Frankfurt School
FS-UNEP Collaborating Centre
for Climate & Sustainable Energy Finance

GLOBAL TRENDS IN RENEWABLE ENERGY INVESTMENT 2015

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FOREWORD FROM BAN KI-MOON

Climate change is defining our present. Our response to it will define our future. To limit global temperature rise to two degrees Celsius we will need a substantial reduction of greenhouse gas emissions. Global Trends in Renewable Energy Investment 2015 increases our confidence that a low-carbon world is obtainable and that we are on the right path to reach our objective, even though there is still much to accomplish.

Global investment in renewable power and fuels in 2014 was nearly 17% higher than in 2013, with a boom in solar installations in China and Japan. Investments in developing countries grew by 36% and almost reached the level of investments in developed countries.

In spite of these positive findings, renewable sources excluding large hydro still account for only 9% of the world's electricity generation. Policy uncertainty and other barriers to investment need to be abolished. We need more private and public investment incentives – including putting a price on carbon to provide markets with the right policy signals to move them to invest in climate solutions.

A key step to this end will be in December 2015, in Paris, when we anticipate a meaningful, universal climate change agreement that can help to further mobilise financial markets to support low-carbon growth. I commend Global Trends in Renewable Energy Investment 2015 to readers in all sectors interested in combatting climate change and supporting a sustainable future for all.

Ban Ki-moon

Secretary-General, United Nations

JOINT FOREWORD FROM ACHIM STEINER, CHRISTIANA FIGUERES AND UDO STEFFENS


ACHIM STEINER


CHRISTIANA FIGUERES


UDO STEFFENS

In 2014, global investments in renewable energy increased by 17% to $270.2 billion. This was the first increase in investment for three years. And the trend was even more impressive in terms of capacity: last year a record of 95GW of wind and solar photovoltaic power was installed globally.

As stated in this Global Trends in Renewable Energy Investment 2015 report, renewable energy excluding large hydro accounted for 48% of new generating capacity installed globally in 2014, and the share of renewables in global electricity generation increased to 9.1%. This is equivalent to avoided greenhouse gases emissions of some 1.3 gigatonnes annually. The increase in renewables sends a strong signal of opportunity to world leaders and delegates, who are negotiating towards a new, universal agreement on climate change, scheduled to be reached in Paris by the end of 2015 and to come into effect in 2020. The transformation to more sustainable development will be principally achievable when existing technologies are combined with good policies and credible leadership.

Global Trends in Renewable Energy Investment 2015 also highlights a record $119 billion in new investment in renewable energy in China and Japan combined – with China taking a clear lead at $83.3 billion, a record, and an increase of 33% from 2013 to 2014. Also of note in this report is the continuous spread of renewable energy into new markets. A remarkable $131.3 billion, an increase of more than 36% from the previous year, was invested in developing countries in 2014. Meanwhile, investment decisions on offshore wind projects in Europe and China accounted for $18.6 billion in 2014, and are drawing increased attention in terms of their scale and growth.

The 50%-plus collapse in oil prices in the second half of last year was a daunting challenge. However, although the fall in oil prices is likely to lower investor confidence, oil and renewables do not compete for the same investment funds so the wind and solar sectors should be able to carry on flourishing, particularly if they continue to cut energy costs.

Overall, Global Trends in Renewable Energy Investments 2015 underlines the increasingly positive role that renewable energies are playing in developing a low-carbon economy. The results from this report indicate that we have made good progress – and indeed picked up some momentum – towards our goal of keeping global temperature within the two degrees Celsius limit. However, policy uncertainties in the US and UK markets, amongst others, and retroactive policy changes in countries such as Italy and Romania, as well as concerns about grid access for small-scale solar power in Japan and some US states, have resulted in early challenges for 2015. In this light, a clear signal for the phase-out of fossil fuel dominance by mid-century through a universal climate change agreement will help to make the world liveable in the long term.

Achim Steiner

UN Under-Secretary General and UNEP Executive Director

Christiana Figueres

Executive Secretary of the United Nations Framework Convention on Climate Change (UNFCCC)

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 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 many tens of thousands of organisations (including start-ups, corporate entities, venture capital and private equity providers, banks and other investors), projects and 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 2015 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 5.

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. 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 historical figures are constantly updated.

This 2015 report contains revisions to a number of investment figures published in the 2014 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, and also new transactions in 2013 and before that have since come to light.

DEFINITIONS

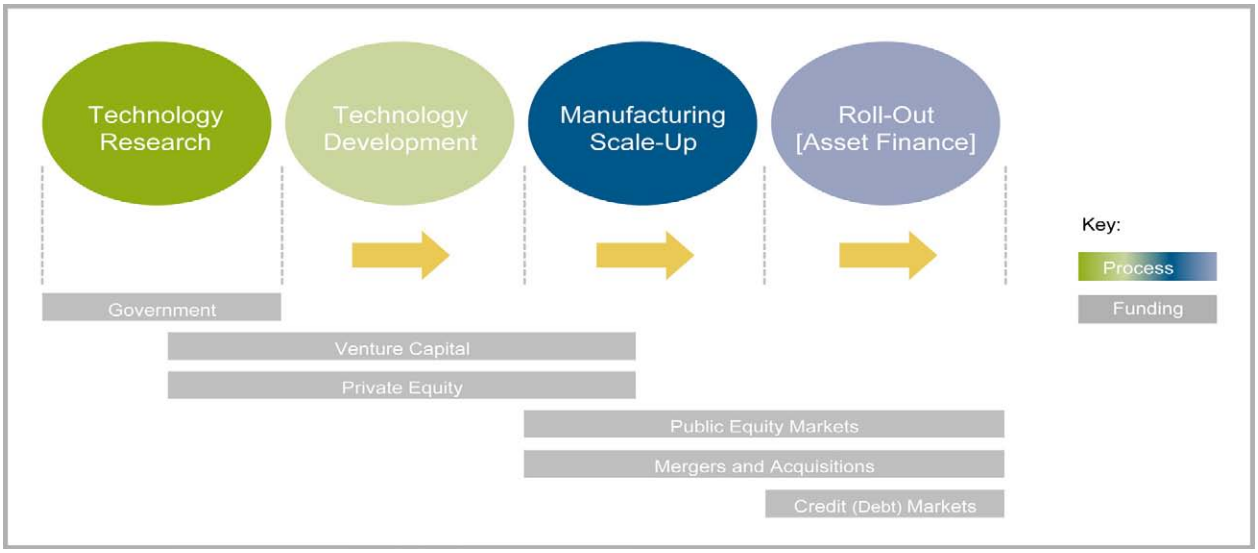
Bloomberg New Energy Finance tracks deals across the financing continuum, from R&D funding and venture capital for technology and early-stage companies, through to public market financing for projects and mature companies. Investment categories are defined as follows:

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 **Renewables Global Status Report (GSR)**, first released in 2005, grew out of an effort to comprehensively capture 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 is a true collaborative effort of several authors, REN21 Secretariat staff and Steering Committee members, regional research partners, and more than 500 individual contributors and reviewers; and has become the most frequently referenced report on renewable energy business and policy, serving a wide range of audiences. The GSR is a sister publication to this Global Trends in Renewable Energy Investment (GTR) report. The most recent edition of the GSR, launch date mid-June 2015, will be available at www.ren21.net/gsr

KEY FINDINGS

- Global investment in renewable power and fuels (excluding large hydro-electric projects) was $270.2 billion in 2014, nearly 17% higher than the previous year. This was the first increase for three years, and reflected several influences, including a boom in solar installations in China and Japan, totalling $74.9 billion between those two countries, and a record $18.6 billion of final investment decisions on offshore wind projects in Europe.

- The trend last year was, arguably, even more impressive than it would seem from the investment numbers, because a record number capacity of wind and solar photovoltaic power was installed, at about 95GW. This compared to 74GW in 2013, 79GW in 2012 and 70GW in 2011, the only year in which dollar investment was higher than 2014, at $278.8 billion. The main reason why investment last year was below that three years earlier was that technology costs, particularly in solar, have fallen sharply during the intervening period.

- A key feature of 2014 was the continuing spread of renewable energy to new markets. Investment in developing countries, at $131.3 billion, was up 36% on the previous year and came the closest ever to overhauling the total for developed economies, at $138.9 billion, up just 3% on the year. Indonesia, Chile, Mexico, Kenya, South Africa and Turkey were all in the billion-dollar-plus club in 2014 in terms of investment in renewables, and others such as Jordan, Uruguay, Panama, the Philippines and Myanmar were in the $500 million to $1 billion range.

- Renewables faced challenges as 2015 began – notably from policy uncertainty in markets such as the US and the UK, retroactive policy changes in countries such as Italy and Romania, and concerns about grid access for small-scale solar in Japan and some US states. The most daunting challenge was, at first sight, the impact of the 50%-plus collapse in the oil price in the second half of last year. However, although the oil price is likely to dampen investor confidence in parts of the sector, such as solar in oil-exporting countries, and biofuels, in most parts of the world, oil and renewables do not compete for power investment dollars. Wind and solar sectors should be able to carry on flourishing, particularly if they continue to cut costs per MWh.

- The cost-cutting achieved to date helped to ensure strong momentum for both those technologies in 2014. Overall investment in solar was up 29% to $149.6 billion, while that in wind advanced 11% to a record $99.5 billion. Other renewable energy sources mostly did less well, biofuels seeing an 8% fall in investment to $5.1 billion, a 10-year low; biomass and waste-to-energy dropping 10% to $8.4 billion; small hydro slipping 17% to $4.5 billion; and geothermal managing to rise 23% to $2.7 billion.

- The biggest locations for renewable energy investment last year were, predictably, the established markets in major economies – with China far out in front at $83.3 billion, a record number and 33% ahead of 2013. In second place came the US, at $38.3 billion, up 7% on the year but still well below its all-time high, reached in 2011. Third came Japan, at $35.7 billion, a tenth higher than in 2013 and its biggest total ever. India was up 14% at $7.4 billion, and Brazil 93% higher, at $7.6 billion.

- Investment in Europe advanced less than 1% to $57.5 billion. There were seven billion-dollar-plus financings of offshore wind projects, boosting the investment totals for the Netherlands, the UK and Germany. These included, at the euro equivalent of $3.8 billion, the largest single renewable energy asset finance deal ever, outside large hydro – that of the 600MW Gemini project in Dutch waters.

- Renewable energy technologies excluding large hydro made up 48% of the net power capacity added worldwide in 2014, the third successive year in which this figure has been above 40%. New investment in renewable power capacity last year, at $242.5 billion excluding large hydro, was below the gross investment in fossil fuel capacity, at some $289 billion, but far above the figure for net investment in additional fossil fuel capacity, at $132 billion.

- Altogether, wind, solar, biomass and waste-to-power, geothermal, small hydro and marine power are estimated to have contributed 9.1% of world electricity generation in 2014, compared to 8.5% in 2013. This would be equivalent to a saving of 1.3 gigatonnes of CO2 taking place as a result of the installed capacity of those renewable sources. The methodology behind this calculation is explained in Chapter 2 below.

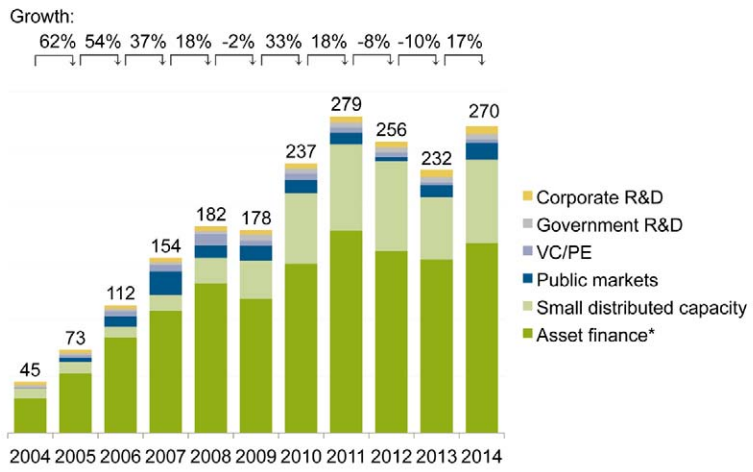
- Equity raising by renewable energy companies on public markets jumped 54% in 2014 to $15.1 billion, helped by the recovery in sector share prices between mid-2012 and March 2014, and by the popularity with investors of US "yieldcos" and their European equivalents, quoted project funds. These vehicles, owning operating-stage wind, solar and other projects, raised a total of $5 billion from stock market investors on both sides of the Atlantic in 2014.

EXECUTIVE SUMMARY

2014 was a year of eye-catching steps forward for renewable energy. Investment rallied strongly after two years of decline, renewables excluding large hydropower reached 100GW of installations for the first time ever, developing countries led by China came within just a few billion dollars of overtaking investment in developed economies, and there were record statistics for financings of solar in China and Japan and offshore wind in Europe.

It is also the case that the recent period has seen the competitive environment for renewables become even more exacting. The near-50% plunge in crude oil prices between June 2014 and March 2015 will have a direct effect on renewable energy in a few places, such as developing countries burning oil for power and biofuel markets not covered by mandates. More significant may be the indirect effect, via downward pressure on gas prices. That will lower the cost of gas-fired generation, a competitor of wind and solar in many countries. So far, renewables have been up to the challenge, with for instance January this year seeing a project in Dubai setting a clear, new record for the lowest price ever agreed for electricity from a solar photovoltaic plant. Further cuts in the cost of generation for both solar and wind look to be on the cards in 2015.

FIGURE 1. GLOBAL NEW INVESTMENT IN RENEWABLE ENERGY BY ASSET CLASS, 2004-2014, $BN



*Asset finance volume adjusts for re-invested equity. Total values include estimates for undisclosed deals

Source: UNEP, Bloomberg New Energy Finance

The top headline for renewable energy in 2014 was that investment rebounded by 17% to $270.2 billion (see Figure 1). This was the first annual increase in dollar commitments to renewables excluding large hydro for three years, and brought the total up to just 3% below the all-time record of $278.8 billion set in 2011.

The 2014 performance by renewable energy investment was arguably more impressive than that in 2011 anyway – because capital costs in wind, and particularly in solar PV, fell sharply in the intervening three years, so each billion dollars committed added up to many more MW of capacity than it did in the earlier year. Some 103GW of renewable power capacity

[1] The Emissions Gap Report 2013, UNEP, Nairobi.

excluding large hydro is estimated to have been built in 2014, compared to 86GW in 2013 and 80.5GW back in 2011. The 2014 total was dominated by wind and PV, with 49GW and 46GW respectively, both record figures.

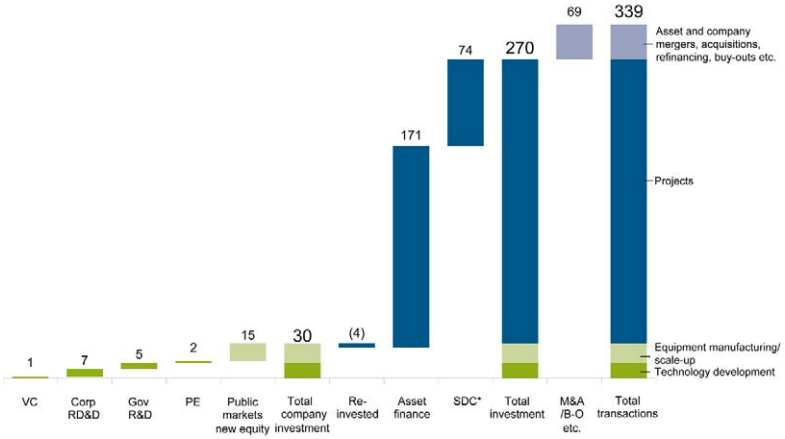
This Executive Summary looks at some of the key elements in the rebound in global renewable energy investment in 2014, and then at the continuing challenges, the role of clean power in the climate issue, and the trends in costs of generation.

SUN IN ASIA, WIND IN NORTH SEA

Figure 2 shows the elements that made up that 2014 investment figure of $270.2 billion. Starting on the left with technology-oriented funding, venture capital equity raising for renewables jumped 39% last year to $1 billion, although this remained less than half the totals achieved in 2008 and in each of the years 2010-12. Research and development spending edged up 2% in 2014 to $11.7 billion, with governments contributing $5.1 billion and companies a record $6.6 billion.

Moving along to the right on Figure 2, private equity investors pumped $1.7 billion into specialist renewable energy companies, up 20% on 2013 but still far below the $6.8 billion record set in 2008.

FIGURE 2. GLOBAL TRANSACTIONS IN RENEWABLE ENERGY, 2014, $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

Equity raising by renewable energy companies on public markets increased more sharply, by 43% to $15.1 billion, the second-highest annual figure ever, thanks partly to the 100%-plus rally in clean energy share prices from summer 2012 to March 2014.

The two biggest categories of renewable energy investment were asset finance of utility-scale projects, at $170.7 billion, up 10% on 2013, and investment in small distributed capacity, largely rooftop solar, at $73.5 billion, no less than 34% higher than in the previous year. Figure 3 provides further data on the growth in these various types of investment since 2004, and also shows the split in investment by sector.

Once again, solar and wind were runaway leaders in terms of renewable energy investment, the former accounting for $149.6 billion, the second highest figure ever and up 25% on 2013; and the latter bringing in $99.5 billion, up 11% to a new record.

Within these solar and wind totals, two features stood out last year. The first was an unprecedented solar boom in China and Japan. The two giant Asian economies invested $74.9 billion between them in solar in 2014, almost exactly half the global total, with China at $40 billion, up 45% on the previous year, and Japan at $34.8 billion, up 13%. In China, utility-scale solar projects (of more than 1MW) made up about three quarters of the solar investment, whereas in Japan, it was small-scale projects of less than 1MW that made up 81%. Chapters 1, 5 and 6 provide much more detail on the drive by these two countries to increase solar capacity.

The other big feature was European offshore wind. No fewer than seven projects costing $1 billion or more reached "final investment decision" stage during 2014, the largest being the $3.8 billion financing by 12 banks, three export credit agencies, the European Investment Bank and a Danish pension fund of the 600MW Gemini installation in waters off the coast of the Netherlands – the largest ever go-ahead for a renewable energy

FIGURE 3. GLOBAL TRENDS IN RENEWABLE ENERGY INVESTMENT 2014 DATA TABLE, $BN

Category / Year / Unit	2004 $bn	2005 $bn	2006 $bn	2007 $bn	2008 $bn	2009 $bn	2010 $bn	2011 $bn	2012 $bn	2013 $bn	2014 $bn	2012-14 Growth %	2004-14 CAGR %
1 Total Investment													
1.1 New investment	45.1	72.9	112.1	153.9	181.8	178.5	237.2	278.8	256.4	231.8	270.2	17%	20%
1.2 Total transactions	53.9	99.1	148.1	212.5	241.1	242.7	295.7	352.3	324.1	298.6	339.0	13%	20%
2 New Investment by Value Chain													
2.1 Technology development													
2.1.1 Venture capital	0.4	0.6	1.2	2.1	3.2	1.6	2.5	2.5	2.4	0.7	1.0	39%	11%
2.1.2 Government R&D	1.9	2.0	2.2	2.7	2.8	5.3	4.7	4.6	4.5	4.9	5.1	3%	10%
2.1.3 Corporate RD&D	3.2	2.9	3.1	3.5	4.0	4.1	4.2	5.1	5.0	6.6	6.6	1%	7%
2.2 Equipment Manufacturing													
2.2.1 Private equity expansion capital	0.3	1.0	3.0	3.6	6.8	2.9	3.1	2.5	1.7	1.4	1.7	20%	18%
2.2.2 Public markets	0.3	3.7	9.1	20.7	10.9	13.1	11.4	10.1	3.9	10.5	15.1	43%	50%
2.3 Projects													
2.3.1 Asset finance	30.4	52.5	84.7	110.4	135.4	120.0	154.6	181.2	163.2	154.6	170.7	10%	19%
Of which re-invested equity	0.0	0.2	0.7	3.1	3.7	1.9	5.6	3.3	2.9	1.9	3.6	90%	-
2.3.3 Small distributed capacity	8.6	10.3	9.5	14.1	22.3	33.4	62.2	76.1	78.8	54.9	73.5	34%	24%
Total Financial Investment	31.4	57.6	97.3	133.7	152.7	135.6	166.1	192.9	168.1	165.4	185.0	12%	19%
Gov't R&D, corporate RD&D, small projects	13.7	15.3	14.8	20.2	29.1	42.8	71.2	85.9	88.3	66.4	85.2	28%	20%
Total New Investment	45.1	72.9	112.1	153.9	181.8	178.5	237.2	278.8	256.4	231.8	270.2	17%	20%
3 M&A Transactions													
3.1 Private equity buy-outs	0.8	3.7	1.8	3.6	5.4	2.2	2.0	3.1	3.3	0.6	2.5	335%	12%
3.2 Public markets investor exits	0.4	2.4	2.7	4.0	1.0	2.5	4.9	0.2	0.4	1.8	1.9	6%	18%
3.3 Corporate M&A	2.4	7.6	12.3	20.3	17.6	21.8	19.4	30.1	10.1	15.2	9.8	-35%	15%
3.4 Project acquistion & refinancing	5.3	12.5	19.1	30.6	35.4	37.8	32.1	40.1	53.8	49.3	54.5	11%	26%
4 New Investment by Sector													
4.1 Wind	17.9	29.1	39.6	61.6	75.2	81.2	98.9	84.2	84.1	89.3	99.5	11%	19%
4.2 Solar	12.0	16.3	22.1	38.0	60.8	63.7	103.3	155.7	144.3	119.8	149.6	25%	29%
4.3 Biofuels	3.9	9.6	28.4	28.7	19.2	10.2	10.1	10.4	7.0	5.5	5.1	-8%	3%
4.4 Biomass & w-t-e	7.4	9.6	12.1	15.8	16.9	13.9	16.0	17.4	12.4	9.3	8.4	-10%	1%
4.5 Small hydro	2.6	7.2	7.6	7.1	7.8	6.3	5.7	7.2	6.4	5.5	4.5	-17%	6%
4.6 Geothermal	1.2	1.0	1.5	2.0	1.7	2.9	3.0	3.7	1.8	2.2	2.7	23%	9%
4.7 Marine	0.0	0.1	0.9	0.8	0.2	0.3	0.3	0.3	0.3	0.2	0.4	110%	24%
Total	45.1	72.9	112.1	153.9	181.8	178.5	237.2	278.8	256.4	231.8	270.2	17%	20%
5 New Investment by Geography													
5.1 United States	5.4	11.6	29.1	33.0	35.1	24.3	35.1	50.0	38.2	36.0	38.3	7%	22%
5.2 Brazil	0.8	3.1	5.2	11.8	12.1	7.9	7.7	10.1	7.2	3.9	7.6	93%	25%
5.3 AMER (excl. US & Brazil)	1.7	3.3	3.9	5.0	5.8	5.8	12.2	9.2	10.2	12.2	14.8	21%	24%
5.4 Europe	23.6	33.6	46.7	66.4	81.6	81.2	111.1	120.7	89.6	57.3	57.5	0%	9%
5.5 Middle East & Africa	0.6	0.8	1.1	2.4	2.3	1.7	4.2	2.9	10.4	8.7	12.6	46%	36%
5.6 China	3.0	8.2	11.1	16.6	25.7	39.5	38.7	49.1	62.8	62.6	83.3	33%	39%
5.7 India	2.7	3.1	4.9	6.3	5.6	4.3	9.0	12.7	7.4	6.4	7.4	14%	10%
5.8 ASOC (excl. China & India)	7.2	9.2	10.0	12.5	13.6	13.7	19.3	24.1	30.5	44.7	48.7	9%	21%
Total	45.1	72.9	112.1	153.9	181.8	178.5	237.2	278.8	256.4	231.8	270.2	17%	20%

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

generation plant anywhere in the world. [1] Globally, $18.6 billion worth of offshore wind projects were financed in 2014, some 148% up on the previous year and 45% above the next highest year ever, 2010. Europe accounted for $16.2 billion of the world offshore wind investment, with China the remaining $2.4 billion.

Previous years' Global Trends reports have followed the spread of renewable energy technologies from their early-adopter locations in Europe and North America to more and more parts of the world, notably to developing economies. Figure 4 shows that the split in investment between developed and developing countries was more equal than ever before in 2014, with the first group attracting $138.9 billion and the second group $131.3 billion. Developing countries have increased their investment in renewable energy almost in a straight line since 2004, with a single blip in 2013, while developed economies saw commitments reach a peak in 2011 on the back of stimulus programmes in the US and runaway solar booms in Germany and Italy. The level of investment in developed nations has fallen back into a range of $135 billion to $150 billion in the last three years.

Much of the surge by developing economies over recent years has been thanks to investment in China. This raced up from just $3 billion in 2004 to $83.3 billion in 2014 (see Figure 3), helped by supportive government policies aimed at boosting power generation in the country, at providing demand for domestic wind and solar manufacturing industries, and – especially recently – at offering an alternative to pollution-inducing fossil fuel generation.

However, the advance of the developing nations in renewable energy has not been only about China. In 2014, Brazil ($7.6 billion), India ($7.4 billion) and South Africa ($5.5 billion) were all in the top 10 of investing countries, while Mexico, Chile, Indonesia, Kenya and Turkey were all in the $1 billion-plus club and several others were challenging to join them.

Figure 5 underlines how far behind wind and solar the other renewable energy technologies have fallen. In 2014, these two sectors accounted for 92% of overall global investment in renewable power and fuels, while biomass and waste-to-energy made up 3% of total, with $8.4 billion invested, biofuels and small hydro each contributed

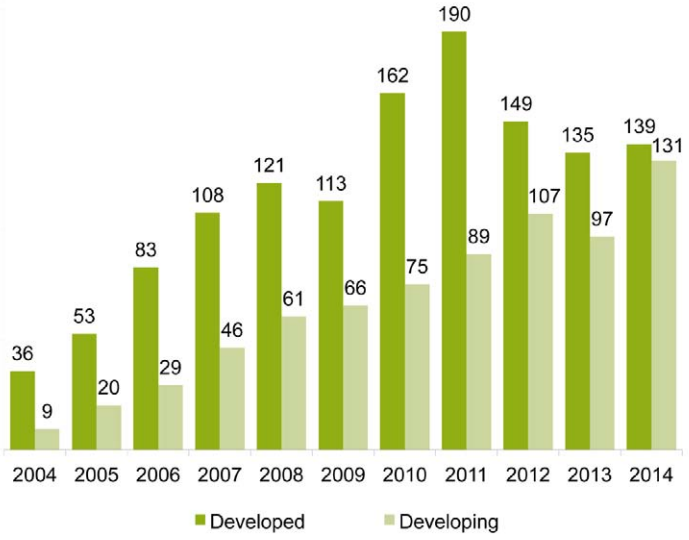
[1] Excluding large hydro-electric projects

just under 2%, with $5.1 million and $4.5 billion respectively, and geothermal was responsible for 1%, with $2.7 billion committed.

Figure 6 shows that the balance was slightly different as far as the venture capital and private equity category of investment was concerned, with solar the largest recipient at $1.6 billion and biofuels second at $610 million. In Figure 7, a relatively strong year for public markets investment in clean energy featured some impressive increases for the individual sectors, with solar companies receiving 73% more equity capital from stock markets than in 2013, at $8.3 billion, and wind companies 120% more, at $5.4 billion.

Wind was the largest sector in terms of utility-scale asset finance in 2014, as previously, but the gap between it and solar narrowed somewhat. Figure 8 shows that asset finance of wind farms increased 10% to $92.4 billion while that for solar parks advanced 15% to $62.8 billion. The next largest sector was biomass and waste-to-power, with $7.4 billion, down 10% on the previous year. If you add together all capacity investment (both utility-scale and small projects), solar came out on top in 2014, with $136.3 billion, up 25% (see Figure 9).

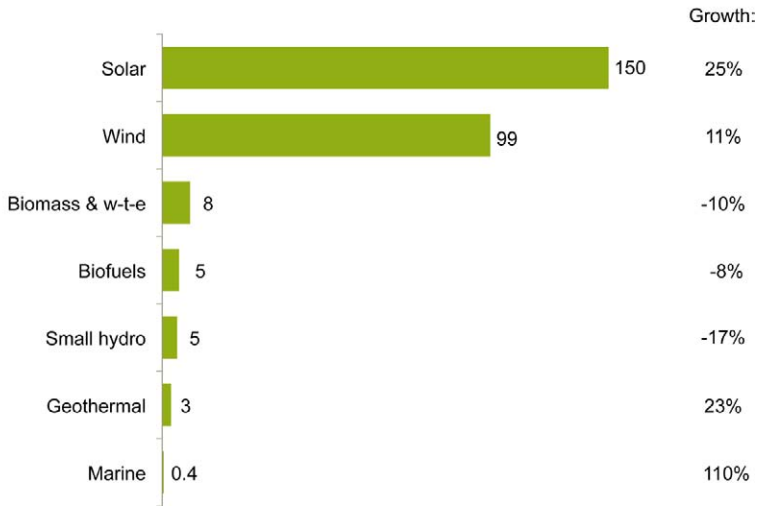
FIGURE 4. GLOBAL NEW INVESTMENT IN RENEWABLE ENERGY: DEVELOPED V DEVELOPING COUNTRIES, 2004-2014, $BN



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

FIGURE 5. GLOBAL NEW INVESTMENT IN RENEWABLE ENERGY BY SECTOR, 2014, AND GROWTH ON 2013, $BN



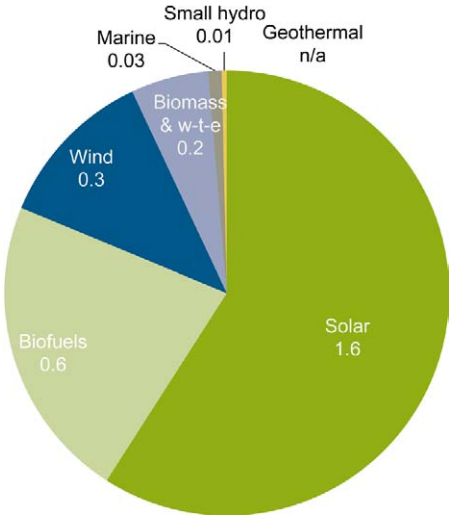
New investment volume adjusts for re-invested equity. Total values include estimates for undisclosed deals.

