Frankfurt School
UNEP Collaborating Centre
for Climate & Sustainable Energy Finance

GLOBAL TRENDS IN RENEWABLE ENERGY INVESTMENT 2013

Bloomberg
NEW ENERGY FINANCE

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Cover Photo: UNEP Headquarters Nairobi 515 kW solar array, the 2nd largest rooftop system in Africa.
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FOREWORD FROM BAN KI-MOON

The climate clock is ticking: concentrations of greenhouse gases in the atmosphere have reached 400 parts per million, the highest in three million years.

Our collective responsibility is to ensure that political momentum keeps pace with what science is telling us about the urgency of the climate challenge. Climate change is an overarching threat to all countries and to people everywhere, in particular the poor and the vulnerable. The dangerous consequences risk reversing and undermining our efforts to achieve sustainable development today and for generations to come.

If we are to keep temperature rise under 2 degrees Centigrade this century – the minimum level needed to avert the worst climate impacts – the world needs a universal, legally-binding global climate agreement by 2015. With that goal in mind, I will convene a meeting at UN Headquarters in New York in 2014 aimed at engaging leaders at the highest level – from governments as well as business, finance and civil society – to accelerate political momentum further and faster.

Energy will be a determining factor in whether the world can avoid dangerous climate change and make a transition to a sustainable, more inclusive global economy. Its centrality led me to launch, two years ago, the Sustainable Energy for All initiative. This public-private partnership has three objectives to be achieved by 2030: first, to provide access to modern sources of energy for all people; second, to double the rate of improvements in energy efficiency; and third, to double the share of renewables in the global energy mix.

Embracing these ambitious but achievable goals can open a world of opportunity for billions of people and lead to massive investment opportunities which can, in turn, stimulate the global economy and generate decent jobs.

Global Trends in Renewable Energy Investment 2013 spotlights how resources for green economy transformation are increasing even in economically challenging times. Clean energy investment has quadrupled over the past decade, and last year's total of $244 billion was the second-highest ever. This should be a source of inspiration for governments, cities, companies and citizens everywhere to raise their ambition towards climate action. A global climate agreement by 2015 would provide dramatic spur in the direction we need to travel.

We need to close the viability gap between green and fossil fuel-based projects, and create a more conducive environment for renewable energy investments. This report shows that this can be done. I commend its information and analysis to a wide global audience.

BAN KI-MOON
SECRETARY-GENERAL, UNITED NATIONS

JOINT FOREWORD FROM ACHIM STEINER, CHRISTIANA FIGUERES AND UDO STEFFENS


ACHIM STEINER


CHRISTIANA FIGUERES


UDO STEFFENS

The pace, scale and now geographical spread of clean energy investments is one of the most positive and remarkable transitions of the past few years.

Driven in part by the UNFCCC process and various provisions and mechanisms of the Kyoto Protocol, the increasing deployment of wind, solar, geothermal and other clean energy power sources serve as a powerful antidote to those who claim that a transition to a low-carbon, resource-efficient future is unobtainable.

Last year, $244 billion of new investment went into renewable energies. While down from the previous record-breaking year, this investment underscores that for the private sector, renewable and clean energy systems have moved from the fringe to a mainstream role within the global energy mix.

The report also underscores how investment patterns are going global, with significant parts of the developing world seeing investment levels climbing at a brisk pace, and not just in the familiar market of China. Morocco, for example, saw the go-ahead for a $1.2 billion investment to finance the Masen Ouarzazate solar thermal project. Close to $1 billion was announced for a 396MW wind project in Oaxaca State, Mexico. And, several Gulf States, including Saudi Arabia, Qatar and the United Arab Emirates, committed to significant investment in renewables over coming years. Other highlights of 2012 include the growth of small-scale hydro with notable investment in countries including Brazil, Ecuador and Indonesia.

The sources of investment funding also continue to grow with $5 billion of 'green' bonds issued last year, a 44% increase over 2011, and the phenomenon of crowd sourcing—in which capital is raised from large numbers of small investors—took off in small-scale solar in Europe and the United States.

This latest Global Trends report comes two and half years in advance of two seminal events:

- The finalising of a post 2015 development agenda, including the design of a suite of Sustainable Development Goals that build on the Millennium Development Goals; and
- The delivery of a new, universal agreement on climate change aimed at limiting the global average temperature rise to less than two degrees Celsius this century.

Sustaining the uptake of renewable energies will be crucial to the success of both interconnected agendas and speaks to the urgent tasks of overcoming poverty and delivering prosperity in a way that keeps humanity's footprint within planetary boundaries.

Renewable energy has been thriving despite an unequal landscape with respect to fossil fuels and the $600 to $800 billion of subsidies they continue to attract. The costs of fossil fuel-based generation, ranging from the impacts on human health to damage to ecosystems such as forests, water demand and, yes, climate change, are also currently outside the ledgers of profit and loss. If renewable and clean energy systems are to reach their full potential over the medium to long term, these imbalances need to be addressed and these externalities recognised.

The time has come for governments to consider a robust and realistic price on carbon as one powerful path to mobilising the investment needed to combat climate change, realise Sustainable Energy for All and contribute to a sustainable century.

Achim Steiner
UN Under-Secretary-General and UNEP Executive Director

Christiana Figueres
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Udo Steffens
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METHODOLOGY AND DEFINITIONS

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

The Bloomberg New Energy Finance Desktop collates all organisations, projects and investments according to transaction type, sector, geography and timing. It covers 61,400 organisations (including start-ups, corporate entities, venture capital and private equity providers, banks and other investors), 40,000 projects and 37,400 transactions.

METHODOLOGY

The following renewable energy projects are included: all biomass and waste-to-energy, geothermal, and wind generation projects of more than 1MW; all hydropower projects of between 1MW and 50MW; all wave and tidal energy projects; all biofuel projects with a capacity of one million litres or more per year; and all solar projects, with those less than 1MW estimated separately and referred to as small-scale projects, or small distributed capacity, in this report.

The 2013 Global Trends report concentrates on renewable power and fuels and does not cover energy-smart technologies such as smart grid, electric vehicles and power storage – except in the box at the end of Chapter 2.

The main body of the report also does not cover large hydro-electric projects of more than 50MW, since this technology has been mature for decades and is at a very different stage of its roll-out than, for instance, wind or solar. However there is coverage of large hydro in the box at the end of Chapter 4, and briefly in the Executive Summary.

Where deal values are not disclosed, Bloomberg 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.

Annual investment in small-scale and residential projects such as rooftop solar is estimated. These figures are based on annual installation data, provided by industry associations and REN21. In Chapter 5, we have also stated estimates for solar water heaters, which do not generate power and are therefore excluded from the main small-scale projects figure and from the overall total for investment in renewable energy. Bloomberg New Energy Finance continuously monitors investment in renewable energy. This is a dynamic process: as the sector's visibility grows, information flow improves. New deals come to light and existing data are refined, meaning that historic figures are constantly updated.

This 2013 report contains revisions to a number of investment figures published in the 2012 UNEP Global Trends In Renewable Energy Investment report. Revisions reflect improvements made by Bloomberg New Energy Finance to its data during the course of the last 12 months.

DEFINITIONS

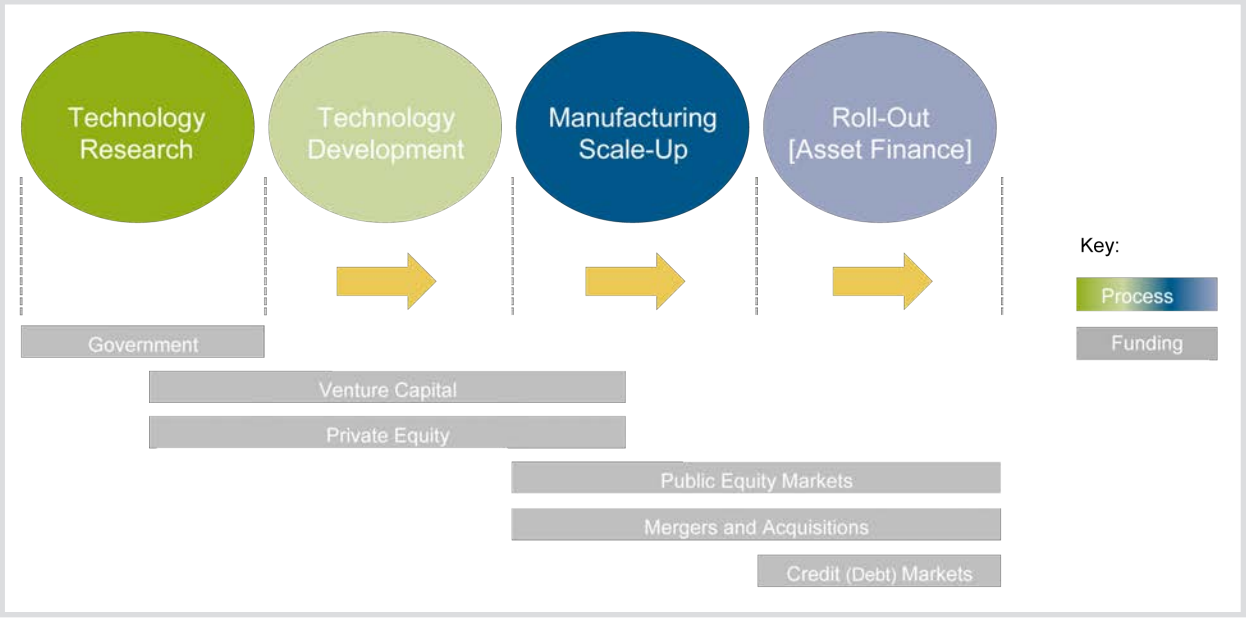
Bloomberg New Energy Finance tracks deals across the financing continuum, from R&D funding and venture capital for technology and early-stage companies, through to public market financing for projects and mature companies. Investment categories are defined as follows:

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.

Asset finance: all money invested in renewable energy generation projects (excluding large hydro), whether from internal company balance sheets, from loans, or from equity capital. This excludes refinancings.

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



REN21's annual **Renewables Global Status Report (GSR)** is the sister publication to UNEP Global Trends in Renewable Energy Investment report and was first released in 2005. It grew out of an effort to comprehensively capture, for the first time, the full status of renewable energy worldwide. Over the years, the GSR has expanded in scope and depth, in parallel with tremendous advances in renewable energy markets and industries. The report has become a major production that involves the amalgamation of thousands of data points, hundreds of reports and other documents, and personal communications with experts from around the world. It is available at http://www.ren21.net/gsr

KEY FINDINGS

- Investment in renewable power and fuels (including small hydro-electric projects) was $244 billion in 2012, down 12% from the previous year's record figure of $279 billion. Despite the setback, 2012's total was still the second-highest ever and 8% up on 2010.

- The main issue holding back investment last year was instability in the policy regime for renewable energy in important developed-economy markets. Future investment is likely to coalesce in countries that can offer policies that command investor confidence, plus the need for extra generating capacity and strong renewable power resources.

- The highlight of 2012 was a further shift in activity from developed, to developing, economies. Total investment in developed economies in 2012 was down 29% at $132 billion while that in developing economies was up 19% at $112 billion, the highest ever.

- After being neck-and-neck with the US in 2011, China was the dominant country in 2012 for investment in renewable energy, its commitments rising 22% to $67 billion, thanks to a jump in solar investment. But there were also sharp increases in investment for several other emerging economies, including South Africa, Morocco, Mexico, Chile and Kenya.

- Activity trends were downbeat in many, but not all, developed economies. Policy uncertainty took a heavy toll of investment in the US – down 34% at $36 billion – and also in former renewable energy early-movers such as Italy and Spain.

- The other major theme of 2012 was a further, significant reduction in the costs of solar photovoltaic technology. The levelised cost of generating a MWh of electricity from PV was around one third lower last year than the 2011 average. This took small-scale residential PV power, in particular, much closer to competitiveness.

- The result was that, despite problems in former market hot-spots in southern Europe, the amount of PV capacity installed in 2012 was a record 30.5GW, up from 2011's 28.8GW. However this came at reduced cost, contributing to an 11% fall in overall solar investment last year, to $140 billion.

- Japan and Germany were two countries at the sharp end of the powerful trends in the solar market in 2012. Japan saw investment in renewable energy (excluding research and development) surge 73% to $16 billion, thanks largely to a boom in small-scale PV on the back of new feed-in tariff subsidies for solar installation.

- Germany saw renewables investment slip 35% to $20 billion. Part of this was down to a pause in offshore wind financings, as grid connection delays were addressed, but the major reason was that the 7.6GW of solar capacity installed in 2012 came at much lower cost than would have been the case in 2010 or 2011.

- Despite high levels of investment in renewable energy, generators are continuing to spend large sums on fossil-fuel assets. In 2012, gross investment on coal, gas and oil power (including replacement plant) was an estimated $262 billion, some $2 billion higher than the total investment in renewable power capacity including large hydro. Net investment in fossil-fuel technologies, at $148 billion, was much less than that in renewables.

- Clean energy share prices had another poor year in 2012, the WilderHill New Energy Global Innovation Index, or NEX, slipping 6% while wider stock markets gained. This followed a 40% plunge in the previous year. The NEX reached a low in late July some 78% below its record level reached in November 2007, before beginning a rally that extended into 2013.

- The main reasons for the further under-performance of renewable energy shares last year were severe distress in the manufacturing supply chain for both wind and solar, caused by over-capacity; and investor unease about future prospects in the light of unhelpful policy moves in Europe and North America.

- There were contrasts in the trends seen among different categories of investment. Small-scale capacity (of less than 1MW) was the strongest area, rising 3% to $80 billion in 2012. Asset finance of large projects slipped 18% to $149 billion.

- Investment in specialist renewable energy companies by public market investors dropped 61% to $4 billion, while that by venture capital and private equity investors fell 30% to $4 billion, the lowest since 2005. Corporate and government research and development spending, however, edged up 1% to $10 billion.

- In addition to the $244 billion worldwide investment total above, there was an important additional sum spent on new hydro-electric projects of more than 50MW. Some 22GW of such projects are estimated to have come online during 2012, equivalent to investment of around $33 billion.

EXECUTIVE SUMMARY

For the first time in several years, 2012 saw a decline, not a new record, for global investment in renewable energy. As last year's Global Trends report warned, dollar investment worldwide was facing a down-draft from uncertainty over support policies in Europe and the US and – more positively – from sharp falls in technology costs.

The 2012 investment total was $244 billion for renewable power and fuels (including small hydro-electric projects). This was 12% down on 2011's record of $279 billion,[1] but 8% above the figure for 2010.

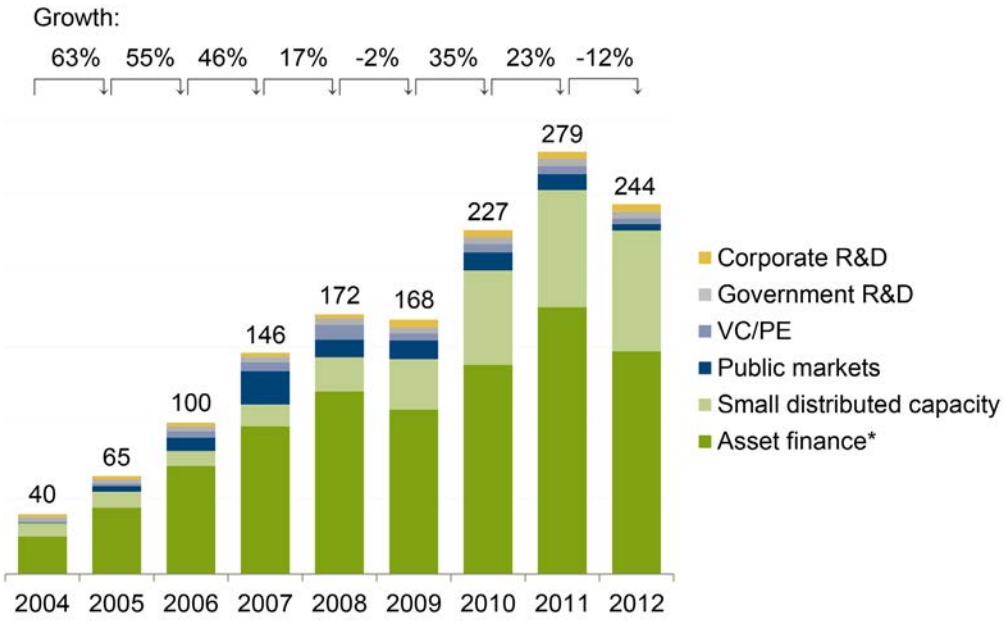
Not included in the headline 2012 number above is approximately $33 billion of investment in large hydro-electric projects – these outlays are discussed in a special section in Chapter 4. Once again, the dollars spent on additional renewable power capacity including large hydro exceeded those spent on additional fossil-fuel generating capacity worldwide, this time by more than $100 billion.[2]

However there is dauntingly far still to go to reduce the carbon intensity of the generation fleet. In 2012, just 6.5% of global electricity was produced using wind, solar, biomass and waste-to-power, geothermal, marine and small hydro technologies,

[1] The 2011 and 2010 totals have been revised upwards since last year's Global Trends, reflecting new information on projects and deals.

[2] See Chapter 2 for further discussion of the investment comparison.

FIGURE 1: GLOBAL NEW INVESTMENT IN RENEWABLE ENERGY BY ASSET CLASS, 2004-2012, $BN



*Asset finance volume adjusts for re-invested equity. Total values include estimates for undisclosed deals
Source: UNEP, Bloomberg New Energy Finance

up from 5.7% in 2011. Although the use of these sources meant that an estimated 900 megatonnes of CO2 were not produced, overall global energy-related emissions remained on a rising trend.

The most important change that took place in 2012 was an acceleration in the geographical shift of renewable energy investment. Back in 2007, developed economies invested two and a half times as much in renewables (excluding large hydro) than developing economies. In 2012, the gap was just 18%.

BITTER-SWEET $244 BILLION

From the standpoint of any year other than 2011, last year was a strong one for investment in renewable energy worldwide. The total of $244 billion was the second-highest ever, nearly one and a half times the 2009 figure and six times the 2004 number (see Figure 1).

However there is no hiding from the fact that 2012 marked the sharpest setback for renewable energy investment in recent years, far exceeding the 2% reverse in 2009 that followed the climax of the financial crisis. So what went wrong?

The main reason for the 12% decline in 2012 was investor concern over policies to support renewable energy in its longest-established markets, Europe and the US. In part this was a case of uncertainty – developers, equity providers and lenders were unsure about whether commitments to subsidise renewable energy deployment would continue beyond scheduled expiry dates in countries like the US, the UK and Germany.

In part it was a case of actual action – Spain's late-2010 retroactive cuts in tariff support for existing PV projects were followed in 2012 by further negative developments in the same country (a moratorium over feed-in tariff support for all new projects, and a tax on the revenues of clean power plants), and in Italy (a tight cap on capacity eligible for feed-in tariffs).

There was also negative impact on investment levels from other factors, notably pressure on utility balance sheets in some European countries, the low natural gas price in the US (which reduced the value of power purchasing agreements available to generators, including wind developers), and the poor performance, once again, of clean energy share prices. The latter factor hit public market investment in specialist renewable energy

companies and made venture capital and private equity funds more hesitant about putting money into the sector.

There was also an ominous, rising tide of protectionism in renewable energy. The US imposed relatively mild tariffs on Chinese-made solar hardware in the spring of 2012, but by the end of the year the pressure was on in Europe for higher duties on Chinese products.

However, the taste of 2012 was not all bitter. First of all, the weaker investment number disguised a much better performance in terms of renewable power megawatts installed. There were falls in utility-scale PV system costs of around 40% (and in residential PV system cost of nearly 30%) between 2011 and 2012, as excess capacity in the manufacturing chain put a fierce squeeze on selling prices and margins. The result was that although solar investment fell 11% worldwide in 2012, the number of PV megawatts installed actually increased, from 28.8GW the previous year, to 30.5GW.

In wind, there was a little of the same. The wind capacity installed in 2012 hit a record of 48.4GW, up from 42.1GW in 2011. Much of this reflected timing effects, so a lot of projects were financed in 2011 – and so showed up in that year's investment figures – but not completed until 2012. But there was also a cost effect – average prices paid for onshore turbines in 2012 were some 2-3% lower than those in 2011.

The continued improvements in cost-competitiveness for solar and wind helped to support demand in many markets. Developers found they could get an acceptable return even with subsidies well below their former levels, in countries such as Germany, and that they could get an attractive return in markets that had just introduced feed-in tariffs, notably Japan. Prices continued to fall in wind capacity auctions and tender mechanisms in emerging economies such as Brazil and South Africa.

There were other sweeter spots too. One was that, despite the fears about policy support, in several countries governments eventually clarified and extended their subsidy programmes and put in place new, more transparent "degression" mechanisms for scaling back subsidy support. In the US, the Production Tax Credit for wind was extended for a further year in a deal in Congress at the start of January this year. In the UK, the

government published last summer new levels of green certificate support that were broadly compatible with industry demands. In India, the administration confirmed that its generation-based incentive for wind would be restored after a period of suspension.

Another was that clean energy share prices finally managed to begin a rally, after a painful decline of 78% from their highs reached in 2007. The WilderHill Global Innovation Index, or NEX, which tracks the performance of 96 clean energy stocks worldwide, bottomed at 102.20 on 25 July 2012, had rallied by 18% by the end of the year, and continued its upswing well into 2013.

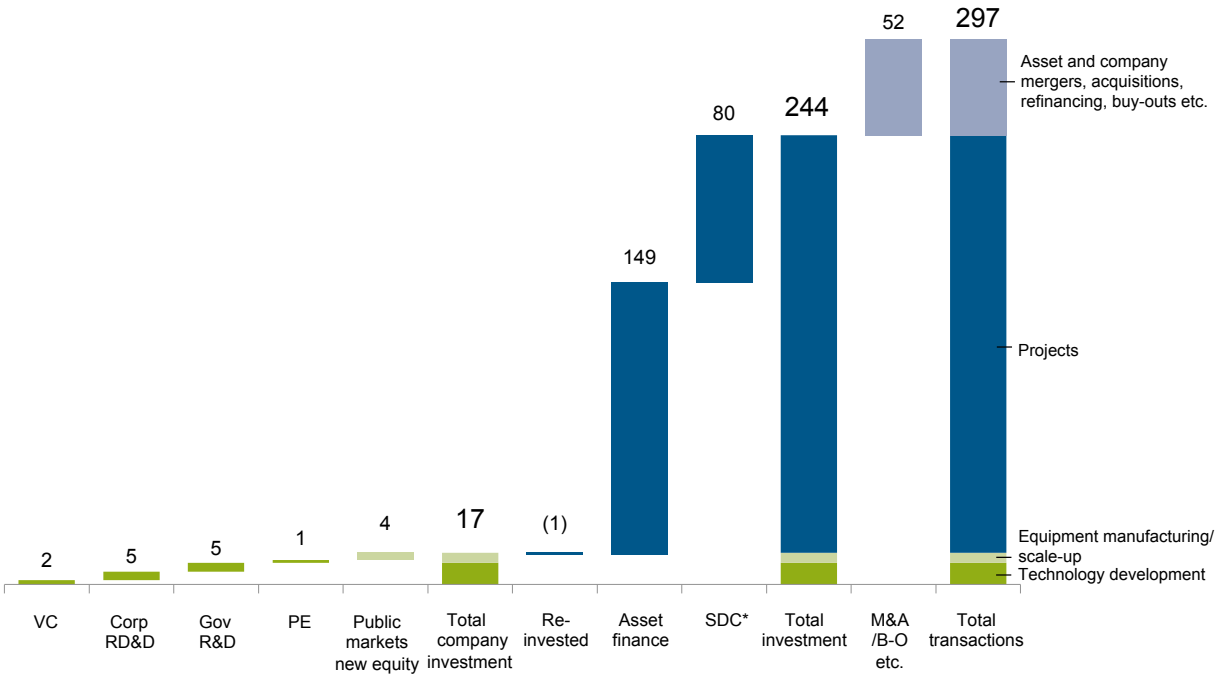
Finally, and most importantly, there was further evidence last year that renewable energy investment is gravitating to the parts of the world that have greatest need for additional power, and have the best natural resources for wind, solar, geothermal, small hydro and other technologies. In many cases, this means developing countries. This trend is explored further in the next section.

SOUTH UP, NORTH DOWN

Figure 2 shows the breakdown of the $244 billion figure for investment in 2012 in renewable energy excluding large hydro. At the technology end of the spectrum, there was $2 billion of venture capital investment, and $1 billion of private equity-raisings, in specialist sector companies, and $5 billion each of corporate, and government, research and development spending. The largest segment of investment was asset finance of utility-scale renewable energy projects, at $149 billion, and this was followed by $80 billion of small distributed capacity, primarily rooftop solar, financings. Finally, there was $52 billion of mergers and acquisitions, buy-outs and refinancings – not included in the $244 billion new investment total but part of the activity in the sector also.

Figure 3 shows how the main numbers varied in 2012 compared to earlier years. The most important contributor to the 12% decline in new investment last year was a fall in asset finance from $180 billion in 2011 to $149 billion last year.

FIGURE 2: GLOBAL TRANSACTIONS IN RENEWABLE ENERGY, 2012, $BN



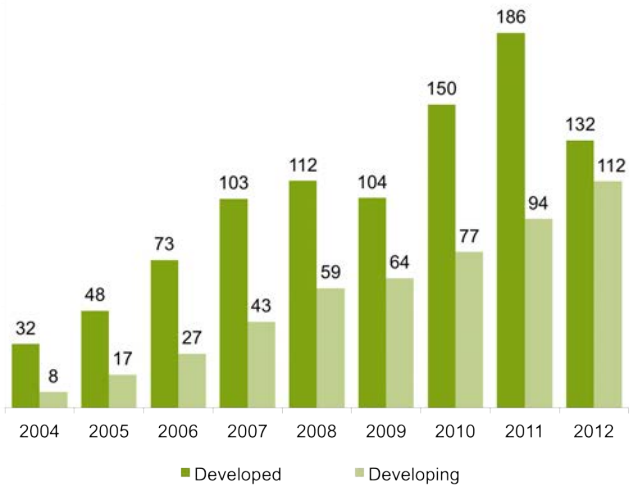
SDC = small distributed capacity. Total values include estimates for undisclosed deals. Figures may not add up exactly to totals, due to rounding.
Source: UNEP, Bloomberg New Energy Finance

FIGURE 3: GLOBAL TRENDS IN RENEWABLE ENERGY INVESTMENT 2012 DATA TABLE, $BN

Category / Year / Unit	2004 $bn	2005 $bn	2006 $bn	2007 $bn	2008 $bn	2009 $bn	2010 $bn	2011 $bn	2012 $bn	2011-12 Growth %	2004-12 CAGR %
1 Total Investment											
1.1 New investment	39.6	64.7	100.0	146.2	171.7	168.2	227.2	279.0	244.4	-12%	26%
1.2 Total transactions	48.4	90.7	135.6	204.7	231.0	232.5	285.8	352.5	296.7	-16%	25%
2 New Investment by Value Chain											
2.1 Technology development											
2.1.1 Venture capital	0.4	0.6	1.2	2.2	3.2	1.6	2.5	2.6	2.3	-15%	25%
2.1.2 Government R&D	2.0	2.1	2.3	2.7	2.8	5.2	4.7	4.7	4.8	3%	12%
2.1.3 Corporate RD&D	3.0	2.9	3.3	3.6	4.0	4.0	4.6	4.8	4.8	-1%	6%
2.2 Equipment Manufacturing											
2.2.1 Private equity expansion capital	0.3	1.0	3.0	3.7	6.8	2.9	3.1	2.6	1.4	-46%	20%
2.2.2 Public markets	0.3	3.8	9.1	22.2	11.6	12.5	11.8	10.6	4.1	-61%	41%
2.3 Projects											
2.3.1 Asset finance	24.8	44.0	72.1	100.6	124.2	110.3	143.7	180.1	148.5	-18%	25%
Of which re-invested equity	0.0	0.1	0.7	3.1	3.4	1.8	5.5	3.7	1.5	-60%	-
2.3.3 Small distributed capacity	8.9	10.5	9.8	14.3	22.5	33.5	62.4	77.4	80.0	3%	32%
Total Financial Investment	25.8	49.3	84.7	125.6	142.4	125.5	155.6	192.2	154.8	-19%	25%
Gov't R&D, corporate RD&D, small projects	13.8	15.4	15.3	20.6	29.3	42.7	71.7	86.8	89.6	3%	26%
Total New Investment	39.6	64.7	100.0	146.2	171.7	168.2	227.2	279.0	244.4	-12%	26%
3 M&A Transactions											
3.1 Private equity buy-outs	0.8	3.8	1.8	3.6	5.5	2.5	1.9	3.0	2.4	-19%	14%
3.2 Public markets investor exits	0.0	1.4	2.7	4.2	1.0	2.6	4.7	0.1	0.4	200%	41%
3.3 Corporate M&A	2.4	7.9	12.7	20.4	18.0	21.5	18.0	29.5	7.1	-76%	14%
3.4 Project acquistion & refinancing	5.4	12.8	18.4	30.4	34.9	37.7	33.9	40.9	42.3	4%	29%
4 New Investment by Sector											
4.1 Wind	14.4	25.5	32.4	57.4	69.9	73.7	96.2	89.3	80.3	-10%	24%
4.2 Solar	12.3	16.4	22.1	39.1	59.3	62.3	99.9	158.1	140.4	-11%	36%
4.3 Biofuels	3.7	8.9	26.1	28.2	19.3	10.6	9.2	8.3	5.0	-40%	4%
4.4 Biomass & w-t-e	6.3	8.3	11.8	13.1	14.1	13.2	13.7	12.9	8.6	-34%	4%
4.5 Small hydro	1.5	4.6	5.4	5.9	7.1	5.3	4.5	6.5	7.8	20%	22%
4.6 Geothermal	1.4	0.9	1.4	1.8	1.8	2.7	3.5	3.7	2.1	-44%	5%
4.7 Marine	0.0	0.1	0.9	0.7	0.2	0.3	0.2	0.3	0.3	13%	30%
Total	39.6	64.7	100.0	146.2	171.7	168.2	227.2	279.0	244.4	-12%	26%
5 New Investment by Geography											
5.1 United States	5.7	11.9	28.2	34.5	36.2	23.3	34.6	54.8	36.0	-34%	26%
5.2 Brazil	0.5	2.2	4.2	10.3	12.5	7.9	7.9	8.6	5.4	-37%	34%
5.3 AMER (excl. US & Brazil)	1.4	3.4	3.4	5.0	5.6	5.9	11.5	8.3	9.5	14%	27%
5.4 Europe	19.6	29.4	38.4	61.7	72.9	74.7	101.3	112.3	79.9	-29%	19%
5.5 Middle East & Africa	0.6	0.6	1.2	1.7	2.7	1.7	5.0	3.5	11.5	228%	46%
5.6 China	2.6	5.8	10.2	15.8	25.0	37.2	40.0	54.7	66.6	22%	50%
5.7 India	2.4	3.2	5.5	6.3	5.2	4.4	8.7	13.0	6.5	-50%	13%
5.8 ASOC (excl. China & India)	6.7	8.3	8.9	11.0	11.5	13.2	18.1	23.8	29.0	22%	20%
Total	39.6	64.7	100.0	146.2	171.7	168.2	227.2	279.0	244.4	-12%	26%

New investment volume adjusts for re-invested equity. Total values include estimates for undisclosed deals.
Source: UNEP, Bloomberg New Energy Finance

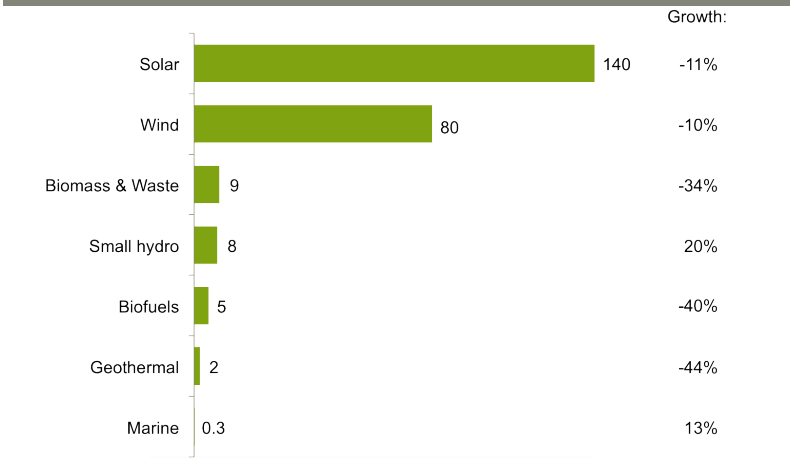
FIGURE 4: GLOBAL NEW INVESTMENT IN RENEWABLE ENERGY: DEVELOPED V DEVELOPING COUNTRIES, 2004-2012, $BN



New investment volume adjusts for re-invested equity. Total values include estimates for undisclosed deals. Developed volumes are based on OECD countries excluding Mexico, Chile, and Turkey.
Source: UNEP, Bloomberg New Energy Finance

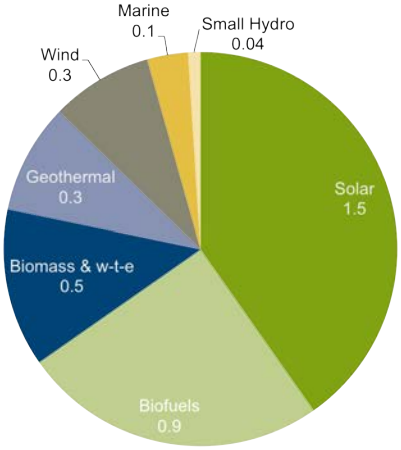
The developed-developing contrast is highlighted in Figure 4. Total investment in developing economies rose 19% in 2012 to $112 billion, so continuing an uninterrupted upward trend since 2004, while investment in developed countries slumped 29% to $132 billion. One milestone was passed in 2010, when developing countries first overtook developed economies in the public markets category of investment. In 2012, the gap between the two in terms of overall investment shrunk to just 18% - suggesting that at some point in the next few years, the majority of renewable energy investment will take place in developing countries.

