

The Taiwan offshore wind market is being driven by a 20-year feed-in tariff, which was trimmed in early 2019 but remained attractive enough to prompt nearly 2GW of financings during the year. Confidence is being supported by government ambitions for 10GW of additional offshore wind capacity between 2026 and 2035.

Vietnam saw a meteoric rise in solar investment in 2018 on the back of a generous feed-in tariff, but this faded markedly after June 2019, when the level of support was cut by the government. Overall renewable energy investment slipped 64% to \$2.6 billion in 2019. The boom resulted in 5.4GW of solar being built in 2019, much of it financed in the previous year. By comparison, less than 200MW of PV were constructed in 2018 itself.

Among the PV projects financed in 2019 was the Trung Nam Construction Tra Vinh Duyen Hai, at 165MW and \$153 million. Vietnam also saw significant projects funded in other technologies – including the 40MW Vietstar Ho Chi Minh Cu Chi waste-to-energy plant, at an estimated \$400 million; and the Sowitec Quang Binh 1 wind farm, at \$328 million for 252MW.

Three other markets in emerging Asia-Pacific came in above the \$500 million mark for renewable energy investment last year. Kazakhstan chalked up a record tally of \$832 million, up 58%, thanks to the financing of a string of medium-sized wind and solar projects developed by international players such as China Power International and Total Eren. The fossil fuel-rich Central Asian country introduced auctions for renewables in 2018, and its energy minister voiced an aspiration in early 2019 to more-than-double green energy capacity in that year.

Pakistan saw renewables capacity investment advance 12% to \$647 million, but this was still below its five-year average of \$1.2 billion. The majority of this (some \$500 million) consisted of small-scale solar systems, many of them built by commercial and industrial firms, for self-consumption and for selling on power to other consumers. Cambodia was a new entrant in the list of investing countries, with a leap to \$568 million in 2019, from almost nothing the previous year. It owed much of this jump to the financing of one big PV park; the 135MW Innergex Kandal project.

Several large economies are notable for their lowly position in, or absence from, Figure 34. Indonesia saw investment slip by half to just \$359 million, almost all in its established geothermal sector, as institutional and regulatory barriers continued to prevent an upswing in solar and wind. In Malaysia, outlays fell 44% to \$250 million, but an auction for 500MW of new solar capacity, closed in August 2019, was heavily over-subscribed and should lead to a flurry of financing activity.

The Philippines, which was an up-and-coming market in the middle of the decade with \$2.4 billion invested in 2015 alone, had little more than \$100 million committed to renewables in 2019. The previous feed-in-tariff schemes drove developments in the wind and solar sectors between 2014 and 2016, but a policy gap after the expiry of those led to green power activity stalling. In July 2019, the Department of Energy in Manila announced plans to auction 2GW of renewable energy capacity to encourage development, but these remain potential rather than certain.

In Thailand, renewables investment was just \$229 million in 2019, compared to a high of \$2.4 billion in 2016. A delay in the release of the government's revised Power Development Plan for the years to 2037, initially expected in the first half of 2018, along with a current supply overcapacity, led developers to adopt a wait-and-see approach, dampening investment appetite for new power plants in the country.

# CAPACITY INVESTMENT – DEVELOPED COUNTRIES

- Investment in new renewable energy capacity in developed economies rose 2% in 2019, to \$130 billion. There were sharp increases in outlays in the U.S., Spain, the Netherlands and Poland, and big falls in the U.K., Germany, Australia and Belgium.
- The U.S. had a particularly strong year for the financing of renewables projects, its total of \$55.5 billion being the highest ever and up 28% on 2018. A rush to qualify wind projects for the Production Tax Credit was the single biggest feature of 2019.
- Europe saw capacity investment shrink 7% to \$54.6 billion, a key reason being that fewer multibillion-dollar offshore wind financings took place during the year than in 2018. This may be a temporary blip, given the large pipeline of sea-based projects under development for the 2020s.
- Solar capacity investment in Europe jumped 25% to \$24.6 billion, the highest since 2012. The increase took place despite the low cost per megawatt of many of the new PV projects built under auction programs or merely with private sector power purchase agreements.
- In Japan, dollar investment in new solar projects continued to edge down, partly due to lower capital costs. That country continued to be a significant location for the construction of new biomass capacity, and it stepped closer to starting an offshore wind program.

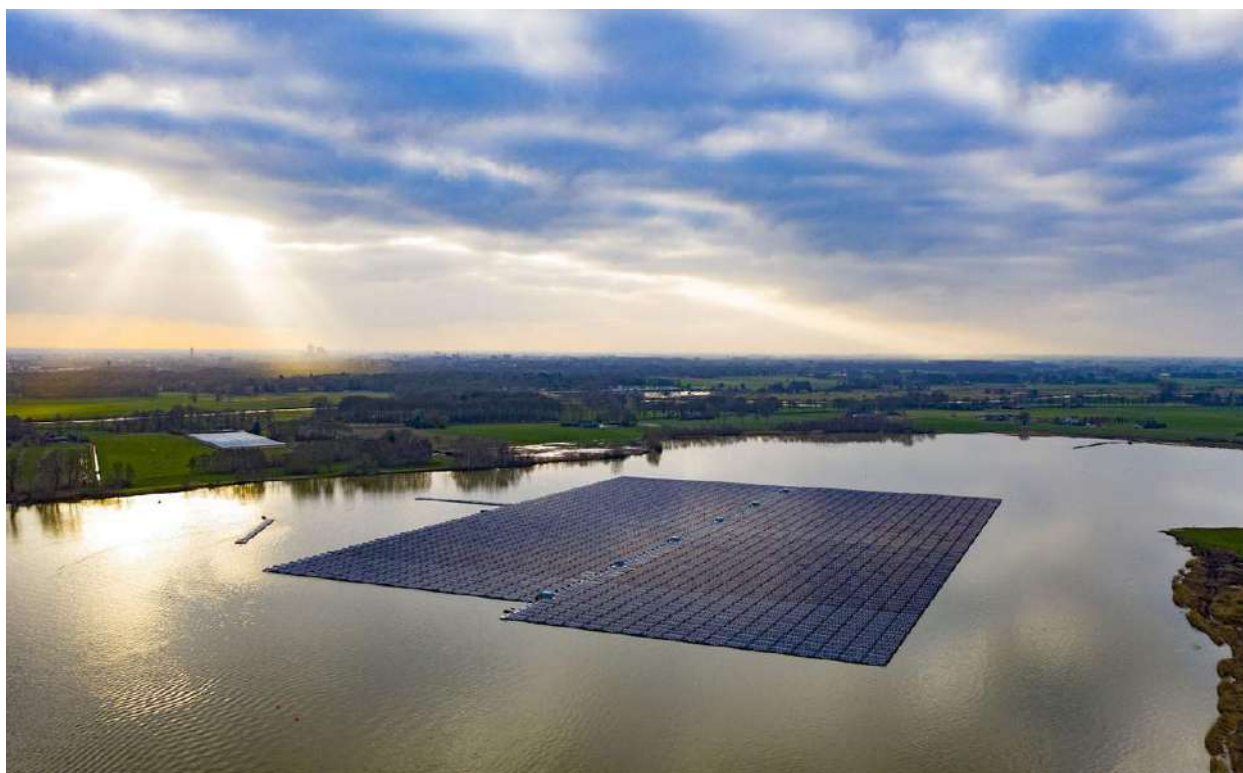
As Figure 13 in Chapter 1 showed, developed economies continued in 2019 to account for a minority of global investment in new renewable energy capacity. However, their total, at \$130 billion, up 2% on 2018, was the highest for three years and still made up 46% of the amount committed worldwide.

Some 13 developed countries, on the definition used in this report, had renewable energy capacity investment of \$1 billion or more last year, and six of them exceeded \$5 billion (see Figure 11 in Chapter 1). The U.S. and Japan continued to be the two biggest developed economy investors in green energy, with the U.S. accounting for more than Europe as a whole for the first time ever.

