WORLD ECONOMIC FORUM

The Future of Materials Systems: Cooperation Opportunities in a Multipolar World

WHITE PAPER

MARCH 2026

Images: Adobe Stock, Getty Images

Contents

Foreword

Fernando Gomez
Head, Future of Materials, Centre for Energy and Materials, World Economic Forum

Sho Nakamura
Director for Promotion of Circular Society, Environmental Regeneration and Material Cycles Bureau, Ministry of the Environment, Japan

This report is released at a moment of profound global reordering. Geostrategic realignment, rapid technological change and environmental pressures are placing growing strain on the materials systems that underpin societal transformations such as the deployment of clean energy and digital technologies.

While the resilience, productivity and sustainability of materials systems can be modified by many levers – including domestic policy reform, corporate innovation and technological change – international cooperation is an important enabler, given the deeply interconnected nature of global supply chains.

Over 90% of global business leaders surveyed for this report identify stronger international cooperation on materials as critical to their organizations' long-term success. At the same time, established multilateral mechanisms face mounting constraints, strengthening the need for more adaptive, interest-based and results-orientated approaches to cooperation.

Against this backdrop, the report is structured around three core elements for progress. First, it highlights the need to adapt international collaboration approaches to a multipolar context, combining agile, interest-based coalitions with stronger intergovernmental coordination to ensure coherence and scale. Second, it reinforces the importance of considering complete material lifecycles, often discussed as the circular economy. Third, it argues for prioritizing three cross-cutting areas where further cooperation can deliver tangible outcomes: data transparency and traceability, international standards, and modernized trade and market cooperation.

The insights in this white paper were derived through a series of expert consultations, interviews, workshops and a survey of 150 global business leaders across six regions, 12 countries and 15 different industries. In sharing these insights, we hope this report provides leaders with a clear and pragmatic guide for strengthening materials systems and ensuring that international cooperation remains a vital driver of resilience, sustainability and shared prosperity.

Executive summary

In a multipolar world, agile interest-based cooperation will be decisive in shaping resilient, productive and sustainable materials systems.

In the coming technological transformations, the real bottleneck is not innovation but materials. Production of electric vehicles, wind turbines, copper cables, batteries, data centres and robotic systems depends upon reliable and affordable access to a wide range of materials, such as steel, cement, copper, semiconductors, and rare and precious metals.

Over time, global materials systems have evolved in complex ways, so that today, the extraction, processing, manufacturing, use and recovery of materials spans multiple countries and often continents. The resilience of these complex and interdependent systems is now being challenged. Factors such as rising dependence on concentrated sources of supply, geopolitical volatility and environmental pressures are amplifying risks, while a weakened multilateral system limits collective capacity to address them.

Mitigating the risks to materials systems is therefore of increasing strategic importance for firms. Of 150 global business leaders surveyed for this report, nine out of 10 identified stronger international cooperation on materials as important or very important for their organization's long-term success (see Figure 1).

FIGURE 1 **Business leaders call for greater international cooperation on materials**

Growing need for international cooperation on materials

- Technologies and industries depend on resilient and affordable access to a diverse and increasingly complex set of materials
- Concentrated supply, inconsistent trade policy and reordering of global value chains are putting strain on material value chains
- 92% of business leaders call for greater international cooperation on materials to achieve resilience, productivity and sustainability goals

Pillars for strengthened cooperation

1 Adapt cooperation approaches to a multipolar world	Shift towards agile, interest-based coalitions that can act on common goals
2 Coordinate systemic approach to circular economy	Coordinate across borders to keep materials in use at their highest value
3 Prioritize data, international standards and trade	Focus cooperation efforts around three areas where progress is both feasible and mutually beneficial

Source: The 92% datapoint comes from World Economic Forum survey of 150 global business leaders across six regions, 12 countries and 15 different industries, commissioned in December 2025 specially for this report.

At the same time, existing cooperation efforts remain hard to engage with in practice. Challenges such as fragmentation across numerous initiatives, uncertainty around data and intellectual property sharing, and a lack of clear intergovernmental coordination or leadership continue to constrain participation and dilute collective impact.

As the pendulum of global politics swings further towards short-term national interest, pressing questions emerge about the capacity of the international community to confront shared challenges and ensure the materials systems of the future are resilient, productive and sustainable. In this evolving landscape, global leadership and the values needed to underpin the next phase of international cooperation on materials are issues that remain critically unresolved.

This white paper examines how international cooperation on materials can adjust to this reality and proposes three key actions for progress:

1 Adapt cooperation approaches to a multipolar world

Cooperation approaches need to adapt to a multipolar context, with greater emphasis on agile, interest-based "coalitions of the doing", comprised of partners who share enough common ground to work together. These efforts should be complemented by strengthened intergovernmental coordination that sustains coherence with ongoing multilateral developments, avoids duplication and removes barriers to cooperation.

2 Coordinate a systemic approach to the circular economy

By systemically considering all stages of materials lifecycles, the circular economy provides a holistic approach to strengthening resilience, productivity and sustainability across materials systems. Yet no country or organization can achieve a circular economy in isolation. Scaling-up circular value chains across borders requires greater international cooperation on data, standards and trade to avoid fragmentation and ensure comparability.

3 Prioritize cooperation efforts on data, international standards and trade

International cooperation efforts should be prioritized and sequenced around three areas where progress is both feasible and mutually reinforcing:

- **Data transparency and traceability** to build a shared evidence base on material flows and impacts.
- **Improved coherence in international standards**, especially for responsible mining and the circular economy.
- **Enhanced trade and market cooperation** to support strategic minerals and scale up circular value chains across borders.

1 Rising pressures on global materials systems

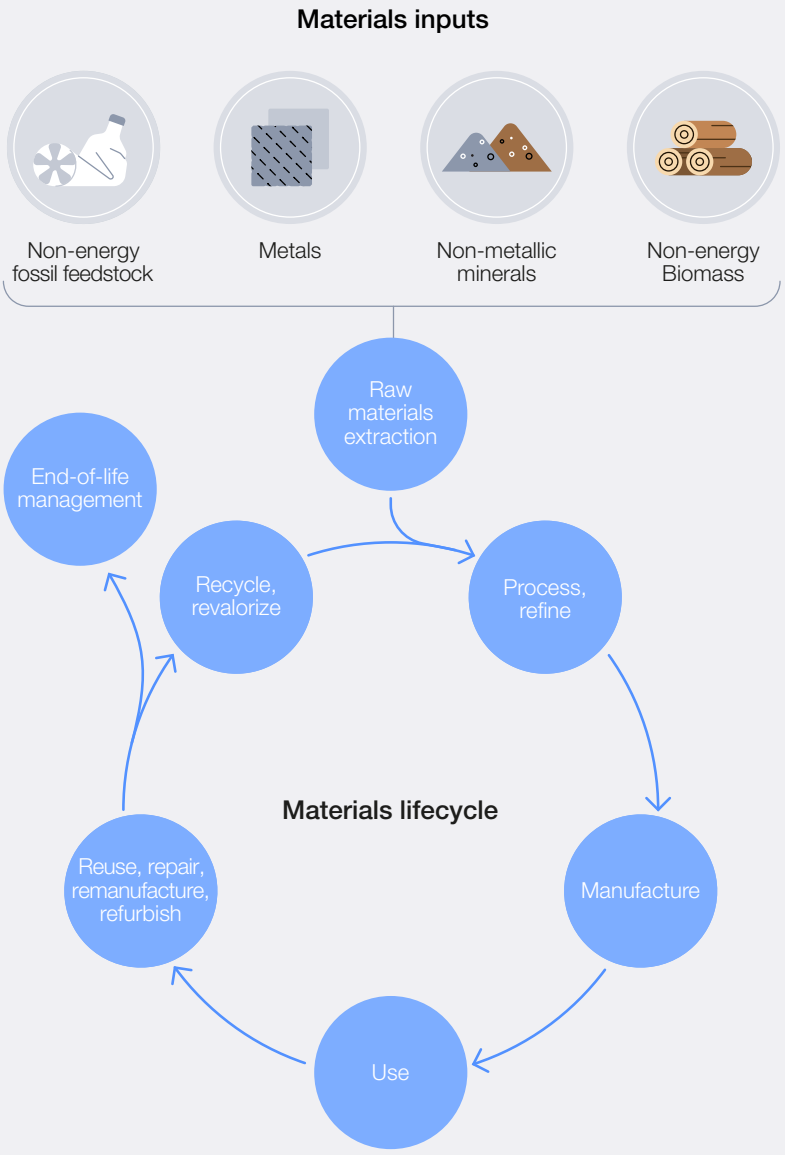
Materials are moving to the forefront of business agendas as geoeconomic, technological and environmental pressures rise.

1.1 Materials systems are under strain

The technologies that shape modern economies, from electric vehicles and wind turbines to semiconductors, data centres and robotics, are fundamentally dependent on affordable and reliable access to a wide range of materials, spanning high-volume industrial inputs, such as steel, cement, copper and rare earth minerals.

Over decades, complex global materials systems have evolved to deliver reliable access to this wide array of inputs. These systems coordinate and govern the flow of materials throughout their full life cycle, from extraction, processing and manufacturing to use and recovery. They are comprised of a number of interconnected components spanning shared digital and physical infrastructures, an international governance architecture, trade and logistics networks, technology, innovation and knowledge systems and many others (see Figure 2).

FIGURE 2 | **The inputs and components of global materials systems**



System components

1. **International norms, rules, standards and regulations**
   Frameworks governing responsible production, interoperability, sustainability and market access
2. **Trade and economic cooperation agreements**
   Legal frameworks structuring cross-border materials trade, market access and cooperation
3. **Technology, innovation and knowledge**
   Research, innovation and skills enabling productivity, circularity and system transformation
4. **Shared infrastructure**
   Foundational digital and physical assets enabling material flows, transparency and coordination
5. **Governance and institutional architecture**
   Public and private institutions shaping oversight, coordination, accountability and collective action
6. **Trade and logistics networks**
   Physical and operational systems moving materials across borders and value chains

Note: Fossil fuels and biomass extracted for direct energy use were not considered in scope for this report. For more detail on what constitutes non-energy fossil feedstock and non-energy biomass, see endnote.[1]

In 2025 alone, a record **226** import and export restrictions on critical minerals were enacted globally, up from 82 in 2024.

The reliability and stability of these materials systems are increasingly under strain, as expectations of efficient, globally integrated markets give way to a more active role for the state as governments prioritize national security and industry in times of increasing geopolitical uncertainty.[2] In 2025 alone, a record 226 import and export restrictions on critical minerals were enacted globally, up from 82 in 2024.[3] Waste and scrap materials remain the most frequently restricted category, often due to environmental concerns and increasing interest in circular supply chains.[4]

At the same time, demand for certain materials, driven in part by rapid technological change, is beginning to outpace planned supply. The International Energy Agency (IEA) has warned that copper supply could fall short of projected demand by around 30% by 2035 without significant new investment.[5] The impacts of disruptions or delays in the supply of key materials such as copper, gallium or rare earth elements can cascade through sectors, slowing and making more costly the deployment of strategic technologies and infrastructure, with direct implications for competitiveness and security.[6]

The International Energy Agency has warned that copper supply could fall short of projected demand by

~30%

by 2035 without significant new investment.

Growing environmental pressures compound these challenges. Resource extraction and use drive over half of global greenhouse gas emissions and more than 90% of biodiversity loss.[7] Environmental degradation is, in return, disrupting supply-chains, as climate-driven extremes and water stress undermine mining, processing, logistics and manufacturing across production regions.[8] Impacts on people, including unsafe working conditions and pollution, further weaken trust and undermine the social licence required for genuine societal transitions.