FIGURE 5: GLOBAL NEW INVESTMENT IN RENEWABLE ENERGY BY SECTOR, 2012, AND GROWTH ON 2011, $BN



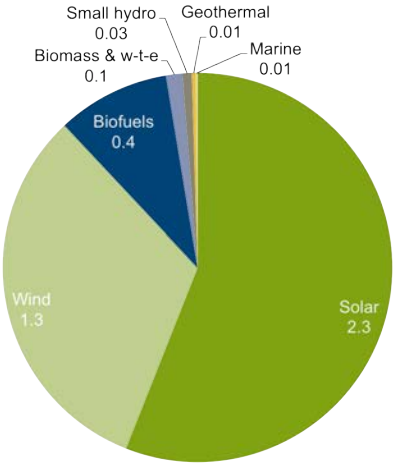
New investment volume adjusts for re-invested equity. Total values include estimates for undisclosed deals. Source: UNEP, Bloomberg New Energy Finance

FIGURE 6: VC/PE NEW INVESTMENT IN RENEWABLE ENERGY BY SECTOR, 2012, $BN



VC/PE new investment excludes PE buy-outs. Total values include estimates for undisclosed deals. Source: UNEP, Bloomberg New Energy Finance

FIGURE 7: PUBLIC MARKETS NEW INVESTMENT IN RENEWABLE ENERGY BY SECTOR, 2012, $BN

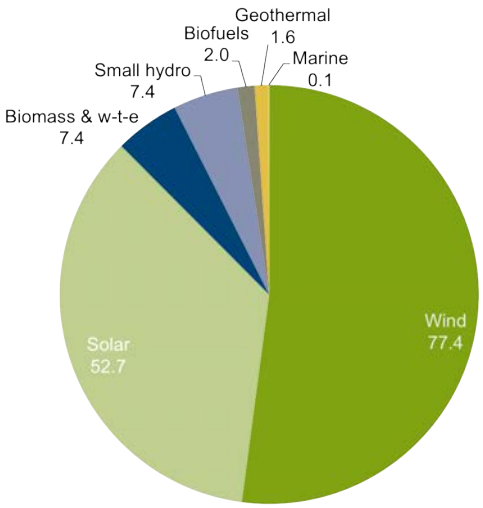


Source: UNEP, Bloomberg New Energy Finance

The further shift in global investment focus from "North" to "South" in 2012 owed much, but not all by any means, to China. As Figure 3 indicates, China raised its investment last year by 22% to $67 billion, making it comfortably the world's biggest destination for renewable energy outlays, at 27% of the global total. However there were strong gains also for the Asia-Oceania region excluding China and India, with a 22% increase to $29 billion, the Americas excluding the US and Brazil, with a 14% rise to $10 billion, and Middle East & Africa, with a 228% jump to $11 billion. The performance of individual developing, and developed, countries are examined in Chapter 1.

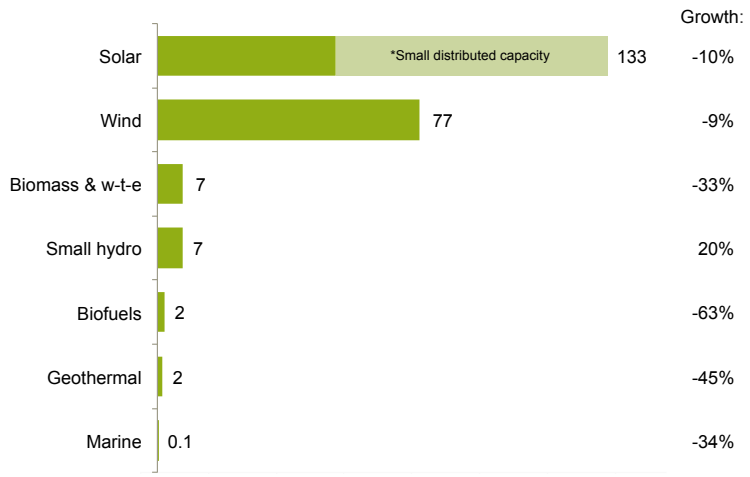
Both solar and wind suffered double-figure declines in investment in 2012 (of 11% and 10% respectively), while biofuels, biomass and waste-to-energy and geothermal all did proportionately much worse – enduring falls of 40%, 34% and 44%. Only small hydro, with a 20% increase to $7.8 billion, and the fledgling marine energy sector with a 13% gain to $300 million, bucked the downward trend (see Figure 5).

FIGURE 8: ASSET FINANCE OF RENEWABLE ENERGY ASSETS BY SECTOR, 2012, $BN



Total values include estimates for undisclosed deals.
Source: UNEP, Bloomberg New Energy Finance

FIGURE 9: ASSET FINANCE OF RENEWABLE ENERGY ASSETS AND SMALL DISTRIBUTED CAPACITY BY SECTOR, 2012, AND GROWTH ON 2011, $BN



Total values include estimates for undisclosed deals.
Source: UNEP, Bloomberg New Energy Finance

These sector splits are further examined in Figures 6, 7 and 8 – highlighting the trends respectively in venture capital and private equity commitments, public markets investment, and utility-scale asset finance. The message from Figure 6 is that solar remains the most popular area for VC/PE investors, even though they are showing much more caution than in 2007-08, with second-generation biofuels the second biggest destination for their funds.

Solar was also the main recipient of equity capital put into quoted renewable energy companies, as Figure 7 shows, although wind came a respectable second. The specific deals and trends of 2012 in VC/PE and public markets are explored in depth in Chapters 6 and 7 of this report.

Figure 8 highlights just how dominant wind and solar have become within the renewable energy sector, accounting between them for some $130 billion of the $149 billion of asset finance last year. Their combined share was much lower in the mid-2000s when the US and Brazilian biofuel booms were in full swing, and solar had yet to attract heavy project investment. Figure 9 provides a different slant on the sectoral picture, combining asset finance and small-scale project outlays to show that solar attracted about 70% more investment in new capacity than wind. Asset finance is examined in detail in Chapter 4 of this report, and small-scale projects in Chapter 5.

INVESTMENT IN 2013

Global investment in renewable energy in the first quarter of this year was $40 billion, the lowest in any quarter since Q1 2009, at the lowest point of the recession that followed the financial crisis. The Q1 2013 outcome was down 36% on the final quarter of last year and 24% below the first quarter of 2012.

The first quarter has often been the weakest of the four in recent years, reflecting the fact that subsidies tend to expire at the end of December, so developers rush to complete in time for that, and then pause. In addition, banks strive to complete loan deals in December, to meet their annual targets, and then start with new transactions in the New Year.

However the weakness in Q1 2013 was more than just seasonal. Figure 10 shows the trend for three categories of investment – asset finance of utility-scale projects, venture capital and private equity investment, and public markets investment. The combined investment in these three was $21 billion in the first quarter, down more than a third from the equivalent in the first three months of 2012.

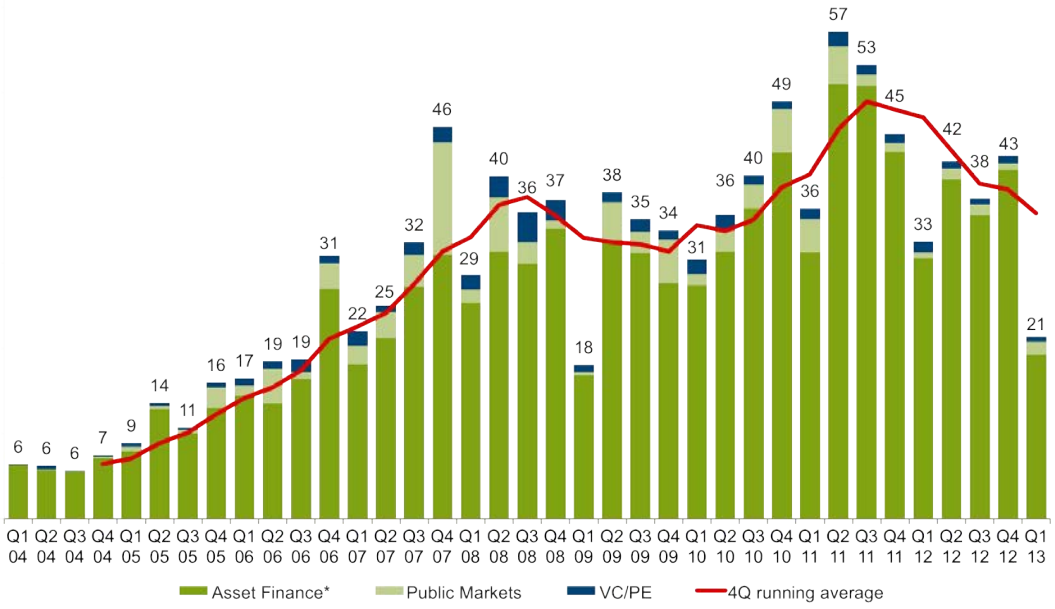
Asset finance was $19.3 billion, compared to $30.8 billion in the same quarter of last year. The largest deal of the quarter was the $1.9 billion financing of the 288MW Butendiek offshore wind farm in German waters, but there was a big gap to the next largest – the $390 million financing of a 234MW Gas Natural Fenosa onshore wind farm in Mexico, and the $345 million investment decision for a 70MW Kyocera solar PV plant in Japan.

A slightly improved showing by clean energy share prices – up 11% in the quarter – helped to stimulate a rebound of 141% in public markets investment in clean energy companies, to $1.5 billion in Q1. The largest deal was the $394 million IPO in London of Greencoat UK Wind, a fund investing in operating wind projects.

However VC/PE investment in specialist renewable energy companies was just $580 million in the first three months of 2013, down 55% on a year earlier and the weakest figure for any quarter since the end of 2005. The largest deal was $125 million of expansion capital for US solar installer Sungevity.

Small-scale project investment was $18.5 billion in the first quarter of this year, down slightly from a $20 billion quarterly average in 2012. This reflected in the main the near-20% fall in PV module costs between Q1 2012 and Q1 2013.

FIGURE 10: VC/PE, PUBLIC MARKETS, AND ASSET FINANCE INVESTMENT IN RENEWABLE ENERGY QUARTERLY TREND, Q1 2004-Q1 2013, $BN



*Asset finance volume adjusts for re-invested equity. Total values include estimates for undisclosed deals
Source: UNEP, Bloomberg New Energy Finance

INVESTMENT BY TYPE OF ECONOMY

- Developing countries raised their share of global renewable energy investment to a record 46% in 2012, up from 34% in the previous year. The total invested by developing countries was $112 billion in 2012, up from $94 billion in 2011 and continuing an unbroken eight-year growth trend.
- By contrast, outlays by developed economies fell sharply to $132 billion in 2012, from $186 billion in 2011, declining to the lowest figure since 2009.
- The setback for the developed world owed much to lower investment in the US (down 36%)[3] on the back of a fall-off in large solar financing, and in Germany (down 35%) in the face of wind market maturity and lower costs for PV.
- China was the dominant performer among the developing economies, raising its investment by 22% to $64.7 billion (excluding R&D), thanks to a take-off in its solar market.
- However there were also higher capital commitments in the Middle East and Africa region – especially South Africa and Morocco – and in relatively new Latin American clean energy markets such as Chile and Mexico.
- Key reasons for the shift southward in new investment included the squeeze on subsidies in Europe and the US, and increased activity in markets with rising power demand and strong renewable resources.

DEVELOPED VERSUS DEVELOPING COUNTRIES

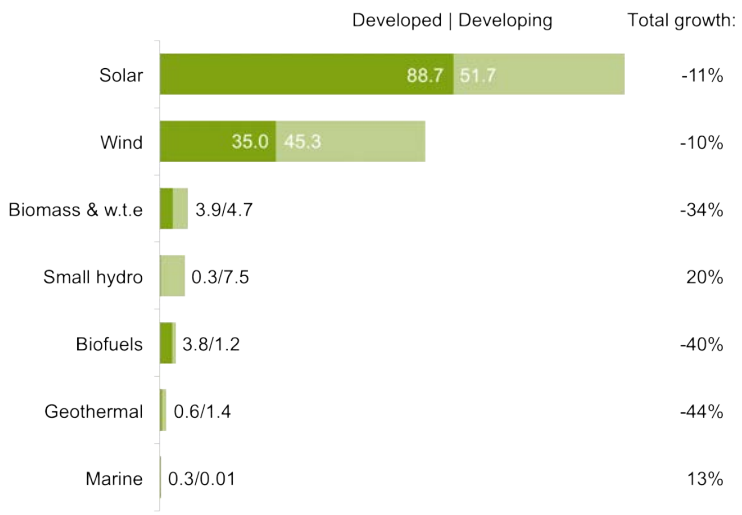
Last year saw the most dramatic shift ever in the balance of renewable energy investment worldwide, as noted in the Executive Summary, and shown in Figure 4. Developing countries have been growing in importance for the sector for many years, and overtook developed economies in terms of asset finance of utility-scale projects in 2010.[4] However another area of investment – in small-scale projects of less than 1MW – has been dominated by Europe, and this kept the overall total investment figure for developed economies well ahead of that for the developing world until last year.

In 2012, the balance in overall investment changed from roughly a two-thirds-one-third split between developed and developing economies to one that was much closer to 50:50. Renewable energy outlays in the developing world reached $112 billion, up from $94 billion in 2011, and some 46% of the world total.

[3] Excluding research and development.

[4] Developed economies pushed back ahead of developing countries in asset finance in 2011, helped by financings under the US Federal Loan Guarantee and Treasury Grant programmes.

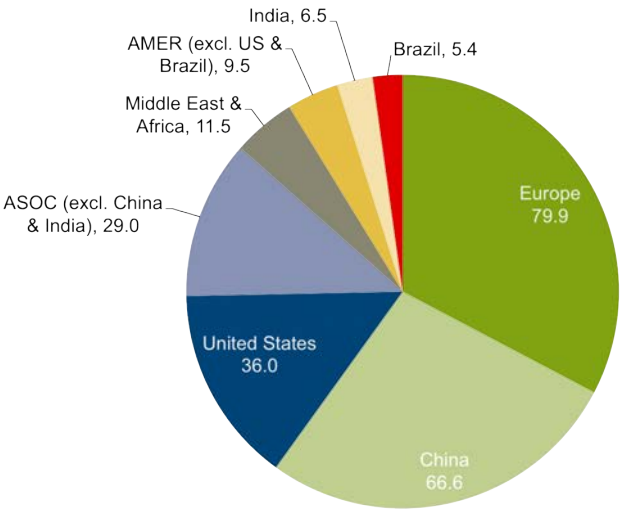
FIGURE 11: GLOBAL NEW INVESTMENT IN RENEWABLE ENERGY: DEVELOPED V DEVELOPING COUNTRIES, 2012, AND TOTAL GROWTH ON 2011, $BN



Total values include estimates for undisclosed deals. New investment volume adjusts for re-invested equity. Includes estimates for small distributed capacity, corporate and government R&D. Developed volumes are based on OECD countries excluding Mexico, Chile, and Turkey.

Source: UNEP, Bloomberg New Energy Finance

FIGURE 12: GLOBAL NEW INVESTMENT IN RENEWABLE ENERGY BY REGION, 2012, $BN



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

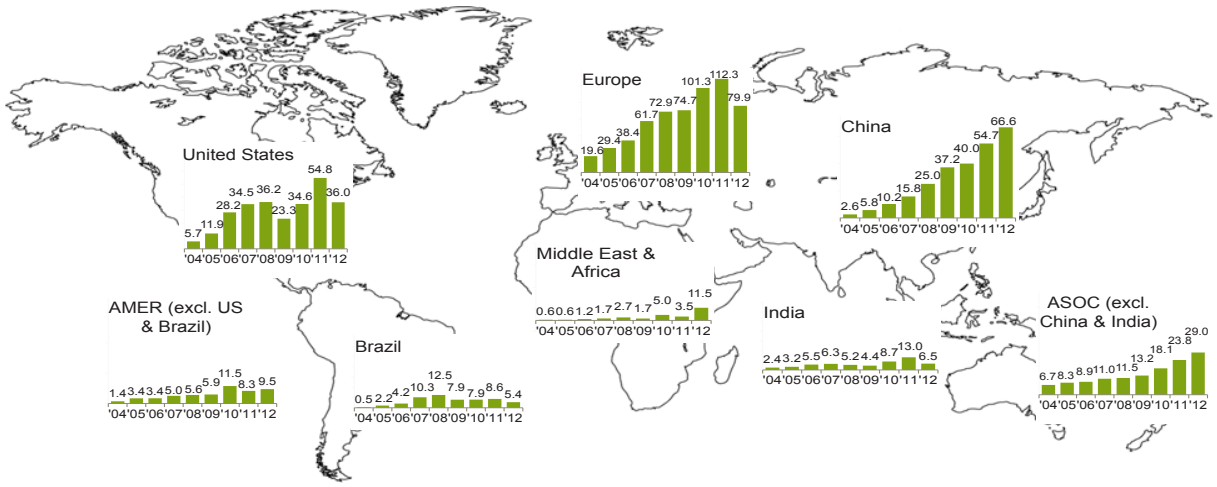
Source: UNEP, Bloomberg New Energy Finance

This shift reflects in part a squeeze on subsidies in Europe and the US, as governments scaled back in late 2011 and 2012 what had been available to encourage wind and solar project development. This triggered sharp falls in investment in countries such as the US, Italy and Spain last year. Also of importance however has been a move by investors to emerging markets that offer both rising power demand and attractive renewable energy resources. The fact that the costs of wind and solar generation have come down adds the vital third element to this mix, making those technologies more affordable in developing countries than ever before.

Figure 11 highlights the fact that the split in investment between developing and developed economies looks very different, depending on the renewable technology chosen. In 2012, solar was by far the leading sector in terms of money committed, at $140.4 billion. It remains dominated by developed economies – last year Germany, the US, Japan and Italy were the four of the five largest investors in solar – but China actually accounted for the largest of all, at $31.3 billion (excluding R&D), up sharply from $17.8 billion in the previous year.

Overall, investment in solar in developing countries rocketed up 72% to $51.7 billion, while that in developed markets fell 31% to $88.7 billion. Contributing greatly to the decline in developed economies was a sharp fall-off in solar thermal project investment in the US and Spain, from a combined $15.2 billion in 2011 to just $1.7 billion in 2012.

FIGURE 13: GLOBAL NEW INVESTMENT IN RENEWABLE ENERGY BY REGION, 2004-2012, $BN



New investment volume adjusts for re-invested equity. Total values include estimates for undisclosed deals.
Source: UNEP, Bloomberg New Energy Finance

The emerging economies were already ahead of the developed ones in terms of investment in 2012 in wind, small hydro, biomass and waste-to-energy and geothermal. Last year, the developed group generated $35 billion of investment in wind, while developing nations produced $45.3 billion. In small hydro, the gap was vast, with developed countries at just $254 million and developing at $7.5 billion, while in geothermal the respective figures were $631 million and $1.4 billion, and in biomass and waste, $3.9 billion and $4.7 billion.

Only biofuels and the tiny, embryonic sector of marine maintained a lead for developed economies in 2012, along with solar. Investment in biofuels was $3.8 billion in developed markets, and $1.2 billion in developing countries. Investment in wave and tidal was $295 million worldwide, with more or less all of that in developed economies.

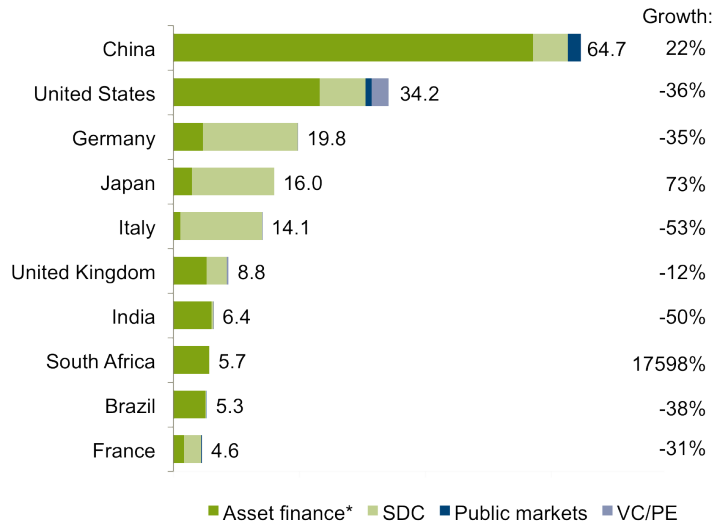
Figures 12 and 13 illustrate some of the striking regional comparisons. In the former, the importance of Europe and China is clear – between them, they accounted for 60% of world investment in 2012, even though it was the weakest year for Europe since 2009.

In Figure 13, a different point emerges – that the trends are changing markedly, region by region. China shows the steepest and most consistent growth in investment, from just $2.6 billion in 2004 to $66.6 billion in 2012, but there is also striking momentum behind Middle East and Africa, which has seen investment in renewable energy rise from less than $1 billion per year in the middle of the last decade to $11.5 billion in 2012.

The trends for India and for Asia-Oceania excluding India and China show contrasting performances in 2012, the former falling back from $13 billion to $6.5 billion and the latter rising from $23.8 billion to $29 billion. The US and Brazilian charts both show spending levels bouncing around. In the US case, the influences have included the establishment and expiry of different renewable energy subsidy programmes and the passing of the 2006-07 corn ethanol boom; and in the Brazilian case, the passing of the 2007-08 sugar ethanol build-out.

The Americas excluding the US and Brazil show a steadily rising line, from just $1.4 billion in 2004 to $9.5 billion in 2012 – via a temporary peak at $11.5

FIGURE 14: NEW INVESTMENT IN RENEWABLE ENERGY BY COUNTRY AND ASSET CLASS, 2012, AND GROWTH ON 2011, $BN



Top 10 countries. *Asset finance volume adjusts for re-invested equity. Excludes corporate and government R&D

Source: UNEP, Bloomberg New Energy Finance

FIGURE 15: ASSET FINANCE OF RENEWABLE ENERGY ASSETS BY COUNTRY, 2012, AND GROWTH ON 2011, $BN

	2012	% growth on 2011
Ukraine	2.8	205%
Japan	3.0	230%
Canada	3.7	-17%
Germany	4.8	-58%
Brazil	5.1	-39%
United Kingdom	5.3	-10%
South Africa	5.7	23410%
India	6.4	-49%
United States	23.4	-49%
China	57.7	23%

Top 10 countries. Total values include estimates for undisclosed deals

Source: UNEP, Bloomberg New Energy Finance

FIGURE 16: SMALL DISTRIBUTED CAPACITY INVESTMENT BY COUNTRY, 2012, AND GROWTH ON 2011, $BN

	2012	% growth on 2011
France	2.7	-32%
Belgium	2.8	-19%
Greece	3.1	195%
United Kingdom	3.2	-16%
Australia	3.3	-30%
China	5.5	195%
United States	7.3	63%
Italy	13.0	-43%
Japan	13.1	56%
Germany	15.0	-15%

Top 10 countries. Represents investments in solar PV projects with capacities below 1MW

Source: UNEP, Bloomberg New Energy Finance

billion in 2010. This region, along with Middle East and Africa, shows some of the most interesting recent developments, as the final section of this chapter will attest.

DETAILED COMPARISONS BY COUNTRY

Figure 14 shows that in 2012, excluding corporate and government research and development (for which national figures are often hard to attain), the developing countries to get into the world top 10 for investment were China, India, Brazil and South Africa – the last with a spectacular jump to $5.7 billion.

The US, Germany, Japan, Italy, the UK and Australia were the six developed economies to get into the top 10 in 2012. Figure 14 also underlines that in 2012, company investment via VC/PE or public markets was a relatively tiny share of overall investment in most important countries – a contrast with earlier years such as 2007 and 2008.

Figures 15 and 16 show the 10 largest investing countries in terms, respectively, of asset finance and of small-scale projects. In asset finance, China was even more dominant than in overall investment, and only the US also got into double figures in terms of billions of dollars deployed.

In small-scale, Germany invested more than any other country, but there was a fairly narrow gap between its $15 billion and Japan and Italy, on $13.1 billion and $13 billion. The US and China took up fourth and fifth places.

FIGURE 17: VC/PE, PUBLIC MARKETS, AND ASSET FINANCE INVESTMENT IN RENEWABLE ENERGY IN THE UNITED STATES BY SECTOR, 2012, $BN

	Asset finance*	Public markets	VC/PE	Total
Wind	14.8	-	0.04	14.8
Solar	6.8	0.6	1.3	8.8
Biofuels	0.8	0.4	0.8	1.9
Biomass & Waste	0.7	0.01	0.2	1.0
Geothermal	0.1	-	0.3	0.4
Marine	-	-	0.003	0.003
Small hydro	-	-	0.002	0.002
Total	23.2	1.0	2.6	26.9

*Asset finance volume adjusts for re-invested equity
Source: UNEP, Bloomberg New Energy Finance

DEVELOPED ECONOMIES

A detailed breakdown of US investment in renewable power and fuels by sector and type of investment, but excluding corporate and government R&D spending, is shown in Figure 17.

Overall asset finance came to $23.2 billion, down by nearly half from $44.4 billion in 2011. This setback reflected in large part the fact that two incentives for renewable energy projects – the Treasury grant and the federal loan guarantee programme – expired in late 2011, and that a third, the Production Tax Credit for wind, looked for much of 2012 as if it would expire at the end of the year. In the event, Congress extended the PTC for another year at the start of January along with its compromise over the "fiscal cliff"[5] – but months before then, the financing of wind projects had slowed to a trickle.

There is always a lag of nine months or so between the financing of wind projects, and the completion of construction, so the high level of wind asset finance in the US in 2011 translated into record capacity additions in 2012 – at around 13GW. But financing itself rose only from $14.1 billion the previous year, to $14.8 billion, with more than $10 billion of that in the first half before the PTC uncertainty tightened its grip on developers and investors.

The impact of the loss of the other two incentives was particularly felt in solar, where asset finance fell from $26.7 billion to $6.9 billion. There were several financings of large solar thermal, or CSP, projects in the US in 2011 under the loan guarantee programme – but there were no significant projects financed using

[5] The increase in tax and cut in public spending that would have occurred without Congressional agreement to prevent it.

these technologies in 2012. If asset finance in solar suffered, small-scale PV did a little to offset that – rising from $4.5 billion in 2011 to $7.3 billion in 2012.