Source: UNEP, Bloomberg New Energy Finance

COSTS AND CHALLENGES

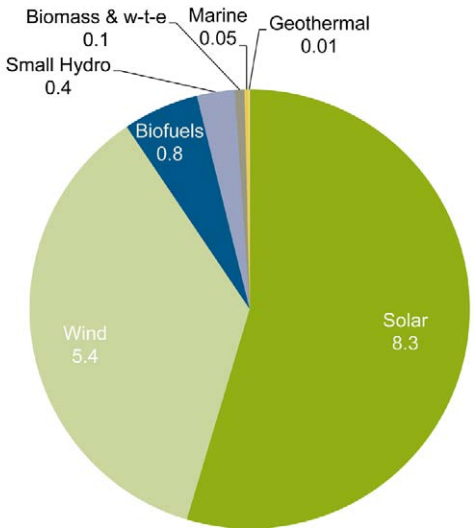
For five years now (2010-14), investment in renewable energy has bobbed around the $230 billion to $280 billion range. Last year's total was towards the top end of that range, but that does not mean that 2014's upward momentum will necessarily continue. In 2015 and after, renewables will face plenty of challenges, including support policies that are less predictable than before for investors – with the trend towards auctions and away from feed-in tariffs or green certificates in countries such as the UK and Germany, and the incidence of retroactive

FIGURE 6. VC/PE NEW INVESTMENT IN RENEWABLE ENERGY BY SECTOR, 2014, $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, 2014, $BN



Source: UNEP, Bloomberg New Energy Finance

changes in subsidy for existing projects (most recently affecting PV parks in Italy). Meanwhile, the all-to-familiar type of policy uncertainty is still in the air, most notably over the continuation or not of the US Production Tax Credit for wind and the steepness of the coming reductions in Japan's feed-in tariff for PV.

Governments in Europe and Asia may also be tempted to see a bigger role for gas in the future generation mix, now that oil prices have plunged to the $50 to $60-a-barrel area and there is a chance of some of this reduction being mirrored in future oil-linked gas purchase contracts. If gas becomes more favoured, then this is likely to be at the expense of coal in the main, but renewables and nuclear could also be affected.

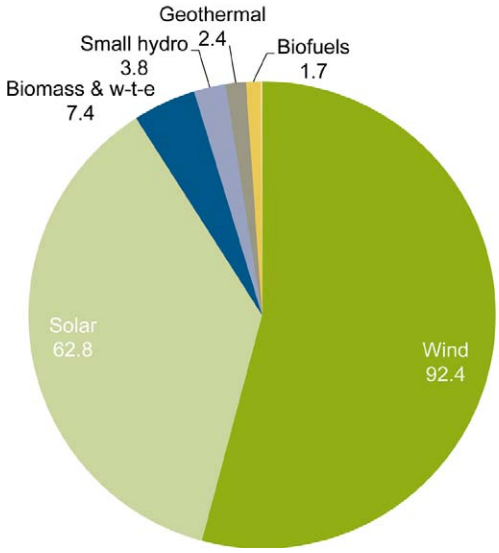
There are also structural challenges in the electricity system, such as the difficulty created for grids and utilities from Japan to Europe and the US, as the penetration of wind and solar increases in the generation mix, and these are explored in Chapter 3 of this report. In developing countries, there are many different obstacles. These can be an entrenched national electricity company with little knowledge of renewables, or a difficulty in accessing project finance at affordable interest rates or in striking power purchase agreements, or the presence of subsidised electricity prices in the local market, making the economics of rooftop generation unattractive.

However, other issues have been moving in favour of renewables. One is that there is increasing evidence of the role that renewables and energy-efficiency technologies are playing in limiting the increase in global emissions. As Chapter 2 shows, renewables excluding large hydro accounted for 9.1% of world electricity generation in 2014, up from 8.5% in 2013. Meanwhile, energy efficiency has been one of the factors contributing to a remarkably weak trend in electricity demand in OECD countries.

A second is the fact that the battle to curb emissions is looking more and more urgent, as the world prepares for the Paris climate change conference in November-December 2015. Recent data on the carbon dioxide content of the atmosphere have shown a three-parts-per-million increase in 12 months and a 21ppm increase in a decade. CO2 could hit 404ppm later this spring.

Third, renewables are being seen increasingly as a stable – even relatively low-risk – investment by institutional funds. This is evident partly in the rising commitment by institutions to renewable power projects, and partly in their backing for green bonds, which hit a record $39 billion of issuance in 2014 (see Chapter 4). Giant German utility EON gave a strong hint in November last year on where it sees relative risk, when it committed to retaining its renewables, distribution and transmission businesses, while putting its conventional generation arm into a separate company.

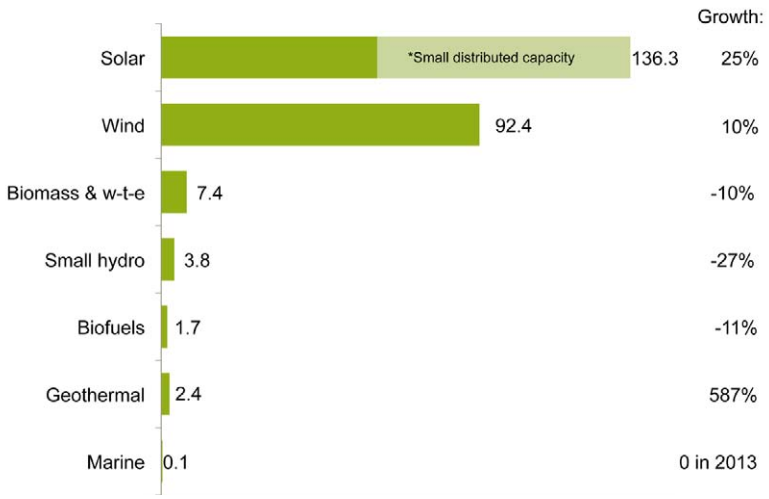
FIGURE 8. ASSET FINANCE OF RENEWABLE ENERGY ASSETS BY SECTOR, 2014, $BN



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

The costs of wind and solar generation are, meanwhile, continuing to fall. Figure 10 shows that Bloomberg New Energy Finance's average for global levelised costs was $315 per MWh for crystalline silicon PV projects in the third quarter of 2009, but this had fallen to $129 per MWh in the first half of 2015, a reduction of 59% in just five and a

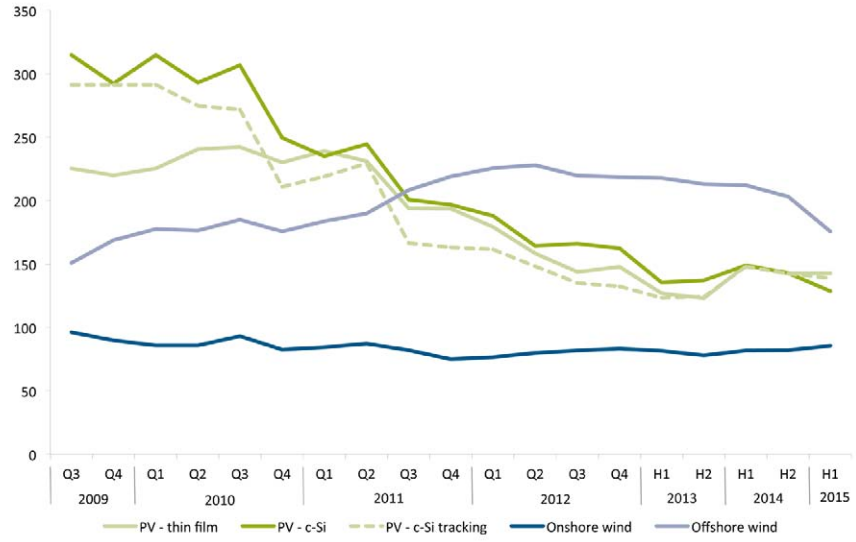
FIGURE 9. ASSET FINANCE OF RENEWABLE ENERGY ASSETS AND SMALL DISTRIBUTED CAPACITY BY SECTOR, 2014, AND GROWTH ON 2013, $BN



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

half years. The equivalent for onshore wind dropped from $96 to $85 per MWh over the same period, a decline of 11.5%. Offshore wind had been travelling in the wrong direction on levelised costs, seeing these increase from $151 to $203 per MWh over 2009-14, as project developers moved out into deeper waters and had to deal with bottlenecks in the supply of vessels and cables. But the latest snapshot, for H1 2015, shows offshore wind levelised costs falling back again in dollar terms, helped by low debt costs and exchange rate effects.

FIGURE 10. GLOBAL AVERAGE LEVELISED COST OF ELECTRICITY FOR WIND AND PV, Q3 2009 TO H1 2015, $ PER MWH



PV-c-Si stands for crystalline silicon photovoltaics
Source: Bloomberg New Energy Finance

The news over the last few months has backed up the story of falling costs. In January this year, Dubai Electricity & Water Authority awarded a contract to build a 200MW, $330 million PV plant to a group led by Saudi Arabia's ACWA Power International, backed by a deal to sell electricity at $58.50 per MWh, the cheapest such contract seen anywhere in the world to date. ACWA later said in an interview: "Is it a repeatable tariff? Absolutely. It is repeatable. If DEWA was to launch another tender on the same basis – with a 25-year off-take contract – in the same locale tomorrow, I am a 100% sure the tariff will be this same number, if not slightly lower."[2]

In the first round of the UK's auction programme for its new Contracts for Difference to support renewables, winning bids came in at tariffs estimated to be some 10% below the all-in remuneration available under the outgoing Renewables Obligation incentive. The results, announced in late February 2015, also showed offshore wind bids winning through at 14-18% below what would have been available under the RO.

In Andhra Pradesh state, India, in October 2014, First Solar and Acme Solar Energy won licences to build PV capacity with bids as low as $86 per MWh, higher than the ACWA deal early this year but nearly 40% below Bloomberg New Energy Finance's estimate for the average global levelised cost of electricity of PV in the second half of 2014.

[2] Bloomberg Briefs: Clean Energy & Carbon Brief, 2 March 2015

INVESTMENT BY TYPE OF ECONOMY

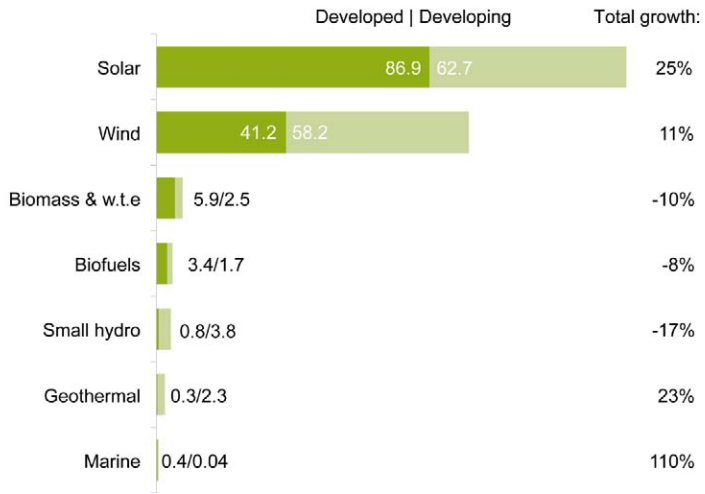
- Developing countries again expanded their share of renewable energy investment in 2014, to 49% – six percentage points up from 2013. This was because while both developing and developed economies saw financing increase last year, the former's 36% growth to $131.3 billion far exceeded the latter's 3% rise to $138.9 billion.
- China was in large part responsible for boosting emerging economies' share of investment, as it alone attracted $83.3 billion last year – a 33% increase on 2013. As a result, of every three dollars of global renewables investment, just under $1 was spent in that Asian country.
- Of the top 10 countries, Brazil and the Netherlands saw the biggest increases in renewables investment, to $7.4 billion and $6.4 billion respectively excluding research and development. Most of Brazil's 93% annual rise was due to 2013 auction winners securing financing last year. The Netherlands saw a 266% surge on the back of the largest ever renewables asset financing.
- Policy uncertainty took its toll on several developed countries: Italy saw investment drop 71% to $1.4 billion due to retroactive subsidy cuts. In Australia, utility-scale financing plunged to $330 million from $2.1 billion in 2013, hit by indecision over the future of the country's renewable energy target.
- Outside the top 10, a growing number of emerging economies attracted investment over $1 billion last year: Mexico ($2.1 billion), Indonesia ($1.8 billion), Turkey ($1.8 billion), Chile ($1.4 billion) and Kenya ($1.3 billion). Even more saw investment over $500 million: Costa Rica, Jordan, Myanmar, Panama, the Philippines, Thailand and Uruguay.

DEVELOPED VERSUS DEVELOPING COUNTRIES

Investment in renewable energy returned to growth in 2014 for both developed and developing countries. While richer economies enjoyed a modest rise of 3% to $138.9 billion, their emerging counterparts saw financing shoot up 36% to $131.3 billion. As a result, developing countries' share of the global total increased by six percentage points to 49% in 2014 – setting a new record.

Last year's total investment split between developing and developed countries varies significantly by technology as shown in Figure 11. Developing nations enjoyed a

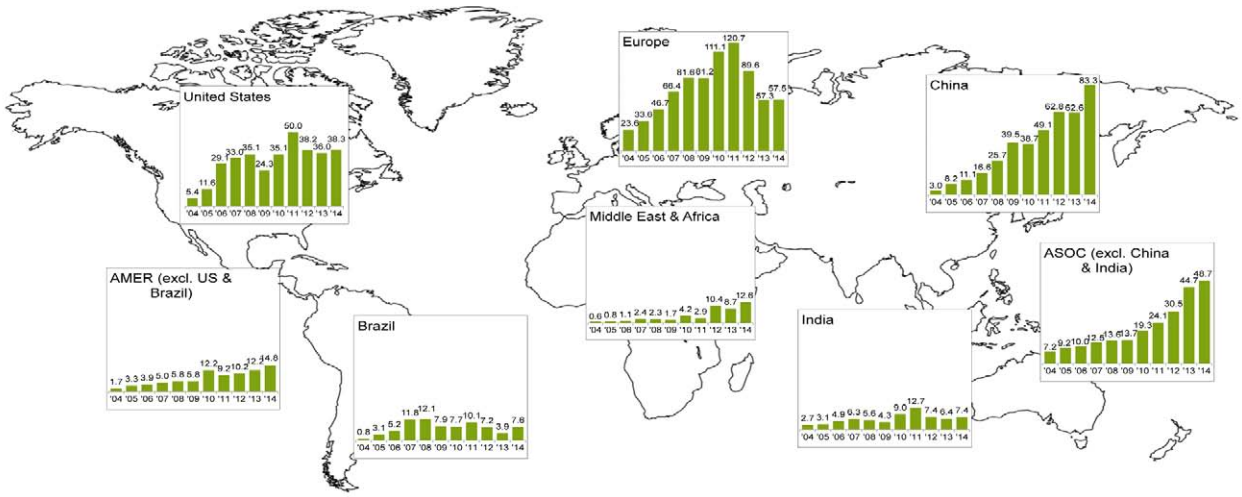
FIGURE 11. GLOBAL NEW INVESTMENT IN RENEWABLE ENERGY: DEVELOPED V DEVELOPING COUNTRIES, 2014, AND TOTAL GROWTH ON 2013, $BN



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, 2004-2014, $BN



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

24% increase in wind investment to $58.2 billion last year, their share of this technology expanding to 59%. With $38.6 billion, China alone accounted for over two-thirds of the wind financing in developing countries, driven in part by anticipated reductions in the feed-in tariff. By contrast, investment in developed economies was spread more evenly: three European countries – Germany, the UK and the Netherlands – had over $5 billion in wind financing, much of it in the offshore sector.

In solar, developed countries may have retained the majority of investment last year, with $86.9 billion, but their share shrank by nine percentage points to 58%. This was due to a 58% surge in financing to $62.7 billion in developing economies, in particular, China, which attracted over a quarter of the global total. The top developed country investor, Japan, dropped to second place, with a 23% share, followed by the US with 19%. Germany saw its share of global solar investment shrink by nearly half to 3% in 2014, with France taking fourth position, also with a share of 3%.

As to the smaller sectors, developing countries attracted 83% of the $4.5 billion invested in small hydro in 2014. Some emerging economies such as those in sub-Saharan Africa and Latin America rely on cost-effective hydro as a core part of their power mix. However, cost reductions elsewhere, incentives and a desire to reduce vulnerability to drought have prompted several countries to turn to other renewable power technologies. This in part drove the 21% decline in developing country investment in small hydro last year.

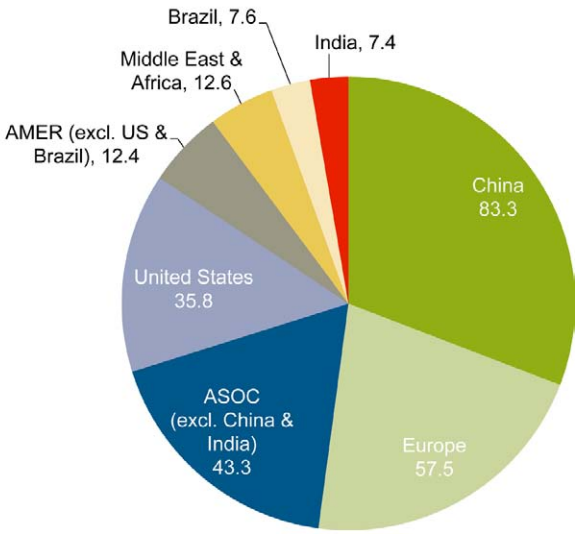
In contrast, just over two-thirds of the $5.1 billion in biofuels investment last year were spent in developed countries, down 18% in dollar terms compared to 2013. The US attracted $2.1 billion thanks to its Renewable Fuels Standard requiring that transport fuel contains a minimum renewable component. However, investment has dwindled in recent years due to the uncertain regulatory landscape. Biofuels spending in developing countries climbed 23% last year, most of which took place in China: thanks to a few large next-generation ethanol deals, its share of the global biofuels total increased from 1% to 16% in 2014.

The balance of geothermal investment also reversed in 2014: developing nations took the majority share last year, having only had 16% in 2013. Relatively few countries are active in geothermal development, so a few large deals can transform the overall picture. In 2014, Indonesia accounted for 62% of the global total thanks to one deal: the 330MW Sarulla project, which reached financial close for $1.6 billion in March.

Figure 12 shows the ups and downs of renewable energy investment across the world. The China chart illustrates the surge in financing over the last decade, to reach $83.3 billion in 2014 – over $20 billion more than the Americas. Excluding China and India, the rest of Asia Oceania has followed a similar trend, with a compound annual growth rate (CAGR) of 21% over the last 11 years, to $48.7 billion in 2014. In recent years, this growth has been thanks mainly to the solar boom in Japan.

In India, investment climbed 25% over 2004-11, but then faltered in part because incentives expired. However, last year saw a 14% rise to $7.4 billion, as political uncertainty was alleviated after the general election and following the restoration in May of accelerated depreciation for wind projects. In Europe, investment plummeted 36% in 2013 on the back of policy fog and retroactive subsidy changes, and then stabilised in 2014.

FIGURE 13. GLOBAL NEW INVESTMENT IN RENEWABLE ENERGY BY REGION, 2014, $BN



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

In the Americas, financing in the US has continued to be swayed by policy developments, with a modest 7% increase last year to $38.3 billion. Renewable energy investment in Brazil has fluctuated in the last decade with the fate of its biofuels sector, the timing of renewables auctions, and infrastructure construction delays.

As a result of these changes, China increased its share of global renewable energy investment in 2014 to nearly a third (31%), as shown in Figure 13. This has been primarily at the expense of Europe, which has seen its share shrink from a quarter to a little above a fifth. The recipients of the third- and fourth-biggest chunks of investment also saw them decline in 2014: Asia Oceania excluding China and India had a one percentage point reduction to 18% and the US went from 16% to 14%. In contrast, the Middle East & Africa attracted $12.6 billion from $8.7 billion in 2013, increasing its share from 4% to 5%. Brazil too saw its stake rise from 2% to 3%.

DETAILED COMPARISONS BY COUNTRY

Brazil's increase in renewable energy investment last year meant that four of the top 10 countries for financing were developing economies – ie, one more than in 2013. Figure 14 shows that the top six nations remained the same, with China in pole position with $81 billion. [1] Brazil took seventh place, pushing down India into eighth. Retroactive subsidy changes in Italy and policy uncertainty in Australia curtailed investment in those countries, helping to raise the Netherlands into ninth place.

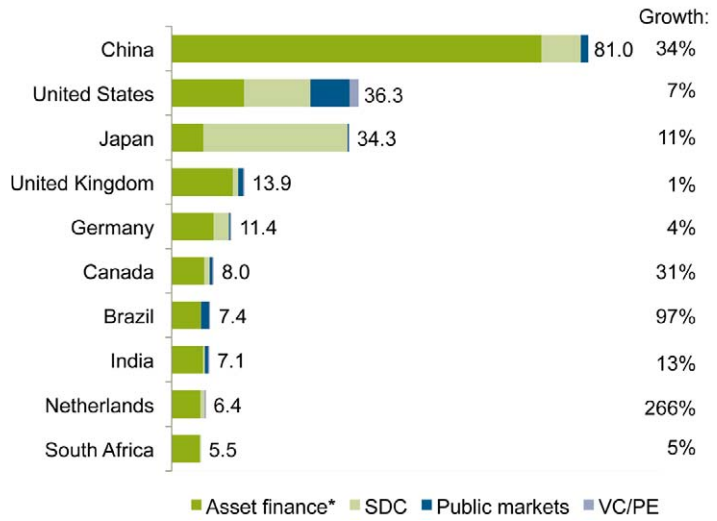
Figure 14 also reveals the types of investment preferred in different countries: 90% of China's total was spent on asset finance of utility-scale projects, with $73 billion – more than the total of the other nine countries in the top 10 shown in Figure 15. [2] The US retained second place but saw a further annual decline in asset finance to $15.5 billion. It was also in runner-up spot for investment in small distributed capacity, with $12.9 billion – a rise of 66% on 2013 thanks to the appeal of installing panels with residential power prices high in some sunny states.

[1] All figures in Figure 14 and the rest of this chapter exclude research and development. This is because, while it is possible to break out R&D cleanly by region and by large economy, it is difficult to do for smaller economies.

[2] The asset finance figures mentioned in this paragraph and in Figure 15 are not adjusted for re-invested equity.

As shown in Figure 16, China has risen to third position for small-scale investment, attracting $7.6 billion, but in the top spot is Japan with $28.1 billion, driven by its generous solar feed-in tariff. Four of the five European countries in the 2014 top 10 saw a fall in small-scale investment, in particular Italy, which saw a 71% drop after a retroactive reduction in incentives for PV projects. The exception was France with an increase of 85% to $1.9 billion, a lot of that activity taking place on commercial rooftops. Small-scale solar financing declined in Australia by 11% as the country found itself mired in policy uncertainty, despite its robust solar resources and well-developed installation industry.

FIGURE 14. NEW INVESTMENT IN RENEWABLE ENERGY BY COUNTRY AND ASSET CLASS, 2014, AND GROWTH ON 2013, $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, 2014, AND GROWTH ON 2013, $BN

	2014	% growth on 2013
South Africa	5.5	4%
Netherlands	5.6	716%
Brazil	5.8	76%
Japan	6.2	-30%
India	6.3	5%
Canada	6.4	20%
Germany	8.1	28%
United Kingdom	12.0	13%
United States	15.5	-25%
China	73.0	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, 2014, AND GROWTH ON 2013, $BN

	2014	% growth on 2013
Austria	0.8	0%
Canada	1.0	104%
Italy	1.0	-71%
United Kingdom	1.1	-5%
France	1.9	85%
Australia	2.1	-11%
Germany	3.0	-34%
China	7.6	555%
United States	12.9	66%
Japan	28.1	27%

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

Source: UNEP, Bloomberg New Energy Finance

DEVELOPED ECONOMIES

The US again saw the most renewable energy investment of all developed economies, with $36.3 billion in 2014 (up 7%), excluding research and development. Solar dominated, as can be seen from the sector breakdown of three types of investment in the US in 2014, shown in Figure 17. In terms of financing types, venture capital and private equity in solar shot up from $373 million in 2013 to $1.3 billion last year. The biggest deal was a $250 million private investment in installer and finance arranger Sunnova, with the proceeds earmarked for expanding residential solar sales.

US public-market activity in solar also had a good 2014, with a 76% increase to $5.9 billion. Three of the top four deals related to the US financing vehicle known as 'yieldcos' (see Chapter 4).

FIGURE 17. VC/PE, PUBLIC MARKETS, AND ASSET FINANCE INVESTMENT IN RENEWABLE ENERGY IN THE UNITED STATES BY SECTOR, 2014, $BN

	Asset finance*	Public markets	VC/PE	Total
Solar	7.5	5.9	1.3	14.8
Wind	5.9	0.9	0.1	6.9
Biofuels	0.3	0.8	0.3	1.4
Geothermal	0.2	-	-	0.2
Biomass & w.t.e	0.04	0.0	0.03	0.1
Small hydro	0.02	-	0.01	0.03
Marine	-	0.01	0.002	0.02
Total	14.0	7.6	1.7	23.4

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

FIGURE 18.VC/PE, PUBLIC MARKETS, AND ASSET FINANCE INVESTMENT IN RENEWABLE ENERGY IN EUROPE BY SECTOR, 2014, $BN

	Asset finance*	Public markets	VC/PE	Total
Wind	27.2	1.8	0.01	29.0
Biomass & w-t-e	4.7	0.04	0.1	4.9
Solar	3.6	0.8	0.1	4.5
Small hydro	0.1	0.1	-	0.2
Biofuels	0.1	0.1	-	0.2
Marine	0.1	0.03	0.02	0.2
Geothermal	0.1	-	-	0.1
Total	36.0	2.8	0.3	39.0

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

For example, in June, Abengoa Yield raised $829 million via an IPO on Nasdaq. In California and some other states, subsidies are no longer needed, shifting the solar policy debate to retail rates and net metering. Investment in US small-scale solar capacity grew by 66% last year to $12.9 billion, with the residential market welcoming new financing methods and other innovation.

The US wind sector did not fare so well in 2014, with investment excluding R&D down by half to $6.9 billion. The main driver was the 56% drop in asset finance to $5.9 billion, as funding was delayed due to uncertainty over whether the Production Tax Credit would be extended. On the bright side, public market investment in wind more than doubled last year to $893 million. Like solar, much of this financing was driven by yieldcos: for example, in May, California-based Pattern Energy Group raised $586 million in a secondary-share placement.

Japan was not far behind the US for renewable energy investment, finishing up with $34.3 billion excluding R&D. However, the breakdown of financing types was very different: thanks to the generous feed-in tariff, 82% of the country's total was spent on small-scale solar projects, with a $6 billion increase on the 2013 total, to $28.1 billion. The feed-in tariff in Japan has been such a success that some 70GW of solar applications were approved by November 2014, prompting half of the country's vertically integrated utilities to announce restrictions in Q4 on grid access. In December, the government proposed changes to the rules on feed-in-tariff applications, grid connection approval and curtailment.

If it were a country, Europe would be in second place, with $53.2 billion of renewable energy investment last year excluding R&D. This represented an increase of less than 1% on the 2013 level but was only 45% of the record high in 2011 at the peak of the German and Italian solar booms. Figure 18 shows the breakdown in European commitments by sector and between VC/PE, public markets and asset finance. [3] The wind sector attracted by far the biggest share of these investment types – 62% – due in large part to a handful of offshore project financings, described below. Not shown in the table is that there was a 43% drop in small-scale solar investment in Europe to $9.9 billion, in the face of retroactive subsidy cuts in Romania and Italy and overall policy uncertainty.

The country contributing most to the European total in 2014 – the UK – saw a modest rise in renewable energy investment of 1% to $13.9 billion. Wind was again its star sector, with $8 billion, compared with $2.7 billion for solar. Offshore projects accounted for 86% of the wind total. The biggest "final investment decisions" were for the 402MW Dudgeon plant, at $2.6 billion, and the 389MW West of Duddon Sands wind farm at $2.1 billion. The UK's largest transaction in onshore wind was also the country's largest renewable energy public-market investment: $200 million for the Greencoat UK Wind fund via a secondary-

[3] Note that this table does not show investment in small-scale projects.

share placement. The UK was also one of the few countries to attract any marine energy investment, at $123 million. Slightly over two-thirds funded the first phase of the 86MW MeyGen Inner Sound tidal stream project – projected to be the world's largest tidal array.