Taken together, these pressures point to a materials landscape characterized by rising uncertainty, strategic competition and structural reconfiguration. The World Economic Forum's *Global Cooperation Barometer 2026* suggests that international cooperation is beginning to adapt to this wider context, with cooperation being increasingly reorganized around interest-based, issue-specific and regional arrangements as established multilateral pathways face growing constraints.[9]

For materials systems, this shift in approaches to international cooperation has mixed implications. On the one hand, more targeted forms of cooperation on different elements of the system can enable faster alignment around shared priorities and practical challenges. On the other, greater fragmentation across cooperation forums and regions can contribute to uneven participation, regulatory misalignment or duplication and reduced predictability.

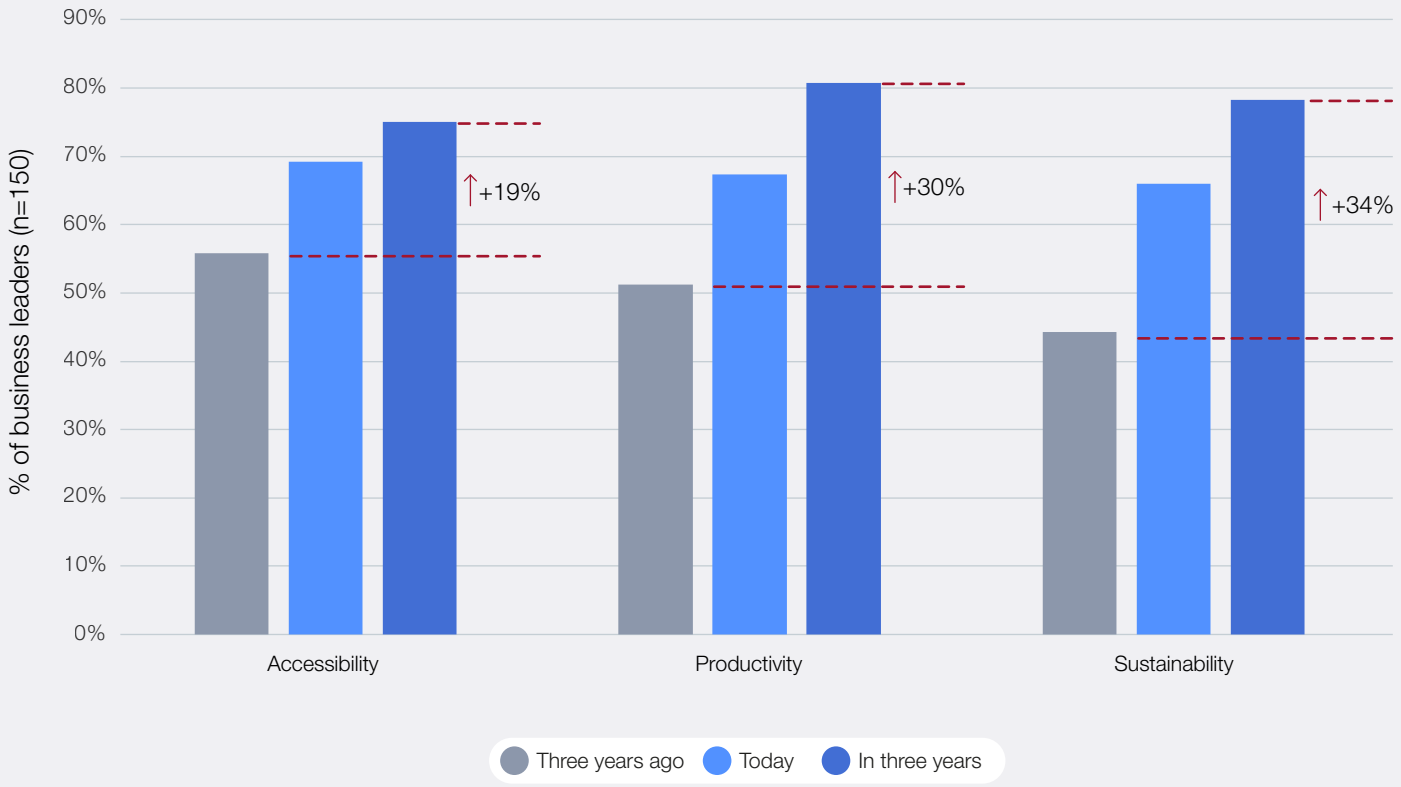
1.2 Cooperation on materials rises to top of business agendas

The Forum surveyed 150 global executives across six regions, 12 countries and 15 different industries to inform this white paper. A clear majority reported escalating challenges related to maintaining three key dimensions of the materials supply chain: accessibility, productivity and sustainability. As a result, materials have become a strategic business priority.

This survey reveals a sharp shift in perceptions over time. For instance, three years ago, just 44% of leaders polled for this report considered challenges to the sustainability of materials to be significant for their industry. Today, the figure is around 66%, rising to an expected 78% within the next three years (see Figure 3). A similar upward trajectory is evident for the productivity and accessibility of materials, indicating that pressures are intensifying simultaneously across all three dimensions rather than in isolation.

FIGURE 3 | **Business leaders predict rising challenges to materials systems in next three years**

Survey question: How significant do you expect this materials-related challenge to be for your industry, for the specified time frames?



Note: Percentage values represent the proportion of leaders identifying materials-related challenges as "significant" or "very significant" over the specified time periods.

Source: World Economic Forum global leaders survey, 2025.

While corporate appetite for cooperation is high, the institutional structures needed to convert that intent into coordinated, scalable action remain underdeveloped.

The perception of mounting materials-related challenges reflects the practical realities firms are already facing in their operations and supply chains (see Figure 4). Among the top pressures shaping materials management today, those most frequently cited by respondents include:

- Growing concentration of materials supply in a small number of countries (64%).
- Inconsistent or protectionist trade policies (63%).
- Rising geopolitical tensions between supplier and consumer regions (62%).

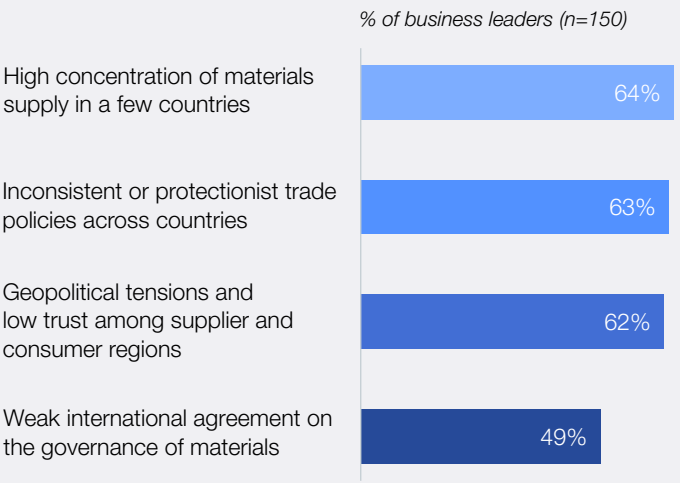
Nearly half of business leaders cited the weak level of international agreement on the governance of materials as being challenging. For companies operating across global value chains, these dynamics translate into higher exposure to disruption, greater price volatility and a less predictable environment for long-term investment and innovation.

At the same time, fragmentation across many initiatives, uncertainty around data sharing and intellectual property, and the absence of clear coordination or leadership at the intergovernmental level continue to limit effective international cooperation.

FIGURE 4 | **Top challenges in materials management and barriers to cooperation**

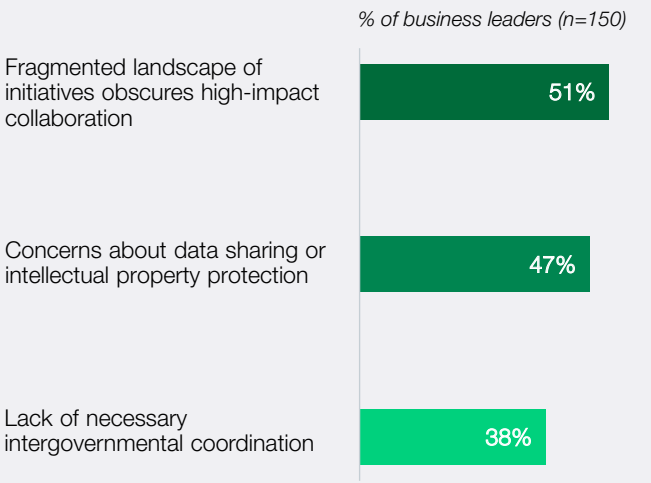
Challenges in global materials management

Survey question: What are the systemic barriers that prevent your organization from managing materials in terms of securing accessibility, boosting productivity and ensuring sustainability?



Barriers to international cooperation

Survey question: What are the main factors holding back your organization from further participating in international partnerships or initiatives to enhance global materials collaboration?



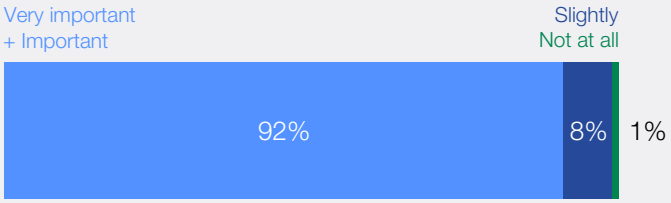
Source: World Economic Forum global leaders survey, 2025.

As these pressures intensify and prove difficult to address unilaterally, business leaders are viewing international cooperation as a core strategic tool. Nine out of 10 surveyed leaders identified stronger international cooperation as critical to their long-term success, while eight out of 10 reported being "very willing" or "considerably willing" to deepen engagement in international partnerships, signalling a broad-based consensus across regions and sectors (see Figure 5).

Together, this points to a core challenge in today's materials systems: while corporate appetite for cooperation is high, the institutional structures needed to convert that intent into coordinated, scalable action remain underdeveloped.

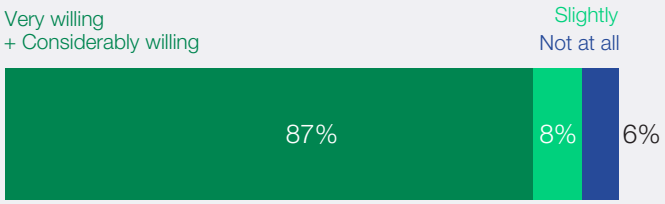
FIGURE 5 **Importance of stronger international cooperation on long-term business success**

Survey question: For the long-term success of your company, strengthened international cooperation on materials is (i) very important, (ii) important, (iii) slightly important, (iv) not important at all



92% of business leaders view international cooperation on materials as (very) important for company long-term success

Survey question: How willing would your organization be to engage further in international partnerships or initiatives that aim to address these barriers?