## UNITED STATES

Figure 35 reveals the technology split of 2019's record year of renewable energy capacity investment in the U.S. Overall outlays increased by 28% to \$55.5 billion. Within this solar rose 16% to \$23.3 billion while wind leapt 44% to \$31.8 billion, almost entirely thanks to onshore projects. Other technologies saw minimal investment, with biofuels for instance down 38% at \$320 million, the lowest tally for that sector since 2016.

Developers in the U.S. of both solar and wind are driving ahead with projects in order to qualify them for as much as possible of the soon-to-expire tax credits. In solar, the incentive is the Investment Tax Credit, or ITC. The rule is that if construction started in 2019, then the project owner (commercial developer or household) would be eligible to receive a credit equivalent to 30% of



**FIGURE 35. RENEWABLE ENERGY CAPACITY INVESTMENT IN THE U.S. BY SECTOR AND SUB-SECTOR, 2019, AND CHANGE ON 2018, \$BN**

	2019	% growth on 2018
<b>Biofuels</b>	<b>0.3</b>	<b>-38%</b>
<b>Biomass &amp; waste</b>	<b>0.0</b>	<b>-89%</b>
<b>Geothermal</b>	<b>0.0</b>	<b>-100%</b>
<b>Marine</b>	<b>0.0</b>	<b>(0 in 2018)</b>
<b>Small hydro</b>	<b>0.0</b>	<b>(0 in 2018)</b>
<b>Solar</b>	<b>23.3</b>	<b>16%</b>
(of which PV)	23.3	16%
(and solar thermal)	0.0	(0 in 2018)
<b>Wind</b>	<b>31.8</b>	<b>44%</b>
(of which offshore)	0.3	(0 in 2018)
(and onshore)	31.5	42%
<b>Total</b>	<b>55.5</b>	<b>28%</b>

Source: UNEP, Frankfurt School-UNEP Centre, BloombergNEF

the capital cost, but this proportion falls to 26% if construction only starts in 2020 and 20% if it begins in 2021. Thereafter, it falls to 10% or zero depending on the nature of the project.

The desire to qualify for the ITC and by that get help with the capital cost provided an incentive for developers, large and small alike, to secure

finance for projects during 2019. This outweighed U.S. solar industry problems such as the tariffs imposed on equipment imported from China.

One of the largest PV parks to reach financial close in 2019 was Danish company Orsted's 546MW Permian project in Texas, which will also have 40MW of battery storage and is scheduled to come online in 2021. Another was the Cove Mountain complex in Utah, at an estimated \$313 million for 234MW. Slated for completion in late 2020, it has agreements to sell power to Facebook data centers.

The biggest story of 2019 in U.S. renewables was the buoyancy of the onshore wind sector. Financings totalled \$31.8 billion, up 44% on the previous year, which was itself a record. Booms and contractions in U.S. wind have often been caused by 'cliff edges' in the availability of Production Tax Credit (PTC) support, and 2019 proved no exception.



To qualify for any level of PTC at all, developers had to qualify their projects by the end of 2019, either by starting construction or by spending 5% of total project capital expenditure, and they had to commission them by the end of 2023.

In the event, this restriction was loosened by the U.S. Congress in December 2019, as part of a bill to keep the federal government running. The deadline for starting construction in order to qualify for 60% of the original PTC was shifted back by one year, to the end of 2020 – and the deadline for commissioning the project was extended to the end of 2024.<sup>22</sup>

However, investors could not know of this temporary reprieve at any earlier stage during last year. Since the money to pay for a large onshore wind project has to be secured a year or more in advance of commissioning, the impending phase-out of the tax credit meant strong pressure on developers and investors to sign financing deals during 2019.

Among the biggest deals in this context during 2019 was Apex's financing of the 525MW Aviator wind farm, for an estimated \$683 million. The project, in Coke County, Texas will have 200MW of its capacity covered by a power purchase agreement, or PPA, with Facebook, and a 220MW deal with McDonald's – the first virtual PPA ever signed by the hamburger chain.

## EUROPE

Capacity investment in Europe fell slightly short of that in the U.S. in 2019, slipping 7% to \$54.6 billion, a couple of billion dollars below the region's five-year average.<sup>23</sup> Figure 36 shows the split of that investment last year, and highlights an intriguing contrast – wind investment fell by 24% to \$26.4 billion, but solar saw a 25% increase to \$24.6 billion.

Both offshore and onshore wind saw reductions in investment, the former of 38% to \$7.5 billion, and the latter of 17% to \$18.9 billion. The reasons were very different: offshore wind simply saw fewer deals falling into the 2019 calendar year, due to the timing of auction rounds; but onshore wind's decline reflected a drift to less favorable policy or planning conditions in key markets such as Germany and the Nordic countries.

Solar in Europe attracted more investment in 2019 than in any year since 2012, which was the tail-end of the booms in Germany and Italy driven by generous government-set feed-in tariffs. The sector in 2019 benefitted from the spread of low-cost projects in Spain and elsewhere, relying on tariffs set in auctions or via private sector power purchase agreements.

Biomass and waste-to-energy was a significant sector for Europe last year, with investment rising 12% to \$3.1 billion, the highest since 2016. Waste-

**FIGURE 36. RENEWABLE ENERGY CAPACITY INVESTMENT IN EUROPE BY SECTOR AND SUB-SECTOR, 2019, AND CHANGE ON 2018, \$BN**

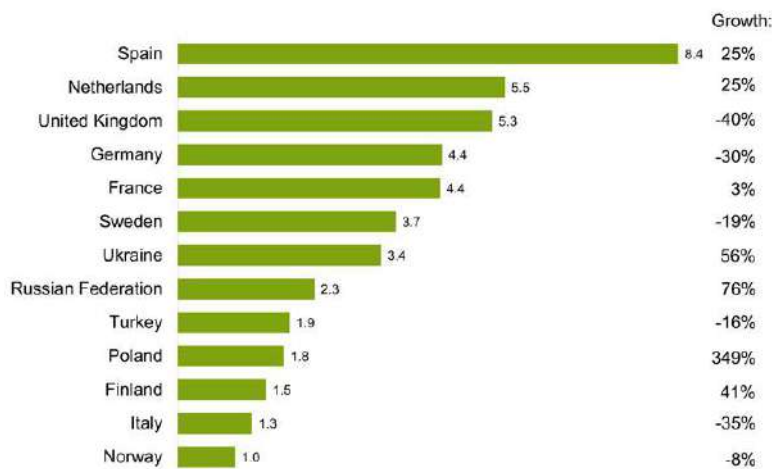
	2019	% growth on 2018
<b>Biofuels</b>	<b>0.0</b>	<b>-100%</b>
<b>Biomass &amp; waste</b>	<b>3.1</b>	<b>12%</b>
<b>Geothermal</b>	<b>0.5</b>	<b>-40%</b>
<b>Marine</b>	<b>0.0</b>	<b>(0 in 2018)</b>
<b>Small hydro</b>	<b>0.0</b>	<b>(0 in 2018)</b>
<b>Solar</b>	<b>24.6</b>	<b>25%</b>
(of which PV)	24.6	25%
(and solar thermal)	0.0	-100%
<b>Wind</b>	<b>26.4</b>	<b>-24%</b>
(of which offshore)	7.5	-38%
(and onshore)	18.9	-17%
<b>Total</b>	<b>54.6</b>	<b>-7%</b>

Source: UNEP, Frankfurt School-UNEP Centre, BloombergNEF

<sup>22</sup> BloombergNEF: *Congress Hands U.S. Wind Another Holiday Gift* <https://www.bnef.com/core/insights/22013>

<sup>23</sup> The total for Europe includes several countries that are classified as developing in Figure 29 (including Russia, Ukraine and Turkey).

**FIGURE 37. RENEWABLE ENERGY CAPACITY INVESTMENT IN EUROPE BY COUNTRY, 2019, \$BN, AND GROWTH ON 2018**



Countries with investments rounding up to \$1 billion or more in 2019

Source: UNEP, Frankfurt School-UNEP Centre, BloombergNEF

to-energy took the lead, with projects worth hundreds of millions of dollars each in the U.K. and Russia.