The other leading investor in offshore wind projects – Germany – saw overall financing excluding R&D edge up 4% to $11.4 billion in 2014. However, the solar market for the former number one almost halved for the second year running, with only about 2GW installed – below the government's target range of 2.4-2.6GW. The decrease in feed-in tariff rates and the self-consumption tax introduced in August led to a one-third reduction in investment in small-scale PV to $3 billion – a far cry from the heights of $25 billion in 2010. In contrast, wind attracted more than 2.5 times as much investment, at $8.2 billion, of which 61% was spent on three offshore projects. The two biggest deals were for the 350MW Wikinger and 277MW Borkum Riffgrund wind farms, both of which had a price tag of $1.7 billion.

Canada retained sixth place for renewable energy investment out of all countries, attracting $8 billion in 2014 – slightly less than a third up on the preceding year. Wind reached a new high, at $4.5 billion, with record new-build of 1.9GW as the backlog of projects that had won contracts in Quebec and Ontario were commissioned. Solar installations also set a new record with 687MW, and investment in that sector climbed 47% to reach $2.8 billion. The number one deal took place in July when Samsung secured $524 million in debt for the development of the 140MW Kingston PV plant.

Of all the top 10 countries for renewable energy investment, the Netherlands saw the fastest growth, of 266% to $6.4 billion. Due to project delays, wind installations faltered in 2014, plummeting to 50MW from 325MW in the preceding year. But the country made headlines in May for having the largest ever renewables asset financing, with $3.8 billion for the 600MW Gemini project. Two months later, Koepel Windenergie secured $579 million for the development of the 144MW Noordoostpolder Urk offshore wind farm.

Italy and Australia dropped out of the top 10 due to policy uncertainty. Italy saw financing decline from $4.6 billion in 2013 to $1.4 billion last year, principally due to retroactive subsidy cuts for solar. The volume of small-scale PV financing shrank by 72% to $1 billion. In Australia, utility-scale investment plummeted to $330 million – from $2.1 billion in 2013 – largely due to uncertainty over the country's renewable energy target.

Of the other developed economies, France was closest behind the top 10 countries, with $5.3 billion of investment in 2014. More than three-quarters of this investment was spent in the solar sector. Four other EU member states were in the $1 billion club last year: Denmark attracted $1.4 billion, of which just under half was in the form of a secondary-share placement by turbine manufacturer Vestas Wind Systems. Sweden saw total investment of $1.2 billion, with biomass and waste accounting for a 65% share due to the 130MW Värtan biomass plant under development by Fortum. Austria also saw $1.2 billion of investment, the same as in 2013, with two thirds going to small-scale solar projects; and lastly, Poland saw investment double to $1 billion, dominated by asset finance in eight wind projects.

CHINA, INDIA, BRAZIL

With $81 billion excluding R&D in 2014, China attracted more than double the renewable energy investment of its nearest competitor, the US. In utility-scale projects, as shown in Figure 19, wind retained the sector lead, attracting $37.9 billion of asset finance (up 30% on 2013) compared with $29.7 billion for solar (a 20% increase on 2013). China set a new global record for wind installations last year, at 21GW, as developers rushed to beat anticipated reductions in the feed-in tariff. The bigger transactions included the 200MW Longyuan Rudong intertidal offshore wind farm, at $990 million, and the 400MW Huadian Qingyang Huanxian Maojing onshore wind farm, at $560 million.

China also built a record volume of solar capacity last year, at some 13GW, of which 10GW were utility-scale plants. The largest sums financed were for the 530MW Longyangxia PV plant (phase II) being developed by Huanghe Hydropower Development, at $848 million, and the 300MW Minqin Hongshagang PV plant (phase one) owned by China Singyes Solar Technologies, at an estimated $420 million.

Small-scale PV investment (not shown in Figure 19) ramped up again last year, to reach $7.6 billion from $1.2 billion in 2013. The sector got a boost in September when the government released the new policy on solar generation systems connected to the distribution grid.

China was one of the few countries to attract significant investment in small hydro, at $2.4 billion – albeit a 9% decline on 2013. Financing of biomass and waste-to-power projects nearly halved last year, to $1.1 billion. That figure was split among 16 projects, the largest for China Science Group's waste-to-energy plant in Mianyang City.

Brazil climbed back into the top 10 countries in 2014 and was second of the developing economies. Some $7.4 billion was invested in renewables – nearly double the 2013 total – with wind attracting 84% of that, at $6.2 billion, 117% more than in 2013. A record amount of capacity, 2.7GW, was commissioned in 2014, as substations began operations after a considerable delay, allowing a large number of projects to be connected to the grid. The driver of renewable energy investment in Brazil is the federal generation auctions, with five held in 2014. Much of the wind financing secured last year was for winning projects in the 2013 auctions.

Biofuels is Brazil's second-biggest renewable energy sector, with $574 million invested in 2014 – a long way from the $8.3 billion seen seven years earlier. Just over a third of the 2014 total was for Raizen's $204 million extension of the Paraguacu and Caarapo bioethanol and power plants. Not far behind was the $130 million VC/PE investment by BNDES Participacoes in the Centro de Tecnologia Canaviera, a sugarcane technology research institute focusing on the ethanol industry.

India saw elections in May and related political uncertainty hurt renewable energy investment in H1 2014, so that it reached only $2.4 billion – 25% below the total for H1 2013. However, better lending norms and loan tenors, and policy implementation, helped boost financing to $7.1 billion over the year as a whole – a 13% increase on 2013. Wind attracted nearly half of the total investment, with $3.4 billion, but this was the lowest sector total since 2009. The year-on-year decrease would have been even greater if the government had not restored accelerated depreciation.

Solar was the only sector to see investment grow in India in 2014, with financing doubling to $3 billion. Unlike those in 2013, the

FIGURE 19. VC/PE, PUBLIC MARKETS, AND ASSET FINANCE INVESTMENT IN RENEWABLE ENERGY IN CHINA BY SECTOR, 2014, $BN

	Asset finance*	Public markets	VC/PE	Total
Wind	37.9	0.3	-	38.2
Solar	29.7	1.2	-	30.9
Small hydro	2.4	-	-	2.4
Biomass & w-t-e	1.1	-	-	1.1
Biofuels	0.7	-	-	0.7
Total	71.8	1.5	-	73.3

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

capacity auctions last year were fully subscribed, suggesting investor confidence has risen. India now has over 3GW of solar capacity installed, including 204MW of solar thermal. The government also announced ambitious targets last year: for 100GW of solar capacity by 2022 and 40GW of new wind installations by 2019.

OTHER DEVELOPING ECONOMIES

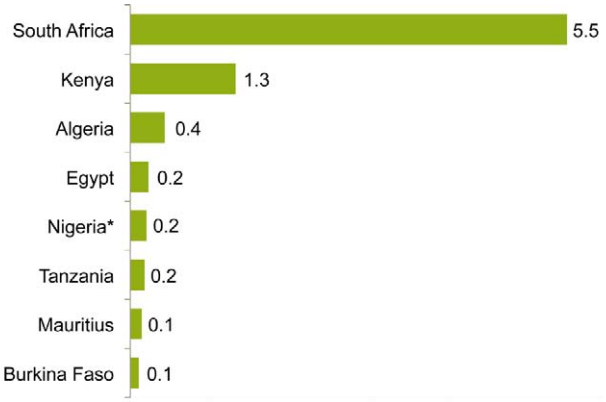
South Africa retained its place in the top 10 countries, though it saw only a modest 5% increase in renewable energy investment in 2014 to $5.5 billion. The principal driver of renewables financing there is its tender programme, which began in 2011. In December 2014, the government announced the financial close of the third round of this programme, with wind accounting for slightly over half of the 1.46GW of winning capacity. This reflects South Africa's wind resources, with many projects believed to have capacity factors of more than 30%.

However, solar attracted the bigger share – 71% – of investment last year, at $3.9 billion, compared with the $1.6 billion spent on wind. South Africa was one of five countries to attract financing of solar thermal electricity generation, or CSP, plants in 2014, at $2.5 billion – a 35% increase on 2013. The biggest deal was the 100MW Xina Solar One project under development by Abengoa Solar, with $1 billion, making it the second-most expensive solar project globally in 2014. The government has prioritised the development of the technology, with a target to install 3.3GW of solar thermal capacity by 2030.

The financing gap between South Africa and the rest of the continent is shown in Figure 20. In 2014, seven countries (other than South Africa) attracted over $100 million in renewable energy investment, compared with three in 2013. Kenya set a new national record, at $1.3 billion – more than the combined total of the preceding three years. Some 90% of its 2014 financing was for the 310MW Lake Turkana wind farm and the associated transmission infrastructure. In addition, Kenya has prioritised geothermal where the largest deal was a $109 million loan from German development bank KfW to the Geothermal Development Company for the drilling of 20 wells at the Bogoria-Silali site.

Algeria and Egypt flew the flag for North Africa, with $428 million and $226 million of renewable energy investment in 2014. Last year was the first time both countries attracted over $100 million, though Egypt did record $918 million on its own in 2010. In Algeria, last year saw the financing of the country's largest PV project – the 233MW Sahara portfolio developed by local state-owned utility Sonelgaz. Egypt's investment went to the 120MW Gulf El Zeit wind farm financed by Italgen. The country introduced feed-in tariffs in September to help it reach 20% of power generation from renewables by 2020, from 12% at present.

FIGURE 20. TOTAL VC/PE, PUBLIC MARKETS, AND ASSET FINANCE INVESTMENT IN RENEWABLE ENERGY IN AFRICA BY COUNTRY, 2014, $BN



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

*Includes the Kashimbila small hydro plant whoes financing was confirmed after the global investment totals had been compiled

Source: UNEP, Bloomberg New Energy Finance

The gap between Brazil and the rest of Latin America for renewable energy investment is shrinking: coming close to setting a new record, Mexico tops Figure 21 with $2 billion – 19% up on the preceding year. With 782MW, it set a new record for capacity additions in the wind sector, which attracted some 86% of the country's renewables investment. The biggest deal was for the 155MW Sierra Juarez wind farm for which Infraestructura Energetica Nova and InterGen International secured $318 million. Solar in Mexico also set a record – this time for investment, with $234 million. Some $80 million was invested in Grupotec's 25MW La Paz PV plant, and $105 million went into small-scale solar.

Chile may have played third fiddle to Brazil and Mexico in 2014, but it was not far behind, attracting $1.4 billion in investment – a 7% rise on 2013. The South American country does not have significant indigenous fossil-fuel resources, and hydro development has slowed due to social and environmental issues, creating an opportunity for other renewables. Merchant and bilateral contracts with mining companies have been the main drivers for wind and solar capacity, which had a record year for installations in 2014 – at 460MW and 421MW respectively. PV was the

principal winner for financing, attracting nearly three-quarters of the country's total.

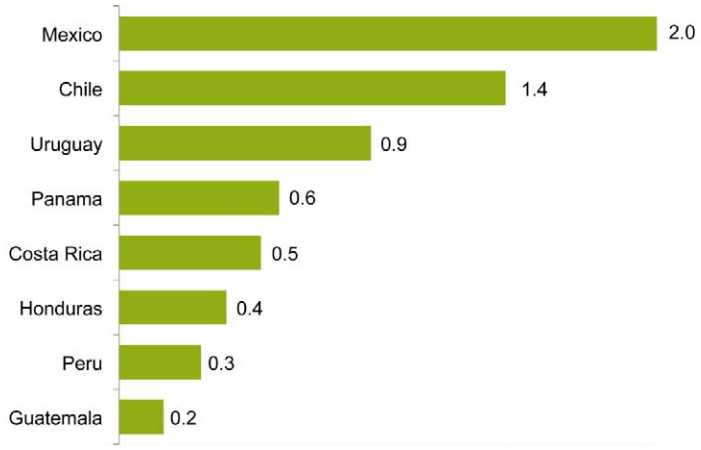
In contrast, in 2014 Uruguay's wind sector dominated investment, which declined by 16% to $934 million. Several auction winners in 2012 reached financial close last year, including Astidey's 50MW Talas de Maciel I and Abengoa's 50MW Talas de Maciel II. The next wave of financing is likely to contain some solar, as 199MW of projects won at last year's auctions.

Renewable energy investment in Panama shot up to $594 million in 2014, having averaged $154 million over the preceding eight years. Wind took the lion's share of the financing, due to the InterEnergy Holdings and Union Eolica Panamena 215MW wind portfolio. But this sector was not the only highlight in 2014, as the 10MW Divisa Solar PV project became the first merchant solar plant in Latin America outside Chile.

In Asia, 10 countries outside China, Japan and India attracted more than $100 million in renewable energy finance last year (see Figure 22). Indonesia set a new record of $1.8 billion in 2014, from just $20 million in the preceding year. Some 94% of the 2014 total was spent in the geothermal sector – specifically the 330MW Sarulla project being developed by the Medco Consortium. Indonesia aims to reach 9.5GW of geothermal capacity by 2025, from 1.3GW at present.

Some way behind was Myanmar: all its $552 million total was used to fund the development of two 150MW PV plants by ACO Investment Group. The project aims to supply power to the Myotha industrial zone. In the Philippines, just under half of the $541 million of investment last year went to three biomass projects, the largest being the 100MW Negros Occidental portfolio, comprising six biomass plants financed by the ThomasLloyd Cleantech Infrastructure Fund. The remainder was split evenly between wind and solar projects.

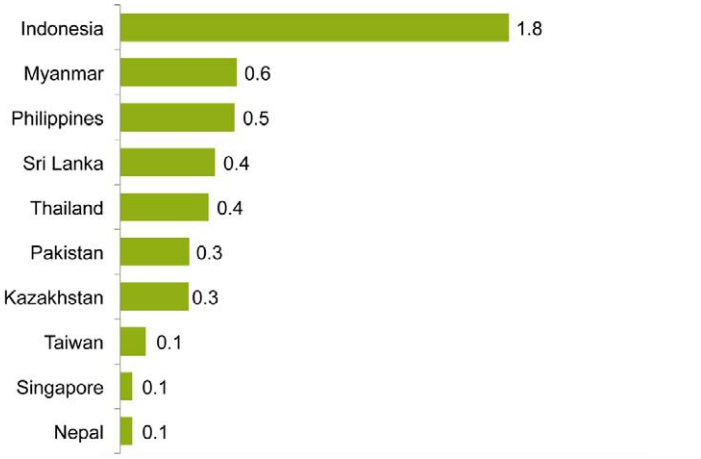
FIGURE 21. TOTAL VC/PE, PUBLIC MARKETS, AND ASSET FINANCE INVESTMENT IN RENEWABLE ENERGY IN LATIN AMERICA (EXCL. BRAZIL) BY COUNTRY, 2014, $BN



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 NON-OECD ASIA (EXCL. CHINA & INDIA) BY COUNTRY, 2014, $BN



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

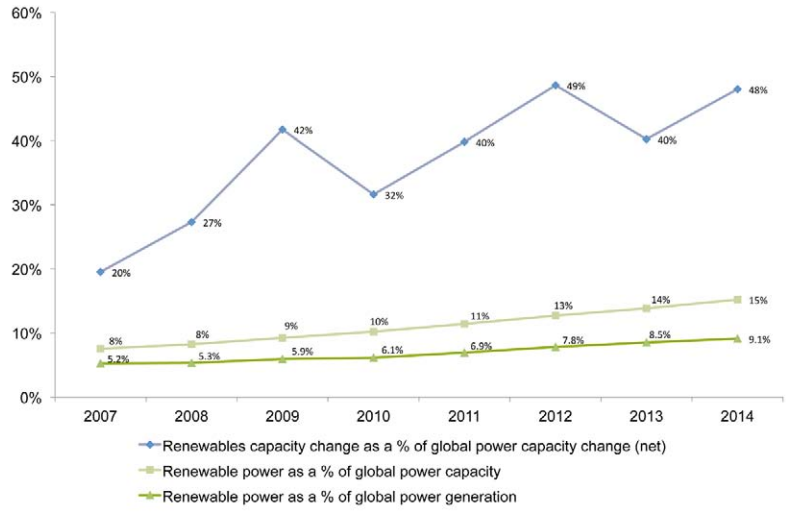
Source: UNEP, Bloomberg New Energy Finance

PUTTING RENEWABLE ENERGY INTO PERSPECTIVE

- Renewables excluding large hydro accounted for 48% of new GW capacity added worldwide in 2014, the third successive year in which this figure has been above 40%. This took renewables to 15.2% of world cumulative generation capacity, from 13.8% in 2013.
- The proportion of world electricity generated from this cumulative installed renewable power capacity rose from 8.5% in 2013 to 9.1% in 2014. That prevented the emission of an estimated 1.3 gigatonnes of CO2.
- However, at the recent rate of increase, it will take until 2030 for renewables excluding large hydro to reach 20% of global generation.
- Looking at the investment comparison, the money committed to build renewable power capacity in 2014, at $242.5 billion, up 17% on the previous year, was once again some way below gross investment in fossil-fuel capacity, at $289 billion (up 7%).
- On the other hand, investment in renewables excluding hydro far exceeded net investment in fossil-fuel capacity, which was $132 billion. This net figure excludes spending on new fossil-fuel capacity that is replacing power stations going out of service.
- Despite the record number of a little more than 100GW of renewables installed in 2015, and continuing investment in energy-smart technologies such as smart grid and efficiency, atmospheric CO2 concentrations are continuing to increase by at least two parts per million each year.

As in previous Global Trends reports, this chapter puts investment in renewables in the context of overall activity in the power generation system and of trends in carbon dioxide emissions. It also examines projections for future global electricity production by technology, and the trends in electricity demand as investment rises in energy-smart technologies.

FIGURE 23. RENEWABLE POWER GENERATION AND CAPACITY AS A SHARE OF GLOBAL POWER, 2006-2014, %



Renewables figure excludes large hydro. Capacity and generation based on Bloomberg New Energy Finance global totals.
Source: Bloomberg New Energy Finance

RENEWABLES VERSUS FOSSIL

Renewables excluding large hydro attracted $242.5 billion of power generation capacity investment in 2014 ($168.9 billion of utility-

scale asset finance and $73.5 billion of small-scale projects). [1] This was up 17% from the figure of $209.5 billion in 2013. The increase in capacity added was even more impressive in nameplate capacity, with an estimated 103GW of renewable power coming online in 2014, compared to 86GW in 2013.

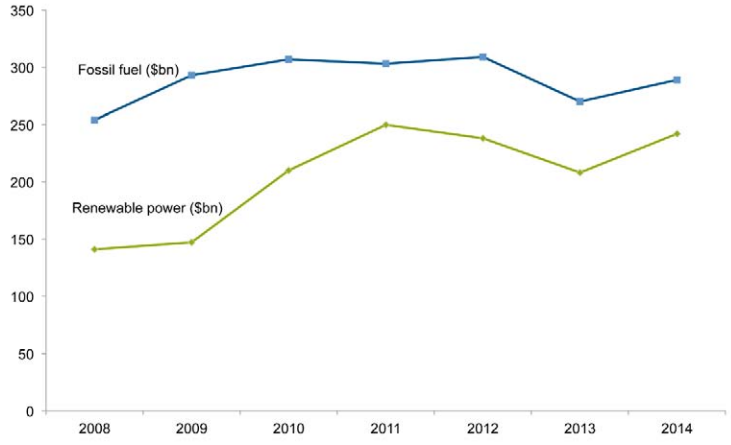
Of the 2014 increment, 49GW was wind (up from 34GW in 2013) and 46GW was PV (up from 40GW). Both the wind and PV capacity additions were record numbers. Renewables (excluding large hydro) increased their share of the new power capacity added worldwide last year, from 40% to 48%, as the top line in Figure 23 shows.

The chart also displays the proportion of total cumulative power capacity accounted for by renewables – this rose from 13.8% to 15.2%. Meanwhile, renewables' share of overall global generation climbed to 9.1%, from 8.5% in 2013. The latter figure has increased steadily since 2008, but it is less reassuring to note that at the current rate of progress (of yearly steps of roughly 0.6-0.7 percentage points), it will take until 2030 to reach 20% of global generation.

The 9.1% of global generation achieved by renewables excluding large hydro in 2014 resulted in an estimated 1.3 gigatonnes fewer CO2 emissions by the world's power system. This is calculated by taking the International Energy Agency's estimate for total power sector emissions in 2012, adjusting that for two years of increase at the annual rate shown by the IEA, and then working out what that figure would be if 9.1% had not been generated by renewables but instead by the same mix of technologies as the remaining 90.9%. [2]

Figure 24 compares world investment in new renewable power capacity with that in fossil-fuel generation capacity. The figure for fossil fuels is a gross one, in that it measures the total financial investment made in new power stations commissioned in 2014, without making

FIGURE 24. RENEWABLE POWER INVESTMENT COMPARED TO GROSS FOSSIL-FUEL POWER INVESTMENT, 2008-2014, $BN



Nominal values. Renewable energy total excludes large hydro, investment made at financial close. Fossil fuel is gross investment on coal, gas and oil capacity. We assume capacity retirement of 3.3%/yr for coal, 4%/yr for gas and 2.5%/yr for coal in all countries where fossil capacity is net positive. We assume retiring capacity is replaced in countries where fossil fuel capacity additions are net positive and not where additions are zero or negative. We count fossil fuel investment in the year when capacity was commissioned (owing to a lower visibility of data).

Source: Bloomberg New Energy Finance

[1] Note that this $242.5 billion figure is power only, and so excludes biofuels.

[2] Emission estimates from IEA World Energy Outlook 2014. That WEO shows an estimate on page 256 that non-hydro renewables resulted in avoided emissions of 0.5 gigatonnes in 2012. The 1.3 gigatonnes estimate in this Global Trends report is for 2014, not 2012, and includes small hydro.

allowance for the substantial fossil-fuel capacity that is being "retired" each year. This euphemism means closed down because the plant has reached the end of its scheduled life, because it no longer meets emission regulations, or because it is no longer economic to run.

On this comparison, global investment in renewable power capacity excluding large hydro, at $242.5 billion, was below global gross investment in fossil-fuel generation, at $289 billion. Both the renewables and the fossil-fuel lines in Figure 24 dipped in 2013 and then rebounded in 2014. To some extent, these dips in that year reflected the economic cycle in that the financial hiatus of 2008-09 and the period of slow growth and weak electricity demand that followed it had a delayed effect on investment.

There is another way of looking at the investment comparison between renewables and fossil-fuel power, and that is by focussing on net commitments. Capacity investment in renewables excluding hydro up until now has been almost all net, because there are very few wind farms or solar parks going out of service, and re-powering (the replacement of an old, normally small, turbine with a new, normally larger one) is a big theme for the future rather than an activity that is globally significant now.

This is not the case for fossil-fuel power, however. New coal- and gas-fired plants are being commissioned in every corner of the world, but in many places they are replacing old units that are being closed. In a few developed economies, the absolute amount of fossil-fuel generation capacity is falling, and this is a small partial offset to countries where the coal and gas gigawatts are growing.

So the net investment in added fossil-fuel power capacity in 2014, at $132 billion by Bloomberg New Energy Finance's estimates was significantly lower than the gross figure ($289 billion) Net investment was also well below the $242.5 billion committed to renewables excluding large hydro.

The investment comparison is subject to a number of caveats. The most important is that capital spending on fossil-fuel generation is far from the full cost of these plants. A large proportion of lifetime cost for coal- and gas-fired generation consists of extracting and transporting the feedstock (coal or gas). This is not the case with renewables, with the exception of biomass-to-power, because their

feedstocks – sun, wind, water – are essentially free and operations and maintenance expenses are also very low per MW.

A second caveat is that the dollar investment comparison above does not cover two other important technologies: nuclear and large hydro. Both are highly capital-intensive, and their projects typically take many years to build. Both are seen by leading forecasters as only edging slightly higher in total share of generation this decade – the IEA for instance, in its World Energy Outlook 2014, had nuclear with 10.8% of total global generation in 2012 and 11.7% in 2020, and all hydro (large and small) with 16.2% in 2012 and 16.4% eight years later. In the large hydro box at the end of Chapter 5, we have estimated 2014 investment in this technology at some $31 billion.

THE EMISSIONS OUTLOOK AND RENEWABLES

Despite record GW installations of wind and solar in 2014, the predictions for annual emissions and the build-up of carbon dioxide concentrations remain alarming. The proportion of CO2 in the atmosphere around Mauna Loa in Hawaii, as measured by the US National Oceanic and Atmospheric Administration, reached 401.1 parts per million (ppm) in the week of 22-28 February 2015, up 3.2 points compared to a year earlier and 21 points in a decade. In late February 1975, a year after the NOAA measurements began, the reading was just 331.9ppm. A figure in excess of 404 is likely to be recorded when the CO2 share at the Mauna Loa site reaches its seasonal peak in May this year.

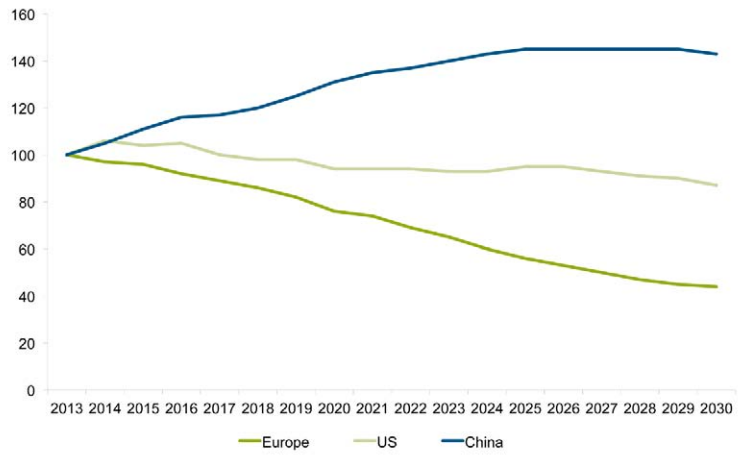
Parties to the United Nations Framework Convention on Climate Change (UNFCCC) have agreed that the rise in global temperatures should be limited to two degrees Celsius compared to pre-industrial levels. The IEA, in successive annual World Energy Outlooks, has defined a "450 Scenario" that would see sufficient change in the world energy system to keep the CO2 content in the atmosphere below 450ppm and therefore have at least a 50% probability of limiting the global temperature increase in the long term to two degrees Celsius or less.

Achieving a 450 Scenario does not look likely at the moment. At the current expansion rate in the NOAA figures, the CO2 content in the atmosphere would reach 450ppm in about 2035. That estimate ignores the fact that annual emissions are still increasing – on the IEA's figures, they are currently running at some 32 gigatonnes of CO2 equivalent per year and are set to increase to 38 gigatonnes per year by 2040. [3] Major energy groups such as ExxonMobil and BP also predict further acceleration in annual emissions.

BP's Energy Outlook 2035, published in January 2015, states: "Total carbon emissions from energy consumption increase by 25% between 2013 and 2035 (1% per annum), with the rate of growth declining from 2.5% over the past decade to 0.7% in the final decade of the Outlook. Even so, the profile for emissions is well above that recommended by the scientific community."

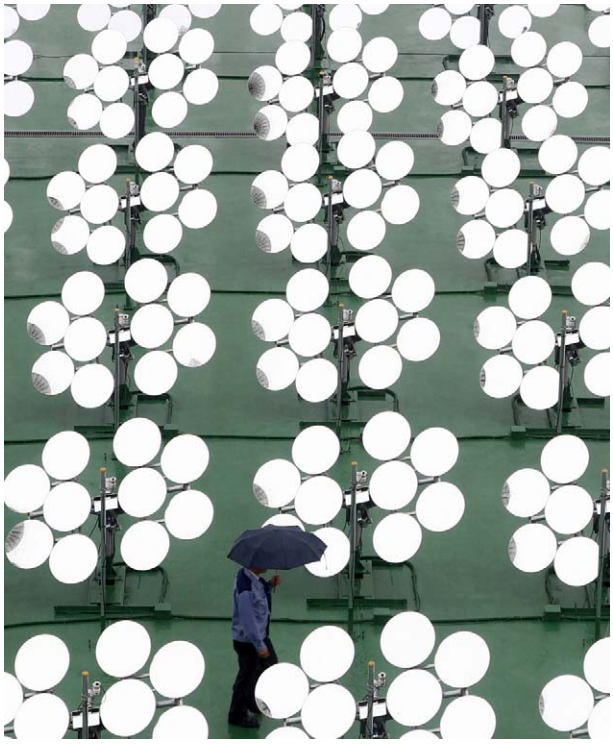
All the mentioned forecasters assume in their models that leading economies continue to make efforts to restrict emissions, and that there are positive trends such as greater use of gas at the expense of coal, a rising share for renewables in the electricity

FIGURE 25. INDEXED POWER SECTOR CO2 EMISSIONS, 2013-30, MILLION TONNES OF CO2



Source: Bloomberg New Energy Finance

[3] International Energy Agency, World Energy Outlook 2014. Note that the IEA estimated on 13 March 2015 that total global emissions in 2014 were 32.3 gigatonnes, the same as in 2013.



system and a gradual trend towards electric and hybrid vehicles. However, those developments are insufficient to bring emissions to a peak in the next few years, let alone stop the march upward in the CO2 content.

Bloomberg New Energy Finance's own projection, its 2030 Market Outlook published in June 2014, includes more aggressive cost reduction assumptions for wind and solar than some of the other forecasters. It predicts, for instance, that between now and 2030, renewables excluding large hydro "will command over 60% of the 5,574GW of new generation capacity and 65% of the $7.7 trillion of investment". Nevertheless, a lot of coal- and gas-fired generation is operating now, more will be added in the next decade and a half, and it will mostly still be generating in 2030.