87% of business leaders are very or considerably willing to strengthen international partnerships

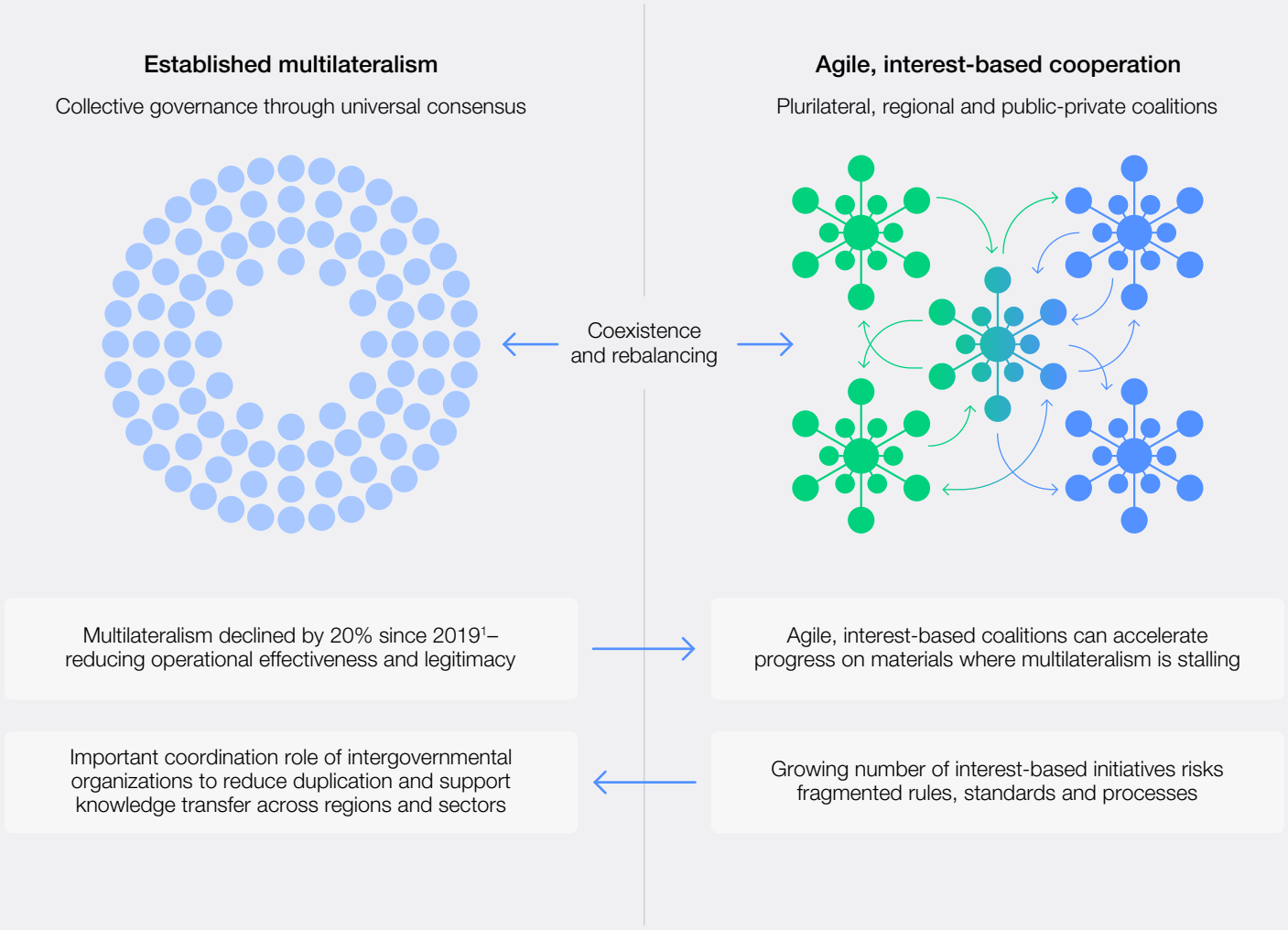
Source: World Economic Forum global leaders survey, 2025.

2 Adapting cooperation approaches to a multipolar world

Materials systems can be strengthened through interest-based coalitions capable of adaptive and targeted cooperation.

As the global order becomes increasingly multipolar, the ways in which international cooperation on materials is conducted will need to adapt. While multilateral cooperation remains important for setting shared principles and long-term direction, it has declined by 20% since 2019 and this trend is likely to continue.[10] Meaningful progress is therefore more likely to advance through flexible, smaller groupings that can act on common interests to achieve pragmatic goals (see Figure 6).

FIGURE 6 **As multilateral consensus slows down, interest-based coalitions can drive progress**



Note: 1. The source for the 20% datapoint is the World Economic Forum's *Global Cooperation Barometer 2026*.

Multilateral cooperation has declined by

20%

since 2019. Meaningful progress is more likely through flexible, smaller groupings that act on common interests to achieve pragmatic goals.

The same trend is observed for materials-related international cooperation initiatives. An analysis conducted for this report mapped 100 different international initiatives spanning intergovernmental approaches (bilateral, plurilateral, regional, multilateral) and multi-stakeholder alliances, coalitions and consortiums (see Table 1). Together, these initiatives encompass the full materials lifecycle, including mining, manufacturing and waste management. Many recent initiatives have targeted cooperation on the circular economy, as well as three closely linked areas: data traceability and transparency, standards development, and trade and market access.

Notably, around 80% of initiatives launched since 2015 took the form of plurilateral, regional or multi-stakeholder arrangements, underscoring the growing role of smaller, interest-aligned groupings in advancing cooperation on materials where broader consensus is harder to achieve.[11]

TABLE 1 **Different approaches to international cooperation**

Cooperation type	Primary actors	Description	Example initiatives
		Intergovernmental	
Bilateral	Two national governments	Formal cooperation between two states, typically under treaties or strategic partnerships	– Australia-Japan Critical Minerals Partnership – EU-Canada Strategic Partnership on Raw Materials
Plurilateral	Limited group of like-minded governments	Cooperation among a small number of states outside universal multilateral forums	– G20 Critical Minerals Framework – G7 Alliance on Resource Efficiency – Global Alliance on Circular Economy and Resource Efficiency – Quad Critical Minerals Initiative
Regional	Governments within a geographic region	Institutionalized cooperation at regional level, often with standing bodies	– ASEAN Framework for Circular Economy for the ASEAN Economic Community – African Mining Vision (AU-led) – Jaipur Declaration on 3R and Circular Economy – African Circular Economy Alliance
Multilateral	All (or near-universal) national governments, typically through intergovernmental organizations	Universal or near-universal cooperation frameworks providing shared principles, rules and coordination mechanisms across the global system	– United Nations General Assembly – UN Environment Assembly – World Trade Organization – Paris Agreement – Sustainable Development Goals – Intergovernmental Negotiating Committee on Plastic Pollution
		Multi-stakeholder	
Alliance	Governments, industry, civil society, international organizations	Strategic, ongoing alignment around shared objectives with light but intentional governance	– Global Battery Alliance – Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development
Coalition	Governments, NGOs, industry, other stakeholders	Looser and often time-bound grouping formed around a shared issue, agenda or reform objective	– Global Plastics Action Partnership – Minerals Security Council
Consortium	Firms, industry bodies, technical experts, sometimes governments	Formal, delivery-orientated collaboration with defined scope, outputs and technical methodologies	– Global Circularity Protocol for Business – Initiative for Responsible Mining Assurance – Responsible Minerals Initiative

BOX 1 **Global Battery Alliance and the Battery Passport**

The Global Battery Alliance (GBA) is a multi-stakeholder organization bringing together governments, battery and automotive manufacturers, mining companies, technology providers, financial institutions and civil society.

A flagship initiative of the GBA is the Battery Passport,[12] an emerging sustainability certification for batteries that leverages digital product passport infrastructure to enable consistent, verifiable and interoperable data on battery sustainability, performance and provenance across borders. The passport integrates information on the battery's carbon footprint, responsible sourcing, material composition and circularity attributes. This in turn supports regulatory compliance and due diligence, by scoring and independently validating performance through GBA certification to inform regulators, investors, procurers and market decision-makers.

By aligning diverse stakeholders around shared data principles and piloting interoperable solutions, the GBA Battery Passport demonstrates how multi-stakeholder cooperation can reduce fragmentation, build trust and create scalable traceability systems. The initiative offers a practical template for traceability in other critical materials value chains.

75%

of global leaders believe non-multilateral forms of cooperation are those most likely to be adopted to address future challenges to materials systems.

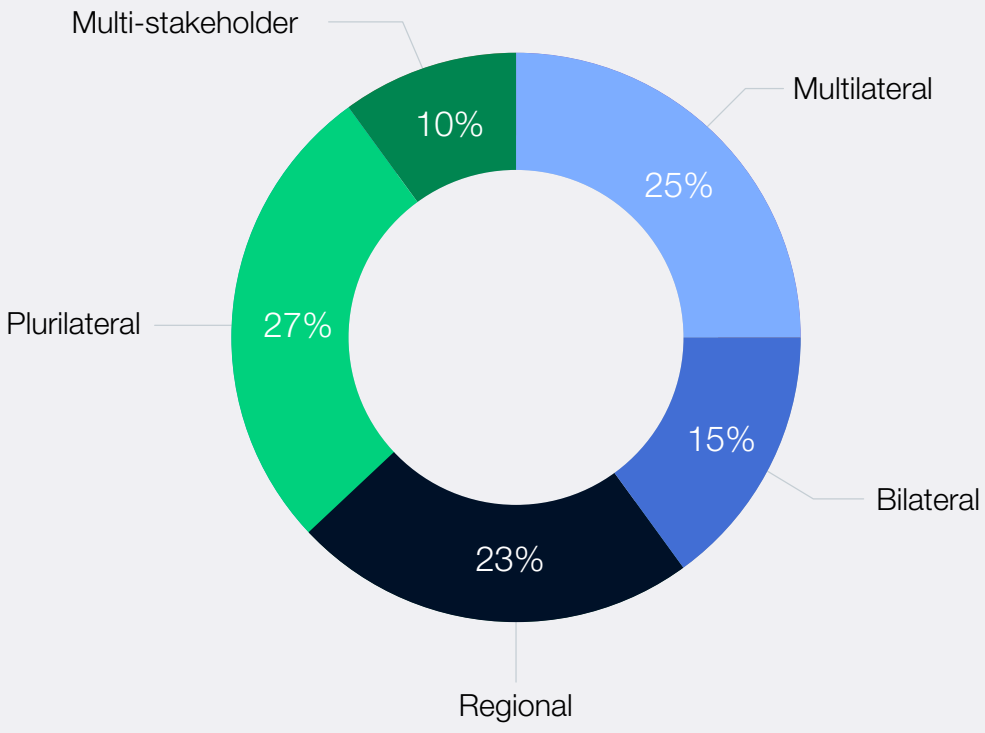
The growing number and diversity of materials-related initiatives has made the landscape harder to navigate. This complexity is reflected in the results of the global leaders' survey, where over half of respondents cited difficulty identifying which initiatives deliver the greatest value and impact as a key barrier to international cooperation.

In the absence of multilateral progress, the number and different forms of cooperation initiatives on materials are likely to increase. For instance, the Forum's survey highlighted that 75% of global leaders believe non-multilateral forms of cooperation are those most likely to be adopted to address future challenges to materials systems (see Figure 7).

As interest-based forms of cooperation increase, the risk of fragmentation, duplication and complexity increases. As a result, intergovernmental organizations and global institutions will need to step up their systemic convening and coordination roles, while seeking where possible to ensure coherence with ongoing multilateral developments, avoid duplication and remove barriers to cooperation.

For more information on the sources behind the Forum's analysis in this chapter, see Appendix.

