



GLOBAL TRENDS IN SUSTAINABLE ENERGY INVESTMENT 2009

*Analysis of Trends and Issues
in the Financing of
Renewable Energy and
Energy Efficiency*

UNITED NATIONS ENVIRONMENT PROGRAMME



Endorsed by



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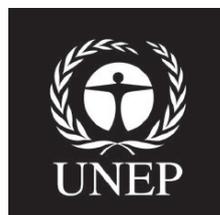
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FOREWORD

The 2009 Global Trends in Sustainable Energy Investment report, considered by many to be the most authoritative appraisal of clean energy investment trends, is being released during one of the worst financial and economic crises for a generation with sharply rising unemployment in many parts of the globe.

It also comes less than six months before the crucial UN climate convention meeting taking place in Copenhagen, Denmark.

It is the view of the UN Environment Programme and increasingly others that a Green Economy approach to these and other emerging challenges, such as energy security, resource efficiency and catalyzing an innovation-based economy, go hand in hand.

Renewable energy, with its low carbon footprint, the relative speed with which it can be deployed into developed and developing communities alike and its ability to generate new kinds of businesses and green jobs, is a key element of that transition.

This year's Global Trends report was never likely to show the kind of extraordinary growth in renewables that has underlined previous years. Nevertheless, investment in the sustainable energy market has in some ways defied the global recession growing by around five per cent—from \$148 billion in 2007 to around \$155 billion in 2008.

Support for sustainable energy investments will now depend on several factors. In response to the economic crisis the G-20 group of nations recently announced stimulus packages totalling \$3 billion, amounting to 2% of their GDP in 2009 and 1.5% in 2010.

Several economies, from China, Japan and many European ones to the Republic of Korea and the United States, have earmarked multi-billion investments in clean energy, including smart grids, under the banner of a global 'green new deal'.

While the \$155 billion sustainable energy investment in 2008 and the multi-billion stimulus packages can go a long way, investment needs to reach a half trillion dollars per annum by 2020 to help ensure a peak in greenhouse gas emissions by then.

Intelligent market mechanisms and incentives will also play a key role in both developed and developing economies, including a review of the well over \$200 billion a year spent on subsidising fossil fuels.

Perhaps the biggest stimulus package of them all will happen in Copenhagen if governments agree a scientifically-credible and forward-looking new climate agreement.

This will give certainty and continuity to the carbon markets and a clear signal that renewable energy will become an increasingly important slice of the overall 'fuel' mix and a major contributor to the sustainable development agenda, including achieving the poverty-related UN Millennium Development Goals.

Achim Steiner

UN Under-Secretary General and UN Environment Programme (UNEP) Executive Director



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METHODOLOGY & DEFINITIONS

All figures in this report, unless otherwise credited, are based on the output of the Desktop database of New Energy Finance – an online portal to the world's most comprehensive database of investors, projects and transactions in clean energy.

The New Energy Finance Desktop collates all organisations, projects and investments according to transaction type, sector, geography and timing. It covers 26,000 organisations (including start-ups, corporates, venture capital and private equity providers, banks and other investors), 18,000 projects and 11,000 transactions.

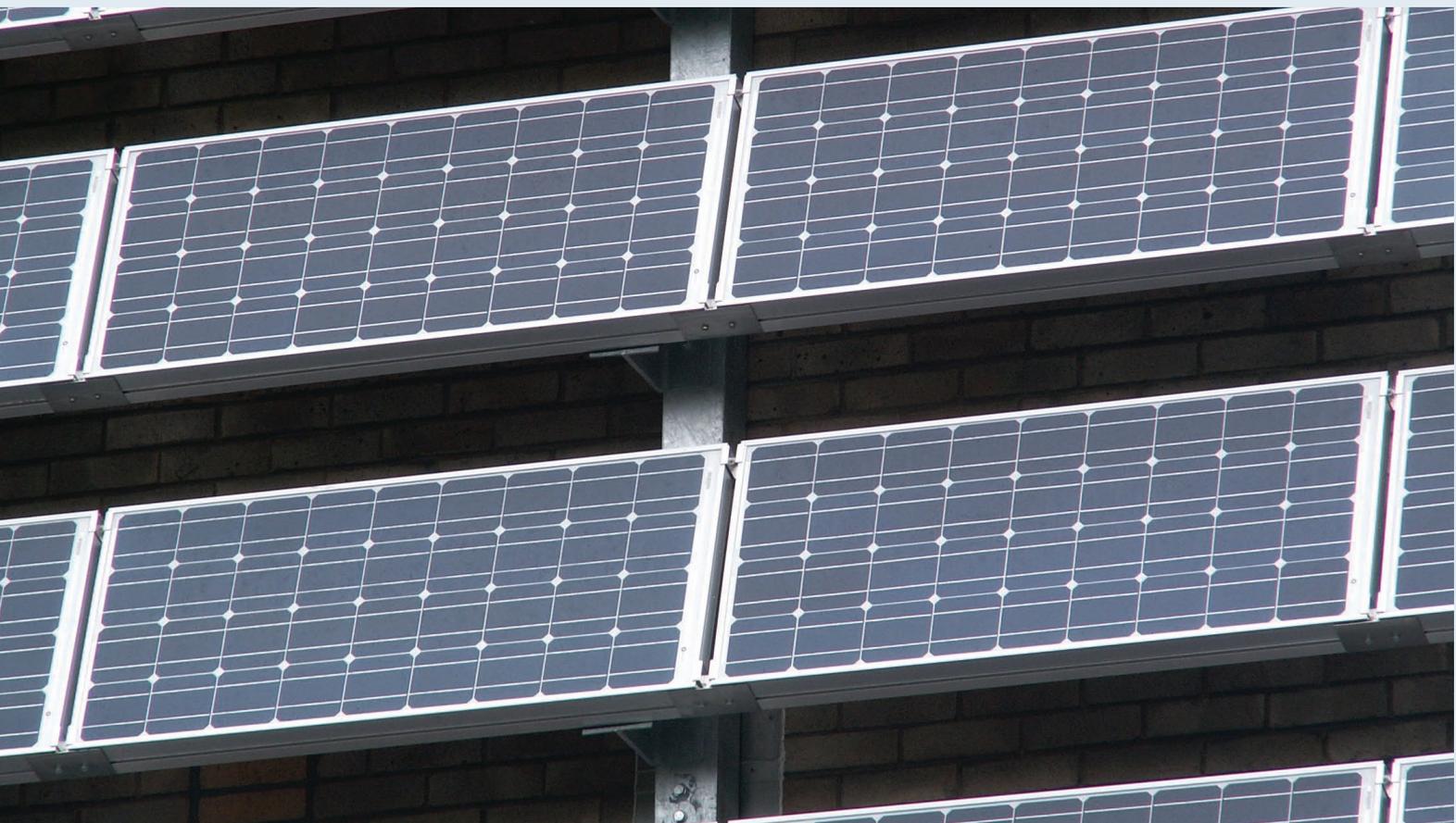
METHODOLOGY

The following renewable energy projects are included: all biomass, geothermal and wind generation projects of more than 1MW, all hydro projects of between 0.5 and 50MW, all solar projects of more than 0.3MW, all marine energy projects, and all biofuels projects with a capacity of 1m litres or more per year.

Annual investment in small scale and residential projects, such as micro wind turbines, solar water heaters and bio-digesters, is estimated. These estimates are based on annual installation data, provided by industry associations and REN21.

Energy efficiency investment includes financial investment in technology companies plus corporate and government investment in R&D. It excludes investment in energy efficiency projects by governments and public financing institutions. Where deal values are not disclosed, New Energy Finance assigns an estimated value based on comparable transactions. Deal values are rigorously back-checked and updated when further information is released about particular companies and projects. The statistics used are historic figures, based on confirmed and disclosed investment.

New Energy Finance continuously monitors investment in renewable energy and energy efficiency. This is a dynamic process: as the sector's visibility grows, information flow improves. New deals come to light and existing data is refined, meaning that historic figures are constantly updated.



DEFINITIONS

New Energy Finance tracks deals across the financing continuum, from R&D funding and venture capital for technology and early-stage companies, through to public market financing for projects and mature companies. Investment categories are defined as follows:

Venture capital and private equity (VC/PE): all money invested by venture capital and private equity funds in the equity of companies developing renewable energy technology. Similar investment in companies setting up generating capacity through Special Purpose Vehicles is counted in the asset financing figure.

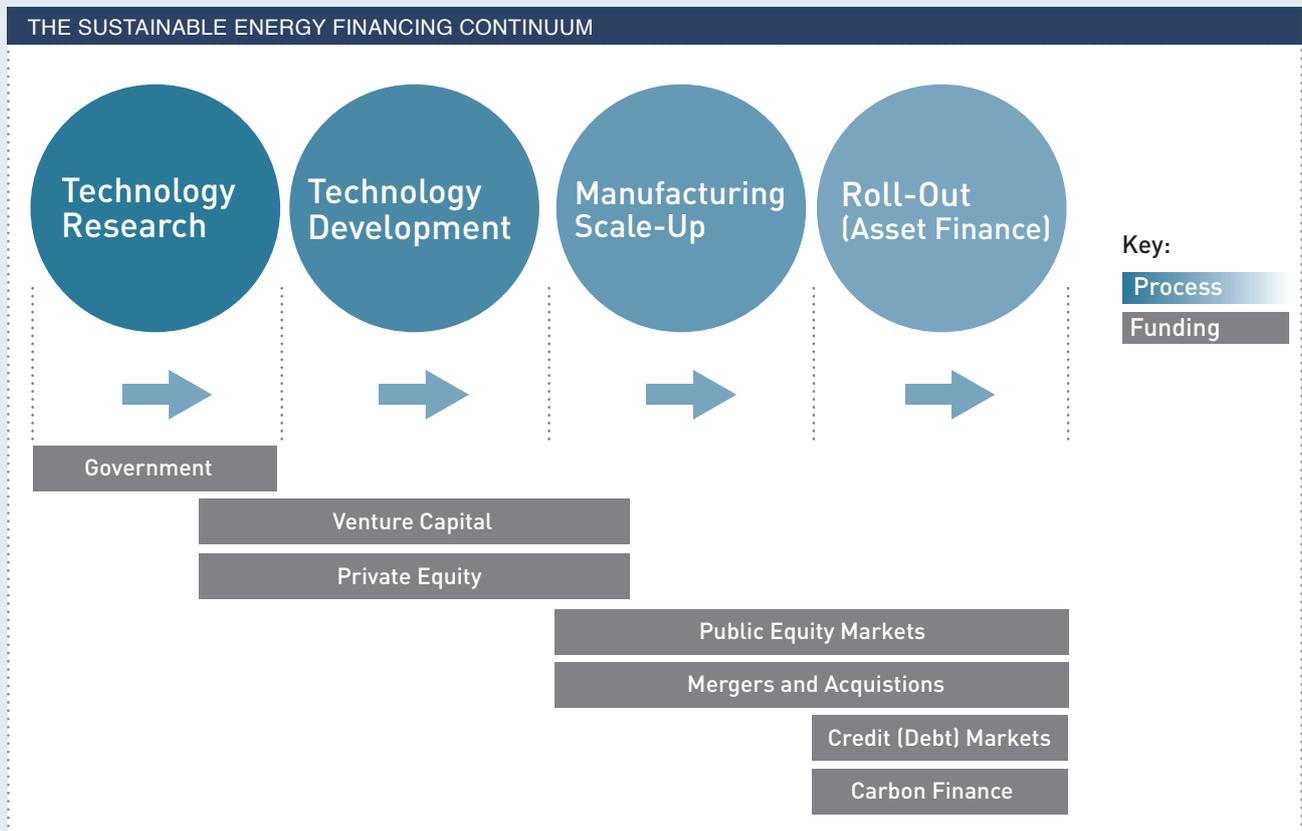
Public markets: all money invested in the equity of publicly quoted companies developing renewable energy technology and clean power generation. Investment in companies setting up generating capacity is included in the asset financing figure.

Asset financing: all money invested in renewable energy generation projects, whether from internal company

balance sheets, from debt finance, or from equity finance. Excludes refinancings and short term construction loans.

Mergers and acquisitions (M&A): the value of existing equity purchased by new corporate buyers in companies developing renewable technology or operating renewable energy projects.

To make it clear which point in the financing continuum each of the investment sections refers to, we have included a small version of this diagram within each of the relevant sections, with the appropriate financing stage highlighted. So, for example, venture capital and private equity – which is mainly for technology development and expansion – would be illustrated as:

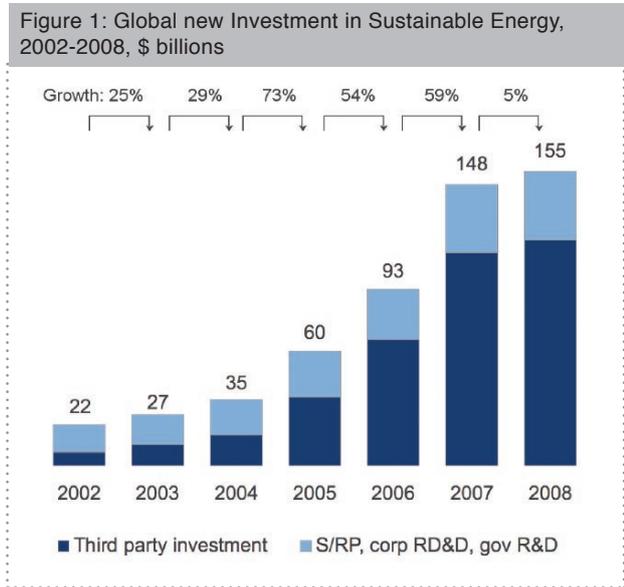




EXECUTIVE SUMMARY

“ Investment in renewable energy generation projects grew by 13% during 2008, to \$117 billion, and new private investment in companies developing and scaling-up new technologies increased by 37% from 2007 to \$13.5 billion.

The year 2008 was another milestone for investment in sustainable energy, especially in view of the difficult overall investment climate. A total of \$155 billion was invested in companies and projects globally, a more than four-fold increase on 2004. As compared with 2007, however, investment growth was only 5%, in stark contrast to the growth rates of over 50% in previous years (see Figure 1). This was mainly due to the global financial crisis, which had a significant impact on investment in the second half of the year: investment in the second half of the year was down 17% on the first half, and down 23% on the final six months of 2007.



S/RP = small/residential projects. New investment volume adjusts for re-invested equity. Total values include estimates for undisclosed deals

Source: New Energy Finance

“ \$180 billion of fiscal stimulus support for sustainable energy suggests the political will has never been greater.

Investment in new energy generation projects (wind, solar, biofuels etc.) grew by 13% during 2008, to \$117 billion, and new private investment in companies developing and scaling-up new technologies, including energy efficiency, increased by 37% from 2007 to \$13.5 billion (see Figure 2). Other types of finance decreased. Capital raised via the public stock markets for equipment manufacturing and project pipelines fell 51% to \$11.4 billion, as clean energy share prices lost 61% of their value during 2008. Total transaction value in the sustainable energy sector during 2008 – including corporate acquisitions, asset re-financings and private equity buy-outs – was \$223 billion (see Figure 2), an increase of 7% over 2007 .

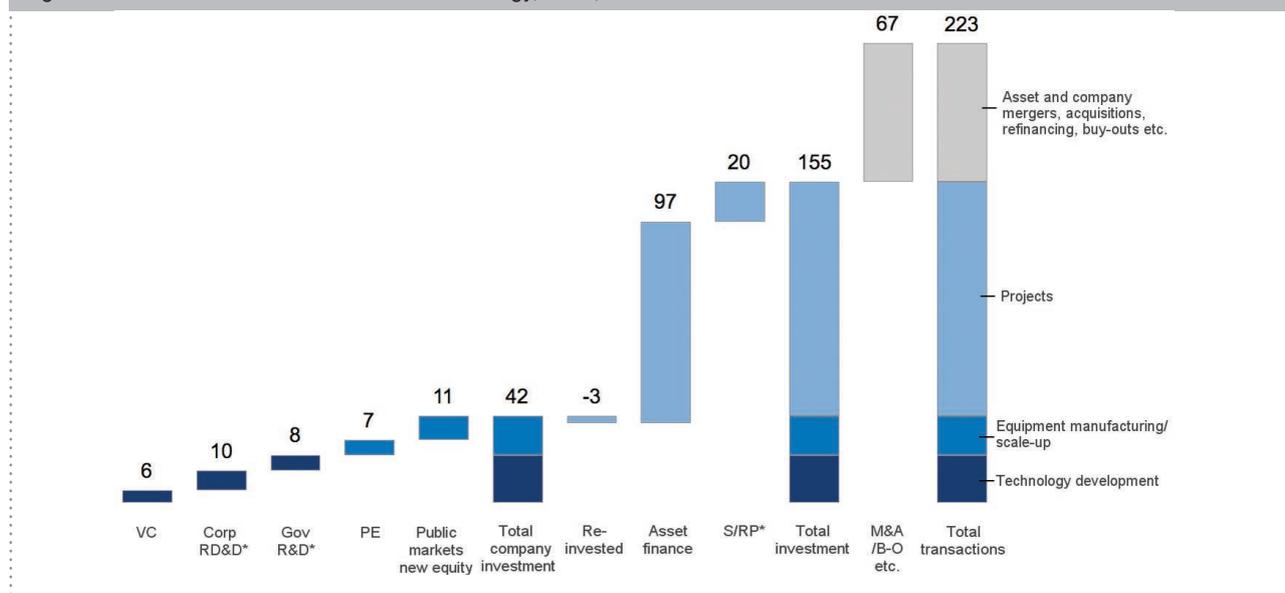
There were some ‘green-shoots’ of recovery during the second quarter of 2009, but the sector has a long way to go this year to reach previous investment levels.

While the sustainable energy sector was showing signs of being negatively affected by the global financial crisis, it was not until the start of 2009 that the full impact was really evident. In the first quarter of 2009, new financial investment fell by 53% to \$13.3 billion compared to the same period in 2008, the lowest level of quarterly investment for three years. There were some ‘green shoots’ of recovery during the second quarter of 2009, but the sector has a long way to go this year to reach the investment levels of late 2007 and early 2008.

At a macro level the sustainable energy sector was impacted by many factors in 2008, including politics and economics, the financial markets, and the wider energy market. The election of a new administration led by President Obama heralded a change in US policy on climate change and sustainable energy. This gave a timely boost to the sector as private sector investment started to fall. The inclusion of an estimated \$180 billion of support for sustainable energy in the major fiscal stimulus packages suggests that the political will to secure sustainable energy supplies and reduce energy-related carbon emissions has never been greater.

Less liquidity in the global financial markets since September 2008 has meant less available capital for clean energy companies and projects. Central banks lowering their interest rates has reduced the cost of financing renewable energy projects, insofar as finance has been

Figure 2: Global Transactions in Sustainable Energy, 2008, \$ billion



S/RP = small/residential projects. Total values include estimates for undisclosed deals. * data based on estimates from various industry sources

Source: New Energy Finance

available, though this reduction has been offset by an increase in the risk premium lenders are now charging. Reassuringly, China has made \$680 billion of finance available through its state-owned banks to support the growth of the domestic market, which is having a positive impact on its sustainable energy sector:

All eyes – including those of politicians, industry players and the media – are on the Copenhagen UNFCCC Conference of the Parties (COP) in December 2009, which will seek to reach agreement on a successor to the Kyoto Protocol. As the current financial crisis recedes, there is still a need for appropriate policies to support the shift to a cleaner, low-carbon energy mix. The industry is seeking a well-designed set of support mechanisms, tailored to each geography and to the technological maturity of each sector: Sectors nearing maturity and competitiveness with fossil fuels need revenue support as they close the gap; technologies that work in the lab but are too risky to scale up need commercialisation support; sectors with longer-term technological promise need research funding. It is encouraging that some of these elements are included in the current stimulus packages.

As a result of the economic slowdown, electricity demand growth fell in 2008 to 2.4% from 2.9% in the previous year; however, renewable energy's share of the overall power generation market increased from 3.9% to 4.4% (see Figure 3). In addition, approximately 40GW of new renewable energy power generation capacity was installed globally in 2008 (REN21 Renewables Global Status Report 2009 Update), resulting from the investments made in

response to government policies over the previous few years. Although the oil price fell to less than \$40 per barrel from its peak of \$147 in mid 2008, the economics of experience curves and oil and gas depletion are working powerfully to level the playing field. In 2008, the new 40GW of renewable energy plants accounted for 25% of new nameplate capacity.

2008 was the first year that new power generation investment in renewables was greater than investment in fossil-fueled technologies

”

Combined with approximately 25GW of new large hydropower stations, renewable energy overall represented 41% of total new global capacity. 2008 was the first year that investment in new power generation capacity sourced from renewable energy technologies (approximately \$140 billion including large hydro) was more than the investment in fossil-fueled technologies (approximately \$110 billion)¹. Given the long life of power sector assets, however, it will be some time before renewable energy dominates the generation mix. In 2008, renewable energy still only accounted for 6.2% of total power sector capacity without large hydro (see Figure 3).

Within the carbon markets several countries have followed the lead of the European Union Greenhouse Gas Emission Trading System (EU ETS) and the Kyoto Compliance Markets, including Australia, Japan, and the US through its regional, federal and voluntary initiatives.

1. Based on approximately 90GW of new fossil-fueled thermal capacity in 2008, and an average capex of \$1.2 billion per GW.



President Obama has clearly stated his support for a federal cap-and-trade scheme and a strengthened global scheme may result from the negotiations in Copenhagen in December. A system of interlinked policy-led financial markets, similar to currency markets, is emerging, where every major economy puts a price on greenhouse gas emissions, thereby providing another enabler for sustainable energy. Despite the turmoil in the world's financial markets, transaction value in the global carbon market grew 87% during 2008, reaching a total of \$120 billion.

“ Despite the turmoil in the world’s financial markets, transaction value in the global carbon market grew 87% during 2008, reaching a total of \$120 billion

During 2008, wind was the largest sector in terms of new investment, while solar took second place by surpassing biofuels. Total financial investment in wind was \$51.8 billion, down 1% on 2007, and in solar was \$33.5 billion, up 49% from the previous year (see Figure 4). A large proportion of this investment went into wind and solar projects, particularly in the established markets of the European Union and North America, but also increasingly in China, Eastern Europe and Latin America.

Sustainable energy technologies on the whole are becoming cheaper to manufacture as they reach scale and gain operating experience. Recently, this has not always translated into price decreases because of demand outstripping supply and commodity prices soaring. But the investment surge of recent years and softened commodity markets have started to ease supply chain bottlenecks, especially in the wind and solar sectors, which will cause prices to fall towards marginal costs and several players to consolidate (at the end of 2008 there were over 70 major wind turbine manufacturers globally and over 450 photovoltaic (PV) module makers). The price of solar PV modules, for example, is predicted to fall by over 43% in 2009.

New investment in biofuels reached \$16.9 billion, down 9% from 2007. Other renewable energies such as geothermal and mini-hydro were up 26% to \$5.4 billion, but there was a 25% fall in investment in biomass and waste-to-energy to \$7.9 billion. Private investment in new energy efficiency technologies was \$1.8 billion, a fall of 33% on the previous year. However, the energy efficiency sector recorded the second highest levels of venture capital and private equity investment (after solar), which will help companies develop the next generation of sustainable energy technologies.

On a regional basis, investment in Europe in 2008 was \$49.7 billion, a rise of 2%, and in North America was \$30.1 billion, a fall of 8% (see Figure 4). These regions experienced a slow-down in the financing of new renewable energy projects due to the lack of project finance and the fact that tax credit-driven markets are mostly ineffective in a downturn. Within South America investment in Brazil increased by 76% to \$10.8 billion, mostly in cane-based ethanol as domestic and foreign demand increased. In China sustainable energy investment grew 18% to \$15.6 billion – driven by some timely policy interventions – and in India by 12% to \$3.7 billion. Investment in Africa was \$1 billion, an increase of 10% on 2007. Total new investment in developed countries was \$82.3 billion, a fall of 1.7% from 2007. Total new investment in developing countries was \$36.6 billion, up 27%.

In conclusion, the drivers that have propelled investment in the sustainable energy sector so dramatically for the past five years are still at work – climate change, energy insecurity, fossil fuel depletion, new technologies etc. There is also a strong core of demand for clean energy based on firm mandates: feed-in tariffs, renewable portfolio standards, renewable fuel standards, building codes, and efficiency regulations. In many markets clean energy also provides strong economic returns, particularly green jobs, even in a period of lower energy prices.

Sustainable energy has a significant role to play in mitigating climate change. According to the Intergovernmental Panel on Climate Change (IPCC)'s Fourth Assessment Report in 2007ⁱⁱⁱ, limiting likely average global temperature to 2.0 to 2.4°C – thought to be the highest “safe” level – means stabilising CO₂ equivalent concentrations at 445 to 490 parts per million, which in turn requires reaching peak CO₂ emissions by 2015. At its Heiligendamm Summit in 2007, the G8 acknowledged the need for CO₂ emissions “to peak within 10 to 15 years”, or between 2017 and 2022.

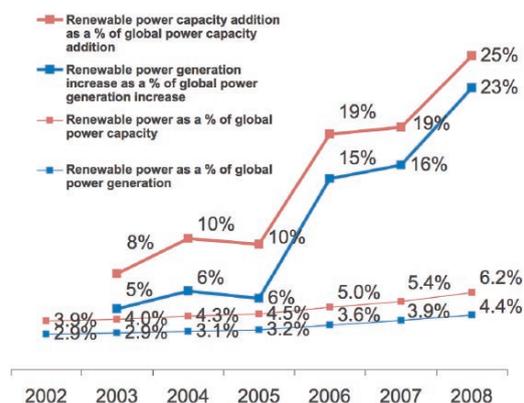
A more rapid transition to – and accelerated pace of investment in – sustainable energy is required so that CO₂ peaks by 2020. Annual investments in renewable energy, energy efficiency and carbon capture and storage need to reach \$500 billion by 2020, rising to \$590 billion by 2030, representing an average investment of 0.44% of GDP between 2006 and 2030. These levels of investment are not impossible to achieve, especially in view of the recent four year growth from \$35 billion to \$155 billion. However, reaching them will require a further scale-up of societal commitments to a more sustainable, low-carbon energy paradigm.