Among the largest utility-scale projects financed in the US in 2012 were the 419MW Flat Ridge Wind Farm Phase II in Kansas, at $885 million, and the 200MW LS Power Centinela PV Plant in California, at $800 million.

Germany remained the third largest investing country in renewable energy worldwide. The country installed some 7.6GW of solar capacity in 2012, the largest for any country, and most of it small-scale. However the value of Germany's investment in sub-1MW PV projects fell by 15% to $15 billion, reflecting the sharp reductions in module prices that took place during the year.

In wind, there was a fall in German asset finance from $8.6 billion in 2011 to $3.1 billion in 2012. Germany is a relatively mature onshore wind market, with some 32GW already installed, so there are fewer new opportunities than there used to be. Also, in offshore wind, there was a hold-up for much of 2012 due to inadequate grid connection arrangements. Nevertheless, late in the year, financing was completed for the 288MW Baltic II project ($1.6 billion).

Total Italian investment in renewable energy fell 53% in 2012, to $14.1 billion. The country's fifth Conto Energia programme put strict limits on the amount of new wind and solar capacity that would be eligible for feed-in tariff support, and in addition, the generosity of that support was greatly reduced. Asset finance tumbled from $6.9 billion to $1.1 billion, and small-scale projects from $22.9 billion to $13 billion – although the latter figure in particular would have been higher were it not for the fall in solar panel prices during the year.

Japan popped up in the top 10 tables for asset finance (Figure 15), and even more spectacularly in dollar terms for small-scale projects (Figure 16). Small-scale grew 56% to $13.1 billion, while utility-scale finance jumped 230% to $3 billion. Both moves reflected the country's decision after the Fukushima nuclear emergency in March 2011 to be much more vigorous in its encouragement of renewable energy. Japan's feed-in tariff for PV installations, starting at JPY 40 ($0.42) per kWh for larger installations, has been particularly attractive for investors.

Overall Japanese investment in renewables reached $16 billion in 2012, putting it in fourth position worldwide. The biggest projects financed during the year included the 50MW Mitsui Chemicals Tahara wind and PV site, at $237 million, and the 22MW Shibaura Group Miyama PV plant, at $87 million. The country has made a decisive shift in favour of renewable power since the tsunami and resulting Fukushima nuclear crisis in March 2011.

Elsewhere, among the most important locations for investment were the UK, which saw the amount deployed slip 12% to $8.8 billion last year; Australia, which saw a 20% fall to $4.4 billion, with small-scale solar again the biggest contributor; France, down 31% at $4.6 billion; and Canada, down 23% at $4.2 billion. Spain saw investment of $2.9 billion in 2012, but this was down 69% from 2011 levels and the weakest figure for at least eight years.

But it was not only the "usual suspect" group of countries that saw billion-dollar investment flows. An interesting surprise was Ukraine, which enjoyed a rise from $919 million to $2.8 billion in 2012. The advance was driven by the financing of a series of small hydro projects totalling 980MW and worth $2.1 billion on the Dnieper River. The largest deal in another sector was that for the 90MW, $126 million Botievo Wind Farm Phase 1.

CHINA, INDIA AND BRAZIL

These three emerging giants stood first, seventh and ninth in the overall renewable energy investment table[6] (Figure 14) and first, third and sixth in the asset finance table (Figure 15).

Solar was the star performer in China, jumping from $13.9 billion in asset finance in 2011 to $24.7 billion in 2012. Wind, meanwhile, managed only a small rise from $26.3 billion to $27.2 billion as some projects were delayed because of grid connection issues.

[6] Excluding R&D

FIGURE 18: VC/PE, PUBLIC MARKETS, AND ASSET FINANCE INVESTMENT IN RENEWABLE ENERGY IN CHINA BY SECTOR, 2012, $BN

	Asset finance*	Public markets	VC/PE	Total
Wind	27.2	0.9	-	28.1
Solar	24.7	1.1	0.01	25.7
Small hydro	2.7	0.01	-	2.7
Biomass & w-t-e	2.5	-	-	2.5
Biofuels	0.04	-	-	0.04
Total	57.1	2.0	0.0	59.1

*Asset finance volume adjusts for re-invested equity
Source: UNEP, Bloomberg New Energy Finance

FIGURE 19: VC/PE, PUBLIC MARKETS, AND ASSET FINANCE INVESTMENT IN RENEWABLE ENERGY IN INDIA BY SECTOR, 2012, $BN

	Asset finance*	Public markets	VC/PE	Total
Wind	3.0	-	0.1	3.1
Solar	1.8	-	0.01	1.8
Small hydro	0.6	-	-	0.6
Biomass & w-t-e	0.5	-	0.03	0.6
Biofuels	0.02	-	-	0.02
Total	6.0	0.0	0.1	6.2

*Asset finance volume adjusts for re-invested equity
Source: UNEP, Bloomberg New Energy Finance

FIGURE 20: VC/PE, PUBLIC MARKETS, AND ASSET FINANCE INVESTMENT IN RENEWABLE ENERGY IN BRAZIL BY SECTOR, 2012, $BN

	Asset finance*	Public markets	VC/PE	Total
Wind	3.2	0.2	-	3.4
Small hydro	0.7	-	-	0.7
Biofuels	0.6	-	-	0.6
Biomass & w-t-e	0.5	-	-	0.5
Solar	0.1	-	-	0.1
Total	5.0	0.2	0.0	5.2

*Asset finance volume adjusts for re-invested equity
Source: UNEP, Bloomberg New Energy Finance

The surge in China's solar development came as Beijing trimmed its national feed-in tariff, but falling system costs enabled developers still to see a return. Also, manufacturers, faced with oversupply in the industry worldwide, opted to develop PV projects in their own country to take up some of the slack.

The largest projects financed included a trio of PV projects of 100MW each, Talesun Gansu Jiayuguan, Zhenfa Solar Jinchuan and Huanghe Hydropower Geermu, all outweighing in estimated investment cost most of the large wind farms financed such as the 199.5MW CGNWP Guyuan Huanggaizhuo project, which came in at $320 million.

Figure 18 shows that there was $2.7 billion investment in small hydro in China in 2012 – there was also a much bigger figure for large hydro-electric projects, as discussed in the box in Chapter 4 – and $2.5 billion of investment in biomass and waste-to-energy projects.

India, as noted above, saw a setback to its previously rising renewables investment trend. Figure 19 shows that wind asset finance came in at just $3 billion, solar at $1.8 billion and small hydro and biomass and waste-to-energy at $641 million and $544 million respectively. Overall asset finance was down by half, at $6.1 billion.

The Indian wind sector was held back in 2012 by the expiry at the end of March that year of the Generation-based Incentive and accelerated depreciation for wind farm development. One of these, the GBI, was reinstated from 1 April 2013 and could help to revive investment from this year onwards. One of the largest wind projects financed last year was the 100.5MW Mytrah Vagarai Wind Farm Phase II in Tamil Nadu.

The reduction in solar asset finance, of around two-thirds in 2012, might seem a surprise, given the ambition of the targets set by India's government for its National Solar Mission, and by some of the states. However last year marked a lull between different phases of the NSM, after the first 1.1GW had largely been financed and before the next 3.6GW phase, due to start in 2013. State governments meanwhile have some 2.2GW already auctioned off for this year.

Brazil also had a lukewarm year for asset finance in 2012, with wind down from $4.9 billion to $3.2 billion, and biofuels down by about a third at $606 million – a fraction of the $7.4 billion peak in 2008. Figure 20 shows that small hydro outstripped

biofuels in terms of asset finance last year, reaching $738 million, while biomass and waste-to-energy was close behind it at $512 million.

The further fall in biofuels investment reflected in part the fact that the domestic and international markets have enough capacity to be going on with, given the government targets set. The dip in wind asset finance came after a series of auctions in the last two years that allocated some 2GW of new capacity. In the December 2012 auction for instance, 282MW of capacity (nearly half of the total) went to wind projects, at a record low average tariff of just $42 per MWh.

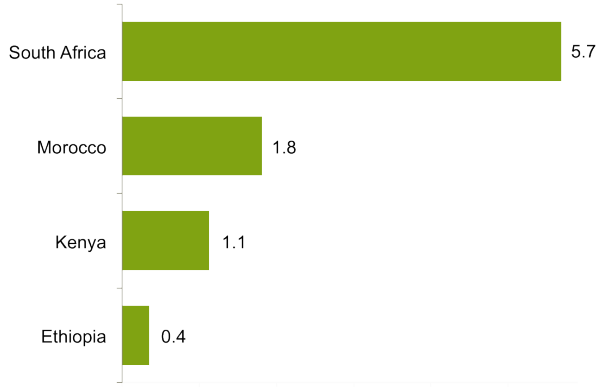
However, once developers clinch winning bids in an auction, there is then a lag before those projects are financed and constructed. National development bank BNDES often takes around two years to disburse financing, and relatively little of this took place in 2012. A rebound in asset finance for Brazilian wind looks likely in 2013 and 2014. It is also more than possible that some of the projects awarded capacity in the low-bid December 2012 auction may not end up getting built.

OTHER DEVELOPING ECONOMIES

South Africa was the runaway star among developing countries outside the "Big Three" in 2012, raising its investment in renewable energy from a few hundred million dollars to $5.7 billion. Some $1.5 billion of this went on wind farms, and $4.2 billion on solar projects, such as the 75MW Solar Capital De Aar PV Plant Phase 1, at $270 million, and the similarly sized Scatec Solar Kalkbult PV Plant, at $259 million. The biggest wind transaction was the Rainmaker Dorper Wind Farm I, at 100MW and $251 million.

In November 2012, the South African government concluded power purchase agreements and lender guarantees for 1.4GW of wind, PV and solar thermal projects, opening their way to financial

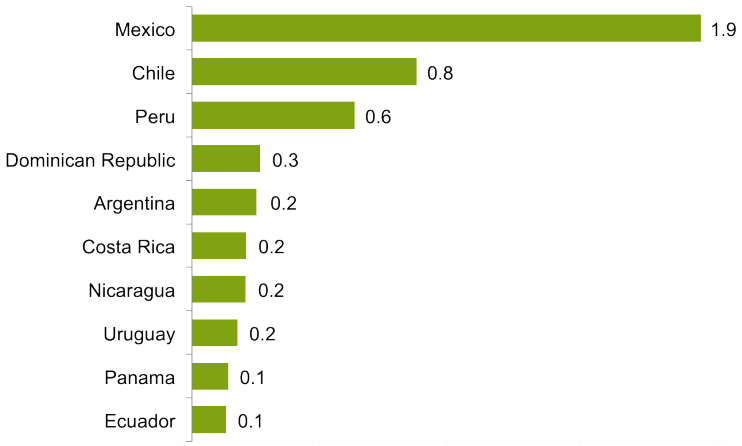
FIGURE 21: TOTAL VC/PE, PUBLIC MARKETS, AND ASSET FINANCE INVESTMENT IN RENEWABLE ENERGY IN AFRICA BY COUNTRY, 2012, $BN



Omits countries with less than $0.1bn investment. Investment volume adjusts for re-invested equity

Source: UNEP, Bloomberg New Energy Finance

FIGURE 22: TOTAL VC/PE, PUBLIC MARKETS, AND ASSET FINANCE INVESTMENT IN RENEWABLE ENERGY IN LATIN AMERICA (EXCLUDING BRAZIL) BY COUNTRY, 2012, $BN



Omits countries with less than $0.1bn investment. Investment volume adjusts for re-invested equity

Source: UNEP, Bloomberg New Energy Finance

close in the weeks that followed. This marked a key stage of progress for winners of the first round of renewable energy tenders, beginning in August 2011. In all, Pretoria is looking to procure 3.2GW of renewable capacity in a rolling plan over the next few years, with nearly half of that in wind and large slices also for PV and solar thermal.

Figure 21 shows that the rise of Africa in renewables was not confined to its southernmost country. Morocco also saw a jump in outlays, to $1.8 billion from $297 million, while Kenya saw $1.1 billion of commitments, up from almost nothing in 2011.

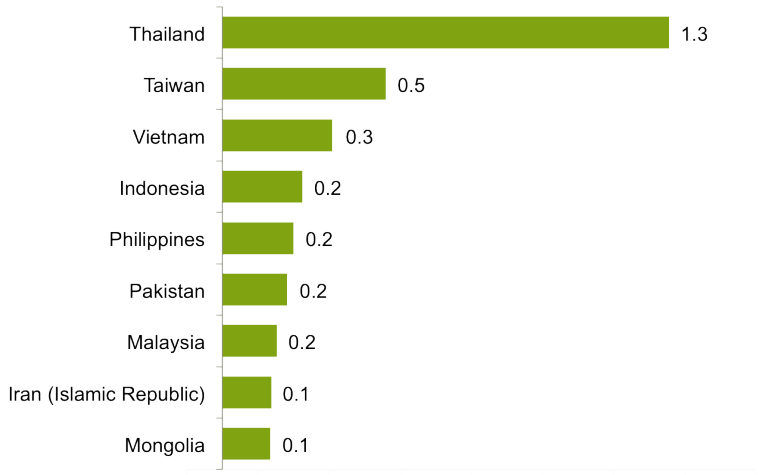
Morocco's government is encouraging wind and solar to achieve three aims – boost power supply, improve energy security and reduce the water dependency of its energy system. It saw two large projects financed during the year: the Masen Ouarzazate solar thermal plant phase one, at 160MW and $1.2 billion; and the Nareva and International Power Tarfaya Wind Farm, at 300MW and $563 million.

Kenya saw an estimated $900 million committed for the 400MW Menengai geothermal project phase one, helped by loans signed by the African Development Bank, and $180 million from OPIC for the 36MW Ormat Olkaria geothermal project expansion phase one; meanwhile, Ethiopia was the destination for $345 million for the 153MW Electric Power Adama wind farm phase two, with Export-Import Bank of China support.

In Latin America outside Brazil, the biggest mover was Mexico, with an increase in investment from $352 million in 2011 to $1.9 billion in 2012, but there were also intriguing developments in Chile, up from $216 million to $840 million, and Peru, up from $239 million to $608 million (see Figure 22).

Mexico's largest transaction of the year was $961 million for the 396MW Marena Wind Portfolio, while Chile's was $283 million for the 115MW El Arrayan Wind Farm. Peru saw significant transactions of more than $200 million in both wind and PV.

FIGURE 23: TOTAL VC/PE, PUBLIC MARKETS, AND ASSET FINANCE INVESTMENT IN RENEWABLE ENERGY IN NON-OECD ASIA (EXCLUDING CHINA AND INDIA) BY COUNTRY, 2012, $BN



Omits countries with less than $0.1bn investment. Investment volume adjusts for re-invested equity

Source: UNEP, Bloomberg New Energy Finance

In Asia outside China, India and Japan, Figure 23 shows that Thailand was the leading player, with investment steady at $1.3 billion. Other significant contributions came from South Korea, up from $560 million to $1.1 billion. Thailand saw a stream of solar plants financed, in the 5MW to 15MW range, while the biggest deal in terms of disclosed value in South Korea was for the 20MW Korea East-West Power Busan PV Plant South Korea is in the OECD and so not included in Figure 23.

Turkey saw investment jump from $460 million to $1.3 billion, as its wind sector attracted bank loans for more of the large project pipeline permitted several years earlier. The biggest deal with a disclosed value was the $227 million financing of the Lodos Elektrik Karaburun wind farm at 119.6MW.

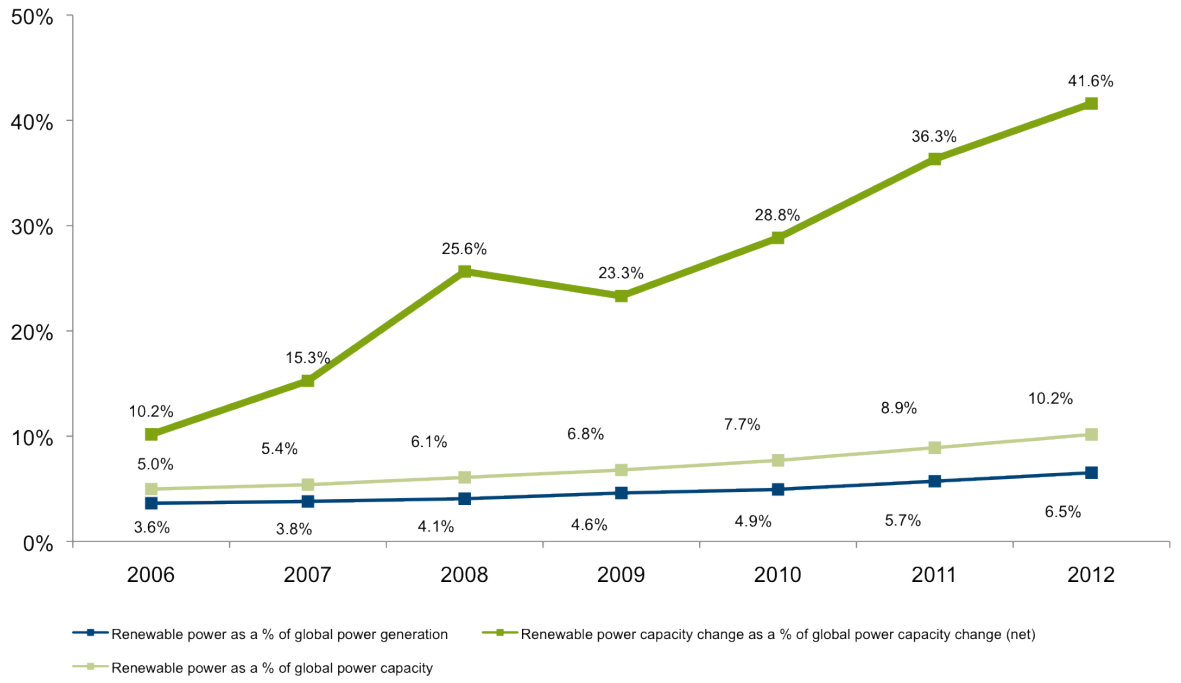
PUTTING RENEWABLE ENERGY INVESTMENT INTO PERSPECTIVE

- Renewable technologies (excluding large hydro) accounted for 42% of the 213GW of total power capacity added worldwide in 2012, up from 36% in 2011, and the highest percentage figure on record.
- Gross investment in renewable capacity in 2012, including large hydro, was roughly equivalent to investment in fossil fuel capacity, the former amounting to $260 billion, and the latter $262 billion. However, net fossil fuel investment, which does not include replacement capacity, was only about 57% of the level of investment in all renewable capacity.
- The levelised costs of generation from onshore wind have fallen by some 15% in the last four years, and those from solar PV by more than 50%, while global average costs (excluding carbon) from coal and gas power generation have increased.
- Lower costs are part of the reason for a geographic shift in renewable energy investment from developed to developing countries where demand growth is greatest and where less subsidised markets are becoming more attractive.
- Installed renewable power capacity excluding large hydro is estimated to have saved 900 megatonnes in annual CO2 emissions in 2012, about 7% of total power sector emissions. But despite this saving, and with the average investment in renewable energy over each of the last three years at $250 million, global power emissions are continuing to rise.
- Investment in two other low-carbon options – energy-smart technologies and carbon capture and storage – slipped back in 2012. The former saw technology investments of $18.7 billion, down from $20.3 billion, while the latter attracted project spending of $2.8 billion, down from $3 billion.

This chapter first puts investment in renewable energy into the context of the overall energy sector. It compares the flows of money going into renewable and fossil-fuel power, and the trends in the global electricity generation mix. It also draws a comparison with the levels of financing required to deliver universal energy access in the developing world, and provides an updated comparison of the costs of generation by different technologies.

The second section of the chapter sizes up the climate challenge and the extent to which investment in renewables is contributing to the quest to curb emissions. Finally, we look at trends in the financial flows going to two other important low-carbon options – energy-smart technologies such as smart grid, efficiency, storage and electric vehicles; and carbon capture and storage.

FIGURE 24: RENEWABLE POWER GENERATION AND CAPACITY AS A PROPORTION OF GLOBAL POWER, 2016-12



Sources: EIA, IEA, Bloomberg New Energy Finance. Note: excludes large hydro. Renewable capacity figures based on Bloomberg New Energy Finance global totals.

OVERALL ENERGY TRENDS

Figure 24 shows that renewable power excluding large hydro made up 42% of the total new generation capacity added in 2012, up from 36% in 2011 and 29% in 2010. Last year's figure reflected the fact that there was record commissioning of wind and solar PV plant, at 48.4GW and 30.5GW respectively. These were up from 42.1GW and 28.8GW in 2011.[7]

However, the chart also highlights the fact that there is a very long way to go before renewables are equally important in overall electricity generation worldwide. Bloomberg New Energy Finance estimates that the share in total generation of renewables, excluding the contribution from large hydro projects of 50MW or more, increased to 6.5% in 2012. This was up from 5.7% in 2011, and was 2.4 percentage points up on the 2008 figure.

Figure 25 highlights the trend in gross fossil-fuel investment against that in renewable power. In 2012, the former was $262 billion, 15% more than the $227 billion spent on renewable power asset finance (excluding large hydro) and small-scale projects.[8] The gap between the two volumes narrowed slightly in 2012, because the 10% setback in renewable power capacity investment covered elsewhere in this report coincided with a decline in fossil-fuel capacity investment of about 13%. If one includes large hydro in this comparison, estimated at $33 billion (see box in Chapter 4), then renewables and fossil-fuel investment was roughly equivalent, at $260 billion and $262 billion respectively.

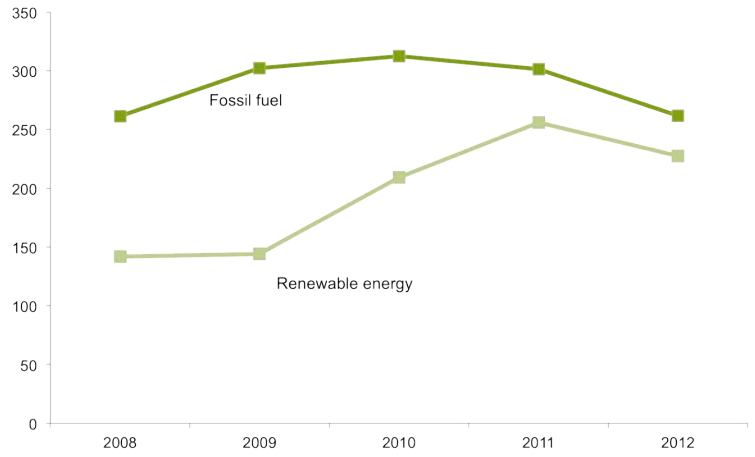
There is, however, a different way of comparing renewable power capacity investment with that in fossil-fuel capacity. Almost all investment in renewables is net, meaning that it adds to overall capacity, rather than replacing existing wind, solar or other equipment. This may change later in the decade, when repowering of existing wind farms becomes more prevalent, but for the moment, there is very little replacement spending on renewables.

This is not the case for fossil fuels. Many aged coal-fired power stations are being closed every year, especially in Europe and North America where emission regulations are increasingly stringent (see Chapter 3). Gas-fired plants are also being shut, some for reasons of age and others because the utility has decided that they will not be economic

[7] Bloomberg New Energy Finance data.

[8] This figure differs from the renewable energy asset finance and small-scale project total shown in Chapter 1, because it covers only power, not biofuels.

FIGURE 25: RENEWABLE POWER INVESTMENT COMPARED TO GROSS FOSSIL-FUEL POWER INVESTMENT, 2008-12, $BN



Renewable energy total excludes large hydro. Fossil fuel is gross investment on coal, gas and oil capacity and includes investment to replace capacity retirements. We assume capacity retirement of 3.3%/yr for coal, 4%/yr for gas and 2.5%/yr for oil
Source: Bloomberg New Energy Finance, EIA

to run – depending on the region – because of weak electricity demand, significant renewables penetration or high gas prices. There has also been a move away from oil-fired generation in many countries, because the high crude price has made this an expensive option.

Therefore net investment in additional fossil-fuel capacity is much lower than gross investment including spending on replacement plant. The net fossil-fuel power investment figure in 2012 is estimated to have been $147.7 billion - down from $180.2 billion in 2011.

This reflects Bloomberg New Energy Finance's estimate that only just over half the 152GW of new coal-fired plant installed worldwide last year, and little more than a third of the 72GW of new gas plant, was actually additional capacity. So investment in renewable power, at $227.4 billion in 2012, comfortably exceeded net investment in fossil-fuel power, at $147.7 billion, for the third successive year. If you include large hydro then investment in all renewable energy capacity was between one and a half and twice the net investment in fossil-fuel capacity.

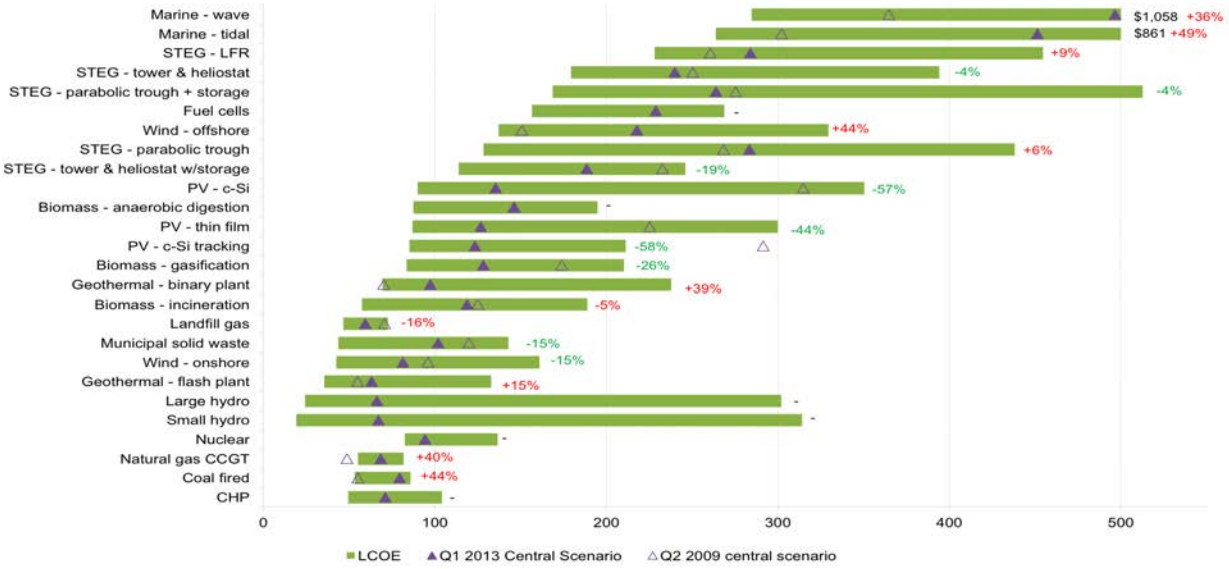
TECHNOLOGY COSTS

One development that is helping spur renewable energy deployment is the continuing improvement in cost-competitiveness. Figure 26 shows Bloomberg New Energy Finance's estimates for the change in levelised costs of generation for different technologies between the second quarter of 2009 (the first period covered by its model) and the first quarter of 2013. The figures are global averages, and do not capture any of the significant local variations, such as the low price of gas in the US or the high price of gas in Japan and other parts of Asia, and they do not make allowance for the cost impact on fossil generation from emission trading schemes, such as in Europe. Levelised costs cover all expenses involved in developing, building, financing and operating a power plant.

Between Q2 2009 and Q1 2013, the cost per MWh of new gas- and coal-fired capacity increased by some 40% on average worldwide, reflecting higher bills for capital equipment. Some renewable energy sources also saw costs rise - for instance, offshore wind levelised costs rose 44% as project developers moved further away from land and into deeper water. Some geothermal and solar thermal technologies also saw costs rise.

However, there were big reductions in the levelised costs of generation for the two principal renewable energy sources - onshore wind and solar PV. Onshore wind costs fell by 15%, reflecting efficiency improvements with the move to larger turbines and, in particular, the effect of increased competition and oversupply in the turbine manufacturing business. Crystalline silicon PV levelised costs fell by 57-58%, while those of thin-film PV dropped by 44%, in the face of ferocious competition and oversupply in the solar manufacturing chain.

FIGURE 26: LEVELISED COST OF ELECTRICITY FOR DIFFERENT GENERATION TECHNOLOGIES, Q2 2009 V Q1 2013



CHP = combined heat and power; c-Si = crystalline silicon; STEG = solar thermal electricity generation or concentrated solar power; CCGT = combined cycle gas turbine

Source: Bloomberg New Energy Finance estimates.

DECREASING SUBSIDY DEPENDENCE

The improvements in levelised cost of some technologies, particularly onshore wind and PV, have brought them closer to competitiveness with fossil-fuel technologies even when no price is put on the carbon emissions of coal and gas-fired plant.

Although it is still a bit early to identify this trend quantitatively within the global investment figures, there are increasing examples of renewable energy uptake in low or fully unsubsidised markets.

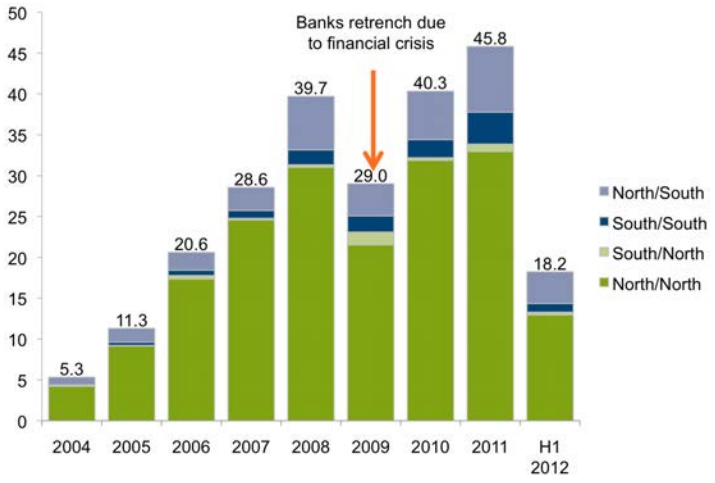
One developed country example is Germany where the rooftop solar feed-in tariff is now lower than the retail cost of energy for residential customers. In the developing world, Brazil has aggressively driven down the cost of wind, with the most recent auction prices coming in around $42/MWh, less than other new forms of generation assuming these projects go ahead (see Chapter 3). Other markets with low, or no, subsidies such as Mexico and Chile are also seeing increases in wind and solar investment activity. In South Africa, the $5.7 billion of investment in 2012 was also helped along by falling costs. The bidding in the second round of the government renewable energy tender mechanism in May 2012 resulted in prices 22% and 40% lower for wind and solar PV than in the first round in late 2011.