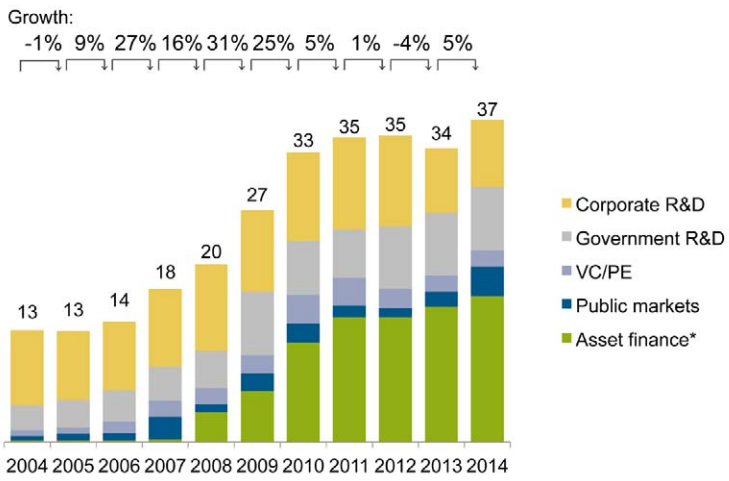
On this forecast, wind, solar, geothermal and biomass will raise their combined share of global generation from 6.2% in 2014 to 19.5% in 2030, and the other two low-carbon technologies, hydro-electric and nuclear, will see their combined share slip slightly to 26.1% in 2030. However, that still leaves more than half of electricity in 2030 coming from fossil fuels, with coal's share at 30% (down from 40% in 2014), gas' share at 21.9% (down from 22.5%) and oil's share at 2.4%, down from 3.8%.

Figure 25 shows that the Bloomberg New Energy Finance projection sees three big economies, the US, the EU and China, all making progress on emissions in the next 15 years, with the European figure falling by more than half, the US making a more modest reduction and China seeing a peak in power sector emissions around 2025.

However, despite those positive moves, further reductions in wind and solar generating costs and some $5 trillion of investment in renewables (including $1.1 trillion in onshore wind, $453 billion in offshore wind, $576 billion in utility-scale PV and $1.3 trillion in small-scale PV) in the next decade and a half, the world as a whole will not be on track to bring emissions to a peak until the late 2020s at the earliest.

The upshot is that the chances of the world limiting the increase in average temperatures to less than two degrees Centigrade appear very slim. It would require a sea-change somewhere

FIGURE 26. GLOBAL NEW INVESTMENT IN ENERGY-SMART TECHNOLOGIES BY ASSET CLASS, 2004-2014, $BN



*Digital energy and smart grid asset finance only. Total values include estimates for undisclosed deals

Source: UNEP, Bloomberg New Energy Finance

in the energy system to change those odds. The IEA has said that its forecast, projected out to 2050 and beyond, would result in a CO2 concentration of 700ppm by 2100 and "a long-term global temperature increase of 3.6 degrees". [4] That is the worrying context in which the UN climate change conference will take place in Paris from 30 November to 11 December this year.

The box below examines one of the key variables in the trends in generation and in emissions over the years ahead – the impact of technology on the demand for energy.

TECHNOLOGIES AND ELECTRICITY DEMAND

One of the intriguing developments of recent years has been the unexpectedly sluggish trend in developed-economy electricity demand as those countries have started to recover from the 2008-09 financial crisis.

According to IEA statistics, electricity supplied in OECD countries in the first 11 months of 2014 was 9,299TWh, some 0.8% lower than in the same period of 2013. If the same rate of reduction is shown in the full-year data, then 2014 electricity supplied will be 10,206TWh, some 1.5% below the figure for seven years earlier, 2007, the last year before the crisis. During that time, economic growth in those developed economies was about 6.3% according to the OECD.

So, rather than tracking GDP, or at least following a similar trend albeit at a more gradual gradient, electricity supplied appears to have loosened its relationship to economic growth. The figures for individual countries show US electricity supplied down 1% from 2007 to 2014 in absolute terms, the equivalent in Japan down 11%, Germany down 7%, France down 4%, the UK down 12%, Italy 10% and Spain 9%. Even resource-rich Australia is down 3%. The economies seeing increases in electricity supplied of more than 10% in that period include Chile, Iceland, South Korea, Mexico, Slovenia and Turkey.

Some of this weakness in OECD electricity demand is likely to reflect the drift of manufacturing to lower-cost parts of the world, such as China and south east Asia. Not all the offshoring is that far: Iceland's 50% jump in electricity supplied in 2007 to 2014 partly reflect the growth in its aluminium-smelting industry, as European Union firms looked to shift production to an island with geothermal and hydro power in order to reduce carbon costs.

However, it is likely that two other influences have also been at work. One is a change in consumer behaviour in the face of rising electricity prices in many countries. As with any other good or service, higher prices will affect demand. In the case of power, consumers become more aware of the need to switch off lights and televisions, or put less water in the kettle. In the UK, to take one example, electricity bills increased in cost per kWh by nearly 44% between 2007 and 2014.

The second is the impact of new technology. Figure 26 shows that global investment in energy-smart technologies rose 5% to $37.1 billion in 2014, a new record. The energy-smart technologies sector includes smart grid and smart meters, demand response, power storage, energy efficiency and electric vehicles. The $37.1 billion figure covers investment in specialist companies in these areas by public market and venture capital and private equity investors, plus government and corporate research and development. It also includes asset finance of smart meters, distribution automation and advanced smart grid. It does not include end-user spending on energy efficiency technologies and electric vehicles.

One product not included in the asset finance part of that total but whose sales are growing rapidly is energy-efficient lighting, such as LEDs. These are reckoned to reduce electricity use by some 50-80%, for large projects such as city street lights. The US Department of Energy cites the energy saved compared to using a 60W incandescent bulb as 25% if you switch to a 43W energy-saving incandescent, 75% if you choose a 15W halogen compact fluorescent, and 75-80% if you go for a 12W LED.

[4] IEA World Energy Outlook 2014, pages 87-88

[5] OECD Economic Outlook, November 2014

STRUCTURAL CHALLENGES IN THE ELECTRICITY SYSTEM

- The growth of renewable generation faces a mixture of old and new barriers in national electricity systems.
- Some of the issues arise because of the very success of renewables. Coping with 25% or more variable generation is more difficult for grids and utilities than managing a 5% proportion.
- Among the policy measures being taken to deal with high wind and solar penetration are caps on renewables subsidies, capacity markets to keep fossil-fuel plants open, and the installation of phase-shifting transformers to control 'loop flows'.
- Two new barriers facing renewables are the levying of grid access charges on owners of small-scale solar installations; and the tendency for utilities, especially in Europe, to cut investment.
- Renewable power in many developing countries faces a struggle to secure debt at interest rates and tenors that make projects viable.
- The move by many governments towards auctioning renewables capacity may push investors into the role of strategic actors within the project cycle.

PROBLEMS OF SUCCESS AND OLD BARRIERS

Chapter 2 showed how renewable power sources such as wind and solar are increasing their share of global generation. The 9.1% figure estimated for 2014 (excluding large hydro) disguises great variation between individual countries and states. Some countries generate almost no electricity from wind, solar, geothermal, small hydro, biomass and waste-to-energy, and others are seeing the share accounted for by those technologies rising to a fifth or more of total supply.

In Germany, for instance, renewable energy including hydro accounted for 26% of total generation in 2014, up from 14% in 2007. In Denmark, wind alone accounted for 34% of generation in 2013, up from 18% in 2007. In the UK, renewable energy made up 18% of generation in the first three quarters of last year, up from 6% in 2008. In the US, despite the shale gas boom, renewable generation was 13% of the total in 2013, up from 8.5% in 2007.

In many cases, variable renewable sources such as wind and solar have already reached higher shares of overall generation than grid operators expected would be possible a few years ago. However, this increasing penetration has led to difficulties in some jurisdictions, and further growth in the renewables share can be expected to lead to additional challenges.

There are a number of issues facing electricity systems as a result of the growth of renewable energy sources that are variable. By variable, we mean that they generate when the conditions are favourable (the wind blows or the sun shines) but do not generate when they are not.

The first is the effect on wholesale power prices. When it is windy or sunny in a country with high renewables penetration, such as Germany, the wholesale power price falls towards zero since there is an abundance of electricity available. Fossil fuel and nuclear generators may have to accept very low prices for their power at these times, or else switch off. Sometimes, wind or solar

power producers may be 'curtailed' – told to stop generating, and paid compensation in return. These low wholesale prices affect the economics of both fossil fuel and renewable generation. For fossil fuel power, low prices and frequent oversupply lead to poor returns for power station operators, and some gas-fired and coal-fired plants may be mothballed or closed. This fuels government concern over how to ensure that sufficient fossil-fuel generation is kept available, to prevent "the lights going out" at periods of heavy demand and low wind and solar output, such as on still winter evenings. Further, for wind and solar in countries offering feed-in-tariffs, the low wholesale prices actually raise the apparent subsidy paid to operators from electricity consumers, since the subsidy is measured as the difference between the set tariff paid to wind and solar, and the wholesale power price.

There is also the impact on utilities themselves. Lower returns for fossil fuel and nuclear stations means a squeeze on the profit margins of incumbent generating companies. And if the territory concerned has a substantial presence of small-scale rooftop PV, as parts of the US, Germany and Italy do, for instance, then the utility may also find that its total sales of electricity come under pressure as more and more power is produced by the household for consumption by the household.

A second issue is that this scenario can affect the transmission of power between territories. For instance, in central Europe, windy and sunny days can cause surplus electricity to surge through international links from Germany into Poland, the Czech Republic and Austria and back into Germany, creating a technical problem known as 'loop flows'. They arise if there are multiple paths between generation and load in the transmission network. This may cause flows on undesirable paths which can damage transmission equipment.

Some older barriers have not fully vanished. In some countries, in particular in Africa, the entrenched position of a national monopoly electricity company is an obstacle to the introduction of wind and solar generation. The monopoly is unlikely to have the expertise, or interest, in diversifying away from familiar generation sources such as coal and oil. If oil or diesel generators are part of the mix, the recent plunge in crude prices might be seen as a new reason for not exploring alternative sources.

The Climatescope study of the suitability of 55 developing countries for renewable energy deployment (see Figure 27) found that 46% of jurisdictions did not offer power purchasing agreements of sufficient duration to encourage investment in off-grid generation. It also reported that 50% did not offer tariffs of sufficient duration, 52% did not have clear rules on interconnection, and 76% did not have a dedicated team looking at renewables within the local utility. [1]

Another barrier to the arrival of small-scale solar, in particular, is the existence of local electricity price subsidies. Such subsidies, such as those offered in Nigeria, Mozambique, Bolivia, Suriname and Venezuela, make it harder for homes and businesses to generate power from rooftop PV at a cost below the retail electricity price. Finally, net metering (the ability for households with their own small-scale project to get paid for electricity sent to the grid) exists in only some developing countries. For instance, Climatescope found that net metering is offered in Kenya and Senegal, but not in Cameroon, Ethiopia and many other Sub-Saharan African countries.

New planning barriers are affecting renewables build-out in specific markets. Wind turbine zoning regulations (such as new ones being introduced in some German states) oblige developers to

[1] Climatescope 2014, commissioned by the Multilateral Investment Fund (MIF) of the Inter-American Development Bank Group (IDB), the UK Department for International Development (DFID), and the US Agency for International Development (USAID), under President Barack Obama's "Power Africa" initiative, and produced in collaboration with Bloomberg New Energy Finance.

FIGURE 27. RESULTS OF CLIMATESCOPE QUESTIONNAIRE OF POLICY-MAKERS AND INVESTORS IN DEVELOPING COUNTRIES

Does your country have these policies in place to aid off-grid power investment?

	% saying yes
Mini-grids: requirements and licence	89
Cost-reflective tariffs	63
Dedicated regulator	63
Mini-grids: threshold	63
PPAs of sufficient duration	54
Duration of tariffs	50
Tariff deregulation	50
Clear rules on interconnection	48
Purchase obligation	39
Light-handed regulatory framework	37
Quality of service standards	35
Small power plants allowed to deliver financial services	33
Standardised PPAs	28
Dedicated team within utility	24
Clear rules on arrival of main grid	22

PPA = power purchase agreement
Source: Bloomberg New Energy Finance

keep a minimum distance from urbanised areas. This makes it harder to get a site approved or to repower existing wind farms.

POLICY RESPONSES

Governments have often struggled to produce policy measures that keep up with the advance of renewable power and its knock-on effect on the rest of the electricity system.

European Union state aid rules now require all member countries to make renewables 'balance responsible' – in other words, project operators must generate what they say they will or make up the difference through the balancing market (or pay a penalty). This makes operations more complex and therefore costly.

More recently, countries such as Germany, the UK and France have tried to use caps on renewable energy capacity eligible for subsidy, or caps on the overall amount of national subsidy, to prevent installation booms.

Another approach, used extensively in Brazil and South Africa and being copied in many other countries, is to award power purchase agreements for wind and solar (and often conventional power technologies too) as a result of an auction, in which bidders offering to accept the lowest tariffs per MWh get selected to build the new capacity.

Countries such as the UK and France are introducing 'capacity markets', by which auctions have identified fossil-fuel power stations that will receive payments per MW of capacity.

In the first UK capacity auction, held in December 2014, generators representing 49GW of capacity were awarded agreements at a price of GBP 19.4 per kW per year, with operators of existing coal-fired plants dominating the ranks of the winners. However, one new gas-fired power station project also clinched a deal.

To balance the mix of renewable power within the grid, Ghana recently introduced feed-in tariffs for solar PV and wind that depend on the storage capacity within the respective project. The tariff paid to solar PV with storage is higher than the one on offer to projects without storage.

Progress towards encouraging more private sector participation is patchy. Tanzania published a 'roadmap' late last year for how it intends to unbundle the current monopoly Tanesco. It will take 11 years or so and $11.4 billion of investment (nearly three-quarters of which will be in generation). Currently, you can set up renewables projects in Tanzania (subject to the usual licensing rules) but the lack of credit-worthiness of Tanesco as the off-taker would be a huge deterrent. Democratic Republic of Congo passed a law in July 2014 to open up the market to 'third-party operators' (previously it was just the state-owned entity SNEL). However, there is no sign yet of a strong response to this. In Botswana,

the generation market is already open to independent power producers but no generator has entered yet. The same is true of Cameroon and Ethiopia. In Liberia, LEC still has a formal monopoly over the power market.

Some new barriers to the adoption of renewables have been evolving in the electricity system. Grid operators have also been looking at, and in some cases implementing, access charges for users of small-scale solar systems. In August 2014, Germany implemented its charge on self-consumption for PV over 10kW – to pay for the feed-in tariffs for systems already built and reduce the EEG-Umlage cost to other users.

RESPONSE BY GRID OPERATORS AND UTILITIES

Faced by the challenge of digesting a growing diet of wind and solar, grid operators and utilities have been taking a variety of approaches. Looking at grid operators first of all, they have increased the ability of their systems to manage the ups and downs of renewable power output. One method has been greatly to improve forecasting – so, for instance, prediction of wind output days ahead is now far better than it was five years ago.

Another has been to have a range of quick-response sources to increase electricity supply or reduce demand when the wind drops or the sun goes down. These may be fast-ramp-up gas-fired plant or pumped hydro storage, or demand response, in which large industrial and business users are paid to switch machines off when there is excess electricity demand on the system. More options on demand response may become available with the spread of smart meters in developed economies.

There has been some progress on installing the phase-shifting transformers, with a German-Polish agreement on the issue, that can help control loop flows or mitigate the worst effects. The ultimate solution may be market coupling so that the price signals across markets line up with the actual supply and demand conditions.

More generally, utilities have been re-examining their priorities in the light of the rise of renewables and the strain on their business models. Many of them have cut back sharply on capital spending, including investment in renewables, to protect balance sheets and credit ratings. In Europe, for instance, aggregate capital expenditure on renewables by the seven leading utilities (SSE, Iberdrola, Enel, EON, RWE, Energias de Portugal and Electricite de France) fell from $12.3 billion in 2010 to $8.1 billion in 2013 (see Figure 28). When full-year 2014 figures become available for this group, they are expected to show that some of the utilities, including SSE and RWE, trimmed renewables capex further last year.

However, the downward trend is far from uniform. Even within that group of seven, Enel has actually increased its renewables capital expenditure, via its part-owned subsidiary, Enel Green Power. It has plans to invest EUR 6.1 billion in clean power sources – most of it outside Europe – over the next five years. EON, meanwhile, late last year decided to keep its renewable power assets and has mentioned a possible increase in investment with a particular emphasis on expanding its wind business in Europe and other selected target markets. At the same time, it said it would divest or float off its fossil-fuel generation portfolio.

In Australia and the US, utilities have tended to follow one of three paths in reaction to the growth of renewables. They have been described as "fight, flight and adapt". [2] In the case of the US, in 2013, the Arizona Public Service imposed a monthly charge of $0.70 per kW on new users of small-scale

[2] *Fight, flight, adapt: US utilities and distributed PV*, Bloomberg New Energy Finance, May 2014
Fight, flight or adapt: Australian utility strategy, Bloomberg New Energy Finance, October 2014

PV needing also to access the grid. Utilities in Ohio, Wisconsin, Massachusetts, Minnesota and many other US states continue to push regulators either to restrict net metering for solar panels, or to allow a fixed fee to (according to them) cover the costs to the grid of providing back-up.

Those actions might fit into the "fight" heading. Under the "adapt" heading, other utilities have been actively building their own PV capacity in their home state, or doing the same outside their territory, or investing in solar at arm's length via tax equity or a partnership. Duke Energy, NRG Energy, Edison International and NextEra Energy are among the US utilities pursuing one or more strands of the "adapt" approach.

EVOLVING ROLE OF INVESTORS

Chapter 4, on investment sources, discusses many of the ways in which dollars are finding their way into the clean energy sector. Some of those conduits address and attempt to circumvent barriers to investment mentioned above. For instance, green bonds provide institutional investors with a liquid, fixed-interest product that channels their money into clean energy, and 'yieldcos' provide an equivalent instrument for equity-oriented funds. The latter are separate and often publicly traded companies that own a portfolio of operating assets. The idea is for those assets to produce a stable cash flow – that can then be paid out as dividends to shareholders.

More generally, institutional investors have emerged with a big role in the 'recycling' of debt and equity capital in operating-stage renewable energy projects. Banks, private equity funds, project developers and utilities hold billions of dollars' worth of mature wind and solar assets that are earning a steady return, and can be sold at some point onto long-term, risk-averse institutions, such as pension and insurance funds and quoted yieldcos. The proceeds can then be redeployed by the original party into the development and construction of new projects.

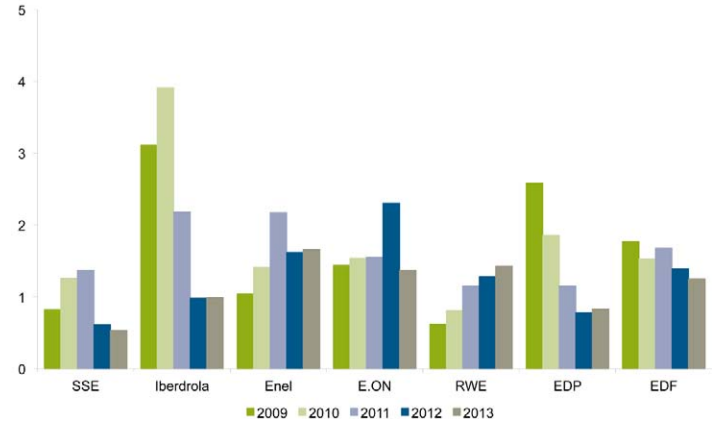
The role of the financial sector in the clean energy transition is changing in other ways too. The move by governments towards holding auctions for the award of tariffs and power purchasing agreements to renewable energy projects may put banks in a pivotal position in the project cycle before the financial close – rather than just from financial close onwards.

The two major reasons why governments use auctions to determine feed-in tariff or PPA prices are first that the process of competitive bidding is expected to lead to lower prices and correspondingly to lower subsidy levels; and second, that they allow for budget as well as volume control and thereby increase the predictability of renewable energy supply. In 2009, about 10 countries had implemented auction schemes, but this number had shot up to 44 countries in 2013, with emerging economies well-represented in that total. [3]

A plethora of design options are available to tailor the auction to policy goals: the capacity to be auctioned can be determined, or auctions may be technology- or even site-specific. Frequently, auctions contain 'local-content' requirements for the participating projects if the government wants to combine the renewables build-out with supporting the local upstream firms in the renewables value chain, such as PV module producers. Two particularly important design details from the investors' perspective are the type of auction mechanism that is used and the timing of the auction in the project cycle. The auctioning mechanisms that are used most frequently are the so-called 'sealed-price', the 'descending clock', and a combination of the two (see Box below).

[3] For an overview on the use of auctions in renewable energy, see IRENA (2013).

FIGURE 28. CAPITAL EXPENDITURE ON RENEWABLE ENERGY BY MAJOR EUROPEAN UTILITIES, $BN



Source: Bloomberg New Energy Finance, annual reports

The timing is important because it largely determines how much money is spent on a project before it is determined whether the electricity price the planning is based on will be available. In general, auctioning may take place before or after financial closing. Since for renewables the financing cost determines much of the bidding price which itself determines whether the project will happen at all, the debt and equity providers – by demanding a certain return – are forced into the role of strategic actors. The higher are the return expectations, the lower the probability that the project will get chosen in the auction.

For strategic actors, it is essential to be well-informed about the environment in which they act. It is therefore likely that investors will profit from technical and market knowhow. This might influence the market structure on the financing side, as larger or specialised investors or institutions might have an advantage.

Typically, the later the auction in the project cycle, the more binding the required commitment from the bidder. If an auction is won, then it must realise the project within a given timeframe or otherwise pay a penalty. Often this is partially implemented through bid-bonds, which have to be provided before participation in an auction and/or after winning the auction. Those bonds would then not (fully) be paid back if a project is won but not implemented. Again, the requirement to provide these bid-bonds might influence the market structure in favour of larger players. Overall, the move towards auctioned PPAs might provide more long-term certainty in regions where credible and coherent policies towards renewables are scarce, but it will certainly offer some challenges in regions where investors are used to attractive feed-in-tariffs. One example will be the widespread energy-cooperatives in Germany. These could find it hard to compete with large players in the new environment.

AUCTION MECHANISMS

In a sealed-price auction, all bidders submit the price and quantity of MWh they are willing to provide. Governments may then start to award the projects from the lowest electricity prices offered, until the desired capacity is reached. Alternatively, the government might specify other criteria by which to rank the bids. Here, bids are not disclosed.

In a descending clock auction, a price is announced by the auctioneer, then corresponding quantities are offered by the bidders. In the next round, the auctioning authority announces a lower price and will get less quantity offered as a result. This may be repeated until the desired capacity is provided at the lowest price. In general, it is possible to combine both mechanisms as, for instance, has been done in Brazil. There, an open descending clock auction was used as a first step to implement a more informed stepwise price determination. However, especially in markets with few agents, this method can be subject to collusion among the bidders. So a second step of a sealed-price auction was added to determine the final winners.

SOURCES OF INVESTMENT

- Declining sector share prices, influenced partly by the oil price fall, contributed to a 13.5% fall in the value of assets under management held by specialist clean energy funds in 2014.
- However, newer types of fund continued to attract interest, with three US 'yieldcos' floated in 2014, raising some $1.6 billion. The share prices of the six US yieldcos have risen by 56% on average since their initial public offerings.
- Their UK cousins – listed project funds – saw their number grow to six in 2014, attracting investors with dividend yields of some 6% compared with the 2% offered by 10-year government bonds. Overall, US yieldcos, UK quoted project funds and one German equivalent raised $5 billion from stock market investors in 2014.
- Issuance of green bonds hit a new record of $39 billion in 2014. But clean energy project bonds were not so lucky, seeing an 82% drop to $630 million, as there was no repeat of the very large issues for solar parks seen in 2013 and as bank debt remained a compelling alternative in Europe. Nonetheless, last year saw Latin America's first clean energy project bond, the world's first labelled green project bond and the first green bond from Asia's private sector.
- Development banks remain crucial to clean energy investment. As top lead arranger in 2014, Brazil's development bank BNDES provided $2.7 billion of debt – up 74% from 2013 – in part to finance the 5.4GW of winning projects from the preceding year's auctions. South-South investment flows are set to increase with the launch of the $100 billion BRICS and Asian Infrastructure Investment Banks.

FUNDS

Nearly all of the traditional types of clean energy funds, investing in public market equities in the sector, ended 2014 in the red: of the 13 such funds with at least $100 million under management, nine saw their share prices fall last year. More than half of the 13.5% decline in assets under management over the year was due to the fall in sector share prices rather than to investor redemptions. This was in part driven by the 46% drop in Brent crude prices in H2 2014. While oil only has a modest direct impact on renewable power generation, some funds contain shares that may be more directly affected by the oil price slump – such as those in electric vehicle companies.

The US-based Guggenheim Solar Fund failed to replicate its 2013 performance, when it more than doubled its share price (see Figure 29). In contrast, its heavy focus on solar shares, which performed worst of the three sector indices (see Chapter 7 on Public Markets), resulted in a 3% decline in price for Guggenheim. PowerShares WilderHill was the worst performer of the clean energy funds: tracking the WilderHill New Energy Global Innovation Index (NEX), the fund saw its share price fall 18% last year.

On the upside, only Julius Baer Smart Energy was able to outdo its 2013 performance and achieve a double-digit increase in its share price. The fund likely benefitted from its diversified portfolios in

North American utilities, which had a resurgence in 2014 as investors looked for stable, higher-yield dividends after years of low interest rates. Environment and climate change funds fared better than their clean energy counterparts: with less than 10% exposure to clean energy shares, the former were better insulated from the sector's lacklustre stock price performance in H2 2014.

Fund-raising was again principally focused on Europe: in September, UK asset manager Glennmont Partners closed its second private equity fund specialising in renewable power projects in Europe, gathering $657 million from investors. In the same month, Scottish Equity Partners accrued $306 million for the new Environmental Capital Fund backed by utility SSE. The fund will invest in around 10 British small-scale projects focusing on energy efficiency, district heating, small hydro and heat pumps. Outside the UK, Swiss private-asset manager Capital Dynamics closed a fund targeting renewables assets, raising $463 million. The company now manages over 1.3GW of clean energy capacity across the world. KGAL, a German asset manager, raised $281 million for its ESPF3 renewable power fund.

Last year also saw the launch of several funds focused on emerging markets: this included one of the first pan-African private equity funds specialising in clean power – the African Renewable Energy Fund: it raised $100 million in March, to finance 5-50MW projects, and aims to raise a further $100 million. It was closely followed

by the Green Africa Power Fund, which launched in Q2 2014 and had raised $189 million by year-end from the UK and Norwegian governments. Its goal is to invest in some 270MW of renewable power-generating capacity by March 2019, to reduce reliance on fossil fuels.

Some funds encountered stumbling blocks in raising financing last year: in the UK, the Temporis Ventus trusts raised in September only a fifth of the $30 million they had targeted for wind and hydro plants. Temporis suggested this may have been due to negative press on wind farms, though political uncertainty ahead of the vote on Scottish independence in September 2014 and the UK general election in May 2015 could also have encroached on investor sentiment.

NEW SOURCES

'Yieldcos' – the term for publicly traded companies formed to own power plants and pass most cash flow to investors as dividends – may not be a totally new concept, since the first of this breed floated in 2013. But this financing strategy seemed to strengthen its appeal during last year in the eyes of both investors and renewable energy companies in the US, looking for cheap capital. Three more yieldcos were floated in 2014: SunEdison's TerraForm Power raised $502 million in its IPO in July and bolstered its initial portfolio of 524MW of solar farms in the Americas and UK with the purchase of First Wind in November. The $2.4 billion sale gave the yieldco 521MW of operating wind and solar assets, together with 1.6GW of projects in the pipeline.

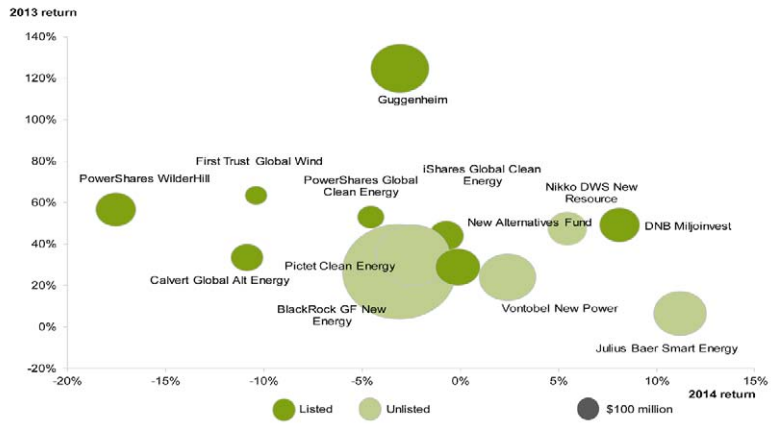
The biggest yieldco IPO came in June when Abengoa Yield raised $721 million. The parent company sold its first power plants – 131MW of solar and 50MW of wind – to the yieldco in September and in January it announced a secondary offering for 9.2 million shares in Abengoa Yield. The six yieldcos in the US launched in the last two years have seen their share prices climb by an average of 56% since their IPOs, with NRG Yield the best performer, surging nearly 150%. In contrast, the S&P 500 Index has risen 22% since the first yieldco IPO in July 2013.