With the current stimulus packages now in play and a hoped-for Copenhagen climate deal in December, the opportunity to meet this challenge is greater than ever, even seen from the depths of an economic downturn.

This report presents the financial perspective on the current state of play in the development of sustainable energy. The analysis consists of actual data on the different types of capital flows and their movement over time, combined with analysis of regional and sectoral trends. The information is intended to serve as a strategic tool to be used by decision makers in the policy and finance communities globally as they weigh-up commitments to the sustainable energy sector. Accompanying resources, including a data set for the report's graphs and a powerpoint presentation, can be downloaded from www.sefi.unep.org.

The drivers that have propelled investment in the sustainable energy sector so dramatically for the past five years are still at work – climate change, energy insecurity, fossil fuel depletion and new technologies.

Figure 3: Renewable power* generation and capacity as a proportion of global power, 2003-2008, %



* Excluding large hydro

Source: EIA, IEA, New Energy Finance, Global Futures, UNEP SEFI

Figure 4: SEFI Global Trends in Sustainable Energy Investment 2009 Data Table, \$ billions

Category	Year	2004 \$bn	2005 \$bn	2006 \$bn	2007 \$bn	2008 \$bn	2007-08 Growth %	2004-08 CAER %
1 Total Investment								
1.1 New Investment		35	60	93	148	155	5%	45%
1.2 Total Transactions		45	91	133	209	223	7%	49%
2 New Investment by Value Chain								
2.1 Technology Development								
2.1.1 Venture capital		1.4	2.0	4.1	5.9	6.0	3%	45%
2.1.2 Government R&D*		4.9	5.8	5.9	7.1	7.5	6%	11%
2.1.3 Corporate RD&D*		5.5	6.8	8.4	9.8	9.5	-3%	15%
2.2 Equipment Manufacturing								
2.2.1 Private equity expansion capital		0.3	1.0	3.3	4.0	7.4	86%	115%
2.2.2 Public markets		0.7	4.1	11.0	23.4	11.4	-51%	100%
2.3 Projects								
2.3.1 Asset finance		14.1	28.5	50.3	84.5	97.4	15%	62%
Of which re-invested equity		0.0	0.0	2.3	5.3	3.4		
2.3.3 Small/residential scale projects*		8.2	11.6	12.5	19.0	19.5	2%	24%
Total Financial Investment		17	36	66	112	119	6%	64%
Gov'n R&D, Corporate RD&D, Small projects		19	24	27	36	37	2%	18%
Total New Investment		35	60	93	148	155	5%	45%
3 Other Transactions								
3.1 Private equity buy-outs		0.9	3.4	1.9	3.6	5.8	60%	60%
3.2 Corporate M&A		4.0	13.2	16.9	25.9	21.7	-16%	52%
3.3 Project acquisition & refinancing		5.1	12.2	19.0	26.1	38.7	48%	66%
4 Financial Sector New Investment by Technology								
4.1 Wind		10.0	19.1	25.0	51.3	51.8	1%	51%
4.2 Solar		0.6	3.2	10.3	22.5	33.5	49%	172%
4.3 Biomass		1.8	4.1	7.0	10.6	7.9	-25%	45%
4.5 Marine & small-hydro		0.6	1.3	1.5	3.4	3.2	-5%	53%
4.4 Geothermal		0.9	0.4	1.0	0.9	2.2	149%	24%
4.6 Efficiency		0.5	0.9	1.6	2.8	1.8	-33%	39%
4.7 Other low carbon technologies		0.8	1.6	1.9	2.4	1.5	-37%	18%
4.8 Biofuels		1.3	5.1	18.0	18.6	16.9	-9%	90%
Total		17	36	66	112	119	6%	64%
5 New Investment by Geography								
5.1 Global								
5.1.1 Europe		8.4	17.7	26.3	48.6	49.7	2%	56%
5.1.2 North America		4.2	10.3	22.6	32.7	30.1	-8%	63%
5.1.3 South America		0.3	1.6	4.3	7.6	12.3	63%	145%
5.1.4 Asia & Oceania		3.3	5.5	12.1	21.7	24.2	12%	64%
5.1.5 Middle East & Africa		0.2	0.3	1.1	2.0	2.6	29%	81%
Total		17	36	66	112	119	6%	64%
5.2 Selected Developing Countries/Regions								
5.2.1 Brazil		0.2	0.8	4.0	6.1	10.8	76%	173%
5.2.2 China		0.9	2.5	7.4	13.2	15.6	18%	106%
5.2.3 India		0.7	0.8	1.1	3.3	3.7	12%	60%
5.2.5 Africa		0.2	0.3	0.2	1.0	1.1	10%	54%

New investment volume adjusts for re-invested equity. Total values include estimates for undisclosed deals. Venture capital figure includes PIPE & OTC.

* Estimates. Other Transactions exclude Public Market exits.

Source: New Energy Finance, UNEP, SEFI



KEY FINDINGS

- **Due to the economic downturn, new investment in sustainable energy was \$155 billion in 2008, slightly (5%) higher than 2007's \$148 billion** – but the second half-year figure was down 17% on the first half, and 23% lower than in the final six months of 2007.
- **Clean energy resisted the global financial crisis more successfully than many other sectors for much of the year**, helped by sky-high oil prices, but felt the impact from September 2008 onwards. Shares prices fell 61%, more sharply than the overall stock market, and have since only made up a fraction of the lost ground. Investor mood will be critical to continued growth. One of the reasons sustainable energy share prices underperformed in late 2008 was a general flight from risk and growth sectors.
- **Leading governments committed over \$180 billion to sustainable energy within their various stimulus packages**, but there has been a big divergence between countries in the generosity and clarity of their measures. An enormous monetary stimulus has also been applied through the drop in global interest rates, but although central bank rates are at historic lows, banks are still too worried about solvency to lend. When lending does start to flow, renewable energy projects stand to be among the early beneficiaries, as they produce a reliable stream of revenues from good counter-parties, the utilities.
- **The number of companies under incubation fell slightly during 2008.** Incubated companies number 338, down just under 2% from last year. The large majority of incubated companies were in the solar sector with 73, or 21% of the total number of incubated companies. Solar is followed by wind, biofuels, and energy efficiency supply and demand side sectors.
- **In 2008, venture capital and private equity funds invested \$19.3 billion in renewable energy and energy efficiency firms**, an increase of 43% compared with 2007. Of this, \$13.5 billion represented “new” money – everything except private equity buy-outs – an improvement of 37% on the \$9.8 billion of fresh investment in 2007. This money helped a broad spectrum of young companies to develop technologies in fields as diverse as carbon capture and storage and tidal power, while enabling those further down the track to ramp up and commercialise production.
- **Investment in clean energy firms via the world's stock markets tumbled 51% to \$11.4 billion, from \$23.4 billion in 2007.** Activity noticeably slowed in the second half of 2008, and the public markets have effectively been closed for clean energy initial public offerings so far in 2009. Fewer companies chose to make their debut on the public markets. In 2008, 18 companies floated on the world's main exchanges raising a total of \$3.6 billion. This was 30 fewer than during 2007, when 48 clean energy firms completed IPOs raising \$13.6 billion.
- **Financing of sustainable energy assets grew by 12.9% in 2008 to \$116.9 billion**, the bulk of which was for new power generation projects. The terms of debt finance deals for renewable energy projects in Europe have become tougher since October 2008, but the ratification of President Obama's \$787 billion stimulus package in February 2009 offers a number of new project financing solutions to developers in the US. New-build wind project financing increased during 2008 to \$47.9 billion from \$41.3 billion in 2007, but collapsed in the first quarter of 2009. New-build solar project financing underwent a dramatic increase in 2008, rising to \$22.1 billion from \$12.1 billion in 2007. However, it too fell sharply in the first quarter of 2009.



- **The volume of money changing hands in mergers and acquisitions of clean energy companies fell 16.2% to \$21.7 billion.** The lack of available credit, plunging stock markets and a worldwide financial crisis made it difficult for deal-makers. This left equipment manufacturers to garner the largest slice of mergers and acquisitions investment, taking \$9.4 billion, or 43.3% of the \$21.7 billion total. Deals targeting developers saw the biggest year-on-year increase. The \$7.3 billion recorded in 2008 was up 156% on 2007 as consolidation swept through Europe's wind market. M&A activity is likely to increase as well-capitalised players take advantage of lower clean energy company valuations and some distressed opportunities.
- **Far fewer clean energy funds were launched in 2008.** In 2007, private clean energy funds were being launched at an average rate of one a week; in 2008, this slowed to one a month. Nevertheless, a number of large funds completed funding rounds during 2008, and a number of new funds have been announced in recent months. Now that markets have lost 40% or more of their value, investors are beginning to venture back into the market. Private and project equity funds have become more prominent in 2008, responding to the effective closure of the world's public markets and very limited access to debt.
- **Despite the turmoil in the world's financial markets, 2008 was another year of record growth in the carbon markets.** Transaction value in the global carbon market grew 87% during 2008, reaching a total value of \$120 billion. Currently, the most liquid markets are the European Union Greenhouse Gas Emission Trading System (EU-ETS) and the global Kyoto compliance market. The EU-ETS, which started its second phase in 2008, covers some 45% of Europe's total greenhouse gas emissions. It has dominated carbon

credit trading to date, accounting for 79% of transactions by value. Despite some downward movement in price towards the end of 2008 as a result of the global economic downturn, the average settlement price of European Union Emissions Allowances (EUAs) closed the year at around \$25 per tonne.

- **Financial investment in developing countries increased to \$36.6 billion in 2008, an increase of 27% on 2007,** whilst investment in developed countries fell by 1.7% to \$82.3 billion. Developing countries' share of total global financial investment increased to 31% in 2008, from 26% in 2007. China led investment in Asia, with \$15.6 billion of new investment, mostly in new wind projects, and some biomass plants. Investment in India grew 12% to \$3.7 billion in 2008, of which asset finance represented \$3.2 billion, up 36%. Brazil accounted for almost all renewable energy investment in Latin America in 2008, receiving \$10.8 billion, up 7% from 2007.



CHAPTER 1: OVERVIEW OF INVESTMENT TRENDS

1

- Global investment in sustainable energy reached record levels again this year, although the industry's pace of growth did reflect the global financial crisis and slowed dramatically from double digits to just 5%.
- Wind attracted the highest new investment, confirming its status as the most mature and best-established sustainable energy technology. Solar makes the largest gains while biofuels investment shifts towards next generation technologies.
- EU Europe continues to dominate new sustainable energy investment, largely supported by asset financing volumes.

1.1 GLOBAL INVESTMENT IN SUSTAINABLE ENERGY

Global investment in sustainable energy again reached record levels in the year 2008, with new investment of \$155 billion (see Figure 7). The industry's pace of growth, however, slowed dramatically from double digits over the previous four years to just 5%, reflecting the contraction of capital markets around the world. The first three quarters of 2008 saw financial investment grow to \$95 billion, 33% up on the same period in 2007 – but the fourth quarter (Q4) saw a 41% decline to \$23 billion (see Figure 5).

Investment totals have been hit particularly hard by a lack of public market activity, which more than halved between 2007 and 2008 from \$23.4 billion to just \$11.4 billion. Initial Public Offerings (IPOs) have dried up altogether; there were only 20 clean energy IPOs in 2008, including just one in the final quarter of the year, and none to date

in 2009. Sustainable energy public companies lost 61% of their value during 2008 as investors reduced their exposure to the sector:

Asset finance continued to be a main driver for growth in 2008, with \$94 billion invested in building new sustainable energy assets, up 15% from 2007. By contrast, venture capital and private equity new investment grew by 37% to \$13.5 billion in 2008 up from \$9.8 billion in 2007. In fact, VC/PE experienced the highest growth rate of all asset classes. The value of corporate merger and acquisition transactions fell by 16% to \$21.7 billion (see Figure 6).

Since mid 2008, the financial crisis has impacted the sustainable energy sector, which had withstood its effects reasonably well in the second half of 2007 and the first half of 2008. Inevitably, the global drying up of liquidity has affected investment volumes in both sustainable energy companies and projects.

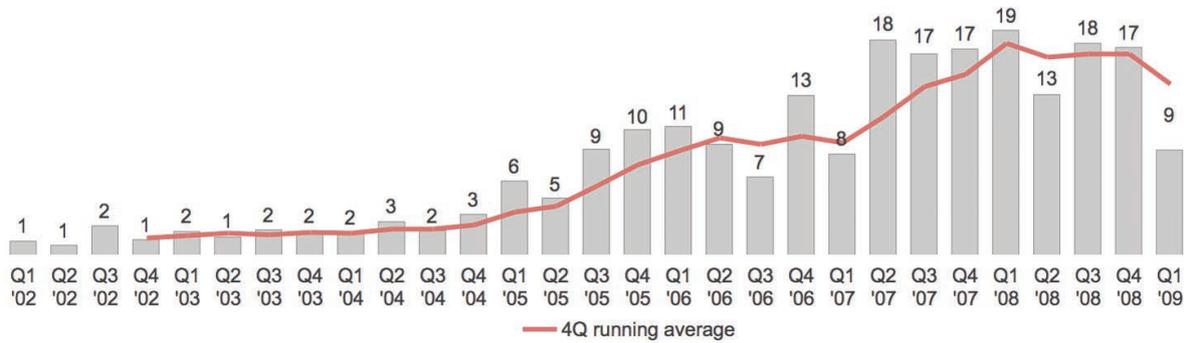
Figure 5: Financial new investment quarterly trend, Global, Q1 2002-Q1 2009, \$ billions



Note: New investment volume adjusts for re-invested equity. Total values include estimates for undisclosed deals.

Source: New Energy Finance

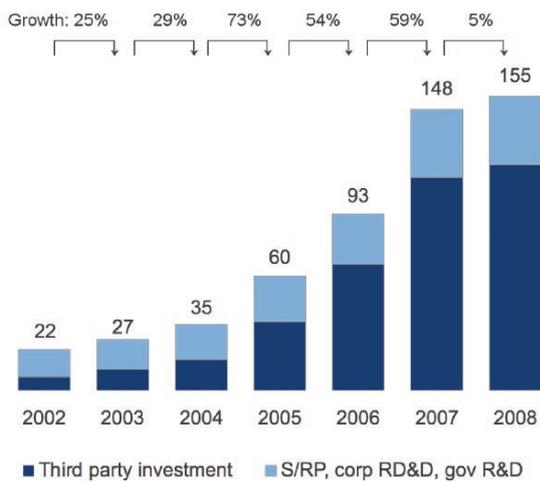
Figure 6: Acquisition transactions quarterly trend, Global, Q1 2002-Q1 2009, \$ billions



Note: Total values include estimates for undisclosed deals

Source: New Energy Finance

Figure 7: Global New Investment in Sustainable Energy, 2002-2008, \$ billions



S/RP = small/residential projects. New investment volume adjusts for re-invested equity. Total values include estimates for undisclosed deals

Source: New Energy Finance

1.2 INVESTMENT BY TECHNOLOGY

In 2008, wind attracted the highest new investment (\$51.8 billion), confirming its status as the most mature and best-established sustainable energy generation technology. However, investment only grew 1% from 2007 (see Figure 8). The solar sector received \$33.5 billion of new investment, up 49% from 2007, followed by biofuels with \$16.9 billion, a fall of 9% on the previous year. Together, these three sectors consolidated their position as the leading sustainable energy sectors, accounting for 86% of new investment, higher than in 2007 (82%) and 2006 (80%).

Wind's leading position continues to be driven by asset finance (see Figure 12), as new generation capacity is added worldwide, particularly in China and the US. Newly installed capacity in 2008 reached 27GW (REN21 Renewables Global Status Update 2009). However, new build project financing experienced its lowest growth year in 2008, although the five year compound annual growth rate was 52%. While on-shore wind still attracts the highest volume of asset financing of all renewable energies, off-shore wind is also a growth area. Regulatory reforms have strengthened support for offshore; for example in the UK installations in 2010 are expected to exceed onshore.

Solar widened its lead over biofuels, which it had overtaken as the second most invested-in sustainable technology in 2007. Solar continues to be the fastest-growing sector for new investment (see Figure 10 & 11), with compound annual growth of 70% between 2006 and 2008. This growth has led to an easing of the silicon bottleneck and falling costs. New installed grid connected PV capacity reached 5.5GW in 2008. However, Q4 2008 saw new investment in PV companies and assets fall from the \$8.4 billion in the previous quarter to \$5 billion.

Investment dropped significantly in Q1 2009, especially when compared to the same period in 2008: new financial investment is down by 52% from \$28 billion to just \$13.3 billion (see Figure 5). As the debt markets have all but dried up, 2009 will see increased private equity financing of early stage projects, with debt financing coming increasingly from multilateral banks.

The main government stimulus packages have promised new investment in renewable energy and energy efficiency, so investment during the rest of 2009 should see an improvement. In addition, the fundamental drivers of the sector, including rising energy prices, climate change concerns and supportive policies remain strong.

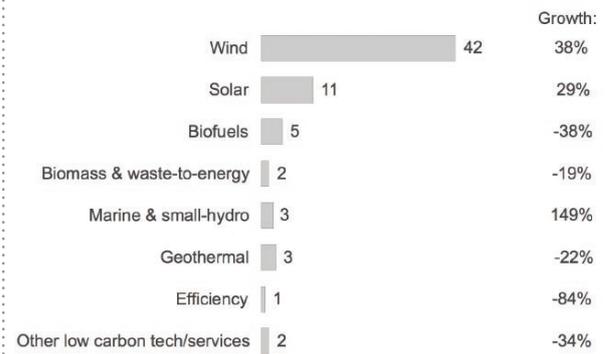


Although biofuels technology is well-established, particularly in Brazil, it suffered from over-investment in early 2007 (5% CAGR 2006-2008), followed by a fall from grace caused by a combination of higher wheat prices, lower oil prices and the increasingly heated food-versus-fuel controversy. Biofuels technology investment is now focused on finding second-generation / non-food biofuels (such as algae, crop technologies and jatropha): Q3 and Q4 2008 saw next-generation technology investment exceed first-generation for the first time.

Geothermal was the highest growth sector for investment in 2008, with \$2.2 billion, up 149% from 2007. A total of 1.3 GW of new capacity was installed. The competitive levelised cost of energy (\$44-102 per MWh) from base load geothermal power production and long plant lifetimes have incentivised its deployment despite the high initial capital cost and exploration risk. Investment in biomass and waste-to-energy was \$7.9 billion, 25% lower than in 2007, due to the relative high cost per MW of new plants.

New private investment in energy efficiency was \$1.8 billion (see Figure 10 & 11) – a fall of 33% on 2007 – although more investment through R&D and projects came from corporates, governments and public financing institutions. The energy efficiency sector recorded the second highest levels of venture capital and private equity investment (after solar), which will help companies develop the next generation of sustainable energy technologies for areas such as the smart grid.

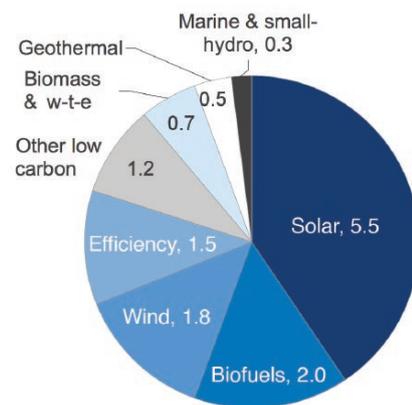
Figure 9: Acquisition transactions by technology, 2008, and growth on 2007, \$ billions



Note: Total values include estimates for undisclosed deals

Source: New Energy Finance, UNEP SEFI

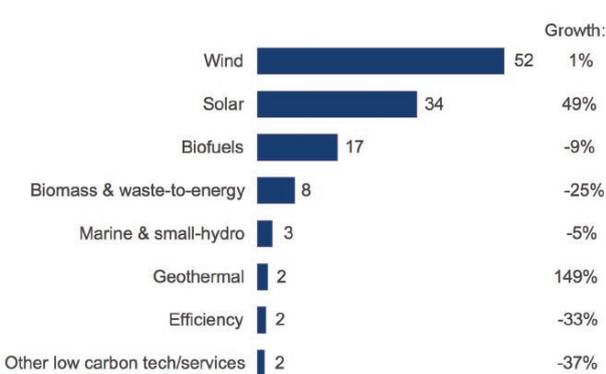
Figure 10: VC/PE new investment by technology, 2008, \$ billions (Total = \$13.5 billion)



Note: VC/PE new investment excludes PE buy-outs. Total values include estimates for undisclosed deals

Source: New Energy Finance, UNEP SEFI

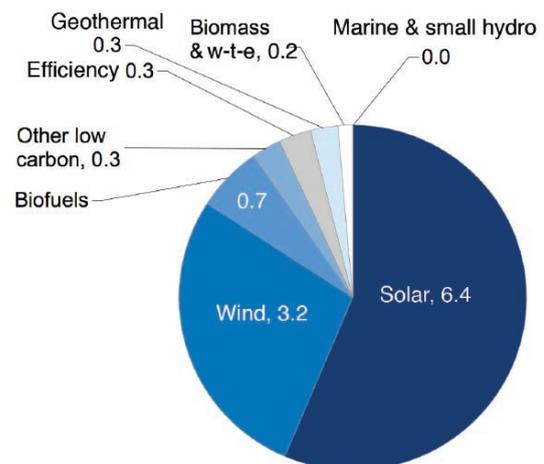
Figure 8: Financial new investment by technology, 2008, and growth on 2007, \$ billions



Note: New investment volume adjusts for re-invested equity. Total values include estimates for undisclosed deals

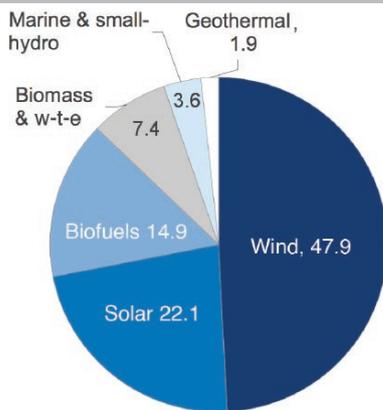
Source: New Energy Finance, UNEP SEFI

Figure 11: Public markets new investment by technology, 2008, \$ billions (Total = \$11.4 billion)



Source: New Energy Finance, UNEP SEFI

Figure 12: Asset finance new build by technology, 2008, \$ billions (Total = \$97.4 billion)



Note: Total values include estimate for undisclosed deals

Source: New Energy Finance, UNEP SEFI

1.3 INVESTMENT BY GEOGRAPHICAL REGION

Europe continues to dominate sustainable energy new investment with \$49.7 billion in 2008, an increase of 2% on 2007 (37% CAGR from 2006-2008) (see Figure 13 & 14). This investment is underpinned by government policies supporting new sustainable energy projects, particularly in countries such as Spain, which saw \$17.4 billion of asset finance investment in 2008.

New investment in sustainable energy in North America was \$30.1 billion in 2008, a fall of 8% compared to 2007 (15% CAGR from 2006-2008). The US saw a slow-down in asset financing following the glut of investment in corn-based ethanol in 2007. Also, the number of tax equity providers fell for wind and solar projects due to the financial crisis.

Developing countries contributed \$24.2 billion of new investment to the Asia and Oceania region in 2008, an increase of 12% on the previous year (42% CAGR from 2006-2008). In China sustainable energy investment grew 18% to \$15.6 billion – driven by some timely policy interventions – and in India by 12% to \$3.7 billion. Investment in South America was \$12.3 billion, up 63% on 2007 (69% CAGR from 2006-2008), mainly driven by Brazil's sugar cane ethanol industry.

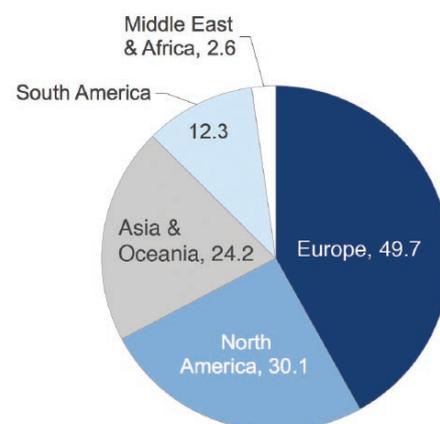
Total new investment in industrialised countries was \$82.3 billion, a fall of 1.7% from 2007. Total new investment in developing countries was \$36.6 billion, up 27%. Developing countries therefore received 31% of total investment, compared to 26% in 2007. This marks a continued expansion of the sustainable energy sector from the core

EU and US markets towards developing countries, as their energy and export markets grow.

Encouragingly, 2008 saw decisive steps taken by countries where sustainable energy had either not been a priority or where interest had lapsed, notably Japan and Australia. Japan was the world leader in installed solar capacity, spurred on by residential subsidies between 1999 and 2005. But in 2006, it was overtaken by Germany, whose more generous subsidy regime increased competition for solar components, which pushed prices up. However, Japan has now been stirred into action (see box out), at least partly by the prospect of missing its 2008-2012 Kyoto Protocol target of lowering greenhouse gas emissions to 6% below 1990 levels. Energy security is also an issue for Japan, which is the world's second largest oil importer after the US. Japan is also a leading manufacturer of electric petrol hybrid vehicles, which are now being exported to international markets.

Sustainable energy in Australia was given a boost when Kevin Rudd was elected Prime Minister in November 2007. Rudd immediately ratified the Kyoto Protocol, announced plans to set up an emissions trading scheme, and set targets including reducing Australia's greenhouse gas emissions by 60% by 2050 and for renewable energy to account for at least 20% of the country's electricity supply by 2020 (see box out). Australia is taking a leadership position in carbon capture and storage technologies given its high dependency on coal-fired power generation and coal exports.

Figure 13: Financial new investment by country region, 2008, \$ billions (Total = \$119 billion)



Note: New investment volume adjusts for re-invested equity. Total values include estimates for undisclosed deals

Source: New Energy Finance, UNEP SEFI



SUSTAINABLE ENERGY IN JAPAN

Japan has relatively low installed renewable energy capacity: around 2GW of solar at the end of 2008 and 1.88GW of wind capacity (Global Wind Energy Council), placing it 13th worldwide. The consensus between Japan's government, utilities and industry is that nuclear energy is the best way forward for the country, but there are encouraging moves to stimulate solar and geothermal development.

