Germany, France, Italy, the Netherlands, Belgium, the UK and Nord Pool) over EU ETS Phases II and III, finding that allowance costs are fully or more-than-fully passed through to wholesale electricity prices, consistent with marginal cost pricing and fuel-switching under competitive power market conditions. More recent evidence for Italy¹⁷⁰ alone suggests that pass-through in electricity markets during Phases III and IV is positive but incomplete, with average pass-through rates of around 30% and substantial regional heterogeneity across bidding zones, reflecting differences in generation mix and market structure. While these studies support the conclusion that carbon costs are at least partially reflected in electricity prices, their applicability is constrained by data coverage (futures or zone-specific prices), sectoral focus (power only), and geography, and none provides EU-wide, multi-country evidence for Phase IV as a whole.

These findings have significant implications for the efficiency of the ETS. Although cost pass through helps internalise the cost of carbon, windfall profits arising from free allocation do not necessarily contribute to decarbonisation. Free allocation is considered to be the primary cause

¹⁶⁷ However, the cost pass through rates applied in the CE Delft study were based on a range of literature sources that are not accepted by industrial sectors who argued strongly during the stakeholder consultation that their ability to pass through costs were very limited.

¹⁶⁸ Johanna Cludius, Sander de Bruyn, Katja Schumacher, Robert Vergeer, 2021. “Ex-post investigation of cost pass-through in the EU ETS - an analysis for six industry sectors”, <https://doi.org/10.1016/j.eneco.2020.104883>.

¹⁶⁹ Yiyi Bai, Samuel J. Okullo, 2023. “Drivers and pass-through of the EU ETS price: Evidence from the power sector”, *Energy Economics*, <https://doi.org/10.1016/j.eneco.2023.106698>.

¹⁷⁰ Pierdomenico Dutillo, Francesco Lisi, 2026. “Carbon cost pass-through rate in power system: evidence from Italy under the EU ETS”, <https://arxiv.org/pdf/2604.03076>

of windfall profits under the ETS. As the system matures, a reduction in free allowances, combined with increased auctioning and the full implementation of the EU CBAM is expected to reduce these undue rents and improve the system's effectiveness, while still shielding industries from international competition.

The extent to which carbon costs could be passed through was, however, strongly contested by industry during interviews with stakeholders from all sectors.

- *Eurofer* outlined that, in their view, the carbon cost cannot be passed through to the consumer with the fundamental reason being that there is simply too much competition from imports entering the domestic market for steel products in Europe. On average, imports currently account for around 25% of the domestic consumption of finished steel products in the EU. As a consequence, there is a constant downward pressure on prices to remain competitive, and this limits the ability of EU producers to pass through the carbon cost. It was, however, acknowledged that some markets may in the future be more open for accepting green products, but this is not currently the case. The pressure faced by EU firms in the steel sector is reflected by the overall negative financial results in recent years with the exception of the post COVID-19 recovery that benefited most industrial sectors.
- *Eurometaux* further argued that the sector operates on thin margins in global markets where carbon costs cannot be passed on, and where competitors (e.g. China) do not face equivalent rules and carbon pricing. As a price-taker industry, these additional carbon costs cannot be passed on to customers without losing significant market share.
- *Fertilisers Europe* stated that as European producers are often the marginal producer, this means that the additional unilateral carbon cost element could act as the trigger that results in a loss in market share and exacerbates issues with the other main cost element of production i.e. the relatively high natural gas prices in Europe. It is not possible, in the view of Fertilisers Europe, to pass through the carbon cost.
- *Glass for Europe* argue that the carbon price is a unilateral cost and there remains a fear within the flat glass industry that a continuation of the recent rising trend in EUA prices will only exacerbate the problems that the industry faces in a very volatile trading environment. In this context, products with low margins means any extra cost will be a great source of concern.
- *CEPI* emphasise that their members operate on small margins and continue to compete at a global level but warn that the risk of carbon leakage is real and may only be definitely proven when it is too late and industry has relocated elsewhere.
- *CEFIC* underlined that the carbon cost is one of the main elements impacting the business operations in Europe due to its role in the marginal price of electricity.

Distortion of the carbon price signal

One of the primary objectives of the EU ETS is to reduce GHG emissions by putting a price on carbon and using market forces to drive cost-effective decarbonisation. The carbon price, set by the market through the trading of emissions allowances, is intended to signal to firms that pollution has a cost and that investing in cleaner technologies is economically desirable. In theory, this price signal should guide both operational and investment decisions, encouraging emitters to reduce emissions and innovate toward low-carbon alternatives.

However, in its earlier phases, the EU ETS failed to deliver on these expectations due to significant design flaws. During Phase I and II, the system was undermined by over-allocation of free allowances, the use of the National Allocation Plan that lacked coordination, and a lack

of robust demand for allowances. This resulted in a persistently low and volatile carbon price, at times close to zero. With allowances in oversupply and compliance costs minimal, many firms opted to trade permits rather than invest in cleaner technologies. This blunted the price signal and significantly weakened the incentive for innovation. The opportunity to reduce emissions for profit by using fewer allowances and selling the surplus, was present in theory but undermined in practice by weak market conditions and allocation choices.

Recognising these shortcomings, the EU gradually improved the ETS. From Phase III onwards, substantial reforms were introduced to improve market functioning and restore the credibility of the price signal. Notably, the system moved from decentralised allocation to a centralised EU-wide cap, tightened the supply of allowances, introduced benchmarking for free allocation based on the most efficient installations, and made auctioning the default method for allocating allowances.

Another persistent challenge is the continued use of free allocation, particularly in sectors deemed at risk of carbon leakage. While free allocation helps shield European industry from competitiveness impacts, it also distorts the carbon price signal by reducing the effective carbon cost faced by firms.¹⁷¹¹⁷² Sectors with higher pass-through capacity firms may pass the notional cost of allowances to consumers while still receiving them for free, leading to windfall profits rather than actual emissions reductions or innovation. In contrast, sectors with lower pass-through ability more likely to show stronger innovation responses to the ETS price signal¹⁷³.

These distortions have important implications for ETS efficiency. The system's design improvements have made the ETS more effective, but empirical evidence remains mixed, particularly for Phase III and IV. The scarcity of research focused on these later phases limits our understanding of whether reforms have fully addressed past distortions and sufficiently improved the incentive for innovation.¹⁷⁴¹⁷⁵

- EQ3: What are the impacts of the allocation rules and carbon leakage provisions on the administrative costs? Can improvements be observed by the harmonised rules compared to previous phases?

A 2025 survey conducted for this evaluation aimed at EU stationary installations operators provides insights on the administrative costs of allocation rules, with responses from 278 installations. Respondents were asked to provide an estimate of the hours per person required to fulfil specific activities related to free allocation rules, including time spent on data reporting, learning rules, purchasing equipment, etc.

Table 12 summarises the estimated average administrative cost by industry¹⁷⁶, considering the data on hours per person required for the activities and the level of emissions indicated by operators.

¹⁷¹ Nguyen, P.-V. and Pellerin-Carlin, T. (2021)

¹⁷² Scotti, F., Flori, A., Crescenzi, R., & Pammolli, F. (2025).

¹⁷³ Ibid

¹⁷⁴ Rahel Mandaroux, Kai Schindelhauer, Houdou Basse Mama, 2023. "How to reinforce the effectiveness of the EU emissions trading system in stimulating low-carbon technological change? Taking stock and future directions", <https://doi.org/10.1016/j.enpol.2023.113697>.

¹⁷⁵ Sitarz, J., Pahle, M., Osorio, S. *et al.*, 2024. "EU carbon prices signal high policy credibility and farsighted actors". *Nat Energy* 9, 691–702, <https://doi.org/10.1038/s41560-024-01505-x>

¹⁷⁶ Data on labour costs per hours by industry and EU country was extracted from Eurostat.

Our estimates indicate that, on average, the administrative cost per tonne of emissions across industry and country is 0.98 EUR. Considering an average EU ETS price in 2025 of 68.77 EUR,¹⁷⁷ the administrative cost is approximately 1.43% of the carbon cost.

Table 12: Average administrator costs per tonne of CO₂ emissions

Industrial activity	Average administrative cost per tonne of CO ₂ -eq
Ammonia production	N/A
Bulk organic chemicals production	EUR 0.36
Carbon black production	EUR 0.09
Cement clinker production	N/A
Ceramics manufacture	EUR 0.42
Combustion of fuels	EUR 1.92
Drying or calcination of gypsum	N/A
Ferrous metals production	EUR 0.17
Glass manufacture	EUR 0.13
Hydrogen production	N/A
Iron & steel production	EUR 0.2
Lime, dolomite, or magnesite calcination	EUR 0.18
Metal ore production	N/A
Mineral wool manufacture	EUR 0.42
Nitric acid production	N/A
Non-ferrous metals production or processing	N/A
Paper production	EUR 0.50
Primary aluminium production	EUR 0.04
Pulp production	EUR 0.58

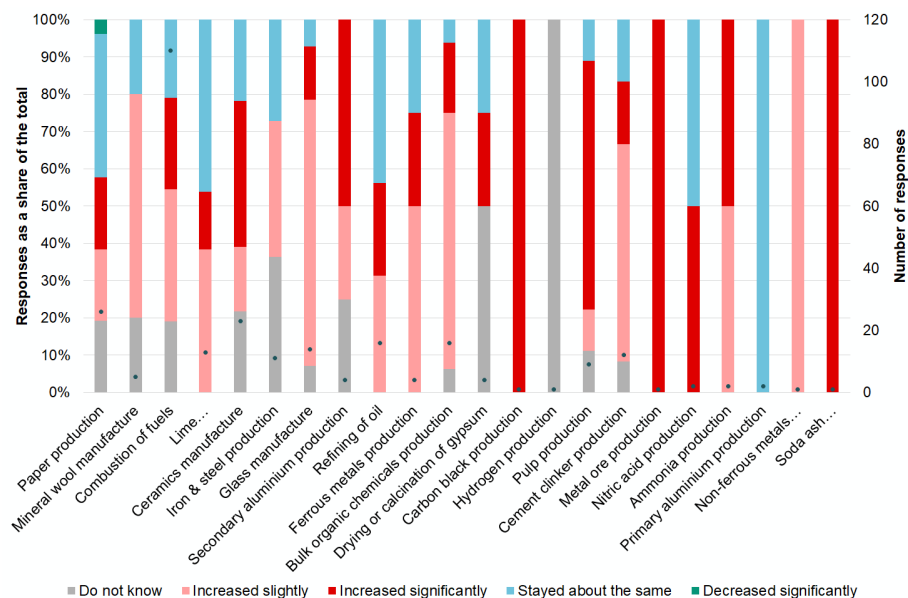
¹⁷⁷ Data on EU ETS price is available on [ICAP Allowance Price Explorer](#)

Refining of oil	EUR 0.07
Secondary aluminium production	EUR 0.04
Soda ash and sodium bicarbonate production	EUR 0.03
Total	EUR 0.98

Source: Own calculation following the Standard Cost Model using survey data collected from ETS operators for the purpose of this evaluation.

The survey inquired on the administrative costs for applying free allocation rules in Phase IV compared to Phase III. Across sectors, the majority of respondents reported either *slight increase* or a *significant increase* in costs, with very few perceiving a decrease. This trend was consistent across company size, although larger installations (>500 staff) more frequently reported significant increases, while very small operators (<10 staff) were more likely to report “do not know”, or only slight increases. Open responses provide context for these answers. Operators pointed to the additional requirements introduced in Phase IV, in particular to the new Activity Level Change rules, expanded monitoring and reporting obligations, and more complex verification procedures. Many respondents highlighted a greater need for external consultants and verifiers, with some reporting fee increases of 15-18%. Inflation, rising staff costs, and a shortage of accredited verifiers further compounds the costs.

Figure 27: Compared to Phase III of the EU ETS, has the administrative cost of applying for free allocation in Phase IV for your company (categorised by industry)



Source: Own calculation following the Standard Cost Model using survey data collected from ETS operators for the purpose of this evaluation

Table 13: Compared to Phase III of the EU ETS, has the administrative cost of applying for free allocation in Phase IV for your company (categorised by company size)

Size	Do not know	Increased slightly	Increased significantly	Stayed about the same	Decreased significantly	Row total
< 10 persons	29%	29%	0%	43%	0%	7
10 - 49 persons	17%	37%	23%	23%	0%	30
50 - 99 persons	25%	13%	28%	34%	0%	32
100 - 199 persons	20%	30%	36%	14%	0%	50
200 - 249 persons	13%	42%	19%	26%	0%	31
250 - 499 persons	19%	45%	18%	18%	0%	62
> 500 persons	3%	40%	27%	29%	2%	63
Do not know	33%	33%	33%	0%	0%	3

Source: Own calculation following the Standard Cost Model using survey data collected from ETS operators for the purpose of this evaluation.

The stakeholders that were interviewed as part of the evaluation were given the opportunity to provide their view on the administrative burden associated with compliance with the EU ETS and specifically with reference to the free allocation application process. Views varied amongst respondents on the proportionality of the administrative burden:

- *Eurofer* discussed that steel is a very large emitter, so the sector has a big responsibility. They believed that the overall administrative burden was proportionate and reflected the relevance of the sector, however recent new administrative requirements related especially to the Activity Level Change reporting feels more disproportionate and especially for installations lower than the value chain with lower emissions such as rolling mills. Given the large number of PRODCOM codes associated with steel these inputs require considerable administrative efforts. Simplification could be improved by improving some rules on free allocation, for instance with fully dynamic free allocation and with simpler rules on conditionality.
- *Cerame-Unie* emphasised that the ceramic industry is composed mainly of SMEs (over 80%) and is the most numerous industrial sector in terms of installations in the ETS system (over 1200) however, they constitute only below 1% of all industrial emissions.

The administrative burden connected with the ETS is extremely high for companies, especially the small emitters and the SMEs, which do not have human or financial resources to hire staff dealing with the administration. Also, the activity changes regulations add up to this burden. With regards to the different types of costs – the question on specific elements of monitoring, reporting, hedging, surrendering must be made to specific companies. For reduction of costs – please see the section on simplification of admin burden.

8.3.4.3 Coherence

At first sight, free allocation appears inconsistent with the core objective of the EU ETS, which is to drive cost-effective emissions reductions through a market-based price on carbon. By granting allowances to certain industries at no cost, it shields them - partially or fully - from the carbon price signal that should incentivise decarbonisation and investment in low-carbon technologies. Yet free allocation has been justified as a necessary measure to prevent carbon leakage: without it, there would be a risk not of decarbonisation, but of deindustrialisation, with production and emissions simply relocating outside the EU, harming both growth and employment. In this sense, free allocation can be seen as coherent with the ETS's long-term aim, as it provides a transitional pathway. It has allowed energy-intensive industries to remain competitive while being gradually exposed to the carbon price, giving them time to internalise costs, adjust investment strategies, and prepare for deeper decarbonisation. Ultimately, free allocation is only effective if accompanied by the right enabling conditions, such as access to affordable low-carbon energy, that ensure domestic production can continue while the cost of mitigation technologies falls and the ETS price signal strengthens.

Feedback from the Open Public Consultation highlighted diverging views on the coherence of free allocation: while critics argued it undermines the EU ETS and the 'polluter pays' principle, industry respondents saw it as essential for preventing carbon leakage and maintaining competitiveness. Many noted that the CBAM could enhance coherence if it enables a phase-out of free allocation without harming industry.

8.3.4.4 EU added value

In addition to the findings in Section 4.2.1. on the EU added value of the EU ETS as a whole, some further considerations should be made concerning the EU added value in the area of carbon leakage and free allocation.

Harmonisation at the EU level ensures that there is no carbon price difference within the EU, which affects the domestic market and prevents internal carbon leakage. If the ETS had been established at the Member States level instead of the EU level, differences in carbon prices would easily move production to the country(ies) within the EU with the lowest carbon prices. Moreover, harmonisation of free allocation rules across Member States and, more specifically, of product benchmarks since Phase III of the EU ETS ensures that firms across the EU are treated equally to prevent any potential market distortions.

8.3.4.5 Relevance

The relevance of free allocation as a measure for reducing the risk of carbon leakage is evaluated on the basis of the following questions:

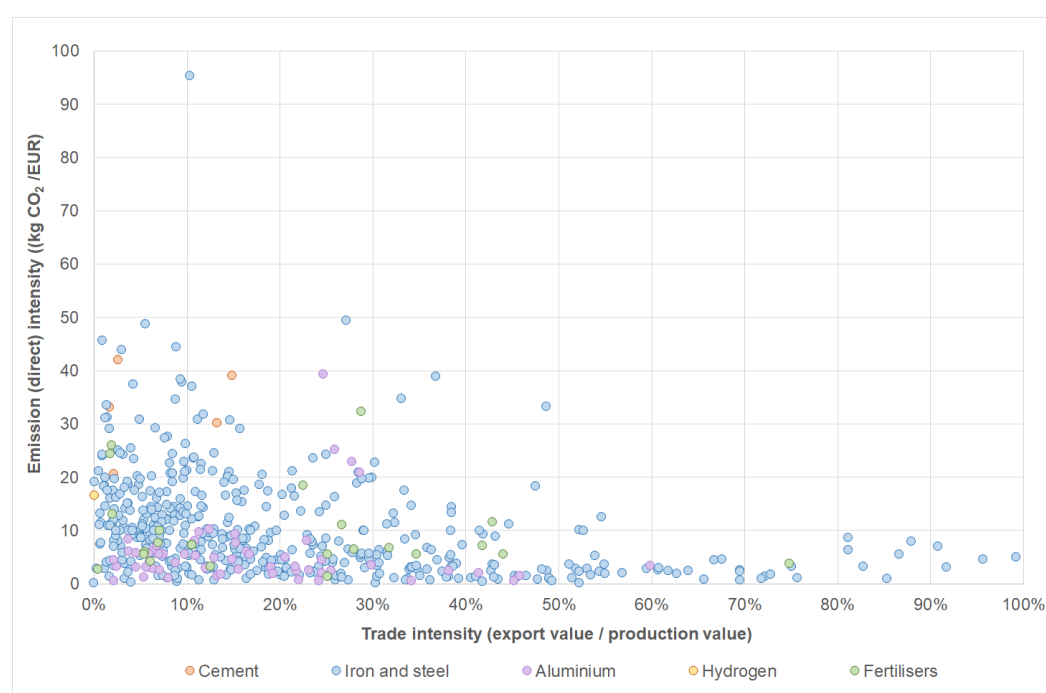
- EQ1: To what extent is the concept of carbon leakage valid in the context of the EU ETS?

As long as certain industrial sectors remain high emitters of CO₂ and assuming that comparable levels of carbon pricing do not exist in key trading partners, then carbon leakage will remain a valid concern in the context of the EU ETS. The following two subsections will briefly examine both the emission intensity of European industrial production and carbon pricing internationally to evaluate the relevance of carbon leakage as a valid concept in the context of the EU ETS.

Sectors currently deemed exposed to a carbon leakage risk

Figure 28 shows a comparison of export intensity¹⁷⁸ and emission intensity¹⁷⁹ values for a selection of CN codes from certain emission intensive sectors covered under the EU ETS that are also currently within the scope of the CBAM (i.e. iron and steel, cement, aluminium, fertilisers and hydrogen).

Figure 28: Comparison of export intensity with emission intensity based on a 2022-24 average for CN codes covered under the CBAM



Source: Own illustration based upon information from PRODCOM, COMEXT and values from JRC (refer to JRC Publications Repository - Greenhouse gas emission intensities of the steel, fertilisers, aluminium and cement industries in the EU and its main trading partners)

For the more emission intensive products that are more frequently traded, carbon leakage remains a valid concept in the context of the EU ETS with the additional cost of compliance potentially undermining levels of international competitiveness. Of course, competitiveness is the result of many factors beyond carbon pricing but the fact that trade intensive products remain currently emission intensive means that the concept of carbon leakage remains relevant and needs to be carefully evaluated.

¹⁷⁸ Export intensity here is a ratio based upon the following calculation: (export value) / (production value). Export value refers to extra EU without the UK, Switzerland or EEA countries.

¹⁷⁹ Emission intensity is expressed in kg CO₂ / EUR and is calculated based upon the following: (direct carbon cost / GVA).

Carbon pricing outside the EU

Figure 29 shows that the number of jurisdictions with carbon pricing has increased considerably so production costs in third countries now also include carbon costs.

Figure 29: Global expansion of emissions trading

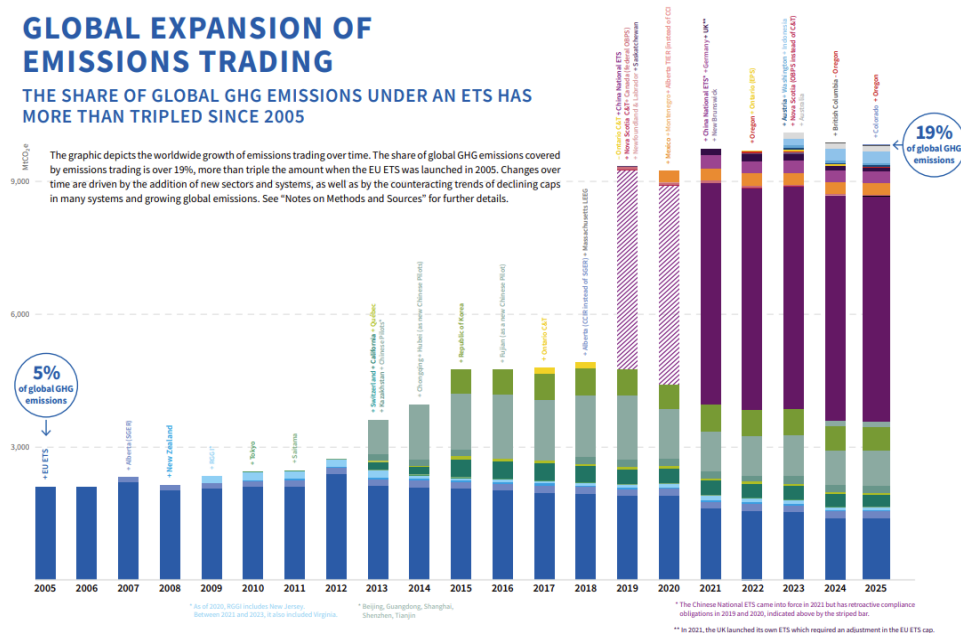
Source: ICAP¹⁸⁰

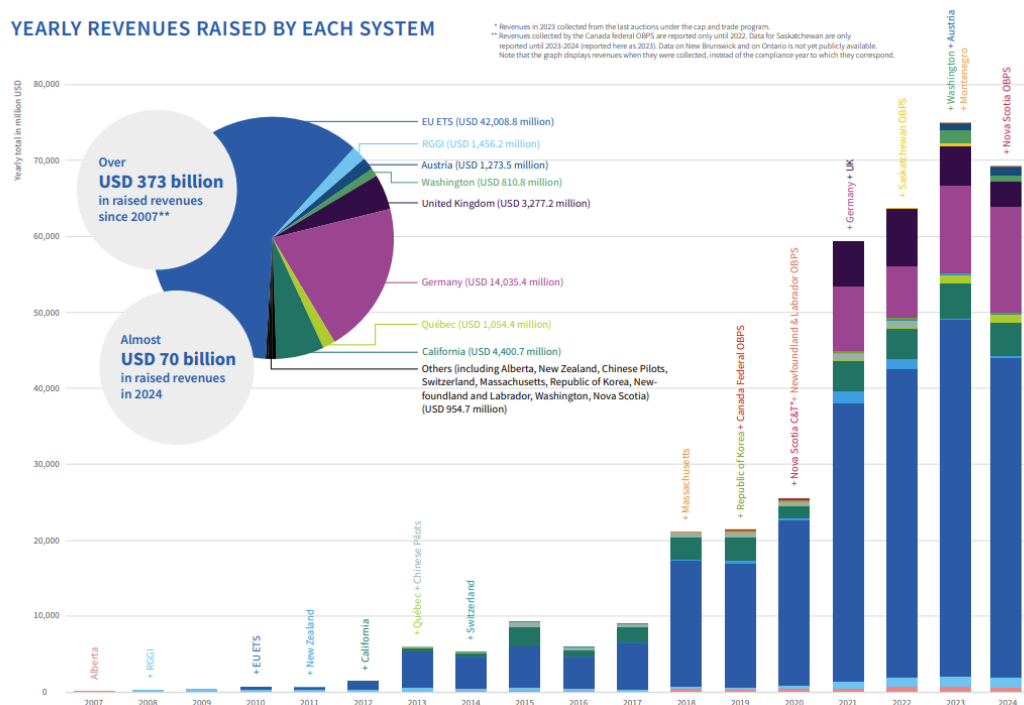
Figure 30 shows that carbon pricing instruments outside of the EU show considerable regional diversity in both price levels and coverage of emissions, though many jurisdictions are positioned for price increases as their systems mature. In Asia, Japan's carbon tax remains significantly lower than the EU ETS price, while South Korea's ETS has experienced price volatility but is expected to stabilise and potentially increase as market mechanisms strengthen. China's national ETS, still in its early stages, maintains relatively low prices, focusing on compliance, but plans to expand sectoral coverage and implement price adjustments, which could eventually see prices increase. Indonesia, having just launched its ETS, has low price levels, but these could increase as the system matures.

In the Americas, California and Québec operate linked ETSs with prices above USD 50 per tCO₂e, positioning them closer to EU ETS levels, though still below the EU average. Argentina and Mexico currently have lower prices through modest taxes targeting fossil fuel combustion, but ongoing discussions around sectoral expansions and price floor adjustments could increase prices over time. Canada's comprehensive approach, which includes both federal and provincial carbon pricing, has already seen some provinces approach EU price levels, with further increases expected as climate targets tighten. Emerging markets like Brazil and Uruguay are also in the early stages of establishing ETSs, with frameworks that have the potential to drive higher prices in the medium term as mechanisms are refined, and market confidence builds.

¹⁸⁰ ICAP Status Report 2025, Emissions Trading Worldwide, https://icapcarbonaction.com/system/files/2025-04/250409_icap_sr25_final_1.pdf

In Africa, South Africa's carbon tax remains well below EU ETS levels, yet the government has signalled intentions to increase the rate, aligning it more closely with international benchmarks. Similarly, countries like Kazakhstan and Ukraine, which have introduced carbon pricing mechanisms at relatively low levels, are expected to gradually increase prices as market structures solidify and policy frameworks evolve.

Figure 30: Annual ETS revenues across different systems



Source: ICAP

While most carbon pricing instruments outside the EU currently cover a limited share of emissions, many jurisdictions are considering expanding sectoral coverage and tightening caps, indicating a clear trajectory toward higher prices and broader coverage over time, aligning more closely with the comprehensive approach seen in the EU ETS. The comparability of these schemes is, however, difficult to determine and, in many cases, the carbon price is significantly lower than the EU. In several key trading partners, it is unlikely that carbon costs are equivalent to those faced by operators in the EU ETS and therefore the provision of free allocation remained relevant to supporting the competitiveness of European industrial production. However, Figure 33 above shows that auction revenues are increasing in international systems too suggesting that free allocation provision is in decline.

- EQ2: Is there evidence whether or not carbon leakage actually happened since the start of the EU ETS?

Short term competitiveness channel

The empirical literature on carbon leakage in the context of the EU ETS presents a complex, but increasingly compelling picture. Earlier research, based largely on datasets covering the first phases of the EU ETS, generally found little or no evidence of significant leakage. This result is consistent across different methodologies, including trade flow analyses, sector-level and firm-level assessments. The most commonly accepted explanation for these findings is that the combination of very low carbon prices and the generous allocation of free allowances

during the early stages of the EU ETS significantly reduced any incentive for companies to relocate production or shift emissions outside the EU. Studies such as Naegele & Zaklan (2019) and Dechezleprêtre et al (2022) found no significant evidence that the EU ETS prompted displacement of emissions to countries outside the EU, neither through trade flows nor through adjustments within multinational corporate structures. Similarly, literature reviews like Grubb et al (2022) concluded that existing climate policies have not been substantially undermined by carbon leakage.

However, more recent studies benefitting from updated data, have started to detect clearer signs of carbon leakage. These studies tend to focus on more recent periods, where the EU ETS was more stringent, carbon prices were higher, and free allocation was reduced.

Wang & Kuusi (2024)¹⁸¹ show that, although the overall effect remains small relative to total trade, there is a measurable increase in the carbon content of imports to the EU, rising by 13% and offsetting a 12% reduction in the carbon content of EU exports.¹⁸² Similarly, a study by Misch & Wingender (2024)¹⁸³ use panel data on country and sector specific changes in effective energy prices to identify changes in domestic carbon emissions and other flows.¹⁸⁴ Short-term carbon leakage rates¹⁸⁵ from unilateral policies were then subsequently derived in the study based upon a simple accounting framework to reflect short run responses of carbon flows to energy price changes. A carbon leakage rate of 0.15 is estimated for the EU14+ group,¹⁸⁶ pointing to a modest but statistically significant evidence of carbon leakage. Another study focusing on the risk of carbon leakage from the French carbon tax by Känzig et al. (2024)¹⁸⁷ highlights that carbon leakage may also occur through multinational firms, showing that emissions from African subsidiaries of French multinationals grew by 2.4 times more than emissions from German subsidiaries, at times when the French carbon tax was higher.¹⁸⁸ Further evidence on the risk of carbon leakage is shown a study by the OECD (2024).¹⁸⁹ The

¹⁸¹ Wang M. & Kuusi T., 2024. “Trade flows, carbon leakage, and the EU Emissions Trading System”, *Energy Economics*, June 2024, <https://www.sciencedirect.com/science/article/pii/S0140988324002640>

¹⁸² The empirical analysis uses a gravity model on a sectoral level based on the use of international manufacturing trade flows for 2000-2018 from the UN Comtrade database and subsequently combine the trade value data with data on emission intensities of imports from the OECD’s ‘Carbon dioxide emissions embodied in international trade’ database.

¹⁸³ Misch & Wingender, 2024. Revisiting carbon leakage”, *Energy Economics*, December 2024, <https://www.sciencedirect.com/science/article/pii/S0140988324004948>

¹⁸⁴ The analysis relies upon 1) the OECD’s Trade in Embodied CO2 Database to measure carbon emissions and carbon embodied in goods and services trade and final demand and 2) sectoral energy prices based on a dataset compiled by Sato et al. (2019). Merging the two datasets results in an unbalanced panel data at an annual frequency that covers 38 countries and 21 sectors over the 2005-15 period.

¹⁸⁵ Wang and Kuusi (2024) define the use of a carbon leakage rate by explaining that a value of one occurs when domestic reductions of emissions are fully offset by emissions abroad leaving global emissions unchanged.

¹⁸⁶ EU14 + 1 countries include Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and United Kingdom.

¹⁸⁷ Känzig et al., 2024. “Carbon Leakage to Developing Countries”, https://dkaenzig.github.io/diegokaenzig.com/Papers/kmo_leakage.pdf

¹⁸⁸ Känzig et al (2024) construct a unique dataset that combines financial information on multinational firms with exposure to European carbon policies, ownership links in Europe and Africa, information on subsidiary locations, and spatial emissions data. The panel dataset used in the study included more than 1,500 large multinational firms with almost 16,000 unique African subsidiaries spanning the period from 2010 to 2019.

¹⁸⁹ OECD, 2025. “How different climate policies affect carbon leakage through trade”, available at: https://www.oecd.org/en/publications/how-different-climate-policies-affect-carbon-leakage-through-trade_5819ce91-en.html

study uses a gravity model on trade to empirically find that, as the carbon price difference between importer and exporter countries widens, the emissions embodied in imports also increase.¹⁹⁰ The OECD study shows that the carbon leakage effect is robust even when accounting for variables like fuel prices and exchange rates, suggesting that carbon price asymmetries caused by the EU ETS may result in carbon leakage in globally traded goods, however the overall carbon leakage rates empirically estimated were deemed to be moderate and varied by country and sector.¹⁹¹

Despite these emerging findings, the literature widely acknowledges that the design of the EU ETS, particularly the use of free allocation, has played a decisive role in keeping leakage risks relatively contained so far. Free allocation was introduced to shield firms from the full cost of carbon and protect their competitiveness, especially in sectors most exposed to international trade. By offsetting direct emissions costs and reducing the likelihood of cost-pass-through, this mechanism helped prevent significant relocation of production or loss of market share due to carbon pricing. Many studies attribute the limited carbon leakage observed in the earlier phases of the EU ETS directly to this design feature. In conclusion, earlier studies found little evidence of carbon leakage, largely because the EU ETS in its early stages was designed to minimise such risks. However, as the system matures, the carbon price increases, and free allocation is phased out, more recent analyses find small but increasingly significant evidence of carbon leakage. While the overall magnitude remains moderate, studies using different methods and datasets suggests that carbon leakage is becoming more visible, especially in emission-intensive and trade-exposed sectors and potentially through channels like multinational corporate structures.

A report published by Bruegel in 2026¹⁹² argues that the EU ETS has so far been broadly compatible with industrial competitiveness, while stressing that this outcome has depended critically on policy design choices rather than the absence of carbon costs. Drawing on a large empirical literature, it finds that the EU ETS reduced emissions substantially with only modest impacts on firm profitability, employment and output, and no clear evidence of large-scale carbon leakage to date, largely because extensive free allowance allocation and cost pass-through mechanisms muted exposure for energy-intensive industries in earlier phases. However, Bruegel emphasises that generous free allocation has also produced sizeable windfall profits and failed to trigger deep industrial transformation, leaving emissions reductions in industry lagging far behind those in the power sector. Looking forward, the report makes clear that competitiveness concerns stem not from the EU ETS per se, but from the next phase of its implementation: as carbon prices rise, free allowances are phased out and CBAM's ability to protect exporters remains uncertain, EU firms are expected to face growing cost pressures. The central competitiveness message is therefore conditional: weakening the ETS would undermine investment signals and penalise first movers, but maintaining competitiveness requires shifting

¹⁹⁰ The analysis uses a gravity model of trade to provide empirical estimates of carbon leakage rates (defined as the ratio of policy-induced changes in imported emissions to changes in domestic emissions) for 14 manufacturing sectors, 49 countries and a broad set of climate policy instruments, covering the 2000-2020 period.

¹⁹¹ The median leakage rate was estimated by the OECD at around 3% (i.e. for every 100 tonnes of emissions that reduced domestically from a unilateral increase in climate policies, imported emissions rise by around 3.0 tonnes).

¹⁹² Mramor, T. and S. Tagliapietra, 2026. "Europe's emissions trading system is an ally, not an enemy, of industrial competitiveness", Analysis 03/2026, Bruegel, available at <https://doi.org/10.64153/GZCE1979>

from a “cap-and-trade” to a “cap-and-invest” logic, using auction revenues more transparently and conditionally to finance industrial decarbonisation rather than permanent compensation.

The impacts of the EU ETS on downstream sectors will depend on the extent to which regulated entities are able to pass through cost on product prices, which can affect customers and businesses operating downstream. However, evidence on impacts of the EU ETS on downstream sectors is limited, and more research is required.

While it was acknowledged by industrial stakeholders that carbon pricing alone was not responsible for changes observed in production and trade, it was widely argued that the carbon cost is unilateral in nature and therefore undermines their short-term competitiveness.

- *Eurofer* advanced the position that free allocation has proven an essential instrument to avoid carbon leakage due to the unilateral EU ETS cost but was only moderately effective against other causes of carbon leakage. In the last few years, the combination of increased carbon and energy costs and the proliferation of global excess capacity has severely impacted the steel sector. Since 2017-2018, the steel sector has lost around 30 million tonnes of production, of which around 10 million tonnes on export markets. While this negative trend is due to the above mentioned several elements, it should be considered in any case as carbon leakage, since it results in higher production by third country producers that are not subject to equivalent climate policy.
- *European Aluminium* believe that there is evidence of carbon leakage for the production of primary aluminium but less clear for downstream processes and this would require further research to determine fully. In terms of carbon leakage, European Aluminium outline that there has been an observable drop in the production of primary aluminium in Europe. For downstream processes there has been an increase in production for semi-fabricated products, but European Aluminium also state that imports have risen. For example, noticeable increase in imports of aluminium wire which needs pure aluminium from primary process to manufacture.
- *Fertilisers Europe* noted that plant closures have been observed in the EU along with production volume reductions not only due to these closures but also due to other operators running at a lower capacity. This is mainly impacting ammonia production, which has declined from around 15 Mt to 10 Mt. This represents a reduction of around one third in recent times. This drop in domestic production has been replaced with the import of products from outside the EU with a higher carbon footprint and therefore this represents, in the view of Fertilisers Europe, carbon leakage.
- *Cement Europe* explained that as competitors such as Turkey can produce cement at a cost of around 65 EUR per tonne – this is substantially less than the average European production cost of around 90 EUR even after subtracting shipping costs. Cement Europe argue that producers in Turkey and Northern Africa do not have a CO₂ cost, have cheaper energy costs and are therefore more competitive and this situation is unlikely to change in the near future. The imported product is mainly clinker & CEM I (which is 95 % clinker – the most energy intensive part of the production process).
- *Cefic* outlined that carbon cost is one of the main elements impacting the business operations in Europe due to its role in the marginal price of electricity. Indirect carbon cost, factored into the company - already high - energy bills is clearly a source of concern. More broadly, energy costs and weak demand remains the top issues for the chemical sector operating in the EU. Compared to the USA, the gas price in Europe (Jan-Mar 2025) is 3.3 times higher, leaving Europe at a competitive disadvantage. The

EU27 chemicals business environment continues to face a limited demand since March 2022.¹⁹³ High energy costs and weak demand has a dramatic impact on plant closures.