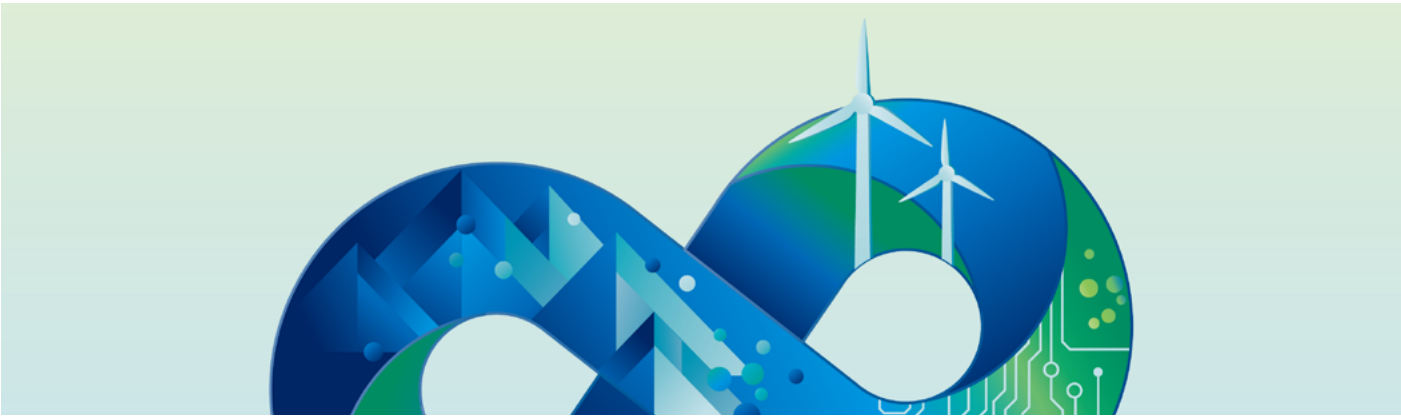
FIGURE 7 **Most likely forms of international cooperation to address challenges to materials systems**



Source: World Economic Forum global leaders survey, 2025.

3 Circular economy as a systemic approach

A systemic lifecycle approach to materials management strengthens resilience, productivity and environmental sustainability across value chains.



30-58%

of global demand for critical minerals such as lithium, cobalt, nickel, manganese, rare earth elements, platinum and copper could be met through circular economy practices by 2050.

95%

of executives across 10 major industrial sectors expect circularity to be important to their organization within the next three years.

Mitigating the growing pressures on global materials systems requires a whole-of-lifecycle perspective. Decisions taken at any single stage of the materials lifecycle, from product design to end-of-life management, shape outcomes across the entire system. Improving resilience, productivity and sustainability cannot therefore depend on isolated interventions, but on coordinated action across all lifecycle stages, identifying opportunities to reduce losses, extend value and minimize negative impacts.

The circular economy provides a systemic approach through which to coordinate these efforts; it is commonly framed around three core principles:

- Designing out waste and pollution.
- Keeping products and materials in use at their highest value for as long as possible.
- Regenerating natural systems.

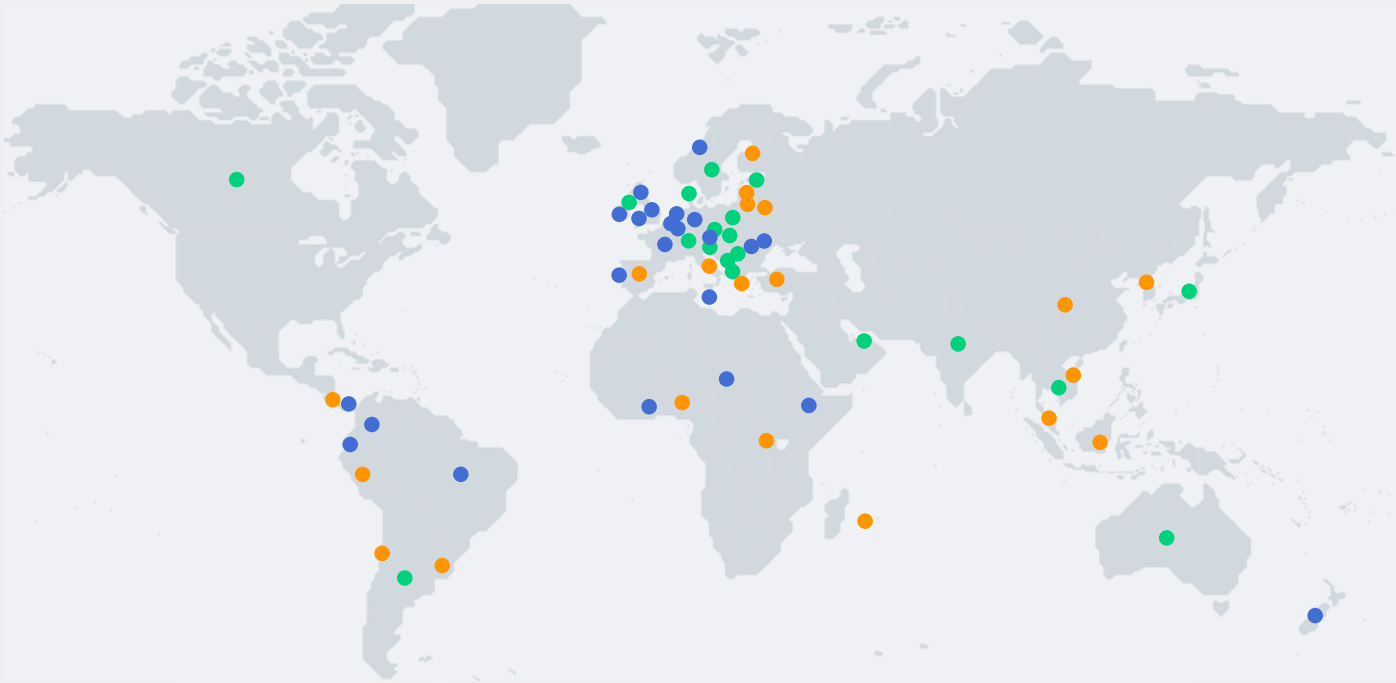
Together, these principles provide a practical framework for coordinating action across the full materials lifecycle, from design and use through to recovery and reintegration into the economy.

Adopting circularity principles in material and product design – such as improved repairability, durability, recyclability and the avoidance of hazardous chemicals – can significantly reduce downstream losses and environmental impacts.

By integrating product sharing, reuse, repair and remanufacturing approaches into business models, companies can decouple revenue from materials use, thereby strengthening supply chain resilience.[13] For example, it is estimated that between 30% and 58% of the global demand for critical energy transition minerals – such as lithium, cobalt, nickel, manganese, rare earth elements, platinum and copper – could be met through circular economy practices by 2050.[14]

Commitments to the circular economy by both governments and business are growing. Research published in the Forum's January 2025 white paper, *Circular Transformation of Industries: Unlocking Economic Value*, shows that 95% of executives across 10 major industrial sectors expect circularity to be important to their organization within the next three years.[15] Within the past decade, 49 countries have published dedicated national circular economy strategies, resulting in policy commitments across 17 sectors (see Figure 8).[16] This momentum suggests a shared recognition that circular economy approaches are no longer peripheral, but increasingly central to the future performance, resilience and sustainability of global materials systems.

FIGURE 8 | **National circular economy calls to action, roadmaps and strategies**



Calls to action: These aim to kick-start national dialogue and coordinated action on the circular economy and can serve as a critical precursor to a roadmap or strategy.

Roadmaps: These offer a qualitative long-term vision, outlining high-level focus and priority areas and actions. They contain sufficient detail on policy actions and priority areas to subsequently produce more specific operational plans.

Operational strategies: These outline time-dependent actions, specified action owners, and a governance strategy that includes monitoring and evaluation; they also consider financing whenever possible. Operational strategies have usually been adopted within an official government programme.

Source: Chatham House, 2026.[17]

National circular economy strategies are being shaped to a greater extent by resource security considerations than by international cooperation. For example, of the roughly 4,300 circular economy policy commitments contained in the 49 national strategies, fewer than 10% address international coordination, while only 9% explicitly consider trade-related aspects.[18]

Yet, for circular activities – such as repair, refurbishing or remanufacturing – to be economically viable, it is often necessary to aggregate end-of-life products, components and secondary raw materials from multiple jurisdictions into regional economic hubs with sufficient economies of scale, technological development and market demand.[19] At the same time, firms commonly require access to advanced overseas technologies, spare parts and expertise with which to perform circular activities.[20] The unilateral approach, independent of any international coordination principles or mechanisms, therefore risks regulatory fragmentation across the likes of technical standards, reporting and disclosure requirements, and market access demands.

A growing number of plurilateral, regional and multi-stakeholder initiatives are emerging, reflecting the need for cross-border cooperation on the circular economy. Examples include the following:

- Global Circularity Protocol for Business.
- Global Alliance on Circular Economy and Resource Efficiency.
- ASEAN Framework for Circular Economy.
- African Circular Economy Alliance.

While these initiatives represent important steps, delivering circularity at scale will require targeted *and* coordinated cooperation, cutting across regions, sectors, value chains and policy domains.

4

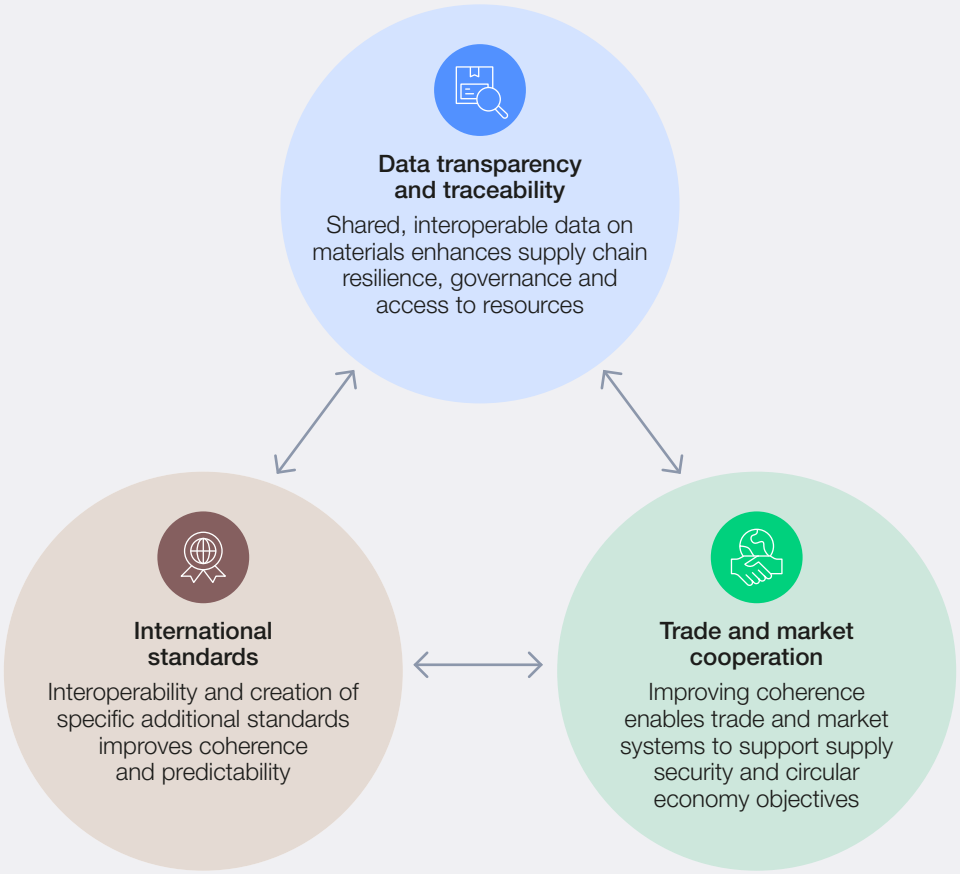
Priority areas for international cooperation

In a fragmented geopolitical context, targeted cooperation around data transparency, standards and trade can deliver meaningful progress.

The Forum's survey of 150 global executives highlighted three cross-cutting areas where targeted international cooperation could help work towards more resilient, productive and sustainable materials systems: data transparency and traceability, stronger international technical standards, and trade and market cooperation (see Figure 9). Each area can play an enabling role in improving materials systems by improving visibility of material flows, enabling comparability and trust across value chains, and supporting the cross-border scaling-up of circular business models.

The three priority areas offer the possibility of progress without relying on multilateral consensus in the first instance. They reflect strong and growing support from both governments and industry, alongside opportunities for flexible, interest-based cooperation.