Residential subsidies from 1999 to 2005 drove solar installation, and allowed several Japanese companies to become world leaders in PV manufacturing, including Sharp, Mitsubishi and Kyocera. Falling global silicon and module prices have since rekindled interest. In December 2008, Japan unveiled a new \$9 billion subsidy package for solar roofs, granting JPY 70,000 (\$785)/kW for rooftop PV installation. This is about half the Californian subsidy (\$1,550/kW), but eligibility criteria are wide and by 1 February 2009, nearly 6000 applications had been received. For the first time in three years, domestic shipments of solar cells rose between April to September (up 6%), indicating a fundamental change in domestic solar demand.

Japan's overarching national goal is for PV energy production to increase 10 times (from 2005 levels) by 2020, and a further 40 times by 2030. The new public sector subsidy therefore also extends to Japan's goal of "mega solar" power generation, which has set a target for each of the country's ten utilities to have built a large-scale solar plant by 2020. The ultimate goal is for 140MW of solar generation spread across 30 sites. In October 2008, Tokyo Electric announced plans to build a 20MW solar plant in Kawasaki, and Sharp has already said it will build a 28MW plant in Sakai City.

Geothermal also seems to be reawakening in Japan, after a twenty-year lull. In January 2009, plans for a 60MW geothermal plant were announced by an offshoot of Mitsubishi Materials, at an estimated cost of JPY40 billion (\$449 million).

SUSTAINABLE ENERGY IN AUSTRALIA

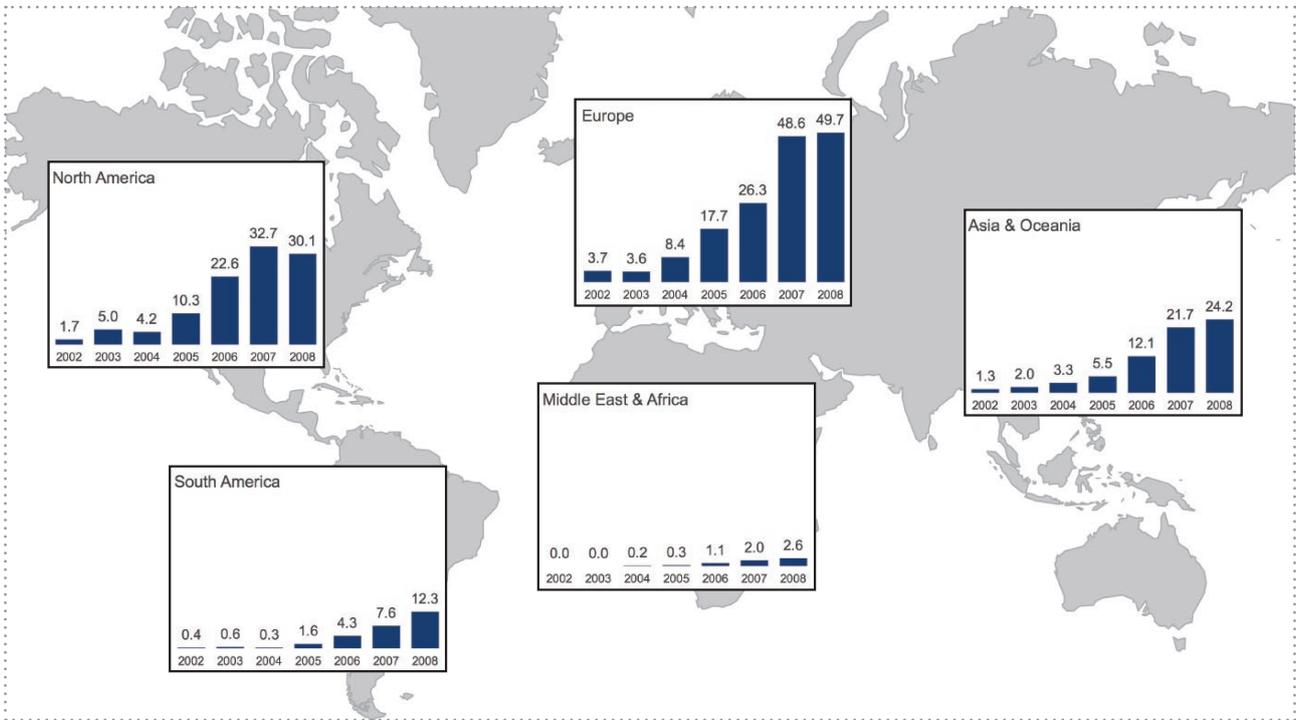
The government has set up a A\$500 million (\$436 million) Renewable Energy Fund to invest in renewable energy projects and new technology alongside private sector money. The Fund, which was originally to be spread over five years, is now earmarked for investment over 18 months, to accelerate the roll-out of sustainable energy in Australia. Australia will be one of the countries worst affected by global warming and is already suffering the effects, as evidenced by the recent catastrophic fires in Victoria.

Within its Renewable Energy Fund, Australia is actively backing geothermal with a A\$50 million (\$43.6 million) Geothermal Drilling Fund, which received its first round of applicants in January 2009. It is designed to help geothermal developers meet the high up-front costs of exploration and drilling. The GDF aims to achieve a geographic spread of geothermal plants (80% of geothermal activity is currently in South Australia), as well as encouraging investment in Enhanced Geothermal System (EGS) power. Geothermal is expected to provide about 7% of the country's baseload power by 2030.

Wind will also benefit from Australia's new push for sustainable energy, and is expected to provide most of the 20% renewable energy by 2020 target. At the end of 2008, Australia had 1.3GW of wind capacity installed, 482MW of which was added during 2008. A further 9GW wind capacity is in the pipeline, mainly in Australia's southern states; Victoria, New South Wales and South Australia.

There is also considerable scope for solar and marine power in Australia, although lack of government support for solar and the fact that most marine technology is pre-commercial mean that these resources are currently under-exploited.

Figure 14: Financial new investment by region, 2002-2008, \$ billions



Note: New investment volume adjusts for re-invested equity. Total values include estimates for undisclosed deals

Source: New Energy Finance, UNEP SEFI

Figure 15: Acquisition transactions by region, 2002-2008, \$ billions



Note: Total values include estimates for undisclosed deals

Source: New Energy Finance, UNEP SEFI



CHAPTER 2: PUTTING SUSTAINABLE ENERGY INVESTMENT INTO PERSPECTIVE

2

- Low carbon technologies accounted for about 41% of new power sector capacity in 2008, including 40GW from new renewables, 25-30GW from large hydro and 0.5GW from nuclear.
- A number of governments are responding to the crisis by stimulating their economies through public investment and have included 'green stimuli' measures totaling \$183 billion; these measures show an important shift in thinking from the world's leading economies.
- In order to achieve a peak in carbon emissions by 2020, global sustainable energy investments need to rise to \$500 billion annually.

Sustainable energy is no longer a set of niche technologies, but part of the mainstream energy sector, and often receives more attention from governments and the media than conventional energy. This reflects the increasing impact the wider macroeconomic and geo-political environment is having on the sector.

This section examines five key areas that together contribute to bringing sustainable energy investment trends into a broader perspective:

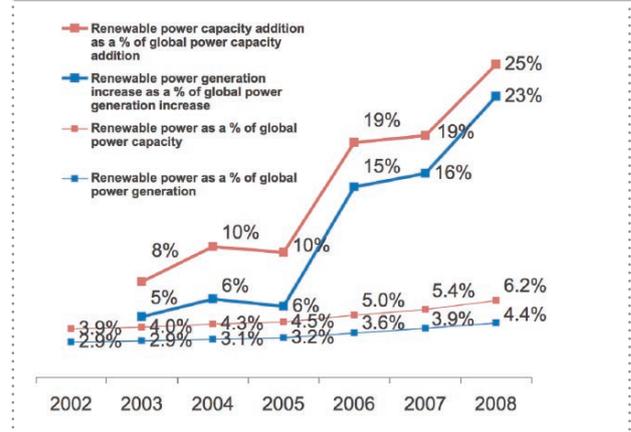
- The level of investment in sustainable energy compared with conventional energy, both now and into the future;
- The share of the stimulus packages for sustainable energy;
- The level of job creation in the sector;
- The role of renewable energy in mitigating climate change;
- The role that sustainable energy may play in achieving a new global deal on climate change in Copenhagen in December 2009.

Investment Levels in Sustainable Energy Compared with Conventional Energy

Sustainable energy - helped by sky-high oil prices - resisted the financial crisis more successfully than many other sectors for much of 2008, only feeling the impact from September onwards and continuing into 2009. In the first quarter (Q1) of 2009, new financial investment fell to \$13.3 billion, the lowest quarterly value since the start of 2006.

Overall investment in the energy sector has been affected by the financial crisis. According to the International Energy Agency's (IEA) recently released report on the Impact of the Financial and Economic Crisis on Global Energy Investment,^{iv} "there is clear evidence that energy investment in most regions and sectors will drop sharply in 2009." The organization estimates that 2009 will see the first contraction in global electricity consumption since the end of the Second World War, reducing the need for new capacity additions. With regard to renewables they project a proportionately larger drop in investment than other energy technologies, up to 38% in 2009, due to their highly capital intensive nature.

Figure 16: Renewable power* generation and capacity as a proportion of global power, 2003-2008, %



* Excluding large hydro

Source: EIA, IEA, New Energy Finance, Global Futures, UNEP SEFI

Excluding large hydro, approximately 40GW of renewable energy power generation capacity was installed globally in 2008 (REN21 Renewables Global Status Report 2009 Update^v), accounting for 25% of new nameplate capacity and 23% of new power generation (see Figure 16). Large

hydropower capacity increased by an estimated 25-30GW in 2008, significantly more than in previous years, led by China (12-15GW added) and India (over 5 GW added) (REN21 Renewables Global Status Report 2009 Update^v). Nuclear, the other major low carbon power generation option, had a less successful year. As of September 2008, no new nuclear plant had come online and total nuclear capacity increased only 0.5GW, mostly through uprating of existing plants (Bulletin of Atomic Scientists)^v.

With more than 65 GW in new nameplate capacity, renewable energy overall represented at least 41% of total new power sector capacity globally. 2008 was actually the first year that investment in renewable energy power generation capacity (approximately \$140 billion including large hydro) was more than investment in fossil-fueled generation capacity (approximately \$110 billion)ⁱⁱ. However, the positive effect on total carbon emissions from these renewables additions may have been countered in 2008 by the high price of oil and gas, which led many generators to switch from gas back to coal. Also, given the long life of power sector assets, it will be some time before renewable energy dominates the generation mix. In 2008, non-large hydro renewables still only accounted for 6.2 % of global power sector capacity and 4.4% of actual generation.

Figure 17. Renewable Energy Added and Existing Capacities, 2008 (estimated)

	Added during 2008	Existing at end of 2008
Power Generation(GW)		
Large hydropower	25-30	860
Wind power	27	121
Small hydropower	6-8	85
Biomass power	2	52
Solar PV, grid-connected	5.4	13
Geothermal power	0.4	10
Concentrating solar thermal power (CSP)	0.06	0.5
Ocean (tidal power)	~ 0	0.3
Hot water/heating (GWth)		
Biomass heating	n/a	~ 250
Solar collectors for hot water/ space heating	19	145
Geothermal heating	n/a	~ 50
Transport fuels (billion litres/year)		
Ethanol production	17	67
Biodiesel production	3	12

Source: REN21 Renewables Global Status Report 2009 Update

Looking forward, the International Energy Agency's 2008 Reference Scenario^{vi} forecasts total cumulative energy investment of \$26.3 trillion (in 2007 \$) for the period 2007 to 2030, over \$4 trillion more than in the IEA World Energy Outlook 2007^{vii}. Cumulative renewable energy investment is foreseen to be \$5.5 trillion (in 2007 \$), of which \$3.3 trillion is for electricity generation. WEO-2008 also illustrates two back-casting CO₂-equivalent stabilisation scenarios.

The 550ppm Policy Scenario's widespread adoption of feed-in tariffs and portfolio-standard policies boosts renewable energy power generation (excluding large hydro) to 3,800TWh in 2030, which will account for 13% of the world's electricity generation, up from 4.4% in 2008. Although this 13% figure may appear quite modest, it would still require 1,700GW of new renewables capacity between now and 2030, or 36% of all new capacity additions. The total share of renewable energy including large hydro in the power generation sector by 2030 would be 30%. The 450ppm Policy Scenario requires a resolute direction shift: hydro and other renewables will eventually result in 40% of total electricity generation, or 12,000TWh – roughly three times the current total US electricity generation.

These climate policy scenarios require a substantial shift in investment patterns. According to the 550ppm Policy Scenario, an additional investment of \$1.2 trillion in power plants and \$3 trillion in energy efficiency is needed relative to the Reference Scenario.

Of the additional investment in energy efficiency, around half is in transport. The 450ppm Policy Scenario requires \$3.6 trillion further power plant investment (on top of the Reference Scenario), and investment in energy efficiency also rises significantly after 2020.

Share of Stimulus Packages targeted at Sustainable Energy

A number of governments are responding to the financial crisis by stimulating their economies through public investment. By April 2009, the G-20 nations had announced \$2.8 trillion of fiscal stimulus packages to be spent over the next 2 to 5 years. For 2009, the stimulus will amount to 2 percent of the G20 combined GDP. Thirteen of these major economies included "green stimulus" measures for sustainable energy totaling \$183 billion (see Figure 18). Green stimuli allocations for sustainable energy account for 6% of the total recovery packages announced – but the countries vary significantly in terms of investment and the clarity of their measures.

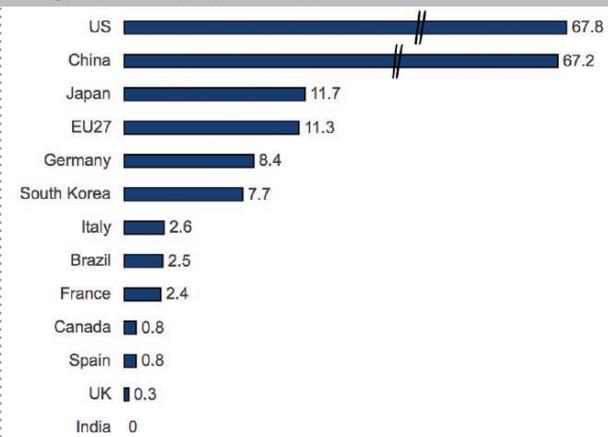
The US and China remain the leaders, each devoting roughly \$67 billion, but South Korea's package is the "greenest", with 20% devoted to sustainable energy.

At a sectoral level energy efficiency has attracted the most money, with more than 33% of global green stimulus funds. The grid is also a major beneficiary, particularly in China, but also in developed economies including the US, Japan and EU-27.



The €5 billion energy, gas and broadband package adopted by the European Union in March adds some €2.5 billion of environmental measures to the €6 billion agreed earlier in the Community's Budget. Germany and France have provided more details of their own packages, with priority given to energy efficiency investments and research and development.

Figure 18: Green Stimulus allocations to Sustainable Energy by Country, April 2009, \$ billions



Note: Total amount announced by the 13 economies totals \$183.4 billion

Source: New Energy Finance

The US has one of the largest and most clearly defined stimulus packages, with \$66 billion in funding available for sustainable energy, energy efficiency and transmission investments. The political will to disburse this funding is robust, but turning it into action in a timely fashion will be a challenge.

Japan, facing a particularly drastic economic contraction, announced a fourth stimulus package. With a total of \$154 billion, sustainable energy has received a considerable boost. The so-called "low-carbon revolution" was given \$22 billion, with solar generation, electric cars, and energy efficiency key beneficiaries.

The South Korean package is acclaimed as the "greenest in the world", however, it shrinks from more than \$36 billion to only \$7 billion to be allocated to sustainable energy when items such as river restoration, mass transit and railroad, forest restoration, water conservation and recycling are excluded.

China's programme is massive and quite environmentally-friendly overall. Many of its green attributes come in the form of so-called "ecological" projects, which include clean-up and water schemes. Its incentives for the power sector, including energy efficiency, exceed \$67 billion.

The key question for industry is whether these stimulus funds will be dispersed quickly enough and in ways that effectively address falling demand and illiquid financial

markets. The key question for governments is whether the public stimulus will deliver the jobs and economic activity needed to drive a recovery. Determining an accurate spending timetable for sustainable energy is difficult, but New Energy Finance's estimate is that only \$40 billion of the \$183 billion of green stimuli allocations to sustainable energy from the 13 major economies will be spent in 2009, with another \$75 billion in 2010, \$43 billion in 2011, and smaller amounts in the years after.

UNEP's Executive Director Achim Steiner recently called for the deployment of a "Global Green New Deal", a concept that is now gaining momentum amongst governments and leaders in industry based on the need to improve the regulation of certain national and international financial systems. Sustainable energy is at the centre of this debate.

Economic impacts of Sustainable Energy through Job Creation

Employment figures from UNEP and the International Labor Organisation (ILO) for the renewable energy industry, suggest that it already generates more jobs than employment in fossil fuels (see Figure 19).

A 2008 UNEP ILO study on GreenJobs^{viii} conducted in collaboration with the WorldWatch Institute estimates that if the sustainable energy sector grows to \$630 billion by 2030, this could translate into at least 20 million additional direct and indirect jobs, including 2 million in wind and 6 million in solar. Investment in improved building efficiency alone could generate an additional 2-3 million green jobs in Europe and the United States by 2030. Energy efficiency in the buildings and construction sector could both reduce carbon emissions and create jobs in the process, namely by greening its 110 million existing jobs. The job potential will be higher in developing than in industrialized countries mainly due to lower labour costs.

Figure 19: Estimated Global Employment in the Renewable Energy Sector, 2008

Technology	Global (2008)
Wind	300,000
Solar	170,000
Solar Thermal	624,000
Biomass	1,174,000
Hydropower	39,000
Geothermal	25,000
Renewables combined	2,332,000

Source: UNEP / ILO / WorldWatch Institute

A recent HSBC study^{viii} concluded that the three most promising sectors in terms of social return, job creation and relevance to the current state of the global economy are i) building efficiency, ii) renewable energy and iii) low carbon vehicles.

Role of Sustainable Energy in Mitigating Climate Change

Sustainable energy has a significant role to play in mitigating climate change. According to the Intergovernmental Panel on Climate Change (IPCC)'s Fourth Assessment Report in 2007^{ix}, limiting likely average global temperature to 2.0 to 2.4°C – thought to be the highest “safe” level – means stabilising CO₂ equivalent concentrations at 445 to 490 parts per million, which in turn requires reaching peak CO₂ emissions by 2015. At its 2007 Summit the G8 acknowledged the need for CO₂ emissions “to peak within 10 to 15 years”, or between 2017 and 2022. A rapid transition to low-carbon infrastructure is therefore needed.

New Energy Finance Global Futures 2009 shows that a 2020 peak in emissions can be achieved, but an accelerated pace of investment is needed. In the Peak Scenario, CO₂ emissions from the world's energy infrastructure peak at 30.8 gigatonnes in 2019. In order to achieve this target, annual investments need to rise from \$155 billion today to \$500 billion by 2020. This represents an average investment of 0.44% of GDP between 2006 and 2030, well within the 1.0% range envisaged by the Stern Review^x but nearly double the 0.25% currently projected in the IEA 2008 WEO Reference Scenario. Also, this 0.44% of GDP investment would only avert the worst effects of climate change, not eliminate it altogether.

In the Global Futures 2020 Peak Scenario, investment in solar PV and onshore wind increases to an average annual level of \$166 billion and \$79 billion, respectively, over the period 2009-2030, or 55% of the total. This scenario also assumes that other technologies, including offshore wind, biofuels, geothermal and waste-to-energy are developed more aggressively, with policy support where needed. For energy efficiency it also assumes a much more concerted effort, with an average of \$24 billion of additional investment annually, improving energy intensities as a result.

Global stimulus package as part of a Copenhagen Deal

The green stimulus packages show an important shift in thinking from the world's leading economies and set a positive tone for climate negotiations at the 15th Conference of the Parties (COP) of the UNFCCC in Copenhagen in December 2009.

The investments and policy measures included in the green economic plans should help stabilise investment activity in the short term and hopefully will contribute to continued upward investment trends once the financial crisis subsides. However, while investment in sustainable energy increased by more than 440% from 2004 to 2008 to reach \$155 billion, it still does not meet the investment of \$500 billion per annum that is needed by 2020 if CO₂ emissions are to peak.

Although the current economic recovery packages are a set of mostly independent domestic stimulus efforts, a deal in Copenhagen provides the opportunity for a global stimulus package that can kick-start the shift to a low carbon world. Any Copenhagen agreement will need to develop appropriate mechanisms to trigger the investment needed. The development of international funding mechanisms, based on countries' emission levels and their ability to pay, are needed to secure the predictable and sustained financial flows required by developing countries.

However, while public funding will play an important role post-Kyoto, most of the investment will need to come from the private sector. The role of governments is to catalyse larger flows of private sector resources, especially from the leading corporations that need to complement the effort of start-up firms that have been driving the sector so far.

Although public funding and domestic regulatory actions will be important for mobilising private investment, the carbon markets will also be crucial. In early 2009, the European Union announced that its goal was to link up the EU Emissions Trading System with the cap-and-trade systems being developed in other industrialised countries to form an OECD-wide international carbon market by 2015. Putting a price on carbon emissions is vital and the systems to do so must continually be improved to help industry and society decouple GHG emissions from economic growth.

Much more detail on the clean energy aspects of the fiscal stimulus packages is included in Section 11.



CHAPTER 3: TECHNOLOGY INCUBATORS

3

- New Energy Finance's 2008 survey of incubators recognised 189 business incubators around the world that support clean energy businesses in the earliest stages of development.
- Since 2000, incubated clean energy companies have raised \$2.5 billion in follow-on funding.
- During the first half of 2008, 13 more companies saw investment events. By comparison, in 2007 35 incubated companies that received follow-on private investment were acquired.
- Given the global financial crisis, incubators will be instrumental in maintaining support for the earliest stages of technological entrepreneurship.

Business incubators play an important role in the clean energy sector by leveraging their experience in growing innovations in the laboratory, fostering company growth, and aiding in the path toward commercialisation. Led by academic and research foundations, organisations incubating clean energy companies are usually affiliated with universities, government facilities, subsidiaries of large corporations and charitable organisations. Incubators typically offer in kind support as well as capital to their companies with the goal of nurturing innovations to reach a stage where the company can attract private financing and deploy a commercial product. From 2000 to mid 2008, companies under incubation or that once were incubated have raised \$2.5 billion in disclosed private financing.

In a survey conducted by New Energy Finance in 2008, the most incubators were located in the EMEA region, accounting for 46% of the global total, followed by the AMER and ASOC regions with 40% and 14% respectively. The EMEA region was driven by European governments setting aside notable amounts of funding for companies in the earliest stages of development. By country, the US with 56 incubators ranks number one as in previous years. The UK and Germany follow with 21 and 16 incubators respectively.

The number of companies under incubation, (also referred to as incubatees) fell slightly during 2008. Incubated companies totalled 338, down just less than 2% from last year. The highest number of incubated companies were in the solar sector at 73, or 21% of the total number of incubated companies (see Figure 21). Solar is followed by the wind, biofuels, and energy efficiency supply and demand side sectors.

Successful incubators are measured by the ability to foster an incubatee's ability to raise follow-on investment

from private investors or become acquired. A significant proportion of successful incubators are affiliated with academic/ research foundations (50), privately-controlled organisations (38), and governments/public sector (37) (see Figure 20).

In the first half of 2008, 13 incubatees either successfully raised funds or were acquired by larger companies. The vast majority of these transactions (10) were located in the US and the UK, and half of them were mergers and acquisitions, accompanied by VC early and late stage funding. The most prominent example was the acquisition of a controlling interest in Stirling Energy System (SES), a US-based developer of utility-scale solar powered electricity generation plants, by NTR plc for \$100 million. NTR is a leading Irish developer, financier, and operator of public infrastructure. SES was incubated by US incubator EcoElectron Ventures Inc. Another highlight was ESolar, a solar company incubated by IdeaLab, which raised \$120 million in private equity in April 2008 from IdeaLab, Google.org, Oak Investment Partners, and others.

Although these deals are encouraging, fewer deals were executed in 2008 than in 2007, which is probably correlated with the reticence of existing investors to take lower valuations on their later stage firms, and potential investors becoming more risk averse at the earliest seed and incubation stages.

Since 2000, 37% (57 of 143) of the follow-on financing rounds raised by incubated companies have been in the solar sector. Fuel cells have witnessed the next most success, followed by power storage and biofuels. In the first half of 2008, 38% (5 of 13) successfully incubated companies were in the solar sector. In many countries, including the US, Spain, and Germany, policy incentives have created a ripe entrepreneurial environment for solar.

The US remains a world leader in terms of number of incubators, incubated companies, and successfully incubated companies. The US combines a strong history in technology research with an atmosphere conducive to venture capital. For example, the Environmental Business Cluster, which has incubated 10 successful companies, works in conjunction with the National Renewable Energy Lab and the National Alliance of Clean Energy Business Incubators.

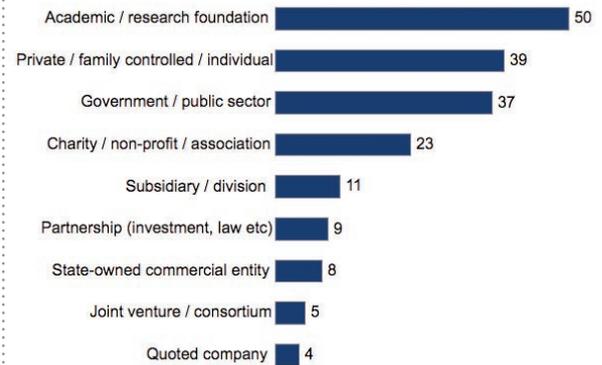
Incubatees in the UK were responsible for a large portion of deals completed in 2008. The UK houses some of the most active incubators in the industry, spurred on by companies like the Carbon Trust, a government-funded entity that provides support to several highly effective incubators in the area of carbon reduction, such as Imperial Innovations Ltd., ANGLE Plc, and Life-IC. To date, these three incubators have enjoyed 62 successes. One of ANGLE's incubatees, Whitfield Solar, closed a \$2 million interim funding round in February from Carbon Trust Investments and offshore investment fund Kilby.

Germany and Spain house important clean energy incubators, with 16 and 7, respectively, aided by particularly good policy incentives.