Figure 37 illustrates the fact that capacity investment in Europe was widely spread between countries in 2019. This has not always been the case – in some earlier years, just a couple of markets (such as Germany and the U.K. in 2016) accounted for a large majority of the money committed in Europe. In 2019, no fewer than 12 countries attracted investment of more than \$1 billion – if Russia and Turkey are included within the European region – and one other (Norway) had a total of just under that figure.

Spain invested more in renewables in 2019 than any other European country, the first time it has done so – although it came close in 2007 and 2008, when its previous boom put it just behind the then regional leader, Germany. The 2019 total for Spain, at \$8.4 billion, was 25% up on the previous year and the country's highest since 2011.

What marks out the latest upswing in Spanish renewables investment is that capacity is being built at far lower capital cost per megawatt than it was a decade ago. Most of the financings in 2019 were in solar, which saw a 75% jump in investment to \$6 billion, while wind deals fell 20% to \$2.4 billion.

The lowest-cost PV projects in Spain are now happening at far below \$1 million per megawatt. The Cobra Zero-E portfolio, for instance, is 900MW but reached financial close with an estimated cost of \$658 million. This portfolio covers 18 plants in Teruel and Ciudad Real, capacity that won fixed tariffs in a renewable energy auction in 2017.

Europe's single biggest PV project, Iberdrola's 500MW Nunez de Balboa plant in Badajoz, was financed in 2019 and completed near the end of the year, at a cost in euros equivalent to about \$330 million. Debt came from the European Investment Bank and Instituto de Credito Oficial, Spain's state financial agency.

The Netherlands and the U.K. came second and third in terms of dollars invested in 2019, respectively attracting \$5.5 billion, up 25% on 2018, and \$5.3 billion, down 40%. Both totals included offshore wind arrays – in the Dutch case, the 383MW Frysland project, financed for an estimated \$925 million; and in the British case, the 432MW Neart na Gaoithe project off the Scottish coast at \$3.4 billion.

However, both countries also witnessed activity in other sectors too. The Netherlands saw \$3.1 billion invested in large- and small-scale solar, as investors took advantage of the country's SDE+ auction program.<sup>24</sup> The U.K. had three waste-to-energy plants financed in 2019, totaling \$1.4 billion, with the main revenues coming from 'gate fees' for accepting rubbish that might otherwise have been subject to landfill taxes.

Germany experienced a 30% fall in renewable energy investment last year, to \$4.4 billion. Solar, led by small-scale, rose 15% to \$3.4 billion, but wind financings came to just \$1 billion, down 68% on 2018 and lower than any other year during the period since 2004. In 2013-2017, annual wind investment in Germany averaged \$12 billion. Part of the reason for the weak number in 2019 was the absence of any large offshore wind financing

<sup>24</sup> SDE+ stands for Stimulation of Sustainable Energy Production, and is a subsidy for the production of renewable energy in the Netherlands



– highly unusual for one of the world’s biggest offshore markets. This is likely to be a temporary blip, since Germany signalled last autumn that it wanted to increase its 2030 offshore wind target to 20GW, from 15GW.

However, the sharp slowdown in onshore wind activity is likely to be more lasting. Five consecutive wind auctions were undersubscribed, with many auction winners just wanting to add two to three turbines to existing wind parks. Contributing factors include a shortage of available sites, litigation and drawn-out lead times for projects.

In France, by contrast, wind made up the lion’s share (\$3.5 billion) of the country’s 2019 investment total. Much of this was thanks to the financing of the 480MW Saint Nazaire project, the first one of France’s offshore wind program to reach that stage. It has an estimated cost of \$2.5 billion, with a consortium of banks providing \$2.1 billion in debt, and equity coming from owners EDF and Enbridge.

Sweden continued to enjoy significant onshore wind investment, backed by corporate power purchase agreements. The country’s green certificate scheme provides an additional incentive for some projects, but not all. The biggest step of 2019 was start of construction at the Enercon Markbygden wind farm phase two, at 844MW and with an investment cost of \$1.1 billion. The project is likely to attract more investors and a buyer for the electricity in due course.

Ukraine and Russia are two names that have not featured often on the list of top investing countries in green power. However, Ukraine’s commitment to wind and solar has been building up in recent years, reflecting its desire to diversify away from reliance on Russian gas, and in 2019 it invested \$3.4 billion in renewables, up 56% on the previous year’s then-record of \$2.2 billion. Russia has raised its interest in clean power in the last two years, investing \$1.3 billion in 2018 and \$2.3 billion in 2019.

The largest Ukrainian financial close of 2019 was an estimated \$975 million for the 750MW NBT Zofia wind farm phases two and three, but there were also large-scale PV projects getting the go-ahead, including the 323MW DTEK Pokrovskaya plant at a cost of \$219 million. Both wind and solar were spurred ahead by feed-in tariffs – but these came under threat in early 2020, as the government threatened to cut them sharply, even for operating projects.

Russia is developing its wind and solar resources via a series of auctions, and 2019 saw the investment go-ahead for several large wind farms, including the Novawind Kochubeyevskaya, at 210MW and \$359 million. However, its biggest deal of the year by far was the estimated \$781 million financing of four waste-to-energy projects around Moscow, totalling 280MW. This new capacity is aimed at addressing the capital city’s overflowing landfill sites.

## OTHER DEVELOPED ECONOMIES

Figure 38 shows the capacity investment volumes in 2019 in five other developed countries – Japan, Australia, South Korea, Canada and Israel. The latter two countries have been significant investors in wind and solar respectively at times in the last decade, but last year activity levels were low in both.

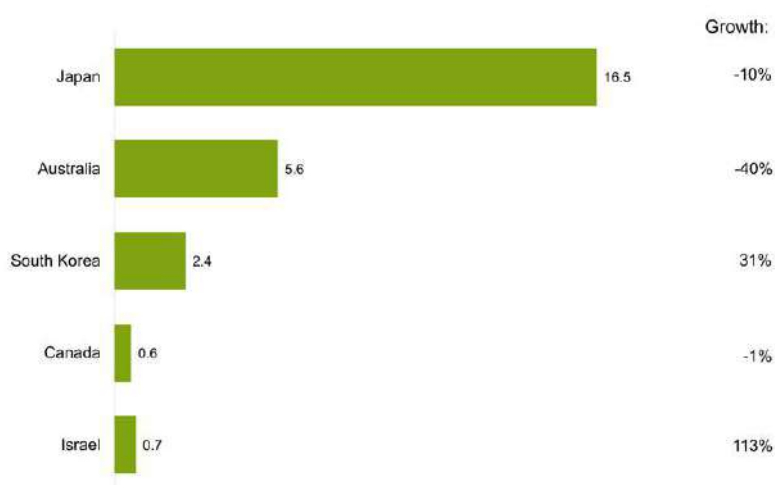
Japan saw investment of \$16.5 billion, down 10% on 2018 levels and its lowest total since 2011. Part of the reason for the fall was lower unit costs for solar, cutting the dollar amount committed per megawatt, and partly the country's continued grid and land constraints that held back developer activity and auction bidding. Overall, solar investment slipped 7% to \$13.6 billion. One of the larger financings was \$154 million for the 45MW Etrion Niigata Agano PV park.

Biomass investment in Japan climbed 26% to \$2.6 billion, with the biggest transaction worth the equivalent of \$395 million for the 75MW Gas and Power Hirohata Himeji plant. A change in the type of project eligible for feed-in tariffs is likely to push projects burning wood pellets and palm kernel shells to compete in a tender for a limited amount of capacity.

Japan looks likely to become a significant offshore wind market in coming years, but 2019 was too early for any actual financings. Its first commercial-scale project, the 220MW Hibikinada array, chose a preferred turbine supplier. It is likely to reach commissioning in 2025.