There are now signs that the yieldco model is spreading outside North America: in January 2015, Spain's biggest construction company, Actividades de Construccion y Servicios (ACS), announced plans to list a yieldco, with a target of $576 million. Saeta Yield will target institutional investors, offering stable dividends from 689MW of wind and solar power plants in Spain.

Meanwhile, financiers in the UK have set up listed renewable energy project funds, with six such vehicles being launched since 2013. Their market capitalisations tend to be lower and their geographical focus narrower than North American yieldcos and more established UK infrastructure funds. But they generally offer higher dividend yields, of around 6%, appealing to institutional and retail investors facing 0.5% official interest rates and yields of some 2% for 10-year government bonds.

Two such project funds launched in 2014 but encountered some stumbling blocks: with 54MW of solar and wind as well as waste assets, John Laing Environmental Assets raised $265 million at its IPO in March 2014 but parent company

FIGURE 29. CLEAN ENERGY FUND PRICE PERFORMANCE, 2013 AND 2014 (% CHANGE)



Data only covers price return and funds with at least $100 million under management. Bubble size indicates market cap of fund.

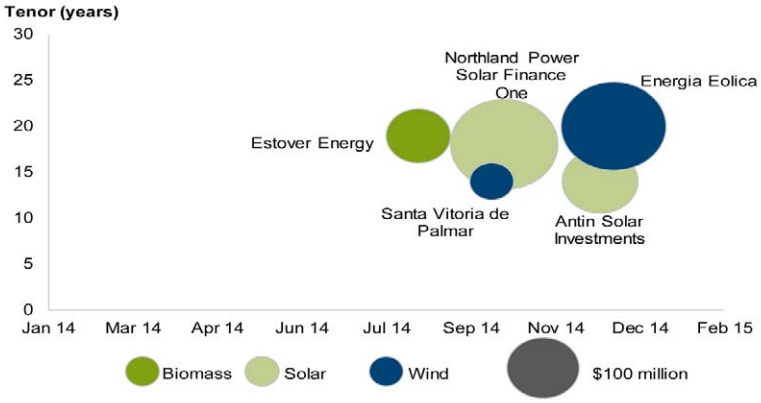
Source: Bloomberg New Energy Finance

John Laing had to take a bigger share than it initially planned. NextEnergy Solar Fund's IPO in April also did not go as planned when it raised 57% of the $228 million it had hoped to gather. To purchase more PV plants, it sold 91 million shares in November for $150 million in the first instalment of a placing programme aimed at offering up to 250 million shares over a year. At year-end, it had 124MW of PV plants, with a market capitalisation of $285 million. NextEnergy was not alone in raising further financing last year: three of the UK-listed project funds that opened in 2013 raised more than $600 million last year via secondary issues. In Germany, Capital Stage raised $209 million for its latest European wind and solar project fund, ESPF3.

Crowd-funding has been another eye-catching innovation in the financing of renewable power projects in recent years, albeit involving mostly modest-sized projects such as one or two local wind turbines. This approach gives project developers and investors the opportunity to circumvent potentially costly third parties and 'democratise' energy. Possibly the largest renewables crowd-funding platform by investment is de WindCentrale based in the Netherlands. It opened its ninth project for bids on 8 September last year and, two days later, the shares had sold out, raising $1.3 million for a 1.8MW wind farm in the north of the country. By September last year, it had amassed over $17 million of capital. Based in the UK, Abundance Generation is not far behind, having raised $13 million since beginning operations in 2012. Its biggest project in 2014 was for $2.3 million raised in five months for the development of a single grid-connected 500kW wind turbine in Cornwall.

Clean energy crowd-funding has continued to expand its geographical spread: in February 2014, United PV became one of the first companies in China to adopt this financing model, by launching a crowd-funding internet-based financing vehicle with Renewable Energy (Hong Kong) Trade Board and

FIGURE 30. CLEAN ENERGY PROJECT BONDS, 2014



Tenor is years from issue to maturity. Bubble size indicates size of bond.
Source: Bloomberg New Energy Finance, company filings

Wangxin Finance Group, for the development of PV power plants in China.

However, such platforms have also come under recent negative press: nearly 1,000 small investors in the UK put $11.4 million into "secured" energy bonds, which promised an income of 6.5% a year. The money was to be spent on installing solar panels in schools across the UK. However, Australia-based parent company CBD Energy went into administration in November. Media reports said that a quarterly interest payment was missed in January 2015, and the investors have no rights to compensation as the bonds are treated the same as shares, and are not covered by the UK's Financial Services Compensation Scheme.

GREEN BONDS

Activity in clean energy project bonds diminished in 2014, with issuance dropping to $630 million – an 82% drop from the preceding year. One reason for the disparity was the record high issuance in 2013 thanks to several large bonds: the two issued by MidAmerican Energy Holdings were alone worth a combined $1.3 billion. In addition, Europe, which has accounted for around a fifth of such issuance in the last two years, has been enjoying access to record-low costs for bank debt, weakening the case for using bonds to finance projects.

Despite seeing over 85% less issuance in 2014, North America was still home to last year's largest clean energy project bond: $209 million for a portfolio of six solar projects in Canada owned by Northland Power (see Figure 30). As well as this sale, two of the other four project bonds last year were issued to refinance portfolios of existing projects – a trend that may well continue. Issuance also shrank by over 85% in Europe last year, with two project bonds: Estover Energy's $76 million bond for a 13MW biomass combined-heat-and-power plant in the UK, and $105 million for a 77MW portfolio of nine Italian PV projects owned by Antin Solar Investments.

Task forces have been set up in China, with a view to revealing plans for a corporate green bond market in 2015.

The broader category of green bonds enjoyed another bumper year in 2014, with issuance reaching $39 billion – some 2.6 times the preceding year's total (see Figure 31). The record volume was driven by a doubling of issuance from development lenders such as the World Bank and from national government agencies, in addition to a fivefold increase in self-labelled corporate bonds from issuers such as GDF Suez of France and Verbund of Austria. Germany's development bank, KfW, raised $2 billion in July through its first ever green bond. Its two issues last year amounting to $3.5 billion meant it was the second-biggest issuer, after the European Investment Bank with 15 deals raising $5.5 billion.

Green bonds saw several 'firsts' last year: in March, Toyota issued the first $1 billion green asset-backed security to finance loans and leases for its electric vehicle models in the US. This helped elevate the Japanese manufacturer to fifth place for green bond issuance. Latin America had its first clean energy project bond for the Verace Geribatu portfolio of 10 wind farms (258MW) in Brazil for $36 million. The region also saw the first ever labelled green project bond in the world:

at $204 million for Energia Eolica's 114MW of wind projects in Peru.

Investor demand for green bonds continued to outstrip supply in 2014: KfW's benchmark $1.5 billion offering saw $2.5 billion in orders, while the first green bond from Asia's private sector – $300 million from Taiwan's ASE – met six times as much interest. One signal of the continued interest in green bonds came in September, at the United Nations climate summit in New York where commitments amounting to just under $19 billion were announced.

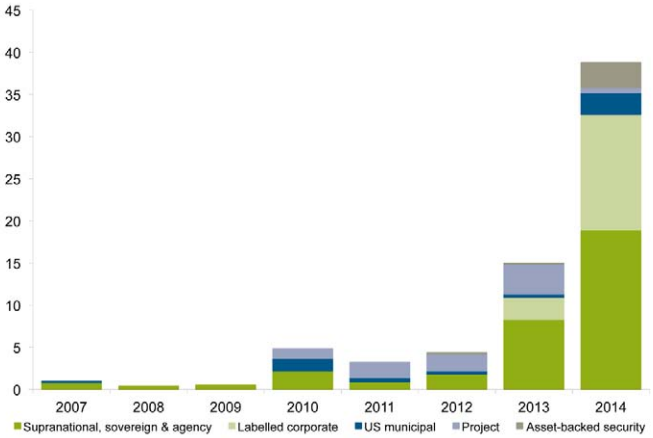
Green bonds also appear to be spreading to new markets from their historical homes of the US and western Europe. For example Brazil's development bank told Bloomberg New Energy Finance in December that the bank is developing a green bonds programme for the renewable energy sector. In Indonesia and Malaysia, green sukuk – Sharia-compliant Islamic bonds – are being devised to finance renewables investments.

DEVELOPMENT BANKS

Development banks remain a significant source of financing for clean energy. In 2013, according to Bloomberg New Energy Finance research, the world's development lenders invested $84.9 billion in "broad clean energy", a category that includes energy efficiency and transmission and distribution as well as renewable energy. This was 10% down on the 2012 figure, reflecting lower lending by such key players as KfW of Germany and BNDES of Brazil. Equivalent figures for 2014 are not yet available.

The 2013 total of $84.9 billion included $37.9 billion of energy efficiency lending, $7.1 billion for hydro-electric projects, $6.5 billion for wind, $3.2 billion for solar and $1.4 billion for bioenergy.

FIGURE 31. GREEN BOND ISSUANCE 2007-2014, BY TYPE, $BN



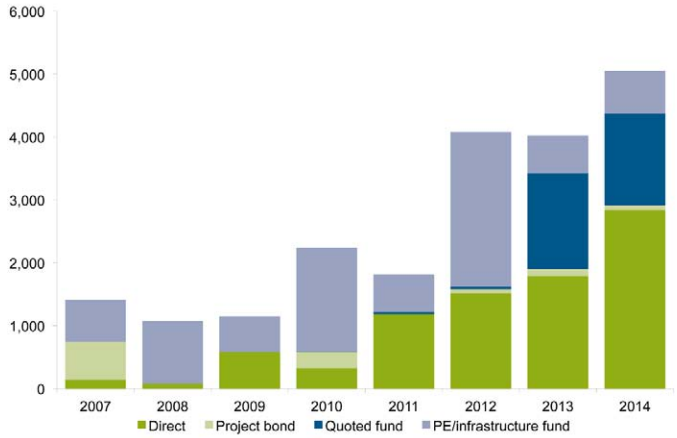
Source: Bloomberg New Energy Finance

For 2014, Bloomberg New Energy Finance's league tables for participants in utility-scale asset finance transactions in clean energy showed Brazil's BNDES as top lead arranger, with a credit of $2.7 billion, up from $1.5 billion in the preceding year. Having historically been the main source of financing for large-scale clean energy projects in Brazil, BNDES ramped up support last year for several reasons: some 5.4GW of projects were contracted in the 2013 auctions and required financing the following year. In addition, the bank has been increasing its exposure to renewable energy in recent years, to reduce use of resources, cut greenhouse-gas emissions and diversify from drought-vulnerable hydro. It has also boosted lending as part of the country's overall economic strategy to help investment. BNDES' largest investments last year were $462 million for Renova Energia to develop 15 wind farms with a total capacity of 386MW and $274 million for the refinancing of the Casa Dos Ventos Santa Brigida wind portfolio amounting to 192MW.

The European Investment Bank dropped to second place for development bank lead arranger in 2014, with a credit for $1.5 billion, nearly 20% below its 2013 total. It financed another round of offshore wind projects last year, contributing $855 million to the 600MW Gemini offshore wind farm and $205 million to the 195MW Noordoostpolder development. The bank also supports projects outside Europe: it provided $277 million of debt for the 300MW Lake Turkana wind farm in Kenya and $204 million for the 121MW Megalim solar thermal project in Israel.

Last year also saw the creation of two new South–South development banks: in July, Brazil, Russia, China, India and South Africa created the $100 billion New Development Bank. Each member country will initially contribute $10 billion and the primary focus will be infrastructure and sustainable development projects, with lending to begin from 2016. A few months later, 23 countries signed the bill creating the Asian Infrastructure Investment Bank. The initial $50 billion was mostly provided by China, which hopes the bank will begin operations at end-2015. Japan, South Korea and Australia did not join the bank, citing concerns about transparency.

FIGURE 32. INSTITUTIONAL INVESTMENT IN EUROPEAN RENEWABLE ENERGY PROJECTS, 2007-2014, $BN



Source: Bloomberg New Energy Finance

INSTITUTIONAL INVESTORS

One of the themes of recent years has been rising interest in renewable energy projects from institutional investors such as pension funds, insurance companies and wealth managers. This has been reflected in the emergence of green bonds, as a fixed-interest product linked to clean energy, and of yieldcos and quoted project funds, as equity products exposed to the cash flows from renewable power projects.

However, another increasingly important conduit for the deployment of institutional money in clean energy is direct investment in projects. Some large institutions have built up competent teams to assess wind and solar projects, in particular, with a view to owning or part-owning them as relatively low-risk, predictable cash-flow investments. With yields on government and corporate bonds at record lows, other income investments such as property, infrastructure and – now – renewable power projects have been attracting attention.

Figure 32 shows that direct institutional investment in European renewable energy projects hit a record $2.8 billion, up from $1.8 billion in 2013. Among the major transactions were four Danish pension funds spending EUR 600 million on a 50% stake in the Gode Wind offshore wind park, La Caisse de Depot & Placement du Quebec investing GBP 644 million in half of the London Array project, and a string of wind farm and solar park purchases by German insurer Allianz.

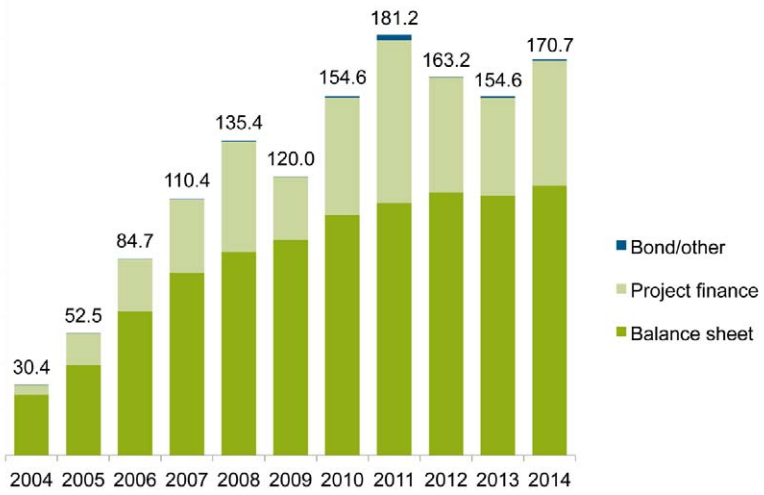
ASSET FINANCE

- Asset finance of utility-scale renewable energy projects (more than 1MW) jumped 10% in 2014 to $170.7 billion, the highest figure since 2011.
- Non-recourse project finance increased its share of the money going to new-build renewable energy assets, from 28% to 32%, reflecting improved availability of low-cost bank loans, particularly for onshore wind and PV.
- China was by far the largest contributor to the world renewable energy asset finance total, its aggregate for 2014 reaching $73 billion, up 23% year-on-year.
- Offshore wind saw $18.6 billion of transactions, up 148% on the previous year, as seven $1 billion-plus European projects reached the "final investment decision" stage.
- Wind was the largest contributor to last year's total, followed by solar, with the former up 10% at $92.4 billion and the latter 15% higher at $62.8 billion.
- The performances by wind and solar were the more impressive for the fact that reduced capital costs over recent years meant that many more gigawatts were installed of both technologies in 2014 than in any previous year.

For the first time since 2011, there was an increase in 2014 in the value of utility-scale renewable energy (projects larger than 1MW). The global total jumped 10% from 2013 levels, to $170.7 billion, but still remained below the peak of $181.2 billion reached in 2011.

Figure 33 shows the split in global renewable energy asset finance between three different ways of funding a project. They are on-balance-sheet financing of projects by utilities, independent power producers and developers; non-recourse project finance involving a mixture of bank debt and equity capital specifically for the project; and other options such as leasing. In 2014, on-balance-sheet financing made up 68% of the total, at $116.3 billion. This was up in dollar terms from the previous year's $112 billion, but four percentage points smaller as a proportion of the total.

FIGURE 33. ASSET FINANCING NEW INVESTMENT IN RENEWABLE ENERGY BY TYPE OF SECURITY, 2004-2014, $BN



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

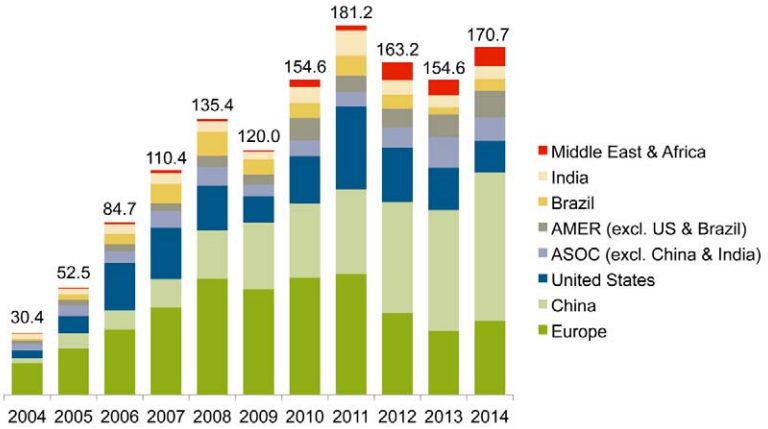
In 2014, non-recourse project finance made up a little less than 32% of the total, at $53.9 billion, up from $42 billion and 28% in 2013. This was thanks to several very large deals such as the $3.8 billion financing of the 600MW Gemini project in Dutch waters and the $1.6 billion funding of the 330MW Sarulla geothermal project in Indonesia. "Other" financing methods accounted for only $469 million in 2014, declining around 19%.

The increased slice of the financing cake accounted for by project finance in 2014 reflected, in part, fierce competition among banks to lend to established-technology renewable energy projects in countries perceived as low-risk, such as the US, Canada, Germany, France and the UK. In the largest deals, there was often a multiplicity of lenders involved. For instance, in the case of Gemini, there was EUR 2 billion of debt provided by 12 commercial banks, including ABN Amro, CIBC and Bank Nederlandse Gemeenten, plus the European Investment Bank. There was also cover from three export credit agencies, EUR 200 million of subordinated loans provided by developer Northland Power and Danish pension fund PKA, and EUR 400 million of equity from Northland, Siemens Financial Services, Van Oord Dredging and utility company HVC.

There were other signs of improved confidence in the banking market, with Societe Generale, lead lender to the 300MW Cestas PV project in France, undertaking to syndicate the EUR 310 million of 18-year project debt. However, bond issues to finance renewable energy projects were few and far between in 2014, even in the US, where the largest deal in 2013 was the $1 billion issue by Warren Buffett's MidAmerican Solar to build and operate the Solar Star projects in California.

China was the biggest centre for renewable energy asset finance in 2014, as shown in Figure 34, with Europe second up 15% and the US third (down 25%). The Chinese total was $73 billion, up 23% on 2013 and continuing the strong upward trend established over many years. Last year's number was double that of 2010 and more than four times that of 2007. As shown in Chapter 1,

FIGURE 34. ASSET FINANCING NEW INVESTMENT IN RENEWABLE ENERGY BY REGION, 2004-2014, $BN



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

Chinese asset finance was dominated by wind, followed by solar, with much smaller figures for small hydro, biomass and waste-to-energy and biofuels.

Among the large projects financed in 2014 were, in offshore wind, the Longyuan Rudong Offshore Intertidal demonstrator, at an estimated $990 million for 200MW; in onshore wind, the Huadian Qinguang Huanxian Maojing project, at an estimated $560 million for 400MW; and, in photovoltaics, the Singyes Solar Minqin Hongshagang PV plant phase one, at $488 million for 300MW.

The second most important region for clean energy asset finance last year was Europe, accounting for $36.2 billion, up 15% on 2013 but significantly below the annual figures attained during the 2007-12 period. The European figure for last year would have been only about half as large were it not for large offshore wind deals, and that highlights the weakness of new-build asset finance in other technologies, such as onshore wind and PV. There were hotspots for both of these – for instance, onshore wind was strong in Germany and PV relatively robust in both the UK and France. However, there were also several European countries where activity was depressed by investor concern at retroactive cuts in support for existing projects (for instance, PV in Italy and both main technologies in Spain, Bulgaria and Romania), or by wider geopolitical issues (notably Ukraine).

The US saw asset finance of $15.5 billion in 2014, down 25% on the previous year and the weakest annual figure since 2009. The prime reason was that the Production Tax Credit, the main incentive for wind farm development in the US, expired at the end of 2013 and, although it was eventually extended to the end of 2014, this extension was only passed by Congress in the dying days of last year so it was too late to bring about a spurt of new financings before the end of December. It could, however, be enough to encourage extra activity in 2015 and early 2016.

Among other regions shown in Figure 34, the Americas excluding the US and Brazil was the fourth biggest region, accounting for $13 billion

of asset finance in 2014, some 16% higher than in the previous year. The dominant contributor was Canada, with asset finance of $6.4 billion, up 20% on the previous year thanks to the financing of some large projects such as the 189MW Armow wind farm, at an estimated cost of $574 million, and the 140MW Kingston PV project, at $525 million. Both projects are in Ontario. Mexico and Chile also showed year-on-year increases, taking them to $2 billion and $1.5 billion respectively, up 10% and 17%.

Asia-Oceania excluding China and India recorded asset finance of $11.6 billion, down 23% on 2013. The key contributor in this region is Japan, which saw its total drop 30% to $6.2 billion, as spending on renewables swung further towards small-scale solar and away from utility-scale projects. However the sharpest decline in percentage terms took place in Australia, where asset finance plunged 87% to $262 million in the face of the Canberra government's shift away from support for renewables.

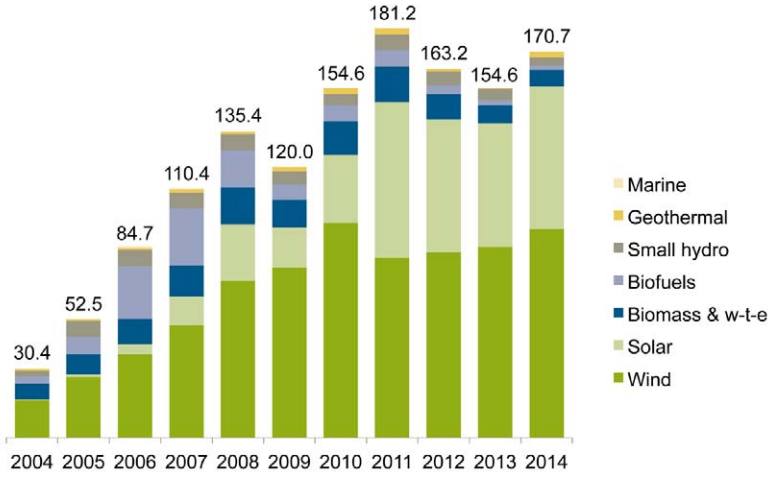
The Middle East and Africa region was a strong feature in utility-scale asset finance, its total rising 23% to $9.4 billion. Among the star performances were Kenya, up 235% at $1.3 billion thanks in large part to the Lake Turkana wind project financing; Israel, up 69% at $924 million, due almost entirely to the Ashalim solar thermal plant (see below); and South Africa, up 4% at $5.5 billion, helped by three solar thermal power stations plus onshore wind undertakings such as the De Aar project phase two, at an estimated $300 million for 144MW, and PV initiatives such as the Total Prieska project, at $176 million for 86MW.

The other two major markets, India and Brazil, also showed increases in asset finance activity. The India total was $6.3 billion, up 5%, but the big mover was Brazil, with a 76% jump to $5.8 billion as some of the wind projects that won auctions in 2014 and in earlier years reached the financing stage.

A breakdown of 2014's global activity into the various different technology groups – as shown in Figure 35 – reveals that both wind and solar enjoyed increases in asset finance commitments. Wind was up 10% to $92.4 billion, the second highest annual figure ever, and solar was up 15% to $62.8 billion, also the second highest ever.

The leader board for wind financings last year was dominated by European offshore deals. These made up the top seven projects, all worth at least $1.2 billion in investment, with one off the Netherlands, three in German waters and three in UK waters. In capacity terms, the seven (Gemini, Dudgeon, West of Duddon, Wikinger, Borkum Riffgrund, Sandbank and Burbo Bank Extension) amounted to 2.5GW.

FIGURE 35. ASSET FINANCING NEW INVESTMENT IN RENEWABLE ENERGY BY SECTOR, 2004-2014, $BN



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

In all, offshore wind financings worldwide totalled $18.6 billion, two and a half times the 2013 figure of $7.5 billion and easily beating the previous record of $12.8 billion in 2010.

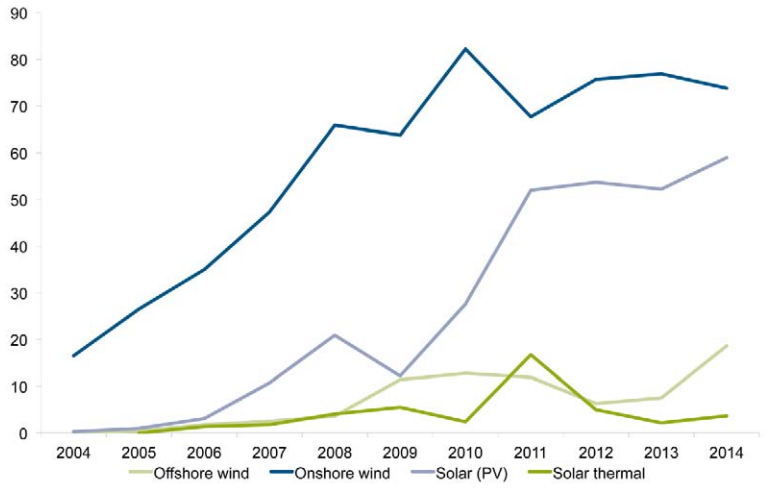
Onshore wind saw much more geographic variety, with the biggest transactions including Lake Turkana in Kenya, at $859 million for 310.5MW, the K2 wind farm in Ontario, Canada, at an estimated $727.5 million for 270MW, the Cemex Ventika portfolio in Mexico, at $647 million for 252MW, and a stream of Chinese projects of up to 400MW each. Overall onshore wind financings amounted to $73.8 billion in 2014, down 5% on 2013 and further below the all-time high of $82.2 billion set in 2010.

The dominant variety of solar power remained photovoltaic. In 2014, asset finance of PV projects climbed 13% to $59 billion, the more impressive for the huge falls in system prices since 2011, and particularly since the time of the Spanish solar boom in 2008.

Last year, there were no fewer than 21 individual PV projects financed for $300 million or more, in countries as widely spread as Japan, China, the US, Canada and France. The two largest were the Setouchi Mega site in Japan, at an estimated $1 billion for 250MW, and the Huanghe Hydropower Gonghe Longyangxia PV plant in China, at an estimated $848 million for 530MW.

Solar thermal electricity generation, also known as CSP, saw asset finance rise to $3.7 billion in 2014, some 68% higher than in 2013. However, this figure was far below the peak of $16.7 billion realised in 2011, when several large US and Spanish solar thermal projects reached

FIGURE 36. ASSET FINANCE OF WIND AND SOLAR PROJECTS WORLDWIDE, BY SUB-SECTOR, 2004-2014, $BN



Source: Bloomberg New Energy Finance

the investment decision stage. The 2014 crop included the Xina Solar One project in South Africa, costing $1 billion for 100MW, and the Ashalim I Sun Negev undertaking in Israel, $820 million for 121MW.

Other sectors outside wind and solar had mixed fortunes. Asset finance of biomass and waste-to-power projects was down 10% at $7.4 billion, small hydro down 27% at $3.8 billion, biofuels down 11% at $1.7 billion, the lowest figure for at least 10 years, but geothermal up nearly sevenfold at $2.4 billion.

In these sectors, the significant transactions of 2014 included the Sarulla geothermal plant in Indonesia mentioned above, the Fortum Vartan biomass project in Sweden, at $684 million for 130MW, the Dublin waste-to-energy project in Ireland, at $642 million for 60MW, and the Raizen Paraguacu & Caarapo bioethanol and power plants expansion, at $204 million.

Figure 36 shows how asset finance in four key technologies (offshore wind, onshore wind, PV and solar thermal) has evolved over the last decade. There are some striking changes – the spike in solar thermal projects in 2011 in the US and Spain, 2014's record year for offshore wind, the consistent strength of onshore wind, and the explosion in utility-scale PV.

LARGE HYDRO-ELECTRIC PROJECTS

Investment in large hydro-electric projects of 50MW or more is outside the main scope of this report, but is nevertheless an important part of the activity in renewable energy. The capacity of new large hydro projects reaching the "final investment decision" stage is estimated to have been 15-20GW worldwide in 2014, down from 20-25GW in 2013.

Taking the middle of that 2014 range, and an average capital cost of $1.75 million per MW, as estimated by Bloomberg New Energy Finance, would be equivalent to investment of around $31 billion last year. That would make capacity investment in large hydro about a third of that in wind and a fifth of that in solar. Large hydro would, however, be much larger in investment terms than biomass and waste, or geothermal.

The estimates for large hydro investment above exclude the active business in refurbishment of existing hydro-electric stations, and the construction of pumped hydro storage capacity. They also exclude small hydro-electric projects of less than 50MW, which are already covered in the main renewable energy totals in this report.

Hydro-electric equipment manufacturers have painted a relatively subdued picture about trends in their sector during 2014. Dongfang Electric, one of the two main Chinese turbine makers, said that it manufactured 3.3GW of generator sets in the first nine months of the year, compared to 7GW in the whole of 2013, while the other leading player, Harbin Electric, said it made 2.8GW in the first half of 2014, against 5.7GW in the whole of 2013.

Austrian hydro-electric turbine supplier Andritz said that its sales and orders in the hydro-electric sector were both down 5% in the first three quarters of 2014 compared to the same period of 2013, while German manufacturer Voith said that sales were down 5% but orders up 24%. A third major European player, Alstom, does not break out its hydro sales and orders from those in the rest of its energy business.