Home to 13 incubators, Israel has a surging clean energy economy, spurred on by factors like fossil fuel dependency, water scarcity, and an abundance of solar energy potential. The country also hosts universities at the forefront of energy research, such as Tel Aviv University, Ben Gurion University, and the Technion. In February, Pythagoras Solar Ltd, an early stage company incubated by Precede Technologies, raised \$10 million in Series A funding in a round led by Israel Cleantech Ventures.

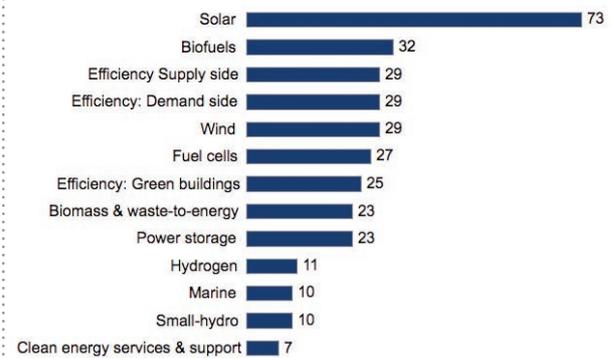
To accompany their industrial surges, both India and China are taking increases steps to promote clean energy. Ten incubators exist in India, and twenty-five have been identified in China, though the actual number in the latter is likely to be much higher given the high level of government involvement in developing new technologies. Within India New Ventures India, an alliance between the World Resources Institute and CII-Sohrabji Godrej Green Business Centre, has incubated ten Indian environmentally-friendly businesses.

Figure 20: Sustainable energy incubators by affiliation, 2008



Source: New Energy Finance

Figure 21: Incubated sustainable energy companies by sector, 2008



Source: New Energy Finance





CHAPTER 4: VENTURE CAPITAL AND PRIVATE EQUITY

4

- Private equity, to some extent, took up the slack from the public markets, where sharp falls in share prices made it hard for companies to raise fresh capital.
- Venture capital and private equity funds invested \$19.3 billion in renewable energy and energy efficiency companies in 2008, an increase of 43% compared with 2007.
- 2008 was a volatile year during which investment rose to an all-time high and then, as the year drew to a close, entered into a steep decline that is lasting well into 2009.
- In the first quarter of 2009, VC and PE finance for clean energy companies fell to \$1.8 billion, a drop of 22% compared with Q4 2008 and its lowest level for more than two years.

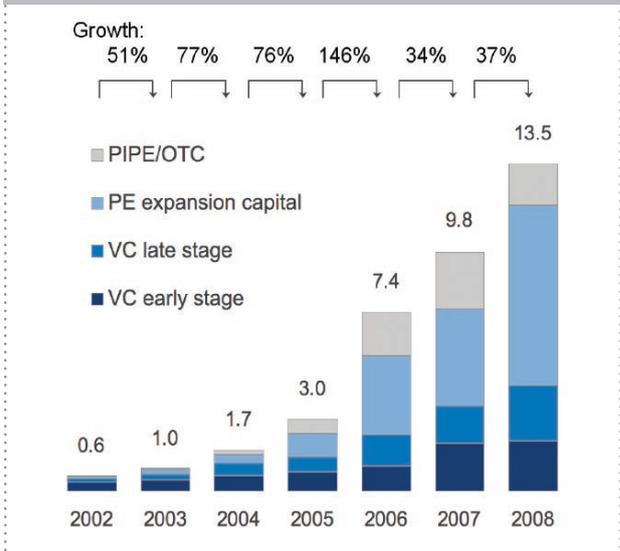
In 2008, venture capital and private equity funds invested \$19.3 billion in renewable energy and energy efficiency firms, an increase of 43% compared with 2007. Of this, \$13.5 billion represented “new” money – everything except private equity buy-outs – an improvement of 36.8% on the \$9.8 billion of fresh investment in 2007 (see Figure 22). This money helped a broad spectrum of young companies to develop technologies in fields as diverse as carbon capture and tidal power, while enabling those further down the track to ramp up and commercialise production.

More than 500 funding rounds took place during 2008. At one end of the scale there are small, early-stage VC rounds that barely run to seven figures, while at the other end there are large PE investments worth hundreds of millions. New Energy Finance also counts over-the-counter deals and PIPEs, or private investment in public entities, in the overall VC/PE total. One type of deal not included, however, is PE investment in renewable energy projects. These are discussed in the chapter on asset financings.

Venture capital and private equity investment in clean energy has increased steadily over the last four years, as interest in clean energy has escalated and as investors have had historically cheap access to debt. The 43% year-on-year growth in 2008 thus perpetuates the recent investment pattern, but closer inspection reveals a volatile 12 months during which investment rose to an all-time high and then, towards the very end of the year, entered into a steep decline that looks set to last well into 2009.

The record investment levels achieved in Q2 and Q3 of 2008 were largely due to a surge in private equity deals (see Figure 23). Private equity to some extent took up the slack from the public markets where sharp falls in share prices made it hard for companies to raise fresh capital.

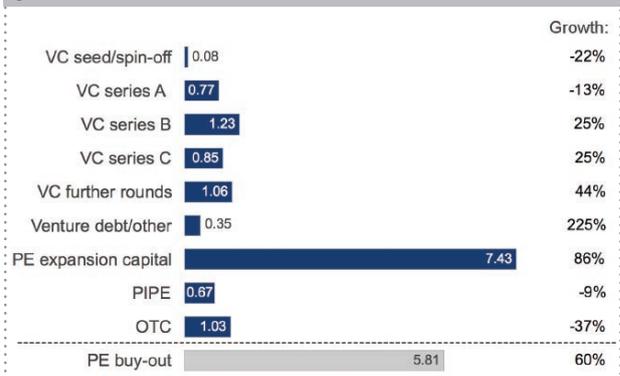
Figure 22: VC/PE new investment by stage, 2002 - 2008, \$ billions



Note: Buy-outs are not included as new investment. Total values include estimates for undisclosed deals

Source: New Energy Finance

Figure 23: VC/PE new investment by stage, 2008, and growth on 2007, \$ billions



Note: Buy-outs are not included as new investment. Total values include estimates for undisclosed deals

Source: New Energy Finance

Total public market investment last year was \$11.4 billion, down more than half from 2007's record \$23.4 billion (see Section 5).

Many of the largest PE deals were in solar (see Figure 24 & 25). In the third quarter, for instance, Grupo Naturener, a Spanish project developer, raised €132 million (\$207 million) from existing shareholders, while German thin-film module maker Sulfurcell clinched €85 million (\$135 million) from a posse of heavyweight private equity investors led by Intel and Climate Change Capital.

Despite the spectre of rising feedstock prices, US bioethanol firms continued to attract investment. In the second quarter, US private equity firm First Reserve Corporation backed Osage Bio Energy to the tune of \$300 million.

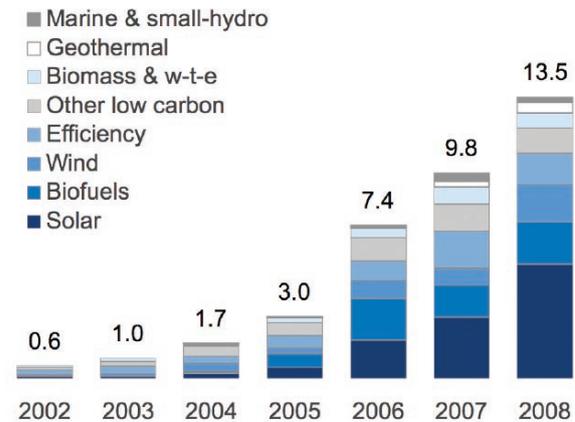
Private equity buyouts were also very much in evidence during the second and third quarters of 2008, having declined sharply in Q4 2007 and Q1 2008. Unlike PE expansion investment in which solar deals dominated, PE buyouts were largely confined to the wind sector. In one of the more notable deals, Abu Dhabi state-backed renewable investment vehicle Masdar took its first stake in a wind company when it paid \$177 million for a slice of Finnish turbine manufacturer WinWind. Other highlights included Doughty Hanson's acquisition of Danish brake manufacturer Svendborg Brakes for €460 million (\$724 million) in the second quarter.

Venture capitalists were also more active than normal in the second and third quarters of the year. A sizable proportion of the deals were early-stage plays in the solar sector, where investors courted a healthy population of young, ambitious, mainly US and Chinese technology firms that had raised money, but not yet started manufacturing and selling their products.

Thin film companies were particularly well represented as VCs lined up to bet that the technology will out-play crystalline silicon. At the end of August 2008, AVA Solar closed a \$104 million Series B round led by DCM Venture Capital that it will use to complete a 200MW per year factory at Longmont, Colorado. Young concentrated PV firms were also successful. GreenVolts, a US company developing a 2MW plant at Tracy, California, secured \$30 million in a Series B round from Oak Investment Partners.

Early-stage investment in biofuels was focused on firms exploring ground-breaking technologies. California's Amyris, for instance, bagged \$91 million to further its efforts to create biofuels from feed stocks such as sugar cane, corn

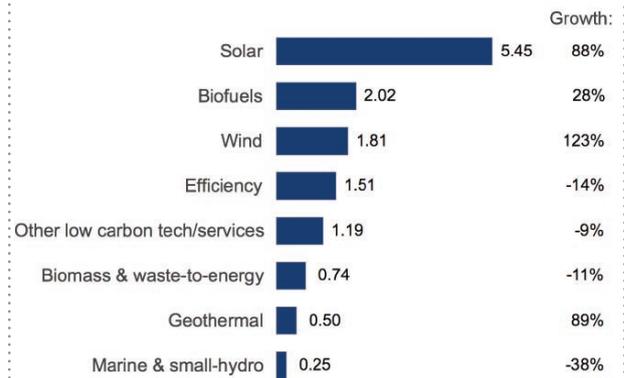
Figure 24: VC/PE new investment by sector, 2002-2008, \$ billions



Note: Buy-outs are not included as new investment. Total values include estimates for undisclosed deals

Source: New Energy Finance

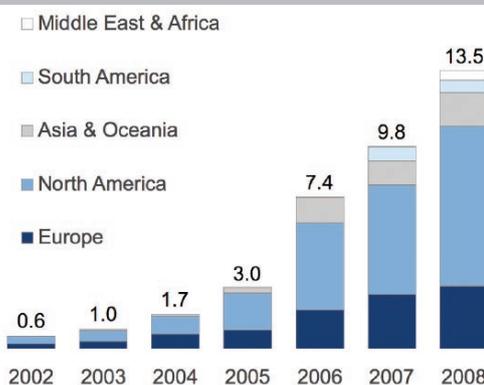
Figure 25: VC/PE new investment by sector, 2008, and growth on 2007, \$ billions



Note: Buy-outs are not included as new investment. Total values include estimates for undisclosed deals

Source: New Energy Finance, UNEP SEFI

Figure 26: VC/PE new investment by region, 2002-2008, \$ billions



Note: Buy-outs are not included as new investment. Total values include estimates for undisclosed deals

Source: New Energy Finance



and cellulose. Others such as Sapphire Energy, which plans to produce commercial volumes of algal biofuel within three to five years, scooped more than \$100 million in Series B funding.

Unfortunately, the resilience of VC/PE investors was not to last. The fabric of modern finance started to unravel in spectacular fashion at the end of September, sending global financial markets into sharp decline and with it VC and PE investment. In the first quarter of 2009, “new” VC and PE finance for clean energy companies fell to \$1.8 billion, a drop of 22% compared with Q4 2008 and its lowest level for more than two years.

Private equity investors are being more cautious. In the midst of a severe downturn, when sales are falling, investors are thinking twice before committing PE expansion capital to businesses that are typically post-revenue and are looking to expand market share. Furthermore, debt finance, if needed, would ideally have to be in place already, or there should at least be a high degree of certainty about its availability.

Meanwhile, VCs looking for fast growth are now less willing to take risks on early-stage pre-profitable businesses for a number of reasons, one of which is that it is taking longer to get companies to commercialisation. This is mainly a consequence of the recession, changes in subsidy regimes in some European countries and the fact that people are less receptive to new technologies during a downturn.

The result is that venture funds are retrenching to positions where they feel more comfortable. In effect, this means that VC firms are moving down the value chain to seek out better quality, later-stage investment

opportunities, of which there seem to be plenty due to the closure of the public markets and the dearth of activity among banks and hedge funds.

Conversely, the absence of a quick and easy exit route may also be dissuading VCs from investing. According to the US National Venture Capital Association and Thomson Reuters, there were just six venture-backed IPOs in 2008, the lowest number since 1977. This makes it harder for venture investors to cash out of previous companies and put money into new ones.

The other main route for start-up investors to realise gains – selling out to other companies – also hit a low point in the US in 2008. According to NVCA and Thomson, there were only 260 such deals, the first time since 2003 that there have been fewer than 300 venture-backed acquisitions in the US.

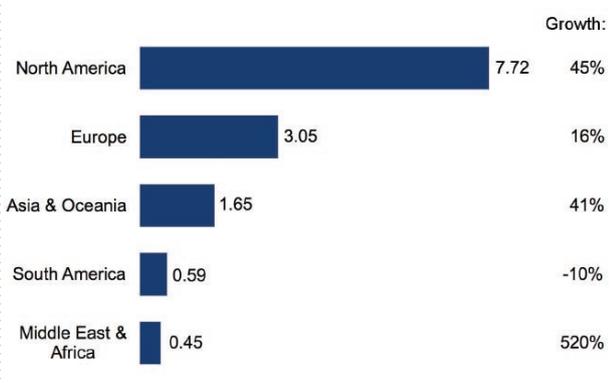
This will doubtless have had an impact on VCs’ appetite for investment. Indeed, in June 2008, the former powerhouse of Europe’s venture capital industry, 3i Group, announced that it was abandoning early-stage investment – its worst performing activity since the technology bubble burst in 2000 – to focus on buy-outs, growth capital and infrastructure. UK investor Apax Partners had done likewise the year before.

Faith in the venture capital model runs far deeper in the US than in Europe and will prove harder to unsettle (see Figure 26 & 27). In Q4 2008, for instance, 60% of early-stage deals and 65% of later-stage VC investment rounds backed companies based in the US. In contrast, PE expansion capital deals were spread throughout Europe, North America and parts of the Far East.

VC/PE investment in non-OECD countries has been affected by the financial crisis and economic recession in much the same way as in OECD countries. In China, for example, the volume of investment increased steadily over the course of 2008 to a high point of \$235 million in Q3 and then fell away in the final three months of the year. Investors in China are actively seeking opportunities in early-stage technology development, particularly PV thin film. VC and PE investment in Brazil and India dwindled in the second half of the year.

The financial crisis and economic recession may have hit share prices hard and stifled investor appetite, yet the impact is not unrelentingly negative. Plummeting values means that those with money to spend should find plenty of attractive investment opportunities. In the early months of 2009, there were several successful new fund raisings, suggesting that there is capital available for the right opportunities.

Figure 27: VC/PE new investment by region, 2008, and growth on 2007, \$ billions



Note: Buy-outs are not included as new investment. Total values include estimates for undisclosed deals

Source: New Energy Finance, UNEP SEFI

Danish pension fund ATP has committed to investing up to \$400 million in late-stage private equity investor Hudson Clean Energy Partners. Another significant pension fund investment was announced by CalPERS. The leading Californian clean technology investor announced in a February filing that it had committed \$200 million to a new \$1 billion technology investment fund set up by Sun Microsystems founder Vinod Khosla.

In addition, US private equity firm Element Partners closed a \$486 million clean technology fund, while London-based Index Ventures closed a \$446 million seed early-stage fund with three targeted sectors, one of which is clean technology; and Brazilian private equity firm DGF closed a \$140 million fund that will invest in the ethanol supply chain.

These commitments correspond to the main conclusion of a survey of 106 institutional investors conducted by New Energy Finance: namely, that asset owners are increasingly focused on clean energy and clean technology.





CHAPTER 5: PUBLIC MARKETS

5

- In 2008, new investment in clean energy firms via the world's stock markets tumbled 51% to \$11.4 billion, from \$23.4 billion in 2007.
- Activity noticeably slowed in the second half of 2008, and the public markets have effectively been closed for clean energy IPOs so far in 2009.
- Fewer companies chose to make their debut on the public markets. In 2008, 18 companies floated on the world's main exchanges, raising a total of \$3.6 billion. This was 30 fewer than during 2007, when 48 IPOs raising \$13.6 billion.
- Solar dominated public market activity, taking over from wind, which led the field in 2007, raising \$6.4 billion on the world's stock markets in 2008, 56% of the total.
- In Q1 2009, the world's stock markets remained closed to any form of fundraising, resulting in a backlog of deals waiting for conditions to improve.

In 2008, investment in clean energy firms via the world's stock markets tumbled 51% to \$11.4 billion, from \$23.4 billion in 2007 (see Figure 28), as turbulence from the worst financial storm in many decades battered share values and recession tightened its grip on the global economy.

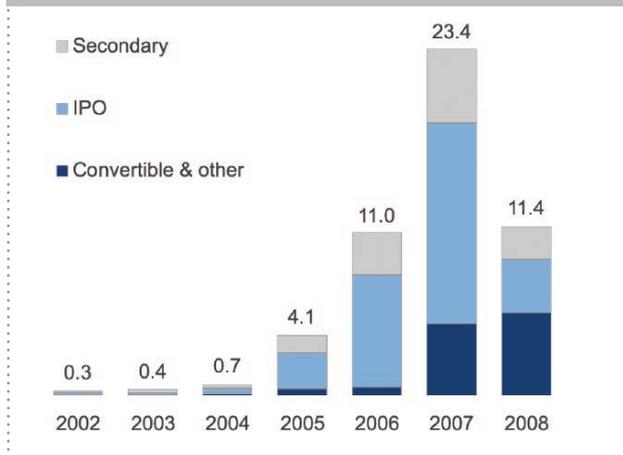
Given the dramatic deterioration in conditions, far fewer companies chose to make their debut on the public markets. In 2008, 18 companies floated on the world's main exchanges, raising a total of \$3.6 billion. This was 30 fewer than during 2007, when 48 clean energy firms completed IPOs that raised \$13.6 billion, nearly four times as much capital.

Similarly, the number of listed companies that undertook secondary or follow-on offerings more than halved. In 2008, 40 secondary offerings raised \$2.2 billion, down from 60 comparable transactions that raised \$5.0 billion the year before.

However, certain deal types thrive during periods of investor parsimony. Convertible bond issuance, for instance, remained strong during 2008, as investors looked for stable returns combined with some equity upside, and there was a surge in rights issues towards the end of the year as companies established on the stock markets turned to their shareholders in a bid to shore up their balance sheets.

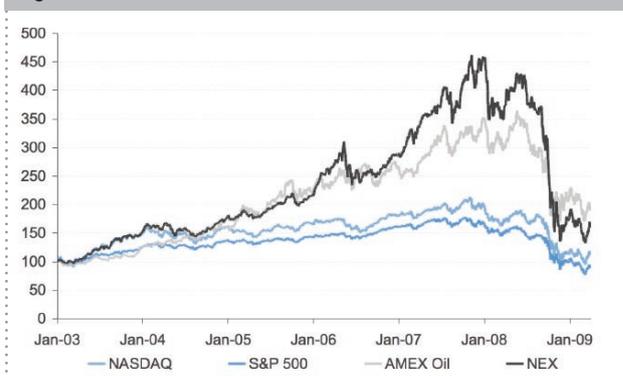
The transactions referred to here concern new investment only and do not include investor exits nor money raised by companies listed on the OTC markets, nor private

Figure 28: Public market new investment by stage, 2002-2008, \$ billions



Source: New Energy Finance

Figure 29: NEX vs selected indices, 2003 -2009



Note: Index Values as of 31 March 2009; AMEX Oil, NASDAQ and S&P 500 rebased to 100 on 30 December 2002

Source: Bloomberg, New Energy Finance

investment in public companies (see Section 4, Venture Capital & Private Equity for more detail on these types of investment).

The market reached its zenith in the final weeks of 2007 when Ibernova, the wind power subsidiary of Spanish power utility Iberdrola, took the opportunity to launch a massive IPO that netted the company \$7.2 billion.

The first three months of 2008, by contrast, saw a number of companies abandon their plans for an IPO as it became clear that the sub-prime mortgage crisis in the US had wound its way much deeper into the fabric of the financial system than had initially been expected.

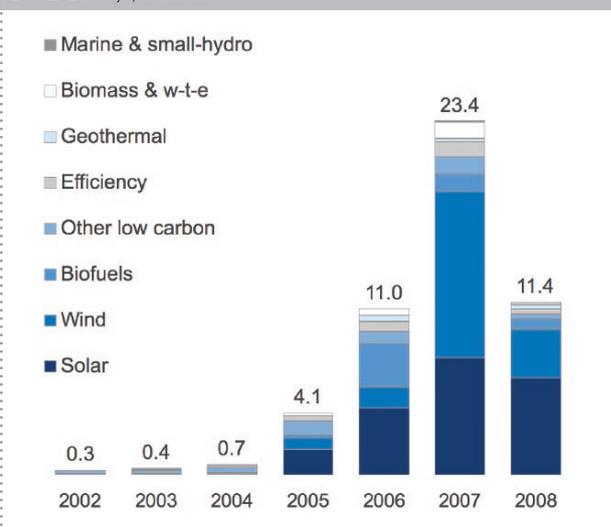
Fund-raising activity also picked up in Q2 and Q3 2008, providing a window of opportunity for Portuguese utility EDP to float around 25% of its renewables division EDP Renovaveis. The deal in June 2008 raised €1.57 billion (\$2.4 billion) for EDP, making it the second-largest IPO by a renewable energy company.

The trend begun by European utilities in late 2007 to finance their renewable energy operations as free-standing entities rather than as part of the larger parent company illustrates how the capital markets have learnt to distinguish between old and new energy businesses, rating the new more highly than the old. Had EDF, Iberdrola or EDP chosen to raise capital through a share offering from the parent company, investors would have valued earnings from the renewable business at a fraction of the value achieved by a separate listing. Investors perceive renewable energy businesses to have a much higher growth potential than a traditional utility operation. Even with renewable energy stocks taking more of a hit than other public equities, in mid 2009, these free-standing entities are still being valued at about 3 times the price-earnings ratio as their old energy parent companies.

In the final three months of the year, fundraising activity came to a sudden halt when the global financial crisis entered a new, more intense phase that saw the collapse of Lehman Brothers and the US government rescue of insurance giant AIG. For the first time since 2003, there was not a single IPO by a clean energy company on a major exchange anywhere in the world in the final three months of the year.

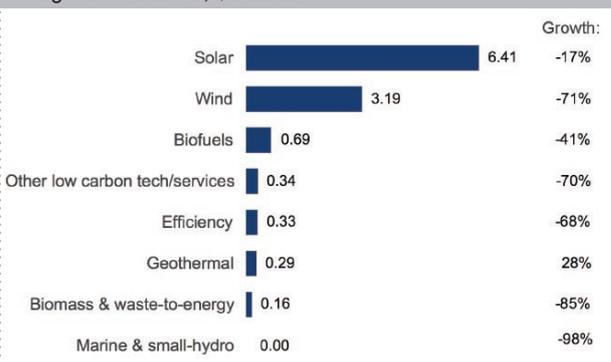
The WilderHill New Energy Global Innovation Index (NEX), a benchmark index of 88 clean energy stocks, tells the same story (see Figure 29). In the first two weeks of 2008, it lost 23.4% of its value, falling from 457.6, very near its all-time high, to 350.5. It later staged a recovery and seemed to defy gravity for much of the spring and

Figure 30: Public market new investment by sector, 2002-2008, \$ billions



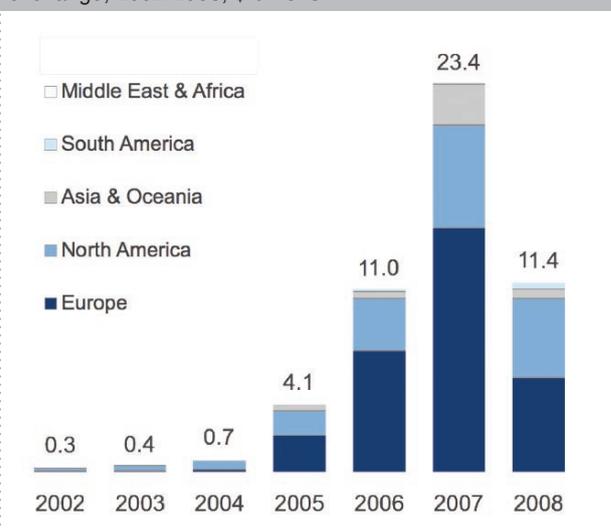
Source: New Energy Finance

Figure 31: Public market new investment by sector, 2008, and growth on 2007, \$ billions



Source: New Energy Finance, UNEP SEFI

Figure 32: Public market new investment by region of exchange, 2002-2008, \$ billions



Source: New Energy Finance



summer, trading mainly in the 350-450 range. However, the NEX went into steep decline in the last quarter of 2008, touching a low of 135.15 in late November, a level not seen since September 2003 – before the ratification of the Kyoto Protocol, Hurricane Katrina and President Bush's statement that the US was "addicted" to oil, the publication of the Stern Review, and the premiere of An Inconvenient Truth.

In the final six weeks of 2008, the NEX bounced back to a slightly more respectable 177.6 as investors reacted positively to the election of Barack Obama who promised to substantially increase support for the sector in the US. In the first three months of the 2009, however, the index retreated to levels near its low point in November 2008, before recovering this lost ground in May.

Stock markets in general have dropped sharply, but clean energy shares have fared worse, particularly since the start of September. In all, the NEX fell 61% in 2008 compared with a 38.5% setback for the US S&P 500 index, a 31% fall for London's FTSE 100, a 44% retreat for Dow Jones Eurostoxx 50, and a 41% fall for the Nasdaq Composite over the same period.