- *Glass for Europe* confirmed that European production has fallen in the last 15 years quite dramatically whereas global production has increased. While this cannot be attributed to carbon pricing solely and there are clearly many factors that are contributing whether this be the spike in energy prices as a consequence of geo-political events or the abrupt change in international tariff regimes. However, the carbon price is a unilateral cost and there remains a fear within the flat glass industry that a continuation of the recent rising trend in EUA prices will only exacerbate the problems that the industry faces in a very volatile trading environment. In this context, products with low margins means any extra cost will be a great source of concern.
- *CEPI* acknowledge that the last few years have been challenging but it is very difficult to isolate the impact of carbon pricing against a very volatile wider context with industry having to respond to the challenges posed by both the COVID pandemic as well as geopolitical instability and the subsequent impact on energy prices. However, regardless of the contribution of each factor the result has been a loss of market share in recent years with a loss in production capacity and lower levels of employment compared to before the onset of the recent years of volatility.

Investment channel

The question on whether the EU ETS has led to investment leakage, defined as increased firms' investment outside of the EU to avoid carbon costs, has been studied using different methods and firm-level datasets. Koch & Mama, (2019)¹⁹⁴ focus on German multinational firms, combining Bundesbank data on outward FDI with the EU ETS registry¹⁹⁵. Using a difference-in-differences matching approach, they find no overall effect of the ETS on foreign investment. On average, regulated firms invested just 0.2% less abroad than unregulated firms, although the result is not statistically significant. However, when looking at a subgroup of "footloose" firms (those in less capital-intensive sectors that can shift production more easily), they estimate that FDI outside the EU was about 52% higher compared to unregulated firms, although the confidence interval is quite wide ($\pm 47\%$). These firms also expanded their network of foreign affiliates by 28%, suggesting that while most German firms did not relocate investment, some mobile firms may have started building options for future relocation.

Other studies confirm the picture of modest and selective effects. D'Arcangelo & Galeotti (2025)¹⁹⁶ study a panel of European firms 2005-2012, focusing on greenfield investments as a direct measure of new productive capacity. Their empirical strategy estimates firms' compliance costs and relates them to investment location choices through a discrete choice model. They find that higher expected carbon costs slightly reduce the probability of investing within the EU ETS area, but the overall effect is economically small. In fact, they conclude that the diversion of investments outside the EU is too limited to justify the very large

¹⁹³ Chemical Trends Report available at [Cefic website](#).

¹⁹⁴ Koch & Mama, 2019. "Does the EU Emissions Trading System induce investment leakage? Evidence from German multinational firms", *Energy Economics*, June 2019, <https://www.sciencedirect.com/science/article/abs/pii/S014098831930132X>

¹⁹⁵ The study combines panel (sample period: 1999–2013) of firm-level data on outward FDI stocks with a plant-level database detailing which firms operate any installations subject to the EU ETS.

¹⁹⁶ Filippo Maria D'Arcangelo, Marzio Galeotti, 2025. "Environmental policy and investment location: The risk of carbon leakage in the EU ETS", <https://doi.org/10.1016/j.enpol.2025.114587>.

compensations, via free allowances, that have been used to protect firms. Looking at Phase III (2013-20), De Beule, Schoubben, & Struyfs (2022)¹⁹⁷ provide evidence of a pollution haven effect. Using data on 358 listed multinationals and their worldwide FDI projects, they show that carbon inefficient firms are significantly more likely to locate investments in countries with weaker environmental regulation. This shift is attributed to rising carbon prices in Phase III, which made compliance more costly and created incentives for relocation. The aforementioned study by Känzig et al. (2024)¹⁹⁸ shows that European firms' domestic investment decreased while overall global investment remained constant, which is consistent with the hypothesis of partial relocation abroad. By contrast, the study by Dechezleprêtre et al. (2022)¹⁹⁹ estimated that the ETS reduced emissions while not only increasing revenues, but also fixed assets of regulated firms, which suggests that firms reinvested domestically in productive assets and efficiency improvements rather than cutting or offshoring investment.

Overall, evidence on investment leakage the literature remains limited and incomplete but large-scale systematic investment leakage has not yet occurred under the EU ETS. Instead, effects are modest and heterogeneous, with some mobile and carbon inefficient firms appearing to have shifted investments abroad, particularly after prices rose in Phase III, while many regulated firms actually increased investment at home.

The extent to which investment leakage has occurred was, however, more strongly suggested as a likely possibility by industry during interviews with stakeholders from all sectors.

- *Eurofer* regard the EU ETS as the overarching instrument to provide the price signal for the necessary investments in the medium term. Investors in EU steel production are aware that if they want their assets to remain viable for the next 30 years that future investments need to be compatible with the ambitious climate policies of the EU. Indeed, in recent years the sector has already seen investments change in response to the price signal of the EU ETS. However, investments are more likely to involve the replacement of existing capacity with new assets rather than retrofitting current assets. The iron and steel sector is impacted by global overcapacity due to an increase in investments in production capacity internationally as more countries wish to capture their own domestic demand, but this is often over-estimated exacerbating oversupply globally.
- *Fertiliser Europe* stated that with regards to evidence of investment leakage, Fertilisers Europe stated that there has been no recent investment in new capacity within the EU, with the last ammonia plant built in the EU was in Slovakia in 2018. In contrast, more investment has occurred outside of the EU and it is already noticeable that the CBAM policy has encouraged new investments in technology abroad to lower the carbon intensity of their production processes. For example, the US has recently invested in blue ammonia with the clear objective of targeting the EU market.
- *European aluminium* noted that since the introduction of the ETS, the EU has lost around 50% of its primary aluminium smelting capacity, with 30% lost since 2008 alone. Several smelters have permanently closed or suspended operations in countries such as Germany, the Netherlands, Slovenia, and Slovakia, citing unsustainable electricity and carbon costs. In 2022, European smelters curtailed over 900,000 tonnes

¹⁹⁷ Filip De Beule, Frederiek Schoubben, Kristof Struyfs, 2022. "The pollution haven effect and investment leakage: The case of the EU-ETS", <https://doi.org/10.1016/j.econlet.2022.110536>.

¹⁹⁸ Känzig et al (2024)

¹⁹⁹ Antoine Dechezleprêtre, Caterina Gennaioli, Ralf Martin, Mirabelle Muûls, Thomas Stoerk (2021)

of capacity amid soaring electricity and ETS prices, while global competitors including China, India, and the Middle East expanded production using fossil-based power.

- *Cement Europe* highlighted their concern that multinational companies are now investing more in clinker grinders within the EU at the border / coast to receive imported clinker from outside the EU.
- *FuelsEurope* see a clear pattern of refineries in Europe closing over the last twenty years. Around 30 installations have ceased operation with only 85 refineries remaining. As a consequence, there has been a decline in capacity with no new investments in Europe. New refineries are coming on stream in Africa, the Middle East and Asia. While nearly 400,000 b/d of capacity, around 3pc of Europe's total, is scheduled for permanent closure in 2025 outside Europe, the world has added more than 2.5mn b/d of crude distillation capacity in the last three years.
- *CEFIC* commented that progressively they have seen a significant shift in the companies' strategy, passing from a long-term planning to a short-term (2/3 years) due to the dramatically changed context in which they operate in the EU. About 11 million tons worth capacity has been lost because of closure announcements between 2023 and 2024²⁰⁰.
- *Glass for Europe* see that in recent investment decisions with more flat glass plants opening outside of the EU but close to the EU border.
- *CEPI* emphasise that their members operate on small margins and continue to compete at a global level but warn that the risk of carbon leakage is real and may only be proven when it is too late and industry has relocated elsewhere. Investments are still happening but if you stop having visibility on carbon leakage protection, if free allocation is regarded as being riskier i.e. conditionality – then this may deter future investments.

3. Firm-level evidence indicates that the EU ETS has induced low-carbon innovation among regulated firms, but that these effects have been uneven and limited in aggregate.

4. Cael and Dechezleprêtre (2016)²⁰¹ analyse the early years of the EU ETS (covering Phases I and II, 2005–2009) using a matched difference-in-differences design at firm level, exploiting installation-size thresholds to compare ETS and non-ETS firms with similar pre-policy characteristics. They find that ETS firms increased low-carbon patenting by 8–10% on average relative to non-ETS firms, while patenting in other technologies was not crowded out.

5. Complementary evidence from Joltreau and Sommerfeld (2018)²⁰² reinforces this conclusion, showing that carbon pricing under the EU ETS primarily stimulated innovation responses among firms with higher absorptive capacity and pre-existing technological capabilities, while having little effect on lagging firms or on technological diffusion across sectors. Together, these studies suggest that early ETS phases reinforced existing innovation trajectories rather than triggering broad-based technological change. This interpretation is consistent with the wider synthesis by Grubb et al. (2021)²⁰³, which concludes that carbon

²⁰⁰ Cefic and Advancy “The Competitiveness of the European Chemical Industry”. p.7.

²⁰¹ Raphael Cael & Antoine Dechezleprêtre (2016)

²⁰² Joltreau, Eugénie; Sommerfeld, Katrin, 2018. “Why does emissions trading under the EU Emissions Trading System (ETS) not affect firms’ competitiveness? Empirical findings from the literature”, *Climate Policy*, ISSN 1469-3062, Taylor & Francis, London, Latest articles, pp. 1-19, <https://doi.org/10.1080/14693062.2018.1502145>

²⁰³ Michael Grubb et al, 2021. “Induced innovation in energy technologies and systems: a review of evidence and potential implications for CO₂ mitigation”, *Environ. Res. Lett.* 16 043007, <https://iopscience.iop.org/article/10.1088/1748-9326/abde07>

pricing and other market-wide demand-pull instruments consistently induce innovation, but tend to deliver incremental and path-dependent outcomes when applied in isolation. The review further highlights the central role of cumulative deployment and complementary policy instruments in translating innovation activity into sustained cost reductions and structural change, implying that carbon pricing alone is unlikely to drive large-scale low-carbon transformation without stable expectations and targeted support measures.

6. In general, evidence of impacts of Phase IV of the EU ETS on patent innovation is lacking, suggesting a need for more research in this field. The evidence provided in this section relates to the previous phases and is complemented by the findings in stakeholder consultation and interviews.

8.3.5 Conclusion

The point of comparison for this section of the evaluation focuses on the introduction of revisions to both the provision of free allocation and indirect cost compensation at the start of Phase IV of the EU ETS in order to prevent the occurrence of carbon leakage. The implementation of these revisions was firstly evaluated before further work was then subsequently undertaken to assess the impact of these changes to the provision of support in terms of the international competitiveness of European producers.

- As a consequence of the revision to free allocation rules, the overall volume of free allowances that has been provided to industry has declined in Phase IV compared to Phase III. This reduction was primarily as a result of a more targeted carbon leakage list, more ambitious benchmarks and the introduction of adjustments to allocation to better take into account changes in activity levels across installations. However, despite these reforms, the share of verified emissions that continue to be covered by free allowances still remains high for the energy intensive sectors.
- With the introduction of further guidance from the Commission in 2021, the maximum state aid payable was reduced to 75 % of the total indirect carbon cost. Some revisions were also made to number of sectors and sub-sectors that were eligible for indirect cost compensation and the provision of the support remained at the discretion of Member States. However, the evaluation demonstrated through a quantitative analysis that the majority of electro-intensive production is located in Member States that provide indirect cost compensation.

With the exposure to a rising carbon price signal likely to have increased for many ETS operators, and without fully comparable carbon prices in key trading partners, the relevance of carbon leakage risk remains, and the focus of the evaluation therefore was to assess a range of evidence to provide further insights into the extent to which carbon pricing is influencing the international competitiveness of European industrial producers.

The evaluation involved detailed consultations with industry via both the OPC and follow up interviews that were further supplemented with quantitative and qualitative assessments of the potential impact of changes to the provision of free allocation and indirect cost compensation on the competitiveness of industry. It was undeniable that industrial output in the EU has declined in recent years and that imports have at the same time increased for a range of emission intensive products. However, the extent to which these observed trends can be attributed to carbon pricing was very difficult to ascertain given the volatility that has been experienced from the start of Phase IV. Indeed, industrial stakeholders themselves acknowledged that the energy price crisis that followed the illegal Russian invasion of Ukraine was more likely to explain the challenging operating environment for European producers. Nevertheless, industry

still strongly argued that the additional unilateral carbon cost has only exacerbated the challenges presented by the recent economic volatility as a consequence of geo-political events.

The risk of carbon leakage will ultimately decline as industry fully decarbonises, however the rate of progress towards this outcome was observed as being more incremental than transformative. While there were examples of the carbon price driving rapid abatement (i.e. the improvements in the specific emissions of adipic acid production), energy intensive production such as hot metal for steel remains very limited. This likely reflects the high share of free allocation that remains available to industry as well as the carbon price not yet reaching a level that would make the more innovative abatement solutions financially viable. Although the more ambitious benchmarks set for Phase IV are likely to have increased the incentives for abatement across industry, the provision of free allocation in high volumes still protects industry from higher levels of exposure to the carbon price signal. However, industry stressed that these abatement solutions will not be realised simply through more exposure to a higher carbon price signal alone and emphasised consistently the need for enabling conditions to be met (i.e. access to low carbon electricity, CCS/CCU infrastructure, demand for low-carbon products) for more ambitious reductions in emissions to be achieved.

8.4 Monitoring, Reporting, Verification and Accreditation (MRVA)

8.4.1 Introduction

The Monitoring, Reporting, Verification, and Accreditation (MRVA) system is a cornerstone of the EU Emissions Trading System (ETS), ensuring the accuracy, transparency, and consistency of emissions data that underpin compliance, market trust, and environmental integrity. Enshrined in Articles 14 and 15 of the ETS Directive and detailed in the Monitoring and Reporting Regulation²⁰⁴ (MRR) and Accreditation and Verification Regulation²⁰⁵ (AVR).

This evaluation builds on the 2015 ETS Directive evaluation, analysing the role of the MRVA system as the backbone of the ETS. It assesses the effectiveness of provisions requiring approved monitoring plans, annual verified reporting, and accredited verification oversight. The system supports the annual compliance cycle—monitoring, reporting, verification, and allowance surrender—which sustains the ETS’s credibility and efficiency. The legal basis for MRVA derives from multiple Articles of the Directive, Articles 4-7 of the ETS Directive, as well as Article 14 and 16 and Annexes IV and V. These provisions in the ETS Directive establish the requirements for GHG emissions permits, monitoring and reporting obligations, verification and accreditation rules. They also require Member States to impose penalties when operators or aircraft operators are not complying with the said rules. The framework is operationalised through the MRR and AVR, and their subsequent amendments, including those adopted in 2020 and 2022, which refined monitoring rules, improved data quality, and aligned procedures with evolving EU climate policy, including with the changes done to the Renewable Energy Directive. Updates in 2023–2025 (as part of the ‘Fit for 55’ package) will apply from 2024 and 2025 onwards but fall outside this evaluation’s scope.

In addition, guidance and templates were developed and updated to ensure a harmonised interpretation of the MRR and AVR, and to structure reporting across sectors and operators. These reforms increased harmonisation and transparency in the application of MRV requirements, not only because of the increased application of standardised methodologies and tools to facilitate implementation but also because several measures were taken to improve MRVA procedures: e.g., rotation of lead auditors to mitigate the risks to impartiality, update of the AVR as a result of revisions in ISO standards, allowing virtual site visits of the verifier in force majeure circumstances such as COVID-19 pandemic. These revisions show that both regulations are adaptable and flexible to political, environmental and social developments. During the third and fourth trading period also the institutional frameworks and external and internal coordination within Member States strengthened having clearer institutional roles, the increased use of IT systems, strengthened competent authority’s procedures to approve monitoring plans, review of reports and inspections. These improvements led to more consistent, transparent, and reliable emissions data across Member States.

²⁰⁴ Commission Implementing Regulation (EU) [2018/2066](#) of 19 December 2018 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council and amending Commission Regulation (EU) No 601/2012. In 2020 and 2022 it was revised for Phase IV of the EU ETS.

²⁰⁵ Commission Implementing Regulation (EU) [2018/2067](#) of 19 December 2018 on the verification of data and on the accreditation of verifiers pursuant to Directive 2003/87/EC of the European Parliament and of the Council, OJ 31 December 2018, L 334/94. In 2020 it was revised for Phase IV of the EU ETS.

Despite challenges such as varying national capacities and pandemic-related disruptions, the MRVA system remains central to maintaining the environmental and market integrity of the EU ETS and ensuring its continued effectiveness in achieving the EU's climate goals.

8.4.2 *Point of comparison*

The evaluation of the MRVA system is based on the provisions of the ETS Directive and its related implementing regulations. The key legal provisions of the ETS Directive relevant to the MRVA are:

- **Article 4: Greenhouse gas emissions permits.** Requires that no installation within the ETS scope may operate without a GHG permit issued by a competent authority.
- **Article 5: Application of GHG permits.** Outlines the information that operators must provide when applying for a permit, including a description of activities, emission sources, and monitoring methodology.
- **Article 6: Conditions for and contents of the GHG permits.** Specifies that permits must include monitoring and reporting requirements, and that operators must comply with conditions laid down in the permit.
- **Article 7: Changes relating to installations.** Requires operators to notify the CA of any planned changes that may affect emissions or the permit's validity, triggering update to the monitoring plan.
- **Article 14: Guidelines for monitoring and reporting of emissions.** Provides the legal mandate for the Commission to adopt detailed rules on monitoring and reporting, which provide the legal basis for the Monitoring and Reporting Regulation.
- **Article 15: Verification and accreditation of verifiers.** Requires that emissions reports be verified by accredited independent verifiers and provides the legal basis for the Accreditation and Verification Regulation.
- **Article 16: Penalties.** Establishes the enforcement regime, including penalties for non-compliance with MRVA obligations, such as failing to surrender allowances equal to verified emissions.

In line with Articles 14 and 15 of the ETS Directive, the Commission has adopted a series of implementing measures to operationalise the MRVA framework. These implementing acts provide technical rules and procedures to ensure the accurate quantification, reporting, and verification of emissions. The key implementing measures for MRVA are the 2018 Monitoring and Reporting Regulation and the 2018 Accreditation and Verification Regulation, which replaced earlier versions of the legislation and introduced a more robust, flexible, and harmonised system with compliance and oversight. Since their implementation, several amendments have been made to address practical challenges, including the improvement of data quality and the alignment with evolving technical standards. These implementing regulations and their amendments are key points of comparison for this evaluation. More specifically, the legislation we will be referring to include:

- Commission Implementing Regulation (EU) 2018/2066 of 19 December 2018 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council and amending Commission Regulation (EU) No 601/2012
- Commission Implementing Regulation (EU) 2018/2067 of 19 December 2018 on the verification of data and on the accreditation of verifiers pursuant to Directive 2003/87/EC of the European Parliament and of the Council

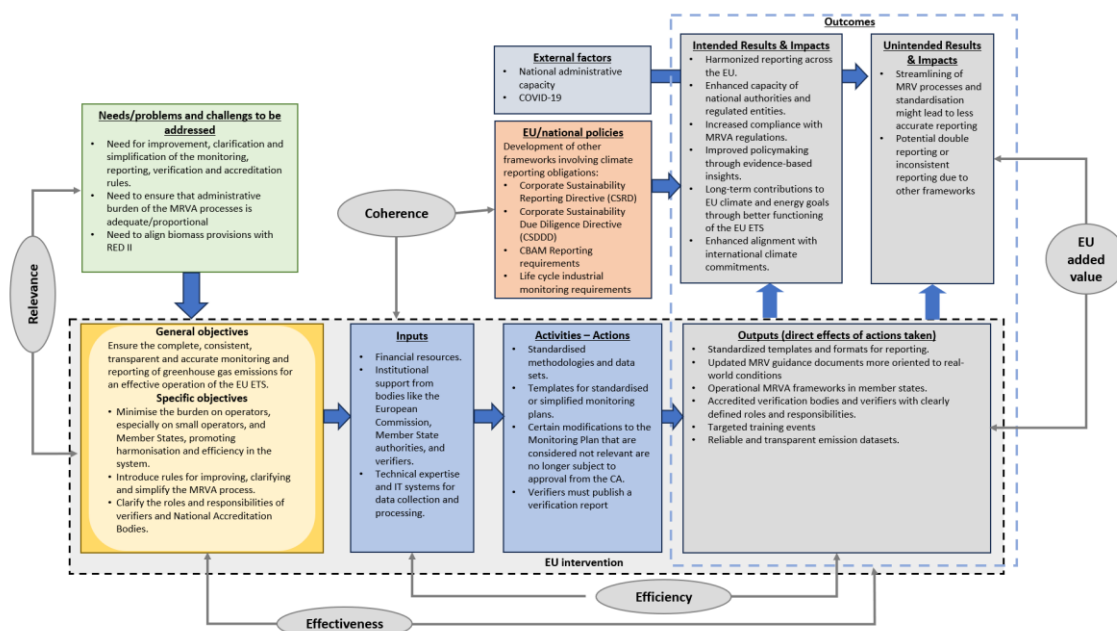
- Commission Implementing Regulation (EU) 2020/2085 of 14 December 2020 amending and correcting Implementing Regulation (EU) 2018/2066 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council
- Commission Implementing Regulation (EU) 2022/388 of 8 March 2022 amending Implementing Regulation (EU) 2018/2066 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council
- Commission Implementing Regulation (EU) 2020/2084 of 14 December 2020 amending and correcting Implementing Regulation (EU) 2018/2067 on the verification of data and on the accreditation of verifiers pursuant to Directive 2003/87/EC of the European Parliament and of the Council.

From the period 2020 to 2023 the MRR and the AVR were also amended to improve the effectiveness of MRV of emissions and to align with other EU ETS legislation. One of the key amendments was the incorporation of a stronger link between the MRR and the REDII, regarding biomass sustainability, the clarification of provisions on how to monitor zero-rated biomass fuels, and revisions to simplify certain elements of the monitoring process: e.g., allowing operators not to submit an improvement report, if the improvement report was only necessary to ensure that non-conformities in accordance with Article 69(4) of the MRR were being managed and that these non-conformities had already been resolved. The revised requirements in the MRR on biomass also had an impact on the verification requirements in the AVR. Provisions were included to clarify the verifier's role in assessing the evidence of the operator. Further changes in the AVR included virtual site visits of verifiers in the case of force majeure circumstances, and rotation of lead auditors that have carried out verification for the same operator of the installation for five consecutive years. Other changes in the AVR included revisions that were made to incorporate the new harmonised verification standard, ISO 17029 and the updated standard ISO 14065 that are used by accreditation bodies to accredit verifiers.

In the years 2023 to 2025 both the Monitoring and Reporting Regulation and the Accreditation and Verification Regulation underwent significant revisions. Among other things MRV requirements were included for the new ETS scheme on road transport, buildings and additional sectors, MRV of non-aviation effects for aircraft operators and new requirements because the scope of ETS activities in Annex I of the Directive has extended (e.g. transfer of CO₂ through other modes than pipelines). These new revisions are however out of scope of this evaluation.

8.4.3 Intervention logic

Figure 31: Intervention logic diagram (MRVA)



Source: Own illustration

8.4.3.1 Problem to address

A reliable and efficient system for monitoring, reporting, verification, and accreditation (MRVA) is fundamental to the effective functioning of the European Union Emissions Trading System (EU ETS). Without a robust MRVA framework, the accuracy and transparency of emissions data may be compromised, undermining the environmental integrity of the system.

There is a clear need to ensure that the administrative burden associated with MRVA processes is proportionate. This is crucial to maintain the integrity of the EU ETS while also supporting the overarching goal of reducing greenhouse gas emissions. This calls for balance between administrative efficiency and regulatory robustness.

Another issue is the alignment of existing MRVA provisions, particularly those concerning emissions from biomass, with updated legislation such as the revised Renewable Energy Directive (RED II). This alignment is necessary to ensure consistency across EU climate and energy policies.

In addition, the costs associated with MRVA processes, which fall on competent authorities, operators, and verifiers, must be examined using real market data. This analysis is vital to understanding the financial implications and ensuring cost-effectiveness across the system.

8.4.3.2 Objectives

The general objective is to ensure the complete, consistent, transparent, and accurate monitoring and reporting of greenhouse gas emissions. This is essential for the effective operation of the EU ETS. A key part of this objective is to operationalise and implement changes introduced by revisions to the ETS Directive within the MRVA framework.

Further specific objectives include:

- Minimise the administrative and financial burden on operators (especially small emitters) and on Member States, while promoting harmonisation and increased efficiency in the MRVA system.
- Improve, clarify, and simplify MRVA procedures to enhance user-friendliness and reduce complexity.
- Clearly define the roles and responsibilities of verifiers and National Accreditation Bodies to improve accountability and ensure high-quality verification processes.

8.4.3.3 Inputs

The successful implementation and enhancement of the MRVA framework depend on several key inputs:

- Financial resources - Adequate funding is required to support both the development and operational phases of the system. This could include funding from Member States as reported under Article 21.
- Institutional support - Collaboration and support from the European Commission, national authorities, and verification bodies are vital for effective coordination and enforcement.
- Technical expertise and IT systems - High-quality data collection and processing depend on specialised knowledge and robust information technology infrastructure.

8.4.3.4 Actions

A series of targeted actions have been taken to strengthen the MRVA framework, with the aim of improving efficiency, consistency, and accuracy across the EU ETS.

- One of the key measures has been the introduction of standardised methodologies and data sets for both operators and aircraft operators. This standardisation supports harmonised data reporting and reduces discrepancies in emissions monitoring.
- To further reduce the administrative burden, templates for standardised and simplified monitoring plans have been developed, enabling more streamlined preparation and submission processes, particularly for small emitters.
- In terms of regulatory simplification in Phase 2 and start of Phase III, certain changes to the monitoring plan that are considered not significant no longer require formal approval by the competent authority (CA), thus reducing administrative delays and improving procedural efficiency. Additionally, verifiers are required to issue a verification report that must comply with harmonised rules in the Accreditation and Verification Regulation and that must contain information on outstanding issues identified in the verification, enhancing transparency and accountability.

Several legislative amendments have also been introduced to align MRVA provisions with updated climate and energy policies.

- Under the revised Monitoring and Reporting Regulation (MRR), the emission factor for biomass is set to zero, reflecting its nature as a renewable source. For biofuels not physically delivered to the site of combustion, aircraft operators may determine the biomass fraction based on purchase records, provided they can prove there is no double counting of emissions reductions. Furthermore, Member States could choose not to apply GHG sustainability or emissions saving criteria for biofuels, bioliquids, and biomass for the year 2022, reflecting a transitional compliance approach.

- The 2020 amendments to the Accreditation and Verification Regulation (AVR) introduced updated rules granting CAs greater access to internal verification documentation, thereby strengthening oversight.
- In response to the challenges posed by the COVID-19 pandemic, verifiers are now permitted to carry out virtual site visits in exceptional, unforeseen circumstances, ensuring business continuity.
- Additionally, a new requirement mandates the rotation of EU ETS lead auditors to maintain objectivity and prevent conflicts of interest in verification practices.

8.4.3.5 Outputs

The implementation of these actions has yielded several important outputs that contribute to the overall functionality and reliability of the MRVA system.

- A centralised MRVA framework has been established in the Monitoring and Reporting regulation and Accreditation and Verification Regulation which harmonised the requirements across Member States.
- Member States implemented more strengthened MRV procedures to manage MRV processes, ensuring that the revised rules are embedded within national procedures.
- Standardised templates and reporting formats have been developed, accompanied by adaptable IT tools that accommodate the varying operational contexts of Member States. These tools and templates promote uniformity while allowing for a degree of flexibility to meet national needs.
- Updated MRV guidance documents have also been produced, focusing more on practical, real-world implementation scenarios. This shift ensures that stakeholders, from operators to verifiers, are better equipped to navigate compliance requirements.

The framework also includes clear provisions for the accreditation of verification bodies, with well-defined roles and responsibilities. This clarity enhances accountability and strengthens institutional capacity.

A series of targeted training events has been launched to support the consistent application of MRVA rules and to build technical competence among all relevant actors. As a result, the MRVA system now generates emissions datasets that are not only reliable and consistent but also transparent, enabling informed decision-making and public scrutiny.

8.4.3.6 Intended results and impacts

The intended outcomes are a more harmonised and cost-effective MRVA system that strengthens data integrity, policy relevance, and international alignment. Improved verification quality and reduced administrative burden should enhance trust and comparability across the EU ETS. However, simplification carries some risks—such as potential data loss or inconsistencies with overlapping EU frameworks (e.g., Industrial Emissions Directive, Renewable Energy Directive, CBAM)—highlighting the need for ongoing coordination and interoperability.

The anticipated outcomes of the revised MRVA framework are both immediate and long-term. In the short term, the reforms aim to ensure harmonised and reliable greenhouse gas reporting across the EU, fostering consistency and comparability among Member States. The capacity of national authorities and relevant stakeholders is expected to increase, enabling them to more effectively implement, monitor, and enforce MRVA-related requirements.

The changes are also designed to facilitate the mutual recognition of verification bodies across borders, reducing duplication and administrative burden while promoting trust and cooperation among Member States. Enhanced clarity and training are expected to lead to higher compliance rates with MRVA regulations, thereby reinforcing the integrity of the EU ETS.

Improved monitoring and data quality will provide more robust evidence to support policymaking, ensuring that climate actions are grounded in accurate and verifiable emissions data. In the long term, these improvements are expected to contribute meaningfully to the EU's climate and energy objectives by enhancing the effectiveness and credibility of the ETS. Moreover, greater alignment with international climate reporting standards will position the EU as a global leader in climate governance, further reinforcing the EU's commitments under multilateral agreements such as the Paris Agreement.

8.4.3.7 Unintended results and impacts

While the ongoing reforms and streamlining of the MRVA framework are expected to yield significant benefits in terms of efficiency and harmonisation, certain unintended consequences may also arise. One potential risk is that the drive toward standardisation and simplification could inadvertently reduce the accuracy or granularity of emissions reporting. Simplified methodologies, while easier to apply, may not always capture the complexity of certain operations or sector-specific nuances, leading to possible under- or over-estimations of emissions.

Another concern is the potential for duplication or inconsistencies in reporting due to overlapping climate-related frameworks at both EU and national levels. As multiple regulatory regimes with distinct reporting requirements are included in EU policies, such as those related to Waste Framework Directive, Industrial Emissions Directive and to some extent, corporate sustainability reporting, there is an increased risk of double reporting. This could lead to confusion among stakeholders and undermine the coherence and comparability of emissions data across systems.

These unintended effects underscore the importance of ensuring interoperability between frameworks and of maintaining flexibility within the MRVA system to account for sectoral and national specificities without compromising the integrity of emissions data.

8.4.3.8 External factors

The effectiveness of the MRVA in achieving its goal might be affected by external factors, including variability in national administrative capacity, which might have affected the uniform application of MRVA processes across Member States, and the COVID-19 pandemic, which posed significant challenges, disrupting inspections, verifications, and site visits due to travel restrictions and safety concerns.

8.4.3.9 EU/national policies

The MRVA framework operates within an increasingly complex policy environment shaped by both EU-level and national legislative developments. Several emerging and evolving policy instruments are introducing new climate-related reporting obligations that potentially interacted with, or overlap, the requirements of the EU ETS.

At the EU level, the Corporate Sustainability Reporting Directive (CSRD) is expanding non-financial disclosure obligations for companies, including the reporting of climate-related risks, absolute emission targets and direct and indirect GHG emissions of a company. The CSRD Directive states that Sustainability Reporting Standards that apply to companies reporting

sustainability information have to comply with EU law, including ETS Directive. Similarly, the Corporate Sustainability Due Diligence Directive (CSDDD) introduces additional expectations for environmental due diligence across value chains, which could influence emissions data tracking and verification processes. Additionally, new frameworks focusing on lifecycle industrial monitoring are being developed, potentially overlapping with MRV processes for industrial installations covered by the EU.

8.4.3.10 Data collection

The evaluation findings rely on several data sources, particularly desk research, as well as surveys, targeted interviews and a reality workshop with key stakeholders.

Literature review focussed particularly on evidence from Article 21 reports, from previous assessments of costs associated with MRVA and other literature on the MRVA.

The surveys with key stakeholders included:

- A survey of stationary installations which resulted in 303 responses.
- A survey of Competent Authorities which resulted in 18 responses.
- A survey of 21 verifiers.
- A survey of 4 National Accreditation Bodies.
- A survey of Article 27 installations.
- A survey of aircraft operators.

Five anonymous semi-structured interviews were conducted with selected CAs and NABs. These interviews provided qualitative insights into the practical functioning of the MRVA system during Phase IV in relation to the evaluation criteria, with a particular focus on effectiveness and efficiency.

Finally, the analysis also draws on the outcomes of a reality check workshop with stakeholders, which was used to validate emerging findings, test preliminary conclusions and identify areas of convergence and divergence across stakeholder groups.

8.4.4 Evaluation findings

8.4.4.1 Effectiveness

The **effectiveness** criterion evaluates how successfully the EU ETS MRVA system has fulfilled its objectives of ensuring robust, transparent, consistent, and accurate monitoring and reporting of greenhouse gas emissions from industrial installations and aircraft operators. It examines four main aspects: the accuracy, completeness, and transparency of emissions data and the system's ability to prevent errors and misreporting; the effectiveness of the verification and accreditation processes in ensuring reliable data and compliance with EU ETS rules; the extent to which Member States have improved MRVA procedures and how these improvements have influenced overall compliance; and finally, how well the MRVA system has adapted to emerging challenges and what further enhancements could strengthen its effectiveness. The criterion covers four evaluation questions related to the effectiveness of the monitoring and reporting system, as well as the verification and accreditation, the improvements proposed by MSs and the adaptability to new challenges.

- EQ1: Effect of the MRVA system on accuracy, completeness and transparency on EU ETS GHG reporting data

Evaluation Question 1 assesses whether Phase IV MRVA arrangements as they applied from 2021-2023 produce accurate, complete and transparent emissions data across Member States

and sectors. The analysis draws primarily on MRVA survey data, complemented by Article 21 reports, targeted consultation inputs and other sources.

The MRVA system delivers high harmonisation and accuracy with standard methods used almost universally. Across Member States and sectors, operators and aircraft operators generally apply the MRR's required methodologies using the tier approach.²⁰⁶ Most stationary installations, apply a calculation-based methodology using the tier system whereas a limited number of installations use continuous emissions monitoring systems (CEMS) used where appropriate. The use of fall-back approaches remains marginal, covering only 3.6% of surveyed installations²⁰⁷ and only 0.3% of all installations in 2022.

For aviation, convergence in applied methodological approaches is even stronger: 85% of aircraft operators use Method B²⁰⁸ for fuel consumption calculation, and 90% of small emitters apply the Eurocontrol EMIS²⁰⁹. This harmonisation is reinforced by change-control rules for monitoring plans that require Competent authority approval of significant modifications and notification of non-significant ones. Article 21 reports record only seven penalties in 2022 for failures to notify changes, indicating that arbitrary methodological changes are rare.²¹⁰

Use of Commission templates and guidance by competent authorities

Use of Commission templates further encourage convergence, with 25 competent authorities reporting that they made use of the Commission's templates for monitoring plans, emission reports, verification reports, and improvement reports, while three countries combined these with national-specific formats.²¹¹ Among the surveyed competent authorities, 83% of respondents (15 out of 18) indicate that they made use of the Commission guidance for stationary installations for Phase IV.²¹² Interviews with CAs and NABs corroborate this by highlighting that Commission forms and guidance help reduce recurring clarification requests from operators and support more harmonised implementation over time. However, some interviewees also noted that the late release of Commission templates and guidance, combined with delays in the availability of national-language versions, can create implementation challenge. Still, overall, these harmonised approaches enhance the consistency and comparability of data across Member States and ensure that standardised methodologies are applied uniformly by operators or aircraft operators.

Completeness and accuracy of EU ETS emissions data

The MRVA system ensures that nearly all emissions from Annex I activities are monitored and reported, with only marginal delays or omissions. Article 21 data show that only a very small share of installations fails to submit verified emission reports by the 31 March deadline. Where

²⁰⁶ Interviews with Competent Authorities

²⁰⁷ Survey of stationary installations (n = 303)

²⁰⁸ Method B is one of the two fuel consumption calculation methods defined in Annex III of the Monitoring and Reporting Regulation. It relies on direct data from aircraft fuel purchase or uplift records, providing higher accuracy than Method A, which is based on estimated fuel consumption derived from flight data.

²⁰⁹ The Eurocontrol Emissions Monitoring and Inventory System is an online small-emitters tool that estimates fuel burn and CO₂ using Eurocontrol flight movement data and standardised algorithms. It is recognised under the MRR for eligible small emitters, easing compliance by providing consistent, traceable inputs for monitoring and verification

²¹⁰ European Commission, 2024. "Analysis of national responses under Article 21 of the EU ETS Directive" (data reported in 2023, reflecting the situation in 2022)

²¹¹ Ibid

²¹² Survey of competent authorities (n =18)

reports are not submitted in time, conservative estimates are applied in line with Article 70 of the MRR, ensuring coverage continuity. Only 25 installations in 2022 required such estimates. These trends confirm that, despite some technical or administrative challenges in isolated Member States, the MRVA framework effectively safeguards near-complete emissions reporting coverage under the Directive.