Among the significant large hydro project milestones of last year were the final commissioning of the giant 13.9GW Xiluodu Dam in Yunnan and Sichuan provinces, China, and the award to Andritz of the contract to supply electromechanical equipment for the 2.1GW Lauca hydropower plant in Angola. Other financings included $904 million for the ICE Reventazon hydro-electric project in Costa Rica, with contributions from the Inter-American Development Bank and the World Bank; and $747 million for the Nam Ngiep 1 project in Laos, backed by seven Asian banks.

SMALL DISTRIBUTED CAPACITY

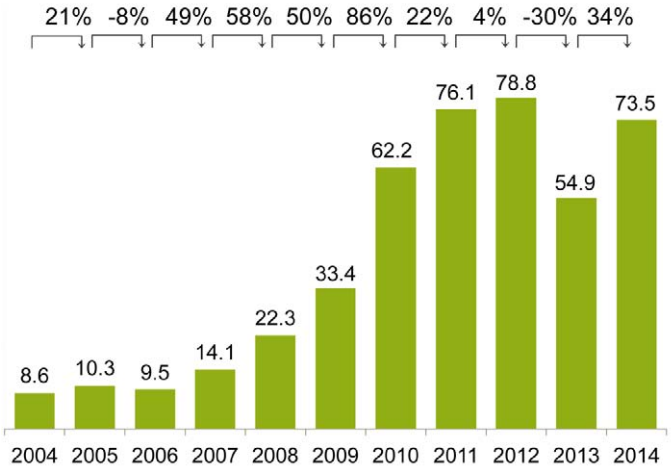
- Small-scale distributed solar is gaining ground in developing nations around the world as an immediate and affordable alternative to centralised, grid-based power systems.
- More than a quarter of all new investment in renewable energy went to small-scale projects last year – some $73.5 billion.
- Japan remained the largest market for small distributed power for the second consecutive year thanks to a set of generous PV feed-in tariffs introduced in mid-2012.
- In the US, the economics of the small distributed solar sector have improved to the point where state subsidy programmes are in some places no longer needed.
- China's small distributed market is primed for take-off, but has been slow to fulfil its enormous potential. Changes in the subsidy regime should light the touch paper in 2015.
- In Europe, investment in the small distributed solar sector continued to contract, with the former top markets of Germany and Italy falling by 34% and 71% respectively compared to 2013.

Small distributed renewable power projects are occupying an increasingly large slice of global electricity generation as falling costs put the technology within reach of more people. In 2014, small-scale projects accounted for 30% of all investment in new clean energy generating capacity, and 27% of all new money flowing into the sector.

All told, some $73.5 billion was spent buying and installing projects of less than 1MW, typically rooftop and other small solar PV installations. This represented an increase of 34% on 2013, yet was slightly less than the totals seen in 2011 and 2012, as shown in Figure 37, due to sharp declines in technology costs in the interim.

These increases prove that small-scale renewable energy has considerable appeal, particularly in developed economies as a way for households and businesses to generate their own power and sometimes sell it back to the grid. Small projects have not been affected by the recent sharp falls in the price of oil and gas because retail power prices – which distributed renewable power competes against – are resilient to declines in wholesale power prices, thanks in part ironically to the

FIGURE 37. SMALL DISTRIBUTED CAPACITY INVESTMENT, 2004-2014, $BN



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

weight of green levies. With stable retail power prices, at least in Europe, distributed renewable power is likely to remain competitive.

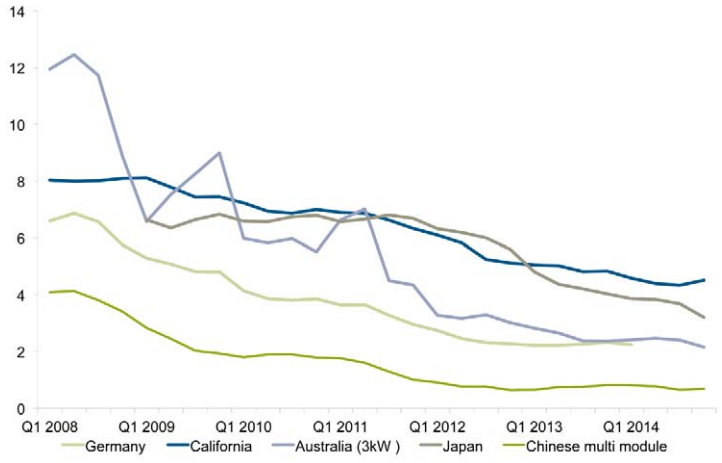
Yet small-scale PV is taking off all over the world, with many countries only just beginning to take advantage of this natural resource. In 2014, for instance, a PV plant was installed at the largest copper mine in the world, the Chuquicamata mine in Chile, while panels sprang up atop shopping malls in the Philippines. Indeed, small-scale distributed solar is gaining ground in developing nations as an immediate and affordable alternative to centralised, grid-based power systems. See Box below for further examples.

Investment in small distributed capacity is driven, in part, by the price of solar modules, which were largely flat in 2014, a change from the sharp declines seen in previous years. However, the market for balance-of-plant components is much less transparent, with the result that quotes for similar projects in the same country can vary considerably. It is estimated that commercial rooftop systems can be built for an average of $1.67 per Watt, while residential systems are a bit more expensive at $2.20/W.

Naturally, there are considerable differences in cost across the various markets, as Figure 38 shows. Japan and the US were the most expensive in terms of cost to the consumer – yet the pair accounted for more than half of all investment in small distributed solar globally worldwide in 2014 – while Germany and Australia were at the lower end of the scale. The more expensive markets are likely to get cheaper as scale and competition grow, and as initiatives aimed at squeezing some of the expense out of the value chain bear fruit, such as using better printing techniques.

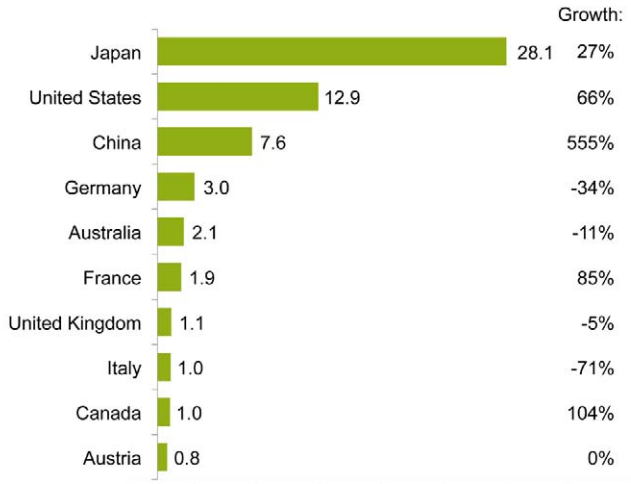
Before it was wound up at the end of 2014, the California Solar Initiative supported residential systems priced at slightly more than $4 per Watt, but there are cheaper systems available elsewhere in the country. For instance, Vivint Solar and SolarCity recently reported equipment and installation costs of $2.34/W and $2.19/W, respectively. The US has comparatively expensive system costs partly because many of the major installers spend a significant amount on marketing, on top of all the other costs.

FIGURE 38. PUBLIC SYSTEM PRICE BENCHMARKS, 2008 TO Q3 2014 ($/W)



Sources: Sources: METI, California Solar Initiative, Solarchoice.au, BSW-Solar, Bloomberg New Energy Finance

FIGURE 39. SMALL DISTRIBUTED CAPACITY INVESTMENT BY COUNTRY, 2014, AND GROWTH ON 2013 $BN



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

Japan may have higher-than-average residential solar costs, but it remained the largest market for small distributed power for the second consecutive year thanks to a set of generous PV feed-in tariffs introduced in mid-2012. As Figure 39 shows, investment in the Asian nation increased 27% in 2014 to $28.1 billion, more than double the $12.9 billion in the US, the next largest market. Growth is predicted to continue in 2015 and 2016 but is likely to decline thereafter as the Tokyo government seeks to curtail further growth through changes to the subsidy regime.

Japanese feed-in tariffs will fall in April 2015 and then again in July, on the third anniversary of the subsidy scheme. In addition, the government recently introduced limits on the amount of new solar and wind that can be connected to the grid in regions served by seven of the 10 vertically integrated utilities. Once this limit has been reached – widely expected to be in 2016 – projects applying for a grid connection will be subject to unlimited curtailment without compensation. This may also help deter speculators who were driving up costs for committed developers by trading in approved feed-in-tariff and grid applications.

The US small distributed solar sector is flourishing. Investment grew by 66% to $12.9 billion in 2014, considerably more than the $7.6 billion invested by China, the next biggest market in terms of investment. Recent US growth is built on a combination of federal subsidies, most notably the 30% Investment Tax Credit (ITC), in conjunction with state support mechanisms, such as Renewable Portfolio Standards and the California Solar Initiative. Taken individually, these measures have proven insufficient, until now.

In some states, most notably California, the sector has reached a point where it is able to thrive on federal subsidies alone. Indeed, such is the rate of growth in some states that local policymakers are considering introducing fees, fixed charges or minimum utility bills to slow expansion. The residential sector will decline if, as scheduled, the ITC steps down from 30% to 10% in 2016 – something that a majority of the solar industry is campaigning against – but it will not stop altogether.

In recent years, third-party financiers and installers have been responsible for the majority of new residential solar capacity in the US, reaching a high of 68% in California in 2013. Many have raised significant sums for their tax equity funds – for instance, SolarCity has raised $2.3 billion since 2008, Sunrun $1.7 billion and Vivint $1.1 billion. In 2014, NRG Home Solar raised $270 million for its first large third-party tax equity fund, which it plans to use for a new $600 million portfolio of residential PV systems.

In 2014, third-party solar developers lost market share to host-owned arrays for the first time. In response to this trend, most major US solar residential developers have hurriedly launched or are developing loan products. SolarCity's MyPower is the most ambitious so far: it offers a 30-year loan at the comparatively low rate of 4.5% and electricity for $0.10-0.11/kWh in California and $0.08-0.09/kWh in Colorado, assuming customers pass on their ITC payment to SolarCity.

China's small distributed market is primed for take-off, but has been slow to fulfil its enormous potential. The government is trying to shift PV

deployment away from transmission-grid projects towards distribution-grid projects in a bid to reduce the need for additional investment in the transmission grid. It set a goal of 8GW connected to the distributed grid in 2014 – some 10 times the 801MW of rooftop PV connected in 2013 – but only an estimated 2GW was realised. Nevertheless, the value of investment in the sub-1MW distributed sector accelerated by a remarkable 555% to $7.6 billion in 2014.

In September 2014, the National Energy Administration announced important changes to the distributed generation policies that should see it ramp up significantly this year: the NEA's quota allocation plan, which was leaked in January, sees 7GW of new PV capacity added to the distributed grid in 2015. Critically, the subsidy regime was expanded to include a feed-in tariff option instead of a premium payment, and the ability to switch between the two during the life of the project. This avoids the risk of having to find a long-term power purchase agreement with a creditworthy off-taker at a good price, and should make the sector more attractive to investors.

In Europe, investment in the small distributed solar sector continued to contract, with the main markets of Germany and Italy falling by 34% and 71%, respectively. In the former, the introduction in August 2014 of a self-consumption tax for systems of more than 10kW knocked market confidence. Growth in the sub-10kW sector was controlled by further degression of the feed-in-tariff in 2014, but this market could increase slowly this year as PV system costs gradually decline.

In Italy, the sharp fall in investment came about because subsidy support for the solar sector reached its EUR 6.7 billion cap in July 2014 and, as established in a decree of 2012, was subsequently withdrawn. In addition, there were retroactive cuts in support. However, the market is not dead. Even without subsidies, PV still looks attractive in light of Italy's high commercial and household power prices and good irradiation. Self-consumption in such an environment is sure to drive demand in 2015, although it is unlikely to be on the scale previously seen.

SMALL-SCALE SOLAR'S GLOBAL FOOTPRINT

Right at the end of 2014, Masdar, the Abu Dhabi-based renewable energy investor, said that it had begun building four PV projects in the Pacific Island countries of Kiribati, Fiji, Tuvalu and Vanuatu. The four will have capacities of 400kW, 550kW, 350kW and 501kW respectively, be financed through the $50 million UAE-Pacific Partnership Fund, and be completed in the second half of 2015.

In land-locked Central Asia, two ministries in Uzbekistan agreed to the construction of a pilot solar plant with a capacity of 130kW, using Korean technology, while in Kenya, Solarcentury of the UK said it would build East Africa's largest rooftop PV plant, of 858kW, on a parking lot in the Garden City Mall, Nairobi.

In the Philippines, St Scholastica's College in Manila said it would save PHP 4 million ($100,000) a year by installing a 96kW PV system on its rooftops, and the Israeli parliament said it was seeking bids for the installation of at least 300kW of capacity on the roof of its Knesset building.

Back in January 2014, Kyocera Corporation of Japan said it would fit a football stadium in The Hague, the Netherlands, with a 725kW PV plant. Later in the year, electricity started flowing from National Life Group's 500kW installation on four acres south of its Montpelier headquarters in Vermont, US.

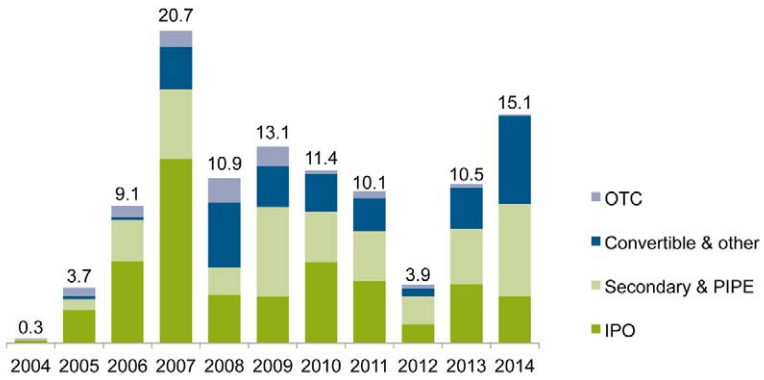
In the UK, a seafood processing company, Five Star Fish, installed 250kW of panels on its factory roof in Grimsby, while in India, a multi-specialty hospital in Aurangabad installed a 100kW PV system, as the first step towards an array of 300kW. In Japan in December, local company Tomatolandiwaki inaugurated a 1MW plant in Fukushima Prefecture, consisting of 412.5kW of solar tracking capacity and 558kW of stationary PV systems.

PUBLIC MARKET INVESTMENT

- Public market investment in renewable energy companies and funds leapt 42% to $15.1 billion in 2014. In its second year of strong recovery, public market investment was almost four times greater than in 2012.
- Funds raised by initial public offerings, or IPOs, fell by 20% to $3.1 billion, but secondary issues and private investment in public equity, known as PIPE, rose by two thirds to a record $6.2 billion, and convertible bond issues more than doubled to $5.8 billion, also a record.
- Investment via public markets in "yieldcos" continued apace, with investors seeing this model as providing steady dividend income at relatively low-risk, at a time of record-low interest rates. Developers, meanwhile, saw yieldcos as useful vehicles for recycling their capital.
- Solar investment soared 73% to an all time high of $8.3 billion, while wind jumped $120% to $5.4 billion, although this was just half the investment that sector attracted at its peak in 2007. Small hydro and marine grew their public market equity raising from a tiny base; biofuels and biomass fell back; and geothermal collapsed to zero after a major privatisation the previous year.
- The WilderHill New Energy Global Innovation Index, or NEX, which tracked 106 clean energy companies in 2014, fell 3% over the course of the year, weighed down by investor reaction to falling oil prices and policy uncertainties facing the wind and solar sectors.

Public investment in renewable power and fuel companies recovered strongly for the second year running in 2014, as shown in Figure 40, rising 42% to $15.1 billion in spite of a disappointing performance by clean energy stock indices. The WilderHill New Energy Global Innovation Index, or NEX, started the year well, rising almost 20% by mid-March, but then lost impetus and finished the year more than 3% lower than it started. This was in contrast to the S&P 500 index and the technology-heavy Nasdaq, which gained 11% and 13% respectively, as shown in Figures 41 and 42.

FIGURE 40. PUBLIC MARKET NEW INVESTMENT IN RENEWABLE ENERGY BY STAGE, 2004-2014, $BN



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

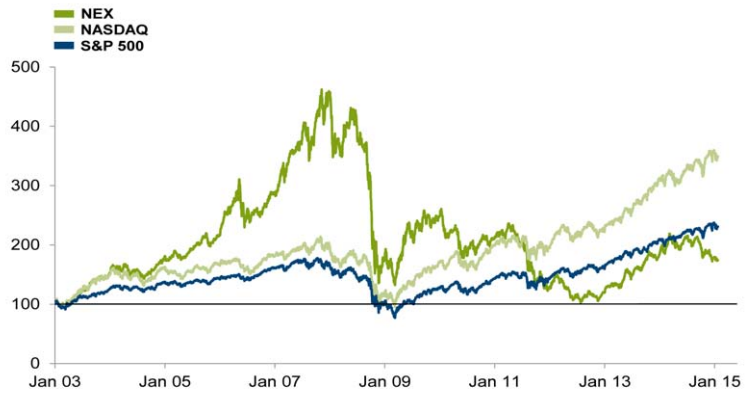
The NEX began to slide in late summer, shortly after the oil price started its six-month collapse, Brent crude falling from $112 per barrel at the end of June to less than $62 by the end of the year. Clean energy valuations fell across the board, with the NYSE Bloomberg indices for the wind, solar

and energy smart technology (EST) sectors moving almost in lock step, as shown in Figure 43. In reality, investors may have over-estimated the impact of the falling oil price on renewable energy. In most parts of the world, oil does not compete directly with wind or solar: oil-fired electricity generation has been all but eliminated except in major oil producing countries such as Saudi Arabia and a few developing economies such as Cuba. Lower oil prices – should they persist – could slow the progress of biofuels and electric vehicles, but the fact that share prices suffered equally across all clean energy sectors suggests the declines were driven largely by sentiment. The reality is that renewables continued to grow strongly in major markets as a result of dramatic improvements in cost competitiveness, even as subsidies became less generous, and in spite of low gas prices in the US. The record amounts of PV and wind capacity installed in 2014, at a combined 95GW or so, was substantially more than the entire generating capacity of the UK or South Korea, and almost double that of Saudi Arabia.

If the weakness of the clean energy public market indices seems out of step with the strength of public investment in clean energy during 2014, their performance may well have affected the nature and timing of some of that investment. IPO issuance fell by $800 million to $3.1 billion in 2014, for example, scarcely a quarter of its 2007 peak, as shown in Figure 40. Most of the year's IPO activity – 12 of the 17 flotations, including all of the largest – happened before the end of July, while the market was still comfortably above its January 2014 starting position, and then subsided as valuations sank.

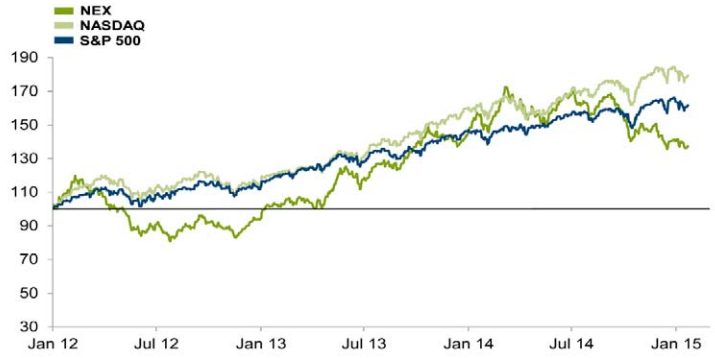
The flow of IPOs might have been weaker still had it not been for the growing popularity of yieldcos. With the US species of yieldco, developers typically hive off a portfolio of renewable generating assets into a subsidiary company, which is then floated on a stock exchange.

FIGURE 41. NEX VS SELECTED INDICES



Index values as of 22 January 2015; Nasdaq and S&P 500 rebased to 100 on 1 January 2003
Source: Bloomberg New Energy Finance

FIGURE 42. NEX VS SELECTED INDICES



Index values as of 22 January 2015; Indices rebased to 100 on 1 January 2012
Source: Bloomberg New Energy Finance

FIGURE 43. NYSE BLOOMBERG WIND, SOLAR AND EST INDICES

Index values as of 22 January 2015; Indices rebased to 1000 on 1 July 2012
Source: Bloomberg New Energy Finance

Yieldcos distribute the great majority of their free cash flows to investors in the form of dividends – highly prized in today's low yield environment – while for the developer they provide a cheap way to raise capital to plough into new projects. The three largest renewable energy IPOs in 2014 were of yieldcos launched on Nasdaq. The largest was Abengoa Yield, which owns a diverse portfolio of renewable generation and transmission assets in the Americas and Spain, and which raised almost $830 million from the sale of 49% of its equity, the rest remaining in the hands of Abengoa, its solar- and biofuels-focussed Spanish parent company. SunEdison, the California-based solar manufacturer and installer, floated off TerraForm Power, which raised $877 million. And NextEra Energy, America's largest wind turbine operator, raised $467 million with the launch of yieldco NextEra Energy Partners.

Aside from yieldcos, and their UK equivalents, the quoted project funds, there were only three "straight" IPOs greater than $100 million in 2014, all of which managed to get away in the autumn despite the weakening market. Vivint Solar, America's second largest residential solar installer, which had installed over 790MW on customers' rooftops the previous year, raised $330 million on the New York Stock Exchange in September. The following month, Scatec Solar, a Norwegian developer of international solar parks as far afield as Utah, Rwanda, Jordan and Honduras, raised $123 million on the Oslo exchange, although this fell short of its target by more than a third. In November, the Korean tower manufacturer CS Wind Corporation raised $232 million on its domestic stock exchange.

The other striking trend of 2014 was the continued strength of convertible bonds – which give investors the right to convert the bonds into equity. Renewable energy companies raised a record $5.8 billion via convertibles, up 115% on 2013. Companies like convertibles because they typically pay a lower coupon than normal bonds, and should investors convert, the debt disappears – although the company's equity is diluted. For investors, the debt can be a cheap way of buying into a company whose shares they expect to rise.

Of the six largest convertible issues, four were by American solar companies: SunEdison, the best performing solar company last year, raised $600 million; SolarCity, the California-based solar finance and services company, raised $566 million; SunPower Corporation, a solar manufacturer and installer, raised $400 million; and in a convergence of the year's two big investment themes, NRG Yield raised $345 million in a convertible issue. The other two issues were by wind companies: Acciona of

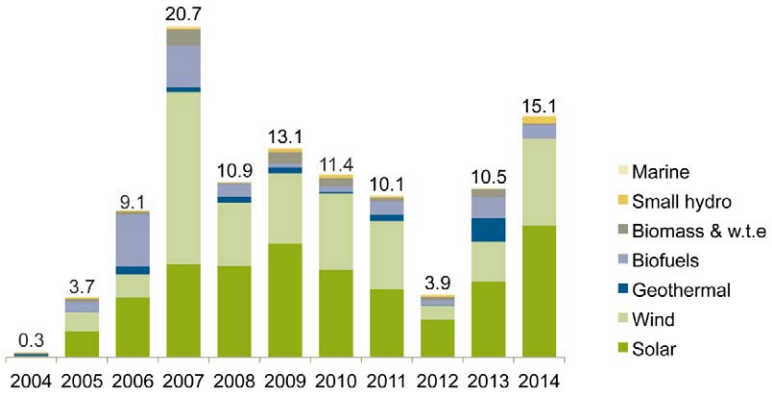
Spain, which raised $468 million; and Suzlon Energy, the Indian turbine manufacturer, which raised $547 in a major debt restructuring, after defaulting on $209 million of convertible debt in 2012.

The biggest single convertible issue in clean energy raised $2 billion for electric car maker Tesla, to part fund the battery "gigafactory" it is building in Nevada with its partner Panasonic, which it hopes will produce 50GW of lithium-ion battery packs per year by 2020. This was the largest convertible bond ever issued according to Bank of America Merrill Lynch, but since this report covers only renewable energy and not energy-smart technologies, the deal is excluded from our figures. The sharp rise in convertible issues in renewable energy came in spite of a fall in global convertible issuance across all sectors, from $93 billion in 2013 to $89 billion in 2014, according to Bank of America Merrill Lynch.

Secondary issues generated even more volume than convertibles, reflecting the improvement in underlying trading conditions and improved margins for many already-quoted companies in sectors such as wind and solar.

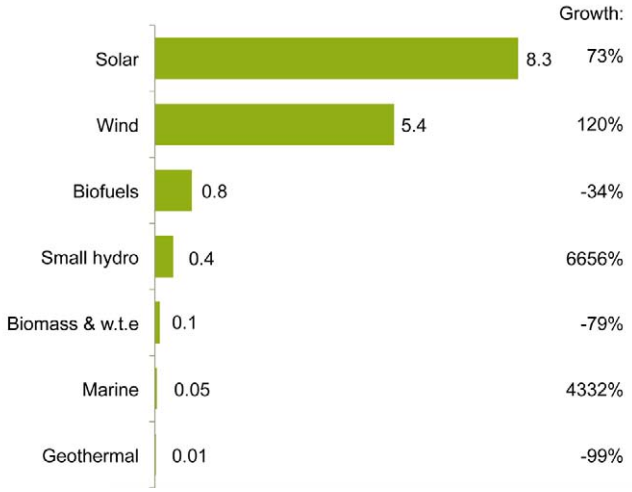
Vestas, the world's largest turbine manufacturer, for example, raised $603 million in a secondary share placement in Copenhagen, after reporting its first quarterly profit in over two years. The issue, which expanded the company's equity by almost 10%, marked the culmination of a major restructuring programme in response to a crisis that saw the company's shares collapse by 96% between 2008 and 2012. Gamesa, the Spanish turbine maker, raised $304 million in Madrid to fund expansion into emerging markets and its offshore wind joint venture with Areva. Greencoat UK Wind, a

FIGURE 44. PUBLIC MARKET NEW INVESTMENT IN RENEWABLE ENERGY BY SECTOR, 2004-2014, $BN



Source: Bloomberg New Energy Finance

FIGURE 45. PUBLIC MARKET NEW INVESTMENT IN RENEWABLE ENERGY BY SECTOR, 2014, AND GROWTH ON 2013, $BN



Source: Bloomberg New Energy Finance, UNEP

British quoted project fund, raised a further $200 million in a secondary issue in London following its successful flotation in 2013. Huaneng Renewables Corporation, a Chinese wind and solar project developer, raised $225 million in Hong Kong.

Total public market investment in wind jumped 120% in 2014 to $5.4 billion, although this was just half its peak level in 2007, as shown in Figures 44 and 45. Total public market investment in solar rose 73% to a record $8.3 billion, despite concerns over prospects for Chinese PV manufacturers.

Shares in Chinese solar manufacturers such as Yingli, Hanwha SolarOne, Renesola and Trina fell in 2014 not only because of caution about the possible impact of the oil price collapse on renewables, but also because the US International Trade Commission extended anti-dumping tariffs, and closed some loopholes these companies had been using to sell into the US. There were also worries during the year about how large the Chinese solar market would prove to be in 2014, since official estimates fluctuated between 10GW and 14GW; Bloomberg New Energy Finance analysts now estimate that 13GW was built in 2014, but that only 10GW may have been connected to the grid.

Nevertheless the combination of yieldcos, convertibles, IPOs and secondary issues combined to push solar investment to a new peak. Secondary issues included many by Chinese manufacturers, including Hareon Solar Technology ($620 million), Shanghai Chaori Solar ($239 million), Trina Solar ($111 million) and Yingli Green Energy ($88 million).

Other sizeable secondary issues included two from other British investment funds: Bluefield Solar Income Fund raised $192 million, and NextEnergy Solar Fund raised $149 million in November, following a $144 million IPO in April. These, and Greencoat, are three of six UK listed funds with attractions similar to those of US yieldcos that have raised a total of $2.7 billion in the last two years. The UK funds buy renewable generating assets from developers, and offer investors low-risk yields of around 6% based on those projects' subsidy-supported earnings.

Public market investment in biofuels fell by over a third as the sector remained subdued in the face

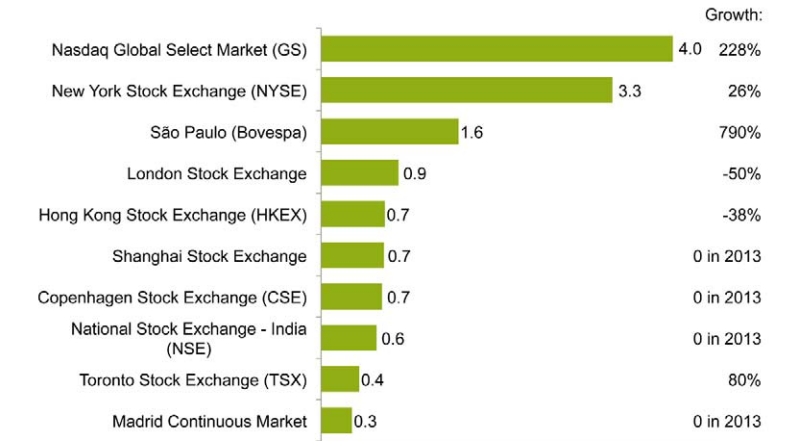
of a number of uncertainties. In the US, the price of ethanol languished as production capacity outstripped the volumes required to be blended with petrol under the country's RFS2 regulation, and the Environmental Protection Agency announced that it would not decide the final volumes required for 2014 until 2015. At the same time, several second-generation cellulosic ethanol plants started production, including those owned by Abengoa and Poet-DSM, and the market seemed inclined to wait and see how they fare. The mood was further depressed by the insolvency in November of KiOR, a former darling of the sector, whose cellulosic plant opened in 2012 but had produced fuel that could only be sold at a loss.