Australia saw record investment in renewables back in 2018, as developers rushed to meet the country's Large-scale Renewable Energy Target, and qualify for the associated certificates. These can then be sold to utilities. However, in 2019 it became clear that no further capacity was required to meet the LRET, so investors were thrown back on other ways of making projects bankable, including Victoria's own auctions and the signing of corporate power purchase agreements.

**FIGURE 38. RENEWABLE ENERGY CAPACITY INVESTMENT IN OTHER MAJOR DEVELOPED ECONOMIES, 2019, AND GROWTH ON 2018, \$BN**



Source: UNEP, Frankfurt School-UNEP Centre, BloombergNEF

This led to a 40% fall in investment in Australian renewables in 2019, to \$5.6 billion. Small-scale solar projects remained an area of strength, driven by reduced costs per MW, strong sunshine and high power prices, and there were a few large utility-scale projects financed – led by the Partners Group CWC Bango wind farm in New South Wales, at 244MW and \$339 million.

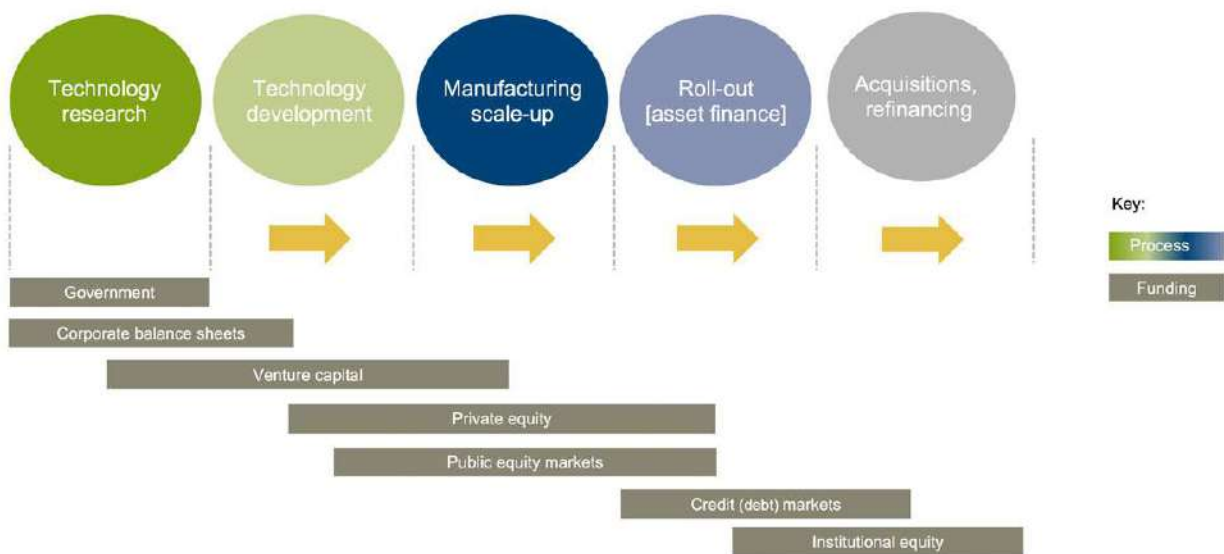
South Korea clinched investment of \$2.4 billion in 2019, up 31% on the previous year and the highest figure to date for the country. Solar dominated, with commitments of \$1.9 billion, but there were also smaller sums going to onshore wind and biomass and waste-to-energy.

BNEF estimates that 75% of South Korea's new PV installations in 2019 came from the sub-1MW segment, mostly 100kW ground-mounted projects developed by small-scale independent power producers or individuals. A temporary feed-in tariff for sub-100kW projects was introduced in late 2018, leading to rushed development activity in 2019 as spot renewable energy certificate prices continued to fall – making the new incentive increasingly attractive. One of the larger projects financed during the year was the DaeMyoung Energy Yeongam PV park, at 92MW and an estimated \$189 million.

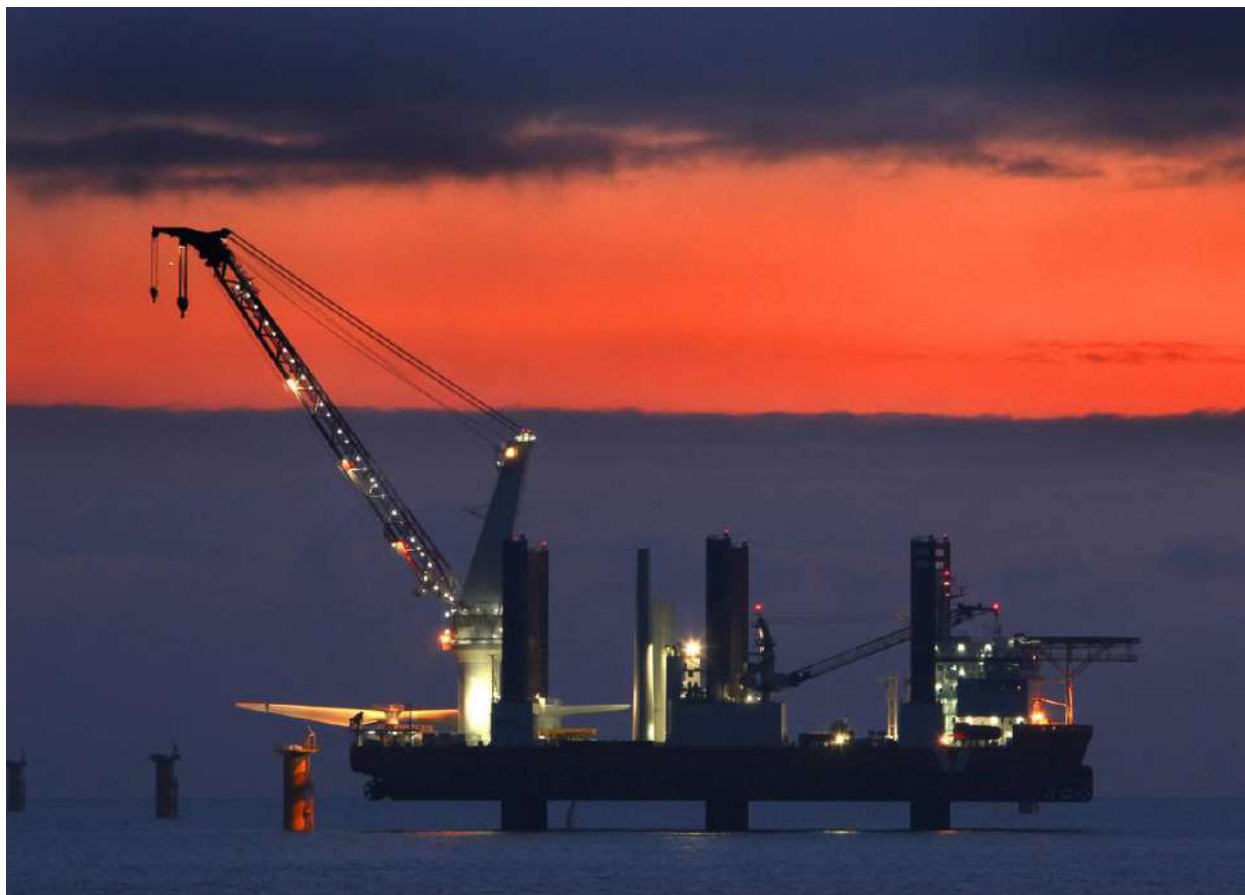
# TOTAL RENEWABLE ENERGY INVESTMENT

- If you include research and development and the funding of specialized companies, as well as the financing of generation capacity, then the resulting figure for total renewable energy investment was \$301.7 billion in 2019.
- This was 2% up on the 2018 total, and the third highest on record – after 2015 and 2017. Over the decade 2010-2019, total renewable energy investment was \$2.8 trillion, or an average of \$284 billion per year.
- Within the 2019 tally, asset finance of utility-scale projects dominated, with the funding of small-scale solar projects the second-biggest element. These types of investment were discussed in earlier chapters.
- Investment in specialist renewable energy companies via the public markets rose 11% to \$6.6 billion, the highest for four years. Venture capital and private equity funding jumped 22% to \$3 billion, also a four-year high – although still less than a third of the record figure set in 2008.
- Corporate research and development spending slipped 1% to \$7.7 billion, after three years of increase. Government R&D spending edged up 4% to \$5.7 billion.
- Acquisition activity in renewable energy dropped 34% in 2019, mainly due to a big fall in the sale and purchase of assets such as solar farms. Corporate mergers and acquisitions in renewables slipped 6% to \$13.7 billion.