Emission data under the EU ETS remain consistently accurate and complete, with residual uncertainties tightly controlled. Across both stationary installations and aviation operators, the share of conservative estimates has remained below 1% of total verified emissions throughout Phase IV, confirming that most emission reports are based on data that is verified as satisfactory. In 2022, only 61 installations (less than 0.8% of all covered facilities) required conservative estimation, primarily due to delayed submissions or negative verification opinions. Completeness of reporting is also near universal, with only 111 failures to submit verified emission reports by the 31 March deadline in 2023, equivalent to roughly 1–1.5 % of all stationary installations. Although this represents an increase from 67 cases in 2021, the absolute number remains low and is concentrated mainly in two Member States²¹³. Negative verification opinions (around 30 per year) and report rejections (about 50 annually) are similarly infrequent.²¹⁴ Together, these indicators demonstrate that nearly all Annex I emissions are accurately monitored, verified, and incorporated into the ETS registry, reflecting a robust MRVA framework that ensures reliable and comprehensive greenhouse gas reporting and forms a solid basis for surrendering allowances that cover reported emissions.

Monitoring plan approval and change procedures have remained stable and well understood since 2020. All Member States conduct completeness, and consistency checks on verified emissions reports, with 14 conducting a detailed analysis of all AERs for stationary installations. Aviation shows even higher consistency, with 25 countries performing systematic cross-checks aided by Eurocontrol's EMIS database and 17 countries conducting detailed analysis of all AERs for aircraft operators.²¹⁵ Enforcement evidence confirms the robustness of the system. In 2022, only 42 penalties were issued to stationary installations across nine countries, about 0.5 % of all covered installations, and nine aviation infringements were recorded across five countries. Excess-emission penalties were imposed on 41 operators (up from 29 in 2021).²¹⁶ At the same time, participants in the EU ETS reality check workshop mentioned that, for stationary installations, monitoring plan approval and change processes can involve non-negligible administrative effort. They reported that minor monitoring plan updates, such as technical like-for-like (e.g. installation of new instrumentation of equivalent quality), can trigger full re-documentation and re-approval cycles, with limited perceived added value for emissions integrity.²¹⁷ Still, the low infringement rates, combined with consistent preventive measures, indicate that Phase IV has consolidated a mature, multi-layered control framework that maintains high data quality and compliance across the EU ETS.

- EQ2: Has the verification and accreditation system been successful in delivering robust implementation of the EU ETS

EQ2 assesses how effectively the EU ETS verification and accreditation framework ensures the successful implementation of the EU ETS, by providing confidence in the accuracy of

²¹³ Germany and Poland, accounting for 65 % of all cases

²¹⁴ European Commission (2024)

²¹⁵ Ibid

²¹⁶ Ibid

²¹⁷ EU ETS Reality Check workshop

emissions data and compliance with monitoring requirements. It draws primarily on MRVA survey data, Article 21 reports, EU ETS Compliance Forum discussions and inputs, and targeted consultation inputs.

NABs maintain consistent and effective supervision of verifiers under AVR and ISO 17029/14065 standards. According to the MRVA survey, three of four NAB respondents (75 %) stated that the effectiveness of their risk-based surveillance had remained unchanged, while one (25 %) reported a slight improvement. None observed deterioration. This suggests that NABs have maintained a strong, targeted approach to supervising verifiers (e.g. focusing on higher-risk areas without any drop in stringency). This is consistent with some of the interviews, which characterised the accreditation and surveillance framework as effective in upholding verification quality, supported by close cooperation with the competent authority and verifiers (including regular alignment meetings) and only minor non-conformities observed in practice.²¹⁸ The dedicated survey among competent authorities further did not flag that there are quality concerns with the accreditation work by NABs. None of the 18 surveyed competent authorities report that they had to take corrective action against NABs in the period of 2021-2023.²¹⁹ Peer evaluation reports by the European Cooperation of Accreditation also do not show any major non-compliance of NAB's activities with the AVR and the harmonised standards. This demonstrates continued confidence in the accreditation framework in delivering robust supervision.

Constraint on verifiers capacity and impartiality risks

Regarding verifier independence, the surveyed NABs generally perceived that impartiality risks (such as conflicts of interest) remained steady in Phase IV. None of the surveyed NABs further reported a worsening trend, with one NAB observed that impartiality had improved significantly.²²⁰ Nevertheless, Compliance Forum discussion does show that the constraints on verifier capacity increase concerns on the impartiality of verifiers. In recent years, competent authorities in the Compliance Forum have identified more cases where there are unacceptable conflicts of interests for verifiers and staff involved in verification activities. This concern is echoed by targeted consultation with competent authorities, where one CA raised concrete impartiality issues observed in practice, including cases where verifier organisations were part of larger corporate groups that also provided consultancy services to ETS operators through other branches. On the other hand, operators participating in the reality check workshop, while acknowledging familiarity risk, also reported that continuity of verifiers is beneficial for effectiveness, particularly for complex installations, as long-standing verifier engagement reduces onboarding time, and improves the efficiency and quality of annual verifications.²²¹

Sanctions against verifiers

Formal sanctions against verifiers (such as suspension or withdrawal or reduction of scope of accreditation) have been very rare, which can be interpreted as a sign that verifiers largely adhere to the rules and ethical standards. According to the Article 21 data, most countries reported zero sanctions in recent years. In 2022, only two suspensions²²² and one accreditation withdrawal (France) were recorded across all EU ETS countries, plus one respective case where

²¹⁸ Interviews with NABs

²¹⁹ Survey of competent authorities (n = 18)

²²⁰ Survey of NABs (n = 4)

²²¹ EU ETS Reality Check workshop

²²² In France and Norway

NABs reduced or withdrew verifier’s scope of accredited activities to address performance issues (Denmark and Romania). This is a decrease compared to 2021, where ten sanctions have been reported to be issued. This very limited level of enforcement actions by NABs is also identified in the MRVA survey, albeit with a small sample size, in which none of surveyed NABs indicated having suspended, withdrawn or reduced the accreditation scope of verifiers.²²³ In addition, only 72 non-conformities in the assessment of verifiers were identified in 2022, up from 54 in 2021 but still at a low number. Complaints against verifiers declined, from 49 in 2020 to 28 in 2021, spiking temporarily to 202 in 2022 (mostly due to backlog of previous year) before falling back to low double-digit levels by 2023. All 2022 complaints were resolved within the year, reflecting responsive oversight.²²⁴ Taken together, the evidence indicates that NABs’ risk-based supervision effectively upholds verifier quality and impartiality while maintaining efficiency across the EU ETS.

Quality of verification activities

Verifications continue to be the cornerstone of the EU ETS assurance framework, providing systematic, independent checks on reported emissions data. Under the AVR, accredited verifiers are required to perform on-site visits for each installation, and evidence confirms that these remain the norm across Member States. Even during the COVID-19 pandemic, when travel restrictions were widespread, remote verifications were limited: only 637 installations and 25 aircraft operators, around 7.5 % of all stationary installations, were audited remotely with competent authority approval. By 2022, this number had dropped sharply to just 31 remote audits as normal conditions resumed.²²⁵

The survey data confirm that on-site visits are done rigorously, typically by 1 – 4 EU ETS (lead) auditors, depending on the complexity of the operators. However, some respondents noted that travel time and compressed verification calendars can pose logistical challenges, particularly during peak reporting periods. Reflecting on this, a number of respondents suggested that a more proportionate, risk-based approach could be introduced, allowing simplified or remote audits for low-risk or small emitters, while maintaining comprehensive on-site checks for complex or high-emission installations.

Such flexibility already exists within the AVR but is tightly controlled. Under Articles 31–32, site visit waivers may only be granted for simple or low-emitting installations that meet strict criteria and obtain prior competent authority approval.²²⁶ Article 21 data confirm that these waivers remain rare: only 48 and 53 installations (out of approx. 8 500 – 9 000 installations in total) emitting more than 25 kt CO₂ received them in 2021 and 2022, respectively.²²⁷ Evidence from targeted consultations reinforces this picture. Operators from the reality check workshop noted that simplified monitoring regimes often do not translate into materially lighter verification practices in practice. Several operators reported that, even where installations qualify as low emitters, verification approaches frequently remain largely unchanged, including requirements for on-site presence. However, it was also noted in the interviews that small installations do not always apply simple monitoring methods or have robust quality control measures in place. Survey responses from verifiers seem to indicate that most of these

²²³ Survey of NABs (n = 4)

²²⁴ European Commission (2024)

²²⁵ Aggregated data from Article 21 Analyses of national responses under Article 21 of the EU ETS Directive, reflecting the situation between 2015 and 2023

²²⁶ Approval of the competent authority is not required for installations with low emissions.

²²⁷ European Commission (2024)

verifiers start the verification already in the reporting period which leaves sufficient time to close misstatements, non-conformities and non-compliance issues that are identified in the verification. While verifiers largely endorse the current verification approach, some respondents express a desire for targeted simplifications or more flexible, risk-based procedures to ease administrative and time pressure for small or low-risk emitters. Overall, the evidence generally points to a high-quality and robust verification audit system.

Misstatements, non-conformities and non-compliance in verification outcomes

While the absolute number of reported misstatements, non-conformities and non-compliance issues fluctuates from year to year, their overall share remains small relative to the 8500 – 9000 of verified reports submitted annually. Across the EEA, misstatements increased moderately from 142 in 2015 to 336 in 2023, but this upward trend is almost entirely driven by one Member State²²⁸ France, which alone accounts for about one third of all reported cases. When France is excluded, the number of misstatements remains stable, oscillating between 87 and 126 over the same period. Non-conformities show a similarly steady pattern, ranging between 859 and 1 090 cases during 2015 - 2023, with a gradual decline (from 510 to 306), when France that represents 31 % of all cases is excluded. The same holds for non-compliance issues, which remain within 315 - 448 annually outside France, but display a mild upward trend at EEA level due to French figures, which make up about 35 % of the total. In total, Article 21 data show that only 10 negative verification opinions in 2021, 30 in 2022, and 6 in 2023 were issued across nearly 9 000 verified reports, equivalent to less than 0.5 % of all verification cases. Similarly, since 2021, the level of rejected AERs has been stagnant with an annual average of about 53 rejections, amounting to around 0.6 %. Overall, these trends point to a mature and stable MRVA system that consistently identifies a limited number of discrepancies, while the French outlier could reflect intensified verification scrutiny or country-specific implementation issues rather than a systemic deterioration in data quality.

Information exchange between CAs and NABs

In addition to the annual surveillance of the verifier by the NAB, the requirements in Chapter VI of the AVR for the NABs and competent authorities to exchange information in relation to verifiers have significantly improved the overall oversight on the quality of verification²²⁹. In general, the requirements in Chapter VI function effectively where a NAB and the competent authority are located within the same country. When the information exchange occurs across borders when a verifier accredited by a NAB is carrying out verification in another country, there are still some opportunities to improve this information exchange. Not all reports are submitted in time, and one NAB indicated in the survey responses that a harmonised approach on what constitutes a complaint on verifier would be helpful as it could simplify the complaint procedures of NABs.²³⁰ Targeted consultations with competent authorities illustrate these cross-border challenges in more detail. One CA reported that work programmes and management reports for verifiers accredited in other Member States, is not always transmitted in practice, despite being formally required. A different CA highlighted practical difficulty in

²²⁸ France

²²⁹ NABs that has accredited a verifier are required to submit work programmes to the competent authority of the country in which the verifier is carrying verification by 31st of December on the planned activities of the accreditation body and a management report by 1st of June on results of accreditation activities. In turn competent authorities must report relevant results from the review of emission reports or inspection or complaints on verifiers to the NAB so that they can this into account in their surveillance.

²³⁰ NAB survey (n = 4)

identifying appropriate contact points within foreign NABs complicating cross-border verifier oversight.²³¹

The robustness of the oversight is shown by the low number of non-conformities and complaints on verifiers. In 2022, eight countries reported a total of 72 non-conformities in their information exchange. This was a slight uptake in the number of countries compared to 2021 with 54 non-conformities reported. The types of non-conformities noted were generally issues like shortcomings in the internal verification documentation, misinterpretation of a guidance detail, or procedural gaps by verifiers, pointing to an absence of pervasive problems. When non-conformities are identified, verifiers are required to correct them, and most are resolved promptly. Of the 72 non-conformities found in 2022, about 66% were already addressed and closed by the time of reporting.²³²

Confidence in the robustness of the system is high among those closest to it. Competent authorities report that verified data are dependable enough to be used directly for compliance assessments and international greenhouse gas inventories, demonstrating institutional trust in verification outcomes. Interviewees confirm that the MRVA system is stable and robust in practice.²³³ NABs likewise confirm that the system functions well, with none identifying fundamental weaknesses; all respondents note quality as stable or improving.²³⁴ Among installations and aircraft operators, confidence in verification quality remains high, but views on procedures related to verification at installation level are mixed: in the MRVA survey, 40 % of installations disagreed that verification had improved or been simplified since Phase III, and 36 % saw no change.²³⁵ Qualitative feedback highlight the added documentation requirements for the operators under new Phase IV rules. Some of this feedback also relates to requirements for free allocation. The increased verifier's role on checking the operator's evidence of compliance with sustainability and greenhouse gas savings criteria under RED II is also mentioned.

Verifiers' capacity

Furthermore, verifier capacity is generally tightening. Both Article 21 reports and the 15th EU ETS Compliance Conference and discussions in the Compliance Forum highlight staff shortages and resulting pressure on verifiers. For example, the German Competent Authority warned that the convergence of new reporting obligations in 2026 (EU ETS AERs, annual activity level reports, municipal waste incineration AERs, and the first ETS2 AERs and climate-neutrality reports), combined with retirements among experienced staff, risks creating a shortage of qualified verifiers. With 110 verifiers for stationary installations and 20 for aviation in 2022, current capacity is tightening.²³⁶ The targeted consultations corroborate this finding. At least one competent authority and a handful operators in the reality check workshop reported difficulties in securing verifiers with the appropriate accreditation scope and sectoral expertise within the required timelines, noting that highly seasonal verification peaks and limited off-season work exacerbate these challenges and raised concerns that the ongoing expansion of the EU ETS could further strain capacity.²³⁷ This is also true for accreditation

²³¹ CA interviews

²³² European Commission (2024)

²³³ CA interview

²³⁴ Survey of national accreditation bodies (N = 4)

²³⁵ Survey of installations (N = 303)

²³⁶ European Commission (2024)

²³⁷ Interviews with Competent Authorities and EU ETS Reality Check workshop

assessors within the national accreditation body that are assessing the competence, impartiality and performance of verifiers in accreditation and surveillance. To ensure quality of the accreditation and verification system it is therefore important to monitor not only verifier resources but also the capacity within accreditation bodies as system complexity and workload increase. In essence, the MRVA system has a high level of trust, but the anticipated strain on verifier resources, coupled with the evolving demands of new reporting obligations, underscores the need for proactive capacity planning. Ensuring sufficient verifier and accreditation assessor capacity will be critical to maintaining the trust in the system as the scope of the EU ETS expands.

- EQ3: Impact of improvement of procedures by MS and their impact

EQ3 assesses how effectively Member States have improved their MRVA procedures under Phase IV of the EU ETS and the resulting impact on coordination, review, accreditation, and enforcement. The question focuses on whether these procedural improvements have strengthened oversight, consistency, and compliance, or whether capacity and coordination challenges persist.

The coordination framework under the EU ETS has reached a high level of procedural maturity, enabling stronger consistency in MRVA implementation within and across Member States.

Evidence from the MRVA survey shows that three competent authorities reported improved coordination with NABs and other agencies in Phase 4, while most noted no change, reflecting continuity in established administrative practices. Where improvements occurred, they were typically procedural, such as revised internal templates to facilitate complaint handling with NABs or enhanced tools for Annual Emission Report (AER) checks and monitoring plan approvals by the competent authority. Nearly all respondents confirmed relying on the Commission's guidance (used to at least a moderate extent by 88 % of competent authorities for stationary installations and 76 % for aviation), underlining the harmonising influence of EU-level support materials. Only one respondent explicitly noted monitoring or technical issues regarding stationary installations for MRVA. These concerns focused on the new requirements on waste incineration, zero-rating of biomass fuels, CCU, CCS, and the linkage between EU ETS 1 and ETS 2 introduced under 'Fit for 55'. Findings from the competent authority interviews point in the same direction. Interviewees noted procedural continuity between Phase III and IV and have also adopted a regular use of the Commission's guidance documents. However, they note that clarifications on new requirements can arrive on short notice and also explicitly mentioned waste incineration and zero-rating of biomass fuels as difficult to implement.²³⁸ Overall, the evidence suggest that coordination have been stable and largely effective from Phase III to Phase IV, with procedural refinements providing a foundation for consistent compliance oversight, while implementation challenges exist for newly introduced requirements.

Organizational structure of the authorities

The internal organisation of competent authorities demonstrates overall stability and sufficient adaptability to national administrative contexts. According to Article 21 reports, 19 Member States apply either fully or largely centralised models for EU ETS implementation in Phase IV, while 12 Member States continue to operate more decentralised arrangements involving regional or local authorities.

²³⁸ Interviews with Competent Authorities

Where responsibilities are decentralised, coordination mechanisms have been reinforced to ensure consistency, including regular inter-authority meetings, structured working groups, and shared training or guidance. For aviation, nine member states have assigned MRV responsibilities to authorities other than those responsible for stationary installations (e.g. ministries of transport or air traffic agencies). This reflects different political or administrative arrangements for the aviation sector. Internal coordination within competent authorities has also strengthened over time through measures such as peer review of monitoring plan approvals, IT systems, structured meetings and checklists, tailored to national circumstances and the number of installations and aircraft operators covered.

Overall, these arrangements indicate a high level of procedural maturity, enabling Member States to balance efficiency and consistency with flexibility for national administrative particularities.

Monitoring plan approvals, use of harmonised templates and review of emission reports

Strict approval procedures and harmonised templates ensure a consistent and non-arbitrary application of monitoring methodologies across the EU ETS. Under the MRR, all significant changes to monitoring plans (such as adding emission sources, changing the monitoring methodology, adjusting tiers or changing source streams) require prior approval from competent authorities, preventing arbitrary deviations in the application of the monitoring methodologies. Article 21 data show that non-compliance with the MRR is low: in 2022, only seven penalties were issued EU-wide for failures to report changes to the monitoring plan, out of roughly 9,000 installations and aircraft operators.

Both Article 21 reports, as well as other studies such as the Compliance Cycle Evaluation study in 2018 and the Compliance Enforcement study in 2021 and 2022 show several Member States take preventive measures to ensure a high compliance rate of stationary installations, e.g. sending reminders, active communication with stationary installations during the monitoring plan approval procedures and notification procedures. Stakeholder feedback confirms that operators face no major difficulties with monitoring plan procedures.²³⁹

Complementing these controls, the ***Commission's harmonised templates and guidance*** have played a key role in aligning practice: in 2022, 25 countries used the common templates for monitoring and reporting, while three combined them with national formats²⁴⁰, and all surveyed competent authorities report relying on Commission guidance to a varying extent. 56% (nine out of 16) and 62% (eight out of 13) of competent authorities engaged with the MRVA of respectively stationary installations and aircraft operators further rely on Commission guidance to a significant extent.²⁴¹ Digital tools further strengthen consistency, with 14 competent authorities (eight of 18 surveyed competent authorities²⁴²) using the ERT in 2025.

Perceived simplification needs of the monitoring process from stakeholders

Feedback from operators highlights a perceived need for further simplification. Approximately 46% of installations disagreed that monitoring procedures were simplified under Phases 4, and 39% felt the same for reporting procedures. Only 10% agreed that reporting procedures

²³⁹ European Commission (2024)

²⁴⁰ European Commission (2024)

²⁴¹ Survey of competent authorities (N = 18). Among these, eleven are responsible for the MRVA of both stationary installations and aircraft operators, four only for stationary installations and three only for aircraft operators

²⁴² Survey of competent authorities (N = 18)

improved, and just 6% agreed that monitoring procedures improved. While the permitting and MP approval systems function effectively from the perspective of competent authorities, operators generally perceive limited simplification.²⁴³ The stationary installations present at the EU ETS reality workshop raised similar concerns. They reported that the monitoring plan approval and update of monitoring plans can be burdensome where small “like-for-like” changes (e.g. small equipment replacement without material emissions impacts) to monitoring plans required full re-documentation/resubmission. Large operators with multiple source streams also questioned why very small emission points are subject to documentation and scrutiny like that applied to major streams.²⁴⁴ As such, while Phase IV has made positive strides in efficiency, there still appears to be room for improvement in reducing perceived administrative complexity for operators. However, from the comments in the survey some of the perceived complexity may relate to free allocation.²⁴⁵

Inspection and enforcement practices

Survey and Article 21 evidence indicate that inspection and enforcement procedures by competent authorities have remained largely stable in Phase IV, reflecting the maturity of existing oversight systems. Improvements were modest: among competent authorities responsible for stationary installations, three of sixteen (19%) reported enhancements to inspection procedures, while the rest noted no change. For aviation, two of thirteen authorities (15%) reported slight progress. Enforcement practices followed a similar trend, with four stationary competent authorities (25%) and three aviation competent authorities (23%) citing procedural improvements. Open comments in the survey report improvements to internal streamlining, expanded use of IT-based monitoring tools, or more systematic follow-up processes.²⁴⁶

Inspection activity continues to be well embedded across the EU. In 2022, 27 of 30 participating countries conducted on-site inspections of stationary installations, often integrated with Industrial Emissions Directive (IED) reviews. Nine Member States combined IED inspections with additional ETS-specific checks, while eight carried out dedicated ETS inspections. It is noted that countries with only IED inspection without covering any ETS specific elements only provide a high-level inspection not necessarily picking up any non-compliance with monitoring plan procedures. Four Member States had yet to establish regular inspection routines due to legal or capacity constraints. A total of 210 inspections were conducted in 2021 and 230 in 2022, indicating a risk-based strategy in which authorities targeted higher-risk or larger installations and those with anomalies in emission data. Complementing these efforts, many competent authorities employ preventive compliance measures such as automated reminders, helpdesks, and IT-based alerts to ensure timely submissions and corrective actions.²⁴⁷ Taken together, the evidence points to a well-institutionalised and steady inspection and enforcement framework, delivering consistent assurance of compliance with small and gradual efficiency improvements. However, also in this area capacity constraints within competent authority’s organisation did have an impact on the frequency on inspections in the more recent years. Furthermore, participants in the

²⁴³ Survey of stationary installations (n = 303)

²⁴⁴ EU ETS Reality Check Workshop

²⁴⁵ Survey of stationary installations (n = 303)

²⁴⁶ Survey of competent authorities (N = 18)

²⁴⁷ European Commission (2024)

workshop did mention that inspection on top of verification can sometimes lead to administrative burden.

- EQ4: Adaptiveness of the MRVA to new challenges

EQ4 assesses the extent to which the MRVA system has been able to adapt to new challenges over time, including changes in the scope of the EU ETS, the inclusion of new sectors, activities and greenhouse gases, and emerging technical or administrative challenges. It examines whether the MRVA framework has remained sufficiently flexible and responsive to ensure continued robustness, consistency and effectiveness of the MRVA system.

Implementing Regulation (EU) 2018/2066 and Implementing Regulation (EU) 2018/2067 respectively introduced the MRR and AVR requirements for Phase IV of the EU ETS in 2018. Implementing Regulations are directly applicable in all Member States and require no transposition. A review of EU infringement proceedings identified no cases related to the implementation of these MRVA rules. The infringements observed were linked to broader EU ETS transposition delays rather than MRVA-specific deficiencies. For example, Austria (INFR (2019)0295), Ireland (INFR (2019)0327), and Italy (INFR (2019)0329) were subject to procedures for non-communication of measures. Furthermore, Poland (INFR (2020)0091) only partially transposed the Directive, and Luxembourg (INFR (2019)0331) received a formal notice for not having notified any implementing measures. Similar cases occurred in Spain, Portugal, Belgium, Romania, Bulgaria, and others. All these infringement cases were eventually closed prior to the start in Phase IV. The overall evidence therefore confirms that Member States successfully embedded the 2018 MRVA requirements within their administrative systems, maintaining legal coherence and continuity with the wider EU ETS framework.

Between the years 2020 and 2022, the MRR and AVR were amended to address emerging challenges such as the COVID-19 pandemic, integration of the RED II, and the international CORSIA scheme for aviation. Implementing Regulation (EU) 2020/2084 introduced provisions for virtual site visits under force majeure, ensuring verification continuity during travel restrictions.²⁴⁸ Implementing Regulation (EU) 2020/2085 clarified biomass definitions and sustainability criteria under RED II²⁴⁹, while Implementing Regulation (EU) 2022/388 was adopted stating Member States or competent authorities may allow operators or aircraft operators to delay the demonstration of compliance of zero-rated biomass with compliance with RED II sustainability criteria in 2022.²⁵⁰ This extension allowed certification schemes to become fully operational and verifiers sufficiently trained. The related guidance for biomass issues was updated in October 2022.²⁵¹

Stationary installation feedback on free allocation and Activity Level Change verification

²⁴⁸ Commission Implementing Regulation (EU) 2020/2084 of 14 December 2020 amending and correcting Implementing Regulation (EU) 2018/2067 on the verification of data and on the accreditation of verifiers pursuant to Directive 2003/87/EC, https://eur-lex.europa.eu/eli/reg_impl/2020/2084/oj/eng

²⁴⁹ Implementing Regulation (EU) 2020/2085, amending and correcting Implementing Regulation (EU) 2018/2066 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC

²⁵⁰ Implementing Regulation (EU) 2022/388, amending Implementing Regulation (EU) 2018/2066 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council, https://eur-lex.europa.eu/eli/reg_impl/2022/388/oj

²⁵¹ Guidance Document Biomass and other zero-rating under the EU ETS, https://climate.ec.europa.eu/document/download/2289952b-4d59-494c-8c49-c0a559c403d6_en?filename=gd3_biomass_issues_en.pdf

Feedback from stakeholders points to increased administrative burden, particularly linked to free allocation and Activity Level Change verification. Participants from stationary installations at the EU ETS reality check workshop reported that ALC reporting templates are very extensive, covering all sectors within a single spreadsheet, with many fields not relevant for individual installations. Certain parts of the templates were also described as difficult to complete in practice, for instance sections requiring the reporting of a single representative value for carbon intensity. Operators further highlighted that the benchmarking-related inputs under ALC and free allocation are burdensome to populate, while transparency on how benchmarks are established and how reported data contribute to benchmark value-setting remains limited. The respondents framed it as a “one-way” information flow, where operators provide extensive data but “do not learn” from the benchmarking exercise. Finally, the workshop participants described the first-quarter reporting period as a concentrated compliance bottleneck where MRVA reporting collide with financial closure and other reporting obligations.²⁵² Evidence from the Open Stakeholder Consultation for the evaluation of the EU ETS and MSR reinforces the perceptions shared in the reality check workshop. The executive summary highlights the need for simplifying monitoring, reporting, verification, and accreditation as one of the key findings. Private sector and SME respondents proposed harmonised digital tools, automated data collection, and simplified compliance obligations, such as longer verification cycles or higher opt-out thresholds (e.g. raising the equivalent-measures threshold from 25,000 tCO₂ to 50,000 tCO₂ per year). While such proposals could lower costs and ease compliance, they raise trade-offs with accuracy, comparability, and environmental integrity. Any future simplification should therefore be risk-based and proportionate, ensuring that efficiency gains do not compromise the credibility and harmonisation of the EU ETS MRVA framework.

Timing of regulatory updates

Feedback from the survey and interviews evidence presents both positive and negative perspectives on the timeliness and clarity of regulatory updates in the AVR and MRR for the preparation of Phase IV. As previously mentioned, the Commission’s guidance documents have supported the clarity of Phase-4 regulatory updates. Nearly all surveyed competent authorities report using them (88% with stationary remits; 76% with aviation). One verifier also describes clearer expectations and a more organised workflow for operators, and three note that internal/external training improved preparedness.²⁵³ This positive assessment is supported by both CA and NAB interviews, with at least three interviewees explicitly mentioning the Commission’s guidance to have improved regulatory clarity and harmonisation for Phase IV. That said, timeliness and clarity concerns recur in both competent authority and verifier feedback. From the competent authority survey, two competent authorities point to continuous legislative changes and delays in publishing templates and guidance. Verifiers echo these challenges: Two respondents explicitly cite late and frequently changing templates and documentation, while one verifier links late provision of legal requirements to compressed planning and extra effort. Two other verifiers also stress compressed calendars and tight reporting deadlines. Overall, competent authorities and verifiers recognise the guidance’s value for clarity but raises issues about the clarity and timeliness of regulatory updates.

The Open Stakeholder Consultation for the evaluation of the EU ETS and the MSR also raise concerns about the timeliness of regulatory updates to the MRV framework. Respondents (not

²⁵² EU ETS Reality Check workshop

²⁵³ Survey of verifiers (n = 21)

quantified, as the question was open-ended) stressed the need for more timely and proactive guidance from the Commission on forthcoming MRV updates. They noted that delays in communicating new requirements had led to inefficiencies in adjusting internal compliance systems, highlighting the importance of early information and clear transitional arrangements. Operators also called for improved access to information and greater transparency on planned regulatory changes to allow sufficient time to adapt their monitoring and reporting procedures effectively.

Participants in the EU ETS reality check workshop report relying on a combination of channels to stay informed about regulatory updates, including communications from national competent authorities, industry and trade associations, consultants, peer networks within corporate groups, and the European Commission's guidance documents and tools. Industry associations and consultants are frequently described as key intermediaries, particularly for translating regulatory changes into operational implications, while smaller installations report limited internal capacity. Across participants, a recurrent concern is that regulatory updates, clarifications and templates are often communicated late in the compliance cycle. Operators further highlight that frequent changes to reporting requirements, templates and related guidance undermine efforts to digitalise and automate MRV processes, as significant effort is required to repeatedly adapt internal IT systems and data workflows to reflect regulatory changes. While operators generally view Commission guidance positively and consider it an important reference point, some report that its non-binding status can slow implementation in practice. Several installations report of instances where that national authorities are cautious in relying on guidance documents and instead prioritise national transposition of legislative acts. Some multinational companies present at the workshop operating installations in several Member States mentioned that in some specific cases there were divergent national approaches to implementation and application of new rules, increasing complexity across jurisdictions.²⁵⁴

Overall, while the Commission's guidance and training materials have supported regulatory understanding and harmonisation, the recurrent concerns over timing and complexity underscore the need for more predictable update cycles.

8.4.4.2 Efficiency

Both MS and ETS operators incur costs for the MRVA of the EU ETS; MS through the competent authorities and accreditation bodies administering the requirements and ETS operators²⁵⁵ fulfilling the monitoring and reporting requirements and paying for the verifier to have their emission report verified. Earlier studies on the administrative costs have found that these costs are reasonable and proportional in relation to the environmental benefits.²⁵⁶ Of these studies the most recent have been carried out for maritime, but studies for aviation and stationary installations were carried out before 2020 (this latter referred to as the 2016 administrative cost report in this section).²⁵⁷

²⁵⁴ EU ETS Reality Check workshop

²⁵⁵ Installations and aircraft operators

²⁵⁶ European Commission, 2025. "Supporting study for the implementation of the ETS Directive and MRV requirements for maritime transport", https://climate.ec.europa.eu/document/download/a069517b-4fcc-4263-84f5-b527fafded91_en?filename=Report+on+MRV+extension+to+vessels+below+5000+GT.pdf&utm_source=chatgpt.com

²⁵⁷ Evaluation of EU ETS Monitoring, Reporting and Verification Administration Costs, 2016

- EQ5: Cost-efficiency of the MRVA system, and opportunities for cost reduction

Evaluation question 5 asks whether the MRVA system has achieved its objectives in a cost-efficient manner and whether there are opportunities for cost reductions.

Monitoring

The survey asked operators of stationary installations and aircraft operators to provide information on costs that are connected to the annual monitoring and reporting cycle.

Annual costs are all costs that an operator or aircraft operator incurs every year when monitoring emissions including:

- Maintaining the data management system, the control system and procedures.
- Calibration of measurement equipment and carrying out other quality assurance and control activities.
- Making sure internal staff continue to be competent (e.g. regular training and capacity building).
- Dealing with changes to the monitoring plan.
- Communicating with the competent authority when notifying changes to the monitoring plan and obtaining approval of significant changes to the monitoring plan.

Respondents from stationary installations indicated that more than 60% of the days dedicated to monitoring activities were for monitoring of emissions and maintaining the data management systems and control system and monitoring procedures. A similar split was indicated for aircraft operators. Monitoring of emissions was also the largest cost in previous reports.

Most relevant responses for both stationary installations and aircraft operators stated that monitoring costs had increased slightly or remained constant between Phase III and Phase IV. Reasons given for the increases include inflation, rising costs of external consultants and the requirements to demonstrate compliance of biomass with sustainability rules. The MRVA requirements for free allocation for stationary installations are also mentioned which is a separate consideration in this evaluation.

Reporting

The costs for reporting are primarily annual expenses related to drafting emission reports. If required by Article 69 MRR,²⁵⁸ these costs also include drafting improvement reports, obtaining approval for these reports, and communicating with the competent authority to address issues reported in the verification report, especially if there are misstatements, non-conformities or non-compliance issues.

According to the survey, respondents from both stationary installations and aircraft operators indicated that around half of their full-time working days were spent gathering data for emission and improvement reports. About 30% of the time of stationary installations was

²⁵⁸ Improvement reports are required in the case lower tiers are allowed because of unreasonable costs and technical infeasibility or a fall-back approach is applied. In those cases, operators must regularly report on their opportunities to improve the monitoring methodology and move up to higher tiers. The reporting interval depends on the category of the installation. According to Article 69(4) of the MRR operators are also required to submit an improvement report, if the verifier has reported non-conformities and recommendations for improvement in the verification report. Such improvement reports are not required if all the non-conformities were addressed before that time.

dedicated to drafting the emission report, including correspondence with the competent authority, and the remaining time was spent on improvement reports. The time spent on improvement reports for aircraft operators is significantly lower as aircraft operators only have to submit an improvement report if non-conformities or recommendations for improvements have been listed in the verification report.

Approximately equal numbers of aircraft operators reported that reporting costs had either increased significantly or remained constant between Phase 3 and Phase IV. The significant cost increases were attributed to reporting on data from sustainable aviation fuel²⁵⁹, although relatively few aircraft operators use biofuels compared to stationary installations,²⁶⁰ or to factors not directly related to the EU ETS, such as Brexit²⁶¹. However, due to the relatively high number of "do not know" or "not applicable" responses, the sample size of relevant responses for aircraft operators is small.

For stationary installations, a larger proportion overall reported a slight increase or that costs had remained constant. Less than 15% of respondents mentioned significant cost increases, and where explanations were given, these were mostly linked to free allocation.

Verification

The costs associated with verification are incurred by operators or aircraft operators due to the need:

- To provide the verifier with access to evidence and information needed to carry out verification as well as access to the control system and procedures.
- Answer questions of the verifier and follow-up on requests from the verifier.
- Accompany the auditor during the site visit of the verifier of the installation or the aircraft operator; and
- Correct issues identified by the verifier during the verification.

Furthermore, the operator of the installation or the aircraft operator pays a verification fee for services of the verifier.

Respondents for stationary installations indicated that for more than half of the installations, site visits required the most effort, whereas for aircraft operators follow up of issues took most time. More than half of the aircraft operator respondents to the survey emit less than 25ktonnes and Article 33 of the AVR²⁶² allows for waiving site visits for such aircraft operators, which may explain the difference. Another reason is that site in the aviation sector is defined as the location where the monitoring process is defined and managed, therefore much more compact than in the industry sectors where a site can consist of multiple locations.

²⁵⁹ This includes demonstrating compliance of the sustainable aviation fuels with sustainability and greenhouse gas savings criteria.

²⁶⁰ European Commission (2024)

²⁶¹ Because of Brexit, aircraft operators carrying out intra-EEA flights that were originally administered by the UK competent authority had to be re-attributed to other Member States which might have caused some administrative costs for those aircraft operators in the years 2020. Furthermore, the changes of scope of EU ETS flights because of Brexit might have had an impact on the internal processes within the aircraft operator in collecting the necessary data for reporting and ensuring completeness of EU ETS flights. Only intra-EEA flights and flights from the EEA to the UK and from the EEA to Switzerland are included in EU ETS whereas flights from the UK to the EEA and Switzerland to the EEA fall into the UK ETS and Swiss ETS respectively.

²⁶² Implementing Regulation (EU) 2018/2067, available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02018R2067-20250622>

For stationary installations, most respondents indicated that verification costs have either increased significantly or slightly. In contrast, for aircraft operators, most of the relevant replies suggest that verification costs have remained constant.

For stationary operators, the cost increases were attributed to additional checks required by verifiers to assess compliance with the sustainability and greenhouse gas savings criteria of the RED II Directive, the rising complexity of control and monitoring activities, and an increase in verification fees or the number of days needed by the verifier. Stationary installations are increasingly using biomass fuels and the amendments in the REDII Directive in 2021 extended for example the applicability to solid biomass which caused more installations to have to demonstrate compliance of biomass fuels with the sustainability and greenhouse gas saving criteria. This was in particular the case in the year 2023 as in 2022 Member States could allow operators not to demonstrate compliance.

The OPC did not include specific questions on MRVA but in some cases, respondents have made relevant comments. There are around 70 unique responses from industry associations, NGOs and aircraft operators where this is the case (out of 377). The majority from industry associations and aircraft operators stated that the administrative burden associated with the MRVA was high. However, like the survey many of these related to the processes involved by free allocation. The responses also indicated that the requirements on accuracy of metering contributed to cost and that delays in responses from CAs resulted in lengthy processes and consequently more costs. Some responses mentioned that verification processes were onerous, but it is not clear whether this also related to verification for the purposes of free allocation.