FIGURE 9 **Three priority areas where international cooperation on materials can be advanced**



During the Forum's survey, the priority to improve data transparency and traceability emerged as the most immediate and broadly supported entry point for deeper cooperation.

The three areas are also mutually reinforcing. Improved data transparency and traceability provide a shared evidence base for understanding the flows and impacts of materials, enabling the development of interoperable standards. Robust and consistent standards facilitate trade and market cooperation by reducing friction, improving regulatory predictability and supporting investment across primary and secondary materials value chains.

During the Forum's survey, the priority to improve data transparency and traceability emerged as the most immediate and broadly supported entry point for deeper cooperation, underpinning progress across the other two areas. Executives consistently emphasised that without a shared, trusted evidence base on the flows, impacts and risks of materials, any efforts to align standards or improve trade cooperation would be constrained.

The remainder of this chapter explores the challenges associated with each priority area, relevant ongoing initiatives and priority actions for further cooperation (summarised in Table 2).

TABLE 2 **Summary of opportunities for stronger international cooperation in priority areas**

Challenges to address	Selected ongoing initiatives	Priority actions for further cooperation
	Data traceability & transparency	
Fragmented and inconsistent availability of data related to flows of materials and associated environmental/social impacts	– International materials data hub (see Box 2)	– Clarify how a materials data hub can add distinct system-level value beyond existing datasets
Risk of incompatibility and reporting duplication of digital product passport (DPP) schemes	– UN Transparency Protocol (UNTP) (see Box 3) – UNECE and ISO initiative on UNTP DPPs – Global Battery Alliance (GBA)	– Create interoperable, sector-specific UNTP extensions to enable cross-border DPP alignment
	International standards	
Overlapping and fragmented mining standards (high compliance costs)	– Consolidated Mining Standard Initiative (CMSI) (see Box 4)	– Design credible benchmarks to improve comparability, trust and usability across responsible mining standards
Lack of international standards for circular activities	– Global Circularity Protocol (GCP) for Business (see Box 5) – ISO 59000 Circular economy series (see Box 5)	– Identify principal gaps in international technical standards for key circular economy activities
	Trade & market cooperation	
Opaque and volatile minerals markets Limited coordination on supply, demand and by-products	– G20 Critical Minerals Framework (see Box 6) – G7 Critical Minerals Action Plan (see Box 6)	– Improve coordination on forecasting, transparency and accountability across strategic minerals supply chains
Trade rules misaligned with circular economy	– WTO Trade And Environmental Sustainability Structured Discussions (TESSD) informal working group on the circular economy – Framework for Circular Economy for the ASEAN Economic Community (see Box 7)	– Identify and pilot practical solutions to remove trade barriers affecting secondary materials and refurbished or remanufactured products

Notes: ASEAN = Association of Southeast Asian Nations, ISO = International Standards Organization, UNECE = United Nations Economic Commission for Europe, WTO = World Trade Organization.

4.1 Data transparency and traceability

The performance of materials systems is highly constrained by the limited transparency and traceability of value chain data. Decision-makers need clarity on aspects such as the provenance of materials, their composition, environmental and social impacts, and the chain of custody. Without this, they will struggle to assess risks, manage trade-offs or build trust between value chain actors, significantly hindering coordinated action.

Stakeholders consistently highlighted two priority challenges:

- The absence of a shared, decision-ready picture of global flows of materials and their associated impacts, which limits effective policy design, investment planning and risk management.
- The emergence of digital traceability mechanisms, particularly digital product passports (DPPs), without sufficient interoperability across jurisdictions and sectors; this risks fragmentation and duplication.

Addressing these two challenges in parallel is important to build a coherent, trusted traceability architecture capable of supporting resilient, productive and sustainable materials systems.

Mapping global flows of materials and impact data

48%

of leaders identified concerns around data sharing as a key obstacle to international cooperation.

A transparent, accurate and shared overview of global flows of materials and their associated environmental and social impacts is important for identifying emerging supply vulnerabilities, assessing cumulative environmental impacts, and coordinating timely and proportionate responses across borders and value chains.

Several different attempts at building databases to track the flows of materials have emerged, including those developed by the UN International Resources Panel, the Organisation for Economic Co-operation and Development, the International Energy Agency, the UN Statistics Division, World Mining Data, Eurostat, as well as private sector and academic initiatives.

Despite the existence of these initiatives, accessing data related to the flows of materials and associated environmental impacts that is consistent and comparable across regions, sectors and materials categories remains complex and often costly. Underlying sources, definitions, methodologies and assumptions such as those used for greenhouse gas emission intensities or shares of secondary materials are frequently outdated or misaligned between datasets. As a result, decision-makers lack a trusted, interoperable evidence base to support coherent policy design, investment decisions and cross-border coordination.

Concerns around commercial confidentiality and proprietary data also significantly limit visibility across global supply chains. This was highlighted in the global leaders' survey, where 48% of leaders identified concerns around data sharing as a key obstacle to international cooperation.

BOX 2 | **Example of ongoing cooperation – international materials data hub**

To address the issue of fragmented, inconsistent and inaccessible data on flows of materials, Systemiq and the International Chamber of Commerce, with support from other stakeholders, are exploring the merits of establishing an international materials data hub. The idea received strong support from stakeholders consulted for this report.

Conceived as a global public good, such a hub could act as a central platform for synthesizing existing data on materials, improving access and usability rather than generating new datasets. It could provide harmonized, open-access data linking national and regional material flow accounts, international models such as Exiobase and data from intergovernmental organizations, industry and research institutions.

Through standardized metadata, methodological guidance and visualization tools, such a hub could enhance global consistency and comparability while delivering practical value across the following three core functions:

- **Industrial and trade strategy:** Mapping cross-border flows of materials to strengthen supply-chain resilience, identify value-addition opportunities and support planning through better visibility of stocks, flows and product lifetimes.
- **Environmental and social impact insights:** Integrating geospatial and site-level data on emissions, water use and biodiversity to inform infrastructure planning, risk assessment and investment decisions.
- **Data completeness and analytical capability:** Using artificial intelligence and other tools to address data gaps, improve data quality, support comparability across datasets and, where relevant, assist in monitoring risk-prone activities such as illegal mining, processing and waste operations.

Areas for further cooperation

PRIORITY ACTION →

Clarify how a materials data hub can add distinct system-level value beyond existing datasets.

Following growing interest in a materials data hub, an important next step is to clarify how such an approach could generate system-level value distinct from the current landscape of materials flow databases and transparency initiatives. This includes reflecting on which functions are best delivered through a shared hub – such as data synthesis, methodological alignment and decision-ready analytics – and which are better left with existing data providers. As part of the hub's formation, careful consideration would need to be given to sequencing, scope and governance to ensure neutrality, trust and equitable participation, while avoiding duplication and unnecessary complexity.

Beyond exploring the merits of a materials data hub, executives interviewed for this report highlighted the value of an international cooperative effort to improve the mapping of strategic materials for the clean energy transition, such as copper, nickel, lithium and cobalt, where data transparency is particularly limited and supply-chain risks are intensifying.

Concentrating early efforts on these materials could help demonstrate near-term value, support risk management and inform policy and investment decisions. It could also build on the work of existing international cooperation, such as:

- Seventh Session of the UN Environment Assembly (UNEA-7), held in December 2025, which aimed to strengthen international cooperation on the environmentally sound management of minerals and metals.
- UN Task Force on Critical Energy Transition Minerals, which hosts a dedicated technical cluster on traceability.

Digital product passport interoperability

> Poor interoperability between DPP schemes risks raising compliance costs, duplicating reporting and impeding cross-border transparency.

Digital product passports (DPPs) offer a promising approach to strengthen material traceability. A DPP is a structured digital record that travels with a product throughout its lifecycle, providing reliable information about what it is made of, where it comes from and how it can be used, repaired, reused or recycled.

By collecting and holding such data in a verifiable manner, DPPs help make materials more transparent and traceable across value chains. This would enable better design and sourcing decisions, and help regulators, businesses and consumers make more informed and responsible choices.

A DPP, such as that being developed in the European Union (EU), could improve the circularity and efficient use of materials through sharing relevant data on a product's material and chemical composition, instructions for maintenance, repair, refurbishment or recycling, and repair or service history (see Figure 10).

As DPP schemes are set to be introduced across different countries and regions, maintaining interoperability will be challenging without a shared underlying protocol. Poor interoperability between DPP schemes risks raising compliance costs, duplicating reporting and impeding cross-border transparency. These risks are amplified by gaps in patchy data availability, supplier capacity and digital infrastructure, especially in lower-income regions, jeopardizing the feasibility of DPPs.

FIGURE 10 **Examples of useful data fields that a digital product passport could contain**

BOX 3 | **Example of ongoing cooperation – UN Transparency Protocol and DPP interoperability**

Recognition of the need for an internationally shared underlying data protocol for DPPs has strengthened. The recently developed UN Transparency Protocol (UNTP) responds to this challenge by providing a globally applicable reference framework that defines how sustainability data is structured, exchanged and verified, allowing DPPs developed under different regulatory, sectoral or technological contexts to be interoperable without requiring full harmonization of underlying systems.[21]

A distinctive feature of the UNTP is its modular architecture, which establishes a common baseline framework while allowing sector-specific UNTP extensions to be bolted on. These extensions operationalize interoperability by translating the core protocol into tailored, industry-relevant data models, vocabularies and verification rules for specific sectors or value-chain contexts. In doing so, they ensure that DPPs can exchange, interpret and verify information consistently across jurisdictions without undermining global interoperability.

The development of UNTP extensions is currently at an early stage. Initial focus areas include batteries, electronics, critical raw materials, textiles and agri-food, where interoperable DPPs could deliver high value but currently face fragmented data requirements. Ongoing work on a battery extension led by the Global Battery Alliance, alongside efforts covering critical raw materials, electronics value chains and data centres led by the Responsible Business Alliance, provide early proof points of how UNTP-aligned extensions can be developed through industry collaboration and scaled up across jurisdictions.

Areas for further cooperation

PRIORITY ACTION →

Create interoperable, sector-specific UNTP extensions to enable cross-border DPP alignment.

There is a clear opportunity for greater international cooperation to support the development and adoption of DPPs anchored in the UNTP. Key priorities to address include:

- Financing the development and testing of new extensions that translate the core UNTP into interoperable, industry-relevant data models, vocabularies and verification rules.
- Piloting the application of these extensions in cross-border DPP use cases.

Cooperation could focus on high-leverage value chain nodes, such as metals processing, where data interoperability challenges are particularly acute, or on breaking persistent data silos between upstream, midstream and downstream actors.

Equally important is ensuring that UNTP-aligned interoperability solutions are demonstrated at low cost and complexity, reducing data collection and exchange burdens for small and medium-sized enterprises and suppliers in emerging economies.

4.2 International standards

“Fragmentation and uneven adoption of standards are emerging as systemic constraints rather than marginal inefficiencies.

International standards play a foundational role in enabling trust, comparability and coordination across global material value chains. As governments and businesses increasingly rely on standards to manage environmental, social and technical risks, fragmentation and uneven adoption are emerging as systemic constraints rather than marginal inefficiencies.

Executives and advisers consulted for this report highlighted two important challenges that could be tackled through closer cooperation on standards:

- The growing number and limited comparability of responsible mining standards, which increases compliance burdens and undermines clarity for investors, regulators and downstream actors.
- Persistent gaps in international technical standards for key circular economy activities, which continue to limit investment certainty and the cross-border scaling-up of circular value chains.

Addressing both challenges is important to building a coherent, credible and globally usable standards architecture for sustainable materials systems.