FIGURE 39. FINANCING CONTINUUM







## FINANCING CONTINUUM

Earlier chapters of this report concentrated on investment in new renewable energy capacity. This chapter looks beyond that, to the full range of funding that was devoted to renewable energy in 2019.

Successive editions of the Global Trends report have highlighted the “financing continuum” that has made possible the growth of renewable energy around the world over recent years. Different types of investor have backed technologies such as wind, solar and bioenergy at different stages of their development. The continuum is shown in Figure 39.

At the left side are the early stages of the process. New technologies have to be investigated and researched in the lab and factory. This work may be done by the research and development departments of large companies, or by entrepreneurial start-ups or in public sector agencies, and it needs to be financed. Some of the money will come from government research programs and grants, and some from corporate balance sheets.

Therefore government and corporate R&D are the first two elements identified in the charts in this chapter showing total renewable energy investment.

Moving slightly further to the right, there is the technology development stage, which can involve a range of different finance sources. Corporate R&D will still be involved in testing and finessing new products, but equity contributed by venture capital investors will too, by backing young companies with a promising technology.

Somewhat further along the line of maturity in Figure 39, private equity investors are likely to come in to back growing companies. Private equity will typically put in larger sums of capital than venture funds, and will look to crystallize a profit by selling shares when the business floats on the stock market, or is taken over. Public equity markets bring money from conventional institutional and private investors into the shares of renewable energy companies, enabling the latter to commercialize their technologies and build manufacturing capacity.



Both private equity and stock market investors are often involved at the stage of rolling out the technologies into utility-scale or small-scale renewable energy installations. Typically, for a wind farm or solar park, some 20-40% of the cash for construction and operation will come from these types of equity provider, or from the project developer themselves, while the remaining, larger share will come from lenders – usually banks but sometimes bond investors.

On the right side of Figure 39 is the stage of the financing continuum that deals with money and assets changing hands, rather than the provision of new money. Projects such as wind farms often

are refinanced once they are operating, so that the owners can take advantage of lower-cost debt. Or they may be acquired by new owners for strategic reasons or because those new owners want to invest in operating-stage assets but not to be exposed to the higher risks that come from developing and constructing the project.

The next section in this chapter discusses those different stages of the financing continuum – both those involving only the provision of new money, and the later, acquisition stage. Those stages, other than the building of new capacity (which was the focus of the earlier chapters of this report), are examined in detail in Chapters 6 and 7.

**OVERALL INVESTMENT**

Figure 40 shows that a total of all the types of new investment described above came to \$301.7 billion in 2019, up 2% on the previous year. This global aggregate was the third-highest on record, behind only 2015's \$317.3 billion and 2017's \$331.4 billion. It was also somewhat above the average for the last decade, of \$284 billion.

The chart shows that there has been a sideways trend in the overall renewable energy investment total since 2015. A large part of the explanation lies, as expounded in Chapter 1, in the fact that wind and solar capital costs have been falling rapidly, with the result that more megawatts of new capacity can be added for the same dollar expenditure. This has restrained the trend in the asset finance of new projects, and the roll-out of small distributed solar capacity.

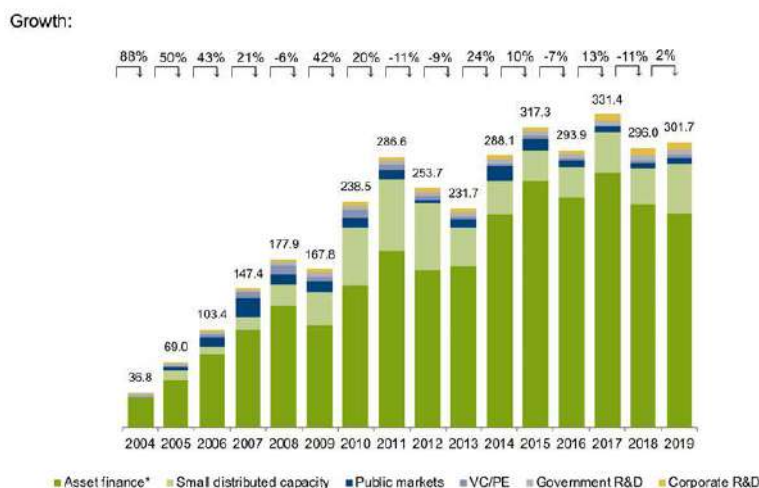
However, that is not the only reason for the lack of clear trend in Figure 40. Some other elements in the financing continuum have also been steady, or have oscillated. Public markets investment, for instance, grew 11% in 2019, to \$6.6 billion – but this was far short of the decadal peaks, at well over \$10 billion a year, seen at the time of the 'yieldco' boom in the U.S. in 2014-2015.<sup>25</sup>

Venture capital and private equity investment has been even more directionless, rising 22% in 2019 to \$3 billion but remaining below the decade's average of \$3.4 billion a year. Wind and solar equipment has become largely standardized and commoditized, leaving much reduced space for young companies to make technological breakthroughs. Other sectors that saw strong VC/PE interest 10-12 years ago, such as biofuels and marine energy, have not grown as hoped.

Corporate R&D spending slipped 1% to \$7.7 billion last year, bringing to an end a steady upswing seen since 2015, while government R&D gained 4% to establish a new record at \$5.7 billion.

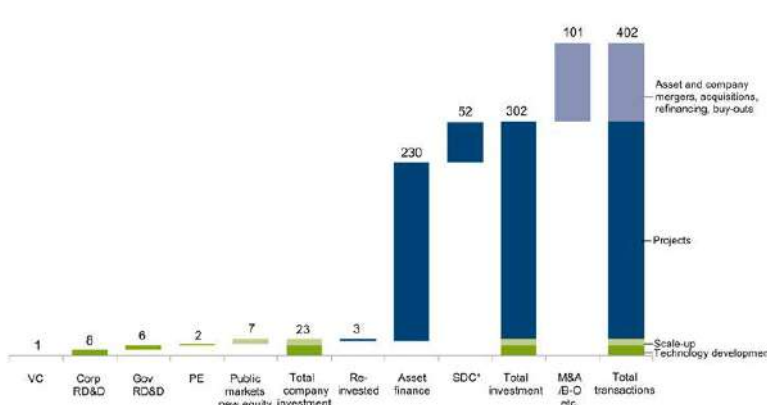
Figure 41 illustrates the relative scale of the different elements of the financing continuum in 2019. At the left end, venture capital funding came in at \$1.2 billion, with government and corporate R&D at \$5.7 billion and \$7.7 billion respectively, and public markets investment at \$6.6 billion. This produced a total for company and early-stage investment of \$23 billion.

**FIGURE 40. GLOBAL NEW INVESTMENT IN RENEWABLE ENERGY BY ASSET CLASS, 2004-2019, \$BN**



\*Asset finance volume adjusts for re-invested equity. Total values include estimates for undisclosed deals  
 Source: UNEP, Frankfurt School-UNEP Centre, BloombergNEF

**FIGURE 41. GLOBAL TRANSACTIONS IN RENEWABLE ENERGY, 2019, \$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, Frankfurt School-UNEP Centre, BloombergNEF

<sup>25</sup> Yieldcos are companies set up to own operating-stage renewable energy companies, and to return the great majority of cash flows to investors.