As renewable energy technologies become less dependent on subsidies, the main market driver becomes energy demand growth and this largely explains the increasing shift of renewable energy investment towards developing countries. According to the IEA, 84% of world growth in electricity generation from 2010 to 2030 will be in the developing world. This year's record figure of 46% for the proportion of global renewable energy investment in developing countries is therefore likely to give way to even higher figures as the decade unfolds.

ENERGY ACCESS

Electricity based on renewables may also contribute to improving energy access for the millions of people, mainly in the poorer developing economies, that have little or no electricity available to them. The International Energy Agency

FIGURE 27: CROSS-BORDER INVESTMENT VOLUMES BY REGIONAL FLOW, 2004-H1 2012 $ BN



Source: Bloomberg New Energy Finance. Note: new-build asset finance for renewable energy projects only.

has estimated that 19% of the world's population had no access to electricity in 2009, including 58% of the one billion people in Africa.[9] The amount of investment needed to achieve universal access to electricity would be $641 billion between 2010 and 2030 according to the IEA - equivalent to some $32 billion per year, on top of the $9.1 billion in 2009.

This identified energy access requirement of $32 billion per year would be a relatively modest investment compared with the sums being spent on renewable power and fossil-fuel capacity worldwide. It would also be modest compared with the amount already being spent on renewables in developing countries, at $112 billion in 2012 (see Figure 4 on page 16). However, the bulk of the latter was deployed to the stronger developing economies, such as China, India, Brazil, South Africa, Morocco, Thailand and Mexico.

It is interesting to compare the $112 billion in developing countries with the size of current North-South flows in renewable investment (see Figure 27). In 2011, the latest full year for which figures are available, just $7.9 billion of renewable energy asset finance made its way from developed to developing economies, although this was up 35% on 2010. This suggests that the investment shift from developed to developing countries as observed earlier (see Chapter 1) is not mainly driven by international sources but that much of the growing investment is sourced in the South itself.

CLIMATE STABILISATION

Energy-related carbon emissions continue to be on a rising trend. Figure 28 shows International Energy Agency estimates for the change in energy sector emissions between 1990 and 2035, based on actual and forecast deployment of fossil-fuel and zero-carbon capacity. The IEA's calculation that emissions are unlikely to peak before the 2030s dovetails with similar projections made by Exxon Mobil and BP,[10] and is consistent with a long-term increase in global temperatures of some 3.6 degrees Centigrade, according to the agency.[11]

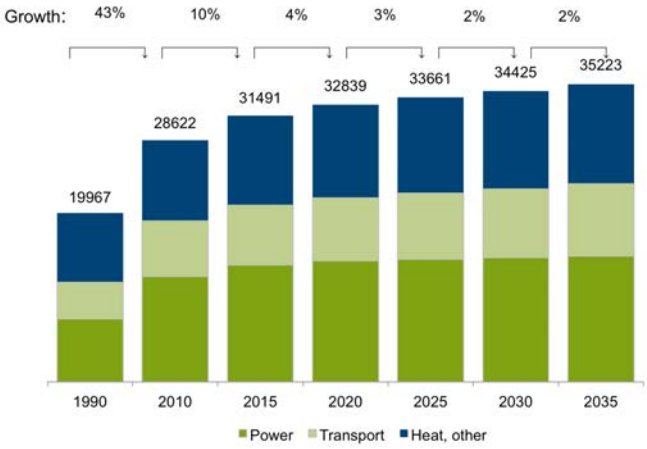
Getting energy-related emissions under control much more quickly, and minimising the temperature

[9] IEA World Energy Outlook 2011, Energy For All: Financing Access For The Poor

[10] Exxon Mobil Outlook for Energy to 2040; BP Energy Outlook 2030

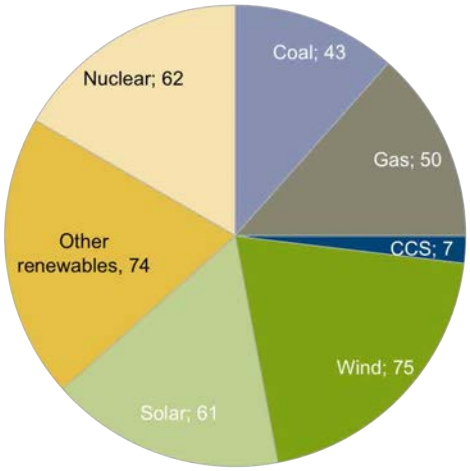
[11] International Energy Agency, World Energy Outlook 2012

FIGURE 28: GLOBAL CO2 EMISSIONS, 1990-2035, MILLION TONNES



Source: International Energy Agency, World Energy Outlook 2012

FIGURE 29: ANNUAL POWER GENERATION INVESTMENT NEEDED IN 2010-2020 TO MEET 2-DEGREE SCENARIO, $BN



Numbers shown are the projected annual energy sector investment needed to stay within 2 degrees C temperature rise. These can be compared with the actual capacity investments reported for 2012 within this Global Trends report, i.e., $77 billion for wind, $133 billion for solar, $50 billion for other renewables including hydro, and $148 billion for net coal and gas additions.

Source: International Energy Agency, Energy Technology Perspectives 2012

increase, would require a much more decisive shift in the balance between coal, gas and zero-carbon generation. Figure 29 shows the annual investment in 2010-20 in different power generation sources that would be compatible with limiting the increase in world temperatures to two degrees Centigrade, according to the IEA's Energy Technology Perspectives model.[12] It also assumes sharp increases in energy efficiency.

The projected investment requirement shown in Figure 29, totalling $210 billion for the renewables slices, can be compared with the actual 2012 investment numbers as found in this report – $260 billion in total, including $133 billion for solar, $77 billion for wind and $50 billion for other technologies. Current investment trends are already outpacing the projected requirements of the IEA's two-degrees Centigrade scenario. However the bad news is that fossil-fuel investment has also been exceeding model projections – the estimates in this report put net coal and gas generation investment at $148 billion last year, compared to $93 billion in the IEA chart.

The implications of that fossil-fuel investment are alarming for the climate. There are a few rays of light through this gloom in the shape of recent emission trends in some developed economies.

For instance, the Energy Information Administration said in April 2013 that energy-related CO2 emissions in the US fell nearly 4% in 2012 to their lowest since 1994. They were down 12% from the 2007 peak. Reasons included the subdued economic growth in recent years, mild winter temperatures, increasing efficiency and use of renewables, but also to a large extent switching from coal-fired to gas-fired generation. In Australia, electricity sector emissions fell nearly 5% in 2012, to stand down 8% on the peak in 2008, according to figures from the country's Department of Climate Change and Energy Efficiency. In the European Union, however, despite economic weakness in 2012, there was no improvement in power sector emissions because the increase in renewable electricity was offset by greater output in coal-fired power stations in response to low world coal prices.

[12] International Energy Agency, Energy Technology Perspectives 2012

Renewable sources such as wind and solar have been criticised in some quarters for making minimal contribution to reducing carbon emissions. Certainly, there is room for a debate about the most effective global strategy for curbing emissions over the next 10-15 years - it could be one that made renewables and energy efficiency the dominant priorities for investment, or one that concentrated on the replacement of coal-fired generation with gas-fired plant, or one that favoured other low-carbon options such as carbon capture and storage and nuclear. In reality, all are needed, and one way to drive them forward would be a global carbon cap and carbon price.

For the moment, progress on emissions at a world level is disappointing - the IEA says that energy-sector carbon intensity is almost as high as it was in 1990 - since then energy demand has risen 46% while emissions have grown 44%.[13]

Despite this, the limited switch to renewable power that has occurred so far is having a certain amount of impact on overall emissions. Assuming global CO2 emissions from the power sector hit 13,000 megatonnes[14] in 2012 and renewables excluding large hydro accounted for 6.5% of global generation last year, then electricity sector emissions would have been 900 megatonnes or 7% higher than if the generation had been done by the same mix of technologies that made up the other 93.5% of total output – in other words, coal, gas, oil, nuclear and large hydro.[15] Therefore, renewable power investments to date, excluding those in large hydro, are now saving approaching a gigatonne (GtCO2e) of CO2 emissions per year.

One of the fundamental questions in the global climate negotiations is: what level of "ambition", in terms of collective emission reductions, is needed to protect the global climate? To help answer this question UNEP and the scientific community have published a series of reports since 2010 on the "emissions gap[16]".

The most recent such report[17] projects that global emissions will need to be reduced from 50 GtCO2e today to not more than 44 GtCO2e in 2020 if we are to have a "likely" chance of meeting the two-degrees Centigrade target. With the current emissions growth trajectory, the emissions gap in 2020 is actually estimated at 8 to 13 GtCO2e. In other words, governments will need to replicate the success of building out the renewable energy sector (excluding large hydro) 8 to 13 times to compensate for the current growth trend in other sectors.

The good news is that the renewable energy sector itself has shown that progress on climate is possible. The recent IEA input to the Clean Energy Ministerial[18] highlighted that "the renewable energy sector and emerging country efforts are lights in the dark as progress on clean energy remains far below a two-degree pathway." Of 11 sectors examined, renewable power was assessed as one of only two sectors being "on-track" from a climate prospective, with nuclear power, CCS, biofuels and energy efficiency in buildings all receiving the lowest "not on track" rating. The following two text boxes provide snap-shot views of recent investment activity in the CCS and energy smart technology sectors.

[13] See International Energy Agency report to Clean Energy Ministerial, Tracking Clean Energy Progress 2013.

[14] A straight line estimate based on IEA figures for 2010 and 2015.

[15] This estimate is, inevitably, an over-simplification. For instance, it assumes that CO2 emissions from biomass and waste-to-energy are counted as nil. It also does not include life-cycle emissions from the manufacture and transport of power generation equipment.

[16] The "emissions gap" is the difference in 2020 between emission levels consistent with the 2°C limit and projected emission levels.

[17] UNEP, Emissions Gap Report 2012.

[18] International Energy Agency, Tracking Clean Energy Progress 2013.

CARBON CAPTURE AND STORAGE

Carbon capture and storage, or CCS, covers a group of emerging technologies that remove and store CO2 gas from the exhaust of coal or gas-fired power stations or industrial installations – reducing greenhouse gas emissions released into the atmosphere.

Global investment in CCS projects has remained relatively steady since 2010: $2.8 billion in 2012, down from $3 billion in 2011 but slightly above 2010's $2.7 billion.

The 2012 figures were dominated by Canada, with smaller commitments from the US and Qatar.

Canada saw investments of $1.4 billion in the Shell Quest CCS Demonstration Project in Alberta, and $1.2 billion for the Enchance ACTL project in the same province. The latter will see CO2 from a fertiliser plant and a bitumen upgrader pumped along a 240km pipeline for use in enhanced oil recovery.

Despite this activity, global investment in CCS asset finance remains a tiny fraction of what would be required to reduce CO2 emissions from coal-fired power stations and industrial processes. There was also $1.3 billion of research and development spending on CCS in 2012, with almost all of that from governments.

ENERGY-SMART TECHNOLOGIES

Investment in specialist energy-smart technology slipped 8% in 2012 to $18.7 billion, the lowest annual figure since 2008.

Energy-smart technologies encompass smart grid, energy efficiency, power storage and advanced transportation, including electric vehicles. Last year, corporate research and development spending in these areas was a fraction ahead of 2011 at $10.3 billion, and government R&D was almost level at $5.2 billion. The major setbacks came in venture capital and private equity investment, down 38% at $2.1 billion; and public market investment, down 27% at $1 billion.

The largest VC/PE deals in energy-smart technologies in 2012 included a $150 million round for US fuel cell company Bloom Energy, and three financings for a total of $390 million by US electric car maker Fisker Automotive.

Viappy/Shutterstock.com

The biggest public market fundraisings were a $225 million secondary share issue by US electric vehicle maker Tesla Motors, and a $157 million initial public offering by Chinese LED chip maker company HC SemiTek Corporation.

EVOLUTION OF POLICIES TO SUPPORT RENEWABLES INVESTMENT

- Policies to support renewable energy have become more flexible and responsive as technology costs have fallen faster than expected. Governments have also learnt from mistakes, notably the poorly designed and over-generous subsidies that led to installation booms in some European countries.
- Germany and the UK have imposed "degression" mechanisms, so that incentives can be lowered frequently to take account of cost reductions. Several European countries are moving towards market-based mechanisms that expose developers to at least some market risk.
- The most damaging development for investor confidence has been retroactive cuts in support for existing wind and solar plants, imposed in countries such as Spain, the Czech Republic and Bulgaria.
- The importance of state-set Renewable Portfolio Standards in the US is declining as many jurisdictions have met or exceeded them. The trends are for greater use of environmental regulation, state emission initiatives such as the California carbon market, and the extension of tax-efficient structures for clean energy investment.
- Emerging economies such as India, Brazil and South Africa have made extensive use of competitive reverse auctions in an attempt to attract renewable power investment at the lowest possible cost.
- China has pursued a mixture of policies, starting off with auctions for wind capacity, then a feed-in tariff. It also offers government support via land grants, low-cost credit and central and provincial targets for renewables development.

EUROPEAN UNION

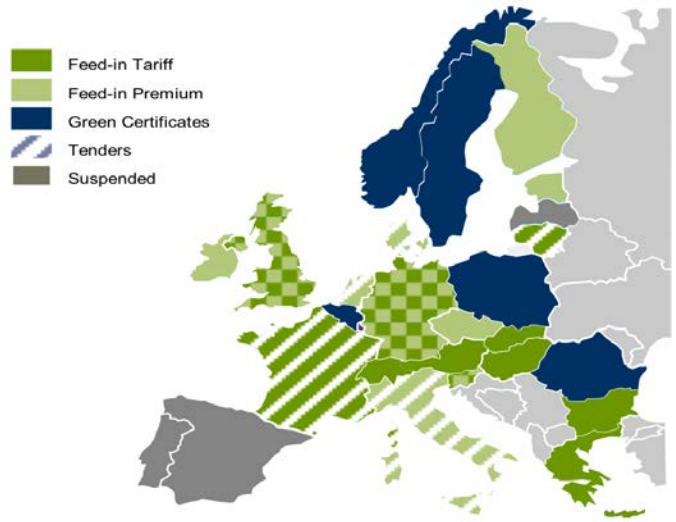
The European Union has been the world's main laboratory on clean energy policy, with every nation offering some form of incentive to achieve its binding 2020 renewable energy target. Together they must source 20% of their final energy consumption from renewable sources by 2020.

In 2012 the region faced multiple difficulties as the increasing penetration of renewable capacity added strains to power systems, bills and budgets, against a backdrop of economic austerity. However, the EU has also pioneered policy reforms to address some of those challenges, with the emphasis on increasing market integration, competitiveness and the predictability of future changes in incentive levels.

Cuts in renewable energy incentives have been widespread in Europe in recent years, and particularly in the last 18 months, as governments realised that subsidies had been incorrectly set. Germany and the UK both brought in sudden, unscheduled cuts to solar support last year, while Spain – by far the world's largest PV market back in 2007 and 2008 – suspended all incentives for new projects at the start of 2012. Italy, the largest solar market in 2011, set an overall EUR 6.7bn cap on subsidies for that technology in 2012. That cap is likely to be breached this year.

More damaging to investor confidence than new caps or sudden reductions are retroactive cuts in support, which reduce the revenues of renewable power projects that are already operating. Spain was the first to announce retroactive cuts – at the end of 2010 – in its case, as part of an attempt to address a multibillion-euro energy system deficit that was technically a government liability. It has since been followed by the Czech Republic, Greece and Bulgaria. In some cases, these curbs on existing wind and solar plants have taken the form of

FIGURE 30: SUPPORT SCHEMES FOR NEW RENEWABLE POWER PROJECTS IN THE EU-27, 2013



Source: Bloomberg New Energy Finance

additional taxes on revenues, in others they have directly limited the plants' access to subsidies. So far in 2013, Romania, Estonia and even Germany, though to a much lesser extent, have also threatened to join the retroactive cut club.

Support for renewables in Europe is being squeezed partly by wider economic forces, and partly by their very success. Technology cost reductions – especially for PV, where average module prices have fallen over 80% in five years – resulted in improved returns for developers, and this all happened faster than incentives could adapt.

Investors have also struggled with policy uncertainty in many markets. The UK and Poland oversaw multiple delays in announcing their new green certificate banding levels, while the UK is also undertaking wider electricity market reforms to kick in next year. France will do likewise this year after a national debate on energy transition, while a legal challenge over the feed-in tariff for onshore wind made debt financing hard to come by in 2012. One step that EU countries have taken to reduce policy uncertainty is through so-called degression mechanisms, which add some predictability to subsidy cuts. There are various designs but all adjust incentives at regular intervals, usually based on the capacity installed in a given period. France brought in such a cost control mechanism for PV in 2011, while Germany started doing so on a monthly basis and the UK followed (quarterly) in 2012. The UK also has a levy control framework that limits how much can be added to consumer energy bills to fund clean energy projects. The aim is to help to reassure investors that costs will not spiral towards sudden or retroactive policy changes.

Second, to drive down costs through competition, and control the type and quantity of capacity installed, EU governments are increasingly turning to tenders and auctions. These have been more the preserve of emerging economies like Brazil (see below), but France and Portugal, and Denmark for offshore wind, have kept them going in the EU. Lithuania joined their ranks in 2011, and last year Italy replaced its green certificate scheme for wind, biomass and some other technologies, with feed-in premiums allocated by auction. The Netherlands does likewise through competitive rounds, and the UK intends to follow a similar path for its new contracts for difference feed-in tariffs by the end of the decade. These schemes reflect hybrid policy designs that combine the competitive allocation of tenders with more market-integrated incentives.

The market integration of renewable energy has become a hot topic in Europe. The aim is to manage system balancing linked to higher levels of variable supply, and lay the ground for renewables to participate ultimately without subsidy. Not so long ago, the region was largely divided between two support schemes – fixed feed-in tariffs, and green certificate schemes spurred by obligations on suppliers to source a rising share of renewable power each year. Now the picture is becoming more complex (see Figure 30).

Notably, the region's foremost green certificate schemes – Italy (in 2012) and the UK (from 2014) – are being phased out in favour of feed-in premiums, allocated by auction. The idea here is that renewable power producers should take responsibility for selling their power into the market, but also get a top-up on the power price to a stable remuneration level, which helps lower their cost of capital.

While that may be a current trend, it is far from inevitable: clean energy policy is not static, rather responding to market needs, risks and technological developments. Indeed, the Netherlands has been examining moving over to a green certificate scheme. Spain, meanwhile, has removed a market premium option for existing producers, instead limiting them to fixed tariffs as a way to control costs as it battles its power sector tariff deficit, now swollen to EUR 30 billion.

The penetration of renewable energy is also an issue for power grids, partly due to those grids' lack of flexible balancing options. In Germany, wind and solar capacity in excess of 30GW each means renewable output frequently meets 20–25% of demand. However, limited grid connections between north and south has resulted in a surge in unscheduled cross-border flows to Poland and the Czech Republic, putting strains on their power systems.

Both those countries are installing transformers to manage those flows better. This is not necessarily a sign of fragmentation: they are tools for grid stability rather than market protection, and market coupling remains in the interest of both countries. A single European market is indeed a central plank of EU policy under the Third Energy Package.

A single market, combined with grid development and greater interconnection and coordination, would also offer more options for hedging variability, especially in the absence of alternative large-scale energy storage. Despite Germany's grid limitations, Austria – which is coupled to the German market – has benefitted by soaking up cheap power with its 7.5GW of pumped hydro storage. Norway still harbours ambitions of becoming 'Europe's battery' through the same technology.

The growing penetration of renewable energy is a challenge for the EU's integration ambitions in other ways. The 27 nations share the burden of reaching their 2020 renewable energy targets, and both physical and statistical transfers could make that more efficient, but separate support schemes add complexity and few countries have explored joint cooperation. The risk of fragmentation has been compounded by the introduction of national capacity mechanisms – with Belgium and the UK

set to join France and Ireland, among others, in laying out new incentives for guaranteed dispatchable capacity or demand response. This is to maintain capacity margins as well as back up intermittent renewables.

The European Commission is grappling with how a patchwork of national incentives impacts market integration, as it looks to further targets for 2030. It is also considering how clean energy and efficiency policies play into the EU Emissions Trading System. That carbon market, supposedly the centrepiece of integrated European low-carbon policy, has been plagued by oversupply – and the European Parliament in April this year failed to agree a fix. In May 2013, the December 2013 European Union Allowance price was EUR 3.53 per tonne, compared to just over EUR 20 two years before. Without moves to bolster the carbon price, there may be more national interventions, such as the UK's carbon price floor, which came into effect in April 2013.

UNITED STATES

The US, the world's largest economy and its second largest emitter of harmful greenhouse gases, is a clean energy policy paradox. The country lacks the types of overarching CO2 reduction or clean energy generation addition goals present in Europe, Australia, and elsewhere. Yet the US made more clean energy financial stimulus available than any other nation from 2009 through 2012. Some 21 US states have virtually no major clean energy policies on their books, yet another 29 have established binding renewable portfolio standards (see Figure 31). The federal government imposes no specific

taxes on CO2 emitters and runs no national cap-and-trade programme, yet the Environmental Protection Agency is trying to finalise rules that would effectively bar the development of any new coal-burning power plants without CO2 capture in the US for the foreseeable future.

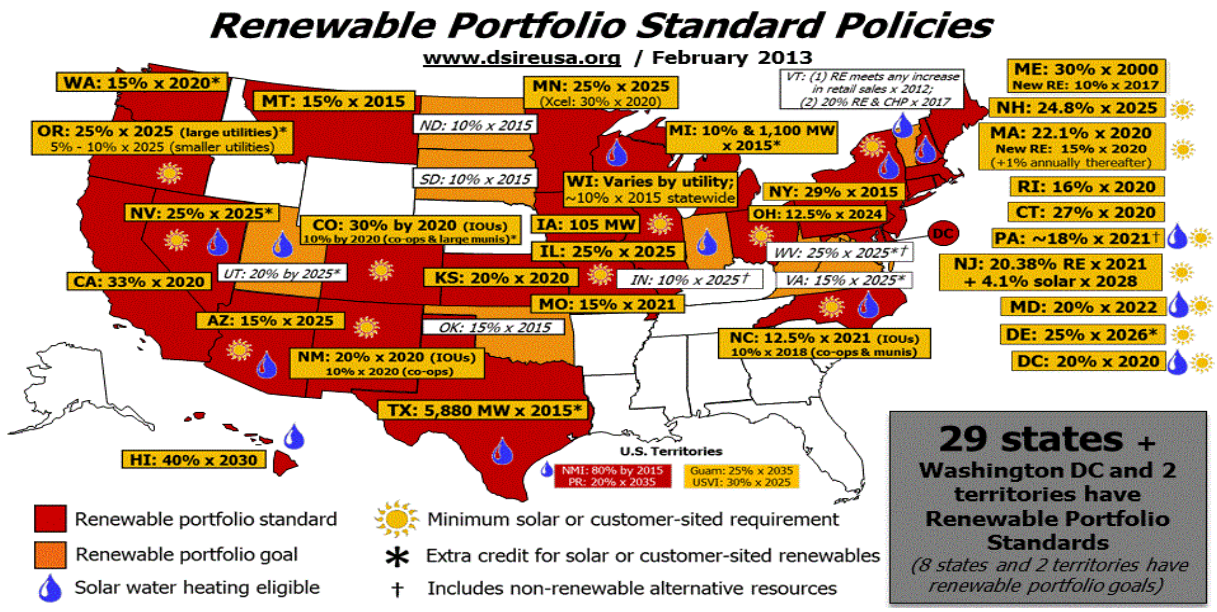
In fact, if there is one consistent theme that defines US clean energy policy it is inconsistency. Project developers, manufacturers, and financiers operate across a patchwork of varying local, state, and federal policies with virtually every jurisdiction offering its own unique set of regulations, subsidies, or tax breaks. Meanwhile, at the federal level, Congress sends its own inconsistent signals by allowing the wind sector's most important subsidy – the Production Tax Credit (PTC) – to lapse repeatedly.

Congress passed no major energy legislation in 2012, which was hardly surprising given the sharp divide between Democrats who control the Senate and Republicans in charge of the House. Election year politics further complicated matters. Efforts to establish a national renewable electricity standard setting binding goals for clean energy capacity additions were unsuccessful and key cap-and-trade champions, recognising the politically challenging conditions, did not make a serious attempt to re-open the issue.

Congress's only recent, albeit relatively minor, clean energy legislative accomplishment actually occurred on 1 January 2013, when it approved a one-year extension of the PTC. For months, clean energy advocates had pleaded for the tax credit's extension, arguing that demand for new wind capacity would collapse in 2013 without it. But Congress waited until the very last minute to act – in fact, after the last minute. The credit expired at the stroke of midnight 31 December 2012; Congress gave final approval to an extension the next day.

President Barack Obama said in his State of the Union address to Congress in February 2013: "If Congress won't act soon to protect future generations, I will." He added: "I will direct my cabinet to come up with executive actions we can take, now and in the future, to reduce pollution, prepare our communities for the consequences of climate change, and speed the transition more sustainable sources of energy." Obama's remarks served as a reminder to Congress of the administration's power to act unilaterally to address climate issues through the EPA.

FIGURE 31: US STATES WITH RENEWABLE PORTFOLIO STANDARDS, AND THOSE WITHOUT



The Database of State Incentives for Renewables & Efficiency (DSIRE) is a comprehensive source of information on state, local, utility, and federal incentives and policies that promote renewable energy and energy efficiency. Established in 1995 and funded by the US Department of Energy, DSIRE is an ongoing project of the NC Solar Center and the Interstate Renewable Energy Council.

Source: Dsireusa.org

The administration must finalise EPA rules on new coal-fired generation projects, then release draft regulations pertaining to existing coal-fired generation. Combined, these actions have the potential to curtail development of any new coal power in the US and hasten the mothballing of some substantial portion of the approximately 317GW of coal capacity currently online. Already, these regulations and low natural gas prices are making it virtually impossible to finance and build a new coal project in the US.

At the state level, renewable portfolio standards are no longer the drivers of clean energy capacity additions they once were. In a number of cases, RPS targets have either been met or exceeded by local power generators. This has prompted some states to try to expand their RPS, though little progress was achieved in 2012. In fact, in November Michigan voters decisively rejected a ballot initiative that would have raised that state's RPS target from 10% by 2015 to 25%.

There are bipartisan efforts in Congress this year to extend tax-efficient structures such as Master Limited Partnerships, currently available to the oil and gas industry, to renewable energy projects in the US for the first time.

Finally, California continues to be the US pacesetter on clean energy and carbon policies. The Golden State for the first time auctioned off allowances to emit carbon in February 2013. The auction was not without its share of snafus and regulators continue to tweak the system today. At the time of writing, California carbon prices, at $14.65 per tonne were around three times as high as those in the European Emission Trading System.

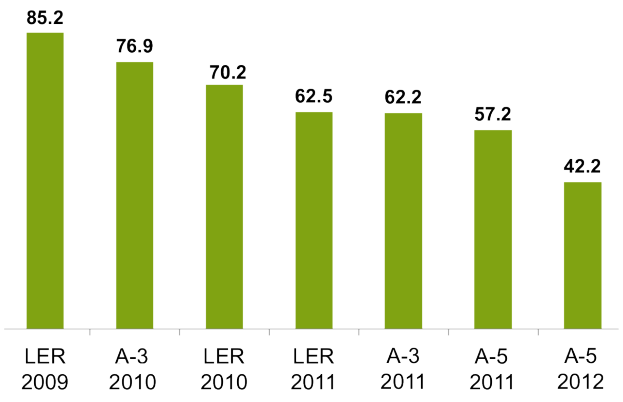
EMERGING MARKETS

Emerging market countries have studied the policy developments in Europe and tried to use the lessons from those in crafting measures to deliver clean energy capacity, minimise costs and deliver job creation. Policy-makers in countries like India, Brazil and South Africa took two important decisions as they launched their own renewable energy programmes. First, they decided to limit incentives to a fixed defined capacity. Second, they opted for reverse auctions on tariffs.

India's National Solar Mission, for instance, began with a target of 1GW of grid-connected installations by 2013. As developers competed to get the right to build projects under what is an implied sovereign guarantee of payment, they drove the price down to record lows.

The disadvantage with a competitive bidding system for renewables is that it is difficult to stop developers lodging unrealistic bids. Though policy has evolved to weed out non-serious players through stringent eligibility criteria and a requirement to provide financial guarantees before bidding, there are often projects that slip through with only a remote chance of ever being built.

FIGURE 32: POWER PURCHASING AGREEMENT PRICES FOR WIND SUBMITTED IN BRAZILIAN AUCTIONS, 2009-2012, $ PER MWH



The X axis shows different capacity and energy auctions. A-3 means project for delivery in three years, A-5 projects for delivery in five years. LER means reserve energy auction.
Source: Bloomberg New Energy Finance

Brazil, the largest economy in South America, has managed to attract some of the lowest tariff bids in the world when it tendered for wind projects. In the December 2012 auction for 574MW, nearly half was allocated to wind projects at a record low average tariff of BRL 88 ($42) per MWh (see Figure 32), much lower than Bloomberg New Energy Finance's lowest estimates of the levelised cost of energy for onshore wind. Estimated equity returns from these projects are at or below 10%, placing a question mark on how much of this capacity will in fact be built.

There is therefore a case for further strengthening the checks and balances for qualified bidders, as competitive bidding becomes the policy tool of choice in the small and large emerging markets. South Africa, a large emerging market that made a sudden entry into the list of top 10 investors in clean energy, toyed with the idea of feed-in tariffs at the beginning stages of its programme before settling in favour of a tender mechanism.

Peru has also opted for reverse auctions for renewable projects, as did Uruguay (in 2011). Morocco is planning an auction for its first batch of solar PV projects, having already held a tender for solar thermal capacity.