Benchmarking responsible mining standards

Responsible mining standards have proliferated into a diverse array of initiatives, each with distinct scopes, whether commodity-specific, scale-specific or topic-specific.[22] Voluntary environmental, social and governance (ESG) standards, due diligence guidelines, commodity-specific schemes, chain-of-custody systems, reporting frameworks and national mining codes co-exist across the sector, often addressing similar risks but applying different scopes, methodologies and assurance models.

This diversity creates compliance challenges and makes it difficult for companies, investors and regulators to identify which standards are most relevant or credible for a given context. This can diminish their overall effectiveness and contribute to reporting fatigue.

The burden falls most heavily on smaller firms, Indigenous Peoples' organizations and producers in emerging economies with limited assessment capacity. This fragmentation of standards drives duplication and inefficiency, through overlapping audits, weak comparability of assurance signals for downstream actors, and limited alignment between private standards and public regulation.

BOX 4 **Example of ongoing cooperation: Consolidated Mining Standards Initiative**

The Consolidated Mining Standards Initiative (CMSI) is a collaborative effort involving mining companies, standards organizations, investors, civil society groups and international organizations, which aims to address the growing fragmentation of responsible mining standards. It responds to a shared recognition that the proliferation of voluntary frameworks has created duplication, raised compliance costs and reduced clarity for regulators and downstream actors.

CMSI operates as a coordination platform rather than a new standard-setter. Participating organizations are working together to map and align a defined subset of globally used mine-site-level responsible mining standards that address environmental performance, social responsibility, human rights, labour conditions and governance.

By fostering cooperation across institutions with different mandates and constituencies, CMSI demonstrates how the alignment of standards can reduce complexity, improve comparability and support more coherent and inclusive global materials governance, particularly for smaller operators and producers in emerging economies.

Areas for further cooperation

PRIORITY ACTION →

Design credible benchmarks to improve comparability, trust and usability across responsible mining standards.

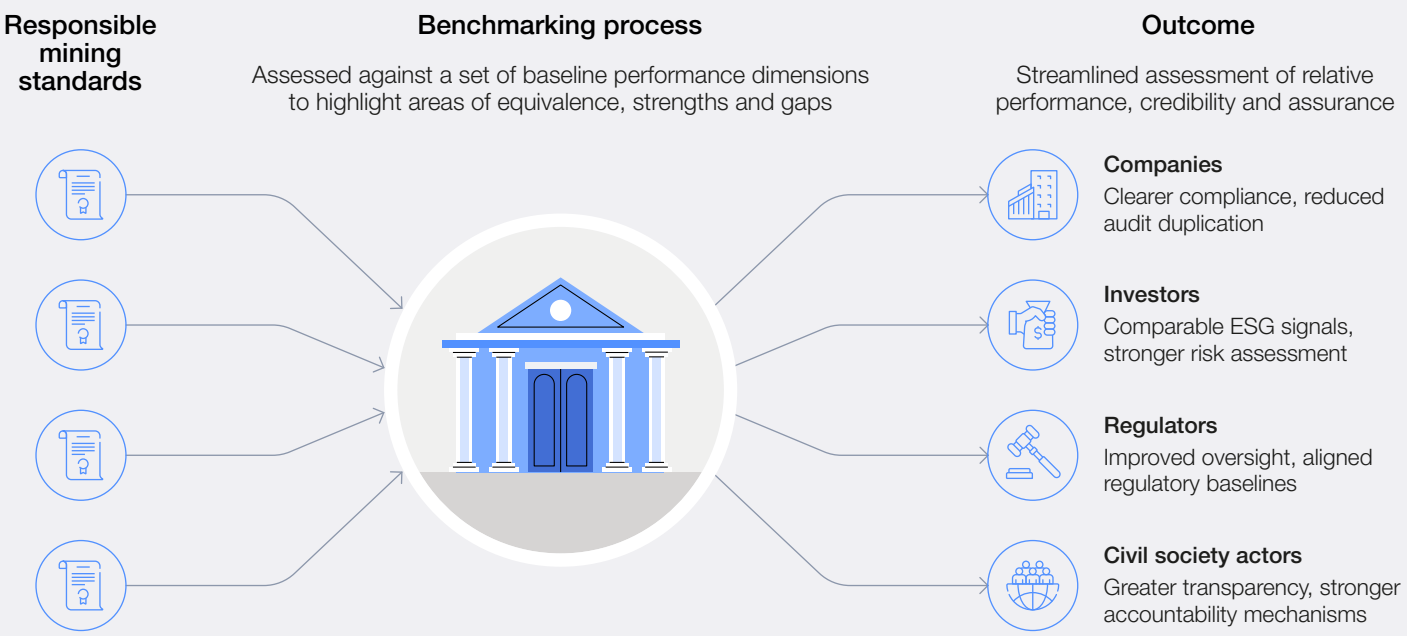
Consolidation efforts, including CMSI, represent an important step towards reducing duplication and improving clarity across responsible mining standards. However, consolidation efforts alone are unlikely to fully address the challenges of the complex, evolving nature of the current standards landscape.

For example, there is scope for stronger international cooperation to boost comparability across standards that remain in use after consolidation. More consistent benchmarking between existing standards could help companies, investors and regulators better understand relative performance, credibility and assurance.

In practice, this could involve assessing standards against a shared set of baseline performance dimensions, such as environmental management, human rights, governance, scope and assurance, using transparent criteria to highlight areas of equivalence, strengths and gaps (see Figure 11). This would complement consolidation efforts by improving coherence and comparability without requiring full alignment.

Realising such an approach would depend upon cooperation among industry, standards bodies, civil society and intergovernmental organizations to develop a shared understanding of baseline criteria for credible responsible mining. Any such effort would need to be governed in a neutral, inclusive and transparent manner, avoid creating additional or duplicative standards, and be orientated towards supporting continuous improvement and potential regulatory uptake rather than acting as a one-off classification exercise.

FIGURE 11 | **Benchmarking responsible mining standards could improve reporting, accountability and regulation**



Developing international technical standards for the circular economy

The relative newness of the circular economy means that international standards for many circular activities remain fragmented, underdeveloped and unevenly adopted. These range from technical standards encompassing eco-design, repair, refurbishment, remanufacturing and production of secondary raw materials through to disclosure and reporting standards.

While overarching frameworks such as the ISO 59000 series and the Global Circularity Protocol for Business are emerging, the absence or fragmentation of technical standards for specific circular activities continues to constrain consistency, investment certainty and the scaling-up of international circular value chains.

BOX 5

Examples of ongoing cooperation – the Global Circularity Protocol for Business (GCP) and ISO 59000 series

The ISO 59000 series, first published in 2024, provides an internationally recognised foundation for the circular economy by establishing common principles, terminology and high-level guidance applicable across sectors and regions. Developed through a formal, consensus-based international standards process, the series offers governments, regulators and industry a shared technical reference point for integrating circular economy concepts into policy, management systems and business practices.

Building on and complementing the ISO 59000 series, the Global Circularity Protocol for Business (GCP) provides practical, decision-useful guidance for measuring circularity at company and value-chain level. Developed by the World Business Council for Sustainable Development (WBCSD) and One Planet Network, in collaboration with businesses and technical experts, the GCP offers shared definitions, metrics and methodologies to assess material flows, circular strategies and performance.

Together, the ISO 59000 series and the GCP illustrate how cooperation between international standards and business-led protocols can reinforce one another, supporting coherence between policy, reporting and investment decisions while enabling scalable, comparable circular economy implementation.

Areas for further cooperation

PRIORITY ACTION →

Identify principal gaps in international technical standards for key circular economy activities.

The first priority is to understand where the absence or fragmentation of international technical standards is most constraining the scaling-up of circular economy value chains.

Global leaders consulted for this report highlighted several areas where targeted international cooperation could help address gaps in the circular economy standards landscape. The first priority is to develop a shared understanding of where the absence or fragmentation of international technical standards is most constraining the scaling-up of circular economy value chains. This includes collaboratively mapping existing standards across sectors and lifecycle activities, identifying overlaps, gaps and inconsistencies, and assessing where greater alignment, consolidation or the development of new technical specifications would generate the greatest practical value.

A second opportunity lies in better leveraging existing national and regional standards as building blocks for international convergence. In areas such as recycling and waste handling,[23] refurbishment and remanufacturing,[24] a range of technical standards already exists but they are applied unevenly across jurisdictions. Greater cooperation could help assess their comparability, identify elements suitable for broader adoption and support the emergence of shared international baselines without requiring full harmonization of national approaches.

Finally, executives noted the importance of considering how emerging standards are being adopted in practice. This includes sharing experiences on incentives, implementation pathways and demonstration approaches that can support uptake across diverse business contexts, particularly for small and medium-sized enterprises and actors in emerging economies.

4.3 Trade and market cooperation

Two-thirds of business leaders surveyed for this report identified inconsistent or protectionist trade policies as a systemic barrier.

Trade and market systems are a critical, yet increasingly fragile, pillar of global materials cooperation. The multilateral trading system as it applies to materials is under growing strain. While the World Trade Organization (WTO) remains the central multilateral institution for global trade, its existing frameworks and processes have limited capacity to adapt rules or coordinate responses to intensifying geoeconomic competition over transition materials. In this context, governments are increasingly turning to resource-nationalistic trade measures, alongside bilateral or plurilateral preferential agreements and strategic alliances, to secure supply and support domestic industries.

These dynamics are already having tangible impacts on business. Two-thirds of business leaders surveyed for this report identified inconsistent or protectionist trade policies as a systemic barrier, noting that the resulting patchwork of overlapping and sometimes conflicting rules reduces market predictability and complicates cross-border investment and operations.

Stakeholders highlighted two key challenges where stronger international cooperation is most urgently needed:

- The absence of effective coordination mechanisms for strategic mineral markets, which is contributing to volatility, opaque market behaviour and supply insecurity.
- Persistent trade and regulatory barriers that constrain the cross-border movement of secondary raw materials and circular products, limiting the scaling-up of circular value chains.

Addressing these challenges is essential to restore predictability, reduce fragmentation and ensure that trade systems support, rather than undermine, resilient and sustainable materials systems.

Market coordination on strategic minerals

Governments are intervening in minerals markets through export controls, domestic processing requirements and strategic stockpiling, often with limited international coordination.

For trade in strategic minerals, including those critical to the energy and digital transitions, market dynamics are increasingly shaped by geopolitical competition and assertions of national sovereignty. Rapid growth in demand for minerals such as lithium, rare earths and advanced semiconductor inputs, combined with high geographic concentration of mining, processing and refining capacity, has heightened concerns over security of access.

In response, governments are intervening more actively in minerals markets through export controls, domestic processing requirements and strategic stockpiling, often with limited international coordination. Recent restrictions on gallium and germanium exports, alongside growing use of critical minerals stockpiles, illustrate how policy interventions can quickly reverberate across global supply chains, amplifying price volatility and investment uncertainty.

These pressures are particularly acute for by-product minerals such as cobalt, indium and germanium, whose supply is tied to the economics of primary commodities like copper, zinc or aluminium. As these materials are rarely produced in response to their own demand signals and are poorly captured in existing trade and market data, their availability is harder to anticipate and their flows more difficult to trace. As a result, by-product minerals are especially exposed to disruption, policy shocks and geopolitical leverage, with limited mechanisms in place today to anticipate risks or coordinate responses across producer and consumer countries.

As a response to these challenges, the Mining 2030 initiative called for the creation of an international coordination and knowledge body for minerals,[25] which could fill intergovernmental governance gaps in:

- Forecasting demand and production trends across minerals supply chains: this would offer a more consistent foundation for long-term planning, helping to strengthen market resilience and address accessibility challenges.
- Improving mechanisms for transparency and accountability, particularly the tracking of illicit mineral flows.
- Developing benchmarks and key performance indicators for responsible mining, processing and finance.