FIGURE 42. GLOBAL TRENDS IN RENEWABLE ENERGY INVESTMENT 2020 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	2015 \$bn	2016 \$bn	2017 \$bn	2018 \$bn	2019 \$bn	2015-19 Growth %	2004-18 CAGR %
<b>1 Total Investment</b>		38.5	59.0	103.4	147.4	177.9	167.8	238.5	286.6	253.7	231.7	283.1	317.3	283.9	331.4	299.0	301.7	2%	15%
1.1 New Investment		38.5	59.0	103.4	147.4	177.9	167.8	238.5	286.6	253.7	231.7	283.1	317.3	283.9	331.4	299.0	301.7	2%	15%
1.2 Total Transactions		45.2	95.2	136.6	204.3	236.2	228.3	290.6	361.6	319.3	296.7	376.8	426.4	427.8	471.7	437.4	402.4	-6%	16%
<b>2 New Investment by Value Chain</b>																			
<b>2.1 Technolgy/development</b>																			
2.1.1 Venture capital		0.4	0.6	1.2	2.1	3.3	1.6	2.6	2.5	2.4	0.8	1.0	1.4	0.8	0.8	0.2	1.2	508%	9%
2.1.2 Government R&D		1.9	2.0	2.2	2.7	2.8	5.4	4.9	4.8	4.7	5.2	4.5	4.4	5.1	5.1	5.5	5.7	4%	8%
2.1.3 Corporate R&D		1.9	1.9	2.2	2.3	3.3	3.3	3.6	4.3	4.1	4.0	4.3	4.1	4.3	6.9	7.8	7.7	-1%	10%
<b>2.2 Scale-up</b>																			
2.2.1 Private equity expansion capital		0.3	1.0	2.9	3.5	6.7	3.0	5.3	2.4	1.8	1.3	1.7	1.8	1.7	0.7	2.2	1.8	-22%	12%
2.2.2 Public markets		0.3	3.6	8.9	19.7	10.5	11.7	10.6	9.9	3.8	9.8	14.9	12.0	6.2	5.6	6.0	5.6	11%	24%
<b>2.3 Projects</b>																			
2.3.1 Asset finance		32.1	50.0	70.2	106.3	133.5	111.8	152.2	166.6	170.1	171.5	229.4	267.7	247.5	272.6	242.0	230.1	-5%	14%
2.3.1.1 Of which re-invested equity		-0.1	-0.2	-0.2	-3.1	-4.4	-3.7	-1.8	-2.1	-2.0	-1.2	-3.5	-6.7	-4.1	-2.0	-5.8	-3.4	-41%	26%
2.3.3 Small distributed capacity		8.0	10.1	9.0	13.9	22.2	34.7	60.9	75.1	69.9	40.2	36.7	32.6	32.5	42.6	38.2	52.1	37%	19%
<b>Total Financial Investment</b>		32.9	55.0	60.5	126.5	149.6	124.4	169.0	202.1	174.9	182.2	242.6	278.1	252.1	276.9	244.6	236.3	3%	14%
<b>Govt R&amp;D, corporate RD&amp;D, small projects</b>		11.9	14.0	13.4	18.0	28.4	43.4	69.5	84.1	78.6	46.4	45.5	41.1	41.8	54.6	51.4	65.5	27%	12%
<b>Total Total Investment</b>		44.8	69.0	103.4	172.4	177.6	167.8	238.5	286.6	253.7	231.7	283.1	317.3	283.9	331.4	299.0	301.7	2%	14%
<b>3 M&amp;A Transactions</b>																			
3.1 Private equity buy-outs		0.6	3.7	1.6	3.3	5.1	1.9	1.9	2.9	3.0	0.5	4.1	3.6	3.2	10.6	10.0	3.2	-76%	10%
3.2 Public markets investor exits		0.4	2.3	2.6	3.9	0.9	2.4	4.8	0.2	6.4	1.7	1.6	1.5	6.4	2.0	0.1	1.1	-100%	-100%
3.3 Corporate M&A		2.2	7.6	10.3	19.6	16.5	22.4	18.7	29.6	9.3	16.2	11.2	18.4	29.5	13.3	14.6	13.7	6%	13%
3.4 Project acquisition & refinancing		5.1	12.5	18.7	23.9	35.8	34.6	32.0	42.3	63.0	48.7	71.9	84.6	94.8	116.5	123.8	83.8	-32%	21%
<b>4 New Investment by Sector</b>																			
4.1 Wind		18.4	23.3	35.4	59.6	73.9	72.5	97.8	83.3	78.3	63.3	111.1	119.7	123.5	133.4	132.7	142.7	6%	15%
4.2 Solar		10.7	15.3	21.5	37.5	60.5	63.6	102.0	160.1	144.0	120.4	147.6	176.6	145.9	160.8	143.5	141.0	-2%	19%
4.3 Biofuels		3.9	5.8	26.3	29.4	17.9	9.4	10.1	10.5	7.7	5.1	5.6	3.6	2.1	3.3	3.9	3.0	-10%	-2%
4.4 Biomass & w-t-e		7.9	9.3	12.0	13.9	16.4	13.4	17.3	20.9	15.4	14.6	13.1	10.4	15.2	7.4	11.5	11.2	-2%	2%
4.5 Small hydro		2.6	7.5	6.0	6.5	7.6	6.0	0.2	7.7	6.3	5.7	7.4	4.2	4.3	4.0	2.3	2.5	6%	-1%
4.6 Geothermal		1.1	0.8	1.3	1.7	1.7	2.5	2.6	3.8	1.7	2.4	2.9	2.5	2.7	2.4	2.5	1.2	-50%	1%
4.7 Marine		0.0	0.1	0.1	0.7	0.2	0.3	0.3	0.3	0.3	0.2	0.4	0.2	0.2	0.2	0.2	0.2	-6%	12%
<b>Total</b>		44.8	69.0	103.4	147.4	177.6	167.8	238.5	286.6	253.7	231.7	283.1	317.3	283.9	331.4	299.0	301.7	2%	14%
<b>5 New Investment by Geography</b>																			
5.1 United States		8.0	11.3	28.5	30.5	34.7	23.0	34.6	50.3	40.7	36.1	38.4	48.9	44.4	45.6	47.1	58.0	22%	16%
5.2 Brazil		0.7	2.4	4.1	8.9	11.1	6.9	7.2	10.2	7.5	3.9	7.7	6.4	5.7	6.2	3.6	5.8	76%	16%
5.3 AMER (excl. US & Brazil)		1.7	3.7	3.5	4.8	5.6	5.0	12.0	9.8	10.4	12.5	15.2	11.5	6.5	13.2	10.7	12.8	20%	14%
5.4 Europe		23.3	31.6	40.7	64.5	79.1	79.5	112.2	131.7	91.1	27.7	86.7	81.1	71.5	49.1	60.8	58.4	-4%	6%
5.5 Middle East & Africa		0.6	0.6	1.2	1.5	2.2	1.5	4.0	5.1	9.9	7.2	6.4	11.8	7.1	10.7	16.3	15.4	-7%	24%
5.6 China		3.0	6.5	10.5	17.2	25.9	33.7	42.4	43.7	55.6	63.4	88.7	121.1	105.6	146.4	85.9	90.1	-6%	25%
5.7 India		2.7	3.0	4.6	6.1	5.3	4.3	7.7	12.4	6.7	5.0	7.4	8.0	12.5	13.7	11.6	11.2	-4%	10%
5.8 ASOC (excl. China & India)		0.7	7.8	10.9	12.6	14.1	13.9	18.5	23.5	30.4	45.8	53.7	59.0	40.7	41.6	48.8	46.2	-2%	14%
<b>Total</b>		44.8	69.0	103.4	147.4	177.6	167.8	238.5	286.6	253.7	231.7	283.1	317.3	283.9	331.4	299.0	301.7	2%	14%

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

Source: UNEP, Frankfurt School-UNEP Centre, BloombergNEF

Moving further to the right in Figure 41, there is a relatively small adjustment of \$3.4 billion for re-invested equity. This is money raised on public markets or from private equity that then finds itself going into the construction of new

renewable energy capacity. Then there are the two largest aggregates – asset finance at \$230.1 billion, and small distributed capacity (solar systems) of \$52.1 billion. That takes the chart to total new investment in renewables in 2019, of \$301.7 billion.