In countries where retail power prices are high however, companies are not waiting for incentives to build renewable energy plants. In northern Chile for example, mining companies are partnering with developers and utilities to build projects. Chilean mining giant Codelco announced (in the third quarter of 2012) that Energia Llaima and Sunmark had won the rights to develop and operate the 35MW Minera Gaby solar thermal plant via a private auction sponsored by Codelco. The project will be financed by the mining company which will also be the power off-taker. Turkey, another country which has high retail tariffs, has renewable energy developers opting to sell power in the merchant market rather than at the feed-in tariff rate since the market prices are higher.

In many emerging economies, clean energy generation is paid for by a small surcharge on consumer bills. There are some local content incentives in place to encourage domestic manufacture and domestic jobs. Brazil makes financing from the local development bank BNDES conditional on securing local content in the project. India insisted on locally manufactured modules in the federal programme, but there were enough loopholes to allow through some imports. Saudi Arabia is also planning additional weighting for companies promising higher local content as it works on a competitive bidding plan for its ambitious 72GW low-carbon energy build-out, which includes 25GW of solar thermal, 16GW of PV and 17.6GW of nuclear.

Chinese solar projects have been supported by capital grants (such as the Golden Sun subsidy programme) and feed-in tariffs, as well as Clean Development Mechanism credits, but there is a move towards market-based mechanisms even in this centrally planned economy. A new proposal under discussion looks at solar PV tariffs based on a tender process, with only maximum rates specified.

Wind capacity auctions came first in China to drive down prices and as a means of price discovery. A feed-in tariff was set in 2009 and that has been in place ever since. Other supportive policies for Chinese wind include massive central and local government support for industries and power companies developing projects, in the form of land grants, low-cost credit and political incentives. Power purchasing agreements at the feed-in tariff level are automatically provided by the State Grid monopoly. The feed-in tariff is paid for by a surcharge on consumers. There are also central and provincial targets for wind and RE development from the five-year plans. Though not legally binding, they act as a form of soft renewable power purchasing mandate.

Feed-in tariffs attract varying amounts of favour in sub-Saharan Africa outside South Africa. In Kenya, the Ministry of Energy finalised a feed-in tariff policy in 2008, but it failed to attract investment. After a review in December 2012, the government intends to start competitive bidding for projects larger than 10MW. Ghana has a feed-in tariff system, and assurances of grid connection for renewable plants. There has been a trickle of announcements of renewable energy projects in this west African country including, in December 2012, from UK-based Blue Energy for the 155MW Nzema solar power plant.

Uganda is also sticking with a feed-in tariff programme, which was started in 2007, revised in 2010 and last updated in 2012. The incentive tariff – which excludes the solar sector – is payable for projects of up to 20MW, for 20 years. In what seems to be a novel arrangement, an additional grant per unit of renewable power generated is payable under the GET FiT programme backed by institutions like KfW, the UK's Department of Energy and Climate Change and UKaid. This East African country also boasts a financial agency to support renewable energy projects: Uganda Energy Credit Capitalisation Company. Similar institutions are also seen in other emerging markets. India, for instance, has the Indian Renewable Energy Development Agency.

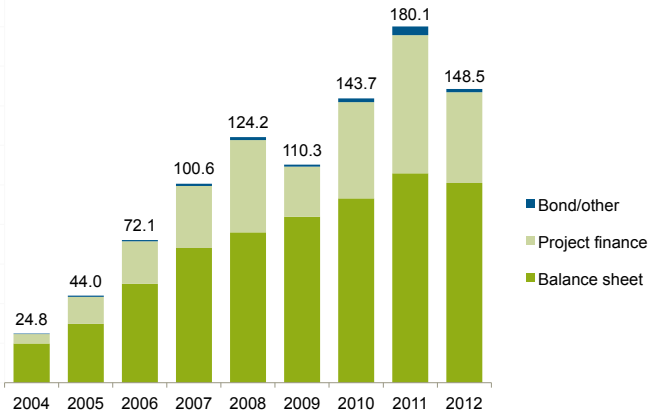
ASSET FINANCE

- Asset finance of utility-scale renewable energy projects fell 18% in 2012 to $148.5 billion, reflecting policy uncertainties in key countries but also reductions in equipment costs.
- Solar asset finance dropped 24% to $52.7 billion. PV system prices were sharply lower than in 2011, and there was a slump in the financing of solar thermal projects in Spain and the US.
- There was a 9% decline in wind asset finance in 2012, as the Chinese market paused for breath and US financings ground almost to a halt.
- The biggest setback in asset finance was that suffered by the biofuel sector, where the 2012 total was down 62% on 2011 and the lowest for at least nine years.
- At the other extreme, small hydro put in the strongest year-on-year performance, its asset finance total running 19% ahead to $7.4 billion in 2012, a record for the last few years.
- Two thirds of asset finance, or some $101 billion, represented balance sheet financing by utilities and energy companies. This compared to 59% of a larger total in 2011.

Once again in 2012, asset finance of utility-scale projects made up the lion's share of total investment in renewable energy. Utility-scale means wind farms, solar parks and other renewable power installations of 1MW or more in size, and biofuel plants of more than one million litres' capacity[19].

In 2012, asset finance totalled $148.5 billion, down 18% on 2011's record figure of $180.1 billion but ahead of the previous year's $143.7 billion. As a proportion of overall renewable energy investment, asset finance represented 61% in 2012, compared to 65% in 2011. That four-point reduction reflected the fact that a rising share of total investment is going into small (less than 1MW) residential and commercial solar projects, rather than larger undertakings. Those small projects are examined in Chapter 5.

FIGURE 33: ASSET FINANCING NEW INVESTMENT IN RENEWABLE ENERGY BY TYPE OF SECURITY, 2004-2012, $BN



Total values include estimates for undisclosed deals.
Source: Bloomberg New Energy Finance

Figure 33 shows the trend in three types of asset finance – on-balance-sheet financing by utilities and large energy companies; non-recourse project finance, in which debt and equity are raised for the project itself rather than for a parent company; and bond and other approaches such as leasing. Significantly, in 2012, there was

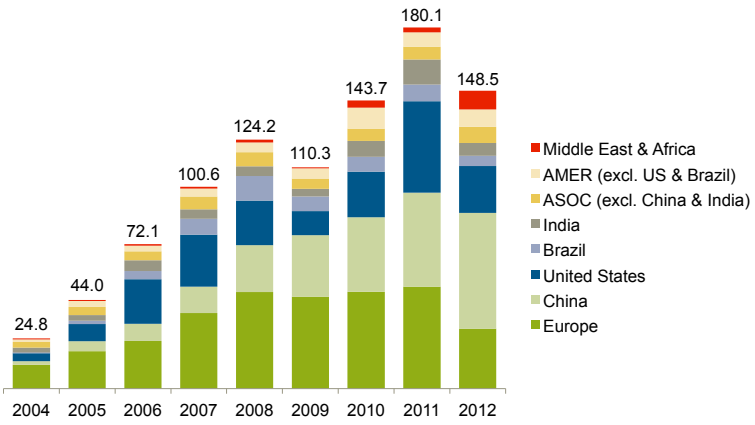
[19] Small hydropower projects of between 1MW and 50MW are included, while larger hydropower undertakings are shown in a separate total for the reasons set out in the Methodology and Definitions section. There is a separate box on large hydro at the end of this chapter.

only a modest setback in the first category – on-balance-sheet financing – with this slipping just $4.9 billion from 2011 levels, to $101 billion. The third category – bond and other – showed a big percentage reduction, albeit from much more modest levels, to $1.6 billion in 2012, from $4.4 billion the previous year.

That meant that the lion's share of the $31.6 billion fall in renewable energy asset finance last year came from non-recourse project finance, which declined from $69.8 billion in 2011 to $45.9 billion in 2012. This reflected three main changes – the sharp fall in US financings last year, after the expiry of the Treasury grant programme and federal loan guarantee scheme; a reduction in deal flow in onshore wind and PV in several European countries, in the face of subsidy cutbacks; and a slump in financings of solar thermal projects in their two main markets, Spain and the US, after a hectic year in 2011, when these technologies saw investment decisions totalling $19.3 billion, with much of the money coming from non-recourse project finance. In 2012, this totalled just $5.3 billion, with the largest deals – at just over $1 billion – being for the 100MW KaXu Solar One project in the Northern Cape, South Africa, which secured debt from a club of six banks led by FirstRand Bank, and the 160MW Masen Ouarzazate solar thermal electricity generation plant in Morocco. The latter received debt from eight lenders, including the African Development Bank, the World Bank, the European Investment Bank and Agence Francaise de Developpement.

The US market has grown familiar and comfortable with bond issues for renewable energy projects, and indeed Warren Buffett's MidAmerican Holdings launched an $850 million bond issue in February 2012 to finance its 550MW Topaz Solar Farm in California, only to see it oversubscribed by more than $400 million. However, the European market for renewable energy bond finance is much less developed. In 2010, SunPower financed its 72MW Montalto di Castro PV project in Italy, then the largest in Europe, via a bond issue partly taken up by the European Investment Bank. However there was no comparable European bond issue in 2011 or 2012 – despite efforts by investment banks to use project bonds as a way of getting pension fund money into the financing of renewable energy projects.

FIGURE 34: ASSET FINANCING NEW INVESTMENT IN RENEWABLE ENERGY BY REGION, 2004-2012, $BN



Total values include estimates for undisclosed deals.
Source: Bloomberg New Energy Finance, UNEP

Figure 34 shows the split in asset finance between regions. China accounted for $57.7 billion, or 39% of the worldwide $148.5 billion total. This was up from $46.9 billion in 2011, thanks to rapid growth in utility-scale solar. The second biggest region for this type of investment was Europe, at $30 billion, but this was down more than 40% from the previous year's record figure of $50.8 billion. The US saw an even bigger percentage drop in asset finance, of 49%, to $23.4 billion, and India also suffered a near-halving in its figure. The Middle East and Africa region showed the biggest jump in asset finance, from $2.3 billion in 2011 to $9.3 billion in 2012.

Looking at the Chinese performance, some of the largest projects getting the investment go-ahead in 2012 included the Talesun Gansu Jiayuguan PV plant phase II, at 100MW and $400 million; the similarly sized Zenfa Solar Jinchuan PV plant and Huanghe Hydropower Geermu PV project; and a stream of large wind parks around the 200MW size level, and either side of $300 million in investment, including CGNWP Guyuan Huanggaizhuo, Huadian Hami Southeast Kushui, and CGNWP Sheyang.

In Europe, two offshore wind financings stood out in terms of dollar value. In June 2012, Centrica, Dong Energy and Siemens Project Ventures secured $660 million in debt for the development of the 270MW Lincs project, off the coast of eastern

England. The lenders to Lincs included Bank of Tokyo-Mitsubishi, Lloyds Banking Group and BNP Paribas, and they offered loans even though the project was only at the construction stage. The balance of the $1.6 billion cost is being provided by equity and debt from the three project owners.

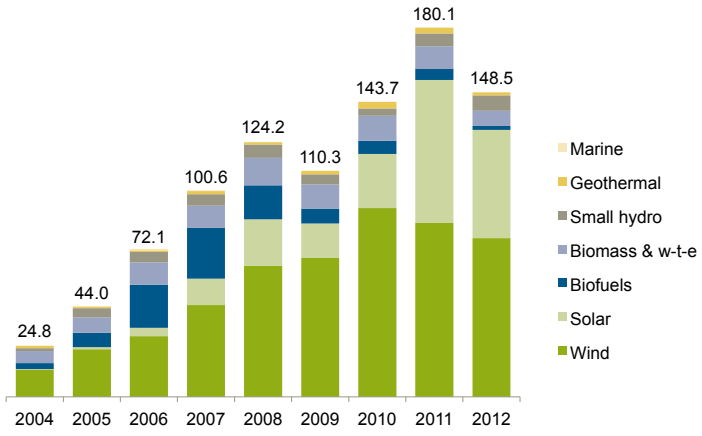
The other deal saw investors Colruyt and Aspiravi harness $742 million in debt for the 216MW Northwind project in Belgian waters. The lenders included the European Investment Bank, Rabobank and ING Groep, and the total investment cost is expected to be $1.1 billion. Construction was due to start on Northwind in 2013.

In North America, the biggest financings included $885 million for the 470MW Flat Ridge Wind Farm Phase II, being developed by BP Wind and Sempra US Gas & Power in Kansas, $719 million for Pattern Energy's 265MW Ocotillo Wind Farm Phase I in California, and $582 million for Tenaska's 130MW Imperial Solar South PV project in the south of the same state. Canada saw the financing of the 150MW Halkirk I wind farm in Alberta, for $373 million.

However the really eye-catching development in asset finance was the spread of large deals out of the "core" markets of China, Europe and North America, to newer markets. Morocco was a classic case, accounting for two deals in the top 10 worldwide last year – the $1.2 billion investment go-ahead for the 160MW Masen Ouarzazate solar thermal project phase one, and the $563 million financing of the 300MW Tarfaya wind farm by Nareva Holding and International Power. Lenders to these two undertakings included multilaterals such as the European Investment Bank and the African Development Bank in the case of the former, and commercial providers Attijariwafa Bank and Banque Centrale Populaire in the case of the latter.

Mexico also boasted a top 10 deal – the $961 million financing of the 396MW Marena Renovables wind portfolio in Oaxaca state, with a group of six banks contributing $693 million in debt, and Danish export credit agency EKF providing cover for the turbine contract with Vestas. Brazil saw the 258MW Verace wind portfolio in Rio Grande do Sul financed for $497 million.

FIGURE 35: ASSET FINANCING NEW INVESTMENT IN RENEWABLE ENERGY BY SECTOR, 2004-2012, $BN



Total values include estimates for undisclosed deals.
Source: Bloomberg New Energy Finance, UNEP

Japan and South Korea also loomed larger in asset finance than in previous years, and contributed to the rise in asset finance in the Figure 34 region called Asia and Oceania (excluding China and India). One of the big projects going ahead in Japan in 2012 was Kyocera's 70MW Nanatsujima PV plant, at $345 million, while South Korea saw $373 million invested in the 80MW first phase of Korea Electric Power's West Sea offshore wind farm.

Figure 35 shows the breakdown of asset finance in 2012 by sector. Wind and solar were even more dominant than in previous years, accounting for 88% of the total compared to 86% in 2011, 82% in 2010 and just 57% back in 2007.

Looking at the smaller sectors, biofuels saw just $2 billion of projects financed in 2012, down from $5.3 billion in 2011, and far below the peak of $24.6 billion in 2007, when the US corn ethanol boom was giving way to the Brazilian sugar ethanol surge. Geothermal asset finance slipped to $1.6 billion, from $2.9 billion.

Biomass and waste-to-power also suffered a setback in terms of asset finance last year, its total dropping to $7.4 billion, the lowest since 2004, from $11.1 billion in 2011. There were still some significant projects financed – including the 167MW Metso Vasteras biomass plant in Sweden, at $388 million, and the 22.5MW MVV Umwelt waste-to-energy plant in Plymouth, England, at $244.5 million.

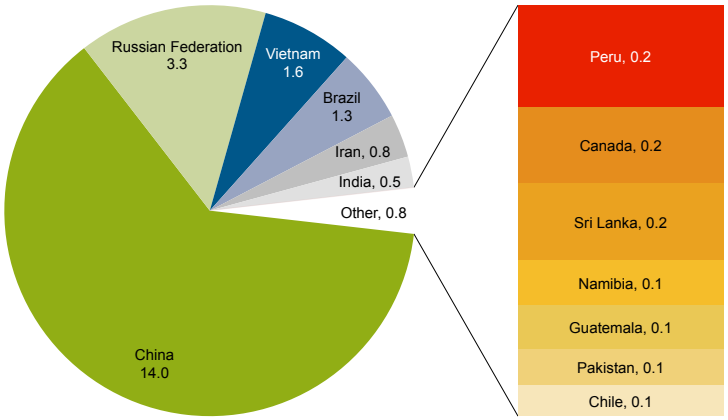
The only renewable energy sector to show clear growth in 2012 was small hydro. As well as a stream of sub-50MW hydro deals in China, there were sizeable transactions in Indonesia – $174 million for the 45MW Wampu project in Sumatra, developed by Korea Midland Power, Mega Power Mandiri and Posco Engineering; and $116 million for the 50MW Celec Quijos plant in Ecuador. Brazil saw $128 million proffered for the 44MW Guanhaes Energia portfolio in Minas Gerais state.

LARGE HYDROPOWER

Investment in large hydro-electric projects of more than 50MW continued to be significant in 2012, amounting to more than any other renewable energy sector other than wind and solar. Bloomberg New Energy Finance's estimate is that some 22GW of large hydro capacity was commissioned last year, roughly in line with the figures for earlier years.

By far the largest part of this (14GW) was installed in China, with the Russian Federation, Vietnam and Brazil the only other countries accounting for more than 1GW in 2012 (see Figure 36).

FIGURE 36: LARGE HYDRO CAPACITY ADDITIONS BY COUNTRY, 2012, GW



Source: Bloomberg New Energy Finance

Translating that into asset finance dollars is not straightforward because the average large hydro project takes four years to build once the final investment decision is made, and some – such as the 22.5GW China Three Gorges dam or the 7.1GW TaSang undertaking in Myanmar – take much longer than that. By comparison, onshore wind projects take an average of nine months to build, and PV projects three-to-six months.

Data on final investment decisions in large hydro in 2012 are not as complete as the equivalent for projects in other renewable energy technologies, so we will instead use an approximation for investment, based on the amount of commissioned capacity last year, times an average value per MW. The latter is around $1.5 million worldwide, based on figures provided by developers of large hydro projects in application for the Clean Development Mechanism[20]. So the estimated asset finance figure for 22GW last year would be some $33 billion – just over a fifth the $148.5 billion value of asset finance in renewables excluding large hydro.

This $33 billion figure excludes investment in small hydro projects of less than 50MW, which was $7.4 billion in 2012, as mentioned above. It also excludes investment in two other areas – in pumped hydro storage, and in the refurbishment and repowering of existing large hydro-electric projects. Refurbishment has grown rapidly in recent years, to account for a significant share of the business in particular of European equipment manufacturers such as Alstom, Andritz and Voith.

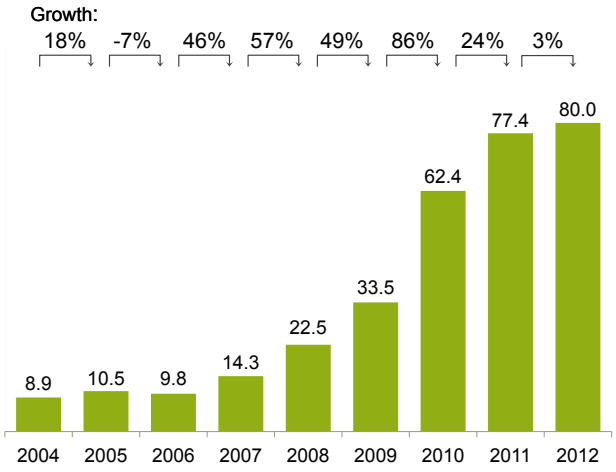
Among the largest hydro projects seeing notable activity in 2012 were the 11GW Belo Monte dam in Brazil, and the 13.9GW Xiluodu and 13.1GW Baihetan projects in China. Elsewhere, the doubling to 520MW of the Alqueva I plant in Portugal was completed; additional capacity was added at the Xiangjiaba plant in China, towards its targeted eventual size of 6.4GW; and Rushydro commissioned three units with a total of 999MW at its Boguchanskaya project in Siberia.

[20] There is in fact a wide range of costs per MW cited in CDM applications, recent ones including $1.3 million per MW for the 260MW Trung Son Hydro Power Project in Vietnam and $1.8 million per MW for the 334MW Adjaristsqali Hydro Project in Georgia.

SMALL DISTRIBUTED CAPACITY

- A third of total investment in renewable energy went to small-scale projects last year – some $80 billion – thanks to generous subsidy support and declining solar module prices.
- Investment in small generation capacity worldwide rose for the sixth consecutive year in 2012, though at a slower rate – 3% compared with the 23% growth seen in 2011.
- Germany took back the lead from Italy last year but both saw spending decline – by 15% (to $15 billion) and 43% (to $13 billion) respectively. Japan overtook Italy in 2012 thanks to its new feed-in tariff: it ramped up spending on small solar PV projects by 56% in 2012 to $13.1 billion.
- All of the European countries in the top 10 (apart from Greece) saw small-scale investment drop in 2012, as austerity-hit governments sought to limit pressure on electricity consumers, by cutting renewable power subsidies.
- Solar water heaters are not included in the main investment figures in this report but nonetheless constitute another important area of activity. China, by far the biggest market for solar water heaters, saw growth of 16% in 2011 – a trend that is likely to continue thanks to policy incentives and cost factors.
- Global solar water heater capacity is estimated to have been 234.6GWh in 2011, and to have increased by 33.5GWh in 2012.

FIGURE 37: SMALL DISTRIBUTED CAPACITY INVESTMENT, 2004-2012, $BN



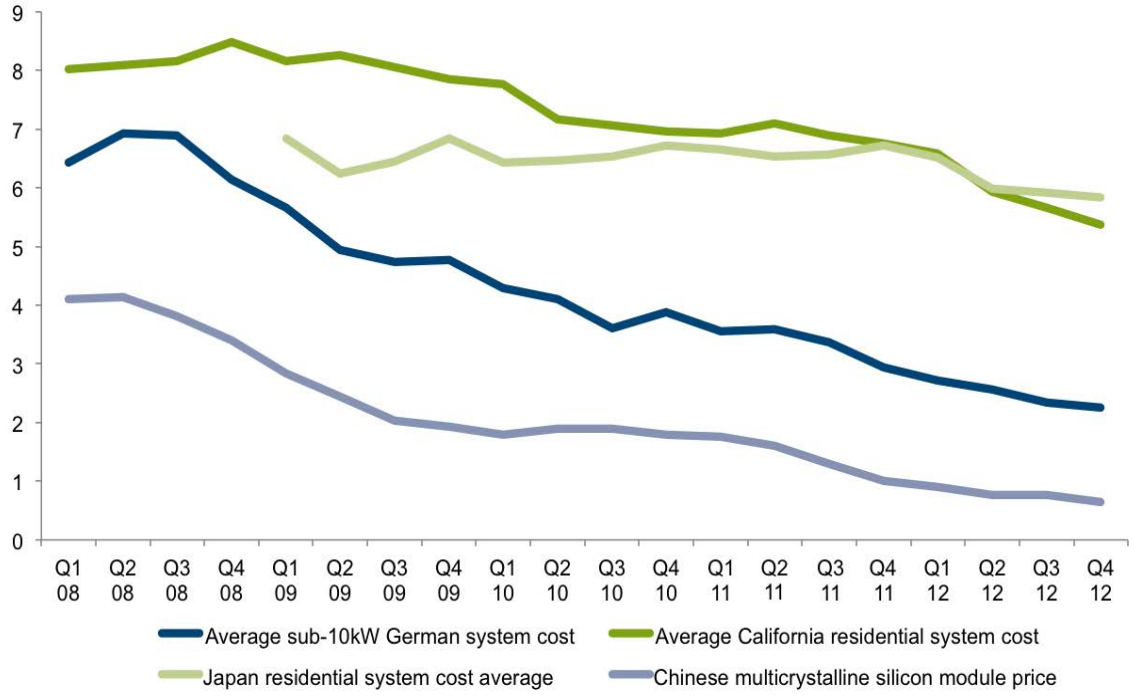
Represents investments in solar PV projects with capacities below 1MW
Source: Bloomberg New Energy Finance

Small distributed capacity[21] was the renewable energy stalwart of 2012, managing to record another year-on-year increase despite the economic woes and policy uncertainty that have hit utility-scale projects. Figure 37 shows that the year 2012 saw investment in small-scale installations rise by 3% to $80 billion, compared with a decline of 12% in total new clean energy spending. This meant that projects of less than 1MW capacity attracted almost a third of the total investment in renewable energy – up from 28% in 2011 and 27% in 2004.

The 3% rise in small-scale investment last year may not be near the 24% growth seen in 2011

[21] Defined as projects of less than 1MW – typically rooftop and other small-scale solar PV installations.

FIGURE 38: SMALL PV SYSTEM COST IN JAPAN, GERMANY AND CALIFORNIA, $/W

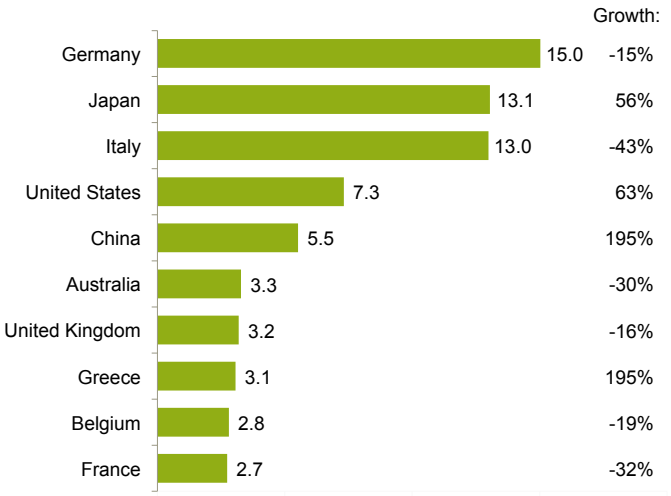


Source: Bloomberg New Energy Finance

but it disguised a stronger trend in terms of capacity added. Average prices for a multicrystalline silicon module dropped from $1.02 per Watt in the first week of 2012 to $0.78 per Watt in the last week.

This helped small-scale system prices to fall across the globe in 2012, causing the levelised cost of solar power to decline by nearly a third over the year, from $196.29/MWh to $138.43/MWh. Japan and California still have more expensive systems than Germany, partly because solar projects in the European country do not pay significant sales tax (around 19%) and incentives in Japan and California support higher prices. Figure 38 shows how small PV system costs have fallen in Japan, Germany and California since 2008.

FIGURE 39: SMALL DISTRIBUTED CAPACITY INVESTMENT BY COUNTRY, 2012, AND GROWTH ON 2011, $BN



Top 10 countries. Represents investments in solar PV projects with capacities below 1MW
Source: Bloomberg New Energy Finance

Three countries attracted just over half of all small-scale investment in 2012 – Germany, Italy and Japan: Germany regained the lead from Italy but both saw spending fall – by 15% and 43% respectively (see Figure 39). The largest EU member economy has implemented a raft of cuts to its solar feed-in tariffs in the last 18 months, with the aim of lessening the burden on consumer electricity bills.

Germany began 2012 with a 15% reduction followed by another decrease of between 20.2% and 29% in April, a cut that was preceded by a rush of installations in March. The grid regulator, Bundesnetzagentur, estimated that some 1.9GW of PV projects were installed in Q1 2012, of which 1.2GW came online in March. The government has since implemented a system of monthly degressions to the feed-in tariff, based on how much capacity is installed in a particular period.

As project developers rushed to pre-empt the subsidy reductions, solar installations in Germany reached 7.6GW in 2012 – up 2% on 2011 – according to the grid regulator. This was double the government's target of 3.5GW. Even with the subsidy cuts, the tariffs still attracted developers, while component prices continued to drop.

The reduced subsidies may start to bite in 2013, however, if a fall of 66% in solar installations in Q4 2012 on 2011 levels is a sign of things to come. Renewable energy policy will be a key issue at this year's federal elections in Germany and the government has been mulling a move away from feed-in tariffs (see Chapter 3).

Germany is not alone in curbing support for renewable energy: in April, the Italian government published the fifth Conto Energia, which cut feed-in tariffs on average by 35% for ground-mounted PV projects and 40% for rooftop systems. The law came into force in August.

Another emerging trend in Europe has been the use of tariff degression mechanisms to reduce support in a predictable way based on the level of the capacity. Like Germany, the UK's feed-in tariffs for small-scale projects now follow a quarterly degression system. The island nation saw a 16% decline in small solar PV investment in 2012.

Greece offered some of highest solar feed-in tariffs in Europe in 2012, helping it to achieve the fastest growth rate in small-scale investment of the top 10 countries. The 195% growth occurred even though the austerity-hit nation reduced its feed-in tariff by 17% in February and halved support for residential projects in August.

Though just over half of small-scale investment still took place in Europe last year, distributed PV has broadened its geographical base in recent years:

Japan remains one of the fastest-growing large solar markets in the world, increasing investment in small-scale projects by 56% in 2012. The increase was partly driven by the initially generous rates of the new feed-in tariff implemented in July as part of the government's strategy to encourage renewable energy investment.

Policy-makers in Tokyo are looking at how to replace the lost power from its shuttered nuclear fleet, as only two of Japan's reactors are online at the time of writing, after the earthquake and tsunami hit the Fukushima-Daiichi nuclear plant in March 2011. Even with the cut in solar power incentives that came into force in April 2013, Japan's support is about three times that offered in Germany and China, meaning the smaller Asian country is likely to be one of the top three solar markets this year.

China more-than-doubled investment in projects under 1MW capacity last year, thanks to a series of supportive policies, as the government worked to diversify its coal-dependent energy industry. In 2012, some 300MW of small-scale projects were approved under the 'Golden Sun' capital subsidy.

China's new leaders, formally endorsed in March 2013, are now focusing on creating a sustainable solar market – not just a big installation number. So far, existing policies do not facilitate grid connection or encourage project quality. As such, in March 2013, the government proposed to set incentive rates based on insolation levels, marking a break from the current feed-in tariff, which sets a uniform subsidy of CNY 1/kWh ($0.16/kWh) for all locations.

Small-scale solar projects may face some challenges in China, such as identifying suitable rooftops and project quality issues. But that country may well unseat Germany as the largest solar market for all project sizes in 2013.

The US came fourth in terms of small-scale outlays in 2012, with $7.3 billion of investment in small PV installations – an increase of 63% on 2011. California leads the country in terms of solar capacity due to lower costs and financial incentives such as the California Solar Initiative. Launched in 2007, this $3.3 billion programme has a target to install 3GW of new solar capacity over the next decade. The state was halfway to achieving this capacity objective by March 2013. Some 442MW of solar projects under 1MW were installed in the state last year compared with 362MW in 2011.

Hawaii is also a good solar market in the US as it has both a high state mandate (40% target for renewable energy by 2030) and attractive incentives for solar PV. In particular, developers can benefit from a 35% state-level investment tax credit on top of the 30% federal tax credit, though authorities intend to reduce the state tax credit to 15% over the next five years.