For most aircraft operators and around half the stationary installations, MRV costs represent less than 30% of the overall administrative cost related to the EU ETS. For installations that do not receive free allocation, the main costs of compliance relate to purchase of allowances rather than administrative MRV costs. For a smaller number of both aircraft operators and stationary installations the MRV costs represent more than 50% of administrative cost. Of the stationary installations more than half of these are in the sector combustion activities and about equally split between the different size categories of installations. There is therefore no clear explanation of why the administrative costs for these installations are a higher proportion of overall cost. The sample size for aircraft operators is too small to draw conclusions.

Stationary installations MRV costs

Respondents to the survey reported averages for MRVA costs and staff days. For stationary installations, the average costs across all categories of installations for monitoring were 58 000 EUR , for reporting 27 000 EUR and for verification 9 000 EUR . Data differentiated by sector, size of installation and country group is discussed under EQ6. These costs are significantly higher than previously identified, partly related to rising labour rates and inflation of equipment prices. Additionally, some costs related to MRVA for free allocation have been included in the estimates given. The implications for MRVA costs per CO₂ are discussed below.

The highest annual costs and number of working days are for monitoring activities which aligns with the activities that installations have carry out according to the MRR.

A standard cost approach has been used to extrapolate to the EU level and put the reported costs in context. Based on this methodology, total costs for operators of stationary installations range from 0.2-0.9 billion EUR. When expressed as cost per tonne emissions, this gives a range

of 0.2 to 0.8 EUR/tonne CO₂.²⁶³ These costs per tonne CO₂ are higher than in the 2016 administrative cost study, which gave an average of 0.16 EUR per tonne CO₂. This seems to contradict the views expressed in the survey and discussed above on the change in costs between Phase III and Phase IV.

Part of the difference between the 2016 study and this one may be the slightly different scope and formulation of the questions in the survey. Additionally, at the high end of the range particularly it may be there is some double counting amongst the costs, for example between total cost and external cost. However, it is also possible that some efficiencies, for example through implementing standard tools, more harmonisation between Member States and improving guidance, may have been offset by additional requirements in some areas that led to higher costs such as the RED requirements discussed previously. It should be noted that not all responses were clear-cut. Even though some stakeholders indicated that the requirements related to metering for stationary installations have become more cost intensive, there is no clear reason for that emanating from the regulation. Compared to 2016 the rules on measurement of fuel consumption or material production as well as the rules on sampling and analysis have not changed significantly

Aircraft operators

The reported annual costs for aircraft operators are smaller than those for stationary installations (respectively 25K for monitoring and 17K for reporting), except in the case of verification fees (12K) which are higher than for stationary installations. In the calculation-based methodology employed in the aviation sector, the fuel consumption for each EU ETS flight and each fuel is multiplied by the applicable emission factor. Mirroring the sector as a whole,²⁶⁴ most aircraft operators responding to the survey used method B for MRV. However, only a small proportion used the small emitters tool or Eurocontrol EMIS. Nevertheless, the relatively more straightforward monitoring and reporting requirements for the aviation sector contribute to lower costs.

In line with the costs, the days spent by aircraft operators on different MRV activities are generally lower than for stationary installations except for activities associated with verification. The costs are significantly higher than the MRV costs discussed in the 2014 aviation report, but that focused on small emitters.²⁶⁵ The sample size in the survey for this study is not high enough to distinguish small emitters.

The sample size in the survey is also too small to allow meaningful disaggregation, so total costs at the EU level have been calculated without disaggregation. Based on 378 active aircraft operators, total costs ranged from EUR 12 – 20 million. With total emissions of the aviation sector of 54 MtCO₂ in 2023, the costs range from EUR 0.2 - 0.4 per tonne CO₂. These are lower than for stationary installations, as would be expected.

Competent authorities MRV costs

The competent authority's costs in relation to MRV can also be distinguished between one-off costs at the start of a trading period when new requirements are introduced and annual costs concerning the continuous management of EU ETS MRV processes. The one-off costs relate

²⁶³ Based on total emissions from stationary installations in 2023 taken from Article 21 reporting.

²⁶⁴ According to the Article 21 reporting, 85% of AOs use method B.

²⁶⁵ PwC, 2014, "ETS Aviation small emitters", <https://cedelft.eu/wp-content/uploads/sites/2/2021/04/eindrapport.pdf>

mostly to organising capacity building activities to train and instruct internal staff on new requirements, setting up or adjusting internal processes to new requirements²⁶⁶ The overall costs will depend on the number and type of installations that are being administered and the organisation of the competent authorities themselves. Annual costs for the competent authorities are mostly related to:

- continuous capacity building activities (e.g. structured training activities, standardised working groups or meetings, maintenance of the helpdesk and for some competent authority maintenance of national IT system)
- addressing notifications of changes to the monitoring plan and approval of significant changes to the monitoring plan
- reviewing annual emission reports and verification reports that are submitted by the operator to the competent authority.
- inspection and enforcement.

Nearly 40% of respondents indicate costs for MRV for stationary installations have increased slightly between Phase III and Phase IV and around 20% that they have remained constant.

The reported costs (321 K euro) and days (725) for competent authorities for MRVA of stationary installations are significantly higher than the 2016 administrative cost study. This is also in contrast to the views expressed on cost changes between Phase III and Phase IV. It is possible that competent authorities included costs related to free allocation in their estimates, which increases the scope of their activities. Furthermore, competent authorities were already taken preparatory measures in 2022-2023 to prepare themselves for the scope extensions in EU ETS in 2024 and 2025 by hiring new staff, implementing new tools such as IT systems and changing procedures. Cost increases can also be explained by the fact that most Member States strengthened their procedures to review annual emission reports and inspection procedures and Competent Authorities had to update themselves on the strengthened rules of zero-rating biomass fuels.²⁶⁷ The costs for MRV procedures for aircraft operators are lower at 65K.

For competent authorities, total costs can be calculated based on either average costs or the number of working days giving a range of 7-13 million EUR.²⁶⁸ Although these are larger than earlier estimates as discussed above, these are small relative to MRV costs for operators of stationary installations. The survey asked respondents about the one-off costs associated with entry into the EU ETS system and capital costs associated with purchase of monitoring and reporting equipment. The estimates provided cover a wide period, depending on when the installation entered EU ETS. Only a few of the survey respondents entered after 2018.

One-off costs for stationary installations and aircraft operators related to monitoring include:

- Training and guiding internal staff on the new MRR monitoring rules.
- Preparing for the implementation of monitoring and reporting practices.

²⁶⁶ Adjusting procedures for the approval of monitoring plan to incorporate the new requirements in these procedures, adapting checklists or adapting national guidance.

²⁶⁷ In 2023 Member States were required to actively enforce the operator's requirement to demonstrate compliance with sustainability and greenhouse gas savings criteria.

²⁶⁸ It is assumed that there are 30 competent authorities, 27 Member States plus Iceland, Northern Ireland and Norway. Northern Ireland is included as 5 installations are covered by the EU ETS. Liechtenstein is not considered in the cost exercise as there are only 2 installations in Liechtenstein with very low emissions and these installations were considered to being opted out of the EU ETS.

- Drafting the monitoring plan and obtaining approval from the competent authority. Generally, these costs cover not only the drafting process but also the communication with the competent authority during the approval process. For stationary installations there are some additional one-off costs that are not applicable to aircraft operators: these costs relate to obtaining an ETS permit from the competent authority.
- Setting up and implementing the operator's or aircraft operator's control system and procedures. This concerns setting-up and implementing the control activities that are tailored to the risks in the data flow of the installation or aircraft operator and the various procedures that must be designed and implemented to mitigate the risks that control activities are not functioning effectively.
- Additional costs may include the purchase of monitoring equipment and reporting equipment.
- One-off costs related to reporting involve setting up data management systems for collecting emission reporting data. If these systems were already available, the costs would be for adapting them to emission reporting.

Surprisingly, estimates for the **capital costs** associated with implementing technologies for reporting are higher than those for monitoring. Most of these costs are for IT systems, which facilitate both monitoring and reporting processes for stationary installations. With respect to monitoring, the reported expenditure is largely for metering devices.

Respondents to the survey indicated that for stationary installations, drafting a monitoring plan and establishing the control system and procedures are each 30% of the one-off costs on entering the EU ETS system.

For aircraft operators, the average costs for MRV on entering the EU ETS system are around half that of stationary installations. Respondents to the survey reported that purchasing of equipment was the biggest component at around 40%.

As described previously, the Commission periodically revises regulations in response to changes in the Directive and/or to improve the functioning of the MRV system. In addition, guidance and templates for various aspects are regularly updated to adapt to new legislation and to facilitate the implementation of MRV implementation and increase the effectiveness and efficiency of the system. A minority of respondents to the survey mentioned improved guidance, improvement in the reporting platforms and more standardised procedures as improvements between Phase III and Phase IV.

Stakeholders regularly share information on their experiences with the implementing MRV requirements in various fora. In the Technical Working Group on MRV MS Competent Authority's provided input into legislation and guidance in stakeholder consultations. In various CCEGs industry associations can exchange information. Another platform for exchanging information is the Compliance Forum where Member State competent authorities share good practices and discuss practical MRV implementation issues. These stakeholder consultation processes not only contribute to a more effective implementation of EU ETS but also increased harmonisation having a positive impact on the overall efficiency of the MRVA system.

Improvements in monitoring and reporting

In the survey, interviews and reality check workshop respondents mentioned that there are still opportunities for improvements, despite improvements, despite the changes already in the

MRV system and made some suggestions. The options for improvements and streamlining identified by respondents to the survey and OPC broadly fall into the following categories:

- **Changes to the requirements for site visits for verification.** A verifier must carry out a site visit during the verification.²⁶⁹ Under certain conditions laid down in Articles 31 and 32 of the AVR, a site visit may be waived for stationary installations. Conditions for waiving site visits in the aviation sector are included in Article 33 of the AVR. In practice the number of site visits waived for both stationary installations and aircraft operators is relatively low.²⁷⁰ It was suggested that more site visits should be waived or conducted remotely, or the frequency of site visits could be reduced, for example where the technological characteristics of a site are unchanged.
- **Changes to deadlines.** Operators must submit verified emissions reports to competent authorities by 31 March of the year following the reporting year. The deadline for submitting improvement report is 30 June. If an operator is receiving free allocation, they also need to submit a verified annual activity level report by 31 March. A fixed deadline for submitting monitoring plans is not prescribed in legislation for stationary installations but aircraft operators are required to submit a monitoring at least 3 months before the monitoring cycle starts. Significant changes to the monitoring plan must be notified without undue delay and other changes to the monitoring plan must be notified at the latest by 31 December of each year. Most of the suggestions regarding an adjustment of deadlines related to an extension of the submission deadline of the annual activity level report. However, others also suggested delaying the deadline for significant changes to the Monitoring Plans and improvement reports. It is however noted that competent authorities may set an alternative date to the required deadline of 30 June, but no later than 30 September.
- **Harmonising EU ETS/RED/Waste Framework Directive requirements.** The ETS Directive allows that the emission factor from biomass and certain other renewable fuels²⁷¹ be set to zero. A precondition for this is that the operator must demonstrate compliance of biomass fuels with applicable greenhouse gas savings or sustainability criteria laid down in Article 29(2) to 29(7) and (10) Renewable Energy Directive.²⁷² Installations also have other reporting requirements under the Industrial Emissions Directive, the Waste Framework Directive and other environmental reporting regulations. Respondents to the survey expressed the need for more streamlining on the evidence needed to demonstrate compliance with the REDII criteria and for seeking more opportunities to integrate EU ETS verification and REDII audits (in terms of timelines and processes). Extending biomass certification schemes to industrial residues and waste streams was also suggested. Aircraft operators also called for simplifications in the rules to demonstrate sustainability of Sustainable Aircraft Fuels. Other suggestions for streamlining concerned the need for avoiding overlap in reporting requirements and to integrate different environmental reporting mechanisms.

²⁶⁹ The risks identified in the installation and the verifier's risk analysis have an impact on the locations to be visited and the number of site visits to be carried out during the verification.

²⁷⁰ European Commission (2024)

²⁷¹ Renewable fuels of non-biological origin, recycled carbon fuels and synthetic low carbon fuels

²⁷² For RNFBs and RCF the greenhouse gas savings criteria are included in Article 29a of REDII and for SLCF compliance of zero-rated synthetic low carbon fuels with the greenhouse gas emission reduction threshold as referred to in Article 2, point (13), of Directive (EU) 2024/1788 must be demonstrated. These requirements entered into force from 1 January 2025 and are therefore not included in this evaluation.

- **Relaxing requirement on monitoring accuracy.** As indicated under the section on effectiveness the MRR currently already allows operators of installations to choose between calculation-based methodologies and measurement-based methodologies.²⁷³ Within the applicable tier approach, even installations that must meet the highest tier and the most stringent MRV requirements can deviate from those requirements in the case of unreasonable costs or technical infeasibility. Only as a last resort can a fall-back approach be applied. A key element in ensuring that the required uncertainty levels associated with the applicable tier and the overall uncertainty level of the fall-back approach is applied are uncertainty assessment. Even though the legislation and guidance already build in several simplifications, respondents to the survey suggest the need for simplified or tailored requirements for uncertainty calculations. Other suggested simplifications concern the use of standard emissions factors for certain fuels, rather than requiring regular sampling of the fuel, without having to demonstrate unreasonable costs or technical infeasibility. The documentation around uncertainty assessments and risk assessment was also highlighted as causing high administrative burden.
- **Further simplifications for small installations.** The current monitoring structure already allows small installations to move to less stringent monitoring requirements. Small aircraft operators and aircraft operators having emissions of less than 3000 tonnes of CO₂ can also choose to use the Small Emitters Tool or the Eurocontrol EMIS tool which simplifies reporting and reduces verification requirements. However, some respondents felt that there could be further simplification for small installations or small sources or source streams within a larger installation.
- **More timely provision of guidance and templates and easier access to the latest version of all documents.** The Commission provides a variety of guidance, templates and tools to facilitate the process of MRVA.²⁷⁴ Additionally, countries implement their own tools and procedures depending on national circumstances. Several respondents in the survey and in interviews mentioned that guidance and templates were not always provided in a timely manner, particularly not in local languages. This was said to introduce inefficiencies into the system. One suggestion was to make more use of AI for these translations. Others suggested that templates needed to be improved, without more specifics. Additionally, it was commented that it was not always easy to find the latest version of all the relevant documents so it would be useful if there was a central place that provided the links only to the most up-to-date documents.
- **More streamlining with the Industrial Emissions Directive (IED).** The IED regulates pollution from industrial production processes. Through its regulation of air pollutants, there is overlap with EU ETS for stationary installations. The ETS Directive already contains requirements for Member States to coordinate permitting procedures under the IED and the EU ETS which was implemented differently by Member States²⁷⁵. Streamlining is in some cases also taken up in the inspection procedures. In most countries the inspection is based on the inspection procedures that have been

²⁷³ In some cases, installations are however required to apply a certain methodology: for example, installations producing nitric acid must apply continuous emission measurement according to the MRR.

²⁷⁴ European Commission, Monitoring, reporting and verification, https://climate.ec.europa.eu/eu-action/carbon-markets/eu-emissions-trading-system-eu-ets/monitoring-reporting-and-verification_en

²⁷⁵ In some Member States the ETS permit is part of the IED permit whereas in other Member States coordination was followed up by regular communication between IED authorities and the EU ETS competent authority or alignment with procedures.

implemented under the scope of the IED. Even though such streamlining does not always guarantee the highest environmental integrity and quality of the MRV process²⁷⁶, Member States themselves have taken step to streamline procedures. It was suggested to create a single reporting platform for both the EU ETS and IED, although there was some concern that this would lead to a too complex system. Other suggestions include removing requirements to report on CO₂ under the IED, creating a single permit for pollution and EU ETS and promoting better co-ordination between the regulators for different systems.

- **Better alignment between EU ETS and CORSIA.** The Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) is a global market-based measure to address CO₂ emissions in aviation. Commission Delegated Regulation 2025/927 regulates that the MRR and the AVR should be applied when monitoring and reporting emissions under CORSIA thereby fully implementing the second Edition of Annex 16, Volume IV of the SARPs on CORSIA. However, some aircraft operators suggest there could be further streamlining without being specific.
- **Simplification of procedures for competent authorities and reduced timelines for approval.** The MRR requires improvement reports to be approved by the Competent Authority and the AVR obligates stationary installations that emit more than 25ktonnes of CO₂e to seek approval from the competent authority to waive a verifier's site visit. It was suggested that some of the requirements for procedures for approving improvement reports or waive of on-site visits could be simplified. It was also noted that processes for approval of the monitoring plan can be lengthy and involve a number of iterations, which adds administrative burden.

In other platforms mentioned earlier, opportunities were also raised for simplification. Some of these simplifications were already followed up in the 2023-2025 revisions of the MRR and the AVR:

- Allowing verifiers to carry out virtual site visits beyond force majeure circumstances in the ETS aviation sector where data flow is automated. The AVR was updated in 2024 to accommodate this.
- Introducing IT tools and virtual site visits in inspection approaches. Some Member States are using such approaches in inspection. A wider uptake of these good practices in the EU could help capacity problems and increase efficiency.
- Allowing more flexibility in the monitoring and reporting requirements of municipal waste incineration installations. Although this falls outside the remit of this study, the data collected could provide some insights for further tasks in this evaluation project.
- Clarifying the role of the stakeholders in using the Union Database and national databases linked to the Union Database to demonstrate compliance with sustainability and greenhouse gas savings criteria. This clarification has already been incorporated in the guidance material.
- Member States expressed a wish to streamline reporting requirements between various EU legislation to strengthen the input to UNFCCC reporting but as of yet there have not been any concrete discussions or recommendations on this.

²⁷⁶ IED inspectors are not always sufficiently competent to assess the EU ETS specific monitoring aspects of the installation, and these are not always picked up in an IED inspection.

Options related to digital tools will be considered under EQ8. The other improvement options are discussed in more detail in EQ7.

- EQ6: Cost-effective application across industries and member states

This evaluation question tests whether the MRVA burden is cost efficient for all parties. For stationary installations in different sectors, the total costs reflect the complexity of the industrial processes and volume of emissions. Additional requirements for biomass reporting seem to lead to higher per unit CO₂ costs in some sectors.

In terms of size of installation, smaller installations bear relatively higher costs per unit of emissions than the larger installations, despite efforts to simplify requirements for these installations. The relative difference between the largest and smallest installations has not however increased since the previous study.

The sample size in the survey means that differences between countries can be considered between two broad groups based on GDP per capita. There are no significant differences between costs in different country groups beyond those that can be explained by differences in labour costs and distribution of installation types.

Different costs for stationary installations reflect the complexity of the industrial process and the level of emissions.

There is a large enough sample from the survey for stationary installations to analyse results by broad categories of industrial sector. Survey results indicate that installations in the chemicals, oil refining, and cement sectors generally incur costs above the average. This is likely attributable to the greater complexity of processes and/or higher emission levels typically associated with these sectors, which results in a higher number of days than average dedicated to activities. The MRVA requirements for installations in these areas account for both the complexity and scale of operations to ensure accurate emissions reporting and uphold environmental integrity. Conversely, installations in the minerals and glass, as well as pulp and paper sectors, report costs below the average but see discussion below. In a similar way to the standard cost calculation, the average EUR per tonne costs for each sector can be extrapolated to the EU level based on the number of installations in each category and the total emissions. Despite the higher per installation costs, cost per tonne of CO₂ for refining and cement sectors are on the lower side because of the higher emissions. Minerals and glass and pulp and paper report relatively high costs per tonne of CO₂. In pulp and paper, there are a high percentage of installations that use biomass (50% and 29% respectively), which adds complexity to the MRV processes. For minerals and glass, the requirements for biomass are mentioned as an issue although the percentage of installations using biomass is relatively small at the EU level (5%).²⁷⁷ MRV associated with free allocation is also mentioned, but there is no clear explanation for why costs per tonne of CO₂ in this sector should be higher than others. There was no change in the allocation rules in the years 2021- 2023 (the period of the study) but the installations from the mineral and glass sector that responded could have the recent NIMS submission that was submitted in 2024 in their mind. As from 2026 installations in these sectors can also apply for allocation for recovered heat in addition to their fuel benchmarks which makes the data collection of baseline data and the annual monitoring of activity level data more complex.

²⁷⁷ European Commission (2024)

The costs for installations below 25kt range from 3-7 EUR per tonne of CO₂, while for the largest installations the range is 0.1-0.4 EUR per tonne of CO₂. This cost differential was also found in the 2016 report on administrative costs, with Category A installations facing costs per tonne CO₂ around 50 times that of Category C.²⁷⁸ In the current study, the difference between these two categories is about the same. As discussed previously, over the years several measures were taken to simplify the monitoring requirements for the smaller installations whilst ensuring the environmental integrity and robustness of monitoring and reporting. Nevertheless, smaller installations still report higher costs.

Stationary installations

To investigate the distribution of costs by country, each country was classified into one of two groups based on GDP per capita. Group I consists of countries with an average GDP per capita above EUR 37,000, while Group II includes those below this threshold. Installations in Group I countries report higher average costs particularly for equipment costs. Conversely, in terms of days, stationary installations in Group II countries report using more days on MRV activities, particularly so for verification. The difference in costs can be partially attributed to higher labour costs in Group I countries. On average the labour costs within Group I countries are 2.5 times those in Group II. The cost differences are mostly within this range.

Additionally, a larger proportion of the biggest installations responding to the survey are located within Group I countries. As these generally have higher costs associated with MRVA, the distribution of installation types between countries has an impact on average cost in a country. Although a few respondents noted variations in the implementation of MRVA requirements between countries, these differences were generally mentioned as being between member states within the same group. Overall, there is limited evidence to suggest that geographical differences, beyond those explained by labour costs and the distribution of installation types, play a significant role in cost variation. This finding echoes the finding from the 2016 administrative cost study.²⁷⁹

Competent authorities

For competent authorities, both the costs and the number of days are greater in Group I countries than in Group II countries. The difference in costs is within the range of differences in labour costs. The difference in number of days is significant. As discussed above, one factor is the type of installations present in a country, and another is the total number of installations. On average, Group I countries administer around twice the number of stationary installations than Group II installations, although there is also significant variation between countries within the groups. The differences are reflected in the number of staff employed by the competent authority particularly for stationary installations with Group I countries employing nearly three times the number compared to Group II countries.

Another factor that can determine costs is the organisation of the administration within a country. As mentioned in the “*Effectiveness*” section, 19 countries currently have a centralised organisation, with other countries have a more decentralised organisation in the form of multiple regional competent authorities. For aviation, many countries have assigned different competent authorities for MRV activities to those for the management of stationary installations. Where multiple competent authorities are involved in EU ETS activities,

²⁷⁸ Evaluation of EU ETS Monitoring, Reporting and Verification Administration Costs, 2016

²⁷⁹ Ibid

additional activities are needed to coordinate to ensure harmonised application of the rules. Such coordination is required in Article 10 of the MRR.²⁸⁰ Internally within a competent authority there will also be differences in the type of resources implemented by the competent authority, size of staff and number of installations or aircraft operators are managed by a competent authority.

- EQ7: Opportunities to streamline or simplify the MRVA

This evaluation question builds on EQ5 to examine whether there is evidence of opportunities to streamline and/or simplify the MRVA system to increase cost efficiency.

Based on a **qualitative assessment of options for simplification** that were suggested by participants in the survey and proposals that were brought forward in the OPC, no options stand out as priorities for regulatory change within EU ETS because these could have a negative impact on the environmental integrity of the ETS system or because they have already been addressed by legislative changes in 2024 and 2025. However, some need more consideration. These include:

- Simplifications in the requirements for installations emitting less than 50 kt CO₂ with very simple monitoring methodologies and low inherent and control risks. Most simplifications are already accommodated in the MRR and low risks in simple and small installation often require less extensive verification approaches. Examples in training events could highlight how to deal with these simplifications.
- Simplification of requirements for uncertainty for smaller source streams and allowing a wider application of default values for the emission factors and calorific value for certain fuels. Generally, the current MRR already allows simplification on uncertainty assessment and the application of default values for commercially standard fuels. However, further research may reveal additional opportunities for simplification.
- Further streamlining procedures or reporting requirements between IED, EU ETS and other legislation, in particular to avoid overlap in reporting data.
- Simplification through digitalisation (see under EQ8).

As mentioned under EQ5, other simplifications were raised in other fora of stakeholders. Some of these issues are not necessarily related to the 2021-2023 evaluation and are either being assessed in other studies. These include:

- Simplification for municipal waste incineration installation as these currently have difficulty meeting the required tiers.
- Simplification of biomass requirements to demonstrate compliance with REDII criteria.
- Simplification of requirements on alternative fuels and eligible aviation fuels in the aviation sectors.
- EQ8: Role of technology in improving the efficiency the MRVA

Evaluation question 8 examines the evidence regarding the role of technology in implementing the MRVA system and whether there are opportunities to increase its use.

Experience to date suggests both efficiency and accuracy of MRVA can be improved by the implementation of digital tools. Additional to the current use, there are further options to incentivise used of digital tools to improve efficiency. Barriers to digitalisation noted in the

²⁸⁰ European Commission (2024)

reality check workshop were non-standardised key inputs such as supplier data and laboratory methods and the frequent changes to templates and requirements noted earlier.

There are also emerging technologies that can be used for different components of MRVA. These include amongst others the Internet of Things (IoT), AI and Machine Learning and Blockchains. The role of regulation in this case would be to enable their use where it can improve efficiency, while maintaining environmental effectiveness.

Various tools have been developed and implemented to help improve efficiency of the MRVA system and increase the accuracy of reported data. The 2016 administrative cost study reported efficiency gains for competent authorities from the use of electronic reporting. Reporting under Article 21 of the ETS Directive gives more up to date information on their use.

Templates have been developed by the European Commission for monitoring plans, emission reports, verification reports and improvement reports (for installations and aviation).²⁸¹ In 2022, 25 countries reported using the Commission templates.

The ETS Reporting Tool

Additionally, the European Commission has developed an IT tool called ETS Reporting Tool MRV (ERT), designed to facilitate the submission of monitoring plans, emission reports, verification reports, and improvement reports. This tool helps streamline reporting to reduce administrative burden and improve the reporting accuracy and increase compliance of installations. The ERT is a web-based platform offering advanced features for all stakeholders and applies to sectors covered by the EU ETS.²⁸² The Commission conducted a survey of competent authorities in 2022 on the use of ERT. Some positive points identified included that changes in templates were immediately and directly accessible in the application, and that aggregated data and reports offer good visibility of the stored reports. The survey and issues raised at the Helpdesk has resulted in some improvements. Respondents also asked for training, which was provided.

According to the Article 21 report, 18 countries (or in some cases only some regions in a country) reported using an IT system to manage the MRV workflow between competent authorities, stationary installation and aircraft operators, and verifiers. This includes a slight increase in the number of countries using ERT. The type of national IT systems that other countries have developed themselves vary between countries in terms of scope, access, functionalities and origin. In some countries simple workflow systems are used, while in other countries integrated reporting systems exist providing access to all parties, including advanced functionalities and managing all steps in the compliance cycle.

In the survey, around half of the CAs responding have implemented the ERT. Of those, more than half reported that it had improved efficiency and quality of reporting significantly or slightly. Fewer CAs in the survey reported having developed their own IT system but those that had, reported that it had improved efficiency.

In general, countries with the highest number of installations have implemented either national IT systems or are using Commission templates. Some of the countries having developed national IT systems, have expressed interest in linking their national systems to ERT. Currently, there are some technical limitations particularly round security that prevent this, but

²⁸¹ European Commission, Monitoring, reporting, and verification, https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/monitoring-reporting-and-verification-eu-ets-emissions_en#tab-0-1

²⁸² [Ibid](#)

solutions are being pursued. These solutions would allow at least sharing of files that need to be submitted to the Commission such as allocation data²⁸³ which would increase efficiency. Another request from countries, who have started or plan to start using ERT, is to allow historical MRVA records to be imported.²⁸⁴

A barrier to entry for some countries with limited resources is that they need to onboard their users to the ERT system i.e. they need to invite installations to use the system and provide appropriate guidance. The Commission has some training sessions recorded that can be used for this purpose, but there still needs to be resources committed by the competent authorities. By expanding the functionalities of ERT, the use of ERT has increased in more recent years (e.g. data can be automatically extracted from the system for the purpose of Article 21 reporting).

ERT has furthermore been updated to include the **relevant processes and forms for ETS2**, which has encouraged more use, although some countries only use it for that purpose. The functionality of ERT would also allow it to be used for other reporting processes for example there are currently discussions on using it for CCS reporting.

Most verifiers in the survey reported using either ERT or a national IT tool (equally split between the two). Around half reported this as having increased efficiency, with the rest reporting no change.

The Compliance Cycle Evaluation Study in 2018 and Analysis of Article 21 responses in addition to the analysis of the survey responses show that opportunities to improve the effectiveness of the IT tools mostly exist in:

- building in harmonised checklists in the monitoring plan approval process and incorporating those in the IT systems. Some Member States have developed good practices that have improved the coordination of this process.
- automated functionalities in the IT system to facilitate the approval process and the notification of changes to the monitoring plan, e.g. automated completeness and consistency checks in the system, automated reminders for submission deadlines, alerts if incomplete or implausible data is inserted in the system
- incentivising more Member States to use the ERT.

There are also emerging technologies that can be used for different components of MRVA. These include amongst others the Internet of Things (IoT), AI and Machine Learning and Blockchains.^{285,286,287} Case studies outside the EU ETS have found that they can reduce administrative burden and effectiveness, although economic efficiency depends on scale of implementation.²⁸⁸ Although these technologies could potentially be useful, because of their

²⁸³ Documents as part of the National Implementation Measures (NIMS) procedures in accordance with Article 11 of the EU ETS Directive

²⁸⁴ Interview 4th Nov 2025

²⁸⁵ Mungroo et al, 2024. “Addressing leakage in mechanism methodologies”, https://unfccc.int/sites/default/files/resource/MEP004_CfI_Addressing_Leakage_Mungroo.pdf

²⁸⁶ TERI, 2025. “Report on international practices on MRV for steel value chain”, https://www.sameeeksha.org/pdf/publications/MRV%20Report_final%2018.08.2025.pdf

²⁸⁷ TBI, 2025. “International Carbon Markets: Climate Action at a Lower Price”, <https://institute.global/insights/climate-and-energy/international-carbon-markets-climate-action-at-a-lower-price>

²⁸⁸ Gold Standard, 2024. “MRV Report on Pilot Projects, Roadmap and Resources”, <https://www.goldstandard.org/publications/mrv-report-on-pilot-projects-roadmap-and-resources>

nature implementation would largely be a commercial decision for installations and aircraft operators. Within the aviation sector such automated systems are more common than in the industry sector and have been used more widely to manage aircraft data.

The role of MRVA regulations would be to enable the use of these technologies where it can be demonstrated that they provide the necessary level of accuracy. No respondents have highlighted that there are regulatory barriers to their use. It is recommended to monitor the operator's or aircraft operator's use of these new technologies as this can improve not only the accuracy of emissions but also effectiveness and efficiency of the monitoring processes.

The Compliance Forum can be a platform where competent authorities share information on new technologies that are used in monitoring and technologies that are applied in their own review and inspection processes. Experiences can for example be shared on how some **competent authorities use virtual site visits with advanced technologies** to inspect installations²⁸⁹ or use automated tools to facilitate the review of emission reports of select installations to be inspected. In some Task Forces external speakers are sometimes invited for a presentation to share good practices or present a study or case study. It could have added value to learn about the use of these new technologies and practices in third countries.²⁹⁰

With respect to verification of stationary installation's emission reports it may have added value to assess whether virtual site visits by verifier could be allowed beyond force majeure circumstances under very strict conditions. Technologies are improving and may allow an effective virtual site visit provided certain conditions have been met. Care should however be taken that the quality of verification will not be hampered by this. Physical site visits are an instrumental part of the verification as it enables the verifier to inspect metering equipment, interview staff and to properly assess the accounting boundaries.

Despite the already established use of digital tools, many of the respondents suggested MRVA could be made more efficient and administrative burden reduced if there were more, and more harmonised, tools available. From the analysis for EQ7, several options can be distinguished to incentivise the use of ERT or further IT systems:

Option 1 - Mandate the use of ERT

Under this option Article 74 and 75 of the MRR would be amended to require Member States and stakeholders to use ERT for the submission of monitoring plans, emission reports, verification reports and improvement reports. The advantage of the option that it would further harmonise procedures between Member States and improve the effectiveness of MRV processes for all stakeholders involved. All Member States would use the same system with similar functionalities and automated checks and the transmission of information to the Commission (e.g. NIMS data collection, reports of municipal waste incineration installations, other relevant information that needs to be submitted to the Commission by law). The disadvantages of this option include the risk of infringing the subsidiarity principle for Member States to set-up national administrative procedures and tools and the additional resources needed to onboard users to the ERT system and adapt it to national procedures. Resistance from countries that have already implemented an IT system and invested in their own systems might

²⁸⁹ In Ireland virtual site visits were carried out to inspect certain installations. Germany uses automated tools to review emissions reports and select installations to be inspected.

²⁹⁰ In the TF CCS ICAP and the Global CCS Institute provided presentations on the use of CCS and CCU technologies across the world.

be mitigated by mandating Member States to use ERT unless they have implemented a national IT system of equivalent nature.

Option 2 - Leave Member States the option to use ERT and continue with efforts to enable linking of national MRVA systems

Under this option Article 75 and 75 of the MRR would not be changed and Member States would be left the option to use ERT or their own national systems, but the European Commission would undertake measures enabling linking of national IT systems to the ERT. This would facilitate the submission of information to the Commission. The disadvantage of this option is that Member States would be allowed to implement different systems or to not use IT systems so the differences in tools and procedures would continue to exist. Links could have risks to confidentiality and security of data and might cause some resistance from Member States or stakeholders in that Member States. This risk could be mitigated by implementing safeguards in the system to ensure confidentiality and security of data.

Option 3 - Leave Member States the option to use ERT and to continue to improve ERT

This option would have similar consequences to option 2. No amendment would be necessary in the MRR and in principle the options could be applied in combination. Opportunities to improve the ERT could include the following: (1)Continue with efforts to allow import of historical records into ERT; (2)Explore ways to link ERT with other reporting systems such as for other environmental reporting mechanisms; (3)Improve other functionalities in the system such as building in certain automated checks; (4)Provide NABs access to the system so that the information exchange between NAB and competent authorities can take place through the ERT. This could standardise and facilitate the information exchange even further.

As with option 2 differences of MS practices and IT systems would still exist if the use of ERT is only on a voluntary basis. Further analysis of the above options could have added value. If no action is taken or only option 2 and 3 is feasible it may be worthwhile considering adapting Article 74 of the MRR and require stakeholders to use the Commission templates unless a Member State has required stakeholders to use a national template or national IT system that contains at least the same information as the Commission template. Although most Member States either have an IT system or prescribe Commission templates, in some countries the use of Commission or national templates is not prescribed as national law prevents them from mandating the use of templates. This has caused differences between stakeholders and caused complications in the implementation. As this only applies for a few Member States, the problem is not significant, but it is still a barrier for EU wide harmonisation on this area.

8.4.5 Conclusions

The evaluation of the EU ETS MRVA system underscores the effectiveness in ensuring accurate, complete, and transparent greenhouse gas emissions data, reinforcing methodological consistency across Member States. Methodological consistency remains very high, with calculation-based monitoring applied to nearly all stationary installations and fall-back approaches limited to less than 1% of cases. In terms of accuracy and completeness, conservative estimates remain below 1 % of total verified emissions, and submissions of verified emission reports that are missed account for only 1–1.5 % of all installations. Negative verification opinions (≈ 30 per year) and report rejections (≈ 50) are rare, while penalties affect just 0.5 % of operators. Overall, the MRVA framework functions as a mature and harmonised system, delivering highly reliable, comparable, and comprehensive greenhouse-gas data across all Member States and sectors.

Together, the evidence also shows a **mature and well-functioning system** that consistently upholds data integrity. NABs effectively supervise verifiers carrying out annual surveillance by conducting office audits, document review and witness audits of verifier's actual performance in the verification, with a majority reporting no deterioration in their risk-based surveillance. Verifications and on-site visits are done with a high consistency and quality. Although reported discrepancies remain low, one Member State²⁹¹ stands out as a statistical outlier, contributing a disproportionate share of misstatements and non-conformities, which may indicate country-specific issues. Trust in the system remains high, but concerns over tightening verifier capacity, especially with upcoming reporting obligations, highlight potential challenges for the future.

Overall, Member States have maintained a high level of **procedural maturity in implementing MRVA processes under Phase IV**, with improvements that are incremental rather than transformative. Coordination between competent authorities, NABs, and other agencies remains well established and effective, supported by EU-level guidance used by nearly all competent authorities. Internal organisation has largely stabilised. Nineteen countries operate with more centralised approaches, while twelve maintain decentralised systems but have strengthened coordination through working groups, regular meetings, a central competent authority overseeing operations and shared training. These arrangements ensure consistency while accommodating national administrative diversity. Permitting, monitoring, and review procedures also show sustained quality, reinforced by digitalisation and standardised templates. Around one-third of competent authorities reported procedural enhancements, often related to digital tools or integration of external datasets. Inspection and enforcement practices remained regular and risk-based, with modest efficiency gains. Collectively, these findings indicate that procedural adjustments by Member States have strengthened administrative efficiency and harmonisation, thereby sustaining high compliance assurance within the MRVA system, though perceived simplification by operators remains limited.