BOX 6

Examples of ongoing cooperation – G20 and G7 commitments on critical minerals

Recent G20 and G7 processes have elevated critical minerals to the centre of international economic and sustainability cooperation. The G20 Critical Minerals Framework is a voluntary, non-binding blueprint to make critical mineral resources a driver of prosperity and sustainable development, through international cooperation to secure sustainable, transparent, stable and resilient value chains. It emphasises unlocking investment in exploration, promoting local beneficiation at source and strengthening governance for sustainable mining practices. It also seeks to preserve the sovereign rights of mineral-endowed countries, while ensuring economic, social and environmental stewardship, conservation, community participation and supply security.[26]

Complementing this, the G7 Critical Minerals Action Plan commits members to transparency and supply-chain diversification, and sets out actions on standards-based markets, traceability and investment partnerships, with an emphasis on innovation including recycling and circular economy approaches.

These plurilateral political commitments are reinforced by UNEA-7's Resolution on "strengthening international cooperation on the environmentally sound management of minerals and metals", which calls for enhanced data, traceability and cooperation across the full minerals lifecycle. Together, these initiatives signal growing consensus on the need for coordinated approaches, while leaving scope for more operational mechanisms to translate commitments into practice.

PRIORITY ACTION →

Areas for further cooperation

Improve coordination on forecasting, transparency and accountability across strategic minerals supply chains.

Building on and complementing the G7 and G20 initiatives on critical minerals and the IEA's Critical Minerals Security Programme, stakeholders emphasised that proposals for an international minerals entity should be viewed as a potential means to address persistent coordination gaps, rather than an end in itself. A structured, inclusive international dialogue is needed to assess whether a dedicated entity would be the most effective delivery mechanism, or whether similar outcomes could be achieved through stronger coordination among existing institutions, while maintaining focus on the overall goals to add value, avoid duplication and align with established mandates.

Regardless of institutional form, executives consulted on this report consistently highlighted three priorities for targeted cooperation to improve market coordination on critical minerals:

- Improve forecasting across strategic minerals supply chains, including by-product minerals, through coordinated analytical platforms and shared modelling approaches across relevant intergovernmental organizations, working in close alignment with national geological surveys and statistical agencies.
- Address transparency and accountability gaps, through interoperable data systems, enhanced information-sharing and closer alignment between customs authorities, financial institutions and traceability initiatives.
- Ensure that shared benchmarks and performance indicators for responsible mining, processing and finance build on existing standards and reporting frameworks, improving comparability without creating new or duplicative standards.

Reducing barriers to trade on the circular economy

Current global trade architecture constrains the emergence of circular value chains.[27] Divergent and evolving definitions, classifications, technical standards and regulatory requirements of the circular economy remain a particular challenge for businesses to navigate.[28] For instance, materials classified as secondary raw materials in one jurisdiction may be treated as waste in another, while used or refurbished goods could be classified as waste in some importing countries but recognised as remanufactured products in others. These inconsistencies increase the chance of delays, rejected shipments and compliance risks, disproportionately affecting small and medium-sized enterprises and firms in developing economies.

Trade nomenclature systems, designed to classify goods primarily by physical characteristics, also struggle to reflect material origin, condition or intended use of a product or material. As a result, customs authorities often cannot reliably distinguish between new, used, refurbished and remanufactured goods, or between secondary raw materials and waste, leading to additional inspections, permitting requirements and restrictions at the border. This increases administrative costs and uncertainty, and makes trusted circular flows harder and more expensive to establish.[29]

BOX 7

Example of ongoing cooperation – Framework for Circular Economy for the ASEAN Economic Community

ASEAN's Framework for Circular Economy provides a coordinated regional approach to scaling-up circular practices across Southeast Asia. Adopted in 2021, it prioritizes harmonized standards, circular innovation and improved trade facilitation. A key initiative is the planned development of a shared list of circular goods, such as recycled plastics and remanufactured electronics, to reduce tariffs, streamline customs and lower technical trade barriers. The framework demonstrates how regional cooperation can enable circular trade and strengthen economic resilience.

PRIORITY ACTION

Areas for further cooperation

Identify and pilot practical solutions to remove trade barriers affecting secondary materials and refurbished or remanufactured products.

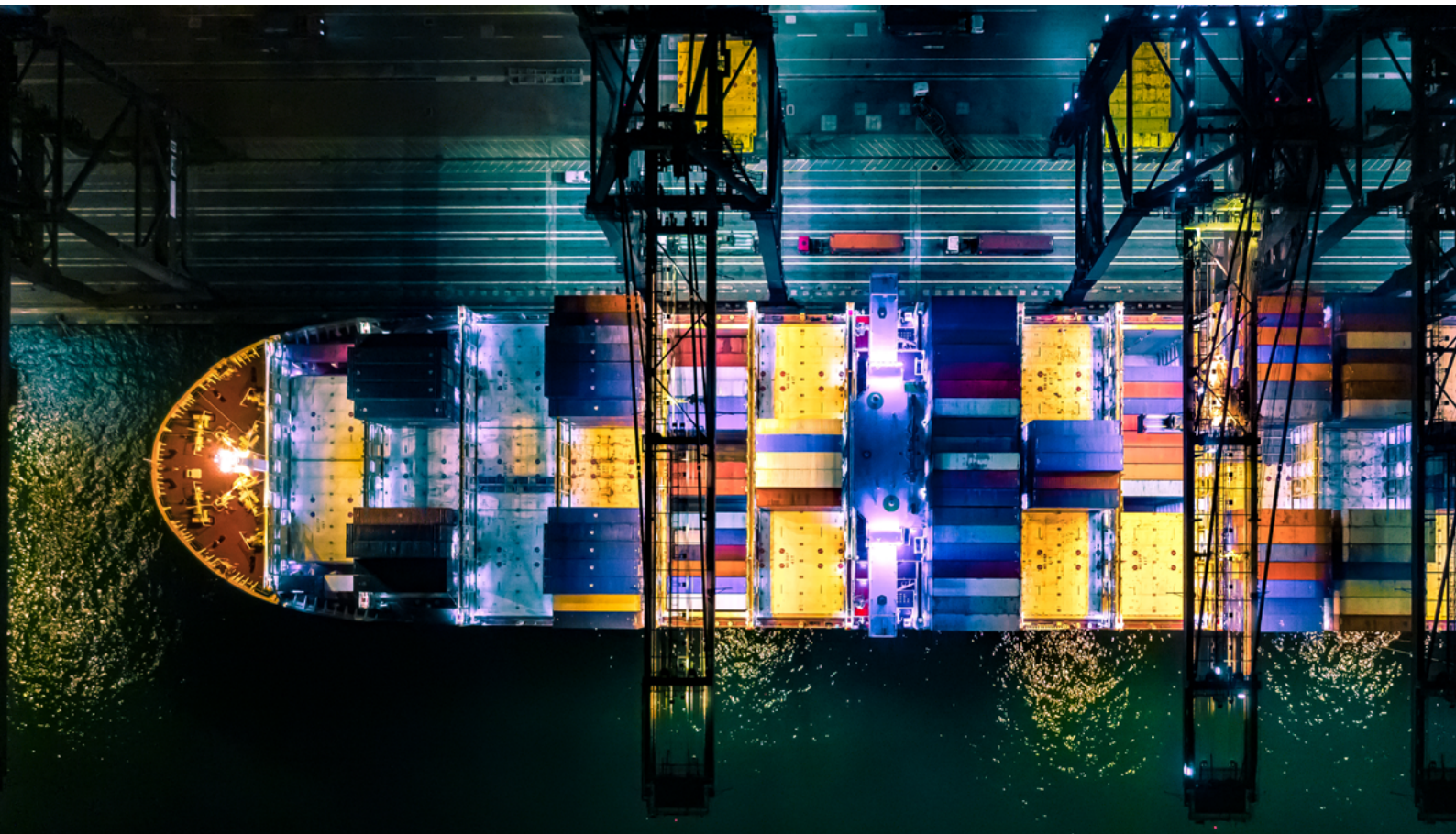
Stronger international cooperation could play an important role in identifying circular economy-related trade barriers that are common across jurisdictions. These include procedural challenges affecting the cross-border movement of secondary raw materials, as well as remanufactured and refurbished goods. By systematically documenting these challenges, cooperation mechanisms can help build a shared understanding of where existing trade, customs and regulatory frameworks are misaligned with circular economy objectives and the associated negative economic impacts.

A key priority is to design and implement cross-border pilot activities to test practical solutions in controlled settings – and international cooperation could help support this goal. Such pilots could explore the following:

- The feasibility and benefits of regional circular resource recovery hubs.
- More streamlined systems for electronic prior informed consent (under the Basel Convention).
- Internationally accredited trading platforms for refurbished and remanufactured products.

In doing so, these pilots could generate practical evidence on how interoperable trade systems and shared certification approaches can support trusted circular flows, while remaining compliant with existing regulatory requirements.

For international cooperation on this agenda to be effective and credible, pilots would need to ensure inclusive participation across developed, emerging and least-developed economies, alongside engagement from relevant intergovernmental and non-governmental organizations. This would help balance interests, align any proposed solutions with existing international rules and conventions (e.g. those governing hazardous waste shipments) and support a more equitable distribution of the benefits of circular trade.



Conclusion

The emerging multipolar order demands more interest-based and adaptive cooperation efforts to ensure materials systems remain resilient, productive and sustainable.

This report is published at a moment when the assumptions that have long underpinned stable and efficient materials markets are being fundamentally reworked. Rapid technological change, geostrategic realignment and intensifying environmental pressures are testing the resilience of the materials systems that sit at the heart of economic growth, societal progress and national security.

The analysis in this paper highlights a central paradox: demand for international cooperation on materials is rising – driven by shared exposure to supply concentration, volatility and systemic risk – yet existing multilateral mechanisms for delivering effective coordination are under growing strain. A crowded and fragmented landscape of initiatives, combined with uncertainty around data sharing and intellectual property, continues to inhibit effective cooperation, even as appetite for cooperation remains strong.

Against this backdrop, the report finds that, in a multipolar context, progress is less likely to emerge through multilateral consensus and more likely through targeted, interest-based forms of cooperation that match specific challenges with coalitions of actors sharing enough common ground to work together.

Building on this finding, the report identifies three core insights to strengthen international cooperation on materials.

Cooperation approaches need to adapt to a multipolar context. Smaller, agile and interest-based "coalitions of the doing" can pilot solutions, generate evidence and share lessons at speed. Meanwhile, intergovernmental organizations play a more critical coordinating role in maintaining coherence, inclusiveness and pathways to scaling-up.

The circular economy provides a systemic approach to strengthening materials systems, by reducing reliance on primary extraction, extending material lifetimes, and improving productivity, resilience and environmental performance. However, circular value chains are inherently transboundary and progress cannot be achieved through unilateral action alone. Without stronger international cooperation on data, standards and market practices, circular economy strategies risk becoming fragmented and ineffective.

Cooperation must be prioritized and sequenced around three areas:

- **Data transparency and traceability,** including improved mapping of global flows of materials, associated impacts and the interoperability of traceability schemes.
- **International standards,** including the benchmarking of responsible mining standards and development of shared standards for circularity.
- **Modernized trade and market cooperation,** including improved market coordination on strategic minerals and reducing barriers to trade for the circular economy.

Taken together, these elements form an action-orientated agenda for international cooperation in an uncertain and rapidly changing global environment.