Public investment in both marine and small hydro grew strongly, but from tiny bases in 2013. Notable deals in small hydro included Brookfield Renewable Energy Partners, which runs hydro-electric plants across North America, raising $298 million on the Toronto exchange, and Kleinkraftwerk Birkseck, a Swiss developer, raising $62 million in Bern. In marine, Atlantis Resources, a Singapore registered tidal turbine maker and project developer, raised $20 million via an IPO on London's Alternative Investment Market, and US wave energy firm Ocean Power Technologies raised $12 million in a secondary issue on Nasdaq.

Investment in geothermal slumped from $1.5 billion in 2013 to almost nothing in 2014, as there was no major IPO or secondary issue to rival the $1.4 billion privatisation of Mighty River Power, New Zealand's geothermal and hydro electricity generator, the previous year.

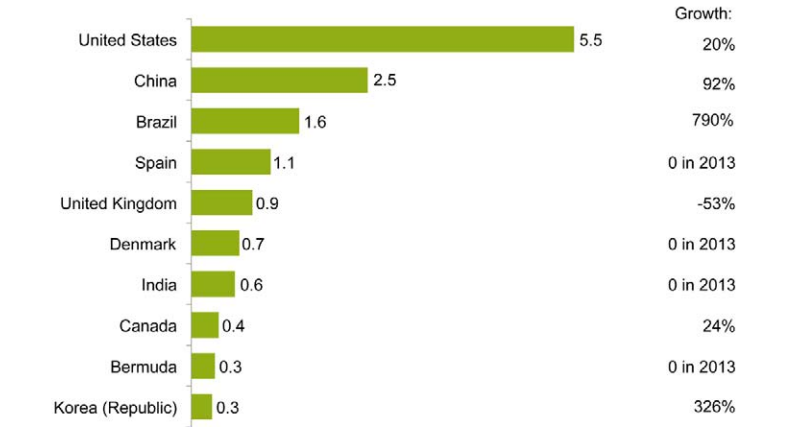
Analysing activity by stock exchange location and issuing company nationality, as shown in Figures 46 and 47, provides a fresh perspective. Nasdaq was the clear winner in 2014, attracting public market issues worth $4 billion, up 228%, overtaking both the London Stock Exchange and the New York Stock Exchange. NYSE grew by more than a quarter to $3.3 billion, while London halved to $876 million. The Bovespa exchange in Sao Paulo saw the biggest rise, up almost ninefold to $1.6 billion, but this was due almost entirely to a single rights issue by Renova Energia, a Brazilian wind and small hydro generator. The breakdown by stock exchange was broadly mirrored by the nationality of the issuing companies, shown in Figure 47.

FIGURE 46. PUBLIC MARKET NEW INVESTMENT IN RENEWABLE ENERGY BY EXCHANGE, 2014, AND GROWTH ON 2013, $BN



Top 10 exchanges
Source: Bloomberg New Energy Finance

FIGURE 47. PUBLIC MARKET NEW INVESTMENT IN RENEWABLE ENERGY BY COMPANY NATIONALITY, 2014, AND GROWTH ON 2013, $BN



Top 10 countries
Source: Bloomberg New Energy Finance

VENTURE CAPITAL AND PRIVATE EQUITY INVESTMENT

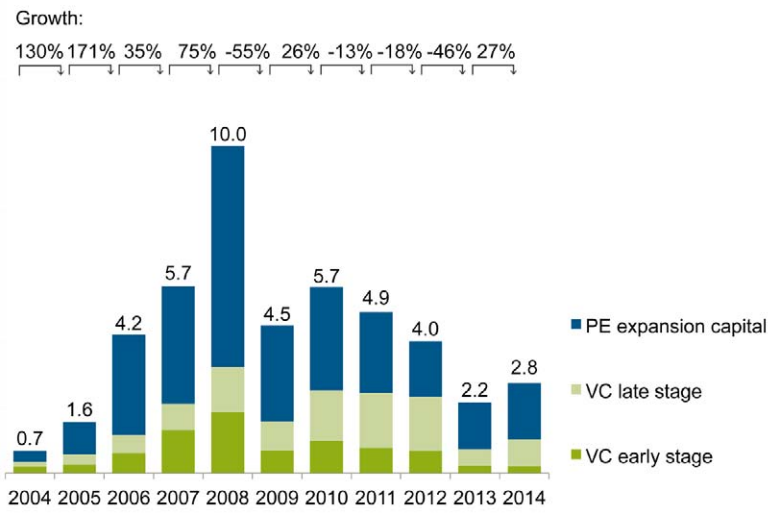
- Venture capital and private equity in renewable energy increased by more than one quarter to $2.8 billion in 2014, but remained at less than a third of the peak reached in 2008.
- Investors continued to shun early-stage opportunities and were only marginally more interested in financing later-stage ventures.
- Private equity expansion capital grew 20% thanks to a number of substantial deals involving US residential solar firms.
- A number of next-generation biofuel manufacturers attracted investment, as the first wave of these technologies approaches commercialisation.
- The US remained the global centre for venture capital investment in renewables, while there was a marked decline in the volume of equity raising in Europe.

Venture capital and private equity investment in renewable energy companies totalled $2.8 billion in 2014, up 27% on the previous year's $2.2 billion, which was the lowest since 2005 (as Figure 48 shows). Last year's figure represented only about 50% of the average invested each year between 2006 and 2012, and was 72% below the all-time high of $10 billion seen in 2008.

VC/PE investors have been slow to return to the renewable energy sector despite improved conditions, including the 2012-14 rebound in sector share prices, the record amount of wind and solar generating capacity installed last year. and the growing realisation among both policy-makers and power companies that the global energy markets will have to embrace ever larger volumes of sustainable, clean power capacity.

The lacklustre volume of money going into renewable energy VC/PE also contrasted with the recent flood of venture finance into other sectors. The US saw a total of $48 billion of VC investment in 2014, the highest level for more than a decade, according to the National Venture Capital Association. Globally, the aggregate value of venture finance rose 58% to $87 billion last year, with five of the top 10 deals taking place in either China or India, research firm Preqin reported.

FIGURE 48. VC/PE NEW INVESTMENT IN RENEWABLE ENERGY BY STAGE, 2004-2014, $BN



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

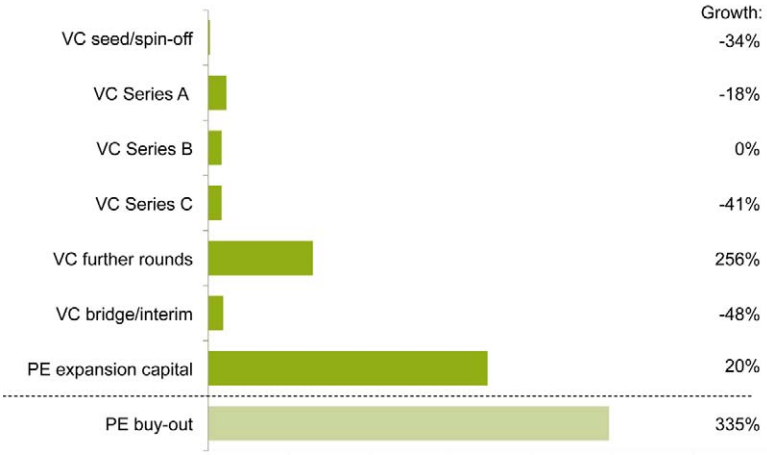
Source: Bloomberg New Energy Finance, UNEP

A breakdown of 2014 deals in renewable energy, by type, as shown in Figure 49, reveals that seed and early-stage venture capital investment – Series A and B rounds – continued to shrink in 2014 compared with the already very low levels seen in 2013. Series C venture funding also fell, but later-stage deals – Series D and pre-IPO rounds – grew by a remarkable 256% to $647 million. Private equity expansion capital investment grew 20% to $1.7 billion.

The decline in early-stage VC reflected a trend of green-themed fund managers moving away from mature and fiercely competitive sectors such as solar and wind. Instead, they have been gravitating towards new and evolving technologies that do not require enormous sums to develop or have capital-light business models, while avoiding exposure to areas with policy and subsidy risk. This has helped to fuel strong interest in areas such as energy-efficient lighting and home energy management.

Furthermore, many fund managers have struggled to realise significant returns for their limited partners in recent years, and this has reduced the volume of capital available for reinvestment in the renewable energy sector. And where they have achieved a successful exit, it has generally taken much longer than in other sectors, which helps

FIGURE 49. VC/PE NEW INVESTMENT IN RENEWABLE ENERGY BY STAGE, 2014, AND GROWTH ON 2013, $BN



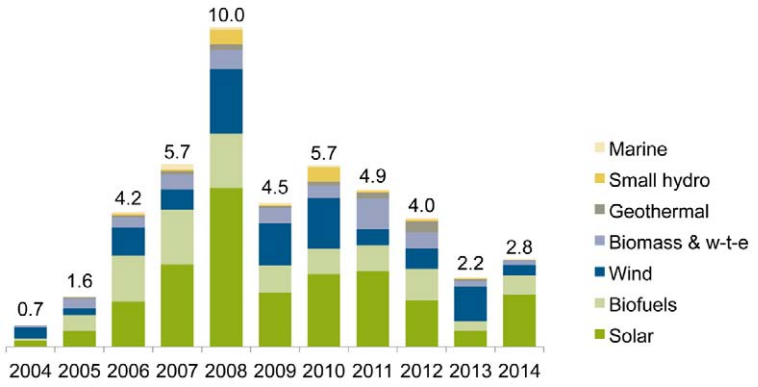
Buy-outs are not included as new investment. Total values include estimates for undisclosed deals
Source: Bloomberg New Energy Finance, UNEP

to explain why there was an increase in later-stage and pre-IPO venture investments in 2014. In addition, appetite of early-stage investors sustained lasting damage as a result of the 78% fall in clean energy share prices in 2007-12 and by the failure of many VC-backed companies in sectors such as solar and marine power.

While VC investors remained lukewarm on the renewable power sector, private equity firms showed greater enthusiasm: the volume of PE expansion capital committed in 2014 climbed by 20% to $1.7 billion. Private equity buy-outs, meanwhile, increased by a remarkable 335% to $2.5 billion, thanks to deals such as KKR's acquisition of a 33% stake in Acciona Energia Internacional, a Spanish clean energy developer, for $540 million. However, as buy-outs are not considered new investment, they are included in acquisition activity (covered in Chapter 10), not in VC/PE investment, covered in this chapter.

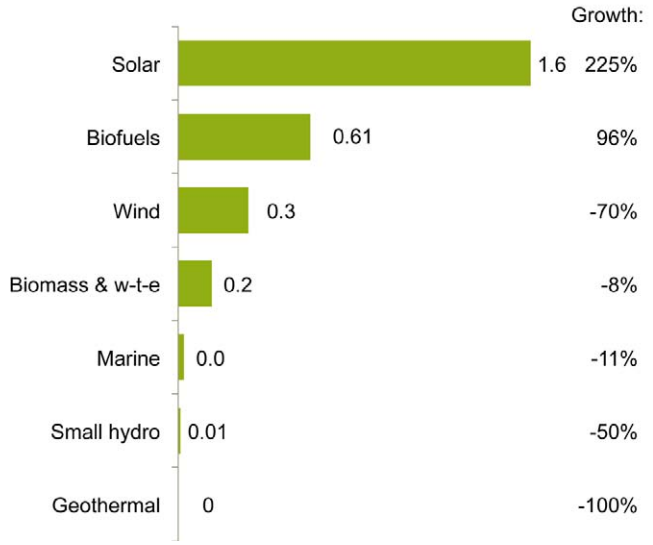
The growth in private equity expansion capital in 2014 reflected, in large part, interest in US consumer-facing residential solar businesses, as pioneered by SolarCity, that offer homeowners solar power through leases or power-purchase agreements. They generate steady, predictable income for investors – usually guaranteed by decades-long contracts – and have proven that they can be scaled up, and are cost-competitive in several states even without federal tax credits.

FIGURE 50. VC/PE NEW INVESTMENT IN RENEWABLE ENERGY BY SECTOR, 2004-2014, $BN



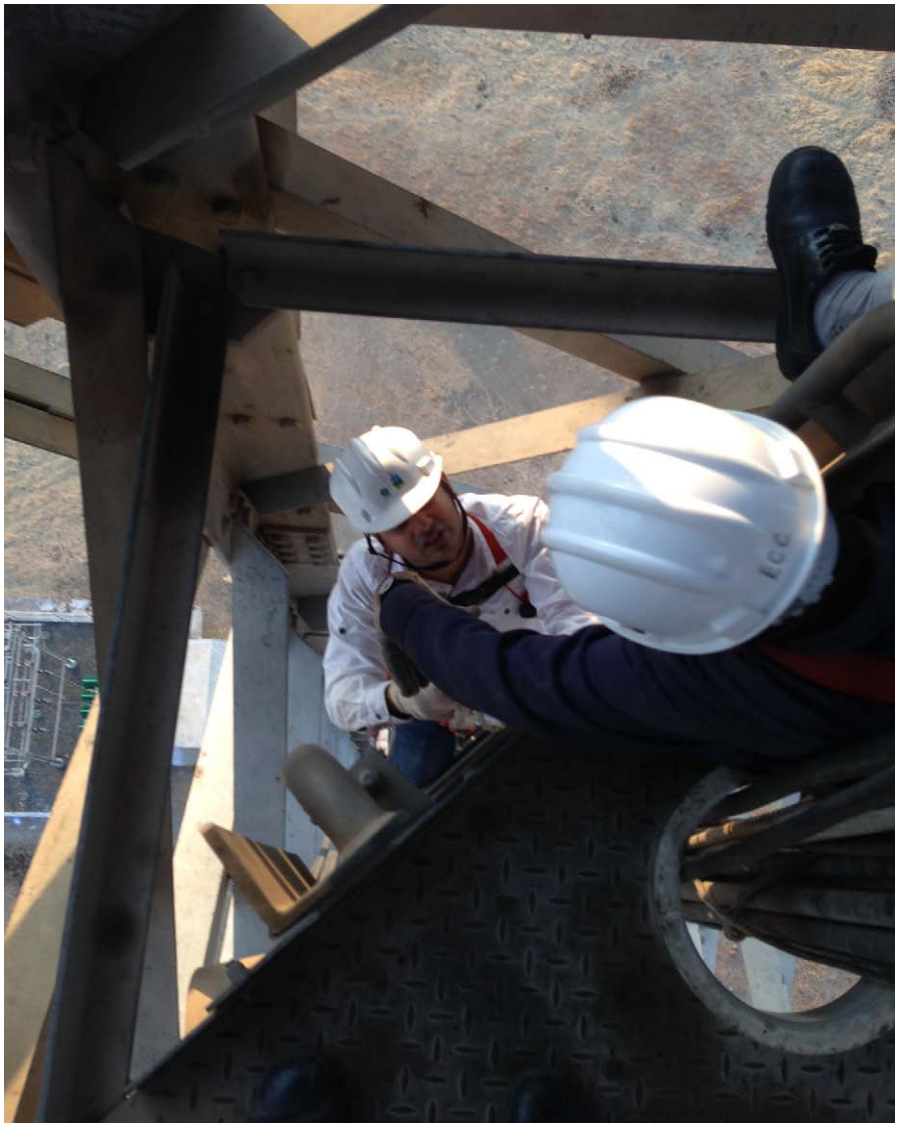
Buy-outs are not included as new investment. Total values include estimates for undisclosed deals.
Source: Bloomberg New Energy Finance, UNEP

FIGURE 51. VC/PE NEW INVESTMENT IN RENEWABLE ENERGY BY SECTOR, 2014, AND GROWTH ON 2013, $BN



Buy-outs are not included as new investment. Total values include estimates for undisclosed deals
Source: Bloomberg New Energy Finance, UNEP

Sungevity scooped $70 million in private equity funding in April 2014, Sunrun got $150 million in a further VC round also in the second quarter, while Sunnova Energy closed $250 million in private equity funding in November, bringing the total amount that company raised last year to almost half a billion dollars. This wave of deals helped to make solar the stand-out sector of the year, as Figures 50 and 51 clearly illustrate. In all, $1.6 billion was funnelled into the solar sector, an increase of 225% on 2013.



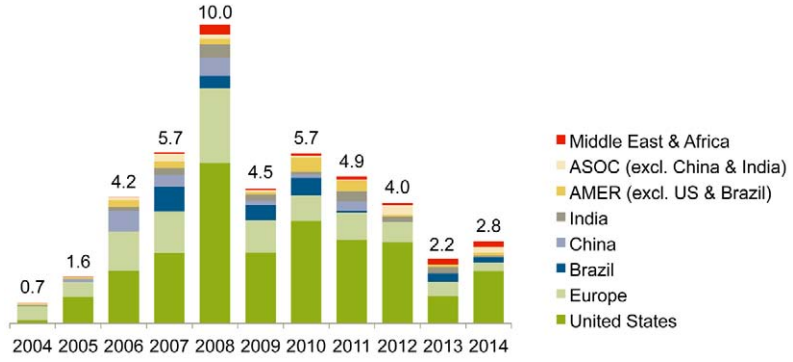
A version of the business model that is helping Americans beat high electricity bills is starting to take off in Africa with companies offering power to people with no access to the grid or any affordable means of generating electricity. In the fourth quarter, Tanzania-based Off Grid Electric raised $16 million from SolarCity and VC investor Zouk Capital, having secured $7 million earlier in the year. In October 2014, SolarNow, a Uganda-based solar asset finance company, closed a $2 million equity round from Novastar Ventures and Acumen. The company provides a range of modular 50W to 500W solar home systems and direct-current appliances through a franchise model.

Others active in Africa include D.light, which sells solar lanterns in Kenya and India, and M-KOPA, a vendor of rent-to-own solar home systems, also in Kenya. A challenge for investors is that firms such as these tend not to look for capital of more than $10 million. This makes due diligence and support an expensive business relative to the dollars invested. Another concern for funds is that the intellectual property may be difficult to defend if other firms selling cheaper products piggyback on the success of top brands.

There was little evidence of new solar technology receiving VC/PE backing in 2014, save for a German manufacturer of organic solar panels, Heliatek, which secured $23 million in a Series C funding round. It uses semiconducting carbon-based molecules instead of silicon to make cells, and has raised $52 million since it was founded in 2006. It is supplying prototypes to building and construction material companies and automotive manufacturers.

After solar, the next biggest sector in terms of funding was biofuel. Many of the deals were concerned with the development of next-generation technologies, such as the microbes being developed by LanzaTech that eat waste gases from industries including steelmaking and oil refining and turn them into fuels and chemicals. That company secured $60 million in financing from The New Zealand Superannuation Fund in December 2014, thereby completing its $113 million Series D funding round. It plans to deploy the technology at a commercial-scale plant in 2016.

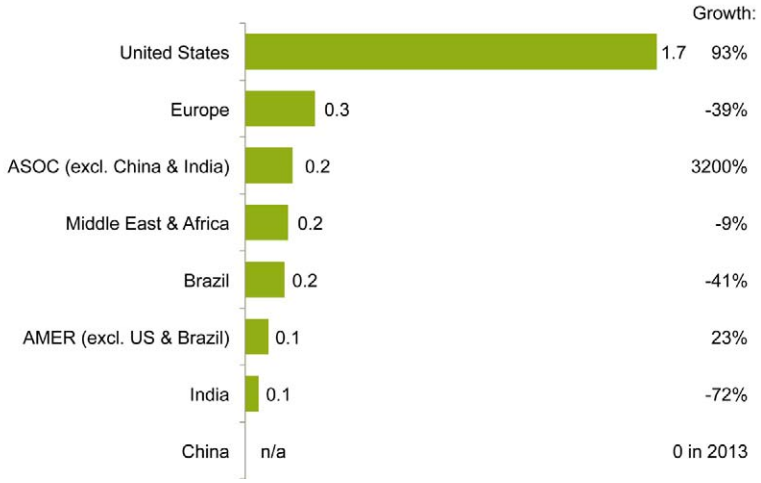
FIGURE 52. VC/PE NEW INVESTMENT IN RENEWABLE ENERGY BY REGION, 2004-2014, $BN



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

Source: Bloomberg New Energy Finance, UNEP

FIGURE 53. VC/PE NEW INVESTMENT IN RENEWABLE ENERGY BY REGION, 2014, AND GROWTH ON 2013, $BN



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

Source: Bloomberg New Energy Finance, UNEP

Another company to get funding in 2014 was Fulcrum BioEnergy, a developer of jet biofuel. Cathay Pacific Airways made a strategic investment in Fulcrum in August as part of a $30.2 million VC funding round, and entered into a supply agreement for 375 million gallons of sustainable aviation fuel over 10 years. The following month, the company was awarded a $105 million loan guarantee by the US Agriculture Department that will cover just under half the cost of a $266 million plant in Nevada. This was the first USDA loan guarantee awarded to a jet biofuel facility.

Some airlines, in an attempt to secure jet fuel, have moved down the supply chain to become equity investors or even jet biofuel plant stakeholders, hoping to stimulate significant commercial volumes. British Airways led the way in 2010 when it committed to an equity stake in Solena's plant in London and signed an 11-year off-take agreement for 74 million gallons. United Airlines followed in 2013, partnering with AltAir to commercialise a 30 million-gallon facility in California and agreeing to buy 15 million gallons over a three-year period.

Venture and private equity investment in the wind sector fell 70% in 2014 to $324 million. Being a mature technology with high upfront costs, the wind sector is not natural territory for venture capitalists hunting for the next breakthrough technology. Instead, investments tend to be larger and by private equity firms buying up stakes in wind project developers. For instance, BluEarth Renewables, a Canada-based wind developer, raised $71.4m in a private equity funding round in November.

Investors are also betting on the biomass sector, but only in 2014 to the tune of $156 million, an 8% drop from 2013 levels. In particular, they are looking at companies focused on cultivation of feedstock. In December 2014, for instance, US-based Genera Energy received a $4 million investment from WindSail Capital Group to help it produce biomass made from crops, including switch grass. It supplies the biofuel, biopower and bio-based products industries.

A similar company, California-based NexSteppe, received $22 million in September to develop crops that can be used in biomass boilers and anaerobic digesters to produce energy, or refined into components for chemicals and plastics. Total Energy Ventures and ELFH Holding joined existing investors, including Braemar Energy Ventures and DuPont Ventures in the Series C funding round. Braemar led a $14 million funding round for NexSteppe in 2011.

The distribution of VC/PE funding around the globe is gradually changing. While the US remains the cultural home of the venture investor – it accounted for 60% of the global total in 2014, a 93% increase on the year before – there has been marked a decline in Europe since 2011, as shown in Figures 52 and 53. The volume of European VC/PE money flowing into the renewables sector in 2014 fell to $297 million, its lowest level in more than a decade, as investors preferred to search for potential winners in other areas of clean energy such as power storage and electric vehicles.

Venture capital and private equity investing in Asia (outside China and India) grew from almost nothing in 2013 to $201 million last year, thanks mainly to Lanzatech's $113 million Series D funding round and a $50 million private equity investment by Goldman Sachs in Sunseap Leasing, a Singapore-based solar leasing company. Aside from these two deals there was little activity outside China and India, where most of the deals were private equity buy-outs.

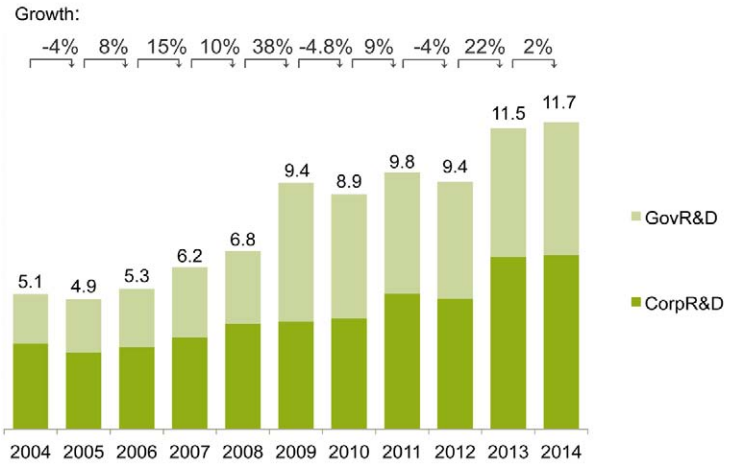
In the Middle East and Africa, the largest deal by a distance was a $125 million private equity investment in project developer Greenko Mauritius by EIG Global Energy Partners. In addition, there were a couple of VC investments in off-grid solar companies in Tanzania and Uganda (as discussed above), and a few small deals in Israel, including $5 million in Series A funding for Tel Aviv-based wave power technology developer Eco Wave Power.

RESEARCH AND DEVELOPMENT

- Research and development spending on renewable energy technologies was resilient in 2014, rising just 2% to $11.7 billion, with government R&D steady at $5.1 billion and corporate R&D at $6.6 billion.
- Total R&D spending last year was almost a quarter higher than it was two years ago, and spending by companies is now around 30% greater than that of governments, rather than broadly equal as they were in the post-crisis 2008-12 period.
- Corporate R&D was highest in Europe, at $2.9 billion, unchanged between 2013 and 2014, while government R&D was greatest in China, up 7% at $1.7 billion.
- Solar R&D rose 2% to $6.1 billion, a bigger total than all other sectors combined. Wind slipped by 2% to $2.1 billion, just ahead of biofuels, up 1% at $2 billion.
- Among the areas of focus for solar R&D last year were reducing the raw materials consumed in PV manufacturing, and moving to thinner wafers for solar, and larger and stronger blades for wind turbines.

On the face of it, research and development spending in 2014 on renewable energy was little changed from the previous year, rising just 2% to $11.7 billion worldwide, with government spending up 3% to $5.1 billion and corporate investment 1% higher at $6.6 billion, as shown in Figure 54. But in fact the figure for corporate R&D for 2013 has been revised upwards by some $2 billion as a result of data reported by companies after the publication of our 2014 edition. Total R&D investment in 2014 was almost 25% higher than in 2012, and investment by companies outstripped that of governments by about $1.5 billion, or 30%.

FIGURE 54. R&D INVESTMENT IN RENEWABLE ENERGY, 2004-2014, $BN



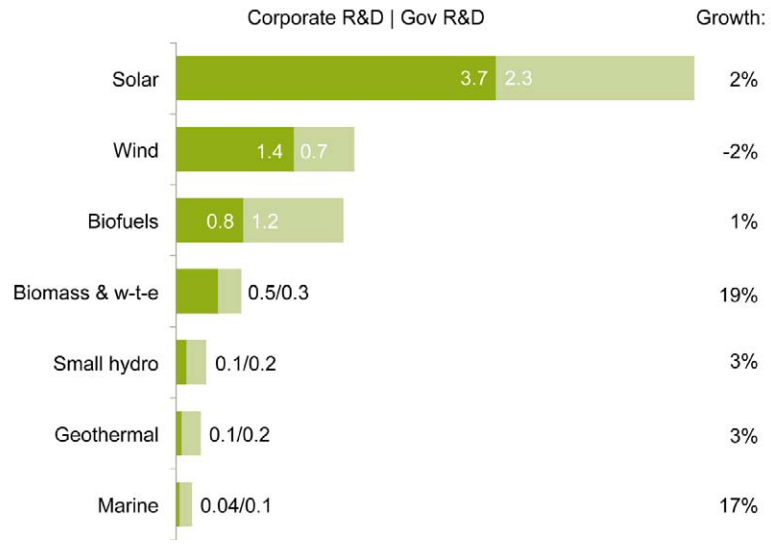
Source: Bloomberg, Bloomberg New Energy Finance, IEA, IMF, various government agencies

The upward revision for 2013 was largely due to increased spending on solar, which gained more than $1 billion, and wind and biofuels, which together added around $600 million. Almost half the additional investment happened in Europe, which gained roughly $900 million, and the ASOC region was revised up by around $500 million.

On the basis of the revised figures, R&D spending on solar rose 2% to $6.1 billion in 2014, which was more than all other sectors combined for the fourth year running, as shown

in Figure 55. Wind slipped 2% to $2.1 billion, as a 5% fall in corporate spending outweighed a 4% rise in government funding, while biofuels inched up by 1% to $2 billion. R&D spending on biomass rose 19%, driven by a 31% increase in corporate investment, while spending on marine technologies rose 17% from a low base, also because of a big increase in company spending.