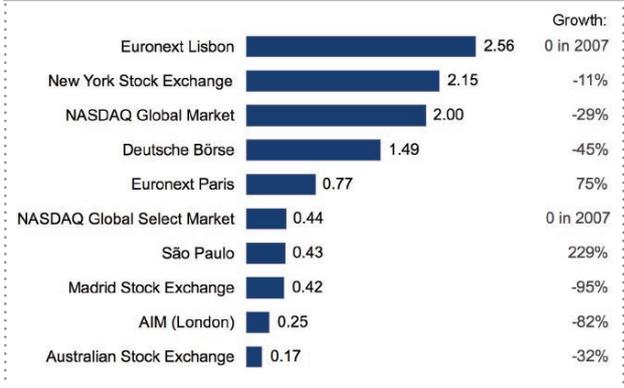
There are three reasons why the sector has been hit so hard. First, with energy prices collapsing by 70%, clean energy stocks were bound to suffer – they are, after all, energy companies. Second, investors shunned stocks with any sort of technology or execution risk in favour of longer-established businesses. Third, in an era of sharply constrained credit, investors penalised companies with high capital requirements – even the more established, asset-based clean energy companies, which carry no technology risk, are deemed to be capital-hungry because they are high-growth and have high capital costs.

A further factor is that the NEX index had experienced an extraordinary run-up during the last few years, particularly in 2007 when it soared by 58%, setting the scene for an almost inevitable correction.

Solar companies raised more money on the world's stock markets in 2008 than all other clean energy sectors combined (see Figure 30 & 31). The investment of \$6.4 billion represented 56% of the clean energy total, but it still fell short of the \$7.7 billion raised by solar companies during 2007.

Chinese solar companies continued to be particularly active participants in the public markets as they sought to fund ambitious expansion plans (see Figure 34). In the first quarter of 2008, three such companies launched IPOs – a thin film PV firm, and two silicon wafer manufacturers –

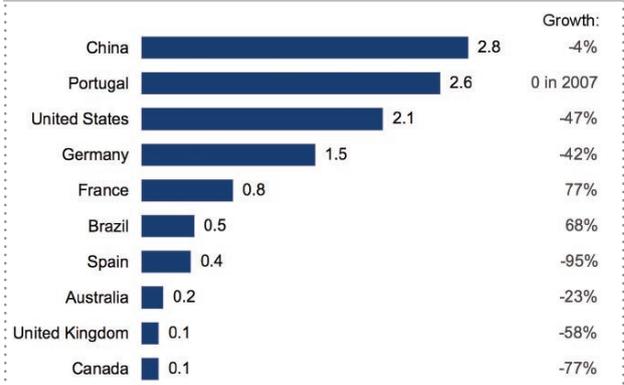
Figure 33: Public market new investment by exchange, 2008, and growth on 2007, \$ billions



Note: Top 10 exchanges

Source: New Energy Finance

Figure 34: Public market new investment by company nationality, 2008, and growth on 2007, \$ billions



Note: Top 10 countries

Source: New Energy Finance

and, over much of the rest of the year, a number of their listed compatriots made substantial follow-on offerings while others became prolific issuers of convertible bonds.

For years the solar sector had enjoyed cloudless skies as stock prices soared and readily available capital fuelled growth of around 40% per year, but economic growth ground to a halt in 2008 and developers found they were no longer able to raise the credit they needed to build out their pipelines. In addition, solar supply caught up with demand in the second half of the year sending prices for PV products sharply lower.

Given that module prices are set to continue falling in 2009 - New Energy Finance estimates this to be 43% to \$2.40/W by the end of the year - the list of distressed solar companies needing to raise funds will get longer. By mid-February 2009, there were known to be 39 solar companies looking to raise funds via the public markets, although some of these are likely to end up in the hands

of Asian conglomerates or cash-rich solar companies before long. Thin film solar technology is also challenging the traditional PV sector, with First Solar reaching its \$1/W production cost target in early 2009.

Wind companies raised a respectable \$3.2 billion in 2008, (see Figure 31) but much of this was accounted for by EDP Renovaveis' \$2.4 billion IPO in June (referred to above). Compared with the solar sector, which produced 37 deals over the course of 2008, the wind sector managed just five.

In comparison, the biofuels sector looked positively vibrant with 11 deals; however, the \$678 million raised in 2008 was much less than the \$1.1 billion raised by biofuels firms in 2007 (see Figure 30 & 31), and was only a fraction of the sums accrued by solar and wind companies. Again, most of the biofuels total reflected a single large deal, in this case Brazilian ethanol producer Cosan raising BRL 880 million (\$413 million) from its parent company NYSE-listed Cosan Ltd.

It was a bruising year for traditional sugar-based ethanol producers everywhere. A number of companies pulled out of IPOs in the early part of 2008 as commodity prices soared, and in the second half of the year, Brazilian producers with US dollar-denominated debt found themselves crippled by the sudden massive decline in the value of the country's currency against the dollar. In Brazil, there was to have been a large IPO by the country's second-largest ethanol producer Santelisa Vale in the first quarter of 2008 but the company decided not to go ahead.

The biomass and waste-to-energy sector also saw a dramatic fall in the volume of funds raised from \$1.1 billion in 2007 to \$159 million in 2008. Power storage companies bucked the downward trend, more than doubling the volume of money they raised to \$240 million from \$101 million in 2007, and geothermal firms were also more active in 2008.

In 2007, most of the fundraising in non-OECD countries was by solar companies based in China and Taiwan (see Figure 34). These firms continued to raise funds throughout much of 2008, but investor enthusiasm waned as the price of solar modules started to fall in the second half of the year.

In India the only other non-OECD country in which clean energy companies raised funds on the stock markets, a wind turbine manufacturer raised around INR 1500m (\$38 million) from its IPO, and a renewable energy project developer raised a similar amount from a rights issue.

Some clean energy companies chose to list on stock markets in their home countries, while others looked farther afield (see Figure 32). In 2007, most Chinese solar companies sought listings on either Nasdaq or NYSE, however in 2008, there were fewer overseas IPOs by Chinese firms owing to the turmoil on the global markets. Many of those that had already listed continued to raise money via secondary offerings or convertible bond issuance.

A comparison of the stock markets on which clean energy companies raised new money (see Figure 33) reveals that Euronext Lisbon led New York Stock Exchange (\$2.2 billion) and Nasdaq Global Markets (\$2 billion) by virtue of a single deal: the €1.57 billion (\$2.4 billion) IPO by Portugal's EDP Renovaveis.

Nasdaq GM would have led the field in 2007 had it not been for Iberenova's \$7.2 billion IPO which propelled the Madrid Stock Exchange to the top spot.

In 2008, London's AIM showed the largest decline, falling from sixth place in 2007, with deals worth \$1.5 billion, to ninth place in 2008 with a total of \$253 million. The market nevertheless produced 20 deals, which was second only to Nasdaq GM with 22 deals, although this included just one IPO compared with 11 in 2007.





CHAPTER 6: ASSET FINANCING

6

- Financing of sustainable energy assets grew by 22.9% in 2008 to \$136.1 billion, the bulk of which was for new electricity power generation projects.
- Western banks' capacity to lend to projects was severely constrained, with the terms of debt finance deals for renewable energy projects in Europe becoming tougher from October 2008.
- The ratification of President Obama's \$787 billion stimulus package in February 2009 offers a number of new project financing solutions to developers in the US.
- New-build wind project financing increased by 16% during 2008 to \$47.9 billion from \$41.3 billion in 2007, but collapsed in the first quarter of 2009.
- New-build solar project financing underwent a dramatic increase in 2008, rising 84% to \$22.1 billion from \$12.1 billion in 2007. It too fell sharply in the first quarter of 2009.

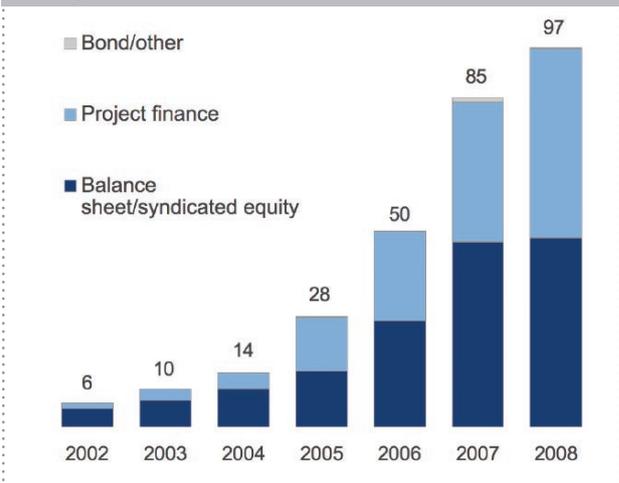
In 2008, as in previous years, the financing of renewable energy assets accounted for the bulk of new investment in clean energy. The total of \$136.1 billion was a 22.9% increase on the \$111 billion recorded in 2007. Of this, \$97.4 billion was ploughed into the development of new wind farms, solar parks, biofuel plants and biomass and waste-to-energy installations, whether from investors' internal balance sheets, or via debt and equity finance (see Figure 35). This represented an increase of 15.4% compared with the \$84.5 billion of new-build investment the previous year.

Non-new investment, mainly in the form of project acquisitions and debt refinancing, was also higher in 2008 than in 2007. A total of \$38.7 billion was recorded, an increase of 48% compared to \$26.1 billion during the previous year.

Financing of renewable power projects increased, yet the full-year figures hide the full extent of the damage inflicted on the sector by the global financial crisis. The collapse of Lehman Brothers in mid-September and the subsequent government-led rescues of major institutions on both sides of the Atlantic effectively paralysed global inter-bank lending. With banks no longer lending to each other, their capacity to lend to projects was severely constrained.

Those borrowers that did manage to secure credit found that it was offered on more stringent terms. Bankers reported that while some of their peers were still prepared to lend for 15 years (compared with 18-20 years in 2007) others were offering much shorter deals, of five years or less, thereby placing the refinancing risk on the sponsors (UNEP study on Global Financial Crisis and its Impact on Renewable Energy Finance).^{xi}

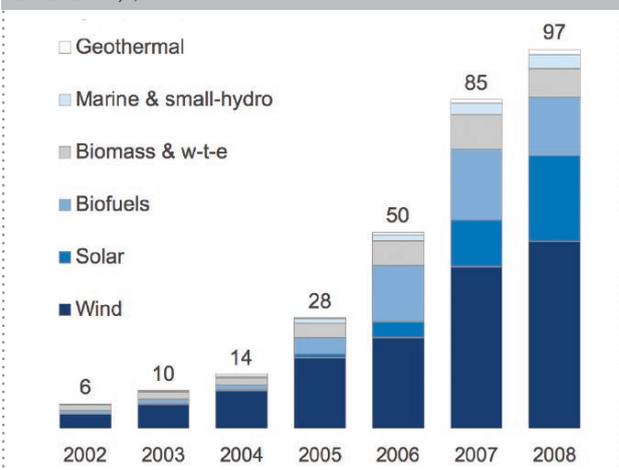
Figure 35: Asset financing new investment by type of security, 2002-2008, \$ billions



Note: Total values include estimates for undisclosed deals.

Source: New Energy Finance

Figure 36: Asset financing new investment by sector, 2002-2008, \$ billions



Note: Total values include estimates for undisclosed deals.

Source: New Energy Finance

Banks have also started to insist on higher upfront fees and a reduction in the proportion of debt to equity.

Debt also became much more costly to service. New Energy Finance estimates that average spreads on European wind project debt soared from 105 basis points in the spring of 2008 to 170 basis points by October. At the end of January 2009, they had risen to an average of around 225 basis points. Of course, some of the increase was offset by sharp falls in central bank rates.

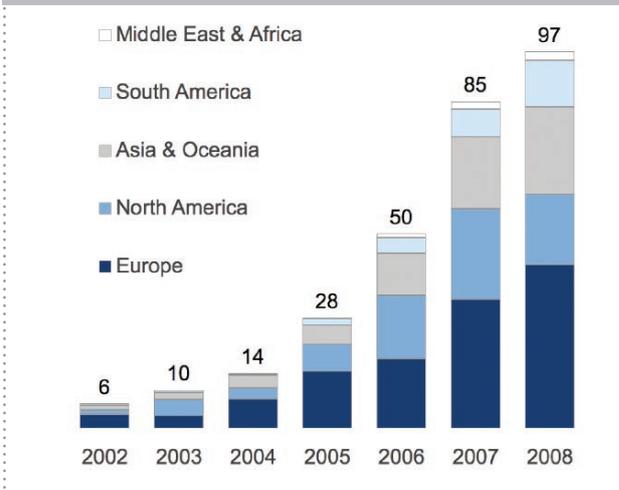
In the US, where tax equity reduces the requirement for debt finance, the situation was equally gloomy. By late 2008, the system of production tax credits used to incentivise renewable energy projects had become all but redundant. The market for tax equity investments, which is used to monetise the tax credits that developers themselves cannot use, had shrunk from around two dozen active participants to just four or five players with substantially reduced appetite for investment.

The ratification of President Obama's \$787 billion stimulus package in February 2009 offers a number of potential solutions. It contains, among other things, several key policy changes with the potential to completely redraw the world of US renewables project finance. The new policies drastically expand options to developers in a capital-intensive industry. It extends the Production Tax Credit for three years, providing unprecedented long-term certainty, and offers developers of PTC-eligible projects the option to exploit the generally more favourable Investment Tax Credit (ITC). The law also extends through to the end of 2009 the 'bonus' 50% depreciation that allows developers to expense a major portion of the projects' capital costs in the first year.

Perhaps the most significant measure is the introduction of a cash grant in lieu of tax credits thus opening up the US to traditional project finance structures employed in Europe and elsewhere that involve simple debt and equity. As the PTC and ITC still run into the general problem of a lack of tax appetite from traditional tax equity investors, the grant programme is a critical change that will do most to unfreeze the market. While these new options may take time to evolve, the overall development is decidedly positive.

Globally, investment in renewable energy projects remained robust during the first three quarters of 2008. Only in the final quarter did it start to fall. Some deals collapsed as developers and their sponsors got cold feet. Massachusetts-based developer First Wind, for instance, walked away from plans to build a 54MW wind farm in Prattsburgh, New York, saying that the credit market conditions were unfavourable.

Figure 37: Asset financing new investment by region 2002-2008, \$ billions



Note: Total values include estimates for undisclosed deals.

Source: New Energy Finance

Even during the final three months of 2008, the volume of new money flowing into renewable projects remained comparatively high as the majority of banks and developers, especially those concerned with larger project financings, stood firm and saw through to completion deals to which they were already committed. This created the impression that investment remained buoyant right up to the end of the year whereas, in truth, few new deals were being closed. The full impact of the shortage of bank finance only really became apparent during first quarter of 2009, when financings of new projects fell to just under \$11.5 billion, a 44% drop from Q4 2008 and half the figure for Q1 last year.

Equity investors in clean energy assets are typically divided into three camps: the developer who identifies the clean energy resource and puts the project together; equity sponsors who help fund the project through its construction phase but aim to sell the completed asset; and those that primarily invest in operating assets. Naturally, there is cross-over between these classes of investor. Developers with sufficient capital, for instance, may build their wind projects without money from equity sponsors and retain the completed assets in their portfolios. However, as capital has become more constrained, this model is now the exception rather than the rule.

On-balance-sheet financing may have remained the predominant deal type in 2008, yet it gradually ceded market share to project financing. The former accounted for \$48.6 billion, an increase of 2.4% compared with 2007, while the latter accounted for \$48.5 billion, a 35.2% increase on 2007.



With capital in short supply just about everywhere, good relationships with banks are now of paramount importance to developers. In early 2009, anecdotal evidence strongly suggested that banks were only providing fresh money to corporates with whom they have very close relationships.

The capital-intensive wind industry has been particularly hard hit, although investment figures only started to flag in the final three months of 2008 and did not finally capitulate until the first quarter of 2009. Indeed, new-build wind project financing increased during 2008 to \$47.9 billion from \$41.3 billion in 2007 (see Figure 36).

In recent years, the rapid pace of growth in the wind industry (25% compound annual growth in installation activity) has afforded financial investors plenty of opportunity. Equity sponsors of wind projects under development may have taken on significant development, financing, turbine supply and interest rate risks, but the rewards have been high.

Meanwhile, those that bought existing wind projects will have seen their returns vary depending on local tariffs and/or tax incentives, the wind regime, maintenance costs and financing structure. Ultimately, returns to investors purchasing operating wind assets will depend on the entry price. With a significant number of portfolios being put on the market by distressed sellers, and the promise of cheaper debt in coming years, 2009 looks set to be a good year for bargain hunters.

The high year-on-year growth rate is unlikely to be repeated in 2009, but there is hope that wind development will bounce back strongly in the US in 2010. It is expected that the debt market will have thawed by then and that being the final year of the new two-year stimulus grant programme, developers will rush to commission projects.

In the EU, meanwhile, most of the best sites have already been developed, with the result that more recent projects are located in areas with lower wind speeds (see Figure 37). This generally means lower returns for investors, which is encouraging some to explore new markets in Latin America (especially Chile) and Eastern Europe (particularly Poland, Romania and Bulgaria). This fall in returns also means that utilities, which have a lower target rate of return than private equity investors, have become the leading proponents of greenfield wind farms.

Solar project financing underwent a dramatic increase in 2008, rising to \$22.1 billion from \$12.1 billion in 2007. Much of this boom took place in Spain, where it is estimated that between 2GW and 3GW of PV capacity was installed as developers sought to take advantage of the

country's generous solar subsidy regime before it came to an end in September.

While the sun went down on Spain's boom years, it seemed to shine more brightly in Italy, the Czech Republic, China, Canada and India. It is also warming the US industry, which in the final weeks of the Bush Administration was boosted by an extension of the federal Investment Tax Credit for a further eight years; however, as in the wind sector this was offset by a precipitous decline in both credit and tax equity appetite among financial institutions. The Obama Administration's grant programme that promises to pay cash instead of credits looks set to resolve this issue once the mechanisms for paying these grants has been established.

The dynamics defining the PV market are shifting rapidly. Silicon supply is no longer constrained as demand has fallen and large volumes of new capacity have come on line. As a result, silicon and module prices are in freefall. New Energy Finance's Solar Silicon and Wafer Price Index published in March 2009 shows that spot silicon prices have fallen from \$332/kg in October and November 2008 to \$136/kg. This is squeezing manufacturers' margins, but has also made the cost of generating solar power cheaper and has triggered a sharp pick-up in demand from project developers and for rooftop systems.

Investment in biofuels plants fell by 18% in 2008 to \$14.9 billion from \$18.1 billion in 2007. This was largely due to a sharp fall in the volume of financing in the US to \$2.2 billion from \$7.0 billion in 2007 as producers struggled with high corn prices in the first half of the year. This decline was somewhat counterbalanced by the booming Brazilian market, which saw investment more than double to \$6.3 billion from \$3.0 billion in 2007.

However, the international financial crisis is taking a heavy toll on Brazil's ethanol and sugarcane industry. The cheap and plentiful US dollar-denominated debt that fuelled tremendous growth is now crippling many producers as the value of the Brazilian real has tumbled against the dollar. New Energy Finance research shows that investment in ethanol producing assets fell by half in Q4 2008 and by an even greater degree in the first quarter of 2009.

It took until the first quarter of 2009 for the credit crunch and the recession to catch up fully with the financing of new-build projects in renewable energy. Despite the sector's medium-term and long-term growth prospects, it is suffering from a severe shortage of bank finance. Although \$180 billion of stimulus spending around the world has been earmarked for clean energy, it has not started to fill the current funding gap.

CHAPTER 7: CORPORATE MERGERS & ACQUISITIONS

7

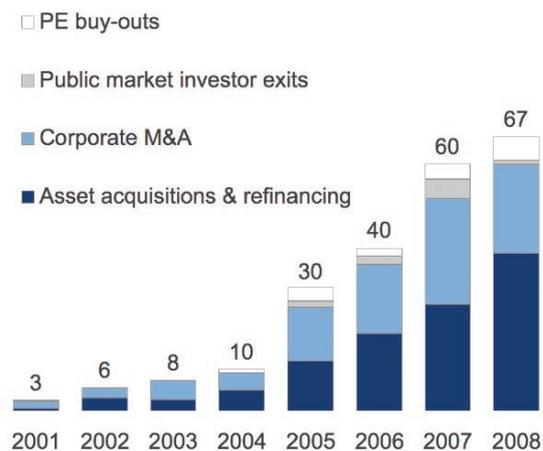
- In 2008, the volume of money changing hands in mergers and acquisitions of clean energy companies fell 16.2% to \$21.7 billion.
- The lack of available credit, plunging stock markets and a worldwide financial crisis made it difficult for deal makers to agree the terms of transactions or focus on new opportunities.
- Equipment manufacturers received the largest slice of M&A investment, taking \$9.4 billion, or 43.3% of the \$21.7 billion total.
- Deals targeting developers saw the biggest year-on-year increase. The \$7.3 billion recorded in 2008 was up 156% on 2007 as consolidation swept through Europe's wind market.
- M&A activity is likely to increase as well-capitalised players take advantage of lower clean energy company valuations and some distressed opportunities.

In 2008, there was a fall in the volume of money changing hands in mergers and acquisitions of clean energy companies. The \$21.7 billion paid by new corporate buyers for existing equity in renewable energy or energy efficiency companies was 16% less than the \$25.9 billion recorded the previous year (see Figure 38). These totals do not include private equity buy-outs, acquisitions of renewable energy projects or the sale of stock by existing investors.

A quarterly comparison of the volume of investment reveals an unsettled year. The first quarter was strong and maintained the momentum that had built up during 2007. This faltered somewhat during Q2, but was soon restored by an exceptionally strong third quarter. Then in the fourth quarter, the tide turned. The lack of available credit, plunging stock markets and a worldwide financial crisis made it difficult for deal-makers – even in a go-ahead sector such as clean energy – to agree the terms of transactions or to focus on new opportunities. The Q4 total of \$3.1 billion was the lowest in more than three years, and yet it towered above the first quarter of 2009, when just \$1.6 billion was exchanged, a level not stooped to since 2004.

M&A deal volumes have fallen across all industries, not just clean energy. According to data from Thomson Reuters, the value of global M&A fell by almost a third in 2008 to \$2.89 trillion, ending five years of deal growth. The decline intensified in the final three months of the year and the volume of mergers plunged 44%, compared with Q4 2007, making it the lowest three-month period since Q3 2004. As perhaps the most dramatic sign of how troubled the

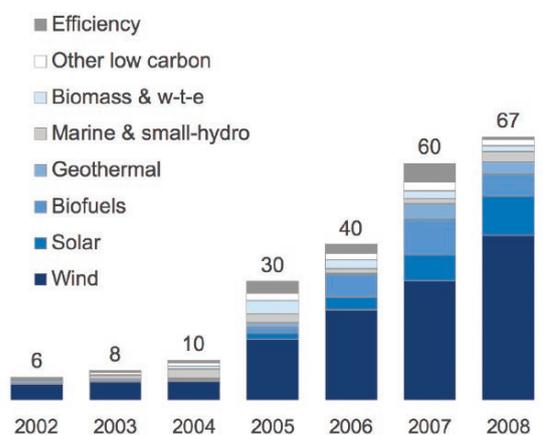
Figure 38: Acquisition transactions by type, 2002-2008, \$ billions



Note: Total values include estimates for undisclosed deals.

Source: New Energy Finance

Figure 39: Acquisition transactions by sector, 2002-2008, \$ billions



Note: Total values include estimates for undisclosed deals.

Source: New Energy Finance



M&A market had become, a record number of previously agreed deals – more than 1,100 – were cancelled in 2008, mostly in the latter part of the year.

The credit crisis not only curbed the capital needed to acquire other companies, it also indirectly helped to remove one of the main drivers behind consolidation in the industry - supply chain bottlenecks. Previously, equipment manufacturers were buying companies further downstream in order to secure an adequate supply of the necessary equipment and materials.

Over the course of the year, some types of clean energy company were more sought after than others. Equipment manufacturers received the largest slice of M&A investment, taking \$9.4 billion or 43.3% of the \$21.7 billion total, an improvement on 2007's total of \$8.1 billion. A number of large deals helped to bolster the 2008 figures, including Bosch's acquisition of German PV firm ErSol Solar Energy for €1.2 billion (\$1.8 billion), and wind turbine manufacturer Suzlon's purchase of rival firm REpower in a number of separate transactions over the course of the year, the largest of which amounted to €498 million (\$769 million).

Deals targeting developers saw the biggest year-on-year increase. The \$7.3 billion recorded in 2008 was up 156% on 2007 as consolidation swept through Europe's wind market. The year began with the acquisition of Irish developer Airtricity by UK utility SSE for €1.5 billion (\$2.1 billion). Later, construction giant FCC acquired the Spanish wind assets of Babcock & Brown Wind Partners for an enterprise value of €780 million (\$1.2 billion).

Other types of companies were less sought after. Power-generating firms worth \$1.3 billion changed hands, a fraction of the \$6.7 billion recorded during the previous year, while the value of technology developers acquired fell 67%, and clean energy 'services' companies slumped 53%. The value of biorefinery deals also fell.

As the economic and financial woes continue, it is foreseeable that there will be an increase in M&A activity as well-capitalised players take advantage of lower clean energy company valuations and some distressed opportunities. Clean energy share prices lost 56.7% of their value in the 12 months to 31st March 2009, according to the WilderHill New Energy Global Innovation Index NEX, and the number of stock market share issues has slumped, closing off a vital source of equity finance for growing companies.

The solar industry's woes have been well publicised. In early 2009, job cuts were announced by US cell maker

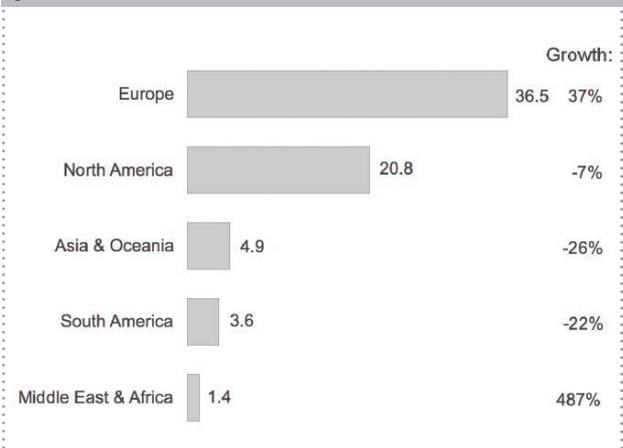
Advent Solar, Chinese cell and module giant Suntech and US stalwart SunPower. German cell manufacturer Q-Cells gave staff time off, solar thermal electricity generator Asura downsized its plans and changed its strategy, and a number of VC-backed solar companies are known to be facing challenging deadlines to raise follow-on finance.