Finally, on the right, there is a column for acquisition activity (asset purchases and refinancings plus company takeovers and buy-outs). This came to \$100.7 billion in 2019. Adding that to the new investment total takes us to a total of \$402.4 billion for the value of all financial transactions in the sector.

Figure 42 draws all these elements together, to show a time series and average growth rates over the period covered. The lower half of the table shows total renewable energy investment broken down, first by sector and second by country group.

The sector split shows the dominance of wind and solar since 2008, when the biofuel boom in the U.S. and Brazil started to abate. In 2019, wind and solar together accounted for \$283.7 billion of total investment, with the other sectors only contributing \$18.1 billion.

The geographical view shows how Europe held a clear lead in overall renewable energy investment in the early years, but was overtaken by China in 2013, and in 2019 for the first time was behind both China and the U.S. This time series also shows the gradual emergence of the Middle East and Africa as a significant investor in renewable energy.

The middle part of the table shows the time series for acquisition activity. Corporate M&A has moved up and down, influenced by the timing of large deals and also the general level of confidence in the sector. Asset acquisitions and refinancings were on a strong upswing from \$32 billion in 2010 until they hit \$123.8 billion in 2018, before falling to \$83.8 billion. The acquisition trend is discussed in Chapter 7 of this report.

Taking the decade 2010-2019 as a whole, total renewable energy investment (including early-stage and corporate as well as the financing of capacity) came to \$2.8 trillion, and the value of acquisition deals to almost exactly \$1 trillion.

# INVESTMENT IN RENEWABLE ENERGY COMPANIES

- Research and development spending in renewable energy edged up 1% to \$13.4 billion in 2019. Half of that went to solar and a fifth to wind, and corporate R&D significantly outstripped government spending for the third year running.
- Venture capital and private equity (VC/PE) investment in renewable energy rose 22% to \$3 billion, its highest level since 2015, but less than a third of its peak in 2008.
- VC/PE investment in solar rose 29% to \$1.8 billion, and more than doubled to \$529 million for wind, while falling just over a third to \$396 million for biofuels. Many of the largest deals were equity injections into project development companies.
- Early-stage and late-stage venture capital both saw large percentage increases from low levels, but PE expansion capital fell by 22% to \$1.8 billion. India was the biggest market for VC/PE, up 169% at \$1.4 billion.
- In public markets, investment in renewable energy companies grew 11% to \$6.6 billion. Initial public offerings (IPOs) jumped 47% to \$2 billion, secondary issues and PIPE (private investment in public equity) edged up 4% to \$2.9 billion, and convertibles slipped 6% to \$1.7 billion. Up or down, all these figures were a fraction of the peaks set earlier this decade, or last.
- The WilderHill New Energy Global Innovation Index, or NEX, which tracks the performance of about 100 clean energy companies, rose by just under 60 points to end the year at 221.76. The NEX's gain of 37% outstripped the S&P500 Index by eight percentage points and the MSCI World Index by 11 percentage points.

Total annual investment in renewable energy has held roughly steady for the last four years, but the amount of capacity built each year for the same outlay continues to grow. The engine for this progress is research and development, which has delivered a continuous stream of efficiency gains and cost reductions, and means that around two-thirds of the world's population now live in countries where wind or solar are the cheapest forms of generation.<sup>26</sup> Improved cost-competitiveness has contributed to the increased appetite for renewable energy generation, evidenced by the installation figures year-by-year shown in Figure 14 of Chapter 1 of this report.

## RESEARCH AND DEVELOPMENT

In 2019, R&D spending in renewable energy rose 1% to \$13.4 billion. As usual, solar took the lion's share, securing \$6.7 billion, just over half the total, followed by wind at \$2.7 billion, or one fifth, as shown in Figure 43. Biofuels came third with \$1.8 billion, or just over 13%. Small hydro saw the strongest growth, up 29% to \$742 million, but from a low base.

Investment in solar R&D continued last year – inching up 1% – even as fierce competition drove one fifth of manufacturers out of business.<sup>27</sup>

<sup>26</sup> <https://about.bnef.com/blog/peak-emissions-are-closer-than-you-think-and-heres-why/>

<sup>27</sup> BloombergNEF: 2019 PV Manufacturing Capacity Review. <https://www.bnef.com/core/insights/22045>

The industry continues to increase the number of busbars – the silver lines that collect the current – on each solar cell. This raises the energy yield by reducing electrical resistance and shading of the underlying cell, and reduces the silver paste required because each busbar is thinner. A few years ago, the standard number was four, but now it is nine.

Another recent development has been the bifacial solar cell, which collects direct sunlight on top and reflected light underneath. On sandy ground this can increase the energy yield by as much as 9%, and some big U.S. developers expect this to reduce the levelized cost of solar energy by 5%.<sup>28</sup> In 2019, only 4-5% of modules shipped were bifacial, but BNEF expects that to rise to 15-21% in 2020, and for them to become the industry standard in the next few years.

In wind, a lot of R&D is about size. For many years the industry talked of cracking the 10MW turbine, and finally in 2018 MHI Vestas upgraded its 164-9.5MW machine to achieve that output. Then last year General Electric unveiled plans for its huge new 12MW Haliade-X offshore turbine. The company claims that not only is the machine 20% more powerful, but also that it will have a capacity factor – actual output as a proportion of rated capacity – five points higher than the industry

standard.<sup>29</sup> GE is testing the turbine onshore in Rotterdam, and will supply Haliade-X turbines for the Dogger Bank Wind Farm off the coast of Yorkshire. The developers, SSE Renewables and the Norwegian company Equinor, expect the 3.6GW wind farm to start generating in 2023.<sup>30</sup>

BNEF expects increasing turbine sizes to lead to a host of knock-on cost reductions, causing the total capital costs of offshore wind to fall 16% to \$2.4 million per megawatt by 2030, in spite of future projects being built further offshore and in deeper water.<sup>31</sup>

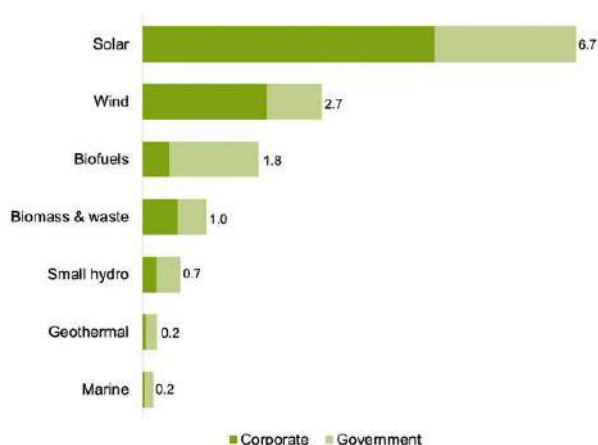
One option in deeper water is to build floating turbines, tethered to the sea floor by cables rather than supported on a rigid structure. This reduces costs in several ways: they need less steel; turbines can be towed into position rather than installed with expensive specialist ships; and they can be manufactured identically, rather than designed for each different site.

Over the past decade, testing of floating turbines has moved from individual machines to multi-turbine demonstration projects, and costs have fallen by 86%. BNEF says the technology is steadily approaching commercial viability, and expect costs to fall a further 56% by 2030, when a floating project will be only 9% more expensive

than a bottom-fixed one. By then, installed capacity should reach 1.2GW, with France the largest market.<sup>32</sup> In Japan, there are sites with combined capacity of 1.8GW where developers have yet to decide on whether to use fixed or floating foundations.

In marine energy, research and development efforts continue to produce wave power machines that can survive the harsh sea environment. Power take-off is a particular focus for a program overseen by Wave Energy Scotland.

**FIGURE 43. R&D INVESTMENT IN RENEWABLE ENERGY BY SECTOR, 2019, \$BN**



Total values include estimates for undisclosed deals.