FIGURE 55. CORPORATE AND GOVERNMENT R&D RENEWABLE ENERGY INVESTMENT BY TECHNOLOGY, 2013, AND GROWTH ON 2012, $BN

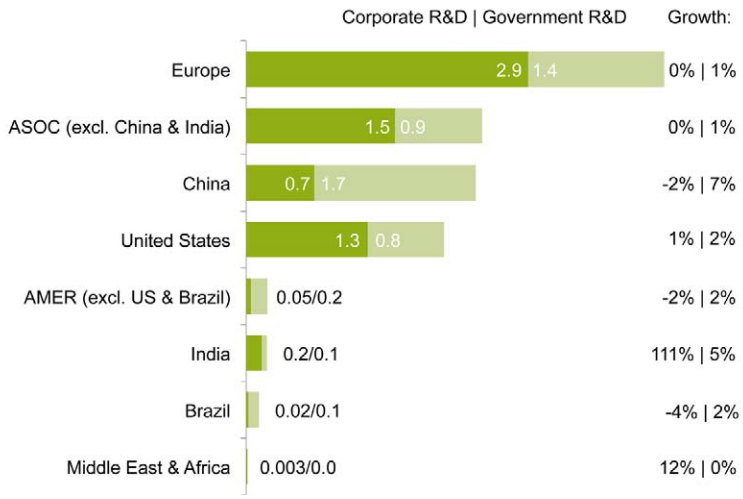


Source: Bloomberg, Bloomberg New Energy Finance, IEA, IMF, various government agencies

Europe remains the biggest investor in renewable energy R&D by far, spending $4.3 billion in 2014, or 36% of the total, and almost equal to the combined outlay of the US and China, as shown in Figure 56. Indeed, spending by European companies alone exceeded combined corporate and government spending in any other single region last year. By contrast, China's government now invests more than any other, committing $1.7 billion in 2014, compared to $1.4 billion in Europe and $788 million in the US.

Almost two thirds of China's government R&D, or some $1.1 billion, went into solar in 2014, to which Chinese companies added another $485 million, making a quarter of the global total. However, this large proportion looks almost modest compared to the country's overwhelming dominance of PV manufacturing; around 70% of the PV capacity installed worldwide in 2014 was made in China. The focus today is the relentless pursuit of lower costs through lower material use and higher cell efficiencies. The price

FIGURE 56. CORPORATE AND GOVERNMENT R&D RENEWABLE ENERGY INVESTMENT BY REGION, 2014, AND GROWTH ON 2013, $BN



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

of solar panels has fallen 75% since 2009, but according to projections by analysts at Bloomberg New Energy Finance, advances through R&D and incremental process improvements could reduce Chinese module costs by another 30% by the end of the decade. [1]

While work continues on thin-film PV and potentially disruptive technologies such as triple-junction cells, most effort is going into improving the cost and efficiency of the industry's workhorse, the crystalline silicon cell. One powerful approach is simply to reduce the amount of raw materials consumed, either per square metre of panel surface or, through improved efficiency, per Watt of nameplate capacity.

The wafers that make up a solar cell are typically at least 180 microns (0.18 millimetres) thick. One way to reduce thickness is to use a diamond wire saw, such as the product supplied by Swiss company Meyer Burger, but historically these have been suitable only for monocrystalline silicon ingots, because the irregular structure of multi ingots leads to fracturing. Now, however, companies such as Longi, a Chinese wafer manufacturer, are starting to use diamond wire saws to produce multicrystalline wafers of just 110 microns – some 40% thinner than commercial products today. This technique not only makes thinner wafers, but also reduces the amount of polysilicon wasted as 'kerf' or sawdust, and consumes less electricity and water.

Analysts expect diamond wire saw technology to be commercialised for multicrystalline wafers within the next two or three years.

Design improvements are of course essential, but there is always a trade-off between the cost of any improvements and the benefits gained, and a good example is the number of 'busbars' on a solar cell. The electricity generated by a cell is collected via thin lines of silver on the surface known as 'fingers', which connect to thicker lines known as 'busbars', and then to external cables. The industry originally settled for only two busbars per cell because silver is expensive, but this increases electrical resistance and losses, so two years ago the industry started to produce cells with three busbars, and in 2014 Canadian Solar and Mitsubishi commercialised cells with four. This trend has increased the energy output of solar cells, and has been made possible by printing techniques that allow the silver to be deposited more thinly – the average silver content of a solar cell fell by a third between 2011 and 2013 – so containing the cost of the additional busbars. A five-busbar design has been demonstrated in the lab with a cell efficiency of more than 21%, compared to an average of 17.6% for commercial products today.

These are just two of many significant developments. Other process improvements include the introduction of fluidised bed reactor technology, which REC Silicon has demonstrated can reduce the electricity needed for polysilicon production by three quarters [2], and stencil printing to save even more silver. Other advances in design include new 'passivated emitter rear cells' (PERC) which raise the sunlight conversion efficiency; smaller junction boxes filled with thermally conducting glue to better dissipate diode heat; new materials to improve the electrical insulation of cells, one of which has been developed by Dow Chemical under the brand Enlight; and new materials for the 'backsheet' on which a solar panel rests, which reduce its cost by half.

[1] The relentless fall in Chinese PV module costs, 17 Oct 2014, Bloomberg New Energy Finance

[2] Ibid

These myriad incremental improvements are driving down the cost of solar electricity generation to such an extent that large-scale solar farms are already starting to undercut power from gas and coal in the best locations – sunny places where fossil fuels are expensive. History suggests that solar costs fall by almost a quarter with each doubling of cumulative capacity, and Bloomberg New Energy Finance expects that by 2030 solar will undercut fossil electricity generation in all but the least promising locations.

Research and development spending on wind slipped 2% to $2.1 billion, but R&D is no less vital in wind than solar for reducing costs, and this technology is evolving too.

One driver is the need to increase the length of the rotor blades, as the industry develops higher-powered turbines for offshore – the rotor of an 8MW machine is around 160 metres in diameter, compared to 125 metres for a 5MW unit – and turbines capable of generating in less windy areas onshore. Longer blades need to be stiffer and stronger, which typically adds weight and cost, so research has concentrated on finding alternative materials. The world's three longest blades are all made with a mixture of traditional glass fibre and lighter, stronger carbon fibre, but carbon fibre is expensive and difficult to handle, so now there is a trend towards alternative materials. Gamesa, for example, is switching to glass-fibre reinforced epoxy composite for its new models, and LM has also developed its longest blade without carbon fibre. [3]

Longer blades put greater strain on the rest of the turbine, particularly the gearbox, and this has prompted some interesting developments. Gearboxes were necessary only because turbine

[3] Wind technology – rotor blades, 23 September 2014, Bloomberg New Energy Finance

blades move slowly – at about 15 revolutions per minute – and because early turbine developers used off-the-shelf industrial generators that need to spin at around 1,500rpm. You can dispense with the gearbox if you replace the high-speed generator with a low-speed one, but these 'direct drive' machines need up to 20 times more electromagnets to produce the same power, and are therefore far bigger and heavier. To reduce weight, some manufacturers replaced electromagnets with permanent magnets made from rare earth metals, but these are expensive.

One recent solution has been to develop hybrid drivetrains that combine a two-stage gearbox with a permanent magnet generator. This arrangement eliminates the third, highest speed gear, which is the one most likely to fail, and reduces the volume of rare earth magnets by 80% compared to a direct drive, meaning the hybrid weighs around half as much.[4] These medium-speed drivetrains are smaller and, according to developers, highly efficient. Winergy (a subsidiary of Siemens) has developed the HybridDrive system, which has been installed for testing on two 3MW wind turbines in Germany and Ukraine, while the FusionDrive developed by Moventas of Finland is in commercial production for DeWind, and the company claims it reduces the cost of wind generation by 6%.

Another approach now on the verge of commercialization is the Digital Displacement technology developed by a UK company, Artemis Intelligent Power, which was taken over by Mitsubishi Heavy Industries in 2010. Digital Displacement is a computer-controlled hydraulic transmission system with an infinitely variable transmission ratio, which keeps the generator running at the same steady speed needed to deliver grid-quality power however wild the gusts. This does away with both the gearbox and the expensive power electronics required by earlier designs. Mitsubishi has started onshore testing of the system in a 7MW turbine at the Hunterston Test Centre in Scotland, and plans to install it on a floating turbine in Japan in 2015. If the tests are successful, the company then plans to supply the system to MHI Vestas Offshore Wind, its joint venture with the world's largest turbine manufacturer.

Research and development in biofuels inched up 1% to $2 billion, which was perhaps surprising given the chronic uncertainty overshadowing the US market. The volumetric biofuel targets required under the Renewable Fuel Standard (RSF2) regulation remain at odds with the 10% 'blend wall' cap needed to protect engines from damage, and the Environmental Protection Agency (EPA) failed to rule how much biofuel would be needed in 2014 during the course of that year. The EPA did say, however, that it could not foresee the market absorbing more than 10%, and in an era of depressed petrol consumption – US demand peaked in 2005 – it puts advanced cellulosic ethanol producers in a direct fight for market share with the corn ethanol producers who dominate at the moment.

It was a seminal year for cellulosic ethanol, nevertheless. After years of delay, the first commercial-scale plants using enzymatic hydrolysis

[4] http://www.rechargenews.com/wind/europe_africa/article1341613.ece

technology were commissioned – by Poet/DSM, Abengoa and DuPont Danisco – raising capacity to 83 million gallons. It remains to be seen how these plants, the result of significant investment in R&D, fare following the EPA announcement.

Biofuel research continues, however, and 60% of it was government funded in 2014. The US Department of Defense awarded a $210 million contract for a cellulosic drop-in replacement fuel, split between Emerald Biofuels, Red Rock Biofuels and Fulcrum Bioenergy. In Europe, Dong Energy and Novzymes were awarded EUR 39 million ($53 million) from the European Commission's New Entrants' Reserve 300 programme to support a cellulosic ethanol project called the Maabjerg Energy Concept.

Research in marine energy jumped 17% in 2014, driven by a 132% rise in corporate spending. This was surprising since two of the sector's leading hopes suffered major setbacks. Towards the end of the year, Pelamis Wave Power announced it had run out of money and had appointed administrators, and two days later Marine Current Turbines was offered up for sale by its owner, Siemens. The sector's top 20 businesses have accumulated losses of some $900 million so far, and several of those involved in wave power (including Wavebob and Oceanlinx as well as Pelamis) have now gone out of business.

However, prospects looked brighter for tidal power than wave, at the start of 2015. This year, Atlantis Resources is due to start construction on the 6MW, GBP 41 million phase 1A of its MeyGen array off the north coast of Scotland. This is due to be the first multi-machine tidal stream power project in the world, and its four turbines are scheduled to start generating in 2016. As well as Atlantis, other tidal stream companies such as Andritz Hydro Hammerfest, OpenHydro, Scotrenewables and Alstom were all continuing intensive development work on their MW-scale devices during 2014.

ACQUISITION ACTIVITY

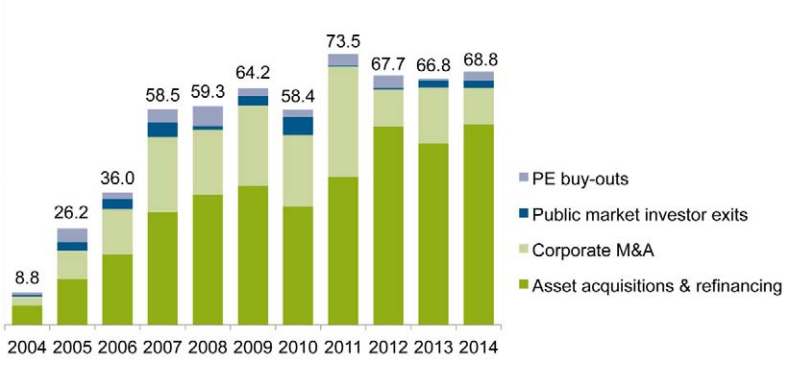
- Acquisition activity in renewable energy rose by $2 billion or 3% to $68.8 billion in 2014, a three-year high, but still almost $5 billion short of its peak in 2011.
- Acquisitions of generating assets and debt refinancing rose by $5.2 billion or 11% to $54.5 billion to establish a new high, narrowly ahead of the previous peak in 2012.
- Corporate mergers and acquisitions (M&A) – the buying and selling of companies – fell by 35% to $9.8 billion.
- The value of wind acquisitions rose by $6 billion or 17% to a record $40.8 billion, which constituted 59% of total activity.
- Solar acquisition activity slipped by just under 3% to $20.1 billion.
- Wind and solar combined made up almost 89% of all activity, up from 83% in 2013.

Acquisitions and debt refinancing in renewable energy rose modestly for the second year running to $68.8 billion in 2014, up from $66.8 billion in 2013 and $67.7 billion in 2012, as shown in Figure 57. But this was still almost $5 billion short of its peak of $73.5 billion in 2011. These figures include corporate mergers and acquisitions (M&A), power infrastructure acquisitions and debt refinancing, private equity buy-outs, and the purchase of stakes in specialist companies by trade buyers.

The overall direction of travel was the same as in 2013, but the drivers were different. Corporate M&A – the buying and selling of companies – fell by 35% to $9.8 billion, wiping out a similar-sized dollar gain in the previous year. Corporate M&A in 2014 was just a third of its value in 2011, when restructuring following the financial crash was at its peak. By contrast, asset acquisitions and refinancing rebounded from its only contraction in the past decade, rising $5.2 billion or 11% to establish a new record of $54.5 billion, more than 10 times higher than in 2004. Public market investor exits were almost unchanged at $1.9 billion, but private equity buy-outs were fourfold higher at $2.5 billion.

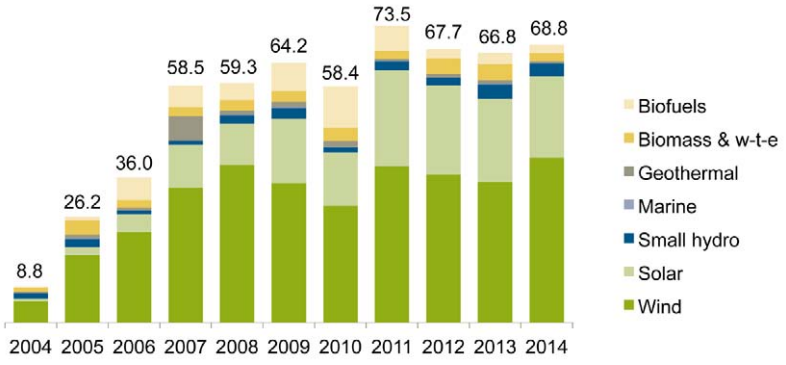
Asset purchasing and debt refinancing have always taken the lion's share of total acquisition activity, averaging well over 50% between 2004 and 2011. In the last three years, however, that proportion has averaged more than 70%, and in 2014 rose to 79%. Corporate M&A's share of the total has done

FIGURE 57. ACQUISITION TRANSACTIONS IN RENEWABLE ENERGY BY TYPE, 2004-2014, $BN



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

FIGURE 58. ACQUISITION TRANSACTIONS IN RENEWABLE ENERGY BY SECTOR, 2004-2014, $BN



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

the opposite, averaging more than 30% during the first decade of the century, but falling to 17% in the last three years, and just 14% in 2014.

Acquisition activity was as usual dominated by wind, which accounted for almost $41 billion, and solar, just over $20 billion, as shown in Figure 58. Together wind and solar made up almost 89% of the total, their highest ever share, squeezing all other sectors combined to their lowest, at just over 11%.

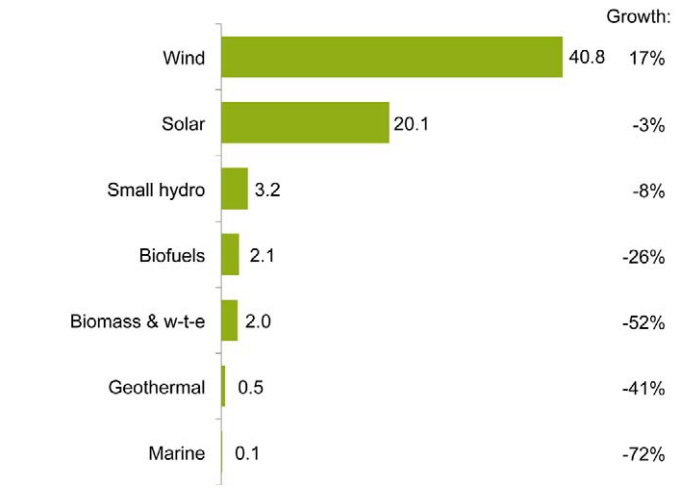
Wind sector acquisition activity rose 17% in 2014, as shown in Figure 59, continuing a decade long expansion broken only in 2010 and 2012. Activity was supported by the underlying performance of the industry, which added a record 51GW of new capacity, with the average price of wind turbines remaining fairly stable compared to 2013, as did the electricity tariffs in most major markets.

Asset acquisition and debt refinancing in wind rose by $7 billion to $35.3 billion in 2014, or 87% of total wind activity. The year started quietly but gathered pace; it is striking that all but one of the 11 largest US deals happened in the second half of the year, and seven in the last two months.

The biggest single deal was the acquisition in August of Alta Wind's 948MW portfolio by NRG Yield for $2.5 billion, through a mixture of cash, equity and the $1.6 billion non-recourse debt financing it assumed from Alta Wind. The deal was significant in that it marked the first major acquisition of third-party assets by a yieldco, which typically buy generating assets from their parent companies (see Public Markets chapter). This channel could make a big impact on developers, enabling them to recycle capital into new projects.

In November last year, SunEdison and its newly floated yieldco, TerraForm Power, took a similar tack when they announced a corporate M&A deal to buy the closely-held First Wind Holdings for $2.4 billion, consisting of a $1.9 billion upfront payment and a further $510 million conditional on First Wind completing projects in its backlog. The deal, finalised in 2015, secured over 520MW of operating wind and solar assets for TerraForm and a pipeline of 1.6GW, of

FIGURE 59. ACQUISITION TRANSACTIONS IN RENEWABLE ENERGY BY SECTOR, 2014, AND GROWTH ON 2013, $BN



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

which around 320MW is thought to be under construction. It also transformed SunEdison into one of the largest US renewables developers, with a position in wind as well as solar.

Other large US asset deals included EON's sale in November of an 80% stake in its 402MW US wind portfolio to Enbridge, the Canadian oil and gas pipeline operator, for $650 million; the acquisition in August by Fiera Axium, a Canadian fund manager, of a 35% stake in the 1,100MW US wind portfolio of EDP Renovaveis, majority owned by Energia de Portugal, for $608 million; and a December deal worth $360 million in which one wind developer, Pattern Energy Group, took over a 200MW project that has yet to start construction from another, Pioneer Green Energy.

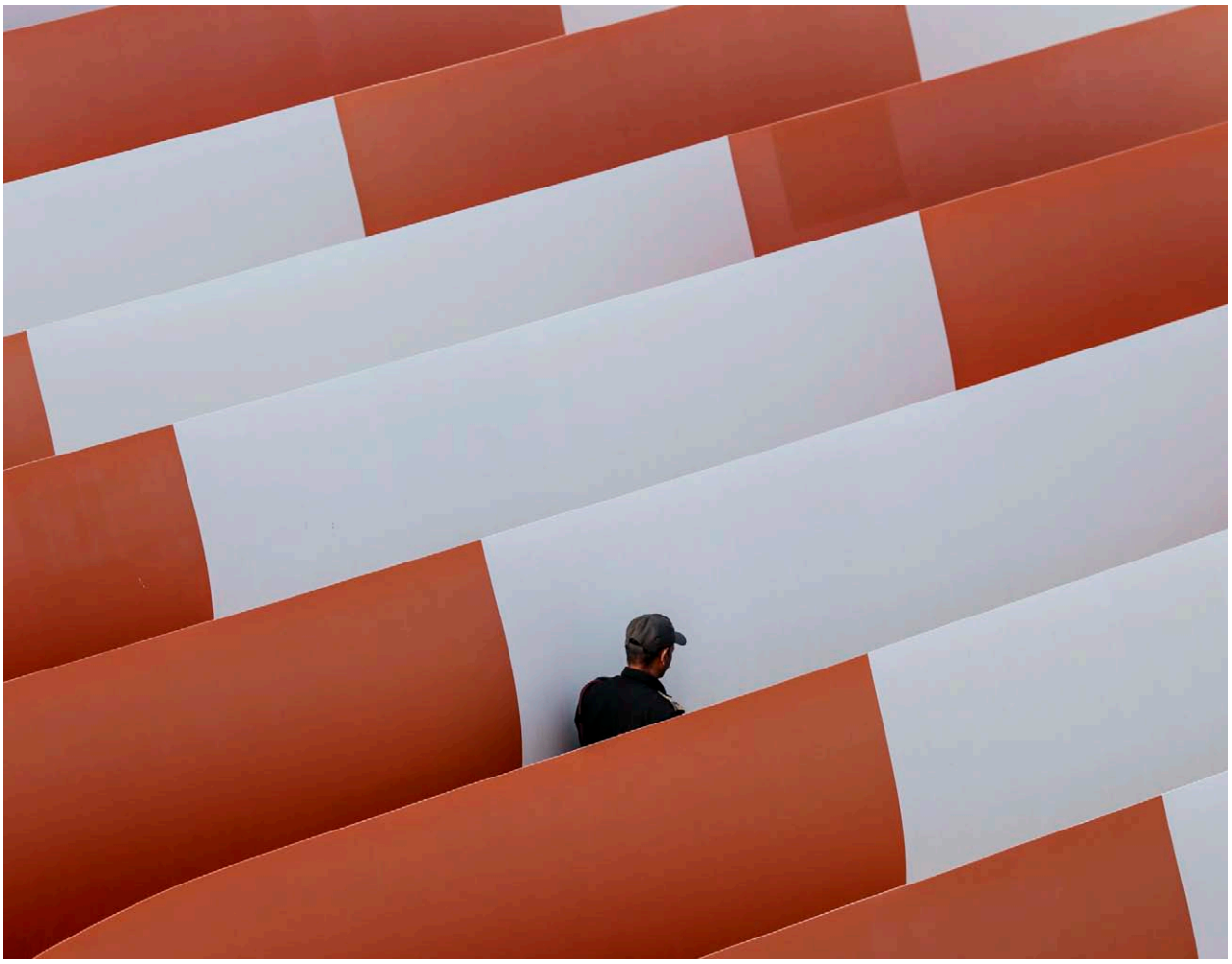
The other big asset acquisitions were all in European offshore wind. Dong Energy sold half its 50% stake in the 630MW first phase of the London Array offshore wind farm to La Caisse de Dépôt et Placement du Québec (La Caisse), a Canadian pension fund manager with $186 billion in net assets, for GBP 644 million ($1 billion). The ownership of the world's largest wind farm, which sits 20 kilometres off the coasts of Kent and Essex, is now divided between La Caisse (25%), Dong (25%), EON (30%) and Masdar, the Abu Dhabi government's renewable energy company, with 20%.

Masdar bought its stake in London Array in 2008, and in 2014 it expanded its presence in the North Sea by acquiring a 35% stake in the 402MW Dudgeon Offshore Wind Farm from Statoil, the national oil company of Norway, for GBP 535 million ($857 million). The deal was announced a month after Statoil (35%) and Statkraft (30%) announced the project would go ahead following the government's award of a contract guaranteeing the power price it would receive.

Dong has also been busy in the North Sea, selling not only half of its stake in the London Array, but also a 50% stake in its 210MW Westermost Rough offshore wind farm to Marubeni Corporation of Japan, and Britain's Green Investment Bank, for a total of around GBP 500 million ($833 million). The GIB invested GBP 241 million into Westermost Rough, and a further GBP 220 million for a 10% stake in the 576MW Gwynt y Mor offshore farm being developed by RWE, both still under construction, in moves explicitly intended to release capital for developers to plough into new projects. The UK is relying on offshore wind to help achieve its binding renewable energy and emission reductions targets, and Bloomberg New Energy Finance expects another 6-7GW to be commissioned in British waters by 2020.

Acquisitions and debt refinancing in solar slipped by 3% to $20.1 billion in 2014, the third consecutive annual decline since peaking at $23.7 billion in 2011. Of this, $15.4 billion represented asset acquisitions and debt refinancing, which was fractionally higher than in 2013. Falling PV technology costs, and declining support via feed-in tariffs, have helped to limit the dollar value of asset acquisitions in solar.

In the largest US refinancing deal of 2014, Google invested $100 million tax equity into a $250 million SunPower PV leasing programme, with SunPower providing the rest of the funds. Leasing allows homeowners to install solar panels for little or no upfront cost, and is the fastest growing part of the



US solar market. Tax equity deals happen because developers often earn more from the US Investment Tax Credit (and Production Tax Credit, in the case of wind) schemes than they can offset against their own tax bill, meaning that it makes financial sense for a big company with a larger tax liability to invest and absorb the surplus. The big company is often a bank, and other large tax equity deals in 2014 included a $200 million investment by Credit Suisse in the Clean Power Finance Solar Fund, and another for $175 million by Bank of America into a fund run by SolarCity.

One of the largest solar asset acquisitions was by SunEdison's yieldco, TerraForm, which bought a 78MW US PV portfolio from Swiss asset manager Capital Dynamics for $236 million, funded by expanding an existing debt facility. Another large asset deal saw Abengoa Solar take a $205 million bridging loan to fund the early stages of construction of a solar thermal electricity generation plant in Antofagasta, Chile. The plant is a tower and heliostat design, rated at 110MW, and will include 17.5 hours' storage capacity in the form of molten salts.

Solar corporate M&A activity fell by 27% in 2014 to $3.4 billion, but one interesting deal was the acquisition by China National Chemical Corporation of Norway's REC Solar, one of the few remaining makers of solar panels in Western ownership, for $640 million. REC Solar employs 1,700 people making solar panels at its factory in Singapore, and the acquisition may help China National Chemical Corporation avoid anti-dumping tariffs imposed by the US on Chinese PV manufacturers.

Among the asset, refinancing and M&A deals in the smaller sectors, RockTenn, a Missouri-based paperboard and packaging manufacturer, bought a 55MW combined-heat-and-power biomass plant in Tacoma, Washington, for $343 million; Rentech, a Californian developer of Fischer-Tropsch synthetic jet and diesel fuels, bought New England Wood

Pellet, for $45 million; and Renewable Energy Group, a biodiesel plant developer based in Iowa, bought LS9, a Californian biofuel and biochemical developer, for $40 million.

Public market investor exits were little changed in 2014, at $1.9 billion, but private equity buy-outs more than quadrupled in value to $2.5 billion. In the biggest deal, buy-out specialist KKR bought a 33% stake in Acciona Energia Internacional, which owns the foreign assets of the Spanish renewables developer Acciona, for EUR 417 million ($567 million). The deal values AEI's assets in 14 countries at EUR 2.6 billion, including EUR 1.3 billion of debt, and the move is intended to lead to an initial public offering to transform the company into yet another yieldco. The search for yield also drove another large European deal, in which the Cairo-based private equity investor EFG-Hermes took a 49% stake in the French wind portfolio of EDP Renovaveis, for $208 million. The deal was half funded by debt provided by European banks, and half by equity, with $5 million from EFG-Hermes and the rest raised from Gulf Cooperation Council countries.

There were also two significant private equity buy-out deals in China, where Hong Kong based NewQuest Capital Advisors took a 50% stake in China Hydroelectric for $330 million, and JinkoSolar sold a 45% stake in its project developer subsidiary, JinkoSolar Power Engineering Group, for $225 million. The buyers were China Development Bank, New Horizon Capital and Macquarie Infrastructure Partners.

The list of the biggest corporate M&A deals in renewable energy in 2014 was led by CPFL Energias Renovaveis' purchase of a 79% stake in Dobreve Energia, a Brazilian small hydro and wind project developer, for $716 million, and Toray Industries' buy-out of Zoltek, a US technology company making carbon fibre for wind turbines and other applications. In third place was Danfoss' acquisition of a 20% stake in SMA Solar Technology, a leading German inverter manufacturer, for $412 million.

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. It excludes refinancings. The 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 (FIT)	A premium rate paid for electricity fed back into the electricity grid from a designated renewable electricity generation source.
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.
OVER-THE-COUNTER (OTC)	Trading of stocks, bonds, commodities or derivatives directly between buyers and sellers as opposed to via a formal exchange.
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 generation.
RENEWABLE PORTFOLIO STANDARD (RPS)	A regulation that requires that a minimum of electricity or heat sold is from renewable sources. Also called Renewable Electricity Standard (RES) at the US 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.

[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.

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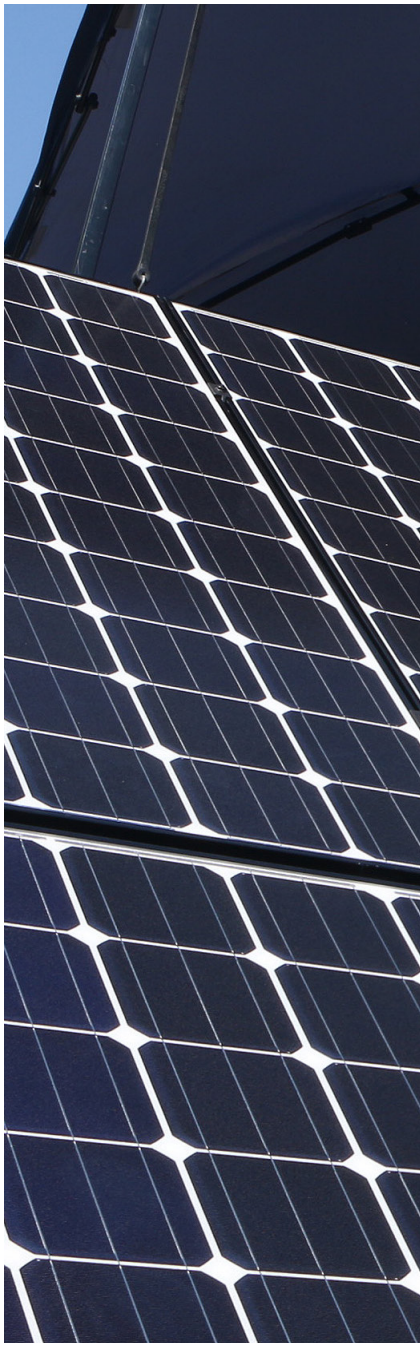

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