In one distressed-asset sale in November 2008, Chinese PV cell and module maker Yingli Green acquired Chinese polysilicon start-up Cyber Power for \$77.6 million in cash and senior notes, a 4% discount to Cyber Power's net tangible book value. As module prices plummet and cash flows dry up, discount rates looks set to rise.

The dynamics defining the PV market have shifted dramatically. Supply of polysilicon – the basic building block of the PV industry – has grown substantially and we are now in a period of chronic oversupply, having been in a situation where supply was severely constrained. As a result, manufacturers are now more worried about their products and are looking to make acquisitions downstream in a bid to lock in demand for their products. In early 2009, for instance, Arizona-based thin-film module maker First Solar bought OptiSolar's project pipeline for \$400 million in First Solar stock, and Spain's Fotowatio agreed to buy nearly all of MMA Renewable Ventures' solar assets from beleaguered parent MuniMae for \$19.7 million.

Solar was the only clean energy sector to see an increase in M&A spending (see Figure 39). In all, \$6.4 billion was paid for solar companies in 2008, an increase of 60% on 2007's total of \$4 billion. In contrast, biofuels M&A tumbled to \$1.9 billion from \$2.6 billion in 2007.

Figure 40: Acquisition transactions by region 2008, and growth on 2007, \$ billions



Note: Total values include estimates for undisclosed deals.

Source: New Energy Finance

The badly ailing US ethanol sector also has its fair share of distressed assets. Bankrupt ethanol producer VeraSun Energy has accepted bids totalling \$993 million from Valero Energy, West LB, Dougherty Funding, and AgStar Financial Services to buy all 16 of its ethanol plants.

Most notably, oil company Valero Energy successfully bid for seven VeraSun plants and one future development site for a total of \$477 million, or the equivalent of \$0.61 per gallon of installed capacity. This is cheap compared with the roughly \$1/gallon it cost to build a greenfield plant at the start of the ethanol excitement in 2006 or the \$2/gallon it cost at the height of the boom, and it becomes painfully clear how much things have deteriorated.

More recently, another giant of the US ethanol industry, Aventine Renewable Energy, filed for Chapter 11 protection. Several smaller producers have gone bust since late-2008, including Panda Ethanol, Renew Energy, Cascade Grain, and Northeast Biofuels, but their plants and pipeline of projects make up a much smaller fraction of the industry. Pacific Ethanol has also said it is nearing bankruptcy, while specialty enzyme and cellulosic ethanol producer Verenum said an audit of its consolidated balance sheet had raised "substantial doubt" about its ability to continue as a going concern.

Brazil's ethanol producers have also been laid low by the falling value of the Brazilian real and some will be picked off at knock-down prices. New Energy Finance recorded 14 M&A and project acquisitions in Brazil's sugarcane sector in 2008 and all signs are that 2009 will produce a wave of consolidation. Alcotra Bioenergy, Cosan, Equipav, ETH and Louis Dreyfus have all stated that they are studying acquisition opportunities. Cosan has even created an M&A department to study opportunities. The only catch might be the lack of available cash.

Consolidation of the wind market continued throughout 2008 and is expected to accelerate in 2009 as smaller firms struggle to raise capital and are either bought or bankrupted. The top 20 owners of wind assets are expected to take back the slice of market share they lost in 2007 to new entrants and smaller independent power producers (IPPs) and developers. In addition, project developers in Eastern Europe and China continue to be acquired as part of the ongoing search for fresh market opportunities.

In the wind turbine market, smaller players are expected to struggle in the new, more competitive environment. There are also indications that the sector will see a wave of new entrants, including major corporations such as

Boeing, which has recently teamed up with Vestas on wind turbine technology development.

In terms of geography there was a dramatic shift away from the US and towards the EU (see Figure 40). In 2007, mergers and acquisitions in the US and EU were almost level, with \$10.7 billion and \$10.9 billion, respectively, but in 2008 this changed to \$3.7 billion in the US and \$14.2 billion in the EU.

Most of this imbalance is due to large-scale consolidation among Europe's developers and power generators. In the early months of 2008, there was a spate of deals in which big firms such as Airtricity were put up for sale.

Most activity has been concentrated in Spain and France, where smaller wind developers such as Desarrollo de Energías Renovables, Desarrollos Eolicos and La Compagnie du Vent were swallowed up by much larger firms.

There has not been the same level of consolidation in the UK, primarily because utilities rather than smaller developers were responsible for developing much of the wind industry in the first place. However, if some of the larger players do decide to hive off their renewables portfolios or subsidiaries in the coming months, they are bound to rouse considerable interest. Only recently, Swedish power generator Vattenfall bought two UK wind developers - Eclipse Energy and AMEC Wind Energy.





CHAPTER 8: INVESTMENT FUNDS

8

- Fewer clean energy funds were launched in 2008 – a total of 12 – compared to 2007, when 40 private clean energy funds were raised.
- Nevertheless, a number of large funds closed during 2008, and a number of new funds have been announced in recent months. Now that markets have lost 40% or more of their value, investors are beginning to venture back into the market.
- Private and project equity funds have become more prominent in 2008, responding to the effective closure of the world's public markets and very limited access to debt. As at March 2009, funds worth \$95.3 billion were earmarked for clean energy investment.
- Global stimulus packages which include products such as loan guarantees, should stimulate private investment.

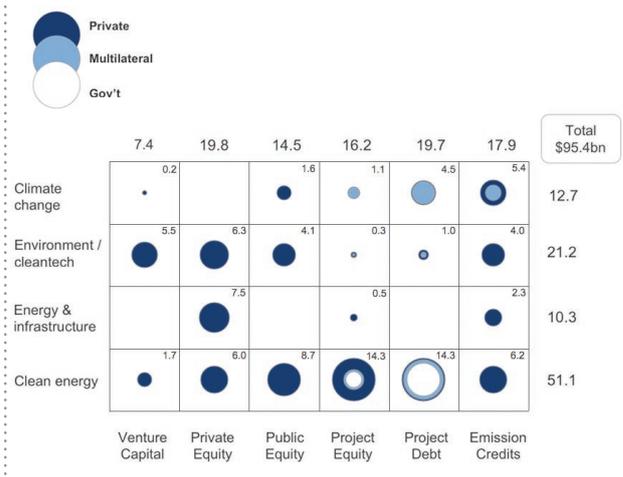
2008 was a testing year for clean energy investment funds. During the year, clean energy funds under management increased only slightly, and the number of new clean energy funds launched fell dramatically from record highs in 2007. In 2007, investors flocked to invest in climate-related stocks, boosting the NEX to record highs, and new funds were launched almost weekly. In 2008, however, the financial crisis made itself felt across all sectors, subduing investor appetite.

At March 2009, \$51.1 billion of private and public money was under management in core clean energy funds, those that invest more than 50% of their money in clean energy or energy efficiency companies and projects (see Figure 41). A further \$10.3 billion was held in energy and infrastructure funds, which comprise large funds with at least 10% earmarked for renewable energy infrastructure investment. Environmental funds (with a significant, but less than 50%, exposure to clean energy / energy efficiency) and climate change funds (for which clean energy is a smaller, but still important proportion of the total portfolio) had \$33.9 billion under management. In total, funds worth \$95.4 billion were earmarked for clean energy investment.

In 2007, public equity funds accounted for the highest proportion of clean energy funds under management, reflecting buoyant market conditions and a surge in investor interest in clean energy. In 2008, however, turbulent market conditions hit public equity funds from two sides: the value of assets held within public equity portfolios fell dramatically, and far fewer new funds were launched.

In 2008, project equity and debt rose to take the lion's share of clean energy funds, accounting for \$14.3 billion

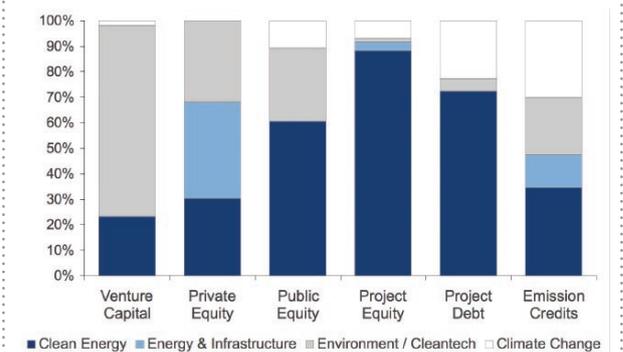
Figure 41: Sustainable energy funds by focus and asset class, as at March 2009, \$ billions



Note: Excludes SRI funds

Source: New Energy Finance

Figure 42: Sustainable energy funds by asset class, March 2009, % share



Note: Excludes SRI funds

Source: New Energy Finance

each, or together 30% of funds under management (see Figure 42). As bank and other private debt became far harder to raise during the year, leading project developers have increasingly looked to private financiers for equity, while governments and multilateral organisations stepped in on the debt side. Also, as public markets have effectively closed in the course of 2008, equity providers – both project and private – have become an alternative source of funding.

A high proportion of funds are earmarked for carbon emission credits, accounting for just under a quarter of total funds under management. A total of \$17.9 billion has been invested in carbon investment vehicles, most of it from private sources.

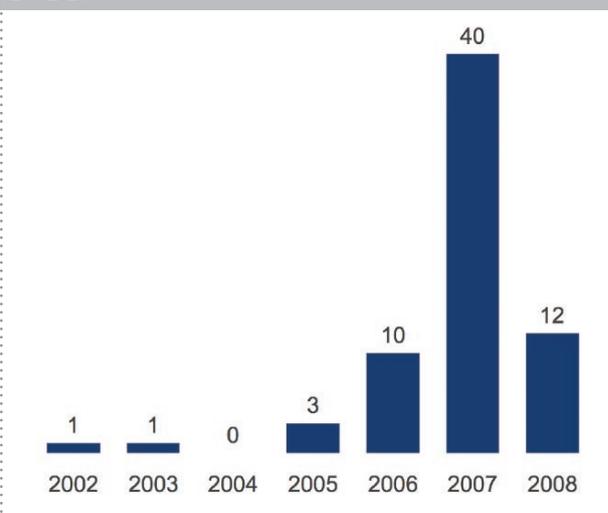
There are distinct trends within the various types of investment funds. Building renewable energy generation capacity remains a niche area, so funding for clean energy projects generally comes from clean energy specialists. Project equity and, to a lesser extent, debt therefore dominate clean energy funds, but are hardly represented in funds with a broader investment remit.

By contrast, venture capital and private equity funding are well-represented in less clearly focused investment funds, representing \$27.2 billion of funds under management, 29% of the total invested across the whole range of funds. These early-stage opportunities attract investors whose experience is in bringing new technology to commercialisation and helping small businesses reach scale, but who do not necessarily operate purely in the clean energy arena.

The number of clean energy launches slowed dramatically in 2008, from 40 in 2007 to just 12 in 2008. New public equity funds were being launched almost weekly in 2007; in 2008 (see Figure 43), this fell to an average of just one per month. Of the 12 funds launched, four were exchange-traded funds (ETFs), all of them in the US, two solar and two wind, while the remaining eight were actively managed. The US remains the strongest market for ETFs, which are a relatively new product. Europe tends to be more traditional in its investment habits, favouring smaller, actively-managed funds.

The reason for the decline in new fund launches is clear – the global financial crisis has hit the public markets hard, and banks have significantly tightened up their lending criteria. Debt and public equity are in short supply and demand for capital has intensified, focusing on specialist equity providers. Many investors are still taking a wait-and-see attitude, given the still considerable uncertainty about when the current financial crisis is likely to end.

Figure 43: Sustainable energy public equity funds launched, 2002-2008



Source: New Energy Finance

Dismal market performance during 2008 has discouraged all but the hardest investors and fund managers. All existing funds saw their net asset values decline during 2008, with even the best-performing seeing falls in value of 40-45%.

In spite of this, several large funds closed during 2008. The three largest were Generation Investment Management, which raised \$683 million for its Climate Solutions Fund; Blue Source, which raised \$525 million for its Och-Ziff Blue Source Carbon Infrastructure Fund; and Kleiner Perkins Caufield & Byers, which raised \$500 million for its KPCB Green Growth Fund.

Carbon funds have also continued to attract new money in spite of the economic slowdown. Since the start of 2008, nine new carbon funds have been created raising a total of \$560 million. The largest single capital raising was Sindicatum's Istithmar & Sindicatum Climate Change Partnership which closed \$280 million during the summer, out of a target of \$600 million. The three other major closings were the ArcelorMittal Carbon Fund at \$157 million, the Nordic Carbon Fund with \$62 million and the NEFCO Carbon Fund with \$58 million.

In early 2009, the rate of new fund launches had not picked up, with just one fund launched in the first quarter. But there are signs that investors are starting to see opportunities as valuations continue to fall, with several private equity funds announced in late 2008, and expecting to close during 2009. Last November, for example, London-based investment manager New Leaf Capital announced that it hoped to raise \$400-500 million by the end of 2009 for a private equity fund-of-funds specialising in wind, solar, energy efficiency and water.



Also in November, Aviva Investors, the asset management arm of the world's fifth largest insurer, announced a European renewable energy project fund that aims to put "at least €500 million" (\$625 million) into generating assets. The fund will focus mainly on solar PV, which will make up around 45% of the portfolio, and "higher return sectors" such as biogas, biomass and geothermal. Man Group, the huge international investment manager, has also launched two new renewable energy private equity funds, totalling up to \$1.3 billion.

A number of successful fundraisings so far in 2009 suggest that there is capital available for the right opportunities, including Danish pension fund ATP's investment of up to \$400 million in late stage private equity investor Hudson Clean Energy Partners; and CalPERS, the leading Californian clean energy technology investor, commitment of \$200 million to a new \$1 billion technology fund – 75% focused on clean technologies - being raised by Sun Microsystems founder Vinod Khosla.

In the longer term, the outlook for investment funds – private and public - is positive. Many governments see clean energy as fundamental to economic recovery and job creation. They are announcing stimulus packages to direct money into clean energy and putting in place supportive legislation for clean energy and energy efficiency, all of which will underpin private investment in the sector. A recent New Energy Finance survey showed that institutional investors are becoming increasingly focused on clean energy and clean technology.



CHAPTER 9: CARBON FINANCE

9

- Transaction value in the global carbon market grew 87% during 2008, reaching a total of \$120 billion.
- If the US introduces a federal cap and trade scheme the global carbon market could increase significantly to \$2.1 trillion (1.5 trillion) per year by 2020.
- The number of registered CDM projects increased to 1,325 during 2008, an increase of 48%, and projects issuing CERs increased to 441 last year, a rise of 57% on 2007.
- As of 1 March 2009, the cumulative volume of CERs issued was 263MtCO₂e from 473 projects (compared to total annual global GHG emissions of 40GtCO₂e).

Despite the turmoil in the world's financial markets, 2008 was another year of record growth in the carbon markets. Transaction value in the global carbon market grew 87% during 2008, reaching a total of \$120 billion. In spite of the gloomy economic conditions, the international community still appears to be committed to tackling climate change.

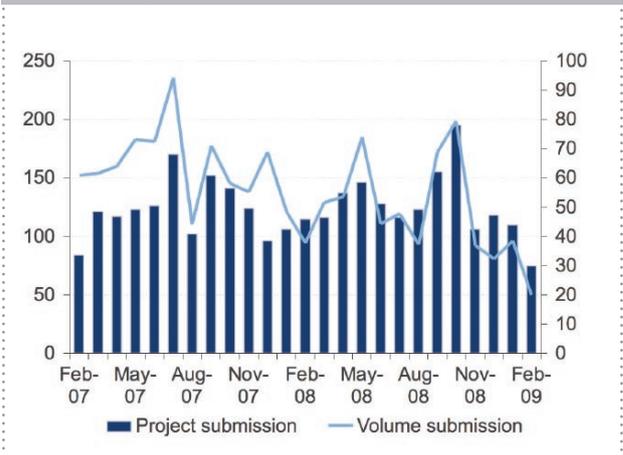
In 2008, the EU Emissions Trading System (ETS) represented 79% of the global carbon market in terms of value. The next largest asset class was the secondary CDM market representing 13% of the traded value. Total allowances and credits in the US, covering the Chicago Climate Exchange (CCX) and Regional Greenhouse Gas Initiative, represented 3% of value of the global carbon market. New Carbon Finance calculates that trading in the carbon market accounted for around 1% of the world's commodity derivatives markets (OTC).

Further progress on finding a successor to Kyoto is likely in Copenhagen in December 2009, and although this may not result in an all-encompassing international agreement, it may well provide the framework to support unilateral emission reduction commitments and trading schemes. In time, these schemes could easily merge into a new global carbon market.

Long-term commitments to tackling emissions growth will not only stem from the UNFCCC Conference of the Parties in Copenhagen. Unilaterally, the EU and Australia are putting in place legislation to implement emission reduction targets extending to 2020, supported by cap and trade legislation. President Obama's commitment to investing in energy efficiency and renewable energy is also likely to drive the US to implement some form of climate change legislation.

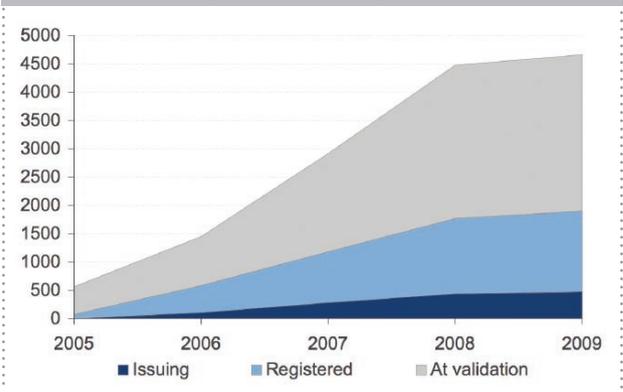
That said, despite the upbeat political rhetoric, such decisions need political capital at a time when politicians

Figure 44: Project submission to the CER pipeline, monthly, number of projects (LHS) and volume 2012 MtCO₂e (RHS)



Source: New Carbon Finance

Figure 45: State of the CER pipeline, 2005-2009 - March 2009, number of projects at each stage



Source: New Carbon Finance

are most preoccupied with protecting jobs. The level of ambition associated with Australian and potential US emissions targets has been watered down for the time being with a view to reducing compliance costs.

Overall, substantial carbon prices are expected for the foreseeable future, with multiple prices created by the presence of individual regional schemes. The highest prices are likely to continue to be seen in Europe, with lower prices in Australia and on the global carbon market. The US market is also likely to have relatively low prices, of the order of €10-20/tCO₂ under a federal programme. Trading on the international market has increased steadily over recent years, with prices slightly below those in the EU ETS.

Creation of trade in carbon credits has given rise to a number of carbon currencies. The two most important are Certified Emission Reductions (CERs) from CDM projects and Emission Reduction Units (ERUs) from JI projects. In many instances these credits are sold forward from projects that have yet to start operations and therefore have material risks of non-delivery (many things can go wrong during the project planning, construction, and operations). These are known as "primary CERs" and "primary ERUs". Credits that have either been generated and approved by the UN or backed by a high grade financial institution are known as "secondary" CERs (sCERs) and "secondary" ERUs (sERUs).

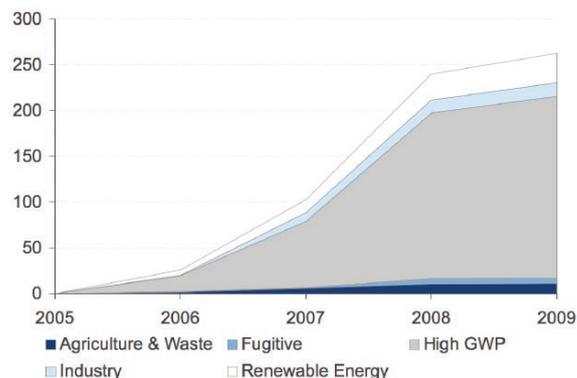
Whilst pCERs have been traded since 2005, sCERs only started trading in 2007. After a slow start in 2007, sCER volumes increased by 136% in 2008 with a total traded value of \$14 billion (€10 billion). At the same time, the sCER share of all carbon transactions rose from 8% in 2007 to 13% in 2008.

In spite of this growth, the carbon market was not spared by the financial crisis in the markets beginning in 2008. Volumes of CERs were down 5% in Q4 compared to Q3 as some traders closed down positions and the commodity markets in general went into freefall (see Figure 44).

In terms of prices, CERs reached a high of €22.9/tonne on 7 July 2008, driven by firm prices in the European carbon market. CER prices then declined steadily over Q4 in response to weakening fundamentals, trading on average at €17.9/tonne in October 2008, €14.8/tonne in November, €13.5/tonne in December and €11.4/tonne in January 2009.

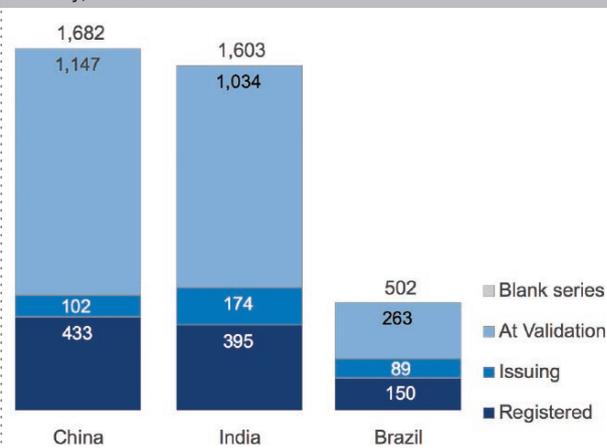
The number of registered CDM projects increased to

Figure 46: CER credit issuances, volume by technology, 2005 - March 2009, MTCO₂e/yr



Source: New Carbon Finance

Figure 47: CER Project pipeline, number at each stage by country, March 2009



Source: New Carbon Finance

1,325 during 2008, an increase of 48% (see Figure 45 & 47). The number of CDM projects issuing CERs increased to 441 last year, a rise of 57% on 2007. As of 1 March 2009, the cumulative volume of CERs issued was 263MtCO₂e (see Figure 46) from 473 projects (compared to total annual global GHG emissions of 40GtCO₂e). To date, CDM and JI credits have been sourced from 76 developing countries involving more than 80 different types of technologies ranging from wind power to landfill gas to industrial process improvement.

By far the largest source of credits, however, has been China, which by virtue of its size and substantial growth rate has been able to demonstrate more opportunities for reducing the rate of growth in its GHG emissions. Most of the credits are not from projects that reduce fossil fuel use, but reduce emissions of very potent GHGs from chemical processes (HFC and N₂O). There are a limited number of these projects around the world and over time, energy efficiency and renewable energy projects should make up a larger proportion of the issued credits. Hydro

and wind projects account for 41% of the pipeline in terms of project number but have contributed just 8% of the total volume of issued CERs (see Figure 46).

Up to 2012, the emission reduction targets for developed countries are largely already set, so there are relatively few changes on the policy front that are likely to materially change the international carbon market between now and 2012. Most of the changes to the market are driven by fundamentals that affect the cost of meeting these targets..

New Carbon Finance expects trading in the global carbon market in 2009 to be the same as 2008 at around \$121 billion, supported by higher trading activity but lower prices. Growth is then expected to be steady to 2012 by when it should reach \$408 billion (€295 billion), as the recession causes prices to remain low in the major schemes.

If the US introduces a federal cap and trade scheme in line with the latest proposals, New Carbon Finance expects the global carbon market to increase significantly in the post 2012 period turning over of the order of \$2.1 trillion (€1.5 trillion) per year by 2020.

In terms of investment activity, fund flow into the carbon market has all but ground to a halt in 2008 following the rapid influx of money during 2006 and 2007. Only one new carbon fund targeting \$95m was created in Q3 2008. No new money was raised for carbon project investment in Q1 2009.

As well as the general lack of liquidity across all investment classes caused by the recession, this fall off in investment activity in the carbon sector reflects the uncertainty of the role carbon instruments, and in particular the CDM, will play in the post 2012 environment.





CHAPTER 10: INVESTMENT IN DEVELOPING COUNTRIES

10

- Financial investment in developing countries increased to \$36.6 billion in 2008, an increase of 27% on 2007, whilst developed countries fell by 1.7% to \$82.3 billion.
- Developing countries share of total global financial investment increased to 31% in 2008, from 26% in 2007.
- China led investment in Asia, with \$15.6 billion of new investment, mostly in new wind projects, and some biomass plants, an 18% increase. During 2008, China became the world's largest PV manufacturing base, with 95% of its production for the export market.
- Investment in India grew 12% to \$3.7 billion in 2008, of which asset finance represented \$3.2 billion, up 25%.
- Brazil accounted for almost all renewable energy investment in Latin America in 2008, receiving \$10.8 billion, 76% higher than 2007. By the end of 2008, ethanol in Brazil accounted for more than 52% of fuel consumption by light vehicles. The Brazilian Development Bank (BNDES) was the year's largest provider globally of project finance to the renewable energy sector.
- Investment in Africa in 2008 remained comparatively low at \$1.1 billion, up 10% from the previous year. However, 2008 saw the African continent's first privately financed geothermal plant in Kenya, activity in other countries on biofuels and wind, and a major policy shift for the first time in South Africa.

10.1 INVESTMENT IN ASIA

China

Figure 48: Installed Renewable Energy Capacity and Targets in China

	2007 Capacity	2008 Capacity	2020 NDRC Target
Large Hydro	100GW	121GW	225GW
Small Hydro	45GW	51GW	75GW
Wind	6GW	12.2GW	30GW
Solar PV	100MW	140MW	1.85GW
Solar Water Heating	130m m2	135m m2	300m m2
Biomass Power	3GW	3.6GW	30GW
Bioethanol	1.6bn litres	1.9bn litres	12.7bn litres
Biodiesel	119m litres	0.1bn litres	2.4bn litres

Source: New Energy Finance, NDRC

By 2008, China was the world's second largest wind market by newly installed capacity and the fourth largest by overall installed capacity. Between 5GW and 6.5GW of new capacity was installed and commissioned in 2008, bringing total capacity to 11GW to 12.5GW (see Figure 48, sources: China Electricity Council, NDRC, New Energy Finance). China's wind capacity demonstrates the country's

continued strong demand for wind energy, even as markets in Europe and the United States began to slow.