Worldwide, a number of small solar PV projects made the headlines last year: in August, Chinese PV manufacturer JinkoSolar won an order to supply 1MW of panels to a chrome mine in South Africa's Limpopo province, reducing the site's daytime use of diesel generators.

Meanwhile in Spain, Gehrlicher Solar completed one of the first self-consumption projects for a residential estate in a rural area of Murcia, Spain. The nine houses are not connected to the public grid but will now be able to generate their own power for at least 30 years. Germany's Gehrlicher installed the system of 90 PV modules on the roof of a farm building. It will achieve output of 30kW with battery support and an estimated annual output of 21,100kWh.

Gehrlicher is also involved in the ongoing project to build a solar plant at the Arena Pernambuco football stadium in Brazil. With 1MW peak of capacity, the plant will cost some BRL 10 million ($5.14 million), of which about 90% will come from the Neoenergia Group and the remainder from Odebrecht Energia.

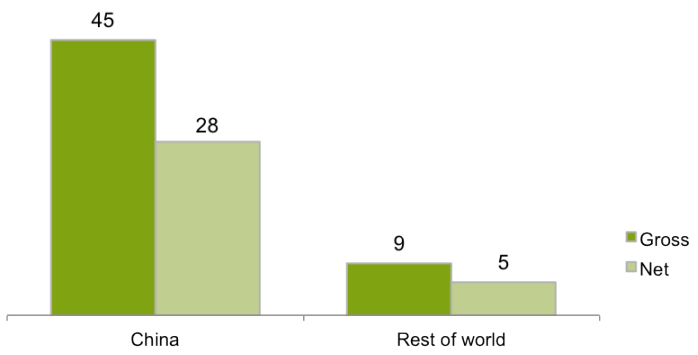
Another German company, Conergy, said in July that it would install a 630kW rooftop solar plant on a Big Shopping Centers site in Beit Shemesh, Israel.

In the US, Solon built 1.15MW of solar systems for the Tanque Verde Unified School District in Arizona. With over 4,000 modules, the system will deliver more than 70% of the campus' energy. The financing structure meant the district did not need to make any upfront investment: under a 'solar services agreement', MP2 Capital will sell all of the power generated from the system to the school district. Tucson Electric Power will buy the renewable energy credits generated by the system, contributing to the local utility provider's renewables target and helping to reduce the overall cost of the system.

In India, Cochin International Airport is set to become the first airport in the country to use solar power for running its utility grid system. Vikram Solar has installed 400 solar panels with peak capacity of 100kW at the airport in the state of Kerala and energy production is estimated at 148MWh a year, to be used primarily for the air conditioning facility. The project benefits from a 30% subsidy under the Jawaharlal Nehru National Solar Mission and the airport has invested some INR 6.3 million ($0.12 million), according to officials.

SOLAR WATER HEATERS

FIGURE 40: GROSS AND NET INCREASE IN CHINESE AND WORLD SOLAR WATER HEATER CAPACITY, 2012, GWTH



Sources: IEA-SHC, REN21 Global Status Report

Water heating accounts for some 15% of households' energy consumption in Europe, with the equivalent figures at 20% for the US and 30% for Japan, according to government and industry estimates. Solar water heaters are compatible with nearly all sources of back-up heat and shield users against rising energy prices as most costs are incurred at the moment of investment, with minimal operating expenses.

It is therefore no surprise that solar water heaters have grown in popularity in recent years: in Europe, for example, the solar thermal market has grown by 9% a year on average over the last decade, according to the European Solar Thermal Industry Federation, though it contracted slightly in 2009-10 due to the financial crisis. The EU and Switzerland saw 2.6GWth of installations in 2011 – a similar volume to that in the preceding year – but this conceals a wealth of variation at country level: its biggest market, Germany, experienced growth of 11% as investors rushed to install heaters before the end of the renewable heat incentives. In contrast, the Italian and Spanish markets shrank by 15% and 20% respectively in 2011 due to policy unpredictability and budget cuts.

The use of hot water heaters in China has continued to increase, expanding by 16% in 2011 to account for over 80% of global installations, according to ESTIF, quoting the Chinese industry association. In addition to subsidies and obligations, this growth is partly driven by solar water heaters' cost-competitiveness with traditional energy sources: on average, electric or gas water heaters cost $95 or $82 a year respectively, compared with $27 for one using energy from the sun, according to the International Energy Agency (IEA). The expansion is likely to continue, as the 12th Five-Year Plan proposes to boost the country's solar water heating capacity to 280GWth by 2015 and 560GWth by 2020.

Global market data from IEA-SHC suggest that year-end 2011 capacity was an estimated 234.6 GWth (335.1 million square meters); the net growth in 2012 was estimated at 33.5GWth.[22] REN21 adds: "Actual installations were higher, however, because there was a significant level of retirements. Most systems last 25 years, but in China system lifetime is below 10 years. China added 44.7 GWth in 2012, but the net increase in operating capacity was only 28.2GWth, so the rest of the market was probably in the 7-10GWth range, bringing the total global market increase in 2012 close to 55GWth." The value of this investment is hard to estimate, given the wide range of prices paid for different solar water heater technologies, but is likely to have exceeded $10 billion.

[22] Mauthner F., Weiss W.: Solar Heat Worldwide – Markets and Contribution to the Energy Supply 2011.

PUBLIC MARKET INVESTMENT

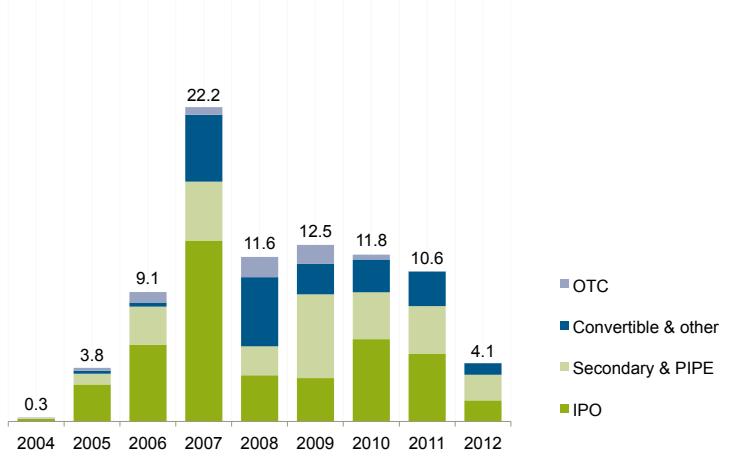
- New public market investment in specialist renewable energy companies slumped by more than 60% to just over $4 billion, scarcely a fifth of the peak level established in 2007, amid economic gloom, a wary investor mood and retrenchment in subsidy support.
- Investment, in the form of new equity-raisings, fell in all sectors, but wind suffered the most: down 72% to $1.3 billion. This left solar as the biggest issuer, down 50% at $2.3 billion. In third place, biofuels shrank 43% to $400 million.
- Equity issues fell in all regions. The US saw a fall of 16%, but China, down 60%, remained the leader and boasted the four largest IPOs. Two bright spots among exchanges were Nasdaq and the Taiwan Stock Exchange, which managed to increase listings values by 66% and 119% respectively.
- Fundraising shrank in all forms of share issue: IPOs and convertibles each raised less than a third of their 2011 totals, while the volume of secondary and private investment in public equity, or PIPE, issues fell by almost half.
- The number of share issues held up better than dollar investment volumes, the former falling only 25% to 81. However, the average deal size almost halved.
- Share values in renewable energy companies suffered another dispiriting year, in spite of a rally from July lows that continued into 2013. The WilderHill New Energy Global Innovation Index (NEX) shed almost 6% in 2012, following a 40% swan-dive in 2011, while solar stocks fell by 29% and wind by 14%.

Last year was another tough one for new public market investment in renewable energy. The economic backdrop, though not quite so turbulent as 2011, remained bleak, and many familiar problems continued to beset the sector. Continuing fiscal austerity and concern about the burden on electricity bill payers led to further reductions in subsidies for renewable generation in Europe, while overcapacity and plunging product prices led to rising losses in wind and a rash of insolvencies in solar. Trade disputes and record low gas prices in the US intensified the discomfort.

The negative cocktail for public market valuations of clean energy companies came despite the fact that installations of both wind and solar capacity set new records in gigawatt terms, as developers scrambled to take advantage of subsidies and tax breaks before the terms worsened or the measures were abolished altogether. Global PV capacity installation managed a rise of 7% to 30.5GW, while global wind installation rose 16% to almost 48.4GW. Neither statistic did much to relieve the general gloom over market conditions, share valuations and issuance. As shown in Figure 41, all forms of public market fundraising fell in 2012, with IPO and convertible issues particularly hard hit. Each fell by more than two thirds, to levels not seen since 2004 and 2006 respectively.

The year 2012 saw further retrenchment in government support for renewable energies. In biofuels, the European Commission reacted to concerns about the sector's impact on agriculture with a proposal to reduce the target share of conventional biofuels in 2020 to 5% of total transport fuel. In the US, a federal mandate for the production of 1 billion gallons of cellulosic ethanol was slashed to just 14 million gallons when it was realised the original target was unrealistic. In solar, there were widespread cuts to feed in tariffs in major markets such as the UK, Germany and

FIGURE 41: PUBLIC MARKET NEW INVESTMENT IN RENEWABLE ENERGY BY STAGE, 2004-2012, $BN



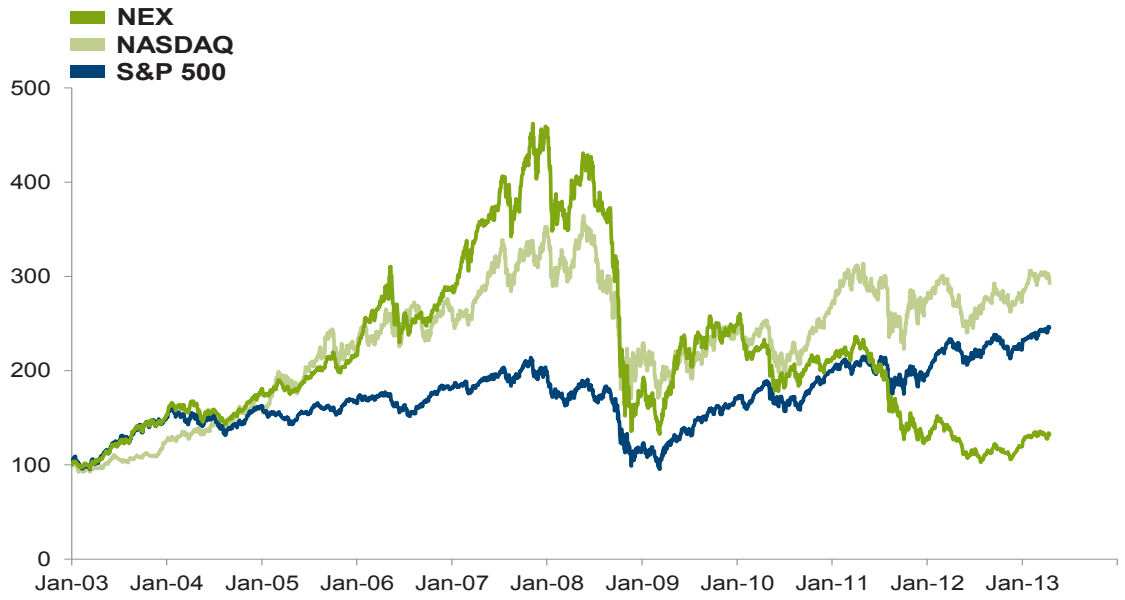
PIPE = private investment in public equity, OTC = over-the-counter
Source: Bloomberg New Energy Finance, UNEP

Italy, reflecting the fact that PV system prices have fallen so fast that the former high tariffs are no longer required to drive growth. Some countries announced capacity caps on the total amount of support available, because PV installation, in particular, has outstripped government expectations. In wind, Italy announced that support for any project over 5MW would only be through reverse auction and subject to an annual limit of 500MW, and the results of the first auction cut support levels by 25% against the previous system. Spain meanwhile introduced a moratorium on support for new clean power installations, and imposed a 7% tax on all renewable power production. In the US, fears that the Production Tax Credit (PTC) for wind would expire at the end of 2012 provoked an installation boom, and made a matching collapse in 2013 inevitable. In the event, the PTC was reprieved for another year as part of Congress' "fiscal cliff" deal.

Continuing massive overcapacity, leading to lower product prices and spiralling losses in the wind sector was another factor contributing to the bleak performance of renewables on the stock market. Suzlon Energy, India's largest turbine manufacturer, defaulted on a $209 million convertible note, the largest ever such default by an Indian company, leading eventually to a $1.8 billion debt restructuring.

Conditions were even worse in the solar sector, as global PV cell and module production capacity of around 60GW outstripped demand by some 30GW. As a result, crystalline silicon module spot prices

FIGURE 42: NEX VS SELECTED INDICES



Index values as of 15 April 2013; Nasdaq and S&P 500 rebased to 100 on 1 January 2003
Source: Bloomberg New Energy Finance

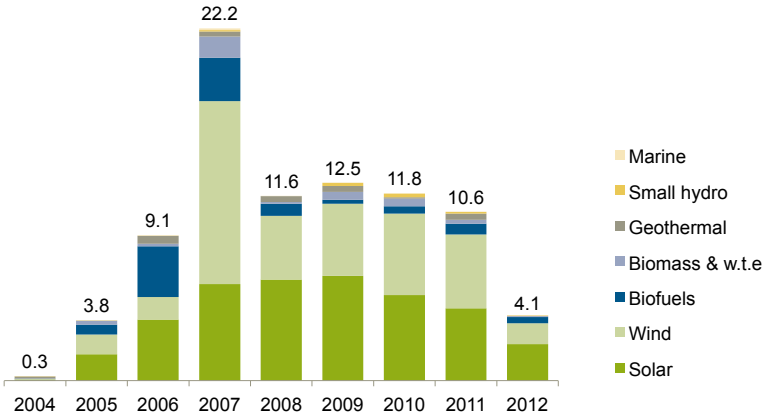
continued to slide, falling from around $1 per Watt to $0.80/W over the course of the year, with some large deals done for as little as $0.60/W. In these conditions, most of the supply chain was losing money, and for some it was all too much. Following a series of solar failures in 2011, the 2012 vintage included Q-Cells, the German PV maker that was once the world's largest; Centrotherm, a German supplier of PV manufacturing equipment; the US thin-film panel technology developer Konarka; and thin-film module maker Abound Solar which – like Solyndra in 2011 – had previously received a large federal loan guarantee before going under. Many publicly quoted solar companies reported heavy net losses.

FIGURE 43: NEX VS SELECTED INDICES

Index values as of 15 April 2013; Nasdaq and S&P 500 rebased to 100 on 1 January 2011
Source: Bloomberg New Energy Finance

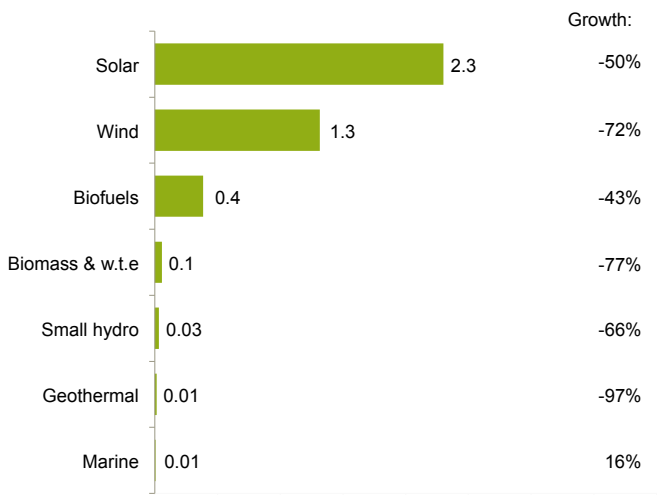
In the circumstances, it was no surprise that share prices languished. The WilderHill New Energy Global Innovation Index (NEX), which tracks some 96 clean energy stocks worldwide and has exposure to the share prices of many manufacturers, fell 5.9% to end the year at 120.02, some 78% below its 2007 peak. As shown in Figures 42 and 43, the NEX has suffered a dismal underperformance against

FIGURE 44: PUBLIC MARKET NEW INVESTMENT IN RENEWABLE ENERGY BY SECTOR, 2004-2012, $BN



Source: Bloomberg New Energy Finance, UNEP

FIGURE 45: PUBLIC MARKET NEW INVESTMENT IN RENEWABLE ENERGY BY SECTOR, 2012, AND GROWTH ON 2011, $BN



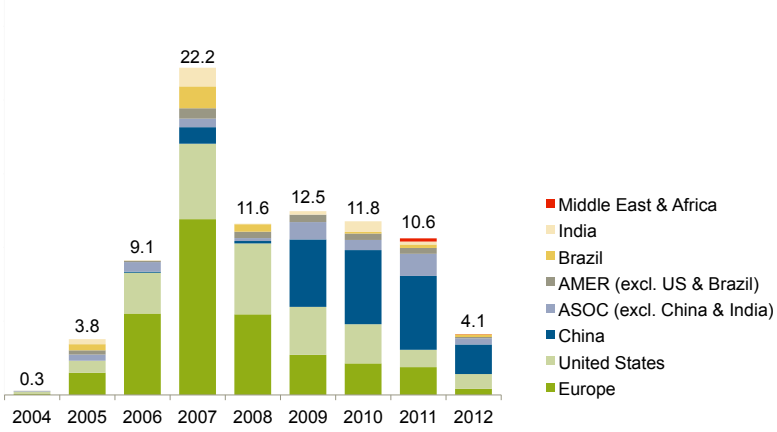
Source: Bloomberg New Energy Finance, UNEP

the wider market on a range of timescales. From the start of 2011 to the end of 2012, the NEX fell 44% while the Nasdaq rose 14% and the S&P500 gained 13%. From 2003 to the end of last year, the under-performance was greater still: the NEX was up 20%, but the Nasdaq and the S&P gained 126% and 62% respectively.

Nor was it any surprise that the IPO window was, if not hermetically sealed, only slightly ajar; the news was dominated as much by the share issues that were pulled as those that got away. The biofuel sector was particularly thwarted, where the performance of next-generation stocks has been disappointing and where opposition to rising production quotas under the US Renewable Fuel Standard has been increasing. IPOs were cancelled by waste-to-biofuel developers Enerkem and Fulcrum BioEnergy, cellulosic ethanol producer Genomatica, and green chemicals company Elevance Renewable Sciences – although most were able to raise funds from private investors (see Chapter 7). BrightSource Energy, the California-based solar thermal developer, withdrew a planned $210 million listing as falling PV prices continued to undercut its sub-sector, and CPFL Energias Renovaveis, Brazil's biggest renewable energy producer, pulled what would have been the year's biggest IPO, worth a planned $741 million.

From the IPOs that did succeed, it is striking that in spite of the torrid business conditions solar remained the largest issuer, as shown in Figures 44 and 45. The largest IPO, from Huadian Fuxin Energy, a Chinese wind developer, raised $345 million and was scarcely a quarter the size of the largest flotation in 2011. But the four next largest IPOs – worth more than $100 million each – were all solar stocks: Jiangsu Sunrain Solar Energy, a solar water heater manufacturer; Xi'An Longi Silicon Materials, which makes silicon rods and wafers; Zhejiang Jingsheng Mechanical & Electrical, a supplier of PV manufacturing equipment; and SolarCity, a Caliornia-based PV installer and service provider – which occupies

FIGURE 46: PUBLIC MARKET NEW INVESTMENT IN RENEWABLE ENERGY BY REGION OF EXCHANGE, 2004-2012, $BN



Source: Bloomberg New Energy Finance, UNEP

the one part of the solar sector to benefit from plunging PV prices.

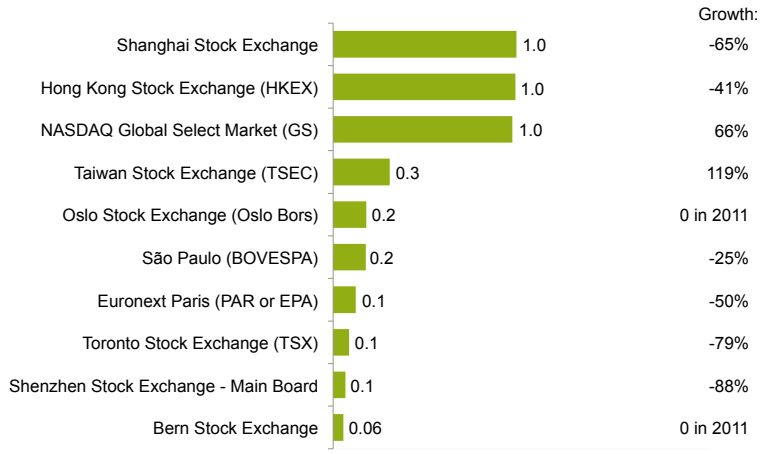
Another striking feature is the continuing dominance of Chinese stock exchanges, as shown in Figure 46. Although new share issues there slumped from $5 billion in 2011 to $2 billion in 2012, they were twice as large as those in the US and five times larger than Europe. The top four IPOs were all launched on Chinese exchanges. The fastest emerging individual exchange, however, was Taiwan, where the value of new issues rose 119% to $300 million as a result of a handful of solar IPOs and secondary share placements.

Secondary issues were unusually prominent too, since their total value at $1.8 billion was higher than that of IPOs for only the second time since 2004. There were sizable secondary share placements from wind developer China Longyuan Power ($375 million), and PV manufacturer Shanghai Aerospace Automobile Electromechanical ($303 million), and also a significant PIPE deal worth $138 million in which oil major Total of France raised its stake in SunPower, a Californian PV manufacturer, to 66%.

While business and stock market conditions were generally dire during 2012, both seemed to brighten towards the end of the year – especially in solar. Germany confirmed record PV installation in 2012 of 7.6GW, as developers rushed to harness subsidies before they fell further; Japan announced a generous feed-in-tariff, which Bloomberg New Energy Finance analysts expect to drive capacity growth of 13-22GW over the next two years; China set an unexpectedly high PV installation target of 10GW for 2013 (although this will be difficult to achieve), and is expected to topple Germany as the number one market this year; and some took comfort from the decision by Warren Buffett's MidAmerican Holdings to invest up to $2.5 billion in two PV projects in California, confirming investor appetite for these plants as low-risk investments.

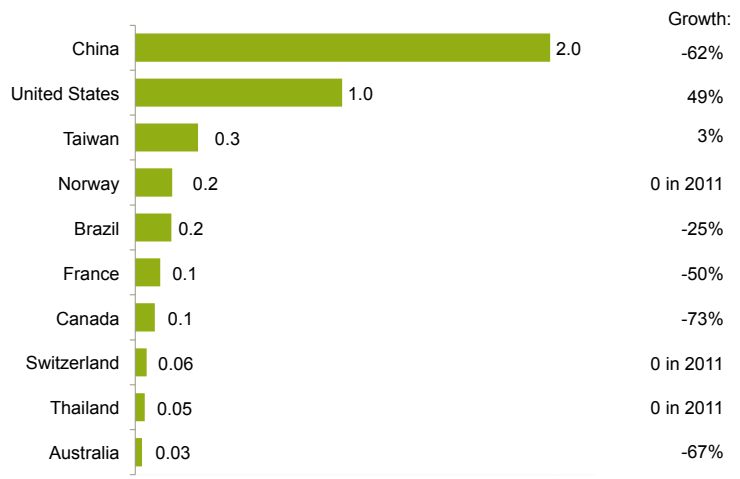
The markets seemed to catch the mood, and rallied strongly into the New Year. Between the beginning of December 2012 and the end of January 2013, the NEX index recovered by 15%, the NYSE Bloomberg Global Wind Energy Index by 19% and the NYSE

FIGURE 47: PUBLIC MARKET NEW INVESTMENT IN RENEWABLE ENERGY BY EXCHANGE, 2012, AND GROWTH ON 2011, $BN



Top 10 exchanges
Source: Bloomberg New Energy Finance

FIGURE 48: PUBLIC MARKET NEW INVESTMENT IN RENEWABLE ENERGY BY COMPANY NATIONALITY, 2012, AND GROWTH ON 2011, $BN



Top 10 countries
Source: Bloomberg New Energy Finance

Bloomberg Global Solar Energy Index by almost 5%. Some commentators interpreted the market bounce as tentative signs of recovery, but others warned that there will be more pain to come before renewable energy markets recover some kind of balance.

One potential threat stems from the trade disputes that broke out in 2012. The US Department of Commerce imposed anti-dumping tariffs of up to 250% on Chinese solar cells; the European Commission imposed anti-dumping duty on US bioethanol exports worth billions of dollars, and also opened an investigation into alleged Chinese solar dumping; and India announced an investigation into the US, China, Taiwan and Malaysia, also for alleged dumping of solar panels. These disputes do not appear to have impacted trade substantially so far, but have the potential to escalate.

A more concrete threat comes from the underlying condition of the major renewable energy industries. According to analysts at Bloomberg New Energy Finance, policy uncertainty in the US and Europe during 2012 means wind installations will inevitably plunge in 2013, with only a modest recovery expected until 2016. In both wind and solar, overcapacity persists, and in solar many more insolvencies are expected before balance is restored. In the circumstances, even if 2013 sees more public market equity-raising than 2012, a substantial recovery for new investment in renewable energy through public markets does not look imminent.

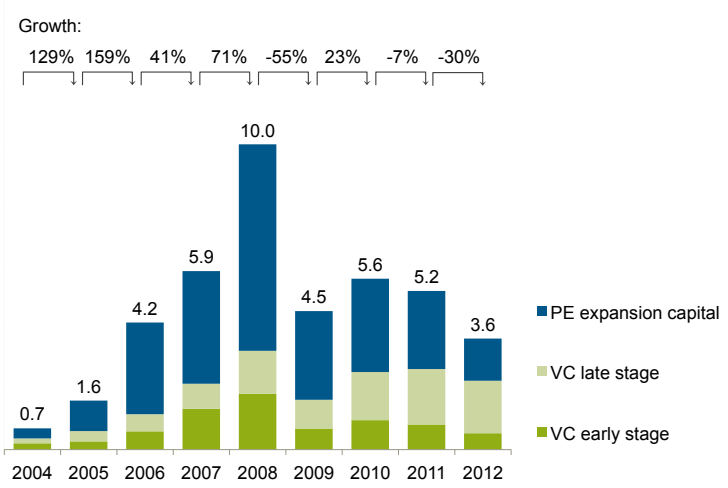
Figures 47 and 48 show detail on the most active exchanges for renewable energy equity raising in 2012, and the amount raised by nationality of the company. Chinese and US companies, predictably, dominated the latter comparison, although the two showed very different trends over the year. Shanghai Stock Exchange, Hong Kong Stock Exchange and Nasdaq Global Select Market all saw equity raisings by renewable energy companies of around $1 billion in 2012.

VENTURE CAPITAL AND PRIVATE EQUITY INVESTMENT

- Venture capital and private equity, or VC/PE, investment in renewable energy fell by 30% in 2012 to $3.6 billion, its lowest level since 2005, reflecting the difficulty of achieving satisfactory exits and a generally subdued risk appetite among investors.
- Three quarters of the decline was in private equity expansion capital, down from $2.6 billion in 2011 to $1.4 billion, and most of the rest was due to early-stage venture capital, down $300 million to $530 million. By contrast, late-stage VC held almost steady at $1.7 billion, against $1.8 billion in 2011.
- Seed funding, the earliest stage of venture capital, was a rare bright spot, rising 146% compared to the previous year. Series C funding also managed a rise, of 21%.
- Solar suffered the steepest decline but remained the biggest sector, down 40% year-on-year to $1.5 billion, and the next biggest loser was biomass and waste-to-energy, which halved to $500 million. Against the trend, biofuels edged up 5% to $900 million, while geothermal and marine both chalked up large percentage increases from a low base.
- There were steep falls in all regions bar the US, which held the decline to 11% and remained the largest market at $2.6 billion, and Asia and Oceania, which almost quadrupled (a rise of 268%) its VC/PE investment from an extremely low base. Investment fell by a third in Europe, and collapsed in China, India, Brazil and the rest of the Americas.

New investment in renewable energy through venture capital and private equity fell for the second year running, to its lowest level since 2005, as shown in Figure 49. The 30% decline in 2012 came as VC/PE investors faced a bleak economic outlook – Europe in recession, China slowing and the US anaemic – and brutal trading conditions for quoted renewable energy stocks. Sector-specific difficulties included overcapacity, plunging product prices, further retrenchment in production subsidies in Europe, and continuing policy uncertainty. However, this disappointing performance should be viewed in the context of falling VC/PE investment across the economy as a whole, where the aggregate value of all deals across every industry worldwide fell 22% to $39 billion, according to data from Preqin, a financial analysis company.

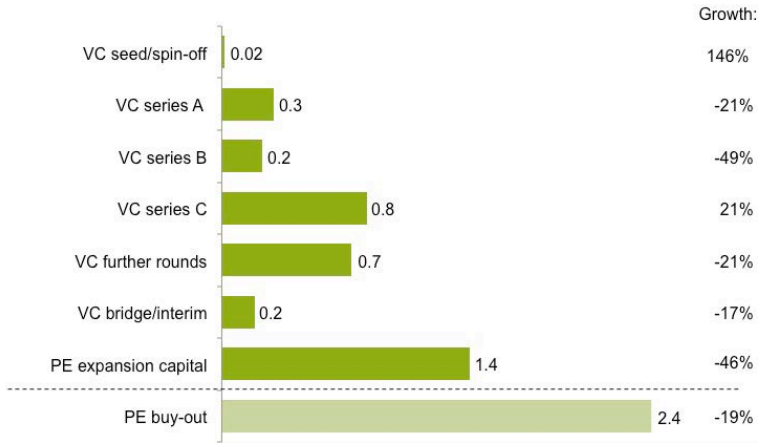
FIGURE 49: VC/PE NEW INVESTMENT IN RENEWABLE ENERGY BY STAGE, 2004-2012, $BN



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

Source: Bloomberg New Energy Finance, UNEP

FIGURE 50: VC/PE NEW INVESTMENT IN RENEWABLE ENERGY BY STAGE, 2012, AND GROWTH ON 2011, $BN



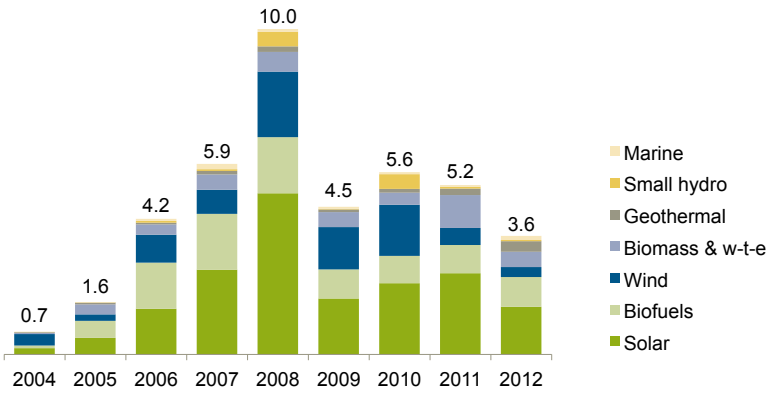
Buy-outs are not included as new investment. Total values include estimates for undisclosed deals

Source: Bloomberg New Energy Finance, UNEP

In public markets, these conditions led to dismal share price performance by renewable energy stocks and a collapse in new investment, and this had inevitable knock-on effects in VC/PE. IPOs raised less than a third of their 2011 total (see Chapter 6), meaning VC/PE investors were forced to hold investments for longer and less capital was available for new ventures. On the other hand, this also produced a number of VC/PE deals that would otherwise not have happened, because several companies that pulled IPOs were then forced to resort to further rounds of private funding.