Appendix: Methodology

Chapter 2 discusses how international cooperation approaches can adapt to meet the challenges of a multipolar world. The analysis is informed by the Forum's global survey of leaders and in consultation with stakeholders across sectors and regions. This includes gathering input from the sources below.

Advisory panel of 28 experts spanning private sector, intergovernmental organizations, governments, academia and civil society.

Landscape mapping of 100 international cooperation initiatives on materials.

30 semi-structured expert interviews.

Global survey of 150 business leaders across 15 industries and 12 countries:

Industries represented

Chemicals

Construction & real estate

Consumer goods & leisure products

Electrical & electronic

Energy systems

Food & agriculture products

Forestry & agriculture

Household goods & furniture

Logistics

Machinery & industrial

Mining & metals

Packaging

Telecommunications

Textiles & apparel

Transport

Countries represented

Australia

Brazil

Canada

China

France

Germany

India

Indonesia

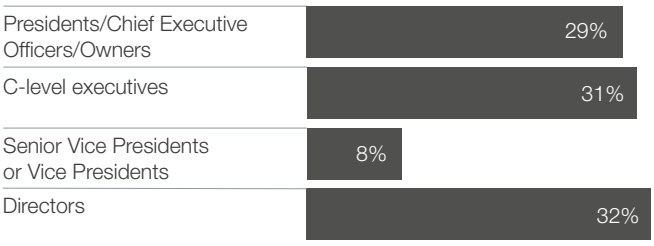
Italy

Japan

United Kingdom

United States

Respondents to the global survey of business leaders comprised the following:



Contributors

Lead author

Jack Barrie
Lead, Global Materials Cooperation,
World Economic Forum

Supporting authors

Anis Nassar
Manager, Materials Systems,
World Economic Forum

Ralitza Naydenova
Specialist, World Economic Forum

Acknowledgements

The World Economic Forum would like to extend their gratitude to the following individuals for their valuable contributions to this report. The paper does not necessarily reflect the views of these individuals and/or their organizations. Expert advice is purely consultative in nature and does not imply any association with the takeaways or conclusions presented within this paper.

Saleem Ali
Distinguished Professor of Energy and the Environment, University of Delaware

Dylan Bos
Senior Policy Advisor International Affairs, Ministry of Infrastructure and Water Management of the Netherlands

Catherine Chevauche
Circular Economy Director, Veolia

Inhee Chung
Corporate Vice President, Corporate Sustainability Center, Samsung Electronics America

Alex Colloricchio
Data Analyst, Circle Economy

Wouter de Groot
Senior Director of Group Sustainability, VELUX

Marc Delobelle
Head of Fossil-free Materials Purchasing, AB Volvo

Mark Draeck
Chief Technical Advisor on SWITCH$_2$Circular, United Nations Industrial Development Organization (UNIDO)

Paul Ekins
Professor of Resources and Environment Policy, University College London (UCL)

Tim Forslund
Circular Economy Specialist, SITRA (Finnish Innovation Fund)

Naoko Ishii
Director, Center for Global Commons, University of Tokyo

Latifahaida Latif
Assistant Director, ASEAN Secretariat, Association of Southeast Asian Nations (ASEAN)

Tania Laurençont
International Chair, ISO TC82/SC7 Sustainable mining and mine closure, International Standards Organization (ISO)

Marvin Nusseck
Senior Strategist, Finance Programme, Circle Economy

Ntokozo Nzimande
Deputy Director General, Department of Mineral and Petroleum Resources, Government of South Africa

Henrique Pacini Silva
Economic Affairs Officer, UN Trade and Development (UNCTAD)

Bruno Pelli
Global Mining Technical Services Director, Vale

James Pennington
Global Director for Sustainability Services, Lenovo Group

Inga Petersen
Executive Director, Global Battery Alliance (GBA)

Janez Potočnik
Co-Chair, International Resource Panel (IRP)

Tomás Saieg Páez
Head of the Circular Economy Office, Ministry of Environment of Chile

Giovanni Santambrogio
Policy Officer, European Commission

Mathias Schluep
Managing Director, World Resources Forum

Patrick Schroeder
Senior Research Fellow, Chatham House

Oleksiy Tatarenko
Senior Principal, Climate-Aligned Industries, Rocky Mountain Institute

Elisa Tonda
Chief, Resources and Markets Branch, Industry and Economy Division, United Nations Environment Programme (UNEP)

Burcu Tuncer
Circular Economy Program Manager, HP

Ke Wang
Global Lead, Energy Minerals and Circularity, World Resources Institute

Anthony Watanabe
Chief Sustainability Officer, Indorama Ventures

Shunta Yamaguchi
Policy Analyst, Trade and Environment, Organisation for Economic Co-operation and Development (OECD)

Production

Bianca Gay-Fulconis
Designer, 1-Pact Edition

Tanya Korniichuk
Illustrator, 1-Pact Edition

Jonathan Walter
Editor

Endnotes

1. **Non-energy fossil feedstocks** are petrochemical, coal and natural gas products used as raw materials (feedstock) for manufacturing, rather than being burned for energy. Representing about 8% of global fossil fuel use, these materials create products such as plastics, fertilizers, asphalt and lubricants. Synonyms include petrochemical feedstocks, non-energy uses of fossil fuels (NEUF) or industrial feedstock. **Non-energy biomass** refers to organic, renewable materials derived from plants and animals – such as agricultural residues, food waste and wood – that are used for materials, chemicals or products rather than being combusted for heat or electricity. Common examples include construction wood waste, paper products, composted waste and specialized fibre crops.
2. International Energy Agency (IEA). (2025). *Global Critical Minerals Outlook 2025*. https://www.iea.org/reports/global-critical-minerals-outlook-2025
3. Global Trade Alert. (2026). *Import and Export Restrictions: Critical Minerals*. https://globaltradealert.org/threads/import-and-export-restrictions-critical-minerals
4. Organisation for Economic Co-operation and Development (OECD). (2025). *Export restrictions on critical raw materials rise sharply amid growing demand*. https://www.oecd.org/en/about/news/press-releases/2025/05/export-restrictions-on-critical-raw-materials-rise-sharply-amid-growing-demand.html
5. International Energy Agency (IEA). (2025). *Global Critical Minerals Outlook 2025*. https://www.iea.org/reports/global-critical-minerals-outlook-2025
6. World Economic Forum. (2025). *From Minerals to Megawatts: Building Resilience for EVs, Data Centres and Power Grids*. https://reports.weforum.org/docs/WEF_From_Minerals_to_Megawatts_2025.pdf
7. United Nations Environment Programme (UNEP). (2024). *Global Resources Outlook 2024*. https://www.unep.org/resources/Global-Resource-Outlook-2024
8. Intergovernmental Panel on Climate Change (IPCC). (2023). *Climate Change 2023: Synthesis Report. Summary for Policymakers*. https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_SPM.pdf
9. World Economic Forum. (2026). *The Global Cooperation Barometer 2026*. https://reports.weforum.org/docs/WEF_The_Global_Cooperation_Barometer_2026.pdf.
10. World Economic Forum. (2026). *The Global Cooperation Barometer 2026*. https://reports.weforum.org/docs/WEF_The_Global_Cooperation_Barometer_2026.pdf
11. This analysis does not include bilateral, regional or plurilateral trade agreements.
12. Global Battery Alliance. (n.d.). *Establishing a Sustainable and Responsible Battery Value Chain*. https://www.globalbattery.org/
13. United Nations Environment Programme (UNEP). (2024). *Global Environment Outlook 7: A future we choose – Why investing in Earth now can lead to a trillion-dollar benefit for all*. https://wedocs.unep.org/items/bba44efd-7715-4054-8432-92b270ee9d67
14. United Nations Environment Programme. (2024). *Global Environment Outlook 7: A future we choose – Why investing in Earth now can lead to a trillion-dollar benefit for all*. https://wedocs.unep.org/items/bba44efd-7715-4054-8432-92b270ee9d67
15. World Economic Forum. (2025). *Circular Transformation of Industries: Unlocking Economic Value*. https://reports.weforum.org/docs/WEF_Circular_Transformation_of_Industries_2025.pdf
16. Barrie, J., Schröder, P., Pfaff, M. & Stucki, J. (2026). *Global stocktake of national circular economy roadmaps and strategies: 2025 update*. United Nations Industrial Development Organization (UNIDO). https://www.unido.org/sites/default/files/unido-publications/2026-01/Stocktake%20CE%20Roadmaps%202025.pdf
17. Chatham House. (2026). https://circulareconomy.earth/about
18. Barrie, J., Schröder, P., Pfaff, M. & Stucki, J. (2026). *Global stocktake of national circular economy roadmaps and strategies: 2025 update*. United Nations Industrial Development Organization (UNIDO). https://www.unido.org/sites/default/files/unido-publications/2026-01/Stocktake%20CE%20Roadmaps%202025.pdf
19. Schröeder, P. & Barrie, J. (2024). *How the circular economy can revive the Sustainable Development Goals*. Chatham House. https://www.chathamhouse.org/sites/default/files/2024-09/2024-09-19-how-the-circular-economy-can-revive-the-sdgs-schr%C3%B6der-barrie.pdf
20. Expert Group on Trade, Circular Economy, and Sustainable Development. (2024). *Trade, Circular Economy, and Sustainable Development: Guidance on Approaches and Good Practices for the Design of Trade-Related Circular Economy Policies and Measures*. https://lyrical-cormorant.files.svdcdn.com/production/assets/images/Publications/TESS-Report-Trade-Circular-Economy-and-Sustainable-Development.pdf
21. United Nations Economic Commission for Europe. (n.d.). *UN Transparency Protocol*. https://untp.unece.org/
22. International Institute for Sustainable Development (IISD) and the Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development. (2024). *Navigating Global Sustainability Standards in the Mining Sector*. https://www.iisd.org/system/files/2024-11/global-sustainability-standards-mining.pdf.

23. Examples include: e-Stewards, R2 Standards, WEEELABEX.

24. Examples include: FIRA/REMAN001:2019, IEC TC 111, ANSI RIC001.1-2016, BS 8887–220:2010.

25. Mining 2030. (2025). *Global Investor Commission on Mining 2030: Summary report for consultation: vision and recommendations*. https://mining2030.org/wp-content/uploads/2025/12/MINING_2030_10-yearVision_NOV25.pdf

26. G20 South Africa 2025. (2025). *G20 South Africa Summit: Leaders' Declaration*. https://www.g20.org.za/wp-content/uploads/2025/11/2025-G20-Summit-Declaration.pdf.

27. Barrie, J., et al. (2022). *Trade for an inclusive circular economy: A framework for collective action*. Chatham House. https://www.chathamhouse.org/sites/default/files/2022-06/2022-06-15-inclusive-circular-trade-barrie-et-al.pdf

28. Barrie, J. et al. (2022). *The role of international trade in realizing an inclusive circular economy*. Chatham House. https://www.chathamhouse.org/sites/default/files/2022-10/2022-10-04-role-international-trade-inclusive-circular-economy-barrie-et-al.pdf

29. Barrie, J. & Grooby, G. (2023). *Going Circular: How the Harmonized System Codes Can/Not Support a Circular Economy and What Else Could Be Done*. Friedrich Ebert Stiftung. https://collections.fes.de/publikationen/ident/fes/20579

WORLD ECONOMIC FORUM

COMMITTED TO IMPROVING THE STATE OF THE WORLD

The World Economic Forum, committed to improving the state of the world, is the International Organization for Public-Private Cooperation.

The Forum engages the foremost political, business and other leaders of society to shape global, regional and industry agendas.

World Economic Forum
91–93 route de la Capite
CH-1223 Cologny/Geneva
Switzerland

Tel.: +41 (0) 22 869 1212
Fax: +41 (0) 22 786 2744
contact@weforum.org
www.weforum.org