In addition, 2008 was another strong year for China's wind turbine manufacturers. Domestic OEMs captured 74% of the new installation market (sources: companies and a report by Pengfei Shi, vice chairman of the Chinese Wind Energy Association). Sinovel overtook Goldwind as China's leading OEM by new installed capacity, and cornered a significant portion of the domestic market. Amongst non-Chinese manufacturers, Vestas and Gamesa, were able to hold their own by securing sizable contracts with the big five Chinese power companies. GE, Suzlon and Nordex were still in play but were overtaken by new domestic players such as Sewind and Mingyang.

Some 800MW of biomass power was added in 2008, bringing the total installed capacity for agriculture waste-fired power plants up to 2.88GW (including 1.7GW of bagasse-fired facilities). The biomass market was largely driven by the national target of 4GW by 2010, rather than huge profit potential. With the exception of a few plants owned by overseas developers, such as Babcock & Brown,

most biomass power plants were supported by domestic investment. One large state-owned player, National Bio Energy (of whom State Grid has 50% ownership), has commissioned 12 facilities with a capacity of 324MW and another 84MW is under construction. Other major players include China Enersave, CLP Power, and Jiangsu Guoxin.

Development of biofuels (ethanol, biodiesel, biomass pellets) in China has all but ground to a halt, mostly due to high feedstock costs and lack of or ambiguous government support. While domestic demand for biomass pellets increased as exports overseas fell, the government has not released any direct support for pellet producers or technology in line with its long term target of 50m tonnes of pellets produced by 2020. On the ethanol side, jatropha and waste oil were left as the only options available since the government prohibited new grain-based production and rapeseed-based biodiesel facilities in late 2007. However, the country was also not on pace to hit its 2010 non-grain-based ethanol production target of 2.5 billion litres per annum, as facilities abandoned their plans due to high 2nd-generation feedstock (cassava and sorghum) costs and a lack of government subsidies.

In 2008, New Energy Finance estimated China to have installed 40MW of new solar PV plants, bringing total installed capacity up to 140MW. Despite China passing the Renewable Energy Law in 2006, and a fast growing wind market thanks to the renewable energy subsidy scheme, solar PV has until recently not been high on the agenda of Chinese policy makers due to the high costs involved. There was also limited incentive to subsidise domestic deployment when Spanish and German markets were buying up all Chinese module output at high prices. Of the \$292 million in renewable power generation subsidies provided from Q4 2007 to Q2 2008, solar received only \$0.4 million.

However, a PV power demonstration project was China's largest asset finance deal in 2008, with some \$785 million secured by Huaneng Lancang River Hydropower for the development of the 100MW Shilin PV demonstration plant. Support for domestic solar installations is increasing following the government's recent announcement of a subsidy of up to CNY 20 (\$2.93)/MW for PV systems over 50kW on buildings, and the bidding results of the first ground-mounted solar concession project.

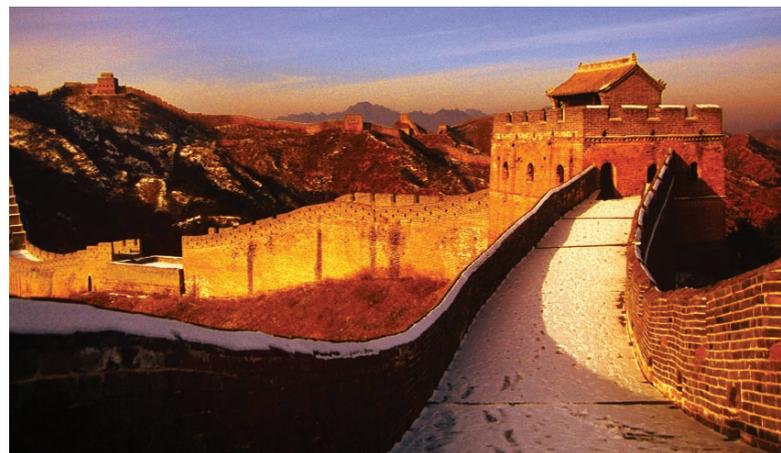
During 2008, China became the world's largest PV manufacturing base, with 95% of its production for the export market. However, overseas market demand has been shrinking due to the financial crisis, meaning many Chinese PV manufacturers had to delay or cancel expansion plans.

2008 saw a slow-down in investment growth in China's clean energy sector, although total investment volume still remained at a significant level compared with previous years. A total of \$15.6 billion in VC/PE, public markets and asset finance investments was made, up 18% from 2007.

VC/PE investment climbed 5% to \$581 million. Over 60% of the investment was made by venture capitalists, while in 2007 it was mostly in the form of private equity. Sound investment opportunities in the private equity area became scarce as the financial crisis and economic uncertainty resulted in low investor confidence in financing private companies. The largest transaction was Hinmin Solar's \$100 million pre-IPO fund raising, a solar water heating system provider. More importantly, about 36% of the total VC/PE investment was early stage companies, with LED, power storage devices and thin-film solar technology and silicon production attracting investment.

Chinese clean energy companies raised a total of \$2.8 billion from public markets in 2008, representing a small decrease of 3.4% from 2007. It was evident that the financial crisis and weak market sentiment forced some existing public companies to cancel or delay expansion plans, and not raise new funding. Some \$196 million of the \$2.8 billion was raised on domestic stock markets, compared to \$698 million in 2007. It was anticipated that the IPO market would shift to the domestic markets in 2008. However, this did not materialise, with just one IPO - solar thin-film developer Topray Solar's \$60 million IPO on the Shenzhen Stock Exchange in February 2008. The main action still continued to take place on overseas stock markets, primarily in the US, where \$2.6 billion was raised, almost entirely through secondary offerings and convertible notes issuance by existing listed companies.

Asset finance grew 24% to reach \$14.9 billion, pushing China into third place globally after the US and Spain. Over 70% was for wind. The largest wind deal was the \$457 million (CNY 3.2 billion) balance sheet financing of a





300MW wind farm located in Fuxin, Liaoning Province, by China Huaneng Group.

Mergers and acquisitions activities made marked progress in 2008 in terms of deal value. \$1.5 billion worth of transactions took place, more than double the 2007 figure, due to accelerated industry consolidation helped by profit margin compression in 2008 and lower valuations caused by the financial crisis. These transactions primarily occurred in the solar and wind sectors. For instance, cell maker Suntech Power acquired 17.8% of wafer maker Jiangsu Shunda, worth \$100 million. Larger electric companies also actively joined the game – Baoding Tianwei Baobian Electric participated in two deals, acquiring Tianwei Sichuan Silicon, a silicon producer and Tibet Huaguan Tech, a PV module and system maker. In the wind sector turbine gearbox, generators and other components manufacturers were the main targets for turbine manufacturers.

Wind will need to grow by 2.5GW in each of the next three years to meet the goal of 17.5GW by 2012. Small hydro grew by 300MW in 2008 and has an additional 1.1GW to be commissioned to meet the 3.4GW target. There were no grid-connected solar projects commissioned in 2008, but a pipeline of 222MW of solar projects was announced in 2008. Biomass grew only 400MW in 2008 and needs to double to reach the 3.5GW target for 2012.

In 2008, India generated 813TWh of electricity, 5.2% of which came from new renewables, compared to 66% from coal, 14% from large hydro, and 3% from nuclear. However, the country faces an electricity shortfall of 16% at peak demand and the grid infrastructure is woefully overloaded. The power sector is faced with increasing demand from both growing industry and the rapidly developing middle class, as well as trying to connect several hundred million Indians who do not have access to electricity.

India

Figure 49: Installed Renewable Energy Capacity and Targets in India

	2007 Capacity	2008 Capacity	Official 2012 Target
Large Hydro	34.2GW	36.7GW	n/a
Small Hydro	2.0GW	2.3GW	3.4GW
Wind	7.8GW	9.8GW	17.5GW
Solar PV	2.1MW	2.1MW	52.1MW
Solar Water Heating	2.2m m2	2.6m m2	13.8m m2
Biomass Power	1.4GW	1.8GW	3.5GW (including WTE)

Source: New Energy Finance, MNRE

India added nearly 3GW of grid-connected renewable energy in 2008, 2GW of which came from the wind sector (see Figure 49). The government is under intense pressure to increase electricity production and has put strong incentives in place to spur investment into renewable energy from both domestic and foreign investors. The Indian government has set targets for each clean energy sector in its 11th Five Year Plan, to be met by 2012.

India's rural electrification scheme was launched in 2005 and has seen some initial success with the installation of nearly four million small biogas plants, over 70,000 solar street lights and 435,000 solar home lighting systems installed to date. Solar lanterns made the biggest leap forward in 2008 with 112,000 sold or distributed to rural areas during the year to bring the total to nearly 700,000. (Source Ministry of New and Renewable Energy).

Wind power continues to dominate renewable energy, both in installed capacity and manufacturing. However, installations are fragmented with 40% of 9.8GW installed capacity from projects that are less than 5MW. Many of these small projects are owned by corporates who are seeking tax benefits and an additional power source for their operations. The government announced an optional Generation Based Incentive (GBI) for wind power in 2008 to take the place of tax benefits, which aims to give a boost to larger projects developed by independent power producers.

The Semiconductor Policy announced in 2007 led to \$347 million of investment in the solar sector in 2008, nearly all of it directed towards manufacturing facilities. Additionally, the central government has instituted a national feed-in tariff for solar power projects of \$240/MWh for PV and \$200/MWh for solar thermal. The policy is intended as a pilot and covers only 50MW total nationally, but several states have introduced supplemental feed-in tariffs for solar as well.

A provisional biofuels policy was announced in September 2008, which targeted 20% blending of biodiesel and



ethanol by 2017, but was taken back to the drawing board two months later. The policy focused on jatropha and other domestically grown non-edible feedstocks for biodiesel and stipulated that they be grown on wasteland, to reduce impact on food crops. The policy also prohibited the import of plant oils for biodiesel production. With the policy environment uncertain, investment into biofuels plummeted from \$251 million in 2007 to only \$49 million in 2008.

Finally, the introduction of renewable portfolio standards in many states began to see traction in the industry. Thirteen Indian states have an RPS policy of between 2% and 10%, dictating the percentage of power purchased by distribution companies from renewable sources. The state of Maharashtra fined distribution companies who did not meet the 5% RPS in 2008, the first penalty of its kind in India. Maharashtra will be the site of a pilot renewable energy certificate trading scheme in the second half of 2009.

New investment activity in India grew 12% to \$3.7 billion in 2008. By far the largest share was asset finance at \$3.2 billion in 2008, up 25%. Venture capital and private equity remains a tiny piece of total clean energy investment in India, but saw a significant increase of 270% to \$493 million in 2008. Moser Baer raised \$93 million to fund expansion of its crystalline silicon and thin-film solar manufacturing capacity.

In 2007, Indian companies began to explore foreign exchanges as a source of funds, raising \$756 million on the Singapore Stock Exchange and London's AIM, compared to \$646 million on domestic exchanges. With the financial turmoil in 2008, both those funding avenues dried up with no money raised internationally in 2008 and only \$74 million raised on Indian exchanges. Shriram EPC, an Indian wind turbine manufacturer and engineering firm, raised approximately INR 1500 million (USD 38 million) in an IPO.

From a sector perspective, the largest portion of new investment went to the wind sector, growing 17% to \$2.6 billion. Thanks to a supportive policy environment, solar investment increased to \$347 million in 2008, most of which went to setting up module and cell manufacturing facilities. Small hydro investment grew nearly fourfold to \$543 million in 2008, while biofuels investment stalled and fell by 80% to only \$49 million in 2008.

Mergers and acquisitions activities totaled \$585 million in 2008, approximately the same level as the previous year. Most acquisition activity was biomass, small hydro and wind projects.

The Rest of Developing Asia

There are changes afoot elsewhere in **Asia**. In late 2008, the Philippine government signed a new Renewable Energy Law, offering specific incentives (mainly tax breaks) for renewable generation. It is the first country in Southeast Asia with such comprehensive renewable energy legislation, and there are hopes that it may become a blueprint for other countries in the region. Thailand and Malaysia have been talking about introducing renewable energy legislation for some time; and other countries are planning biofuel blending mandates, similar to those introduced by the Philippines in 2007 and subsequently by Thailand.

The **Philippines** already has high renewable energy capacity, deriving 33% of its energy from modern biomass, geothermal and hydro. The government aims to increase renewable energy capacity from 33% to 60% by 2013, equivalent to 4GW, with 1.2GW from geothermal sources. The Philippine Department of Energy has other targets: to be the largest geothermal producer in the world; the leading wind energy producer in Southeast Asia; and to install up to 250MW of capacity from biomass, solar and marine.

Geothermal and wind are likely to benefit most from the new legislation. The Philippines is already the world's second largest producer of geothermal, after the US. Its geothermal capacity is 1.9GW currently, providing 20% of the country's electricity. High untapped geothermal resource, estimated at 7GW, and typically large project size should enable the Philippines to scale up rapidly.

The Philippines also has huge untapped wind resources, with estimates ranging from 10GW to 76GW. In spite of this, there is only one operating plant, NorthWind Power's 33MW project, the largest in Southeast Asia. There is now strong interest in Philippines wind generation and a good pipeline of projects that have been waiting for the new incentives to be put in place. A Renewable Portfolio Standard (RPS) is due to be introduced later in the year and the government expects this to help installed wind capacity reach about 1.2GW by 2013.

Geothermal in **Indonesia** is also poised to grow. A tender for 15 geothermal plants totalling 1.5GW has been issued and is expected to attract \$4.5 billion of investment. Indonesia has enormous geothermal potential - estimated to be 27GW - but so far only 1GW has been exploited.

There has also been investment activity in other developing countries in the region, such as Thailand, Vietnam, Bangladesh, Sri Lanka and Pakistan. Most



investments in **Thailand** in 2008 were concentrated on bioethanol and biodiesel. However, its biofuels sector was affected by the fall in oil prices, soaring feedstock price and supply storage. There is a growing interest in biomass power, wind and other renewable energy sectors. The Thai government is setting aside a THB15.6 billion (\$440 million) budget in its masterplan for renewable energy development through to 2022. Wind, mini-hydro and biofuels are the three sectors that have seen most investment activity in **Vietnam** in 2008, with foreign companies looking to tap the market potential and low manufacturing costs there. The Vietnam government also aims for at least 10% of all its energy to come from renewable energy sources by 2015.

Within **Bangladesh** there are a number of programmes aiming to provide affordable energy to the rural areas. The Bangladeshi government has set targets for renewable energy use of 5% by 2015 and 10% by 2020. **Sri Lanka** has a "Renewable Energy for Rural Economic Development" initiative and other rural electrification programmes focusing on mini hydro and solar PV power. Wind is one of the few renewable energy sectors that have seen some developments in **Pakistan**. Despite slow progress in 2008, Pakistan's first commercial scale wind power project, 6MW in Jhimpir, came online in April 2009. The small project has kicked off the country's nascent wind energy market which is estimated to have a gross potential of 346GW of power. Pakistan's Alternative Energy Development Board claims that nearly 1.2GW of wind power projects are currently in various stages of implementation.



10.2 INVESTMENT IN LATIN AMERICA

Brazil

Figure 50: Installed Renewable Energy Capacity and Targets in Brazil

	2007 Capacity	2008 Capacity	2012 Capacity
Large Hydro	72.9GW	73.6GW	80.8GW
Small Hydro	3.5GW	3.8GW	11.5GW
Wind	247MW	359MW	1.5GW
Solar PV	8.6MW	8.6MW	8.6MW
Solar Water Heating	560MW	600MW	786MW
Biomass Power	4.1GW	4.8GW	8GW
Biogas	41.6MW	41.6MW	41.7MW
Bioethanol	22bn litres	25bn litres	25% of all gasoline consumption
Biodiesel	2.6bn litres	3.4bn litres	5% of diesel consumption

Note: Small hydro 2007/8 capacity includes all less than 50MW

Source: New Energy Finance, Brazilian Government (mainly Ministry for Mines & Energy)

Brazil is the world's largest renewable energy market, thanks to hydropower and its long-established ethanol sector which has thrived alongside the country's sugarcane industry. 46% of the country's energy comes from renewable sources, and 85% of its power generation capacity. Large hydro provides four-fifths of the country's electricity (see Figure 50).

90% of Brazil's new cars run on both ethanol and petrol (all of which is blended with around 25% ethanol) and by the end of 2008, ethanol accounted for more than 52% of fuel consumption by light vehicles. After two decades of slow growth, Brazil's ethanol consumption increased by 25% from 15.6 billion litres in 2007 to 19.5 billion litres in 2008, on the back of a surge in new flex fuel car sales and cheap ethanol. Ethanol consumption is expected to rise to 53 billion litres by 2017, driven by its price competitiveness rather than the government's 25% blending mandate.

Brazil was the world's largest producer of ethanol until 2006, when it was overtaken by the booming US ethanol market. Most of Brazil's ethanol (just over 80%) is consumed domestically. Brazil's ethanol exports rose by 46% from 3.5 billion litres in 2007 to a record 5.1 billion litres in 2008, mainly to the US and Europe (Source Ministry for Mines & Energy). However, Brazil's ethanol exports are held back by tariffs and subsidies that developed countries have put in place to protect their own industries, including a 54c/gallon tariff for exports to the US. The surge in 2008 exports was mainly due to floods in the US, which resulted in much US ethanol capacity being temporarily shut down.

Brazil recently introduced mandatory blending of biodiesel – starting at 2% in early 2008 - but as production capacity expanded rapidly, the 3% mandatory blend was brought forward to 1 July 2008. This is due to rise to 5% in 2013, but this level too is expected to be brought forward as current production capacity is already enough to fulfill the 5% blend. Biodiesel production (90% from soybeans) is currently a fraction of Brazil's ethanol production, but is poised to take off. Biodiesel consumption in 2008 surpassed the expected 1 billion litres, reaching 1.3 billion litres.

Biofuels have thrived in Brazil thanks to its large areas of arable land, abundant water resources, solid government support, expanding working age population and a cost advantage over competing fuels. However, lack of transport infrastructure, a policy emphasis on social (rather than commercial) goals and increasing awareness of sustainability concerns in export markets such as the EU may hamper the industry's growth. The global financial crisis has also triggered problems for Brazilian ethanol and, out of the 35 announced projects due to come online in 2008, nine have been postponed. The rate of postponements is likely to increase in 2009.

Wind remains a secondary source of energy in Brazil, in spite of the government's PROINFA programme, established in 2002 to encourage wind, biomass and mini-hydro projects by guaranteeing developers power purchase agreements at favourable rates. However, the government has announced a wind-specific auction with 20-year PPAs to take place in mid-2009 for the sale of approximately 1 GW of wind energy per year. This is expected to boost wind power development in Brazil.

Brazil's wind potential is estimated to be 143GW (by the Brazilian Wind Energy Centre (CBEE)), and to date 1.4GW has been contracted by PROINFA. However, by the end of 2008 only 359 MW of capacity had actually been installed. A strong pipeline of wind projects has been built-up since the government relaxed restrictions on foreign turbine components, particularly in the country's north-east which is estimated to have half the country's wind resource. But it is taking time for plans to translate into installed capacity, especially since shipping turbines from Europe pushes installation costs up by as much as 20%.

Five new wind projects were commissioned in 2008, adding 91MW of new capacity in Brazil. 20 new projects were announced in 2008 (1,170MW) and six projects secured financing of \$940 million, including New Energy Options' Alegria Wind Farm (\$380 million, 152MW) and Impa's \$314 million wind portfolio in Ceará.

There is also growing interest in cogeneration using sugar cane bagasse as a feedstock on the back of Brazil's sugar / ethanol industry. Many mills are investing in cogeneration so they can export electricity to the grid. These developments are being driven by talk of an imminent Brazilian electricity blackout, and because electricity from bagasse is cheap. In 2008, to support biomass development in Brazil, the government organised a successful biomass-specific auction. The auction, which included long-term PPAs and connection to the grid, made several projects feasible. New Energy Finance expects that by 2020 the burning of bagasse in Brazilian sugar and ethanol mills could generate 15GW of power and account for up to 15% of the country's electricity needs, up from current levels of 2%. In 2008, sugarcane byproducts (ethanol and bagasse) became the second most important source of energy in Brazil (16%), less than oil and its byproducts (37%) but overtaking hydro (15%).

As PROINFA targets are reached, new legislation to support the development of renewable energy is being drafted, as set out in President Lula's National Climate Change Plan published on 1 December 2008. Plans include several auctions for the commercialisation of biomass, wind and small hydro power through 20-year PPAs, as well as the development of transmission lines along the same principles as those introduced for biomass power in 2008: the power distributor makes the investment, while the power generator only pays a monthly fee for using these services, which will make several otherwise unfeasible projects profitable.

Brazil accounted for almost all renewable energy investment in Latin America in 2008. Total financial investment in Brazil was \$10.8 billion, an increase of 76% on 2007. Ethanol continues to dominate investment in Brazil, representing 70% of new renewables investment in the country.

VC/PE investment of \$565 million consisted almost entirely of private equity for ethanol production expansion. Notable deals in 2008 included \$144 million raised by Comanche Clean Energy, \$80 million by Brenco in a second funding round, and \$85 million by SantelisaVale.

Public market activity was subdued. Cosan SA raised \$303 million in a secondary issue, and a further \$413 million in a capital restructuring, both on Bovespa (SP Stock Exchange). Renova, Infinity Bio-Energy and SantelisaVale cancelled their IPOs, as public market conditions deteriorated worldwide.

Asset financing in Brazil increased by 83%, reaching \$9.8 billion in 2008. This flowed mainly into biofuels



projects (biodiesel as well as ethanol), followed by mini-hydro and wind projects. The Brazilian Development Bank (BNDES) was the mandated lead arranger for over 70% of these projects, making it the largest provider of project finance to the renewable energy sector globally. Notable deals include \$800 million raised by Brenco and \$1.2 billion by ETH.

Asset acquisitions were the same in 2008, at \$2.2 billion, whilst corporate M&A activity was \$600 million, only 32% of the previous year. Most acquisitions were in ethanol, involving players such as Infinity Bio-Energy, BP and Cosan, as well as in wind and biomass.

The Rest of Latin America

Brazil accounted for more than 90% of new investment in Latin America, although there were increasing investment opportunities in renewable energy outside Brazil. Several Latin American countries, rich in natural resources, are seeking to implement regulatory frameworks supportive of renewable energy.

Chile's recently approved Renewable Energy Legislation is responsible for regulating the country's renewable energy sector, where small hydro, wind and geothermal projects have become increasingly attractive for investors. It requires electricity generators of more than 200MW to source 10% of their energy mix from renewable sources. The obligation will be phased in gradually, starting at 5% from 2010-14, and then increasing by 0.5% every year until 2024.

In 2008, **Peru** introduced legislation that requires 5% of electricity produced in the country to be derived from renewable sources over the next five years, including financial incentives such as preferential feed-in-tariffs and 20-year PPAs for project developers.

Mexico has a non-mandatory target to source 8% of its energy consumption from renewable sources by 2012. However, on 28 October 2008, Mexico's president signed into effect a decree stipulating that the country will have in place a national renewable energy plan by 30 June 2009, which could double the country's renewable energy target to 16%. The legislation also includes a MXN 3 billion (\$230 million) fund that will start to invest in projects next year.

Elsewhere in Central America and the Caribbean, countries such as Costa Rica, El Salvador, Jamaica and Guatemala have the potential to expand their biofuels industry, with productivity levels as high as Brazilian ethanol, although this has yet to be exploited. Brazil,

Colombia, Argentina and Peru are the main countries in the region supporting development of biofuels through mandatory biofuels blends and legislation, which in turn has resulted in investment opportunities.

10.3 INVESTMENT IN AFRICA

Investment in sustainable energy in Africa remains comparatively low, but there have been advances in both government policies and some new investment activity in renewable energy across the continent. In 2008, financial investment in Africa was \$1.1 billion, up 10% from the previous year.

Sub-Saharan Africa

In **Sub-Saharan Africa** (SSA), excluding South Africa, lack of finance is the principal barrier to sustainable energy roll-out. While official aid flows have risen in recent years, additional external financing mechanisms are needed to reduce poverty and improve lives, and this takes precedence over sustainable energy development.

There have been some developments, particularly in **Kenya** which is Africa's leading source of geothermal power, with about 130MW of installed capacity. In 2008, Kenya Electricity Generating Company (KenGen) raised \$91m to expand one of their geothermal plants, and geothermal developer Ormat Technologies commissioned the first privately financed geothermal plant on the continent, the 35MW Olkaria III project. Kenya, whose current power sector capacity is approximately 1GW, has set a target of 1.2GW from geothermal by 2015.

Hydroelectricity already accounts for two thirds of existing power capacity in Kenya, at 677MW, according to official data. The country hopes to make more use of hydroelectricity to ease their recent energy crisis. In October 2008, Nairobi-based PowerTech Solutions announced their plans to build three more mini-hydro power plants in the Nyeri region using equipment and engineers from China. Kenya is also looking into wind energy. A 300MW wind farm, planned by a consortium of investors, is expected to be built in 2010 on a site near Lake Turkana in northwest Kenya.

In addition to geothermal, hydroelectricity and wind energy, the government announced in November 2008 that Kenya could host some \$500 million of biofuels investment over the next few years. The investment will go towards the production of biofuels derived from crops

including jatropha and sweet sorghum - five multinational companies have reportedly filed applications for land-lease agreements with the government.

In **Ethiopia**, French wind turbine manufacturer Vergnet signed a €210 million (\$284 million) supply contract in October 2008 with the Ethiopian Electric Power Corporation, the sole power producer of the country. The contract covered the supply and installation of one hundred and twenty 1MW turbines.

Ethiopia started mixing and distributing a 5% blend of ethanol with gasoline in October 2008 to cover a shortage of fuel supplies. The ethanol-gasoline blend is being sold in the capital Addis Ababa and the surrounding area, according to local press.

2008 saw the installation of **Uganda's** first hydro plants, with the Emerging Africa Infrastructure Fund providing \$49 million to two small hydro power projects at Mpanga. The power generated from the first of these, an 18MW run-of-the-river project, is set to be sold to the grid under a long-term PPA.

In **Angola**, Brazilian industrial conglomerate Odebrecht set up an Angolan sugar cane processing plant and plans to steer its production from ethanol to sugar when it comes online late next year. The company will plant its first crop in May-August and harvest it in September-December 2010.

In September 2008, UK-based Cams Group said it planned to bring online a 240 million litre per year sweet sorghum ethanol facility in **Tanzania**. A week later, Swedish ethanol producer and distributor SEKAB announced it was developing its own 100 million litre per year sugar cane plant some 50km east of the Cams project.