Private equity expansion capital took the biggest hit, falling by almost half (46%) to $1.4 billion, while early-stage VC slid by over a third to $500 million. Late-stage VC also slipped but only marginally, to $1.7 billion, scarcely lower than the peak established in 2011. As Figure 50 shows, this was due to a 21% increase in Series C funding, and reflects the maturing requirements of existing early-stage companies, and perhaps the difficulty VC investors had in finding an exit. Only seed capital truly bucked the trend, jumping 146% to $15 million.

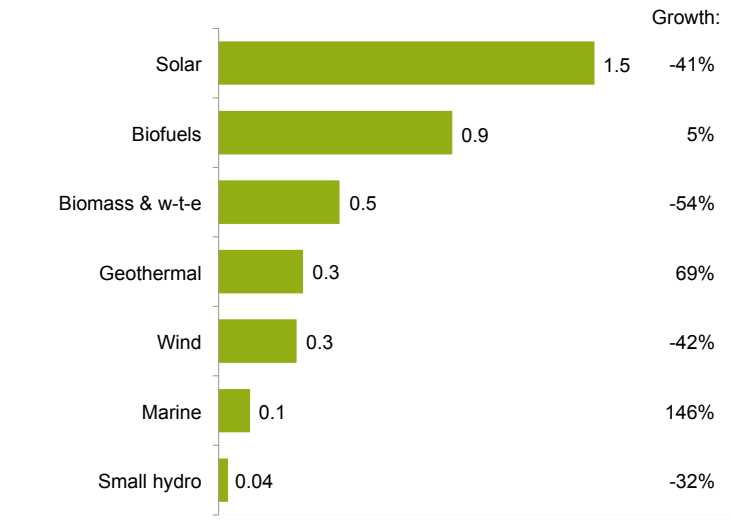
FIGURE 51: VC/PE NEW INVESTMENT IN RENEWABLE ENERGY BY SECTOR, 2004-2012, $BN



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

Source: Bloomberg New Energy Finance, UNEP

FIGURE 52: VC/PE NEW INVESTMENT IN RENEWABLE ENERGY BY SECTOR, 2012, AND GROWTH ON 2011, $BN



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

Source: Bloomberg New Energy Finance, UNEP

Conditions were toughest in the solar sector, where a wave of insolvencies continued to roll through quoted stocks, and the mood was further soured by a series of failures among VC/PE-backed companies, typically developers of more expensive technologies that have been increasingly undercut by falling crystalline PV prices. Konarka, the Massachusetts-based thin-film developer once backed by Chevron and Total, filed for bankruptcy after burning through almost $190 million in 11 funding rounds since the turn of the century. GreenVolts, a concentrating photovoltaic developer based in California, also shut down, with 80 redundancies, as a strategic investor withdrew support, after raising $120 million over the last few years. MiaSole, a Californian thin-film producer, was acquired by the Chinese company Hanergy for $30 million, scarcely half the $55 million Miasole had raised in a pre-IPO funding round earlier in the year, and a fraction of its estimated cumulative VC/PE funding of $500 million.

Yet solar firms continued to find backing, and the sector remained the largest for VC/PE investment, as shown in Figures 51 and 52, although solar also suffered the largest decline, down $1 billion to $1.5 billion.

Some of the largest funding rounds were for installers and service providers who stand to benefit from falling PV prices. California based SolarCity secured two tranches totalling $281 million before going on to raise another $106 million by IPO. SunRun, another Californian solar installer and finance provider, secured $60 million in a Series D round. The business model of both companies is to install solar systems on houses for free and then sell the electricity generated under long-term contracts. There was also PE funding for project developer Fotowatio Renewable Ventures ($190 million).

However, investment was not restricted to only the safest bets, as funding also extended to thin-

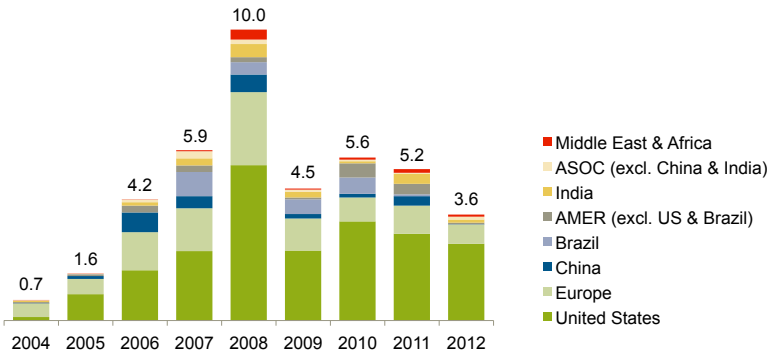
film technology developers such as Nanosolar (two rounds totalling $90 million), Solexel ($36 million) and Stion ($25 million). BrightSource Energy, a California-based solar thermal technology developer building the world's first really large-scale tower and heliostat project, secured $83 million in PE funding after abandoning a planned $210 million IPO. Meanwhile, venture capital investment went to inverters (SolarBridge Technologies, $25 million), concentrating photovoltaic (Solar Junction, $19 million), and building-integrated panels (Abakus Solar, $13 million). Thin-film developer Solo Power raised a further $23 million in two rounds, taking its cumulative VC funding to more than $200 million.

While solar investment fell sharply overall, biofuels gained 5% to $900 million – broadly the same level of funding the sector has secured every year since 2009. Next-generation technologies that do not rely on food crops continued to dominate, and companies on the rebound from failed IPO attempts were prominent, including waste-to-ethanol producer Fulcrum Bioenergy ($70 million), Elevance Renewable Sciences, which produces green chemicals from crops ($104 million) and Genomatica, another renewable chemicals developer ($42 million). In the largest deal, Sapphire Energy secured $144 million in Series C funding to build an algal oil demonstrator plant in New Mexico. The company has developed a 'wet extraction' process to convert the algae into what it calls 'Green Crude' without the need for expensive drying, and has secured a contract to supply the independent refiner Tesoro.

After solar, the second biggest loser was biomass and waste-to-energy, where investment halved to $500 million in 2012. However, there were still a number of substantial deals with interesting backers. Harvest Power, which operates 29 anaerobic digesters across North America, raised $125 million in two tranches, with support from Al Gore's Generation Investment Management. Tamar Energy, a British firm that plans to build a portfolio of 40 anaerobic digesters over the next five years, raised $153 million in three tranches, with backing from supermarket chain Sainsbury's and the Duchy of Cornwall.

In another noteworthy deal, Renmatix, a Georgia, US, based company that employs supercritical hydrolysis to break down non-food biomass into sugars for chemicals or fuel, raised $75 million in two tranches with the backing of Waste Management, the biggest waste disposal company in the US. This was the ninth investment in waste-

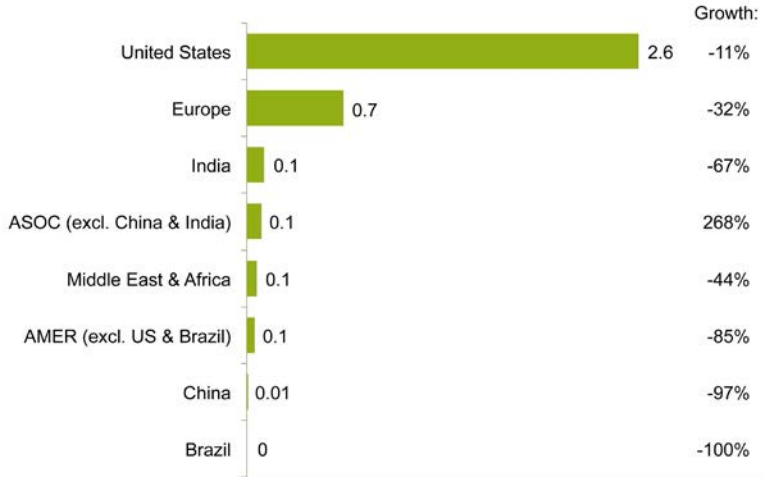
FIGURE 53: VC/PE NEW INVESTMENT IN RENEWABLE ENERGY BY REGION, 2004-2012, $BN



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

Source: Bloomberg New Energy Finance, UNEP

FIGURE 54: VC/PE NEW INVESTMENT IN RENEWABLE ENERGY BY REGION, 2012, AND GROWTH ON 2011, $BN



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

Source: Bloomberg New Energy Finance, UNEP

to-energy developers by Waste Management, and is perhaps a sign of growing corporate interest in early-stage ventures. There were similar moves from China Wanxiang Holdings, which invested $1.25 billion in VC-backed GreatPoint Energy, a coal gasification developer, and Shell, which took part in $26 million round for GlassPoint Solar, a Massachusetts-based company developing a solar system to raise steam for use in oil production. Both technologies are classified as 'clean' rather than renewable energy – and therefore strictly beyond the scope of this report - but such deals may point to an alternative source of VC funding, or even a potential future exit route for early-stage investors should the IPO window stay only narrowly ajar.

Two brighter spots were marine and geothermal, which are tiny sectors for VC/PE but saw strong growth on the basis of a handful of deals. Investment in marine jumped 146% to $120 million, helped by funding rounds for UK technology developer ScotRenewables Tidal Power and Finnish wave power firm AW-Energy. The Scotrenewables deal was backed by engineering giant ABB and oil major Total, in another sign of corporate strategic interest in early-stage ventures. Meanwhile, investment in geothermal lifted 69%, but this was solely due to a single PE debt refinancing deal by EnergySource, a Californian developer, worth $313 million.

Whereas there has been a geographic shift southwards in other types of financing for renewable energy, no such trend has yet become apparent for VC/PE funding. In 2012, the US remained the undisputed centre of global VC/PE investment in renewable energy, as shown in Figures 53 and 54. Total investment volumes there fell 11% to $2.6 billion, but remained almost four times larger than the next biggest region, Europe, down 32% to $700 million. Almost everywhere else, VC/PE investment collapsed. Funding fell to zero in Brazil, and to negligible levels in China,

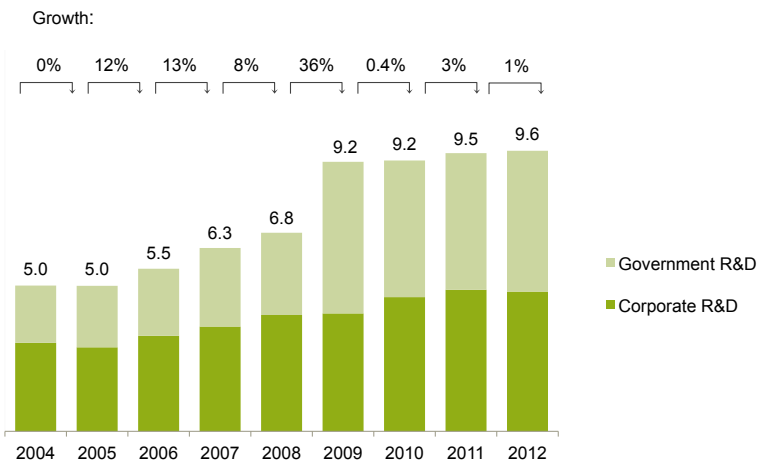
the Americas excluding the US and Brazil, India, and Middle East & Africa. Only in Asia & Oceania excluding China and India was there any growth – investment values almost quadrupled (268%) to $99 million. However, three quarters of the total value was raised in two late-stage VC rounds by a single company, Lanzatech NZ, which is developing technology to produce transport fuel and chemicals from industrial waste gas.

While VC/PE investment slumped across most regions and sectors, one investment stage offered a glimmer of hope; seed financing leapt 146% to $15 million (Figure 50). Funding included $4 million for Mumbai-based solar lantern maker Greenlight Planet; $3.9 million for Spanish next-generation biofuels developers AlgaEnergy; $1.2 million for Italian biofuels developer Agroils Technologies; $500,000 for Lucintech, an Ohio based thin-film solar developer; and $200,000 for Greensky Windsystems, a small wind turbine developer based in North Carolina.

RESEARCH AND DEVELOPMENT

- Global R&D spending on renewable energy inched 1% higher to $9.6 billion in 2012, in spite of the winding-down of green stimulus programmes and pressure on the profit margins of many renewable energy companies.
- Government R&D spending rose 3% to $4.8 billion, while corporate R&D fell 1% to fractionally below $4.8 billion, making public and private spending broadly equal for the third year in a row.
- Solar continued to dominate, claiming a fraction over half (51%) of all research dollars spent, despite a 1% fall to $4.9 billion. R&D efforts focussed on improving the energy output of PV cells and the efficiency of production processes.
- Wind R&D was up 4% at $1.7 billion, one major focus being the quest to reduce the cost of offshore development.
- Biofuels R&D was up 2% at $1.7 billion, much of it going on next-generation technologies like cellulosic ethanol, Fischer-Tropsch biodiesel and algal oil.
- 2012 marked the eighth consecutive rise in global R&D spending, which has now almost doubled since 2004 in absolute terms (up 93%). However, R&D spending by OECD governments as a proportion of GDP is scarcely a quarter of its level 30 years ago according to the International Energy Agency.
- Europe remained the largest centre for R&D worldwide in 2012, but China was a little ahead on the government component and was by far the largest location for solar R&D.

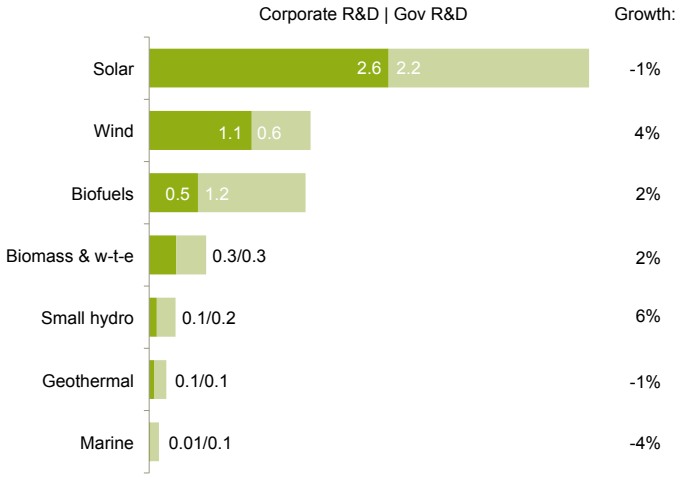
FIGURE 55: R&D INVESTMENT IN RENEWABLE ENERGY, 2004-2012, $BN



Source: Bloomberg, Bloomberg New Energy Finance, IEA, IMF, various government agencies

Global investment in research and development in renewable energy held up surprisingly well in difficult circumstances in 2012. As Figure 55 shows, total investment in R&D rose for the eighth consecutive year, although it has increased only modestly since 2009, when it jumped by more than a third following the widespread introduction of green stimulus plans in response to the financial crisis. Government R&D spending in 2012 rose 3% in spite of the fact that green stimulus programmes have largely wound down according to estimates by Bloomberg New Energy Finance. Corporate investment slipped by just 1% to fractionally under $4.8 billion, a resilient result given the policy

FIGURE 56: CORPORATE AND GOVERNMENT R&D RENEWABLE ENERGY INVESTMENT BY TECHNOLOGY, 2012, AND TOTAL GROWTH ON 2011, $BN



Source: Bloomberg, Bloomberg New Energy Finance, IEA, IMF, various government agencies

uncertainty and pressure on manufacturers' margins in some of the main renewable energy markets.

Solar continued to dominate both government and corporate R&D, claiming just over half (51%) of all research dollars spent, as shown in Figure 56. The tiny (1%) fall in solar R&D spending might seem surprising given the problems experienced in the sector, with massive overcapacity driving crystalline silicon module prices down by a fifth over the course of the year, widespread insolvencies and major cuts in market support schemes around the world. However, while most of the industry lost money in 2012, manufacturers throughout the global supply chain could ill-afford to skimp on R&D; in such conditions, the need to raise the efficiency of solar technologies and cut production costs yet further became existential.

Research priorities in solar include improving the energy output of photovoltaic cells, and raising the resource and cost efficiency of production processes. In the US, corporate R&D in solar rose $37 million to $537 million, while government spending rose slightly to $405 million. One major programme is the Department of Energy's SunShot Initiative, which funds academic and commercial R&D, and is intended to reduce the cost of installed solar systems by 75% and make the technology competitive with fossil energy, by the end of the decade. During 2012, the initiative invested over $24 million in more than 20 projects, including one at the Massachusetts Institute of Technology to develop a thin-film photovoltaic cell based on tin sulphide, which could cut costs because both tin and sulphur are abundant and can be processed at temperatures below 400 degrees Centigrade; another at University of California Irvine to build a prototype cell from iron pyrite, also known as Fool's Gold, which the developers claim offers a clear pathway to meeting SunShot targets on cost, efficiency and terawatt scalability; and another by commercial developer Bandgap Engineering to produce a 36% efficient silicon cell using nanotechnology.

In China, the world's biggest investor in solar R&D by far, corporate spending fell by more than $50 million to $360 million, while state spending increased almost $70 million to $927 million. In February 2012, the Ministry of Industry and Information Technology published its 12th Five-Year Plan for the photovoltaic industry, including 2015 efficiency targets of 21% for mono cells, 19% for multi cells and 12% for thin-film silicon.

Investment in wind R&D managed a small increase, of 4%, in 2012 to $1.7 billion, of which almost two thirds was corporate (Figure 56). Like solar, the wind industry battled structural overcapacity and falling prices, and here too, intensive R&D is vital if the industry is to become fully commercial. One of the industry's major preoccupations, as offshore wind development gathers pace, is to reduce the cost of offshore turbine foundations and develop new concepts for use in deeper water further offshore where the winds are stronger.

The European offshore wind industry is growing exponentially, driven by supportive policies in countries such as the UK, Germany, Belgium and France; in 2012, Europe commissioned 1.8GW of new capacity, a near six-fold increase on 2011. Analysts at Bloomberg New Energy Finance expect a further 30GW to be installed by 2020, which will require around 5,500 foundations – or 900

per year by 2020. Since foundations account for up to 30% of total project costs, there is a huge incentive to develop cheaper technologies. The standard solution today is to drive a monopile into the seabed, but this is limited to smaller turbines under 5MW and water depths of up to 30 metres. Newer concepts include 'gravity base' foundations, a heavy conical structure; 'jackets' similar to those used to support deep water offshore oil production platforms; tripods; and even floating platforms tethered by cables to the seabed.

The floating platform is the least proven concept, but also the most promising for water depths beyond 70 metres. Floating turbines have only been tested in Norway and Denmark so far, and the biggest challenge is to stop the turbine from tilting. One potential solution may be the TetraFloat design invented by Professor Seamus Garvey of the University of Nottingham.

Most designs on the market involve a floating platform that supports a tower with the turbine mounted on top. Because of the enormous forces exerted by the wind, a single tower has to be extremely strong, and that means heavy and expensive. By contrast, in the TetraFloat design the wind turbine is mounted at the top of a lopsided tetrahedron – a triangular pyramidal structure - which because of its shape can be made of much thinner and lighter tubing. In a conventional design the turbine has to swivel or 'yaw' at the top of the tower to face the wind, but in the TetraFloat the entire floating structure yaws over the surface of the sea, pivoting around a single anchor on the seabed. The design is backed by a consortium including engineering consultants Arup and Ramboll, and was granted a UK patent last year.

The need for offshore wind R&D, and its huge expense, seemed to be among the driving forces behind one of the sector's biggest potential deals. In August 2012, the financially embattled industry leader Vestas of Denmark announced it was in talks about "strategic cooperation" with Mitsubishi Heavy Industries of Japan. A deadline was set by Vestas' creditors for agreement by the end of the year, but no deal was reached and the talks continue.

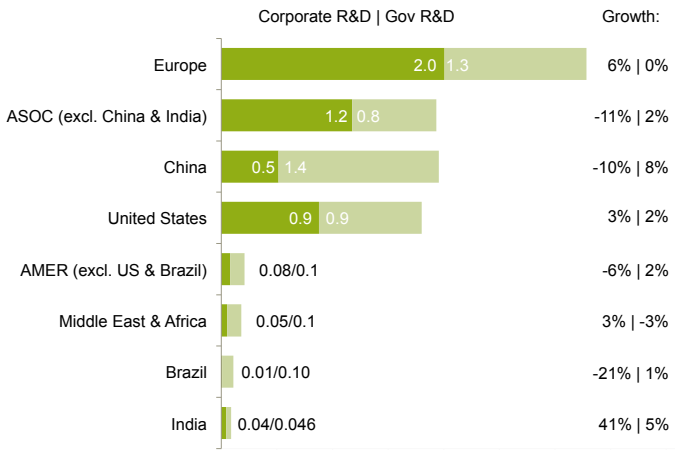
Vestas has suffered spiralling losses and repeated rounds of downsizing mainly because of structural overcapacity in the global turbine market and falling prices, but also because of the extremely high R&D costs associated with its lower wind-speed V112-3.0MW turbine, which took $466 million and four years to develop. The company's flagship offshore model, the V164-8.0MW, the blades of which are as long as nine London buses, is expected to cost even more, and has been repeatedly delayed by spending cuts. Vestas was forced to abandon R&D at five centres in Denmark, China and the US during 2012.

Mitsubishi, on the other hand, is a Fortune "Global 150" company and financially robust, but has only a small wind business. The company refocused on offshore wind following the Fukushima disaster, and acquired Artemis Intelligent Power of the UK, whose smart hydraulic transmission technology is at the heart of Mitsubishi's new 7MW offshore

turbine design, which is due to be tested in 2013. If some kind of joint venture is agreed, it could benefit both companies by marrying Mitsubishi's financial muscle and wider expertise in heavy machinery with Vestas' R&D capabilities and market share.

Investment in R&D in biofuels, the third largest sector, saw small gains in both corporate and government spending, amounting to a 2% rise to $1.7 billion overall. Most funding was directed to next-generation technologies such as cellulosic ethanol, Fischer-Tropsch biodiesel or algal oil (see also Chapter 7 on venture capital and private equity). However, in the US, the world's biggest biofuel market, the future of next-generation technologies hung in the balance as opposition to the country's ambitious production targets grew.

FIGURE 57: CORPORATE AND GOVERNMENT R&D RENEWABLE ENERGY INVESTMENT BY REGION, 2012, AND GROWTH ON 2011, $BN



Source: Bloomberg, Bloomberg New Energy Finance, IEA, IMF, various government agencies

US federal mandate RFS2 obliges fuel producers to blend 16 billion gallons of next-generation biofuels – those that do not directly impact food production - into petrol and diesel supplies by 2022. The target remains astronomically out of reach - production to date is less than 100 million gallons – and each year the Environmental Protection Agency typically reduces the annual targets to a level closer to what the young industry can actually deliver. If next-generation biofuel production volumes continue to disappoint, then pressure from the oil and corn-ethanol lobbies to scrap the target will become harder to resist. The removal of the target would destroy the entire market, and with it any incentive for companies to invest in further R&D. If the target is simply scaled back to more realistic levels, however, it might provide a more stable framework. Analysts at Bloomberg New Energy Finance say next-generation developers need to prove production can be scaled up to commercial levels over the next two years, or risk the RFS2 rug being pulled.

In the tiny marine power sector, developers were buoyed by the announcement of further government support, including confirmation that the UK will provide five Renewable Obligation Certificates per MWh for wave and tidal projects under 30MW until 2017, and two ROCs for any project over that level. There was also further public funding from a range sources: the UK government announced a GBP 20 million Marine Energy Array Demonstration Fund to help scale up existing prototypes; the Scottish government confirmed the four contestants for its GBP 20 million Saltire Prize, which will go to the marine project that generates most power during 2015-17; and the European Commission granted NER300 funding for three UK wave and tidal projects.

However, at the end of the year SSE announced that upgraded transmission links from Scotland to Orkney and Shetland would be delayed by two years to 2018, because of hold-ups in land acquisition, planning permission and cable delivery, and that links to the Western Isles may also be postponed. Industry sources say this could mean that some planned projects cannot proceed, and this amounts to a 'serious setback'.

Figure 57 shows the geographical split for corporate and government R&D. Europe remained the largest centre for R&D in total in 2012, but China moved a little ahead of it on government spending alone. The US was the only region to show positive trends in both corporate and government outlays last year, albeit thanks to modest increases of 3% and 2% in the two figures.

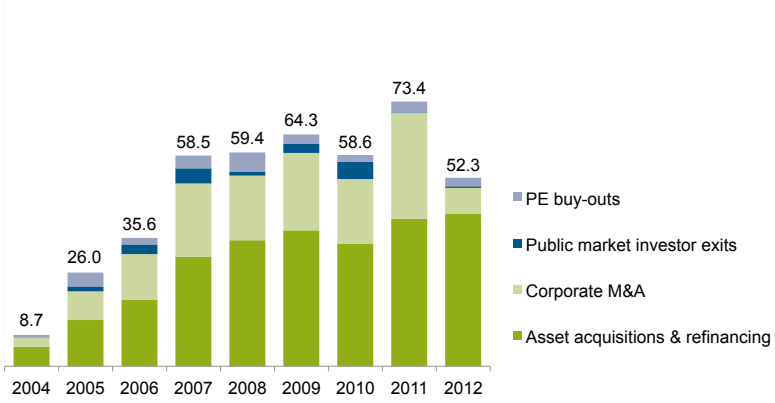
ACQUISITION ACTIVITY

- From all all-time high of $73.4 billion in 2011, total acquisition spending in renewable energy in 2012 dropped 29% to $52.3 billion.
- Corporate M&A – the buying and selling of companies – plummeted 76% from a record $29.5 billion, to a mere $7.1 billion.
- Asset acquisitions and refinancing was the only area that defied the downward trend, to crawl up 3% to $42.3 billion from the 2011 figure of $40.9 billion.
- Acquisition activity fell in all renewable energy sectors, with wind down 20%, solar down 36% and biofuels down 70%.
- Activity in China dived to $480 million from $3.2 billion in 2011, while Europe slid from $37.1 billion to $16.7 billion.

Figure 58 shows that overall acquisition activity in renewable energy fell sharply last year, from $73.4 billion in 2011 to $52.3 billion in 2012. The decline was almost entirely due to a collapse in corporate mergers and acquisitions. By contrast, the value of the other main deal type – asset acquisitions and refinancings – actually edged up slightly, from $40.9 billion to $42.3 billion.

The sector split is shown in Figures 59 and 60. Acquisitions were dominated by the two main sectors, with wind accounting for $32.6 billion and solar for $14.1 billion. Three other sectors - biomass and waste-to-energy, biofuels and small hydro - were limited to total acquisition volumes of just under $2 billion. In the case of biofuels, this represented a major comedown after six years in a row in the $4.4 billion to $8.2 billion range.

FIGURE 58: ACQUISITION TRANSACTIONS IN RENEWABLE ENERGY BY TYPE, 2004-2012, $BN

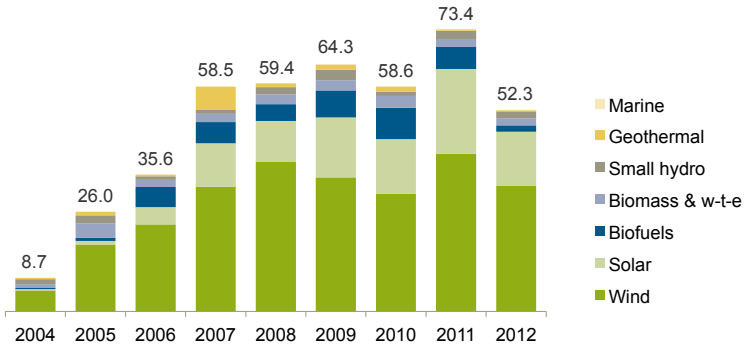


Total values include estimates for undisclosed deals.
Source: Bloomberg New Energy Finance

The best way to understand the sector shifts is to do so through the different deal types - corporate M&A, asset acquisitions and refinancings, private equity buy-outs and public market exits.

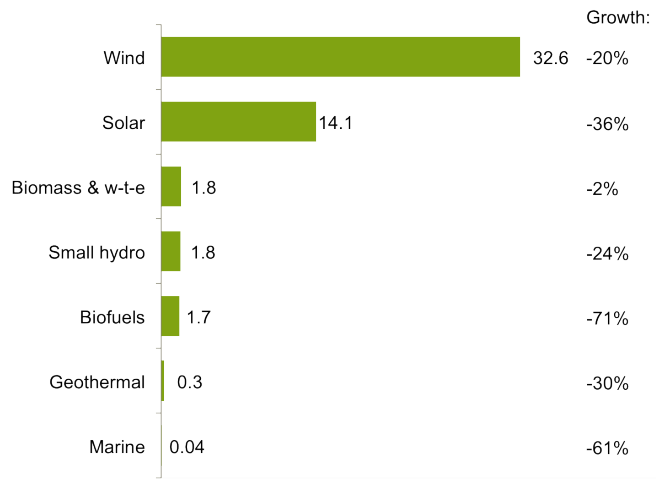
Corporate M&A had a good year in 2011 – a record $29.5 billion changed hands – and it was always going to be difficult to match that in 2012, given the uncertain economic climate and the depressed state of clean energy share prices. In the event, last year did not even come close. The total nosedived 76% to $7.1 billion. The 2012 total was the lowest since 2004. Significantly also, there was a progressive decline

FIGURE 59: ACQUISITION TRANSACTIONS IN RENEWABLE ENERGY BY SECTOR, 2004-2012, $BN



Total values include estimates for undisclosed deals.
Source: Bloomberg New Energy Finance

FIGURE 60: ACQUISITION TRANSACTIONS IN RENEWABLE ENERGY BY SECTOR, 2012, AND GROWTH ON 2011, $BN



Total values include estimates for undisclosed deals.
Source: Bloomberg New Energy Finance

quarter-by-quarter in terms of the number of deals and their total value, with the first three months of the year throwing up a total of $3.2 billion. The second, third and fourth quarters came in at $1.5 billion, $1.4 billion and $1 billion respectively.