The EU ETS MRVA framework remains legally solid and operationally robust, with the 2018 MRR and AVR effectively integrated across Member States and no MRVA-related infringement cases. Subsequent amendments between 2020 and 2022 enhanced adaptability, ensuring verification continuity during COVID-19, as well as aligning with RED II and CORSIA. However, new challenges are emerging as the system expands to the scope (including maritime transport), exposing coordination and readiness gaps. Stakeholders also report limited simplification and delays in regulatory updates, particularly on free allocation. Overall, while the MRVA system ensures compliance integrity, further improvements could be beneficial to enhance timeliness and proportionate simplification in future phases.

Although the MRVA system has achieved its objectives cost-efficiently, concerns persist regarding administrative costs. Costs associated with MRVA are identified as an issue by both stationary installations and aircraft operators but for most still represent a relatively small proportion of the compliance costs for the EU ETS. Evidence is slightly contradictory about differences in annual costs between Phase III and Phase IV of the EU ETS, with opinions suggesting limited changes but the reported costs being higher than previous estimates. Where larger changes are flagged it is often associated with MRVA for free allocation. Drafting a monitoring plan and establishing the control system are the biggest components of one-off costs for stationary installations and for aircraft operators it is purchase of equipment.

²⁹¹ France

Evidence for cost effective application across different stakeholders is similar to previous studies. For stationary installations in different sectors, the total costs reflect the complexity of the industrial processes and volume of emissions. Additional requirements for biomass reporting seem to lead to higher per unit CO₂ costs in some sectors. In terms of size of installation, smaller installations bear relatively higher costs per unit of emissions than the larger installations, despite efforts to simplify requirements for these installations. The relative difference between the largest and smallest installations has not however increased since the previous study. The sample size in the survey means that differences between countries can be considered between two broad groups based on GDP per capita. There are no significant differences between costs in different country groups beyond those that can be explained by differences in labour costs and distribution of installation types.

The MRVA system has already been streamlined and simplified as it developed, motivated by increasing cost efficiency but also improving equal treatment. No significant opportunities to streamline or simplify the system have yet been identified in the evidence, but there are options that might provide incremental efficiency gains. While potentially providing some efficiencies, many of the options have implications for environmental effectiveness or legal/practical implications that need more consideration. Both survey and consultation results from the ETS and MSR evaluation indicate that Phase IV reforms strengthened traceability and consistency, but stakeholders felt that it did not totally deliver on simplification, leaving administrative burden a key concern for future MRVA improvements.

Experience to date suggests both efficiency and accuracy of MRVA can be improved by the implementation of digital tools, such as the Commission reporting tool ERT. Additional to the current use, there are further options to incentivise use of digital tools to improve efficiency. There are also emerging technologies that can be used for different components of MRVA. These include amongst others the Internet of Things (IoT), AI and Machine Learning and Blockchains. The role of regulation in this case would be to enable their use where it can improve efficiency, while maintaining environmental effectiveness.

Overall, the findings indicate that the EU ETS MRVA system functions as a mature and harmonised framework. While incremental improvements have been noted, ongoing evaluations and strategic investments in technology and simplification initiatives are vital to enhance both effectiveness and efficiency, ensuring sustainable environmental compliance across the EU.

8.5 The Monitoring, Reporting and Verification (MRV) Maritime Regulation

8.5.1 Introduction

The MRV Maritime Regulation (EU) 2015/757 established a system for the monitoring, reporting and verification of greenhouse gas emissions based on the fuel consumption of ships (MRV maritime system) as a first step of a staged approach for the inclusion of maritime transport emissions in the EU ETS.

This evaluation analyses the role of the MRV maritime system concerning its policy objectives of supporting shipping decarbonisation, by establishing a robust and transparent reporting system for greenhouse gas emissions and supporting the ETS extension to the sector. The evaluation covers the entire period since the application (2018) of the MRV Maritime Regulation and takes into due account the recent (2023) revision of the system, to the extent relevant to the MRV scope and in a manner compatible with the limited evidence and experience of its implementation, which only started in the reporting period 2024. This evaluation builds on a dedicated support study of which finalisation is still ongoing at the time of writing, and of which publication is expected in 2026²⁹².

Regulation (EU) 2015/757 was limited to ships of 5,000 GT and above in respect of the carbon dioxide emissions released during their voyages from or/and the EEA for transporting for commercial purposes cargo or passengers. The amendments introduced by Regulation (EU) 2023/957 provided for the inclusion of maritime transport activities in the EU ETS. The main changes to the MRV system brought by the 2023 revision are illustrated in the following table:

Table 14: Key changes to the MRV system introduced with the 2023 revision (amending Regulation (EU) 2023/957)

Issue	Key changes introduced
Scope of greenhouse gases	Expansion of monitored gases beyond CO ₂ : from 1 January 2024, both methane (CH ₄) and nitrous oxide (N ₂ O) must be monitored and reported. Monitoring methods and parameter rules updated through Delegated Regulation 2023/2776
Ships under scope	From 1 January 2025, the scope extends to general cargo ships of 400 GT and above (but below 5,000 GT) and offshore ships of 400 GT and above.
Company and fleet-level reporting and partial reports	From 2025, verified aggregated emissions data at company (fleet) level must also be submitted annually, together with ship-level emissions, using a standardised electronic template. Introduction of “partial emissions reports” in case of change of company during a reporting period: the prior company must submit a verified partial emissions report covering its period of responsibility.

²⁹² RICARDO, 2026, Support study for the evaluation of the EU Maritime MRV system in the context of the ETS Directive review (forthcoming).

Monitoring plans/submission deadlines/administration	New and updated templates and electronic formats adopted through Implementing Regulation (EU) 2023/2449 to capture CH₄/N₂O, company-level aggregates and new data requirements. Deadline: by 1 April 2024 (or within three months after first EEA port call) companies to submit verified monitoring plans under the amended rules. The administering authority (Member State authority responsible for ETS administration) is introduced in the MRV/ETS compliance cycle.

8.5.2 Point of comparison

The evaluation of the MRV maritime system is based on the provisions of the ETS Directive, the MRV maritime Regulation, and its related implementing regulations. The key legal provisions of the ETS Directive relevant to the MRV maritime are:

Article 3gd: Monitoring and reporting of emissions from maritime transport. Requires shipping companies to monitor and report relevant parameters and aggregate emissions data at company level in accordance with the MRV maritime system.

Article 3ge: Verification and accreditation rules for emissions from maritime transport. Requires that emissions reports be verified by accredited independent verifiers in accordance with the verification and accreditation rules set in the MRV maritime Regulation.

Article 3gf: Administering authority in respect of a shipping company. Outlines the role of administering authorities in respect of shipping companies, including with respect to the attribution mechanism.

The key provisions outlining the principles of the MRV maritime system as in Regulation (EU) 2015/757 are:

Article 6: Content and submission of the monitoring plan. Requires companies to establish a monitoring plan and outlines its main elements.

Article 8: Monitoring of activities within a reporting period. Requires companies to carry out the monitoring of relevant parameters on the basis of the monitoring plan.

Article 11: Content of the emissions report. Establish the obligation for companies to submit verified emissions reports and outlines the information to be contained therein.

Article 13 Scope of verification activities and verification report. Outlines the verifier's role in respect of the different elements of the MRV compliance cycle and provides the legal basis for the Delegated Regulation on Accreditation and Verification for MRV maritime.

Article 20: Penalties, information exchange and expulsion order. Establishes the enforcement regime for non-compliance in respect of MRV maritime obligations.

Delegated and implementing acts have also been adopted by the Commission to operationalise the MRV Maritime framework. These include:

Commission Delegated Regulation (EU) 2023/2776 that amended the rules for monitoring greenhouse gas emissions and other relevant information

Commission Delegated Regulation (EU) 2023/2917 that replaced Delegated Regulation (EU) 2016/2072 covering verification activities, accreditation of verifiers and approval of monitoring plans by administering authorities

Implementing Regulation (EU) 2023/2449 that repealed Implementing Regulation (EU) 2016/1927 providing templates to be used for monitoring plans, emission reports and Documents of Compliance

Implementing Regulation (EU) 2016/1928 providing the rules to determine cargo carried for certain ship categories

Following the adoption of Regulation (EU) 2023/957, a further amendment was adopted in late 2024 through Commission Delegated Regulation (EU) 2024/3214 to clarify MRV application to offshore activities and the zero-rating of sustainable fuels.

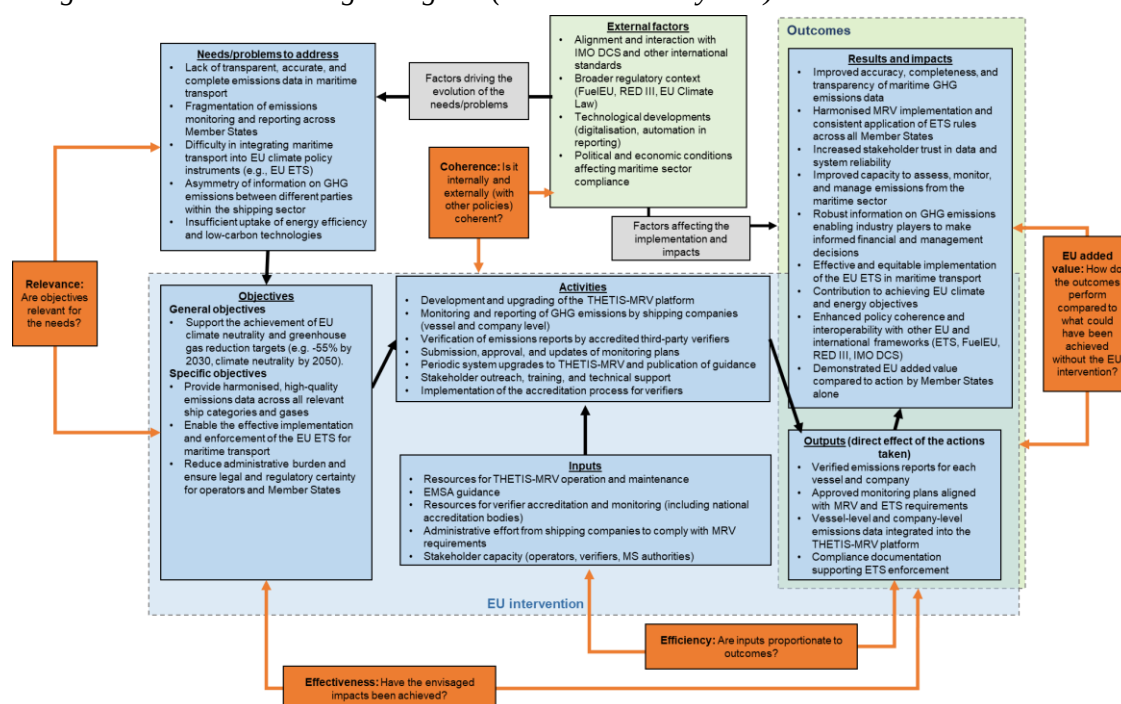
Because of the 2023 revision of the Regulation, guidance and templates were developed and updated in relevant expert groups to ensure a harmonised interpretation of the new requirements.

8.5.3 Intervention logic

The below figure provides a structured representation of how different actors and actions have been interacting under the EU maritime MRV system and how they contribute to deliver on the general and specific objectives of the system. It sets out the causal chain linking inputs, activities, outputs, results, and impacts, while identifying the assumptions underpinning each stage.

The objectives, needs and problems identified in the diagram reflect the issues the MRV Regulation was designed to address. The intervention logic has therefore been developed drawing on the relevant legislation as well as on the 2013 Impact Assessment supporting the 2015 MRV Regulation, and the Commission's 2021 Impact Assessment for the inclusion of maritime transport in the ETS.

Figure 32: Intervention logic diagram (MRV Maritime system)



Source: Own illustration

8.5.3.1 Problem to address

The MRV Maritime system was established to collect transparent, accurate and complete data on greenhouse gas emissions and energy efficiency from maritime transport activities. Before the implementation of the system, few Member States had piloted partial or sector-specific initiatives to monitor and report shipping emissions, resulting in a fragmented scenario, unfit to support the integration of the sector into EU climate policy instruments and causing an asymmetry of information between different actors within the shipping industry, thus hindering the uptake of energy efficiency and low-carbon technologies.

8.5.3.2 Objectives

The general objective of the MRV maritime system is to support EU climate neutrality by 2050 and greenhouse gas reduction targets, as set in the EU Climate Law and the Fit for 55 legislation to deliver the European Green Deal. To deliver this, the system pursues three specific objectives. The first one is to establish and maintain a harmonised emissions data system applicable to all relevant ship categories, activities, and greenhouse gases. The second specific objective of the system is to enable the effective implementation of the EU ETS application to maritime transport activities. The third specific objective of the system is to ensure legal and regulatory certainty for involved actors, while reducing administrative burden.

8.5.3.3 Inputs

The successful implementation and enhancement of the MRV maritime framework is expected to rely on several key inputs allocated by different actors, both at national and EU level: collaboration and support from relevant Commission services and the European Maritime Safety Agency (EMSA) to provide the necessary support to implementation, administrative and financial support to maintain in operation the mandatory IT system for compliance (THETIS-MRV), resources from actors involved in the verification and accreditation system (accredited verifiers and National Accreditation Bodies - NABs) to ensure the quality of verification activities, adequate technical, financial, and administrative capacity by the actors required to administer and implementing the system (shipping companies, verifiers, Administering Authorities of Member State).

8.5.3.4 Actions

Relevant actors affected by the establishment of the MRV system are expected to be undertaking different activities, depending on their role in the MRV compliance cycle stemming from the respective legislative requirements. The European Commission Services and EMSA provide the necessary support to stakeholders, through guidance and maintenance of relevant technical tools for implementation. Operators collect and aggregate the data required under the system, producing reports for submission on the basis of monitoring plans. Verifiers and NABs provide respectively verification and accreditation services. Member State authorities are responsible for the implementation of the system in respect of the companies under their responsibility, including through exchange of information with NABs to ensure quality of verification, and further complement the support to implementation provided by EMSA.

8.5.3.5 Output

Because of the implementation of the system, different outputs are expected in the short term by relevant stakeholders. European Commission services and EMSA deliver guidance, provide

support to implementation, and maintain the technical tools necessary for compliance (e.g. THETIS-MRV). Accredited verifiers deliver third party verification on the relevant outputs by shipping companies and NABs carry out surveillance activities to ensure the robustness of the verification framework under which accredited verifiers operate. After establishing and implementing monitoring methods in accordance with MRV requirements, shipping companies submit relevant emissions data. Member State authorities administer the system, ensuring compliance checks on key deliverables and imposing enforcement measures.

8.5.3.6 Intended results and impacts

The expected effects of the intervention in the medium and long term include the implementation of a coherent MRV system by shipping companies, thus supporting the accuracy, completeness, and transparency of reported greenhouse gas emissions and energy efficiency data from maritime transport activities. The harmonised implementation across different EU Member State is expected to increase stakeholders' trust in the system's reliability in collecting energy and emissions performance data, while serving as a necessary element for the robust implementation of the ETS extension to shipping.

The reliance on robust, complete and transparent data is further expected to enable industry players to better understand emissions data and behaviours, thus making informed financial and management decisions on their operations to ultimately better contribute to the uptake of decarbonisation technologies to support the EU policy objective of shipping decarbonisation. Also, regulators and national authorities are expected to increasingly rely on robust and complete emissions data as reported under the MRV maritime system, to design regulatory measures to further support shipping decarbonisation, while enhancing coherence and interoperability with other relevant frameworks.

8.5.3.7 Unintended results and impacts

The implementation of the MRV Regulation may potentially lead to unintended effects in the form of increased complexity and administrative costs, in particular as a consequence of the 2023 revision to prepare for the extension of ETS to maritime. A further concern stems from the potential for duplications or inconsistencies in reporting requirements established by other regulatory measures affecting the sector, within and outside the EU.

8.5.3.8 External factors

External factors relevant to the MRV maritime system include the interactions with international regulations establishing data collection and reporting for the purpose of shipping decarbonisation and potentially covering the same regulated entities and/or activities, such as the Data Collection System (IMO DCS) established under the International Maritime Organisation (IMO). The pace and depth of the uptake of technological solutions to implement MRV system (e.g. digitisation) may further affect the intervention, as well as any general major political and economic event affecting the shipping sector's ability to comply.

8.5.3.9 EU/national policies

The MRV maritime system works in the context of the broader EU climate policy, one of its main objectives being to support the implementation of the EU ETS system insofar maritime transport activities. In addition to this, the system operates within a complex policy environment, at the intersection of climate action, transport, energy, and innovation policy. A number of emerging and evolving policy instruments are introducing new climate-related reporting obligations that potentially interacted with, or overlap, the requirements of the MRV system for maritime. These notably include some of the key elements to support shipping

decarbonisation under the ‘Fit for 55’ package, such as the FuelEU maritime Regulation and the revision of the Renewable Energy Directive.

8.5.3.10 Data collection

The evaluation findings rely on several data sources, which include:

- legislative and policy documents (e.g. primary and secondary legal acts).
- available impact assessment and evaluations carried out by the European Commission on MRV and ETS maritime.
- any relevant studies, guidance, and information material on MRV and ETS system for maritime produced by the European Commission or the European Maritime Safety Agency.
- research and academic studies on MRV systems and shipping decarbonisation.
- quantitative datasets.

Desk research activity was combined with an online survey which collected 152 complete questionnaires from shipping companies, verifiers, NABs, and Member State authorities. Follow-up interviews were conducted with selected stakeholders to gain deeper understanding of selected issues raised in the survey.

8.5.4 Evaluation findings

8.5.4.1 Effectiveness

The effectiveness criterion evaluates how successfully the MRV maritime system has fulfilled its objectives of ensuring that greenhouse gas and energy efficiency data reported by shipping companies are accurate, complete and transparent, in compliance with the requirements of Regulation (EU) 2015/757, as amended in 2023. To this end, the analysis of this criterion examines whether the procedures, digital infrastructure, and governance mechanisms put in place covering monitoring, verification, reporting, and publication, have effectively prevented errors, misreporting and inconsistencies, thereby ensuring the reliability of the data used for policy and compliance purposes. This criterion is developed through three evaluation questions related to the effectiveness of the monitoring and reporting system, as well as that of the verification and accreditation framework, and to the ability of the system to respond to new challenges.

- EQ1: To what extent has the MRV maritime system ensured the accuracy, completeness, and transparency of greenhouse gas emissions data, and has it effectively prevented errors and misreporting?

To answer this question, the analysis was developed in respect of three main data dimensions: relevant procedures and control mechanisms in place under the system, the observed results and quality trends, and the transparency and accessibility of MRV data. The analysis draws on quantitative indicators, as collected through THETIS-MRV, survey evidence, follow-up interviews with stakeholders, and desk research activity.

Evidence shows that the MRV maritime system has substantially strengthened the accuracy, completeness and transparency of greenhouse gas emissions data. The MRV system can rely on a multi-step and multi-actor compliance system based on harmonised monitoring plans, standardised monitoring and calculations methods (for fuel consumption, emissions, and other relevant parameters), risk-based accredited verification, administering authority checks, and public disclosure. These elements have contributed to a marked improvement in the quality of

reported data: the number of outliers as in verified submissions considerably declined since the first reporting period (i.e. 2018), with remaining anomalies generally not impacting emissions data, yet still showing some residual data quality issues.

On completeness, coverage is robust for the fleet above 5 000 gross tonnage and main emitting ship types and routes, capturing roughly 87% of CO₂ from EEA-related traffic. Smaller vessels, some specific ship types (e.g. the type of LNG carrier, the type “other ships”), and newly added methane and nitrous oxide reporting requirements, were found to present higher incompleteness risk, in particular due to knowledge and capacity constraints among small and first-time operators in the first reporting year after the 2023 revision (i.e. 2024). These, however, are expected to be temporary issues.

The MRV system guarantees access to transparent and easy-to-read data to the wider public. Verified ship-level datasets and MRV aggregate annual reports are openly available, technically reliable, and widely used by regulators, researchers and market actors. Still, some users indicate potential improvements in the IT infrastructure to enhance their ability to access and use available data. Verifiers and authorities supported additional download or filtering functionalities, and the general public highlighted the need to manually detect, remove or correct residual obvious errors (i.e. outliers) in the extracts before the data can be further exploited for further analytical purposes. Furthermore, non-disclosure of some additional datapoints at ship level (e.g. ship’s technical efficiency values, tonnage, IMO carbon intensity indicator, or fuel consumption differentiated by fuel type) could further help researchers to fully exploit the potential of published datasets.

There is currently no evidence of widespread deliberate misreporting or falsification of reported data, and enforcement and verification rules are in place to avoid it, but data on issued sanctions and key quality-related performance indicators (e.g. verification outcomes, monitoring plan approval rates, type and frequency of corrections) are not made public nor systematically reported yet, thus limiting the ability to fully assess system performance.

Overall, the MRV framework has proved to be effective and credible in ensuring the accuracy, completeness, and transparency of the reported data for the main regulated fleet and activity parameters. The procedures and governance infrastructure of the system proved capable of detecting and minimizing the risk of errors and misreporting. The 2023 revision determined an increase in the complexity of reporting requirements, including the inclusion of new fleet segments and new greenhouse gases (i.e. methane and nitrous oxide) under the scope, which presented new challenges for the completeness and quality of the reported data. This is expected to require closer compliance monitoring to fully assess the MRV robustness across all elements of the system in the next reporting periods.

- EQ2: Has the verification and accreditation system been successful in delivering robust implementation of the MRV and ETS system for maritime?

EQ2 assesses how effectively the verification and accreditation framework established under the MRV Regulation ensured the successful implementation of the overall MRV and ETS system for maritime, by providing confidence on the accuracy of reported emissions data. It draws primarily on stakeholder survey findings, supplemented by evidence from desk research.

Together, these sources confirm that the MRV maritime framework can rely on a mature and well-functioning system that consistently upholds data integrity. Verifiers and NABs generally fulfil their expected roles, ensuring compliance and data accuracy through rigorous, harmonised methodologies aligned with EU-wide standards. A comprehensive accreditation framework, supported by structured audit cycles ensures the accuracy, consistency and

credibility of emissions data underpinned by clearly defined roles for verifiers and NABs. The EU-wide alignment of accreditation standards and processes have ensured a baseline level of competence and independence for the different verifiers active under the scope, irrespective of the Member State where they operate. These features have collectively established a credible and functionally robust system that contributes significantly to the accuracy, consistency and credibility of emissions data.

However, the evidence also suggests that this robustness may potentially be constrained by some limitations. Verification capacity remains concentrated among a limited number of providers, which could lead to bottlenecks and delays in verification works. Both authorities and shipping companies have flagged a lack of responsiveness or poor communication by some verifiers, and authorities noted some variability in the quality of the verification services provided across accredited verifiers. Both these elements, if properly addressed, could contribute to improve stakeholders' confidence in the verification system.

While oversight through accreditation appears overall robust, the analysis conducted under this evaluation could not find wide evidence to ascertain in detail how NABs implement conflict-of-interest checks, corrective actions, and information exchange mechanisms, which could potentially hide cases of uneven enforcement.

Overall, while the verification and accreditation system has successfully supported the implementation of the MRV system so far, the 2023 revision has been presenting new challenges in the verification pillar of the system. Strengthening verifiers capacity and enhancing coordination between verifiers, NABs and Member State Authorities, are two key elements which could further reinforce the system's credibility, transparency and effectiveness in the long term.

- EQ3: How well has the MRV maritime system adapted to new challenges, such as the inclusion of new gases and activities, and what improvements can be made to ensure its continued effectiveness?

EQ3 examines how effectively the MRV maritime system (comprising its regulatory framework, digital infrastructure, and institutional capacities) has adapted to the new challenges stemming from the 2023 revision to prepare for the ETS extension to shipping. More specifically, the analysis assesses the fitness of support to stakeholders' initiatives and technical IT tools, the preparedness of companies, verifiers, NABs and Member State authorities to implement the new requirements, and the extent to which the system's operational effectiveness has been maintained during this transition.

The analysis found that overall, the MRV maritime system has demonstrated a high degree of adaptability in response to the 2023 amendments, successfully absorbing an expanded regulatory scope while maintaining operational continuity and data reliability. The integration of new gases (methane and nitrous oxide – starting 2024), the inclusion of additional ship categories (starting 2025), the introduction of company-level and partial emissions reporting requirements, and the changes to the workflow for compliance documents submission, were all implemented within tight timelines, supported by timely technical upgrades to the IT system THETIS-MRV, and sustained support to implementation available to all relevant actors. Most companies, verifiers, and Member States managed to adjust their procedures in time for the 2024 reporting cycle, and the overall system was ready for the full integration with the ETS framework, as confirmed by the findings on punctuality and completeness of submissions. This allowed for high ETS compliance, paving the way for a smooth start of EU ETS for maritime, with shipping companies surrendering allowances for more than 99% of their relevant

surrendering requirements by the 30 September deadline in 2025. The extension of the reporting system to small general cargo ships and offshore vessels closed a significant coverage gap, ensuring, starting 2025, the monitoring and reporting of emissions by types responsible for a meaningful amount of additional emissions, thus extending the completeness of MRV data.

At the same time, the adaptation process revealed transitional weaknesses stemming from some of the new reporting requirements and changes to the workflow in the compliance process. Uneven familiarity among smaller operators, late or incomplete publication of guidance updates on specific interpretative points, and limited IT system-performance issues have been flagged by some stakeholders as adjustment frictions following the 2023 revision. The evidence suggests that the system can rely on the technical and institutional capacities of relevant authorities to overcome these challenges through further support to stakeholders, provided that the necessary resources, both technical and administrative ones, are made available in the future.

8.5.4.2 Efficiency

The efficiency criterion evaluates whether the monitoring, reporting and verification of greenhouse gas emissions for maritime was implemented cost effectively and whether any options for simplification are apparent with a view to reduce administrative burden on relevant stakeholders. Efficiency is achieved by the MRV system as long as the administrative costs are balanced by tangible gains in data quality, relevance and usability, and wider regulatory synergies (e.g. alignment with ETS, FuelEU, and IMO DCS) are exploited without compromising the effectiveness of the measure. This criterion is developed through three evaluation questions to gain a detailed understanding of the cost elements of the system, to investigate opportunities for further cost reductions and simplification, and to assess the role technology and increased harmonisation could play in supporting efficiency.

- EQ4: Has the MRV maritime system achieved its objectives in a cost-efficient manner for all the parties involved, industry and Member States?

The costs associated to the operation the MRV for maritime are investigated through desk research and the additional input provided through a survey and follow-up interviews with stakeholders implementing the system.

To answer this question, the analysis mainly focused on the recurrent costs for shipping companies, as the costs incurred every year by operators to implement the monitoring and reporting of emissions per each vessel.

The analysis estimated the average median cost for MRV compliance for shipping companies at 3 150 EUR per vessel/year, overall, in line with recent findings from studies carried out on the MRV maritime system (e.g. 3 390 EUR per vessel/year for tonnage above 4,999 GT) and ex-ante assumptions made in the European Commission's impact assessment (3 470 euro/vessel/year in current prices). Most respondents further indicated that the estimated costs incurred for MRV compliance are in fact shared with other reporting systems, such as EU ETS, FuelEU Maritime, or the IMO DCS, rather than being MRV-only specific. Around half of the inputs received indicated that most of the person-hours employed to ensure MRV compliance are in fact also serving the compliance under those other schemes.

In terms of MRV costs components, the answers collected through survey and follow-up interviews indicate that costs are generally well distributed across a range of activities (staff costs, data collection and internal monitoring, IT systems, verification fees, preparation and

revision of monitoring plans, emissions report preparation and submission, administrative coordination and interactions with relevant authorities). Staff costs emerged as the more prominent cost driver, generally accounting for more than half of total incurred MRV administrative costs, followed by monitoring plans and emissions report preparation and submission, indicated by most respondents as a minor contributor to total costs (less than quarter than total costs). Shipping companies generally find that costs are higher when voyage frequency and/or data granularity are greater, which is often the case for smaller vessels and sometimes for specific vessel segments like containerships and offshore vessels. Most inputs to the survey found MRV compliance costs to have increased following the 2023 revision, mainly in the form of one-off adjustment costs associated with the need to update reporting processes and templates following in particular to adapt to new ETS-related reporting requirements which primarily required additional training to prepare relevant staff.

The analysis further covered verification costs, as a component of the overall MRV costs incurred by shipping companies to comply, which are passed over by accredited verifiers through verification fees. Inputs collected from accredited verifiers indicated that the main verification activities (i.e. monitoring plan and emissions data checks) are highly harmonised and in fact run in parallel across different emissions and energy efficiency reporting regulatory frameworks (i.e. FuelEU Maritime, IMO DCS). In terms of costs composition, verifiers indicated that most resources to ensure MRV verification are absorbed by the review of monitoring plans and of emissions reports, which remain staff-intensive, followed by site visits.

No quantifiable benefits have been identified to allow the extraction of meaningful cost–benefit ratios or any conclusions of how these have performed relative to benchmarks. Yet, the survey could collect some qualitative insight on this point, as half of shipping companies consulted found the data collected through the MRV system to be appropriate, thus suggesting that administrative requirements may be proportional to the benefits of the system. Many companies also reported the use of MRV-derived data for other purposes, such as, in order of relevance, helping to achieve wider business goals including regulatory submissions related to other regulatory frameworks, internal energy management, environmental, social and governance (ESG) goals, customer reporting, and financing. This suggests that significant synergies may at least partially offset the administrative burden to comply with MRV maritime requirements.

- EQ5: Are there opportunities for further cost reductions, including opportunities to streamline or simplify the MRV maritime system process, without compromising effectiveness?

This evaluation question examines whether, and to what extent, the MRV maritime system could be further simplified or streamlined to reduce administrative costs, while preserving the accuracy, transparency, and regulatory effectiveness achieved under the current framework. The 2023 revision of the MRV system have increased the requirements on operators and verifiers but also created opportunities for process integration and data reuse synergies across regulatory regimes. This question therefore assesses the potential for cost reductions through harmonisation, automation, and procedural simplification, identifying measures that could enhance the robustness of the system while reducing redundant effort.

The analysis confirmed the maturity and robustness of the MRV maritime system but also identified some procedural overlaps and administrative inefficiencies that could be reduced through targeted digital and implementation improvements, in the absence of changes to the legislative framework. Most stakeholders perceive duplication not in the MRV design itself,

but in its co-existence with other regimes, particularly FuelEU Maritime and IMO DCS. Survey data show that around 80 % of respondents share MRV-related processes with these other compliance systems and over 90 % routinely cross-check data across regimes. Roughly half reported they encounter occasional discrepancies to reuse relevant data caused by divergent voyage definitions, aggregation rules or validation logic.

At the same time, the analysis found that developments undertaken in the THETIS-MRV IT system following the 2023 revision to prepare for the ETS extension to maritime and the targeted support to implementation provided by relevant authorities have been considerably reducing duplications in implementation and improving interoperability across systems already. This suggests that remaining cost-saving potential is likely to lie mainly in further digital alignment, additional and updated guidance, and possibly expanding targeted training opportunities for smaller operators and verifiers.

These targeted improvement elements within the existing MRV legislative framework for maritime are found to be achievable without compromising data quality or regulatory robustness. The priority should therefore be to enhance the integration and consistency of existing digital and methodological processes, rather than introduce new obligations, thereby reinforcing both efficiency and effectiveness of the MRV maritime framework.

- EQ6: What role can technology (e.g., digitalisation, automation) and increased harmonisation play in improving the efficiency of the MRV maritime system, and what investments are needed to realise these benefits?

This evaluation question explores how the use of technology (in particular digitalisation and automation) and the degree of harmonisation across processes, tools and actors, contribute to the efficiency of the EU maritime MRV system. It also considers what further investments may be required to fully realise these potential efficiency gains.

The assessment focuses on the extent to which the current digital infrastructure (notably the THETIS-MRV platform managed by EMSA) and the associated harmonised procedures (templates, verifier accreditation, common guidance, and data publication) reduce administrative effort, improve data quality and facilitate compliance for all actors involved. These include shipping companies, managers, verifiers, NABs, Member State authorities, EMSA and the European Commission. The evaluation considers both current efficiency gains achieved through digitalisation and harmonisation and remaining inefficiencies that hinder further optimisation, before identifying key investment priorities and potential future improvements such as enhanced interoperability, automation, and data exchange between systems.

Overall, the evidence indicates that further efficiency gains could primarily stem from deeper digital integration and automation, while long-term cost reductions and implementation consistency will depend on complementary investments in human and institutional capacity. Both strands are mutually reinforcing and should be pursued in parallel to consolidate the efficiency and effectiveness of the MRV maritime framework. The further consolidation of workflows within THETIS-MRV, the introduction of automated validation checks to detect potential outliers and typos, and the use of harmonised templates have markedly reduced already administrative duplication and facilitated consistency across companies, verifiers, and national authorities. Approximately half of the companies replying to the survey reported a positive experience with the IT platform, and a majority of verifiers indicated shorter verification cycles and fewer manual interventions compared to the MRV implementation phase before the revision (i.e. 2018-2023). Member States similarly acknowledged that the

centralisation of verified MRV data and shared access to Documents of Compliance have simplified enforcement and reduced redundant exchanges of information.

At the same time, the evaluation highlighted residual inefficiencies that limit the full realisation of these benefits. The most significant barriers identified by companies and verifiers relate to incomplete interoperability between THETIS-MRV and companies IT systems, which still requires partial manual data entry or file uploads. Other recurring concerns include usability and performance issues following system updates and limited analytical capacity and staff resources in several national administrations. These findings align with external analyses showing that while MRV data are reliable and comprehensive, overlaps with other reporting frameworks (e.g. IMO DCS) continue to impose redundant administrative effort.

Addressing these challenges will require targeted investment and capacity-building, both from regulators and business actors (i.e. shipping companies, verifiers, other services providers). Stakeholders and authorities emphasised the need for continued investments in API development and full automation of data exchanges, enhanced training and technical support for different user types, and reinforced cybersecurity and maintenance budgets as the THETIS-MRV system is being constantly updated to cater for both ETS and FuelEU Maritime requirements. Illustrative examples of potential efficiency improvements mentioned by stakeholders include:

- implementation of automated data transfers from fuel suppliers (e.g. through electronic Bunker Delivery Notes or fuel sustainability documentation) directly into THETIS-MRV.
- deployment of advanced analytics and Artificial Intelligence-based anomaly detection tools to support risk-based verification.
- enhanced API interoperability allowing companies' internal systems to exchange data directly with THETIS-MRV without manual uploads.

These examples illustrate that most efficiency gains expected in the next phase will derive from investments in deeper automation, stronger inter-system connectivity, and improved analytical capacity.

8.5.4.3 Relevance

This criterion was developed through two evaluation questions to assess to what extent the objectives and design of the MRV maritime system remain relevant to the objectives of the overall EU climate policy framework, including by addressing current and emerging challenges.

- EQ7: To what extent do the objectives and design of the MRV system remain relevant to the objectives of the compliance cycle and the overall EU climate policy framework, and are they still appropriate in light of the evolving regulatory context?

The assessment of this evaluation question focused on three key objectives of the MRV system:

- Provide harmonised, high-quality emissions data across all relevant ship categories and gases.
- Enable the effective implementation and enforcement of the EU ETS for maritime transport.
- Reduce administrative burden and ensure legal and regulatory certainty for operators and Member States.

These objectives were assessed against the relevance of the MRV system for the EU climate policy, its compatibility with the EU ETS and FuelEU Maritime compliance cycles, the usefulness of the data reported to different stakeholders groups, the responsiveness of the scope and structure of the system to sectoral changes, and the level of support of the reported data to EU ETS, FuelEU Maritime and the Renewable Energy Directive (RED) frameworks.

The analysis found that MRV provides accurate data on maritime greenhouse gas emissions and energy efficiency that serve as the primary data source for the operation of EU ETS and for the implementation of FuelEU Maritime requirements. Its scope is overall aligned with the EU ETS in terms of ships and emissions covered and its verification and reporting timelines are synchronized with EU ETS deadlines. As such, the MRV maritime system is closely aligned with the EU's climate policy, one of its key objectives being to support the implementation of the EU ETS compliance cycle.

The data collected under the MRV maritime system are relevant and useful for stakeholders beyond the scope of MRV compliance alone, being used for compliance with FuelEU Maritime, IMO DCS, as well as for ESG, internal energy management, customer reporting and financing purposes.

The MRV Regulation has demonstrated a high level of responsiveness to sectoral changes in maritime transport, aligning to evolving EU climate and transport legislation, market dynamics, and technological advancements. The expansion of its scope to include additional vessel types and greenhouse gases reflects a proactive approach to capturing more comprehensive emissions data, for instance in relation to the uptake of new fuels (e.g. LNG).

The MRV system provides essential support to the implementation of EU ETS, FuelEU Maritime, and RED III by supplying verified emissions and fuel consumption data that underpin relevant compliance and reporting mechanisms. Stakeholder feedback confirms the system's foundational role but also highlights areas for improvement, particularly insofar further alignment between MRV and EU ETS and FuelEU Maritime systems, usability, and digital integration.

- EQ8: To what extent are the scope and structure of the MRV system appropriate to address current and emerging challenges?

The readiness of the MRV system to adapt to current and emerging challenges was analysed in relation to the inclusion of non-CO₂ gases under its scope starting 2024 and in terms of its capability in handling the increased data quality and complexity stemming from the 2023 revision without compromising data quality or usability.