The two announcements indicate a growing interest amongst investors for land in Africa's tropical south-eastern regions. Tanzania has the right investment climate, soil and transport infrastructure to develop a stable biofuels industry – in fact, the country ultimately has the potential to surpass its neighbour Mozambique. It has seen several announcements of planned biofuels plants by both local and international companies, and in early 2009 approved a National Biofuels Policy and Strategy for the country's nascent, but fast-growing, renewable fuels sector.

South Africa

For the time being, **South Africa** has become the focal point for renewable energy on the continent. The country had been slow to embrace sustainable energy, in spite of good renewable resources, developed financial markets and a reasonably stable political environment, but there have been recent positive developments.

On 31 March 2009, South Africa announced feed-in tariffs that guarantee a stable rate-of-return to Independent Power Producers (IPP) feeding renewable power into the national grid. The feed-in tariffs currently cover four renewable energy technologies, namely wind, concentrated solar, landfill gas and small hydropower.

There are early signs of success. Ahead of the official announcement, South Africa's Department of Minerals and Energy said it had received more than 100 renewable energy proposals that could add up to 5,000 MW (roughly equivalent to 6 coal power plants) to the country's energy mix. Of the projects, the greatest interest related to wind energy (45% of proposals), biomass (34%), and hydroelectric power (8%).

The successful application of these strategies is evident in the Bethlehem hydropower project, Darling wind farm and Nelson Mandela Bay Renewable Energy Project. These projects were structured by a combination of incentive mechanisms: Clean Development Mechanism (CDM), Tradable Renewable Energy Certificate (TREC), grant financing and a premium power purchase price.

In November 2008, UK-based carbon developer Trading Emissions signed an agreement to purchase approximately one million carbon credits from the eThekweni Municipality landfill gas project. Known as the Durban Landfill-Gas-to-Electricity Clean Development Mechanism Project, it will extract gas comprising 40%-60% methane from the Bissar Road landfill site.

Approval of the government's draft biofuels strategy back in December 2007 – which set a target of 2% of the country's fuel from biofuels by 2013 (excluding maize as a feedstock because of food security concerns – although subsequent comments from the South African Department of Agriculture suggest that this restriction may be relaxed). Biofuels is expected to play a prominent role in South African renewable energy, with Ethanol Africa's 473,000 litres/day Bothaville Bioethanol plant, the first of six planned plants, completed at the end of 2007.

Rising interest in sustainable energy in South Africa is having a positive effect on neighbouring Sub-Saharan



African countries, particularly in biofuels. While South Africa has just 8.7 million hectares of land suitable for feedstock cultivation, Angola, Zambia and Mozambique have respectively 22.1 million, 24.1 million and 31.1 million hectares of land classified as very suitable or suitable.

North Africa

Renewable energy development in **North Africa** remains focused on Morocco, Tunisia and Egypt, particularly in solar and wind.

The **Egyptian** minister of electricity and energy has said that the first unit in the country's \$220 million Kuraimat combined gas and solar power station is about to be installed. The state information service's website says Kuraimat (Kuraymat) "depends on using the natural gas at night as a fuel to continue operating the station all the day". It also says that the country expects to have 850MW of operating wind projects by 2010, up from 60MW in 2005-06. Egypt has also recently announced its expectation that wind farms in the Saidi area will produce 20% of the country's energy needs by 2020.

In **Morocco**, Isofoton, a Spanish manufacturer of PV wafers, cells and modules, won a deal in late 2008 to supply 724kW (1,215 installations) of solar modules to the Moroccan national electricity company (ONE). ONE will then lease the systems to homeowners at a subsidised price. This purchase is a part of the Chorouk ONE initiative, which aims at development of up to 500MW of solar power in Morocco with the financial backing of the Spanish Development Assistance Fund (FAD).

According to Spanish media reports, Spain's Ministry of Industry is expected to loan Morocco €100 million (\$130 million) in early 2009 to finance a solar thermal electricity generation (STEG) plant currently being built by Spanish firm Abengoa. The company is also currently building a similar hybrid plant in Algeria. The Moroccan project, Ain-Beni-Mathar, is a 470MW integrated combined cycle gas plant with a 20MW solar thermal component, expected to cost €400 million (\$544 million). It is being backed by ONE, the Global Environment Facility (GEF) and the Spanish Development Agency (ICO), with top-up funding from the African Development Bank.

In **Tunisia**, a subsidiary of Spanish renewable technology firm Gamesa signed a 120MW turbine supply deal in September 2008 with energy company Societe Tunisienne de L'Electricite et du Gaz (STEG). The contract, worth around €200 million (\$284 million), is for the installation of the Metline and Kchabta wind farms, both of which are located in the Bizerte region of Tunisia. In a statement Gamesa said this contract takes the total agreements for installation of turbines in Tunisia to date to 170MW. The project, which can also count on financing from the Spanish Development Aid Fund (Fondo Espanol de Ayuda al Desarrollo), will engage local businesses in Tunisia. Part of the ancillary equipment will be built in Tunisia and the wind farms' civil and electrical works will be subcontracted in the country. Solar thermal activity also continued to grow in Tunisia, with 83,000m² of domestic solar water heaters installed under the Prosol programme with backing from UNEP, STEG, the Ministry of Energy, the Tunisian Energy Agency (ANME) and the Government of Italy.

CHAPTER 11. SPECIAL FOCUS SECTION – GREEN STIMULUS PACKAGES

11

This section examines the new political climate that has arisen out of the global financial crisis, and in particular the green stimuli packages that governments have been announcing. In addition, the current impact of the financial crisis on the sector is detailed, based on recent research undertaken by UNEP SEFI and New Energy Finance.^{xi}

GREEN STIMULI PACKAGES

There are three main reasons why low-carbon measures have been included in national as well as multilateral recovery plans. First, global leaders realise that the clean energy sector is likely to help their economies revive, as it has the potential to create hundreds of thousands of “green collar” jobs. Second, last year’s turmoil in the oil market, combined with gas supply problems in Eastern Europe, put energy security high on the political agenda. Third, with climate change as a broadly accepted phenomena and December’s UNFCCC conference in Copenhagen marking the deadline for reaching a global “Green New Deal”, clean energy packages help to underline that their countries are already making the right efforts.

In absolute terms, at \$67.7 billion the US green stimulus is still the largest, but China’s almost matches it, with \$67.2 billion earmarked for sustainable energy (see Figure 51 & 52). However, the low-carbon credentials of the overall economic packages differs vastly. The South Korean one can be named “the greenest” with 20% of it earmarked for environmental measures, while the packages of some European countries and Japan are pale green at best, with less than 3% dedicated to low-carbon spending.

At a sector level, energy efficiency comes out as the global winner, attracting \$62 billion. Grid development also receives a substantial boost of \$48.7 billion. Renewable energy projects came third, at \$34 billion, more than two thirds of this from the US. European countries have devoted very little to clean energy projects. The most likely reason for that is the existence of well established incentive mechanisms in these countries.

Determining an accurate spending timetable for clean energy is difficult, but New Energy Finance’s estimate is that only \$40 billion of the \$183 billion of green stimuli packages from the 12 major economies will be spent in 2009, with another \$75 billion in 2010, \$43 billion in 2011 and smaller amounts in the years after.

Figure 51: Break down of Global Stimulus allocation to Sustainable Energy, by Support Mechanism, March 2009, \$ millions

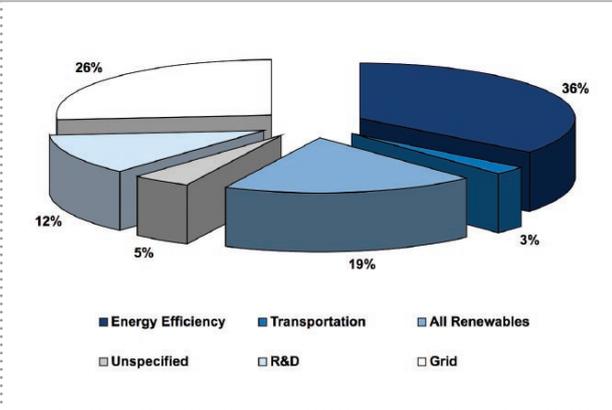
Country or Multilateral	Grant	Grant/Loan	Loan	Loan Guarantee	ROC	Tax Credit	Tax Credit Bond	Tax Deduction	Other	Grand Total
Australia	2,887							186	303	3,376
Brazil				1,100				818		1,918
Canada	808									808
China	68,724									68,724
EU-27	3,342	7,940								11,282
France	2,157		331							2,488
Germany	1,740								1,985	3,725
India										
Italy										
Japan	1,070	2,900				4,000				7,970
South Korea	7,737									7,737
Spain	953		0						6,617	7,570
UK	441	551			771				962	2,724
US	27,568			17,000		19,739	1,381	0	872	66,560
Grand Total	117,427	11,391	331	18,100	771	23,739	1,381	1,004	10,739	184,883

Source: New Energy Finance

DEFINITIONS & METHODOLOGY

The numbers presented in this analysis often differ from those officially trumpeted by governments. This is so due to a more narrow definition of “low-carbon measures”. Railroad development is not included as a clean provision, although it makes up for a vast portion of the green stimuli in the European countries as well as in South Korea. Measures such as waterways or recycling were also not considered in the final analysis.

Figure 52. Green Stimulus allocations to Sustainable Energy by Sector, April 2009, % share (Total = \$184 billion)



Source: New Energy Finance

Europe

The total fiscal stimulus by European Union (EU-27) countries since the economic crisis began now amounts to some €400 billion. Most of this money, however, will be implemented at the national level, through individual plans of the member states. The only green measures announced at the European Community level amount to €5 billion, as it sets out to meet its 20% renewable energy and energy efficiency targets by 2020.

The initial proposal by the European Commission has been approved without major changes, despite some governments' protests earlier this year. Grid development, offshore wind and carbon capture and storage all received major boosts. €565 million has been earmarked for grid connections and turbines, components and manufacturing for five offshore wind projects located in strategic areas. Carbon capture and storage has received a boost of €1.05 billion, with five countries (Germany, the Netherlands, Poland, Spain and UK) receiving €180 million each, for development of CCS demonstration projects. A further €910 million will support European grid development and the rest of the money will go for gas interconnections and extension of broadband infrastructure.

Compared to the plans of individual member states, the European package seems clear and comprehensive. The financing of projects in the field of energy is scheduled to be equally spread over two years, 2009 and 2010. Although these measures account for only 2.1% of the whole €400 billion recovery plan, if only joint Community efforts are considered, more than 50% of the stimulus is clearly green.

France's €26.5 billion recovery package is finally taking shape with details of the €11.1 billion public investment programme coming to light and the Prime Minister's reassurance that 75% of the package would be spent

this year. The 1,000 projects, announced in February, have been determined but the only measure of note is €100 million in grants to improve the energy efficiency performance of 80,000 houses. However, the package also entails measures supporting specific sectors particularly hit by the recession, with housing and the car industry on the top of the list. A special fund for housing and energy costs has been created, which will enable homeowners on modest incomes to carry out work to save energy.

Furthermore, France was among the countries that announced major help for the struggling automotive industry. Its €7 billion "Automobile Pact", however, only provides a modest €250 million in loans for "decarbonisation" of the sector. The break-down of a €4 billion programme of investments to be carried out by the large state-run companies "with a view of modernising and developing rail and energy infrastructures and the postal service" is still unknown. Until more precise figures are revealed, New Energy Finance analysis assumes that a third of this money would be dedicated to each of these priorities. Energy would then be left with EUR 1.33 billion and most of this sum would, it is to be hoped, boost clean generation.

Germany's two packages, amounting to €80 billion, initially only include two clean energy measures: €450 million for energy efficiency, and a separate €115 million programme for development of energy efficiency and clean technologies. However, the government has recently revealed a breakdown of more than €16 billion of spending on infrastructure. €4 billion of this sum is aimed at what could be broadly classified as environmental projects, but only the €750 million for building rehabilitation with special focus on energy efficiency, is directly related to low-carbon investments. €2 billion will be directed towards new roads, railways and waterways, while the remaining €1.25 billion has not been allocated yet. Unsurprisingly, Germany is among the countries providing huge incentives for scrapping old cars and purchasing new ones. The previously announced €3.5 billion has now been increased to €5 billion and will be spent before the end of 2009.

Italy's scrapping of old cars incentives provide €2 billion for those who buy less polluting cars.

Rome also recently revised its economic outlook, predicting Italy will face its worst recession in three decades. The government forecast a 2% contraction in gross domestic product this year. In September, the government had previously foreseen 0.5% growth in 2009. There are two reasons why Italy seems to be overlooking green investments in its recovery programmes. First, clean

energy benefits from one of the highest feed-in tariff systems in Europe. Secondly, the recent catastrophe in the city of L'Aguila placed reconstruction and support for the victims as over-riding priorities for the government.

The green content of Spain's €11 billion stimulus package is yet to be defined. Focused mainly on support for families and social policy, the only measures of note have concerned energy efficiency and clean car development, but even here the total amounts have remained unspecified. Nevertheless, the numbers confirmed for low-carbon sectors account for some 5.6% of the whole stimulus. Compared with the UK's 1% or Italy's 2.5% proportions, the Spanish package appears to be quite verdant. Measures to enhance employment, after a dramatic jump in the jobless total in Spain in recent months, will emerge from the newly created €8 billion Extraordinary Public Local Investment Fund with modernisation of buildings surely high on the agenda, given the crisis in the country's building industry.

A further €3 billion will support specific sectors, with €800 million to boost the Spanish vehicle sector. However, as the crisis deepened, the government announced a specific €4 billion automotive plan in February 2009. Although the emphasis has been put on increasing competitiveness and preserving jobs, research for cleaner cars is likely to be boosted as well.

Out of the €3 billion targeted sectors programme, there are €600 million of investments in unspecified "environmental actions", €500 million in research and development likely to concern clean technologies, and a further €120 million for housing refurbishment.

Apart from the €11 billion fiscal stimulus, Spain has revealed its cluster plan for economic and employment stimulation (Plan E). It embraces a set of 82 measures, many of them already announced last year or even earlier. They included measures for the transport sector, modernisation of energy and climate change. Energy efficiency promotion programmes and car scrapping incentives were included, but the plan earmarked no new money for either.

The Prime Minister has repeatedly stated that further stimuli are possible. He has said that Spain would use its EU presidency in the first half of 2010 to coordinate spending in the development of renewable energy and biotechnology.

The UK's £535 million green stimulus, announced in the Pre-Budget Report last December proved "pale green" at best. Excluding railway development, water infrastructure and flood defences, the real "green" measures amount to a modest £210 million, fully dedicated to energy efficiency

for buildings. If this remains unchanged, the clean energy proportion of the £20 billion stimulus will account for mere 0.7%.

Asia

China's \$586 billion stimulus plan is quite 'green', at least in the broad sketches released by the government. It includes the largest dedicated funding for energy efficiency at \$30.7 billion. Some of this funding, however, includes very vaguely defined 'ecological' projects which are unlikely to include any power generation aspects. The government plans to spend \$219 billion on infrastructure, including upgrades to the grid, estimated at \$36.5 billion. The government has not provided further details on the stimulus package and it has in fact been criticised for its lack of transparency on the matter. Some of the funding will come through increased bank lending to large energy and infrastructure projects, and some of this money has begun to trickle down into the economy. China has also instituted generous subsidies for building-integrated PV systems, up to \$2.93/W, that could provide a 50-100MW market in 2009 and may also lead to provincial initiatives. These funds are not expressly stimulus-related, though they do support a sector that is flagging in the face of global PV module oversupply.

India's \$13.7 billion two-part stimulus programme includes no dedicated funding for renewable energy or energy efficiency measures. Both parts allow the Indian Infrastructure Finance Company to raise \$8 billion through tax-free bonds in order to fund infrastructure projects, which it did handily, at 6.85%. However the target for this funding is entirely at the discretion of the IIFC, which could spend it on roads, airports, waterways, special economic zones, urban infrastructure, or what it terms 'tourism.' Given this opacity, it is impossible to determine what portion will flow to the power sector in general, let alone to clean energy specifically.

Japan's long-awaited fourth stimulus package was finally announced in April 2009. The JPY 15.4 trillion (\$154 billion) includes \$22 billion to be spent on the "low-carbon revolution". Not all of this money has been allocated yet, but the breakdown presented by the government is clear and comprehensive, compared to those of many of its counterparts. Prime Minister Taro Aso said that solar energy, electric cars and energy efficiency are the three items "that hold the key to future economic growth". These three sectors have received considerable sums. Solar energy will be supported by grants for residences and offices willing to install solar panels

(\$470 million). A further \$600 million will be allocated to schools. A large sum of \$3.7 billion was earmarked for subsidies to purchase eco-friendly cars and \$2.9 billion will be injected into "eco-friendly consumer electronics". Given the mammoth sum of all the four stimulus packages announced by Japan so far, the measures earmarked for clean energy so far amount to only a modest 1.3% of the total stimulus.

South Korea's official announcement its "Green New Deal" came in January 2009 and is designed to stimulate job creation through green growth. It has been acclaimed as the greenest stimulus package from any major world economy, given that some 80% of the overall \$38 billion is dedicated to environmental measures. However, under scrutiny only \$7.7 billion will be devoted to "clean energy", and again, energy efficiency is the key beneficiary. In other words, a vast chunk of the overall \$30 billion is earmarked to railway, river and forest restoration, as well as to recycling and building green communal space. An interesting part of the Korean stimulus is the involvement of the private sector, a feature employed also by the Japanese government. The Korean Prime Minister, Seungsoo Han, said: "Mutual understanding and cooperation between the government and the private sector will be needed." The government has earmarked at least \$1.3 billion that will be contributed by the private sector and this figure is set to grow substantially as more than five conglomerates have already committed to join, with SK Group leading the pack by announcing an investment of nearly \$700 million in clean energy back in February.

Americas

Brazil's clean energy stimulus package is similar to Canada's, as it bootstraps a crucial national industry; in this case, sugarcane ethanol. The largest funding item is a \$1.1 billion credit facility for ethanol producers so that they can store their product rather than dump it into an oversupplied market. Brazil also offers substantial tax deductions for solar water heater installation and new vehicle purchase incentives.

Canada's clean energy stimulus package is almost entirely targeted on carbon capture and storage. The country's generation portfolio is already highly decarbonised, virtue of its massive hydro and nuclear portfolios. However, its exceptionally carbon-intensive oil sands operations are a serious carbon risk, a risk compounded by Alberta's atypically coal-heavy generation portfolio. The national government effectively views carbon capture and storage

as the only way to salvage the Alberta economy in the long run, and is devoting funding accordingly.

At \$66 billion of 'clean' stimulus funding, the United States' American Reinvestment and Recovery Act is one of the most generous of clean energy support schemes. It is also by far the most clearly defined, with 21 distinct categories of disbursement, with clear start dates and estimated durations of disbursement. The largest single item benefits the wind sector, with the Production Tax Credit extension valued at \$13 billion. The solar sector receives \$5 billion, and both sectors benefit from a conversion of tax equity financing structures into direct cash grants. Some \$6 billion in loan guarantees, when properly leveraged, could spur a further \$60 billion in new manufacturing and power generation projects.

The biggest winner in the US stimulus is energy efficiency. A full \$11 billion flows to grid upgrade loan guarantees, with more than \$10 billion in federal and local efficiency grants and upgrades. Energy Efficiency research collects a further \$2.5 billion, with \$2 billion for EE tax credits. US clean energy stimulus funding is generous and well-targeted for the industry's needs; the concern now is for the speed and efficiency with which the federal government can disburse the relevant funds

Large sums have been announced and the robust political will behind the issue is clear. The implementation of the measures will require administrative savvy as well as quick and decisive reaction by investors. There is likely to be a minimum six-month delay before this money really starts to flow to companies and projects. The next three years should see at least \$152 billion of money spent, which is likely to increase, raising the chances of meeting the ambitious emission reduction targets of the states concerned.

Governments are not the only public institutions capable of injecting additional funds into the sector. Various development banks around the world, both national and international, have signalled increased lending in programmes generally much greener than those announced by the governments. Japan Bank of International Cooperation (JBIC) has already dedicated \$5 billion for environmental projects in Asian developing countries. European and Inter-American development banks have also dedicated large sums for the sector and the French national development bank has made €8 billion available in loans for infrastructure projects, including the modernisation of the country's energy infrastructure. These programmes carry a lower administrative burden than national stimuli and hence their effects are likely to be seen sooner.

GLOSSARY

AMER	North & South Americas geographic region
ASOC	Asia & Oceania geographic region
EMEA	Europe, Middle East & Africa geographic region
CAGR	Compound Annual Growth Rate
CDM	Clean Development Mechanism. The CDM relates to project-based emission-reduction activities in developing countries. If these projects meet certain criteria, they are approved by the CDM EB and are given CERs for every tCO ₂ e saved.
CER	Certified Emission Reduction. These are permits generated through the CDM.
EUA	European Union Allowance – tradable unit used within the EU ETS.
EU ETS	European Union Greenhouse Gas Emissions Trading System
G-20	G-20 major economies, an economic forum consisting of 19 of the world's largest economies, plus the European Union.
GHG	Greenhouse gas
IEA	International Energy Agency (see http://www.iea.org/)
IPO	Initial Public Offering of a company's shares for purchase via an exchange. Initial offerings are sometimes followed by secondary offerings, where additional shares are made available for purchase through the exchange.
ITC, PTC	Investment Tax Credit & Production Tax Credit, a tax credit provided by the government to renewable energy producers.
JI	Joint implementation (JI) is one of the flexibility mechanisms set forth in the Kyoto Protocol to help countries with binding greenhouse gas emissions targets (so-called Annex I countries) meet their obligations.
kW, MW, GW	Unit of measurement for power generation or demand capacity (1GW = 1,000MW = 1,000,000kW)
kWh, MWh, GWh	Unit of measurement for power generation production or consumption (1GWh = 1000MWh = 1,000,000kWh)
LULUCF	Land use, land-use change and forestry.
tCO ₂ e	Metric tonne of carbon-dioxide or equivalent emissions. This is a measurement of GHG that takes into account the differences in global warming potential (GWP). It is referenced to the most important GHG: carbon dioxide.
OEM	Original Equipment Manufacturer
OTC	Over-the-counter (OTC) trading is used to trade financial instruments such as stocks, bonds, commodities or derivatives directly between two parties. It is contrasted with exchange trading, which occurs via facilities constructed for the purpose of trading (i.e., exchanges), such as futures exchanges or stock exchanges.
PV	Photovoltaics (PV) is the field of technology and research related to the application of solar cells for energy by converting sun energy (sunlight, including sun ultra violet radiation) directly into electricity.
R&D	Research & Development activities undertaken and financed by governments, corporations and other organisations.
REN21	Renewable Energy Policy Network for the 21st Century (http://www.ren21.net/).
UNEP	United Nations Environment Programme (see http://www.unep.org/).
UNFCCC	United Nations Framework Convention on Climate Change. The UNFCCC was established in 1992 at the Rio Earth Summit. It is the overall framework for the guidance of international climate negotiations. Its main aim is: "Stabilisation of greenhouse-gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." The UNFCCC Conference of the Parties (COP) will meet again in Copenhagen in December 2009.
VC / PE	Venture capital (also known as VC or Venture) is a type of private equity capital typically provided to early-stage, high-potential, growth companies in the interest of generating a return through an eventual realization event such as an IPO or trade sale of the company. Private equity is (PE) an asset class consisting of equity securities in operating companies that are not publicly traded on a stock exchange.

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ABOUT SEFI

UNEP is working to create the policy and economic framework whereby sustainable energy can increasingly meet the global energy challenge. Changing attitudes and helping mainstream financiers to consider sustainable energy investments are key components of the energy work within UNEP and the starting point for the UNEP Sustainable Energy Finance Initiative.

SEFI provides current and targeted information to financiers and facilitates new economic tools that combine social and environmental factors – both risks and returns – as integral measures of economic performance.

SEFI is modelled as a platform to provide financiers with the tools, support and networks to drive financial innovation that improves the environmental performance of the energy mix. The overall strategy is to use this platform and modest amounts of capital to convene financiers, engage them to do jointly what they may have been reluctant to do individually, and to catalyze public-private alliances that together share the costs and lower the barriers to sustainable energy investment.

SEFI is managed jointly by the UNEP Energy Branch in Paris, the UNEP Finance Initiative in Geneva and BASE, a UNEP Collaborating Centre located in Basel.

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ABOUT NEW ENERGY FINANCE

New Energy Finance is the world's leading independent provider of subscription-based research to decision-makers in renewable energy, energy efficiency, biofuels, carbon capture and storage, nuclear power and the carbon markets. The company has a staff of more than 130, based in London, Washington DC, New York, Palo Alto, Beijing, Shanghai, New Delhi, Hyderabad, Cape Town, São Paulo, Sydney and Perth.

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New Carbon Finance is the leading provider of high quality fundamental analysis of the European, North American, Kyoto and Australian carbon markets. Its team of analysts has been providing professional advice on carbon markets since 1998, including assistance in the design of various national and international schemes and company-level strategic advice. During this time New Carbon Finance has built up highly detailed abatement curves and market models that analyse carbon market demand and supply and provide regular forecasts of future carbon prices. New Carbon Finance operates as a division of New Energy Finance.

www.newenergyfinance.com



Global investment in sustainable energy reached \$155 billion in 2008, a modest increase of 5% over 2007. Following several years of over 50% growth, this marks a dramatic slowdown as a result of the global economic downturn.

There were some “green shoots” during the second quarter of 2009, but the sector has a long way to go this year to reach previous levels of investment.

The drivers that have propelled investment in the sustainable energy sector for the past five years, however, are still at work – climate change, energy insecurity, fossil fuel depletion and new technologies. As well, political support remains strong, with an estimated \$180 billion of fiscal stimulus committed to sustainable energy.

While the \$155 billion of investment in 2008 and \$180 billion of government support in 2009 are impressive, investment needs to reach half a trillion dollars per annum by 2020 to help ensure a peak in greenhouse gas emissions.

The report provides an overview of different types of capital flows and an analysis of the trends in sustainable energy investment activity in developed and developing countries.

This information is intended to be a strategic tool for understanding the status of sustainable energy development and for weighing future public and private commitments to the sector.

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