The biggest corporate acquisition deal was CPFL Energias Renovaveis' purchase of Sao-Paulo-based wind project developer BVP for $529.4 million. BVP had a generating capacity of 157.5MW at the time of the deal in February last year.

The next largest transaction was in the same country, with SN Power Energia Brasil's acquisition of a 40.7% stake in renewable energy developer Desenvix Energias Renovaveis for $410.6 million.

Wind saw the highest volume of corporate M&A, but it was still down sharply from the $15.9 billion figure of 2011, the latter number inflated by the buy-out of minority shareholders in EDF Energies Nouvelles and Iberdrola Renovables by their parent companies. In 2012, corporate M&A in wind amounted to just $3.6 billion. Apart from those mentioned above, there was the purchase for $258 million of a 20% stake in Eurus Energy Holdings, a Tokyo-based wind developer, by Toyota Tsusho Corporation.

Solar saw a fall in corporate M&A from $7 billion in 2011 to $2.2 billion in 2012, with the biggest – and most eye-catching – deal being the $323.4 million paid by Hanwha Chemical Corporation for Global PVQ, the business assets of Q-Cells, once the world's biggest maker of solar cells. The Brandenburg-based company filed for insolvency in April last year with

While it was a relatively subdued year for corporate M&A, asset transactions rose further to beat their 2011 record of $40.9 billion. Asset acquisitions and refinancing edged up 3% to end the year at $42.3 billion.

As the most mature of the "new" renewable energy sectors, wind predictably dominated the asset acquisitions and refinancing numbers. The sector saw $27.5 billion of transactions, up from $22.7 billion in 2011.

the deal taking place in the third quarter. German solar companies struggled in 2012 in the face of reduced subsidies for developers at home, and increased competition from Chinese companies in the European market.

Earlier in the first quarter, SunPower bought all of French polycrystalline silicon module distributor Tenesol for $165.4 million. This was followed up in the second quarter by LDK Solar's acquisition of a 37.9% stake in Baden-Württemberg-based PV cell, module, inverter, and integrated systems manufacturer Sunways for $42.6 million.

Apart from wind and solar, the next biggest corporate M&A deals of 2012 were in biofuels. US companies Butylfuel and North American Bioproducts were taken over for estimated figures of just over $100 million apiece – the first by Green Biologics and the second by Lallemand.

The slowly emerging sector of marine energy saw important corporate activity in 2012, although it was not reflected in a high aggregate value. First, Siemens, Europe's largest engineering company, bought UK tidal stream technology developer Marine Current Turbines in February 2012 at a price equivalent to a valuation of $29 million. Subsequently, Alstom agreed to buy another ocean turbine maker, Tidal Generation, from Rolls Royce. Year 2012 also saw Andritz Hydro acquire an additional 22.1% in a third tidal turbine maker, Norway-based Hammerfest Strom, to take its total stake in the company to 55.4%, and, in a smaller deal, Ecotricity Group acquired 40% of Dartmouth Wave Energy.

The largest deals included the purchase from Terra-Gen Power in November 2012 of the 300MW Pinyon Pines wind portfolio in California, by Warren Buffett's MidAmerican Holdings; and the refinancing in September 2012 of Kruger Energy's 202.4MW wind portfolio in Ontario. Outside North America, one of the highlights was Marubeni Corporation's buy-out of a 49.9% stake in the 172MW Gunfleet Sands offshore wind project in UK waters from Dong Energy in March last year. The acquisition price in the last case was $270 million.

Institutional investors such as pension funds and insurers have become more active in investing in green projects, in the face of depressed government and corporate bond yields. The opportunity is there, especially in Europe, where banks are still in recovery mode from the 2008 financial crisis and the subsequent euro area sovereign debt problems.

Two deals that have been announced but had yet to be completed by the end of 2012 were examples of this trend. In early October, PensionDanmark agreed to buy a 50% stake in three US wind farms with a total capacity of 433MW from German giant Eon. Then, in November, Borealis Infrastructure, which manages investments for the Ontario Municipal Employees Retirement System, agreed to buy a 49% stake in four US wind farms for $230 million from EDP Renovaveis, the renewable energy unit of Portuguese utility EDP-Energias de Portugal.

Similarly, 2012 saw German reinsurer Munich Re agree to buy six wind parks in Germany totalling 48MW from developer Wpd, and then follow this up with the purchase in August of three UK wind farms with a combined 102MW.

Solar project acquisitions and refinancings slipped from $13.1 billion in 2011 to $11.9 billion in 2012. It was still comfortably the second highest figure ever, a sign of that sector's greater maturity - and the increased size of the installed base. The largest deals included Activ Solar's $362 million refinancing of its 100MW Perovo PV plant in Ukraine, and Capital Dynamics' purchase of an 80MW PV portfolio in California. In Bulgaria in July 2012, a group consisting of First Reserve Corporation, Crescent Capital and ACWA Power bought the 60.4MW Karadzhalovo PV project from SunEdison.

The biggest project transaction outside wind and solar was the $132 million refinancing of Hydro Chile's 80MW Colchagua small hydro portfolio. In bioenergy, it was the purchase in December 2012 by Flint Hills Resources of the 379 million-litres-per-year Fairmont bioethanol plant in the US from Advanced BioEnergy.

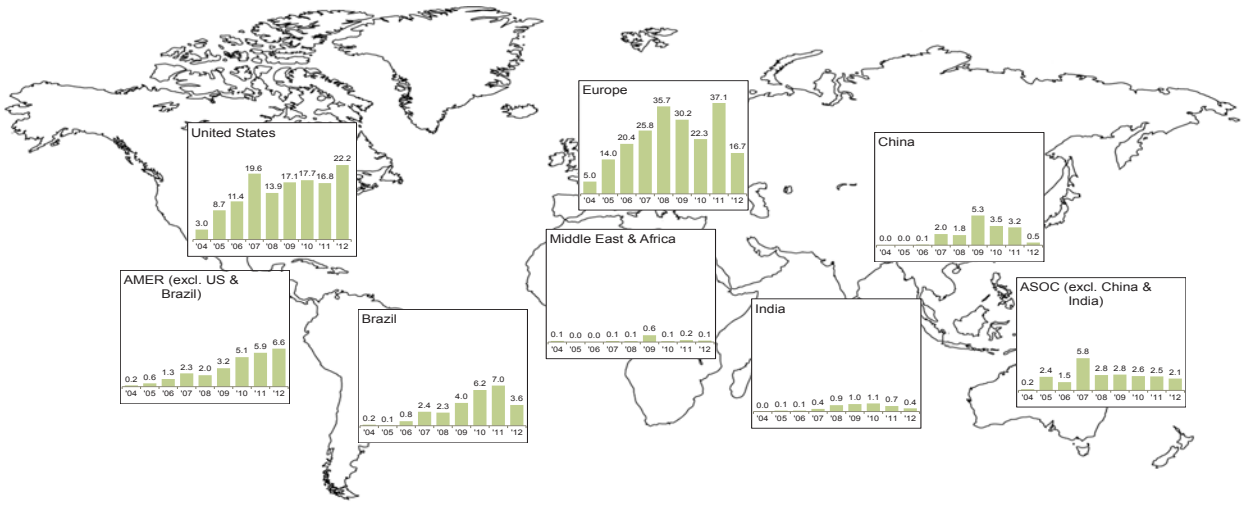
The other categories of acquisition activity remained relatively modest in 2012, and were not helped by the depressed state of clean energy share prices. Private equity buy-outs fell to $2.4 billion from $3 billion, with one of the largest deals with a disclosed price being the $138 million takeover of London-based biofuel project developer GTL Resources by Sinav, a special purpose vehicle created specifically for that acquisition. Public market investor exits were just $432 million, up from an even more modest figure in 2011 but well below 2010's $4.9 billion.

Figure 61 shows a comparison of the trend in all types of acquisition transaction by region. Europe saw a slump in deal value, from $37.1 billion in 2011 to $16.7 billion in 2012, reflecting a mixture of economic woes, uncertainty over the direction of renewable energy support policies in key countries, and the absence of multibillion dollar corporate deals to compare with the 2011 squeeze-outs by EDF and Iberdrola, mentioned above.

The US saw a rise in transaction value, from $16.8 billion to $22.2 billion, smashing the 2007 record. This was largely due to project acquisitions, rather than corporate M&A. There was a downturn in Brazil to $3.6 billion, with acquisition activity in sugar-based ethanol particularly sparse, but the rest of the Americas saw an uptick to $6.6 billion, a record figure.

Acquisition activity in China was remarkably subdued, given the importance of that country to the new investment total last year. It totalled less than $500 million in 2012, down from $3.2 billion in the previous year and well below the record of $5.3 billion in 2009. The rest of Asia-Oceania excluding China and India saw acquisitions at $2.1 billion, down from $2.5 billion in 2011.

FIGURE 61: ACQUISITION TRANSACTIONS IN RENEWABLE ENERGY BY REGION, 2004-2012, $BN



Total values include estimates for undisclosed deals.
Source: Bloomberg New Energy Finance, UNEP

SOURCES OF INVESTMENT – SOME KEY TRENDS

- Clean energy funds had a better year in 2012, achieving an asset-weighted average gain of 1.5% compared with a 20% drop in 2011. Those that invested in energy smart technologies tended to perform better than those focusing on renewable energy.
- Green bonds worth some $5 billion were issued last year, a 44% increase on 2011. With $2.5 billion already issued in Q1 2013, this year may well mark a new record high.
- In February 2012, MidAmerican Holdings issued $850 million in bonds for its 550MW Topaz solar project in California. The offering was oversubscribed by more than $400 million.
- Development banks provided $50.8 billion of finance to renewable energy projects, manufacturers and research efforts in 2012, down slightly from the previous year. They also contributed $28.3 billion to energy efficiency, transmission and distribution.
- "Crowd-sourcing", a recently created mechanism for raising capital from large number of small investors, is starting to be used to fund clean energy projects, particularly small-scale solar in the US and Europe.

FUNDS

As discussed in Chapter 6 on public markets, clean energy shares continued to underperform in 2012. The WilderHill New Energy Global Innovation Index (NEX) declined 5.2%, while wider indices such as the S&P 500 index gained ground in the year. On the bright side, the NEX's showing was an improvement on its 40% drop seen in 2011 – and the rally that began in late summer 2012 extended into the early months of 2013.

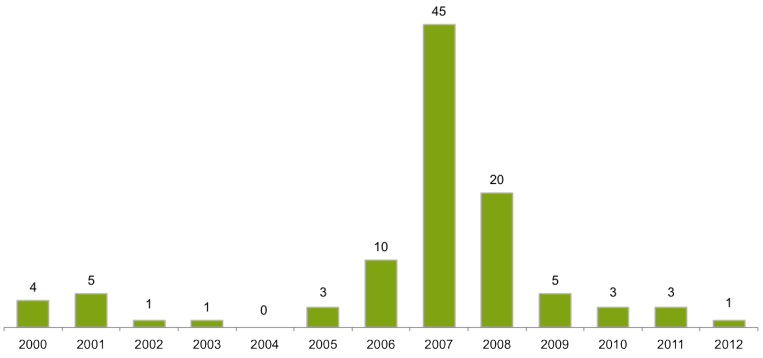
All of the funds focusing on renewable energy and energy smart technologies tracked by Bloomberg New Energy Finance underperformed the MSCI World & Emerging Markets Index in 2012. But it was not all doom and gloom: clean energy funds, weighted by assets under management, closed the year up 1.5% – a decidedly better performance than clean energy index averages, and an improvement on 2011 which saw a decline of 20%.

The top two clean energy funds in 2012 owed their performance in part to their focus on energy smart technologies and electrical equipment, as well as renewable energy: Blackrock's New Energy Investment Trust gained 10.5% over the year, while Vontobel Asset Management's New Power Fund increased by 7.6% over the year.

Some funds managed to raise new money in 2012 but the volumes involved tended to be slightly smaller than in previous years: Singapore-based Armstrong Asset Management raised $65 million in September for its $150 million fund to invest in small-scale renewable power projects in Southeast Asia. The monies came from the Global Energy Efficiency and Renewable Energy Fund, KfW's DEG unit, a Thai family office and the Seed Capital Assistance Facility.

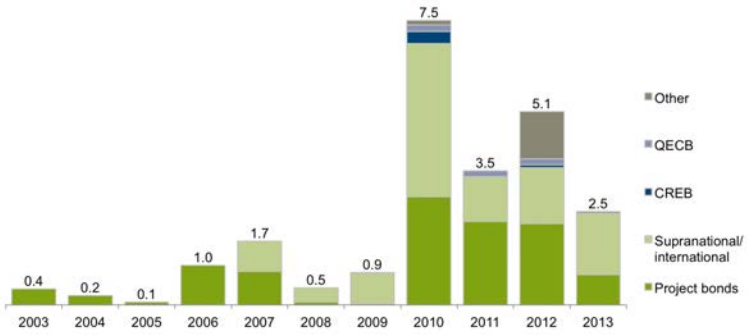
In Europe, UK investment group Ingenious launched its new Renewable Energy Fund of up to GBP 250 million ($390 million). Just over a third of the open-

FIGURE 62: NEW CLEAN ENERGY PUBLIC EQUITY FUNDS LAUNCHED, BY YEAR, 2000-2012



Total values include estimates for undisclosed deals.
Source: Bloomberg New Energy Finance

FIGURE 63: TIER 1 GREEN BOND ISSUANCE, 2003-2012, $BN



Source: Bloomberg New Energy Finance

ended fund will be for solar, 30% for wind and the remainder for biomass and energy efficiency. This adds to the company's African Solar Fund, which opened in November and will invest in companies distributing innovative off-grid solar technology.

One of the biggest successes of the year came right at the end, when the Dutch Infrastructure Fund raised EUR 463 million ($614 million) from investors for renewable energy and other infrastructure projects. Its fourth infrastructure fund reached its second close, having already raised finance in May. It has a target size of EUR 600 million and a cap of EUR 750 million at final close.

With renewable energy shares continuing to languish in 2012, there was predictably little demand from investors for new funds. Figure 62 shows that there was just one new public equity fund specialising in renewables launched in 2012, compared to three in 2011 and a distant peak of 45 in 2007, the peak year for sector stock prices.

GREEN BONDS

Some $5 billion in green bonds were issued last year – a solid 44% up on 2011, though still some way from the peak in 2010 (see Figure 63). These figures include bonds issued by projects, international financial institutions, national governments and under the US municipal green debt programmes, QECB and CREB. Project bonds were the largest single category for the second year running. Some $2.5 billion of green bonds have already been issued this year thanks to the $1 billion offering from the World Bank's International Finance Corporation (IFC), suggesting that 2013 may be on track for a new record.

Demand for project and international bonds continues to be high and oversubscriptions are common: to give an example, in February 2012, MidAmerican's 550MW Topaz solar project in California elicited $1.2 billion of interest for what was initially a $750 million issue (subsequently expanded to $850 million).

Clean energy projects issued just over $2 billion in green bonds last year, with six issues in North America and two in the UK (for small solar and wind projects). Most demand comes from insurance companies, pension funds and privately managed infrastructure investment funds drawn to the long tenors and stable cash flows. Mexico's first renewable bond offer, for example – the 240MW Oaxaca wind projects last August – attracted pension funds (61%), life insurance companies (27%) and private banks and hedge funds (12%). In November, Pension Insurance Corporation purchased $64 million worth of bonds linked to

two 5MW solar parks in southwest England owned by Solar Power Corporation. The more mature renewable technologies – in particular solar and wind – have dominated the space. In the case of biomass projects, feedstock cost risk may be a barrier, forcing developers to rely on higher-cost mezzanine financing.

With regard to supranational bonds, the most prolific issuer was the World Bank's IFC, selling $515 million in 2012. The Asian Development Bank was a close second, with $343 million. The market has shifted over the last 18 months from one with many small offerings to one with fewer, larger ones. The average issuance size has increased from $42 million in 2011 to $167 million over the period since. The composition of the market has also changed, the African Development Bank and Nordic Investment Bank pulling back after an active 2010, as the World Bank's market share has grown.

This category (supranational) includes bonds issued to the international investment community by the development banks for funding clean energy and climate change-related projects, typically through ring-fenced loans. Such bonds appeal to investors as they can satisfy their green investing mandates and, because bonds take on the credit ratings of their issuers (all of which are investment grade), they can minimise risk.

The IFC targeted US institutional investors for the first time in April 2012, with a $500 million issue that drew Teachers Insurance Annuity Association-College Retirement Equities Fund, BlackRock and California State Teachers' Retirement System on the buy side. In May, the Asian Development Bank raised $339 million from its second sale of 'clean energy bonds' to Japanese retail investors.

In October, South Africa's Industrial Development Commission raised $578 million in a bond issue to fund renewable energy projects. The buyers were the South African Government Employee's Pension Fund and the Public Investment Corporation.

Also in October, the directors of the European Investment Bank signed an agreement with the European Commission on the pilot phase of the 2020 Project Bond Initiative. This will see the EIB provide a subordinated loan or contingent facility to support the senior debt bonds issued by companies financing infrastructure projects. The pilot phase will concentrate on energy, as well as transport and broadband. If successful, the initiative could act as a catalyst to produce a self-sustaining European market for renewable energy project bonds.

Over $2.5 billion in green bonds were raised worldwide in the first quarter of this year: if offerings continue at the current pace, 2013 will make a new record. The market has already seen the entry of some new players: the Korea Export-Import Bank, for example, raised $500 million in February, attracting $1.8 billion of orders – again illustrating the volume of interest.

DEVELOPMENT BANKS

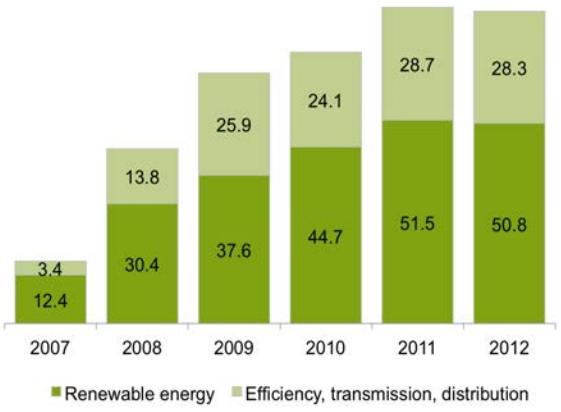
Development banks provided $79.1 billion of finance in 2012 to broad clean energy, including hydro and other renewable energy projects, manufacturers, research, energy efficiency, transmissions and distribution. This was down just over 1% on 2011 levels (see Figure 64). The

largest player was once again Germany's KfW, which made EUR 20 billion of finance available, down 10% on 2011 levels, followed by China Development Bank with $15 billion, up 1%, BNDES of Brazil with $11.9 billion, European Investment Bank with $6 billion and World Bank Group with $5 billion (see Figure 64).

The numbers above include energy efficiency and grid finance. Looking at core renewable energy lending, the EIB lent some EUR 4.3 billion ($5.6 billion) to renewable energy initiatives in 2012 compared with EUR 5.9 billion in 2011, as countries battled the European debt crisis. The bank is likely to increase overall lending this year, after countries agreed to boost overall disbursements to all sectors by a further EUR 60 billion ($77 billion) over 2013-15. This follows the decision during 2012 to increase its paid-in capital by EUR 10 billion ($13 billion).

As 2012 drew to a close, the EIB lent Enel Green Power EUR 160 million ($204 million) to support its renewable energy plans in Italy, and Ireland's Bord Gáis received a EUR 155 million ($198 million) loan for the construction and operation of six onshore wind farms. The latter plants are expected to be finished in 2013-14 and will boost the company's operational wind capacity by over 50% to 365MW. Finally, on the penultimate working day of December, the bank announced that Gamesa, Spain's wind turbine maker, would receive a EUR 260 million ($337 million) loan over the next three years.

FIGURE 64: DEVELOPMENT BANK FINANCE FOR BROAD CLEAN ENERGY, TRANSMISSION AND DISTRIBUTION, 2007-12, $BN



Source: Bloomberg New Energy Finance, development banks

Germany's KfW issued EUR 1.3 billion ($1.7 billion) in renewable energy and energy efficiency loans in 2012 compared with EUR 1.5 billion ($2.1 billion) in 2011. Much of the financing went to projects in developing countries: in July, its export finance unit – together with Landesbank Baden-Wuerttemberg – announced they were to loan $165 million to a Turkish wind farm – another sign that clean energy investment activity has spread beyond the traditional targets of China, the US and EU. In December, KfW agreed to lend Brazilian utility Companhia Energetica de Minas Gerais EUR 10 million ($13 million) for two solar projects. With a total capacity of 2.6MW, the projects will be built on the roofs of football stadiums hosting the 2014 World Cup.

Across the Atlantic, the Inter-American Development Bank granted $3.6 billion in loans targeting environmental sustainability, climate change and sustainable energy in 2012 – compared with just under $5 billion in 2011. Of this financing, it is likely to have issued some $700 million to renewable energy projects last year, with the largest recipient

being the Reventazón Hydroelectric power project in Costa Rica, receiving $450 million. In addition, the bank lent $100 million to two 20MW solar PV plants in southern Peru, and the same amount to two wind farms in Uruguay.

The Brazilian national development bank (BNDES) focused on bioenergy and wind projects in 2012 – the country's core renewables sectors, with small hydro: sugar-cane producer Usina de Acucar Santa Terezinha was granted a BRL 26 million ($115 million) loan in May to develop crops and Energias Renovaveis do Brasil signed a BRL 210 million ($104 million) financing contract with the bank in July for a biomass project with Dow Chemical. The previous month, BNDES approved a loan of BRL 378 million ($185 million) to Forca Eolica do Brasil for the construction of five wind farms. Headlines in the second half of the year centred around local content requirements, after the bank stopped authorising loans for foreign companies to buy wind turbines produced in Brazil that did not source 40% of their components locally. This threshold has now risen to 60%.

Some development banks, such as the EIB, reduced renewable energy lending in 2012, while others increased it: the World Bank, for example, boosted such lending to $3.6 billion in the financial year ending 30 June 2012 from $2.9 billion in the preceding year. This brings its total financing since the 2006-07 financial year to $12.5 billion, of which some 43% has gone to hydropower projects, followed by 9% to geothermal and 8% to solar PV. In terms of geography, South and East Asia have benefitted from $3.2 billion and $2.7 billion respectively since 2007, with $2.1 billion each to Sub-Saharan Africa and Europe-Central Asia.

As examples of projects in 2011-12, the bank approved a $172 million loan to support installation of an additional 630,000 solar home systems and other renewable energy mini-grid schemes in Bangladesh. The project has already installed 1.4 million such systems. Also last year, a subsidiary of Indonesia's Pertamina received a $175 million World Bank loan and $125 million from the Clean Technology Fund. The state-owned company is working to increase its geothermal capacity in south Sumatra and north Sulawesi. With a scheduled completion date of 2015, the project should add 150MW to the grid, displacing coal-based power generation.

In Asia, the China Development Bank continued to support the renewable energy industry last year: in October, it issued a $1.6 billion credit line to solar project developer Sky Solar Holdings. Running until 2016, the agreement is aimed at alleviating the considerable overcapacity in the domestic solar panel market. The bank is shifting support towards project developers, away from solar panel manufacturers, after a boom in factory production reduced prices. Sky Solar could help the Chinese government to boost demand for panels in its domestic market.

Last year, the bank pledged to provide billions of yuan in financing to solar developers. In March, for example China Merchants New Energy Group secured $1.6 billion from the state-owned bank, which will provide loans, leasing and other forms of financing over the next four years. The backing should help the company to build and operate solar plant both domestically and internationally as well as to fund mergers and acquisitions in new energy businesses. The China Development Bank did not only support domestic solar projects in 2012, however: in January, it made a deal with Xinjiang Goldwind, China's second-largest wind turbine maker, for projects worth CNY 35 billion ($5.5 billion) and in July, Generadora Eolica Argentina del Sur said it would receive $3 billion in financing from the bank to install 1.35GW of Chinese turbines in the Latin American country. The wind projects will supply 4% of Argentina's power once fully operational in 2017.

Development banks in Africa were also highly active in lending to renewable energy in 2012. For example, the Development Bank of Southern Africa approved loan facilities in October totalling ZAR 9.6 billion ($1 billion) earmarked for renewable energy projects. When completed, these initiatives should fulfil a quarter of the country's 3.7GW renewable energy target and are all solar PV or thermal projects, with one being wind. And in September, the African Development Bank granted Morocco $800 million in loans to support renewable energy programmes. These projects include the country's plans to build a solar thermal power plant in Ouarzazate and its integrated wind/hydro rural electrification programme. The solar project has also been financed by the World Bank, European Investment Bank, Agence Française de Developpement, KfW and the Neighbourhood Investment Facility, together with Moroccan institutions.

CROWD FUNDING

The last few years have seen the development of a new direct investment model connecting individual investors with projects via a clearing house or aggregator. Through this mechanism – known as 'crowd-funding' – small companies and start-ups raise capital from many small investors, in return for an equity stake, structured payments, products or a combination thereof.[23]

Now the idea is being applied to clean energy: some notable examples in 2012 were Solar Mosaic, which had raised $1.1 million from 400 crowd-funders by January 2013. It lists available projects on its website, and investors provide the capital that is used to buy and install rooftop solar panels, currently on affordable housing in the US. When the systems are complete and selling power, typically to building owners or occupants, the backers are repaid with interest. In May 2012, Solar Mosaic raised $2.5 million in venture capital and it has received a $2 million grant from the US Department of Energy. Launched last year, US-based site SunFunder raises finance for off-grid solar projects in developing countries. By April 2013, it had raised some $70,670 from 539 people for projects in Uganda, Zambia, Kenya and the Philippines.

Crowd-funding is not restricted to the US: Abundance Generation enables individuals to put in as little as GBP 5 ($7.59) to renewable energy projects in the UK. Backers invest in 'debentures', which pay a share of the profits generated from the investment over 25 years. The platform has raised GBP 2.2 million ($3.3 million), according to its website. In Germany, the Crowd Energy Internet portal handled its first project in August 2012 – a 93kW solar array, which received EUR 19,000 (10% of the total cost).

The passage of the US JOBS Act in April 2012 is likely to increase crowd funding's popularity further, as the legislation aims to enable unaccredited investors to make equity investments easily in small and start-up businesses. However, this financing mechanism is not problem-free: it does not offset project credit risk, for example. This may not be an issue for early investments as backers may be more motivated by the environmental and social values behind a project, rather than risk-less returns. However, if crowd funding is to expand substantially, credit risk and insurance products will be needed to protect investors. Likewise a healthy, long-term crowd-funding market is likely to require a secondary market for crowd-funded debt.

[23] Crowd funding was originally conceived as a way to support creative projects such as films, band tours and album recordings. By spring 2013, some 3.7 million people had pledged $551 million through the biggest crowd-funding website – US Kickstarter – founded in 2009.

GLOSSARY[1]

ASSET FINANCE	All money invested in renewable energy generation projects, whether from internal company balance sheets, from debt finance, or from equity finance. This excludes refinancings. The asset finance numbers represent investment raised in each year – i.e., equity that is committed, or debt that is provided (sometimes in tranches). The plant or project may not be commissioned in the same year.
CAPITAL EXPENDITURE – CAPEX	Funds used by a company to acquire or upgrade physical assets such as property, industrial buildings or equipment. Some investment will translate into capacity in the following year.
CONVERTIBLE BOND	A bond that can be exchanged for a fixed number of shares in the issuing company.
DISTRIBUTED GENERATION	Generation of power from small-scale technologies close to where it is used.
FEED-IN TARIFF	A premium rate paid for electricity fed back into the electricity grid from a designated renewable electricity generation source.
GREEN STIMULUS	The share of government economic recovery packages allocated to "green" initiatives such as renewable energy, energy efficiency, smart power grid, transport, and other clean energy technologies.
INITIAL PUBLIC OFFERING (IPO)	A company's first offering of stock or shares for purchase via an exchange. Also referred to as "flotation".
INVESTMENT TAX CREDIT (ITC)	Allows investment in renewable energy in the US to be deducted from income tax.
MERGERS & ACQUISITIONS (M&A)	The value of existing equity and debt purchased by new corporate buyers in companies developing renewable technology or operating renewable energy projects.
NON-RECOURSE PROJECT FINANCE	Debt and equity provided directly to projects rather than to the companies developing them. The lender is only entitled to repayment from the profits of the project and has no access to the borrower's other assets in the event of default.
OVER-THE-COUNTER (OTC)	Trading of stocks, bonds, commodities or derivatives directly between buyers and sellers as opposed to via a formal exchange.

[1] Further definitions and explanations can be found in Private Financing of Renewable Energy – a Guide for Policymakers. S. Justice/K. Hamilton. Chatham House, UNEP Sustainable Energy Finance Initiative, and Bloomberg New Energy Finance, December 2009 and in the REN21 2013 Renewables Global Status Report

PRIVATE INVESTMENT IN PUBLIC EQUITY (PIPE)	The purchase of securities directly from a publicly traded company by private investors.
PRODUCTION TAX CREDIT (PTC)	The support instrument for wind energy projects at federal level in the US.
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.
RENEWABLE PORTFOLIO STANDARD (RPS)	A regulation that requires that a minimum of electricity or heat sold is from renewable energy sources. Also called Renewable Electricity Standard (RES) at the United States federal level and Renewables Obligation in the UK.
TAX EQUITY	Tax equity investors invest in renewable energy projects in exchange for federal tax credits.
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.

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