The analysis found that the monitoring and reporting provisions of the MRV maritime system have been broadly adequate in covering the newly included greenhouse gases (methane and nitrous oxide) and vessel categories (offshore ships and small general cargo vessels), following the 2023 revision. The secondary legislation developed following the revision provided clear templates and definitions, enabling technical adaptation of the THETIS-MRV platform and timely procedural adjustments by relevant stakeholders. However, the majority of surveyed companies and a significant share of verifiers, flagged the support for more detailed and more timely guidance on the legislative requirements of the system, so to ensure consistent implementation and further uphold stakeholder compliance under the expanded MRV scope.

The MRV maritime system has demonstrated a general capability to handle the increased data volume and complexity without compromising overall data quality or usability. Following the 2023 amendment, the THETIS-MRV IT platform, which companies, verifiers and

Administering Authorities are required to use to implement and enforce the system, accommodated the changes without performance degradation. While some of the respondents flagged potential technical improvements to further enhance efficiency and data accuracy, the IT system's core functionalities remain adequate, also thanks to EMSA ability to adapt it to emerging needs and inputs from users, as in the case of a built-in validation mechanisms to flag likely inconsistencies and errors, confirming the adaptability of the IT system to emerging needs.

8.5.4.4 Coherence

The evaluation of coherence assesses how well the MRV maritime system is functioning in a harmonised way with other regulatory frameworks pursuing or supporting shipping decarbonisation objectives, both at the EU level and globally. This criterion has been analysed through three evaluation questions, both to assess the overall systemic coherence with measures at global level (IMO DCS) and at the EU level (EU ETS, FuelEU Maritime, RED), but also to detect potential areas of conflict.

- EQ9: Has the MRV been coherent with the IMO DCS?

The MRV maritime system set in Regulation (EU) 2015/757 and the IMO DCS both require the monitoring and reporting of the fuel consumption from ships as means to inform policy makers and design policy tools towards the reduction of emissions from shipping. The basic general requirement of monitoring and aggregating fuel consumption data is therefore common to the two systems and the three monitoring methods being applied under the MRV system are also accepted under the IMO DCS. Despite such general design similarities, several details in the measures details result in divergences between the two systems. For example, the scope of affected ships is not fully harmonised, and the IMO DCS mandates fuel consumption reporting, excluding the quantification of greenhouse emissions. Differences also exist in the verification processes: the MRV system requires third-party independent verification, while the IMO DCS relies on flag state procedures based on IMO guidelines. A further area of divergence concerns data transparency. The MRV mandates full public disclosure of a defined set of data, capable of gaining a general understanding of the emissions and energy efficiency performance of the fleet, with granularity at ship level. In contrast, the IMO DCS only publishes anonymized, fleet-level aggregated data, through an annual report. The full alignment on these elements would imply structural changes to the MRV system, in a manner not compatible with the measure's effectiveness in delivering on its policy objectives.

On the contrary, there are some other divergencies between the two systems which could be mitigated without compromising the overall design of the measure, thus minimising administrative burden for operators. This is the case of some inconsistencies in definitions applicable to reporting parameters (e.g. on time and distance travelled), or in the type and detail of information required where the requirement to report fuel consumption by consumer type (e.g., engines vs. boilers) under IMO DCS could represent an added value also under the MRV system.

In conclusion, the evaluation underscored some divergences in the design and implementation of the MRV and IMO DCS system, which determine duplications for the entities required to comply with both schemes. Despite such differences which are mostly inherent to the different objectives of the measures, the evaluation identified the potential for closer alignment in respect to some limited reporting requirements and applicable definitions between the two system. To the extent that these remain compatible with the policy objectives and effectiveness of the MRV

maritime system, these could reduce the administrative burden for operators and further enhance the granularity of the reporting requirements under MRV.

- EQ10: Has the MRV maritime system been coherent with the EU ETS legal framework and, secondly, how well does the MRV maritime system align with other EU policies such as FuelEU and the RED?

The EU MRV is highly coherent with the EU ETS framework. This coherence is by design, as the MRV system provides the verified greenhouse gas emissions data required for ETS implementation for shipping. The coherence is ensured through definitions, cross references in key legal instruments, a common verification system for reported data, and an aligned administrative process which is integrated within the THETIS-MRV platform.

The MRV system used for ETS compliance and FuelEU Maritime are slightly less aligned while maintaining overall coherence. The different approaches to the regulated entity may result in two different entities being responsible for the same ship under FuelEU on the one hand, and under EU ETS/MRV on the other hand²⁹³. Further differences exist in the scope of application: FuelEU applies to a slightly different subset of ships in terms of size and type than the MRV system. The MRV system mandates the reporting of tank-to-wake (TtW) CO₂e emissions, whereas FuelEU requires the calculation of well-to-wake (WtW) GHG intensity. As a result, FuelEU requires additional fuel characteristics and life-cycle data that are not relevant under the MRV system. The monitoring and reporting requirements between MRV and FuelEU are generally aligned, but some divergences persist: FuelEU requires some additional parameters to be reported, which currently prevents the use of unique templates for reporting purposes (i.e. monitoring plans and emissions reports). Despite these differences, both systems share high consistency in the methods for monitoring fuel consumption, rules for determining emission factors, and procedures for verifying the sustainability and GHG savings of alternative fuels. Data submission by users is further facilitated by THETIS-MRV, as a shared digital single interface for compliance.

8.5.4.5 EU added value

- EQ11: To what extent has the MRV system delivered added value at EU level compared to what could have been achieved through acting by individual Member States?

The EU maritime MRV framework has delivered added value compared to what could have been achieved through uncoordinated national action. The Regulation replaced a fragmented landscape of partial or voluntary national initiatives with a harmonised, legally binding and verifier-based system covering all ships calling at EU ports. The establishment of common templates, definitions and accreditation procedures, supported by the mandatory use of a centralised THETIS-MRV IT platform, has ensured uniform data quality, administrative efficiency and transparency across Member States. The system has reduced compliance costs, avoided duplication and overlap of verification markets, and provided the methodological and technical foundation necessary for the integration of maritime transport into the EU Emissions

²⁹³ The definitions of the regulated entity under EU ETS/EU MRV and FuelEU Maritime are aligned. The legally non-binding FAQs of FuelEU Maritime explain that the ‘ISM Company’ distinct from the shipowner is the entity responsible for compliance with FuelEU Maritime. By contrast, under EU ETS and EU MRV, the regulated entity can be either the shipowner or the ISM Company, with the shipowner being the regulated entity by default. The ISM Company refers to the entity responsible for the compliance of a ship with the requirements of the International Management Code for the Safe Operation of Ships and for Pollution Prevention.

Trading System. In the absence of EU intervention, Member States would have implemented divergent or overlapping schemes, increasing costs and undermining data comparability and policy coherence. The EU-level approach has therefore generated economies of scale, ensured a level playing field for operators, and strengthened the overall effectiveness of the Union's climate-policy framework in the maritime sector.

- EQ12: To what extent has the EU-level MRV maritime system enabled results that would not have been possible through MS national systems alone, in terms of supporting ETS implementation and broader EU climate objectives?

The analysis found that the EU-level MRV maritime framework has enabled outcomes that Member States acting individually could not have achieved. By establishing a harmonised, verifier-based, and digitally integrated monitoring system, it provided the essential infrastructure for extending the EU ETS to maritime transport and for supporting the Union's broader decarbonisation objectives. The system's verified and transparent emissions database now serves as the reference for ETS compliance, the assessment of fuel and energy-efficiency measures, and evidence-based policy design across multiple climate instruments.

In the absence of EU intervention, Member States would likely have implemented divergent or voluntary monitoring schemes, leading to inconsistent data, higher administrative costs, and limited policy interoperability. The MRV system therefore represents a clear case of EU added value: it has created the analytical, regulatory and technical foundation for the integration of maritime transport into the EU climate framework and for the Union's leadership in global maritime decarbonisation.

8.5.5 Conclusions

The evaluation of the MRV maritime system confirmed the effectiveness and efficiency of the framework in ensuring the reporting of accurate, complete, and transparent greenhouse gas emissions data from maritime transport activities. The revision of the system, effective as of the 2024 reporting period, brought an expansion of the activities under scope as well as additional complexity for operators.

The evaluation found that stakeholders were overall well prepared and adapted quickly to these new challenges, thus ensuring that the MRV system could keep fulfilling its policy objectives as the ETS extension to maritime came to implementation. While the system can at present rely on a centralised digital infrastructure for reporting and compliance, on the use of uniform mandatory templates, and on robust support to implementation, some temporary adjustment frictions following the 2023 revision were detected during the evaluation. These may require closer attention by relevant authorities, in the form of sustained support to implementation, continuous adaptations of the IT infrastructure, and closer attention to potential capacity limitations in the verification and accreditation system.

Consulted stakeholders overall confirmed that administrative requirements are proportional to the benefits of the system and that the MRV maritime system is delivering its objectives cost-efficiently. While the evaluation found the average recurrent compliance cost per vessel to be in line with previous estimates, operators also highlighted having incurred one-off adjustment costs following the 2023 revision. Most of the consulted stakeholders indicated that MRV compliance costs are in fact shared with other reporting systems, such as EU ETS, FuelEU Maritime, or the IMO DCS, rather than being MRV-specific, and that MRV-derived data is used for other purposes within the company, including internal energy management, ESG goals, customer reporting, and financing. This indicates that MRV compliance costs for

operators are at least partially offset due to interdependencies with other regulatory frameworks or business goals.

Despite such evident synergies, the evaluation also identified some procedural overlaps and discrepancies between the MRV system and other regulatory frameworks mandating emissions and energy efficiency data reporting to the shipping sector. These may result in administrative inefficiencies for operators being required to comply with parallel yet somewhat divergent requirements under MRV, EU ETS, FuelEU Maritime, and IMO DCS. The evaluation found that some of these could be addressed under the current legislative framework through investments in deeper digital integration, automation in data management and reporting, further guidance and targeted training opportunities for users. Others, such as discrepancies in definitions, monitoring and reporting requirements, or overlaps in compliance processes, could be mitigated through legislative amendments to the MRV maritime Regulation or FuelEU Maritime, to be considered against their potential in terms of cost reductions and compatibility with the effectiveness of the measure. Aligning the approach to the regulated entity under FuelEU and EU ETS/MRV Maritime would ensure that one entity is responsible for compliance with the monitoring and reporting requirements under FuelEU and EU ETS/MRV Maritime. This would in turn enable the implementation of the monitoring-and-reporting-only-once principle.

In conclusion, the findings indicate that the MRV maritime system functions as a robust framework, which has demonstrated its capability to handle the increased data volume and complexity stemming from the 2023 revision without compromising overall data quality or usability, while delivering added value compared to uncoordinated national action efficiently. The evaluation found that rather than a structural overhaul of the system, incremental improvements through investments in technology and simplification initiatives could further enhance the harmonised and robust implementation of the system, thus ensuring the policy objectives of the measure and notably the adequate support to the ETS implementation for maritime transport.

8.6 Union Registry

8.6.1 Introduction

The Union Registry is a system of electronic databases established in 2012 and serves to guarantee accurate accounting for all allowances issued under the EU Emissions Trading System (EU ETS). The Union Registry hosts over 16 000 operator (compliance entity) and trading accounts. While the number of yearly transactions is below 100.000, the average value of allowances held on the accounts exceeds 200 billion EUR. This evaluation is based on the 2015 ETS Directive assessment, which examined the performance of the Union Registry. The assessment focuses on the Union Registry's effectiveness and efficiency in carrying out its key tasks, including the allocation, surrender, and cancellation of allowances, as well as the tracking of transfers and administration of central holding accounts. The overall goal of the evaluation is to determine whether the Union Registry can execute these tasks in a secure, robust, and cost-effective manner, ensuring the integrity and reliability of the system.

The ETS Directive provides the main requirements for the functioning of the Union Registry. The Directive stipulates that the Union registry holds all EU ETS allowances (EUAs) issued from 1 January 2012 onwards and executes processes related to account maintenance, allocation, surrender, and cancellation of allowances. The Union Registry must be public and allow anyone who fulfils the criteria (compliance entity or trading account) to hold allowances. And finally, Union registry must have modalities in place for undertaking transactions, implementing arrangements, and managing changes and incidents.

The Commission was empowered to adopt delegated acts to establish a standardised and secured system of the Union Registry that tracks and manages the issuance, holding, transfer, and cancellation of EUAs and other units. The Registry Regulation²⁹⁴ sets out rules for account management, allowance issuance, Kyoto units, and compliance, and establishes a centralised electronic database. The Registry Regulation enables the Union Registry to comply with the requirements for Phase IV set by the revised ETS Directive, for example by adjusting the functionalities so that allowances are valid indefinitely and can only be used to cover emissions as of the first year of the ten-year period in which they were issued, as well as to ensure that international credits cannot be used to cover emissions as of 2021. Moreover, the new Regulation was adapted following the classification of emission allowances as 'financial instruments' under Directive 2014/65/EU14 (MiFID2)²⁹⁵ as of 3 January 2018 and updated with the requirements of the revised data protection rules.

An essential component of the Union Registry is the EU Transaction Log (EUTL²⁹⁶). For transparency, the public website discloses all transactions older than three years. Additionally, it provides easy access to data for researchers, policymakers, and other stakeholders to analyse trends and make informed decisions.

The management of the system is shared by several stakeholders. The central administrator whose main responsibilities are to provide, operate and maintain the Union Registry, to manage

²⁹⁴ Commission Delegated Regulation (EU) 2019/1122 of 12 March 2019 supplementing Directive 2003/87/EC of the European Parliament and of the Council as regards the functioning of the Union Registry (Text with EEA relevance)

²⁹⁵ Directive 2014/65/EU of the European Parliament and of the Council of 15 May 2014 on markets in financial instruments and amending Directive 2002/92/EC and Directive 2011/61/EU (recast) Text with EEA relevance

²⁹⁶ As of 2024 the EUTL has changed its name to become Union Registry public website: <https://union-registry-data.ec.europa.eu/report/welcome>

central accounts and to perform operations which are carried out centrally (such as issuing of allowances).). The Commission assigned the task of the central administrator of the Union Registry to the Director General of DG CLIMA.

There are also national administrators who manage the accounts under their jurisdiction. It is the national administrators' main responsibilities to be the contact point with their respective account holders in the Union Registry and perform all operations involving direct contact with them, including the opening, suspension, and closure of accounts. To participate in the ETS, for compliance or trading of allowances, legal or natural persons must open an account in the Union Registry. To open an account, the persons must send a request to their respective national administrator, who collects and verifies all supporting documentation. Once their request is approved, they receive credentials to access their account on the Union Registry portal.

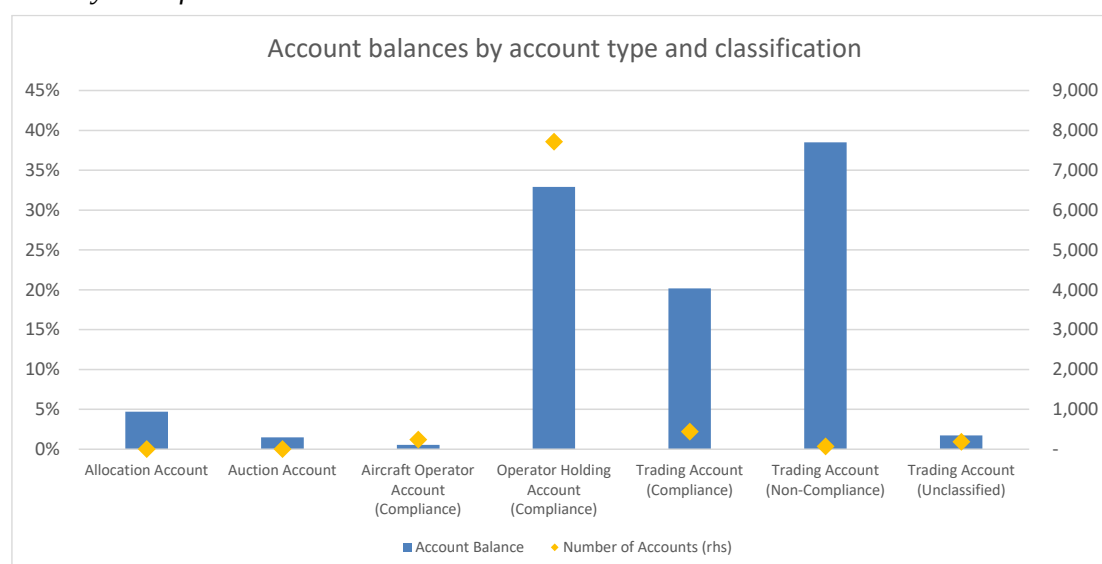
The Union Registry keeps records of the accounts of Member States and all transactions of EUAs performed. Furthermore, national implementation measures are documented, including the list of installations covered by the EU ETS in each country and the free allocations to each of those installations. The Union Registry also records annual verified CO₂ emissions from installations and aircraft operators, as well as the surrendered allowances by the compliance entities to ensure that they cover all verified emissions.

The Registry Regulation outlines the types of accounts to manage emissions allowances. operator holding accounts and aircraft operator accounts enable installations and aircraft operators to comply with their emissions. Person holding accounts allow market participants to buy, sell, or hold allowances. Trading accounts facilitate market transactions without compliance links. One allocation account and one auction account are both run by the Commission (Central Administrator), and represent the accounts used to distribute newly issued EUAs via free allocations and auctions, respectively. In 2022²⁹⁷, the analysis of the outstanding balance reveals that most allowances are held in Operator Holding Accounts and Trading Accounts.

There were almost 7,700 Operator Holding Accounts, holding around 33% of outstanding allowances. Combining this with the Trading Accounts of compliance operators, 53% of EUAs were held by compliance entities. Another 39% were held in the Trading Accounts of non-compliance entities.

²⁹⁷ ESMA report 'Emission Allowances and derivatives thereof'. In 2022 ESMA has analysed the data regarding emission allowances gathered from different sources, including EU Registry. The results of the analysis are the report

Figure 33: Share of outstanding account balances and number of accounts, by account type and entity classification.



Source: European Commission, GLEIF, Refinitiv, ESMA.

When looking at the balances and number of accounts, it's clear that EUAs are more concentrated in Trading Accounts than in Operator Holding Accounts. In fact, the top 10 companies hold 36% of all EUAs, and the top 100 companies hold 75%. This shows that a small number of companies control a large portion of EUAs.

However, it is important to state that compliance entities sometimes open trading accounts as well, in addition to the compulsory compliance account. In 2022, the Union Registry holds 3.1 billion general allowances and 38.5 million aviation allowances, worth about EUR 79 billion. Yearly, around 8 billion allowances, worth EUR 200 billion, are exchanged between accounts. It is imperative to safeguard the integrity of the Union Registry. Considering the high value of the allowances in the Registry, it is worth evaluating its functioning.

This evaluation primarily considers the provisions outlined in the ETS Directive in particular the principles governing the Registry system listed in Article 19. According to these principles, the Union Registry should be designed to ensure that:

- **Central Registry:** All allowances issued from January 1, 2012, onwards must be recorded in the Union Registry.
- **Public Access:** The Registry must be publicly accessible, allowing anyone to view the accounts and transactions of allowances.
- **Standardised Tracking:** The Registry must track the issuance, holding, transfer, and cancellation of allowances in a standardized and electronic format.
- **Transparency and Security:** The Registry must ensure transparency and security in its operations, including provisions for confidentiality, incident management, and change management, to maintain the integrity of the emission system.
- The **technical** details are to be laid down in a Regulation adopted by the Commission.

The technical specifications are outlined in the Registry Regulation and are generally outside the scope of this evaluation, except for one notable provision. Given the importance and value of the allowances and the number of transactions the functioning of the Union Registry requires resources. Article 81(2) of the Registry Regulation allows national administrators to impose “reasonable fees” on account holders for accounts under their administration, provided they

notify the European Commission. The Commission is then required to make this information publicly available on its website. However, the fees levied on accounts holders in the Union Registry vary substantially across Member States, prompting prolonged discussions on potential harmonization of these fees.

The Union Registry covers a variety of instruments, including EUAs, EUAA, Certified Emission Reductions (CERs) and Removal Units (RMUs) and their Swiss equivalents (CHUs & CHUAs). Indeed, the agreement on linking the EU ETS with Switzerland's ETS entered into force on 1 January 2020. To operationalise the link between the emissions trading systems, the parties agreed to establish a provisional solution for linking the two registries and enabling the transfer of allowances between them. Also, from 1 January 2019, the Commission suspended all processes for the UK relating to free allocation, auctioning and the exchange of international credits, in accordance with the safeguard measures to protect the environmental integrity of the EU ETS in cases where EU law ceases to apply to a Member State withdrawing from the EU.

The evaluation will focus on EUAs and EUAAs, which represent by far the largest proportion of the market.

8.6.2 Point of comparison

The Union Registry has been governed by the provisions laid out in Article 19 of the ETS Directive.

- (1) Allowances issued from 1 January 2012 onwards shall be held in the Union registry for the execution of processes pertaining to the maintenance of the holding accounts opened in the Member State and the allocation, surrender and cancellation of allowances under the Commission Acts referred to in paragraph 3. Each Member State shall be able to fulfil the execution of authorised operations under the UNFCCC or the Kyoto Protocol.
- (2) Any person may hold allowances. The registry shall be accessible to the public and shall contain separate accounts to record the allowances held by each person to whom and from whom allowances are issued or transferred.

The 2018 revision of the ETS Directive has added the empowerment for the Commission to adopt requirements for the functioning of the Union Registry, included in paragraph 3 of Article 19:

- (3) The Commission is empowered to adopt delegated acts in accordance with Article 23 to supplement this Directive by laying down all necessary requirements concerning the Union Registry for the trading period commencing on 1 January 2013 and subsequent periods, in the form of standardised electronic databases containing common data elements to track the issue, holding, transfer and cancellation, as applicable, of allowances, and to provide for public access and confidentiality, as appropriate. Those delegated acts shall also include provisions to put into effect rules on the mutual recognition of allowances in agreements to link emission trading systems.

On the basis of this empowerment, the Commission developed and adopted Commission Delegated Regulation (EU) 2019/1122 supplementing Directive 2003/87/EC of the European Parliament and of the Council as regards the functioning of the Union Registry (the Registry Regulation). The regulation covers several aspects, including the following:

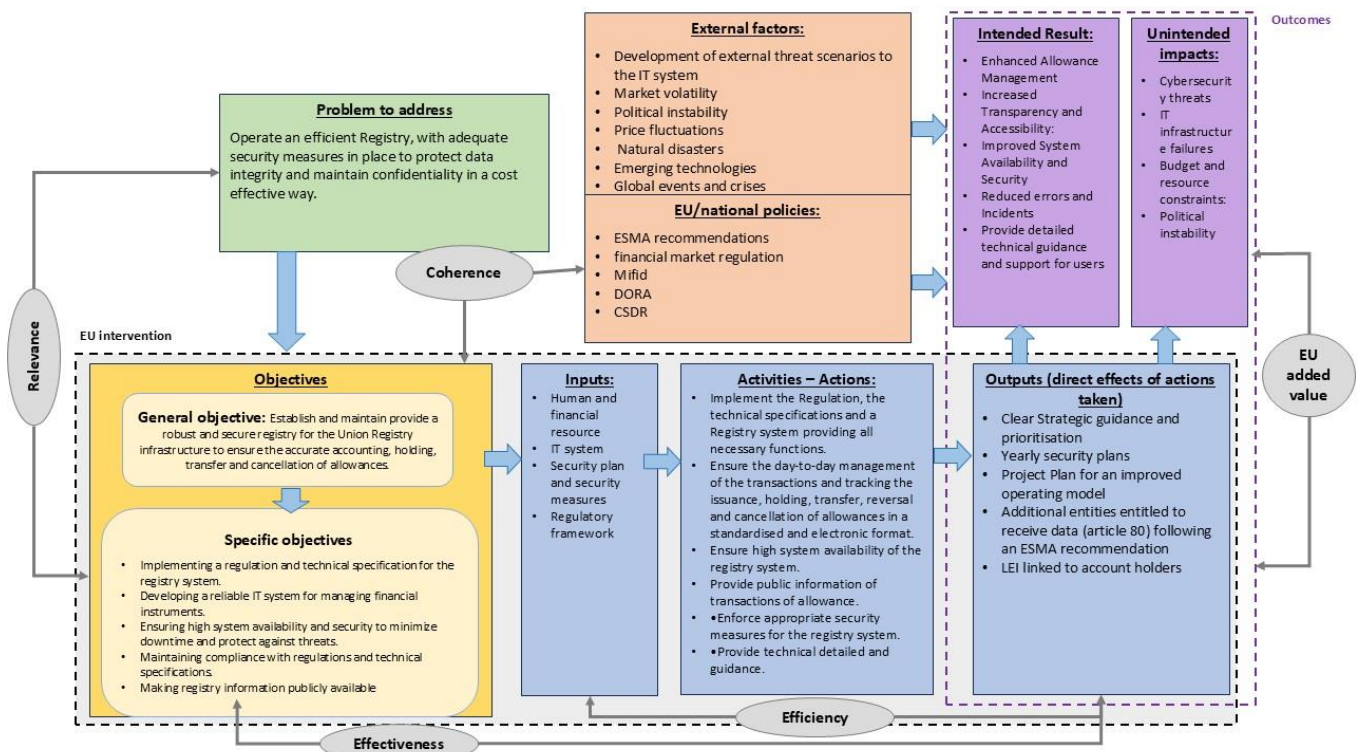
- The registries system is operated and maintained by a **central administrator** and **national administrators**.

- The regulation **simplifies rules on account management** with the aim of reducing the burden on national administrators.
- Specific rules for the EU ETS registry regarding issues such as:
 - verified emissions and compliance.
 - transactions, including rules on the execution of transfers and the creation, allocation and transfer of allowances.
 - trusted account lists for transactions above a particular threshold (value) to be set by the central administrator, to ensure high-value transactions are secure.
 - improving links between the EU ETS and other ETS schemes where a linking agreement has been concluded (e.g. the Swiss ETS – see [summary](#)).
- Where **discrepancies** are detected, the central administrator must ensure that the registry terminates the relevant processes and must inform the relevant account or allowance holders that the process has been terminated.
- **Technical rules and requirements** for the registry, including national helpdesks for account holders and representatives.

8.6.3 Intervention logic

Figure 34: Intervention logic Union Registry

Source: Own illustration



8.6.3.1 Problem to address

Operate an efficient Registry, with adequate security measures in place to protect data integrity and maintain confidentiality in a cost-effective way. Continuous evaluations of the Union Registry have identified structural issues inside the Commission that prevent from reaching appropriate security levels. This is expressed in a reservation in the AAR Commission's Annual Activity Report since 2010. Commission IT services are designed to support most IT

needs inside the Commission, but they do not come up to the levels required by the need to manage financial instruments.

8.6.3.2 Objectives

General objective:

The general objective is to establish and maintain a robust and secure registry for the Union Registry infrastructure to ensure the accurate accounting, holding, transfer and cancellation of allowances.

Specific objectives:

- The primary objective is to establish a comprehensive registry system. This involves implementing a Regulation for the registry system and a detailed technical specification that enables it to perform its intended functions efficiently and effectively.
- Providing an IT system that ensures appropriate management of financial instruments.
- Ensuring the registry system is reliable and accessible, a high level of system availability must be maintained to minimize downtime in case of system failures.
- Ensuring the security of the registry system and taking appropriate measures to protect it from potential threats.
- Ensuring compliance with the Regulation and technical specification.
- Making the information publicly available.

8.6.3.3 Actions

- Implement the Regulation, the technical specifications and a Registry system providing all necessary functions.
- Ensure the day-to-day management of the transactions and tracking the issuance, holding, transfer, reversal and cancellation of allowances in a standardised and electronic format.
- Ensure high system availability of the registry system.
- Provide public information of transactions of allowances.
- Enforce appropriate security measures for the registry system.
- Provide technical details and guidance.

8.6.3.4 Inputs:

- Human and financial resources to maintain the Registry system. IT system for the management of the financial instrument
- Security plan and security measures
- Strong regulatory framework

8.6.3.5 Outputs

- A fully functional Registry system with technical specifications and an implementation plan in place, providing all necessary functions for managing allowances.
- A standardised and electronic system for tracking and managing transactions, including issuance, holding, transfer, and cancellation of allowances.
- A highly available registry system with minimal downtime, ensuring continuous access to allowance management functions.
- Prevention of market abuse, so that integrity is ensured.
- A publicly accessible platform for viewing transactions of allowances, to ensure transparency and accountability.

- A comprehensive security plan for the Registry system, including measures to prevent security threats, with regular audits and reviews to ensure compliance.
- Detailed technical guidance and support for users of the registry system, including user manuals, training materials, and technical assistance, to ensure effective use and management of the system.

8.6.3.6 Intended Results

- **Enhanced Allowance Management:** Establish a fully functional Registry system and ensure that the registry system provides a robust and reliable platform for managing allowances, enabling efficient and effective tracking and management of transactions.
- **Improved System Availability and Security:** Ensure that the Registry system is highly available, secure, and compliant with relevant standards and regulations, minimizing downtime and preventing security threats.
- **Increased Transparency and Accessibility:** Provide a standardised and accessible platform for stakeholders to access information and manage allowances, promoting transparency and accountability.
- **Reduced errors and Incidents:** Reduce the number of incidents and errors associated with allowance management to ensure a more efficient and reliable system.
- Provide detailed technical guidance and support for users of the registry system, including user manuals, training materials, and technical assistance, to ensure effective use and management of the system.

8.6.3.7 Unintended results and impacts

- **Cybersecurity threats:** Hacking, phishing, and other cyberattacks can compromise the security and integrity of the Registry system.
- **IT infrastructure failures:** Failures of hardware, software, or network infrastructure can cause downtime, data loss, or system crashes.
- **Budget and resource constraints:** Limited budget or resources can restrict the Registry system's development, maintenance, or operation.
- Political instability.

8.6.3.8 External factors

- Development of external threat scenarios to the IT system
- Market volatility
- Political instability
- Natural disasters: Earthquakes, floods, or other natural disasters can damage or destroy infrastructure, causing system downtime or data loss.
- Emerging technologies: Rapidly evolving technologies such as artificial intelligence, or cloud computing, can challenge the Registry System.
- Global events and crises: Global events, such as pandemics, can create new challenges requiring adaptability and resilience.

8.6.4 Evaluation of findings

8.6.4.1 Effectiveness

The effectiveness of the Registry system will be evaluated via the following questions:

- EQ1: To which extent registry system was fully operational, with a reliable and accessible IT system that ensures efficient management?

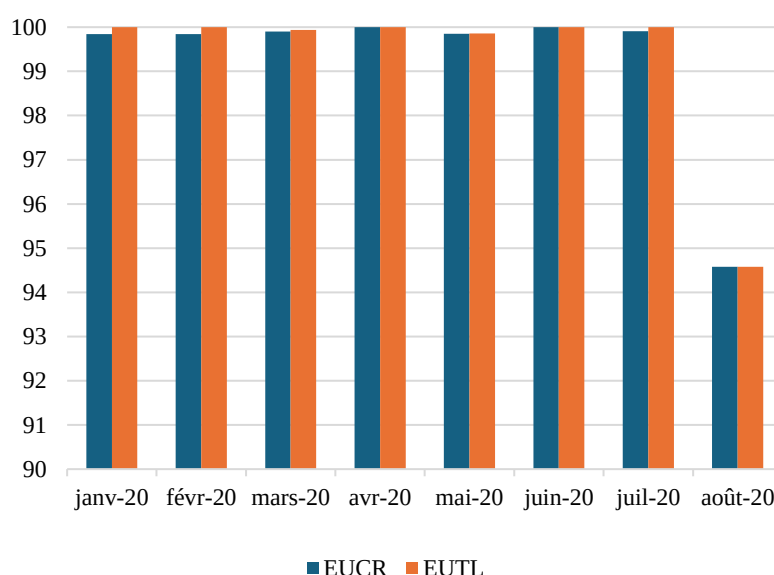
The Union Registry and the EUTL operated seamlessly for the entirety of 2018, with only minor technical interruptions totalling approximately 26 hours. These brief disruptions were necessary for scheduled upgrades and did not significantly impact overall functionality. In 2019, the system maintained its high level of performance, experiencing only minor interruptions that added up to around 7 hours, again due to technical upgrades²⁹⁸.

However, in 2020, the Union Registry encountered unexpected technical difficulties, resulting in a temporary unavailability on August 18, 2020. Several transactions were not processed correctly during this time. Prompt action was taken and troubleshooting and repair work were conducted between August 19 and 21. Following these efforts, the Union Registry resumed full operation, ensuring uninterrupted service to its users.

During the evaluation period, the Union Registry encountered several minor incidents, including technical glitches, EU Login issues, SMS routing problems, and network connectivity disruptions. Although these incidents were limited in scope and did not affect all users, they still caused brief disruptions to the service. This underscores the importance of ongoing maintenance and improvement efforts to guarantee stability, reliability, and overall performance of the system.

²⁹⁸ ETS Service Desk report

Figure 35: Availability of the registry system from January to August 2020



Source: ETS Service Desk

To ensure efficient management of allowances in the Union Registry by all stakeholders involved, including the Commission, the central administrator, Member States competent authorities, National Administrators, and account holders, the Commission provided a robust framework enshrined in the Terms of Cooperation adopted in accordance with article 7 of the Registry Regulation. This framework provides stakeholders with the necessary guidelines to operate the system in accordance with applicable regulations, including security and confidentiality requirements, protection of personal data, and the use of secure means of communication, as well as user education and development.

- EQ2: Is the information provided by the registry system accurate, up-to-date, and easily accessible to the public,

The data recorded in the Union Registry and the EUTL is an important source of information for various types of ETS reporting. The EUTL website serves as a vital resource for promoting transparency, accountability, and compliance within the EU ETS. By providing unrestricted access to data on emissions trading, the website enables the public to track the allocation, transfer, and surrender of allowances, as well as verified emissions from compliance entities participating in the system. This not only facilitates compliance monitoring but also fosters market integrity by preventing fraudulent activities and ensuring a fair and efficient trading environment. Furthermore, the website's easily accessible data enables researchers, policymakers, and environmental organizations to analyse trends, conduct studies, and make informed decisions.

Table 15: Compliance data 2018-2023: Public Union Registry

Year	Op. Reported	Op. Surrendered	Verified Emission	% YoY	Surrendered Units	%	Allocations
2023	10.481	8.390	1.150.199.843	-15,5 %	1.153.661.430	100,3 %	559.026.924
2022	10.560	8.460	1.361.850.781	-0,2 %	1.358.745.816	99,8 %	565.112.263
2021	10.879	8.573	1.364.436.716	-1,2 %	1.360.207.303	99,7 %	569.352.868
2020	12.094	9.982	1.380.952.173	-13,6 %	1.370.083.511	99,2 %	674.216.759
2019	12.385	10.372	1.598.557.918	-8,7 %	1.583.910.898	99,1 %	697.807.029
2018	12.523	10.505	1.750.590.404	-3,8 %	1.737.025.162	99,2 %	718.274.508

The Union Registry appears to meet transparency and accountability requirements by providing publicly available and regularly updated data on greenhouse gas emissions. The data, which covers the years 2018 to 2023, shows detailed information on the number of operators the verified emissions and the surrendered units.

However, one key challenge with using the EUTL data from a financial supervisory perspective was the limited availability of legal entity identifiers (LEIs) that can be used to uniquely pinpoint account holders/legal entities and match those with other data sources for market analysis purposes. LEIs were only recently introduced as a requirement to open an account in the Union Registry and are not consistently filled in by account holders and/or checked by the National Administrators.

- EQ3: To what extent do the technical rules and requirements for the Registry system, effectively support account holders and representatives?

The Union Registry provides access to the data to the National Administrators. They can access the necessary data concerning users, accounts, transactions and compliance data pertaining to accounts of the relevant Member State.

The Commission put in place measures to help users to operate the Union Registry to resolve technical issues and ensure the overall security and integrity of the system. The ETS Service Desk, set up by the Commission, acts as a second-level support for incidents related to the software and IT infrastructure of the Union Registry. Additionally, the Commission provides guidance, tools, and information²⁹⁹ to national helpdesks to improve their responses to incidents. The Commission also monitors the quality of incidents raised by national helpdesks and aims to improve response times and quality. Furthermore, the Commission supports national helpdesks in providing local support to account holders and authorized representatives, enabling them to resolve issues and help users.

- EQ4: Are the security measures in place sufficient to ensure integrity of the system and confidentiality of the data?

The Commission has implemented a security framework to protect the confidentiality and integrity of the data held in the EUTL and the Union Registry. A yearly IT Security Plan for

²⁹⁹ [Registry system - European Commission](#)

the Union Registry System has been developed to manage the security of the Registry System and implementing security measures to protect against potential threats. It identifies the system's functionality, roles and responsibilities, user population, operational status, and business requirements. The plan also conducts a business impact analysis to identify potential risks and assess the attractiveness of the assets to potential attackers. Additionally, it includes a risk assessment to identify potential security risks and selects treatment strategies to mitigate them.

The terms of cooperation³⁰⁰ contain also detailed security measures including on the confidentiality of sensitive information. Minimum security requirements have also been established for account holders. Secure means of communication are also used to prevent unauthorised access to the Union Registry. Furthermore, national administrators and the central administrator are required to exchange security-related data, including information on breaches and temporary suspensions of access, through secure channels to ensure the proper functioning of the Union Registry and protect the personal data of account holders and authorized representatives.

The integrity of the data in the system has been evaluated high, as only very few incidents have led to inconsistencies in the data. One single major incident occurred during a database operation in 2022 due to human error. No confidentiality breaches such as data theft or accidental publication have been observed.

However, since 2012, the DG CLIMA has expressed concerns about IT security related the Union Registry in its Annual Activity Report. The European carbon market has experienced significant growth, with the total asset value in the Union Registry now exceeding EUR 200 billion. The carbon price has also been steadily increasing since 2014, rising from approximately EUR 6 to EUR 85 in 2022, and reaching a peak of EUR 100 in 2023. Furthermore, over the past decade, the regulatory environment for financial market institutions has undergone significant changes, and the risk of cyber-attacks from foreign states or hostile actors against the EU has increased. As a result, the IT risk landscape is evolving rapidly, necessitating additional security measures to mitigate these growing threats.

The 2019 risk assessment confirmed several vulnerabilities to be addressed in a 'security plan' involving 12 reinforcing security measures and the unusually high residual risk situation was escalated in September 2019 to the IT and Cybersecurity Board (ITCB) for advice. In addition, an independent study was commissioned in 2019 to benchmark the resources and operating model of the Union Registry against other institutions with comparable systems. The results highlighted significant weaknesses in terms of economic and human resources.

A subsequent study³⁰¹ was launched in December 2020 on potential alternative operating models for the Union Registry concluding that there was a pressing need to reduce the persistently high risks resulting from holding and handling high value assets that the current operating model fails to address.

A risk assessment was finalised in July 2022. It reconfirmed that the risk landscape had evolved in such a way that the 2019 measures even upon completion would not result in acceptable risk levels. A new security plan was proposed in 2022 that recommends finalising the

³⁰⁰ According to Article 7(4) of Regulation 2019/1122, the central administrator and the national administrators shall agree on the terms of cooperation that shall include common operational procedures,

³⁰¹ Union Registry Operating Model Study, Deloitte

implementation of the measures from the previous plan (2019) and suggested 10 additional measures. Challenges to operate the system in the Commission internal governance structure facing the budgetary and HR constraints, remain. Therefore, a new business operating model is required to address thoroughly the remaining issues to reach highest compliance with applicable financial market frameworks.

The Union Registry's security framework has some strengths, such as the implementation of security measures and low incidence of data inconsistencies. However, the effectiveness of the Union Registry's security framework is compromised by the inadequacies in its operating model and the evolving IT risk landscape, which necessitate additional security measures and a new business operating model to mitigate the growing threats.

8.6.4.2 Efficiency

The efficiency of the Registry system is evaluated on the basis of the following question:

- EQ5: Are there significant differences in registry fees charged by Member States and if yes what is causing them?

Article 81(2) of the Registry Regulation stipulates that national administrators may charge reasonable fees to account holders administered by them. This gives national administrators considerable leeway in determining the fees. The fees charge by the national administrators are published on the Commission's website³⁰². The fees vary with some countries charging no fees and others imposing substantially high charges for the opening, maintenance/management of accounts. Notably, several Member States, including Cyprus, Estonia, Finland, Germany, Malta, Netherlands, and Sweden, do not charge any fees for certain account types. In contrast, countries like Hungary, Latvia, Italy, and Poland have higher fees. For example, Hungary's trading account fee is EUR 5/tCO₂/year, and Portugal's fees range from EUR 107.24 to EUR 1,072.40 for different account types. Some Member States differentiate the fee based on the amount of verified emissions, such as Austria with fees ranging from EUR 450 to EUR 15 862; some also add a fee for changing name or authorised representatives of the account. For instance, Belgium charges a uniform fee of EUR 600.71 for all account types, whereas France has a tiered fee structure, with Operator Holding Accounts and Aircraft Operator Holding Accounts incurring fees between EUR 500 and EUR 3,500. Denmark's fees are in Danish Krone (DKK), with a range of 10,500 DKK to 350,000 DKK.

The structure and amount of the fee vary considerably across the Member States. The Registry Regulation provides a framework within which Member States can decide on the fees related to the registry services they offer. Each Member State has the autonomy to determine the specific structure and amount of these fees, resulting to variability across countries.

³⁰² https://climate.ec.europa.eu/eu-action/carbon-markets/eu-emissions-trading-system-eu-ets/union-registry_en#fees

Table 16: Overview of the fees³⁰³

Member State	Operator Holding Account	Aircraft Operator Holding Account	Trading Account	Verifier Account
Austria	EUR 450 - EUR 15,862	EUR 450 - EUR 15,862	EUR 1,700	EUR 0
Belgium	EUR 600,71	EUR 600,71	EUR 600,71	EUR 0
Bulgaria	EUR 100	EUR 100	EUR 175	EUR 50
Cyprus	EUR 0	EUR 0	EUR 0	EUR 0
Croatia	EUR 0	EUR 0	EUR 0	EUR 0
Czech Republic	EUR 47.62	EUR 47.62	EUR 59.52	EUR 0
Denmark	DKK14,000 - DK 350,000	DKK 14,000 - DK 350,000	DKK10,500	DKK7,200
Estonia	EUR 0	EUR 0	EUR 300	EUR 0
Finland	EUR 570	EUR 1620	EUR 570	EUR 570
France	EUR 500 - EUR 1250	EUR 500 - EUR 3,500	EUR 1,100- EUR 1,250	EUR 0
Germany	EUR 0	EUR 0	EUR 393	EUR 0
Greece	EUR 100 - EUR 300	EUR 300	EUR 300	EUR 0
Hungary	5/tCO ₂ /year	5/tCO ₂ /year	HUF 150,000/year	EUR 0
Iceland	ISK72200	ISK 72200	ISK72200	ISK72200
Ireland	EUR 350	EUR 350	EUR 1,000	EUR 0
Italy	EUR 400	EUR 400	EUR 700	EUR 500

³⁰³ Overview of the fees charge by the Member States: the table does not reflect all the disparities regarding the fees; detailed information can be found on the website: https://climate.ec.europa.eu/eu-action/carbon-markets/eu-emissions-trading-system-eu-ets/union-registry_en

Latvia	EUR 95.70 - EUR 957	EUR 95.70 - EUR 957	EUR 803 - EUR 1,276	EUR 638
Liechtenstein	EUR 3,000	EUR 3,000	EUR 3,000	EUR 3,000
Lithuania	EUR 144	EUR 144	EUR 144	EUR 144
Luxembourg	EUR 500	EUR 500	EUR 500	EUR 0
Malta	EUR 0	EUR 0	EUR 0	EUR 0
Norway	NOK 9500	NOK 9500	NOK 9500	NOK 9500
Netherlands	EUR 0	EUR 0	EUR 400	EUR 0
Poland	PLN 2000	PLN 2000	PLN 2000	0
Portugal	EUR 375,34 - 750,68	EUR 375,34 - 750,68	EUR 1.072,00	EUR 857,92
Romania	EUR 200	EUR 200	EUR 300	EUR 250
Slovakia	EUR 500	EUR 500	EUR 625	EUR 0
Slovenia	EUR 100.15	EUR 100.15	EUR 50.07	EUR 0
Spain	EUR 575	EUR 575	EUR 805	0
Sweden	EUR 0	EUR 0	SEK 2000	EUR 0
United Kingdom (Northern Ireland)	£284	0	0	0

- EQ6: In what way the Union Registry has been operated cost effectively?

The annual costs to operate and maintain the Registry has been estimated at EUR 8 million. However, the studies on the Union Registry Operating Model underlined that the current economic and human resources are not sufficient to fully protect the confidentiality and integrity of the data held in the EUTL and the Union Registry. The European carbon market has experienced significant growth, with the total asset value in the Union Registry now exceeding EUR 200 billion, and the carbon price has been steadily increasing, making it an attractive target for cyber-attacks. Challenges in operating the system within the Commission's internal governance structure, facing budgetary and human resources constraints, remain. The studies informed that a new operating model would be required to thoroughly address the remaining issues and achieve the highest compliance with applicable financial market frameworks. An evaluation of the costs needed to have adequate infrastructure indicates that the proposed amount needed is EUR 30-40 million per year. This investment would be justified, as the cost of a proper infrastructure would represent only 0.00016% of the assets hold in the

Union Registry and would ensure the integrity and security of the system and the European carbon market. The creation of a new infrastructure would be essential to mitigate the growing threats and address the remaining issues, and the investment would be a critical step in maintaining the trust and stability of the European carbon market. The efficiency of the Union Registry, regarding the value of the assets, is linked to the creation and improvement of the IT infrastructure.

8.6.5 Conclusion

The evaluation of the Union Registry from 2018 to 2023 demonstrates its effectiveness in maintaining a reliable and secure IT system for tracking the creation, allocation, surrender, and reversal of allowances. The Registry operated efficiently, maintaining 99% uptime despite scheduled upgrades and minor technical issues, particularly in 2020. It successfully provides accurate, up-to-date, and publicly accessible information vital for ETS reporting, ensuring transparency and accountability while supporting compliance monitoring, market integrity, and informed decision-making. However, the Registry encounters challenges such as the limited LEIs, impacting financial supervisory capabilities, though integration is underway. Furthermore, while the security framework developed has protected data confidentiality and system integrity, emerging threats necessitate ongoing enhancements. The Registry's cost efficiency reveals significant fee variations across Member States and limitations in resources, which are crucial for system confidentiality and integrity. To address the evolving threats and resource constraints faced by the Union Registry, enhancements would be recommended. Studies suggest adapting security measures to meet increasing IT risks and market changes, ensuring the system's integrity remains robust. Strengthening the infrastructure security and revising the operating model would be necessary to align with financial market frameworks. Investment in a new operating model, estimated at EUR 30-40 million annually, would enhance these security measures without posing a significant financial burden, representing only 0.00016% of the assets held within the Registry. This investment would guaranty the overall security and integrity of the system and ensuring the credibility and reliability of the European carbon market.

8.7 Auctioning

8.7.1 Introduction

Since January 2013 auctioning is the default method for allocating allowances within the European Union Emission Trading System (EU ETS). The auctioning system plays a vital role in the EU ETS, enabling Member States to generate revenues while promoting a market-based approach to reduce greenhouse gas emission. Between 2015 and 2023, over 5 billion allowances were auctioned, generating more than 169 billion EUR.

The ETS Directive³⁰⁴ establishes a regulatory framework for auctioning allowances. As of 2019, Member States are mandated to auction all allowances that are not allocated free of charge, with a share of 57% of allowances to be auctioned from 2021 onwards. The distribution of auctioned allowances among Member States is determined by a combination of factors, including historical emissions from installations covered by the ETS, with 90% of the total allowance volume allocated to Member States according to their verified emissions and 10% allocated to support solidarity, growth, and interconnections among Member States. The Directive ensures that revenues generated from the auctioning of allowances are reinvested in efforts to reduce greenhouse gas emissions and promote a low-carbon economy.

Pursuant to Article 10(4) of the ETS Directive, the Commission is empowered to adopt a delegated act that outlines the timing, administration, and other key aspects of the auctioning process. To ensure the integrity and effectiveness of this process, operators, and in particular small and medium-sized enterprises (SMEs) as well as small emitters covered by the EU ETS, must have full, fair and equitable access to the auctions and have simultaneous access to the same information. Additionally, the organisation and participation in the auctions should also be cost-efficient. The Auctioning Regulation³⁰⁵ consequently complements these core requirements and establishes a robust framework for ensuring the transparency and efficiency of the auction process.

In 2018, the Auctioning Regulation was revised to align with the new EU ETS rules for the 2021-2030 period. The revised regulation introduced additional requirements namely the classification of EU ETS allowances as financial instruments under Directive 2014/65/EU³⁰⁶ on markets in financial instruments (MiFID2). Those requirements strengthened the integrity of the carbon market by preventing market abuse, money laundering, and terrorist financing. New requirements have also been introduced for the determination of the annual auction volumes, which can be reduced by up to 3% in certain circumstances.

From 2021 the European Investment Bank (EIB) was appointed to auction allowances for the Innovation Fund and the Modernisation Fund. In addition, the auctioning system was sufficiently agile to make quick adjustments that allowed, as of July 2023, the auctioning of

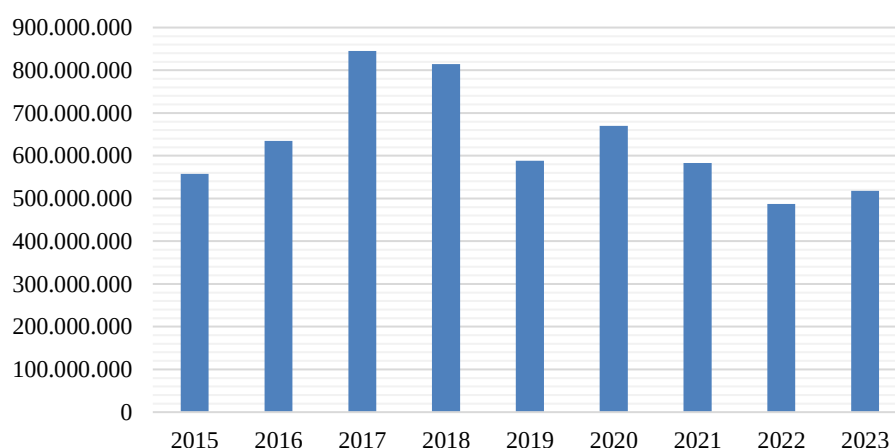
³⁰⁴ Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC (Text with EEA relevance)

³⁰⁵ Commission Regulation (EU) No 1031/2010 of 12 November 2010 on the timing, administration and other aspects of auctioning of greenhouse gas emission allowances pursuant to Directive 2003/87/EC of the European Parliament and of the Council establishing a scheme for greenhouse gas emission allowances trading within the Community Text with EEA relevance

³⁰⁶ Directive 2014/65/EU of the European Parliament and of the Council of 15 May 2014 on markets in financial instruments and amending Directive 2002/92/EC and Directive 2011/61/EU (recast) Text with EEA relevance

allowances to generate EUR 20 billion for the Recovery and Resilience Facility (RRF) under the REPowerEU Regulation (Regulation 2023/435)³⁰⁷

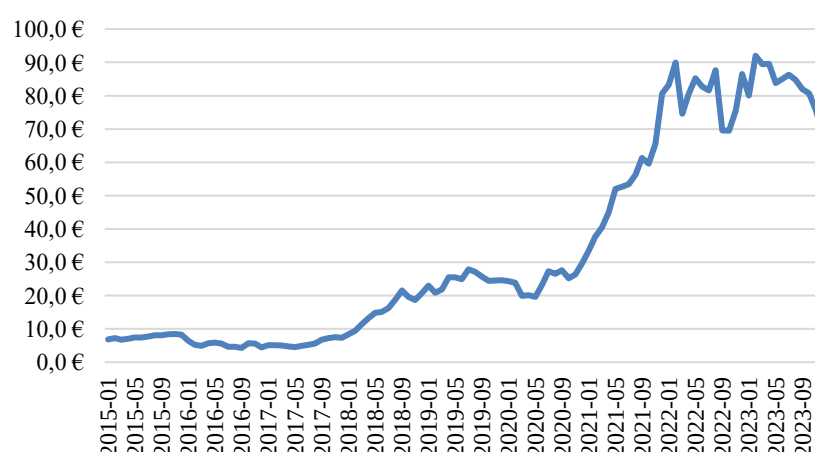
Figure 36: Volumes of allowances auctioned by EEX from 1 January 2015 to 31 December 2023



Source: EEX data, Own illustration

In 2018, the EU ETS auctioned 815 million allowances. Since 2019, with the introduction of the Market Stability Reserve (MSR), the auctions volumes are adjusted based on the surplus or deficit of allowances above or below pre-defined levels. This has stabilised the allowances market. Some surplus was observed in 2020 and 2021 during the COVID-19 pandemic. In that period, the drop in industrial production led to a decrease in the need of allowances. Other mechanisms such as the Linear Reduction Factor (LRF) have played a crucial role in stabilizing the allowances market. The increase in auctioned volume in 2023 reflects the additional volumes allocated to the Recovery and Resilience Facility (RRF) under the REPowerEU Regulation.

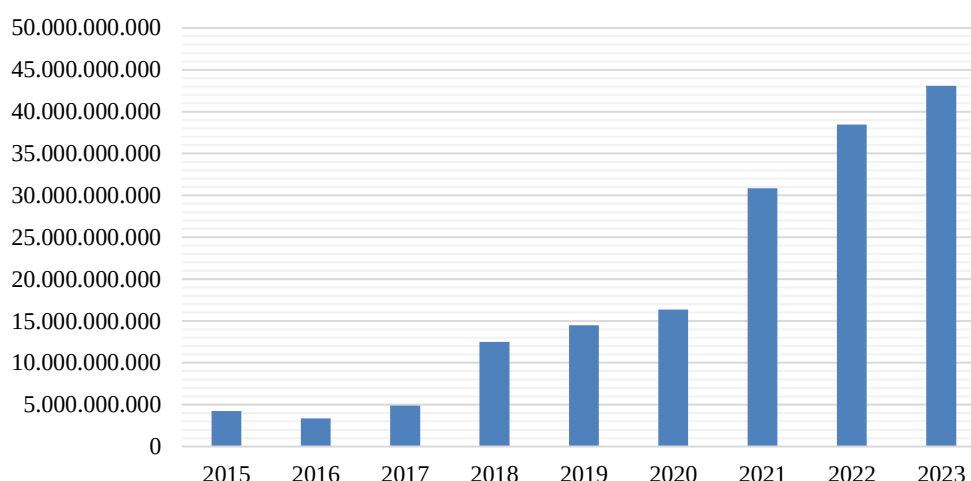
Figure 37: Evolution of the average monthly clearing price from 1 January 2015 to 31 December 2023



Source: EEX data, Own illustration

³⁰⁷ Regulation (EU) 2023/435 of the European Parliament and of the Council of 27 February 2023 amending Regulation (EU) 2021/241 as regards REPowerEU chapters in recovery and resilience plans and amending Regulations (EU) No 1303/2013, (EU) 2021/1060 and (EU) 2021/1755, and Directive 2003/87/EC

Figure 38: Auction revenues from 1 January 2015 to 31 December 2023



Source: EEX data, Own illustration

The increase in EU ETS revenues between 2021 and 2023 can be attributed to a combination of factors, including higher clearing prices, increased auction volumes, and changes in the energy market. Indeed, the EU ETS Phase IV introduced several changes, including a more ambitious emissions reduction target (-61% by 2030 compared to 2005 levels) and a higher linear reduction factor (2.2% per year).

The substantial volume of allowances and resulting revenues generated through auctioning make it a critical component to assess within the EU ETS. Following up on the 2015 Evaluation of the ETS Directive, this evaluation focuses on the auctioning process, covering the period from January 2015 to 2023.

Auctions are used to allocate two types of allowances: European Union Allowances (EUAs) and Aviation Allowances (EUAAAs). EUAs can be purchased by any entity and surrendered for compliance by stationary or aircraft operators, whereas EUAAAs can be bought by any entity but can only be surrendered for compliance by aircraft operators. The volume and frequency of EUAA auctions are significantly lower than those of EUA auctions, primarily due to the scope of EUAAAs, limited to the aviation sector. The high percentage of allowances allocated for free in the aviation sector and the reduced coverage of flights, as per Regulation 189/2014 (following the "stop-the-clock" Decision 2014/746), also contribute to this disparity. As a result, the conclusions drawn in this section primarily apply to EUA auctions, although they may also be relevant to EUAA auctions to the extent that they are auctioned on the same platform and follow the same rules and procedures.

Following the United Kingdom's withdrawal from the European Union, the UK's emissions are no longer part of the EU ETS. This evaluation will therefore exclude the allowances that were previously auctioned on the Intercontinental Exchange (ICE) platform for the UK.

This evaluation primarily considers the provisions outlined in the ETS Directive³⁰⁸, in particular the principles of auction design listed in Article 10(4). According to these principles, auctioning should be designed to ensure that:

³⁰⁸ The Auctioning Regulation is not a primary focus of this evaluation

- auctioning is conducted in an open, transparent, harmonised and non-discriminatory manner.
- operators, and any SMEs covered by the EU ETS, have full, fair and equitable access.
- all participants have access to the same information at the same time and that participants do not undermine the operation of the auctions.
- the organisation of, and participation in, the auctions is cost-efficient and undue administrative costs are avoided; and
- access to allowances is granted to small emitters.

The auction system has been in operation for several years. For the purpose of this evaluation, we focused on assessing its effectiveness and efficiency, as these aspects can be more readily measured. Other evaluation criteria, such as relevance and coherence, are more challenging to quantify and would require additional data or counterfactual scenarios. Therefore, our evaluation will primarily examine how well the individual components of the auction system are functioning and whether they are achieving their intended objectives.

8.7.2 Point of comparison

Provisions of relevance from the 2018 ETS Directive

Following the revision to the ETS Directive in 2018, several changes have been made that are relevant to the auctioning process. The changes concern the overall share of allowances to be auctioned, as well as their distribution to the Member States and to the Modernisation and Innovation Funds, established for Phase IV of the ETS. The main legal provisions are as follows:

- Article 10, paragraph 1 was amended as follows:

From 2021 onwards, and without prejudice to a possible reduction pursuant to Article 10a(5a), the share of allowances to be auctioned shall be 57 %.

- Article 10, paragraph 1, was amended as follows:

2 % of the total quantity of allowances between 2021 and 2030 shall be auctioned to establish a fund to improve energy efficiency and modernise the energy systems of certain Member States as set out in Article 10d ('the Modernisation Fund').

- Article 10a, paragraph 8, was added as follows:

325 million allowances from the quantity which could otherwise be allocated for free pursuant to this Article, and 75 million allowances from the quantity which could otherwise be auctioned pursuant to Article 10, shall be made available to support innovation in low-carbon technologies and processes in sectors listed in Annex I, including environmentally safe carbon capture and utilisation ('CCU') that contributes substantially to mitigating climate change, as well as products substituting carbon intensive ones produced in sectors listed in Annex I, and to help stimulate the construction and operation of projects that aim at the environmentally safe capture and geological storage ('CCS') of CO₂, as well as of innovative renewable energy and energy storage technologies; in geographically balanced locations within the territory of the Union (the 'innovation fund'). Projects in all Member States, including small-scale projects, shall be eligible.

In addition, 50 million unallocated allowances from the market stability reserve shall supplement any remaining revenues from the 300 million allowances available in the period

from 2013 to 2020 under Commission Decision 2010/670/EU (5), and shall be used in a timely manner for innovation support as referred to in the first subparagraph.

- Article 10, paragraph 2 (a) was amended as follows:

The total quantity of allowances to be auctioned by each Member State shall be composed as follows: 90 % of the total quantity of allowances to be auctioned being distributed amongst Member States in shares that are identical to the share of verified emissions under the EU ETS for 2005 or the average of the period from 2005 to 2007, whichever one is the highest, of the Member State concerned;

- Article 10, paragraph 2 (b) was amended as follows:

10 % of the total quantity of allowances to be auctioned being distributed amongst certain Member States for the purposes of solidarity, growth and interconnections within the Union, thereby increasing the number of allowances that those Member States auction under point (a) by the percentages specified in Annex I.

- While the above provisions in the ETS Directive are relevant for determining the quantity and distribution of allowances to be auctioned, the main provision that lies at the basis of the detailed rules for the functioning of the auctioning system can be found in Article 10, paragraph 4 as follows:

The Commission is empowered to adopt delegated acts in accordance with Article 23 to supplement this Directive concerning the timing, administration and other aspects of auctioning, in order to ensure that it is conducted in an open, transparent, harmonised and non-discriminatory manner. To that end, the process shall be predictable, in particular as regards the timing and sequencing of auctions and the estimated volumes of allowances to be made available.

On the basis of the empowerment in Article 10(4) of the ETS Directive, the Commission developed and adopted the Commission Regulation (EU) No 1031/2010 of 12 November 2010 on the timing, administration and other aspects of auctioning of greenhouse gas emission allowances pursuant to Directive 2003/87/EC of the European Parliament and of the Council establishing a system for greenhouse gas emission allowances trading within the Union (**the Auctioning Regulation**). The main elements regulated in the Auctioning Regulation, are as follows:

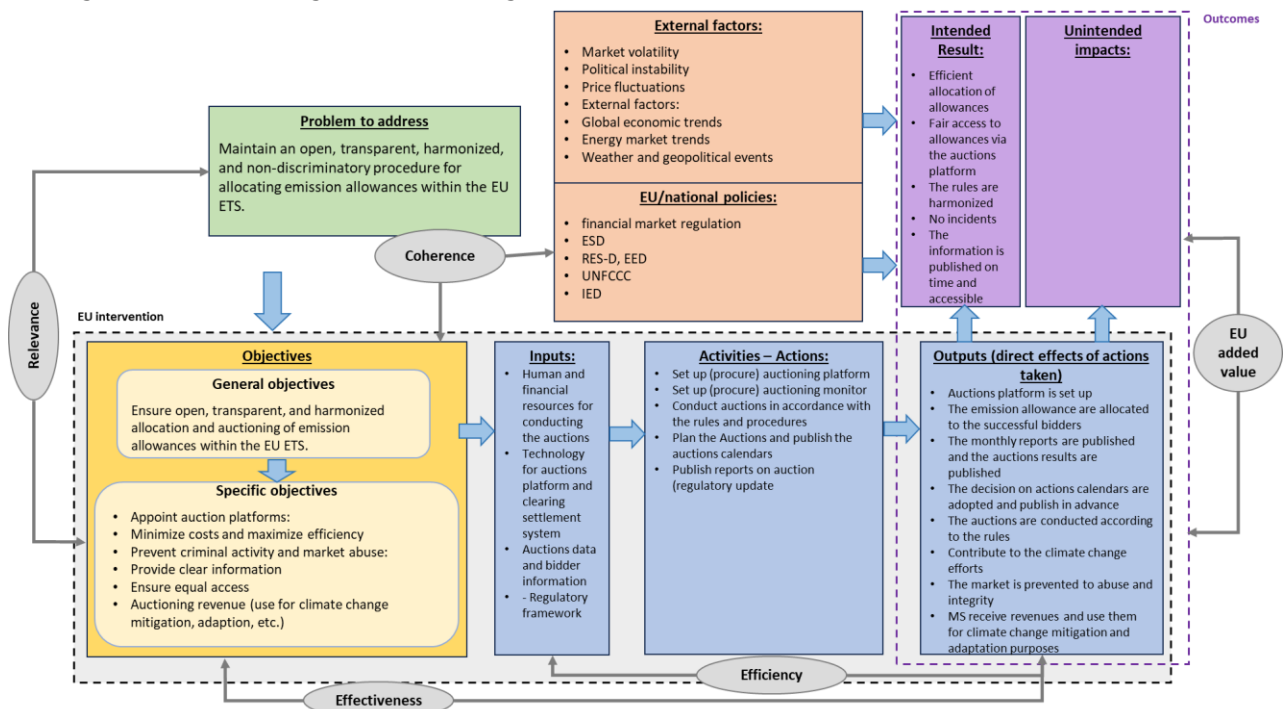
- the design of auctions (auctioned products, auction format, submission and withdrawal of bids, auction clearing price and resolution of tied bids).).
- auction calendars (timing, frequency and distribution of the volume of allowances, circumstances preventing auctions from taking place, annual volumes of auctioned allowances).).
- access to auctions.
- appointment of auctioneer(s) and related tasks.
- procedures for the cancellation of allowances.
- appointment of a common auction platform and services that the platform provides to Member States and the Commission.
- appointment and tasks of opt-out auction platforms (where a Member State does not participate in the appointment of the common auction platform).

During the evaluation period, the Auctioning Regulation was amended three times by:

- Commission Regulation (EU) 2017/1902 of 18 October 2017 amending Commission Regulation (EU) No 1031/2010 to align the auctioning of allowances with Decision (EU) 2015/1814 of the European Parliament and of the Council and to list an auction platform to be appointed by the United Kingdom.
- Commission Delegated Regulation (EU) 2019/7 of 30 October 2018 amending Regulation (EU) No 1031/2010 as regards the auctioning of 50 million unallocated allowances from the market stability reserve for the innovation fund and to list an auction platform to be appointed by Germany.
- Commission Delegated Regulation (EU) 2019/1868 of 28 August 2019 amending Regulation (EU) No 1031/2010 to align the auctioning of allowances with the EU ETS rules for the period 2021 to 2030 and with the classification of allowances as financial instruments pursuant to Directive 2014/65/EU of the European Parliament and of the Council.

8.7.3 Intervention logic

Figure 39: Auctioning Intervention logic



Source: Own illustration

8.7.3.1 Problem to address

Maintain an efficient allocation mechanism for allocating emission allowances

8.7.3.2 Objectives

The general objective is to ensure an open, transparent, harmonised and non-discriminatory auctioning allocation of emission allowances within the EU ETS. This is essential for the operation of the EU ETS as it distributes more than half of the quantity of ETS allowances (the share not allocated for free to installations at risk of carbon leakage) and creates the basis for the functioning of the carbon market and the formation of a carbon price.

A key part of this objective is to operationalise and implement the detailed provisions necessary to ensure the functioning of the auctioning system, reflected in the following specific objectives:

- **Appoint auction platforms:** the auction platform should be set up and function as intended, the auctions should be conducted according to the rules and procedures.
- **Minimize costs and maximize efficiency:** the auction process should be designed to reduce costs for participants and the auction platform, optimise the use of resources, minimise administrative burdens and ensure a smooth and efficient auction process.
- **Monitoring and preventing criminal activity, market abuse and ensure integrity:** the auction process should be monitored to prevent and detect criminal activities, market manipulation and abusive practices and ensure the integrity of the auction process and the EU ETS as a whole.
- **Providing clear and accessible information to participants:** ensuring that the participants have the necessary information to participate in the auctions and keeping them informed about the auction process and results.
- **Participants:** ensuring that all eligible participants, in particular SMEs and small emitters, have equal access to the auction process and a clear understanding of the auction rules and procedures.
- **Auctioning revenue use:** the revenues generated from the auctions should be used in accordance with the Directive.

8.7.3.3 Inputs

The successful implementation of the auctioning system depends on several key inputs:

- the issuance of allowances is crucial, as it determines the quantity of units to be auctioned and provides a foundation for the entire process.
- sufficient human and financial resources to procure the auction platform is essential for conducting the auctions efficiently and effectively as well as the collaboration with the national competent authorities.
- a reliable technology infrastructure, including a robust auction platform and clearing settlement system, is also vital to ensure the smooth operation of the auctions.
- access to accurate and timely auctions data, as well as information, is necessary to monitor the auction process and make informed decisions.
- a well-defined regulatory framework is required to provide a clear and stable environment for the auctioning system to operate, outlining the rules, guidelines, and standards that govern the auctions and ensuring their integrity and transparency.

8.7.3.4 Actions

A series of targeted actions have been taken to strengthen the auctioning system and to enhance the efficiency and transparency:

- settings up a reliable auction platform and IT system to facilitate smooth transactions.
- developing and implementing a robust legal framework that outlines the auction process, bidder eligibility and conducting auctions in strict conformity to predefined rules and procedures.
- ensuring access to auctions for all eligible participants and provide regular training to the bidders.

- the auction process is closely monitored and overseen to prevent any irregularities and maintain the integrity of the system and the allowances have been classified as financial instruments.
- planning auctions in advance, including the publication of auction volumes and calendars, provides clarity and predictability for participants.
- publishing detailed reports on auction outcomes and providing ongoing information about the auction process.

8.7.3.5 Outputs

The implementation of these actions has yielded several important outputs that contribute to the overall functioning of the auctioning system:

- the auction platform has been successfully set up, and operates as intended, providing a reliable and efficient environment for conducting auctions.
- all auctions have been conducted in accordance with the established rules and regulations, ensuring fairness, transparency, and integrity throughout the process.
- the system has ensured that all eligible participants have equal and unhindered access to the auctions.
- measures have been in place to prevent market abuse, ensuring the integrity of the auction process and maintaining trust among participants.
- emission allowances have efficiently allocated to the successful bidders following each auction.
- decisions on auction calendars have been made and published well in advance, providing clarity and predictability for all stakeholders.
- comprehensive monthly reports and detailed results of each auction have been published, ensuring transparency and accountability.
- Member States have received revenues generated from the auctions and utilise these funds for initiatives aimed at mitigating the effects of climate change and adapting to its impacts.

8.7.3.6 Intended results and impacts

The intended outcomes of the auction system are an efficient allocation of allowances that provides a transparent and non-discriminatory process, ensuring that all participants have equal access to allowances. The auctions system should continue to promote fairness. The auction platform has operated under a set of harmonised rules, ensuring consistency and coherence across all Member States. The auction system should ensure that the significant revenues received by the Member States from the auctioning of allowance are used to support climate change mitigation and adaptation efforts. The auction platform should operate smoothly and without incidents, ensuring that the allocation of allowances is not disrupted, and that the integrity of the system is maintained. It provides timely and publicly available information on auction results, allowance prices, and other relevant data. This increases transparency, facilitates market analysis, and enables stakeholders to make informed decisions.

8.7.3.7 Unintended results and impacts

The auction system, designed to promote efficient allocation allowances and reduce emissions, can have several unintended consequences that affect it like the market, politics, and the environment. Firstly, volatility uncertainty and speculation among bidders can lead to overbidding or underbidding based on expectations of market conditions. Additionally, information asymmetry, where bidders have varied levels of market knowledge, can create

uneven competition and further contributing to volatility. Political instability can also emerge while the implementation and management of the auction system require a robust regulatory framework. Another unintended result can be the fluctuation in prices, making difficult for market participants to plan investments. Significant price fluctuations can lead to windfall profits for some participants. Besides, high prices can increase the production costs for companies operating within the auction system, making them less competitive and lead to carbon leakage.

8.7.3.8 External factors

Various external factors over the past years, such as the economic crisis and subsequent recovery, have impacted the demand for allowances, with lower economic activity leading to reduced emissions and lower prices. Energy market trends, including fluctuations in gas and fuel prices, affect the competitiveness and the demand for allowances. Additionally, weather conditions, such as mild winters or hot summers, have influenced energy demand and, consequently, emissions levels, affecting the auction prices. Geopolitical events, including the COVID-19 pandemic, led to reduced economic activity and lower emissions.

8.7.3.9 Data collection

The evaluation findings are based on desk research based on several reports, such as:

- the reports prepared by the Commission on behalf of the participating Member States pursuant to Article 10(4) of the ETS Directive.
- the ESMA report: ‘Report on Emission Allowances and associated derivatives’.
- the Carbon Market Reports prepared by the Commission pursuant Articles 10(5) and 21(2) of the ETS Directive.
- the report by Europe Economics on the ‘Analysis of the functioning of the EU Carbon Market and the recent market developments’.
- the report by Europe Economics on ‘Participation in the EU ETS markets’.
- auction results and reports from the auction platform EEX.

8.7.4 *Evaluation of findings*

8.7.4.1 Effectiveness

The **effectiveness** criterion evaluates how successfully the EU ETS auctioning system has fulfilled its objectives of ensuring an open, transparent, harmonised and non-discriminatory auctioning allocation of emission allowances within the EU ETS.

The criterion is evaluated based on the following evaluation question:

- EQ1: To what extent has the auctioning system achieved its general objective of ensuring open, transparent, harmonised, and non-discriminatory allocation of emission allowances?

Auctions have been conducted in an open and transparent manner.

The rules and procedures governing the auctions, including timing, format, and participation requirements, are clearly defined and made publicly available on the EEX and European Commission websites. Entities willing to participate in auctions must comply with eligibility

criteria³⁰⁹ which guarantee the integrity of the auction process and a fair and open access for all auction participants³¹⁰.

The auction platform provides participants with transparency and predictability: auction volumes and calendars are published in advance, allowing potential bidders to plan and prepare for upcoming auctions. Following each auction, the results are publicly disclosed on the EEX website, including the clearing price and volume of allowances sold, which ensures not only transparency but also accountability within the system.

The EU ETS provides a harmonised framework for auctioning allowances across all Member States, ensuring consistency and coherence in the allocation of allowances. All Member States used the common auction platform operated by EEX, either through joint action or as the opt-out platform, with the same auctioning rules applied equally to all Member States and EFTA countries. Moreover, the European Commission and national authorities coordinate and oversee the auctioning process, ensuring that the system operates in a harmonised and effective manner.

The European Securities and Markets Authority (ESMA) has released a report³¹¹ on '*Emission allowances and associated derivatives*'. The report provides evidence supporting the conclusion that the auction market is functioning effectively, with the auctioning process performing as expected. One of the drawbacks could be the concentration of a few large participants dominating the primary markets, but the report highlighted that these same players are also active in the secondary market. This fosters the distribution of allowances to a wider range of market participants. Overall, ESMA's findings suggested that the European carbon market is operating normally, with no major abnormalities or fundamental issues detected.

- EQ2: Is the auction platform set up and functioning as intended, and are the auctions conducted according to the rules and procedures

The auction platform is functioning as planned and the auctions are conducted according to the rules and procedures.

In 2016 European Energy Exchange (EEX), based in Leipzig, has been appointed as common auction platform (the second common auction platform or CAP2) pursuant to Article 26(1) of the Auctioning Regulation for 25 Member States participating in a joint procurement

³⁰⁹ Articles 18 and 19 of Regulation 1031/2010 on the timing, administration and other aspects of auctioning of greenhouse gas emission allowances (the Auctioning Regulation)

³¹⁰ The following persons are eligible to apply for admission to bid directly in the auctions: operators with compliance obligations (including other subsidiaries of the same group of undertakings as the operator with compliance obligations), investment firms authorised under Directive 2014/65/EU, credit institutions authorised under Directive 2013/36/EU, business groupings of compliance operators bidding on their own account and acting as agent on behalf of their members, public bodies that control any compliance operator, and persons covered by the "ancillary activity exemption" of MiFID II when the Member State where they are established has enacted legislation enabling the "relevant competent national authority" in that Member State to authorise them to bid on their own account or on behalf of clients of their main business.

³¹¹ In its Communication on Energy Prices "Tackling rising energy prices: a toolbox for action and support" published on 13 October 2021, the European Commission highlighted that questions have emerged around the functioning of the European carbon market. To examine more closely patterns of trading behaviours and the potential need for targeted actions, the Commission asked ESMA for a first preliminary assessment of European carbon markets by 15 November 2021 and asked it to analyse, by early 2022, the trading of emission allowances. In its report, ESMA has analysed the data regarding emission allowances gathered from different sources, including EMIR reporting, MiFIR transaction reporting, MiFID II daily and weekly position reports, auction data and data obtained from the EU Registry.

procedure. Poland concluded an agreement with EEX to make use of the CAP to auction its share of allowances in the absence of listing of its auction platform. EEX also auctions for Germany as an 'opt-out' auction platform. Iceland, Liechtenstein and Norway have started to auction allowances in June 2019, after the EEA Agreement was amended to allow them to participate in the in the Joint Procurement Agreement for the common auction platform.

In May 2020, the Commission launched a procurement procedure to appoint the third common auction platform (CAP3). EEX was appointed as the common auction platform to conduct auctions on behalf of 28 Member States³¹² as well as the auction platform for Poland and Germany. The CAP 3 contract was signed in November 2020 and the first auctions under CAP3 started in February 2021. No auctions have been conducted in January 2021 due to the transitional period between CAP2 and CAP3. The contract covers the first period of Phase IV (2021-2025).

The Leipzig-based exchange now runs the single-round, sealed-bid, uniform-price auctions of allowances in the form of spot products, with auctions of general allowances occurring three days per week for the CAP, once a week for Germany and every other week for Poland. Auctions of aviation allowances occurring less frequently. The hand-over and transfer of responsibilities from the CAP2 to CAP3 was executed smoothly with only a minimum delay of a few weeks in the resumption of auctions in 2021 in order to put in place all the necessary administrative and technical arrangements under the new contract, such as new auctioneer agreements, developing a new reserve price methodology, etc.

The conduct of the auctions requires the implementation of a collaborative process. The calculation of the auction volumes and the preparation of auction calendars involve multiple stakeholders, including the European Commission, the auction platform, and Member States via the Joint Procurement Agreement. This process consists of several steps that ensure the accurate computation of the auction volumes, considering all requirements and provisions of the legislation³¹³. The procedures put in place ensured that errors were avoided and that the volumes to be auctioned were correctly calculated and decisions were adopted in a timely manner. Although calendars were typically published on a regular schedule between 2018 and 2022, a small delay occurred during the transition period from CAP2 to CAP3.

To illustrate the good functioning of the auctioning system, to date over 3000 auctions have been held (for all auction platforms) and only 12 auctions have been cancelled, representing less than 0.5% of the auctions. Cancellations of auctions are necessary in order to ensure the integrity of the auctions, such as if the minimum set reserve price is not met, or if there are not enough bids to cover the full amount auctions. Disruptions to the auction process due to technical incidents or other issues can also lead to a cancellation.

- EQ3: Have the calculations of the auction volumes taken into account all the requirements of the provisions?

³¹² 25 EU Member States, Iceland, Liechtenstein and Norway.

³¹³ The calculation of auction volumes considers the intakes to, or releases from the MSR as well as Articles 10c, 10d, 27 and 27a of the ETS Directive. Once the auction volumes are calculated, EEX is informed and creates draft auction calendars and tables, which are then verified by the Commission to ensure compliance with regulatory requirements. The draft auction calendars are approved by the Joint Procurement Steering Committee (JPSC), after which the Commission adopts a decision on the auction volumes and calendars. On average, two decisions are adopted within a year: one in December for the calendars of the following year, and another in July, adjusting the calendar of the current year, considering the MSR and the volumes of the following year.

EEX has regularly published on its website the auction calendars in coordination with the European Commission, the EU Member States and the EEA EFTA States auctioning on the common auction platform as well as with the competent authorities of Germany and Poland and the United Kingdom on behalf of Northern Ireland. The calendars reflect the planned amounts of allowances to be sold at each auction and are published several weeks in advance. Each year in July, the auction volumes are adjusted for the period from September to December in accordance with the Auctioning Regulation due to the operations of the MSR. Auctions on the common auction platform take place on Mondays, Tuesdays, and Thursdays. The auctions on behalf of Germany were conducted by EEX on Fridays, while the auctions on behalf of Poland were scheduled bi-weekly on Wednesdays. During the two-hour bidding windows, the entities admitted participating can submit their bids. Winning bidders receive allowances delivered in their accounts in the Union Registry³¹⁴. The success of a bid depends on the price and the number of allowances auctioned. Article 7 of the Auctioning Regulation specifies how the auction clearing price is determined.

The European Commission publishes detailed auction reports on a quarterly basis on its website. The reports are prepared in collaboration with the participating Member States and Poland, based on information provided by the common auction platform, in accordance with Article 10(4) of the ETS Directive. Germany also publishes auction reports regularly based on data from its opt-out platform. The auction results published in those reports show that the auctioned volumes were indeed purchased by the winning bidders.

The volumes were distributed evenly over the scheduled auctions, as specified in the Auctioning Regulation.

- EQ4: Are the auction results published in a timely and accessible manner, and do they provide sufficient information to participants and stakeholders?

The auction results have been published in a timely and accessible manner, and the participants and stakeholders have been provided all the necessary information.

In accordance with the transparency requirements set forth in the Article 61 of the Auctioning Regulation the auction platform publishes detailed auction results no later than 15 minutes after the close of the bidding window. Throughout the evaluation period, full compliance with the specified requirements was maintained, and no deviations or discrepancies were observed. Furthermore, the auction platform submitted and continues to submit a monthly report to the Commission, by the fifteenth day of each calendar month, as stipulated in the CAP contract. The report served as the basis for the publication of a quarterly report prepared by the Commission on behalf of the Member States participating in the joint action and Poland in accordance with Article 10(4) of the ETS Directive. The German auction platform also publishes a quarterly report. The most recent auction report for CAP3 presents the results of the second quarter of 2025. Although this can be considered as a timely publication, the date of publication must be indicated on the website to properly monitor the timely publication of the reports.

³¹⁴ From an operational perspective, two parallel processes are to be distinguished. Firstly, at the level of the Union Registry, allowances are transferred from the Auction Account to the successful bidder's account in the Registry, via the Auction Collateral Delivery Account of ECC, the central counterparty. Secondly, at the level of ECC, winning bidders pay the auction proceeds to the auctioneers of the Member States.

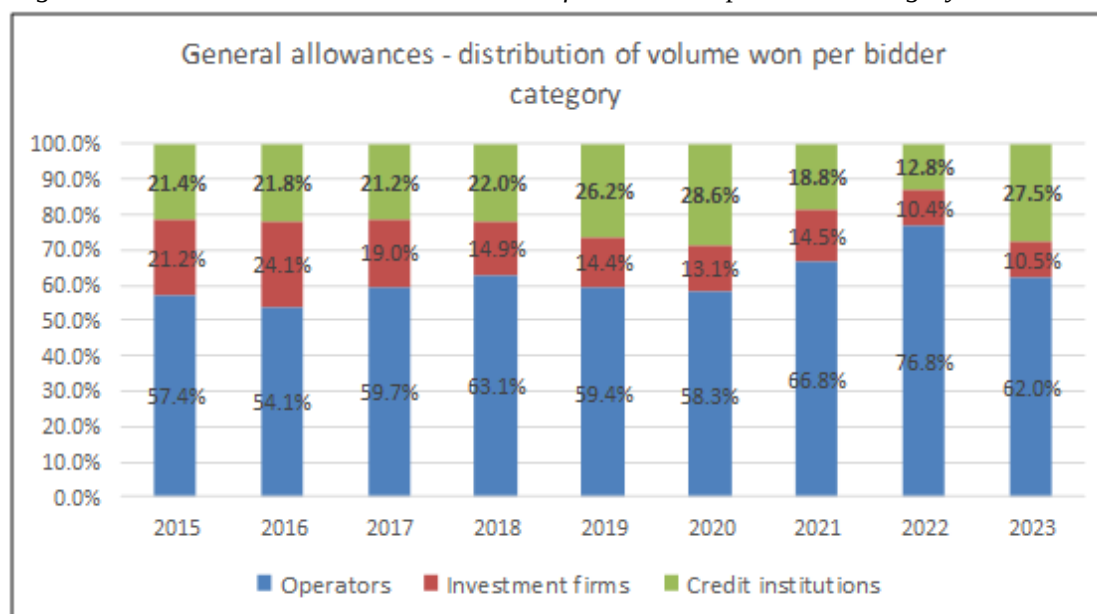
- EQ5: To what extent does the auctioning system ensure equitable access to allowances for all eligible parties, including SMEs and smaller emitters?

The auctioning system has ensured an equitable access to allowances for all eligible parties, including SMEs and smaller emitters.

The European Union Allowance (EUA) auctions have a relatively small number of participants; 117 bidders are registered with 48 unique entities participating in 2021, consisting of 34 non-financials and 14 financials.

The auction reports show the distribution of successful auction volume won between operators, investment firms, and credit institutions. As displayed in figure below, operators won most of the allowances (62% on average between 2015 and 2023). Investment firms and credit institutions play an important role in the secondary market. They act as intermediaries and market makers and facilitate the trading of emission allowances and allowance derivatives for the compliance entities in the secondary market. As ESMA concluded in its report, while the auction market is somewhat concentrated, the largest participants are also active in the secondary market and ensure that the auctioned allowances are disseminated to other secondary market participants.

Figure 40: General allowances - distribution of volume won per bidder category



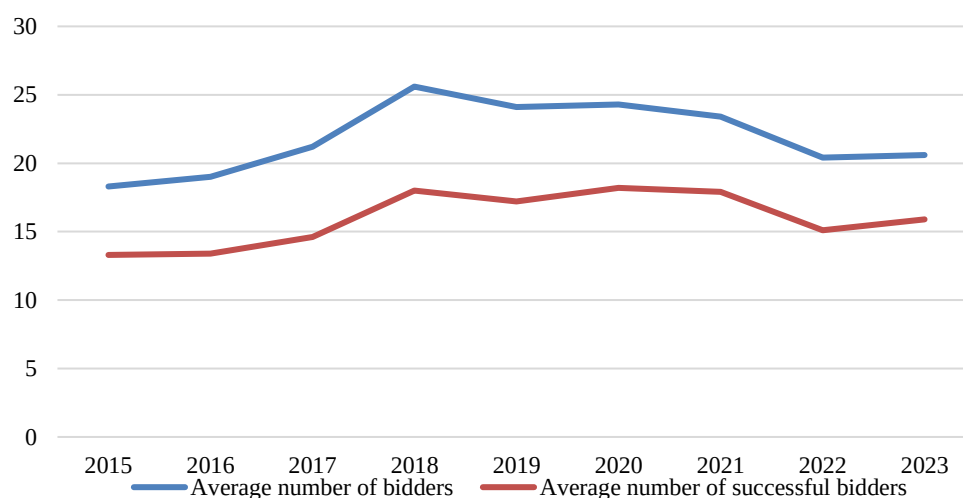
Source: EEX auction report

Figure 41 below illustrates a relatively stable trend in the number of bidders per auction, with a narrow fluctuation range between 18.3 bidders per auction in 2015 and a peak of 25.6 in 2018. This peak can be attributed to the revision of the ETS, which introduced measures aimed at stimulating participation in the carbon market. Over the 2015-2023 period, the average number of bidders showed a small increase of 12.4% (from 18.3 to 20.6), indicating a gradual expansion of market engagement. Notably, the number of successful bidders closely tracks the trend in overall bidders, suggesting a consistent level of competitive participation in the auctions.

Furthermore, Figure 42 shows that subscription to ETS auctions have been stable over time with a cover ratio, i.e. the volumes of bids submitted vs the volume of allowances auctioned between 1.5-2. A cover ratio under 1 would result in the cancellation of the auction, while a

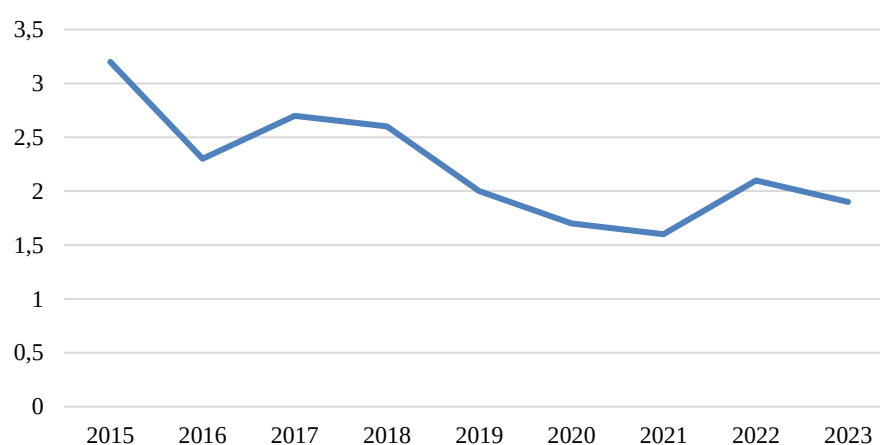
cover ratio significantly above 2 would mean that auctions are oversubscribed and a significant share of bidders would not be able to be successful in their bids. Therefore, a cover ratio of around 1.5 shows the healthy balance between the demand and supply for allowances in the ETS auctions.

Figure 41: Evolution of number of bidders in ETS auctions (participating and successful)



Source: EEX data, own illustration

Figure 42: Annual average cover ratio³¹⁵ in EUA auctions held at EEX between 2015-2023



Source: EEX data, own illustration

The top 10 auction participants are significant players in the secondary market, holding a substantial portion of allowance derivatives positions and acting as large net suppliers of physical allowances to other market participants and compliance entities. Indeed, analyses provided by ESMA, show that SMEs and small emitters prefer to cover their allowance needs through intermediaries and to avoid the learning curve and the costs associated with establishing their eligibility for auction participation and obtaining electronic-based access to the auction.

³¹⁵ Cover ratio is the ratio between the total bid volume and the auction volume.

According to the report from Europe Economics, ‘Participation in the EU ETS markets’³¹⁶ The current system of acquiring allowances is functioning well, with firms not experiencing significant barriers to participation or feeling exploited by other economic agents. As a result, they rely heavily on financial institutions to acquire allowances. This dependence on financial entities is particularly prevalent among SMEs, but it also applies to larger firms with limited needs for allowances. The compliance entities reported that it is a convenient arrangement that saves them from having to develop their own expertise. Any lack of direct participation in auctions by SMEs and small emitters cannot be characterised as a failure on behalf of the regulator to ensure fair auction access specifically to these entities.

The evaluation on this point concerns the degree of effort made by the Commission and auctioning platform to inform and involve smaller emitters. That degree of effort is high, with the EEX offering since mid-2012 an “auction-only” (Figure 43) exchange membership category that exempts participants from obligations applying to larger exchange members. Auction reports for CAP2 and CAP3 auctions specify the number of such auction-only participants: between 2016 and 2023 the average number of “auction-only bidders” per month is four. Thus at least some (possibly) smaller firms have taken advantage of this option. EEX also offered regular training sessions and conferences to encourage and support the participation of SMEs in the primary market.

Figure 43: Auction only participants

Number of participants		Operator		Investment firm	Credit Institution	Business grouping	Person exempt from MiFID requirements	Total
		Stationary	Aircraft					
Auction-only access	Dec 16	2	-	1	-	-	1	4
	Dec 17	2	-	1	-	-	1	4
	Dec 18	1	-	-	-	-	1	2
	Dec 19	1	-	-	-	-	1	2
	Dec 20	2	-	-	-	-	1	3
	Dec 21	3	-	-	-	-	1	4
	Dec 22	2	-	2	1	-	1	6
	Dec 23	2	-	2	1	-	1	6

Source: EEX monthly reports

- EQ6: Has the auctioning system prevented market manipulation and abusive practices, ensuring the integrity of the EU ETS?

The auctioning system has prevented market manipulation and abusive practices and ensured the integrity of the EU ETS.

Since 2018, the MiFID II Directive has classified allowances as financial instruments. By requiring trading venues to report transactions to their national competent authority, MiFID II has contributed to the integrity of the EU ETS. MiFID II also requires trading venues to establish arrangements, systems, and procedures to detect and report suspicious orders and transactions. As financial instruments, the allowances fall within the scope of the Market Abuse Regime (MAR). MAR aims to promote market integrity by prohibiting insider dealing, unlawful disclosure of inside information, and market manipulation. To achieve this, MAR provides rules for issuers, intermediaries, and trading venues to follow, as well as powers for

³¹⁶ https://climate.ec.europa.eu/document/download/6496c9a4-a4b3-4259-8908-466f8356aa31_en?filename=policy_ets_integrity_report_participation_en.pdf&prefLang=fi

competent authorities (NCAs) to detect and prosecute breaches. EEX also provides a framework for market oversight shared between the management board and the market surveillance office of the exchange platform. The market surveillance office is an independent pillar of the public exchange and by law a public authority. It must collect and analyse all trading, reporting and clearing data daily. The auction reports provided by EEX to the European Commission include data on bidding behaviour, market trends, and other relevant information. Since the introduction of MAR, EEX has not detected any suspicious activity or market manipulation in the auctions (primary market) or in allowance derivatives (secondary market). MAR, combined with the market oversight activities of EEX and the reporting requirements under the Auction Regulation, provides a robust framework to prevent any wrongdoing.

8.7.4.2 Efficiency

The efficiency criterion is meant to assess costs associated with auctioning and whether they have been justified, given the cost-saving effects auctioning has achieved. Since the alternative to auctioning is free allocation, the efficiency criterion in this case asks in what ways auctioning has been more cost-effective than free allocation and to what extent inefficiencies have been observed.

The efficiency of the EU ETS auctioning system is assessed through the following evaluation questions:

- EQ8: In what ways has auctioning been more cost-effective than free allocation?

Overall, the goal of the efficiency criterion is to determine whether auctioning has been a successful and effective way to allocate resources, and to identify areas for improvement in the future.

Literature review and analyses provide some evidence. Auctioning is considered the most efficient way for allocating allowances, as it provides a market-based approach to allocation and allows for a more efficient distribution. According to the study ‘Emissions trading with transaction costs’ by Marc Baudry, Anouk Faure, and Simon Quemin³¹⁷, auctioning can help to reduce the risk of over-allocation and windfall profit and ensure that allowances are allocated to those who value them the most. Additionally, auctioning can generate revenues for governments, which can be used to support climate change mitigation and adaptation efforts. As noted by authors such as Gbenga Adamolekun in ‘Carbon price and firm greenhouse gas emissions’³¹⁸, auctioning can lead to a greater reduction in greenhouse gas emissions compared to free allocation.

The use of auctioning as an allocation method has been shown to be effective in reducing emissions and increasing investment in abatement measures. Authors such as Frank Maarten and Jan Venmans in ‘The effect of allocation above emissions and price uncertainty on abatement investments under the EU ETS’³¹⁹ suggest that auctioning can provide a stronger incentive for companies to invest in abatement measures and reduce barriers to investment. Furthermore, auctioning can help to reduce market manipulation and increase transparency,

³¹⁷ Marc Baudry, Anouk Faure, Simon Quemin, Emissions trading with transaction costs, *Journal of Environmental Economics and Management*, Volume 108, 2021, 102468, ISSN 0095-0696, <https://doi.org/10.1016/j.jeem.2021.102468>.

³¹⁸ Gbenga Adamolekun, Carbon price and firm greenhouse gas emissions, *Journal of Environmental Management*, Volume 349, 2024, 119496, ISSN 0301-4797, <https://doi.org/10.1016/j.jenvman.2023.119496>.

³¹⁹ Frank Maarten Jan Venmans, The effect of allocation above emissions and price uncertainty on abatement investments under the EU ETS, *Journal of Cleaner Production*, <https://doi.org/10.1016/j.jclepro.2016.02.108>.

which are essential for a well-functioning emissions trading scheme. As noted by Jan Abrell, Johanna Cludius, Sascha Lehmann, Joachim Schleich, and Regina Betz in ‘Corporate Emissions-Trading Behaviour During the First Decade of the EU ETS³²⁰’, auctioning can increase companies' ability and willingness to actively participate in emissions trading, thus increasing efficiency.

In practice, the administrative time and resource involved in setting benchmarks and determining free allocation amounts by assessing National Implementing Measures (NIMs) is eliminated to the extent that auctioning is used. It is challenging to precisely measure the cost savings of auctions in the EU ETS, as auctions are not the only method of allocation. Instead, they are compared to a scenario where free allocation is the sole method. Auctioning is the default method, but free allocation still occurs, particularly outside the power sector. Auctioning requires additional administrative and financial resources, including selecting the auction platform, overseeing the auction process and managing associated procedures and reports. However, the cost savings from auctioning are due to increase, as the percentage of the total allowances freely allocated declines.

In contrast to the above-described costs to regulators, costs to auction participants are higher than under free allocation (leaving aside the costs for baseline data collection and verification). Buying allowances rather than getting them for free is of course more expensive. One must also add the cost of participating in the auctions and trading on the auction platform. Entities wishing to participate in the auctions must pay a registration fee to the auction platform. Besides, fees³²¹ per lot of allowances won in auctions are equivalent to those on the secondary market (currently 2 EUR per lot of 500 allowances). Power sector players regularly trade electricity products in addition to being active on the secondary market for emissions allowances. They are therefore very likely to have paid the requisite fees already. However, for SMEs those fees may constitute an effective barrier to participate in auctions. They may find it more economical to access the auctions via intermediaries or to obtain allowances in the secondary market.

- EQ9: Have there been significant structural premiums or discounts on auction prices, compared to secondary market prices?

There have not been any significant structural premiums on auction prices compared to the secondary market.

Each auction report for each month from 2020 to 2022 state that ‘the auction clearing price was in line with the price signal in the secondary market’. The CAP reports compare the auction clearing prices with the secondary market price for spot emission allowances. The differences

³²⁰ Sascha Lehmann, Joachim Schleich, “Does increasing auctioning in the EU ETS increase companies' search efforts for favourable trading options?”, *Journal of Environmental Management*, Volume 387, 2025, 125830, ISSN 0301-4797, <https://doi.org/10.1016/j.jenvman.2025.125830>.

³²¹ The EEX market participants have five options to participate in auctions, with four options offering direct access and one option providing indirect access via intermediaries. The fees for direct access vary depending on the membership model, with new trading participants not being charged annual fees for the first 12 months. The yearly costs range from EUR 0 for auction-only membership to EUR 37,000 for trading all products on all EEX markets. Additionally, a maximum fee of EUR 1,000 per year may apply for the Clearing House ECC, but only if a participant trades very little or nothing. In contrast, the terms and conditions for indirect access need to be agreed upon with the intermediary, and the fees are not explicitly stated. Regardless of the option chosen, companies must meet the eligibility criteria in accordance with Article 18 of the Auctioning Regulation and fulfil specific requirements, such as having a contract with a clearing member and liable equity of EUR 50,000, depending on the membership option.

were small, ranging from EUR 0.05 to 0.63, with most values between EUR 0.10 and 0.40. The German annual auction reports even include tables illustrating the relationship of EUA spot auction clearing prices to secondary market prices over time, as illustrated in the table below. In 2022, the maximum deviation was EUR 0,62 (in April).

Figure 44: EUA-Auctions and deviations from secondary market prices in 2022 (Germany)

Date	Contract	Clearing price	Deviation from secondary market	
			Absolute	%
January	EUA Spot 4 th TP	*€ 84.93	€ 0.21	0.25%
February	EUA Spot 4 th TP	*€ 89.80	€ 0.15	0.17%
March	EUA Spot 4 th TP	*€ 75.36	€ 0.39	0.52%
April	EUA Spot 4 th TP	*€ 82.12	€ 0.62	0.76%
May	EUA Spot 4 th TP	*€ 86.89	€ 0.36	0.41%
June	EUA Spot 4 th TP	*€ 82.21	€ 0.43	0.53%
July	EUA Spot 4 th TP	*€ 82.12	€ 0.38	0.45%
August	EUA Spot 4 th TP	**€ 89.56	€ 0.43	0.47%
September	EUA Spot 4 th TP	*€ 69.81	€ 0.39	0.55%
October	EUA Spot 4 th TP	*€ 70.97	€ 0.26	0.36%
November	EUA Spot 4 th TP	*€ 75.76	€ 0.25	0.33%
December	EUA Spot 4 th TP	**€ 85.63	€ 0.35	0.41%
Mean absolute deviation			€ 0.35	0.44%

Source: ICE, EEX, Refinitiv Eikon, DEHSt
 * Average
 ** Volume-weighted average
 *** ICE EUA Daily Future/EEX EUA Spot

Source: German Emissions Trading Authority (DEHSt) - German Auctioning of Emission Allowances report

- EQ10: To what extent has the auctions system demonstrated agility in responding to changing requirements and generating revenue?

The auctions system has demonstrated significant agility in responding to changing requirements and generating revenue to reduce greenhouse gas emissions.

Since 2015, several changes have been made to align the auctioning of allowances with the EU ETS rules, including the establishment of a market stability reserve, the introduction of new funds such as the Modernisation Fund and the Innovation Fund, and the adaptation of auctioning rules to support climate change mitigation and adaptation efforts.

The system has also been modified to increase the share of allowances to be auctioned, with 57% of allowances to be auctioned from 2021 onwards, and to allocate 2% of the total quantity of allowances to the Modernisation Fund. Furthermore, the system has been adapted to provide a 3% buffer for free allocations, ensuring that the auctioning share is respected while also allowing for flexibility in the allocation of allowances. The operation of the MSR has contributed to a significant increase in the carbon price, making low-carbon investments more attractive and leading to a reduction in greenhouse gas emissions.

Additionally, the increased carbon price has also generated higher revenues for Member States, which can be used to support climate change mitigation and adaptation efforts. The EU ETS has undergone significant developments in recent years, particularly in relation to the auctioning of allowances, demonstrating its ability to respond to new policy objectives and financial requirements. A notable example of this agility is the ability to generate revenue for

specific purposes, such as improving energy efficiency and modernising energy systems, and to support key initiatives like the REPowerEU Regulation. The ability to swiftly redirect and allocate funds through the auctioning mechanism underscores the flexibility and responsiveness of the EU ETS, allowing it to play a pivotal role in supporting the EU's broader climate and energy policy goals.

8.7.5 Conclusion

The evaluation of the auctioning process reveals a largely successful system that has achieved its objectives of ensuring open, transparent, harmonised, and non-discriminatory allocation of emission allowances. The auctioning system has provided a consistent and fair approach to allocating allowances across the EU Member States, with auctions conducted in an open and transparent manner, and auction results published in a timely and accessible manner, providing sufficient information to participants and stakeholders. The system has also ensured equitable access to allowances for all eligible parties, including SMEs and smaller emitters, although some challenges remain, such as the concentration of auction participants and limited direct participation of SMEs.

Notably, the auctioning system has resulted in the allocation of planned amounts of allowances, with over 5 billion allowances auctioned between 2015 and 2023, generating more than 169 billion EUR in revenue. The system has prevented market manipulation and abusive practices, ensuring the integrity of the EU ETS. Furthermore, the auctioning system has been efficient in allocating allowances reducing the risk of over-allocation and windfall profits, and generating revenues for Member States, which can be used to support climate change mitigation and adaptation efforts.

To further enhance transparency, several minor improvements could be implemented. Providing a detailed publication information for reports would be beneficial. Additionally, harmonising the reports from the Common Auction Platform and the German auction platform would promote consistency and facilitate comparison. Furthermore, expanding the data presented to offer more insights into the participation of SMEs and small emitters in the primary market would be valuable, even though the current evaluation indicates that these entities are satisfied with the system and are procuring their allowances on the secondary market.

Overall, the evaluation concludes that the auctioning system has been a success in achieving its objectives, and its continued use is likely to play a crucial role in the EU's efforts to reduce greenhouse gas emissions and transition to a low-carbon economy.

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9 APPENDIX IV. OVERVIEW OF BENEFITS AND COSTS

Table 1: Overview of costs and benefits identified in the evaluation			
		Businesses	
		Quantitative	Comment
Compliance costs to directly regulated entities			
Direct cost	compliance Recurrent	Partly quantified/mostly qualitative	7. The value of allocation used for compliance that were not provided for free between 2018 and 2024 was estimated in Section 4.1.1.2.2 at approximately 238 billion EUR. 8. More exposure to carbon cost in Phase IV of the EU ETS due to higher prices and less free allocation. In Section 8.3.4.1, a quantitative analysis was undertaken to compare the volume of free allowances provided to industry in Phase III and IV for a selection of the most energy intensive product benchmarks. The outcome of this exercise was that the volume of free allowances has declined due to reforms to free allocation at the start of Phase IV but it is likely that the greater exposure to the carbon cost was at least partially offset by the fact that free allocation in Phase III was set based on ex-ante activity level that was higher than what actually over the 2013-20 time period. 9. The carbon cost per tonne of output was subsequently estimated in Section 8.3.4.1 for a selection of energy intensive product benchmarks. These estimated carbon costs ranged from 1 to 32 EUR/t or CWT. Industrial stakeholders estimated higher carbon costs (often citing higher specific emissions than the 2016/17 average values

			previously published by the Commission or assuming higher carbon prices) and these costs were then translated into a share of the overall product price. There was a consensus amongst industrial stakeholders that the carbon cost could not be passed through without impacting their competitiveness. Academic literature on evidence on cost pass through is limited but it does suggest that it may be more possible than implied by industrial stakeholders (refer to Section 8.3.4.2).

Table 1 continued.: Overview of costs and benefits identified in the evaluation			
		Public administration	
		Quantitative	Comment
Administrative and enforcement costs			
Enforcement costs	Recurrent	Not quantified	Costs linked to monitoring, reporting, verification, allocation and auctioning

Table 1 continued: Overview of costs and benefits identified in the evaluation			
		Businesses (regulated entities)	
		Quantitative	Comment

Provision of free allowances to lower compliance costs			
Direct benefit	Recurrent	Quantitative	The value of the free allocation provided between 2018 and 2024 was estimated in Section 4.1.1.2.2 at approximately 195 billion EUR.
Provision of compensation for indirect costs			
Direct benefit	Recurrent	Quantitative	Section 8.3.4.1 outlines that total ICC payments has risen over time, from EUR 0.5bn for costs incurred in 2017, to EUR 1.8bn for costs incurred in 2019, EUR 2.3 bn in 2020, EUR 3.1 bn in 2022 and EUR 5.5 bn in 2023.
Reduced regulatory uncertainty			
Direct benefit	Recurrent	Qualitative	Predictable carbon pricing framework supports investment planning
Cost savings from simplification			
Direct benefit	One-off Recurrent	& Partly quantified	Exclusion of small emitters; targeted free allocation; simplified procedures. SMEs: Simplified requirements and exclusions reduce burden for smaller emitters. Installations with low emissions may submit simplified monitoring plans under 2018 Monitoring and Reporting Regulation. Exemption of very small installations from ETS surrendering obligation (ETS Directive Art 27a, introduced in 2018) See Section 4.1.1.2.3
Energy and carbon efficiency improvements			

Indirect benefit	Recurrent	Partly quantified	Econometric literature cited in the evaluation demonstrates improvements in industrial carbon efficiency e.g. evidence of stronger effect in sectors that lost carbon leakage status in Phase IV of ETS (from 2021). e.g. 0.5 tCO₂e emission reduction per additional allowance purchased (rather than allocated for free), and up to 10% increase in patents in ETS-covered sectors. See Section 4.1.1.1 & 4.1.1.3. However, the specific effect of 2018 intervention is difficult to disentangle from earlier and later developments.

Table 1 continued: Overview of costs and benefits identified in the evaluation			
		Businesses / citizens	
		Quantitative	Comment
Stabilised carbon market			
Direct benefit	Recurrent	Quantitative	Benefit: the intervention removed the historic surplus of allowances, and increased market stability and confidence. EUA prices responded in 2019. Price behaviour since 2020 is consistent with market fundamentals as confirmed in ESMA reports and has been influenced by events (COVID-19, Russia invasion of Ukraine) and subsequent policy interventions (Fit for 55). See Section 4.1.2.1. Carbon prices permanently above <EUR 10 level seen in 2013-2017, up to EUR 25 in 2019. See Section 4.1.2.1.4.

			Annual TNAC communication increases availability of ETS data to market participants and stakeholders. See Section 4.1.2.2.3
Costs of understanding Market Stability Reserve			
Cost	One-off recurrent	& Qualitative	Uncertainty of auction volumes and complexity of price formation reported by some stakeholders, partially addressed by introduction of upper buffer in Fit for 55 ETS reform. See 4.1.2.2.2 & 4.1.2.3.4.

Table 1 continued: Overview of costs and benefits identified in the evaluation			
		Citizens / Public administration	
		Quantitative	Comment
Revenue from auctioning of allowances			
Direct benefit	Recurrent	Quantified	More targeted free allocation allows for increased auction revenues. Auctioning revenue between 2018 and 2024 estimated in Section 4.1.1.2.2 at around EUR 196 billion based upon EEX data. A large share of this revenue was distributed to public administrations. Part of this revenue was also distributed to the Innovation Fund and Modernisation Fund to support investments in low carbon technologies across industry.
Reduced administration related to provision of free allocation			

Direct benefit	Recurrent	Not quantified in monetary terms	It was assessed in Section 8.3.4.1 that the adoption of a single based indicator reduced the number of sectors at the NACE 4-digit level covered on the 2021-30 carbon leakage list declined by around 65% compared to the 2015-20 carbon leakage list.
Stable costs related to monitoring, reporting, verification and accreditation			
Direct benefit	Recurrent	Partially quantified	Stable MRVA costs to operators between ETS phase III and phase IV. With efficiency improvements (e.g. standard tools) largely offsetting increased requirements. See Section 4.1.1.2.3. Standard cost model estimate of MRVA cost is 0.2-0.9 EUR/tCO₂ for stationary installations and 0.2-04 EUR/tCO₂ for aviation operators
More efficient use of free allocation			
Direct benefit	Recurrent	Partially quantified	Reduction in windfall profits due to reformed free allocation framework. See Section 4.1.1.2.2. Windfall profits from free allocation cost pass-through estimated at EUR 26-46 billion (2008-2019) in the literature but industrial stakeholders in contrast suggested their ability to pass through cost was very limited. Evidence suggests that the 2018 reform did not result yet in carbon leakage. See Section 4.1.1.1.3

Table 1 continued: Overview of costs and benefits identified in the evaluation			
		Citizens	
		Quantitative	Comment
Environmental benefit of greenhouse gas emissions reduction			
Direct and indirect benefit	Recurrent	Not quantified in monetary terms	Direct emissions reduction benefit from steeper linear reduction factor. Indirect benefits related to decarbonisation include air quality improvement, Increased energy efficiency and reduced fossil fuel dependency.
Reduced administration related to provision of free allocation			
Direct benefit	Recurrent	Qualitative judgement	Evidence suggests benefits outweigh costs, though not all impacts can be monetised

TABLE 2: Simplification and burden reduction (savings already achieved)

Report any simplification, burden reduction and cost savings **achieved already** by the intervention evaluated, including the points of comparison/ where available (e.g. REFIT savings predicted in the IA or other sources).

	Citizens/Consumers/Workers		Businesses		Administrations		[Other...] _ specify	
	Quantitative	Comment	Quantitative	Comment	Quantitative	Comment	Quantitative	Comment
Direct compliance cost savings (for example adjustment cost savings, administrative cost savings, savings from regulatory charges)								
One-off			Not quantified	Exclusion of very small emitters (below 2,500 tCO ₂ e per year).				
Enforcement cost savings (for example cost savings associated with activities linked to the implementation of an initiative such as monitoring, inspections, and adjudication/litigation)								
One-off					Not quantified	Targeted free allocation reduces the number of sub-sectors covered.		
Recurrent				MRVA simplifications achieved through amendments to Monitor and Reporting Regulation. See Section 5.2 & 10.4				

PART II: II <u>Potential</u> simplification and burden reduction (savings) Identify further potential simplification and savings that could be achieved with a view to make the initiative more effective and efficient without prejudice to its policy objectives³²².								
	Citizens/Consumers/Workers		Businesses		Administrations		[Other...] _ specify	
	Quantitative	Comment	Quantitative	Comment	Quantitative	Comment	Quantitative	Comment
Reforming conditionality for free allocation								
One-off			Up to 0.02 EUR/ton of CO ₂ -eq. could be saved if conditionality rules were not applied. See Annex 12, Section 1.4.1.2 of Impact Assessment	Although free allocation implies a cost burden, this has to be weighed against its potential benefit as a means of encouraging decarbonisation investment and allocating increasingly scarce free allowances as the emissions cap declines.	Not quantified	Further targeting of the carbon leakage list to simplify burden on the European Commission. See Impact Assessment preferred policy option for addressing carbon leakage.		
Simplification of the MSR								

³²² This assessment is without prejudice to a possible future Impact Assessment.

One-off / recurring				While simplification of the MSR appears to have advantages (e.g. transparency), a simpler MSR would not necessarily deliver a more stable carbon market.			

10 APPENDIX V. STAKEHOLDER CONSULTATION

See Annex 2 on Stakeholder Consultation