Source: UNEP, Frankfurt School-UNEP Centre, BloombergNEF

<sup>28</sup> BloombergNEF: *Bifacial Modules: If You Book Them, They Will Come*. <https://www.bnef.com/core/insights/21571>

<sup>29</sup> <https://www.ge.com/renewableenergy/wind-energy/offshore-wind/haliade-x-offshore-turbine>

<sup>30</sup> <https://doggerbank.com/>

<sup>31</sup> BloombergNEF: *Tomorrow's Cost of Offshore Wind*. <https://www.bnef.com/core/insights/21481>

<sup>32</sup> BloombergNEF: *Floating Wind Drifts Toward Viability*. <https://www.bnef.com/core/insights/20531>

Tidal stream technology, by contrast, is much closer to being proven, with the 6MW MeyGen array off the north coast of the U.K. and some smaller projects producing consistent electricity through the seasons. The emphasis of R&D now in tidal stream is to reduce costs per MWh to closer to those of offshore wind, partly by producing larger machines and partly by making them cheaper to install and maintain.

In spite of all this activity, corporate R&D remained almost static, slipping just 1% to \$7.7 billion, but sticking at the substantially higher levels seen since 2017 compared to the previous decade – as shown in Figure 44. Corporate R&D has also overtaken government spending in the last three years, again in contrast to the general picture in the previous decade.

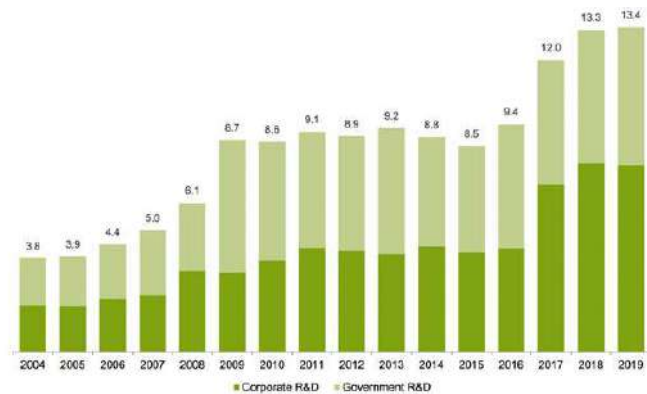
**VENTURE CAPITAL AND PRIVATE EQUITY**

Venture capital and private equity investment in renewable energy rose 22% to \$3 billion, as shown in Figure 45. This was its highest level since 2015, but less than a third of its peak in 2008. Early-stage and late-stage venture capital investments both saw large percentage increases from low levels, but PE expansion capital fell by 22% to \$1.8 billion to scarcely a quarter of its 2008 peak.

The main renewable energy technologies, and the companies that manufacture them, are now mature, so there is less need for these earlier-stage forms of financing than there was more than a decade ago.

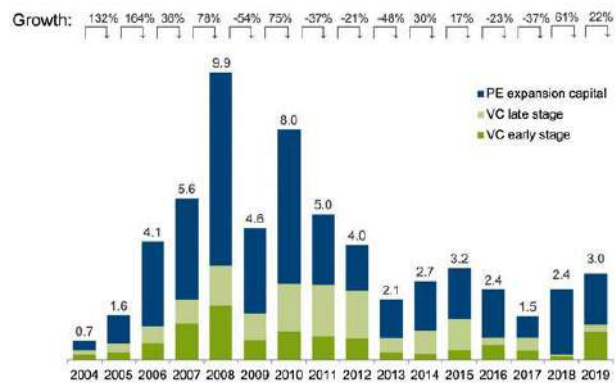
Two other factors have also contributed to the lower trajectory in VC/PE financing of renewables

**FIGURE 44. CORPORATE AND GOVERNMENT RENEWABLE ENERGY R&D 2004-2019, \$BN**



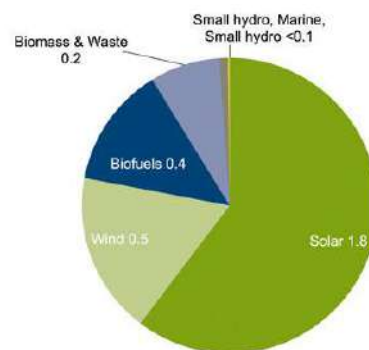
Source: UNEP, Frankfurt School-UNEP Centre, BloombergNEF

**FIGURE 45. VC/PE NEW INVESTMENT IN RENEWABLE ENERGY BY STAGE, 2004-2019, \$BN**



Buy-outs are not included as new investment. Total values include estimates for undisclosed deals  
Source: UNEP, Frankfurt School-UNEP Centre, BloombergNEF

**FIGURE 46. VC/PE NEW INVESTMENT IN RENEWABLE ENERGY BY SECTOR, 2019, \$BN**

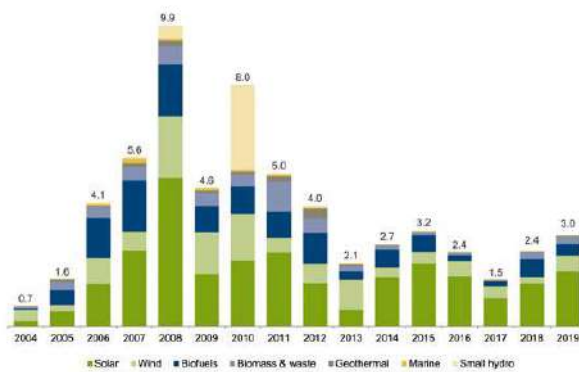


VC/PE new investment excludes PE buy-outs. Total values include estimates for undisclosed deals.  
Source: UNEP, Frankfurt School-UNEP Centre, BloombergNEF



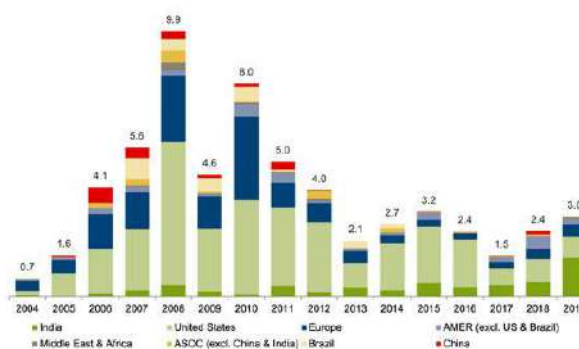


**FIGURE 47. VC/PE NEW INVESTMENT IN RENEWABLE ENERGY BY SECTOR, 2004-2019, \$BN**



Buy-outs are not included as new investment. Total values include estimates for undisclosed deals. Source: UNEP, Frankfurt School-UNEP Centre, BloombergNEF

**FIGURE 48. VC/PE NEW INVESTMENT IN RENEWABLE ENERGY BY REGION, 2004-2019, \$BN**



Buy-outs are not included as new investment. Total values include estimates for undisclosed deals. Source: UNEP, Frankfurt School-UNEP Centre, BloombergNEF

compared to the earlier period. One is that much of the research in the main sectors of wind, solar and biomass and waste-to-energy is now taking place inside large companies rather than in small ventures.

The other is that early-stage funds had distinctly mixed results with their investments in green energy previously, with many of their investee companies struggling in the face of the fierce competition in solar manufacturing, in particular. Some of those investors have now moved onto other low-carbon industries such as electric transport and energy storage. See the low-emission transport box on page 18. Electric vehicles saw two VC/PE deals of more than \$1 billion in 2019, and batteries one.

Nevertheless, renewable energy did see sizeable year-on-year increases in some of its own sectors in 2019. The sector split is shown in Figure 46, and the historical series by sector in Figure 47.

VC/PE investment in solar rose 29% to \$1.8 billion, and for wind it jumped 157% to \$529 million, with project developers rather than manufacturers or technology pioneers often taking the new capital. In the tiny marine sector, where technology development is at an early stage, VC/PE investment quadrupled to \$6 million on the basis of just two small deals, involving Scottish and French tidal turbine developers.

By geography, India was by far the biggest market, with VC/PE investment up 169% at \$1.4 billion, as shown in Figure 48. In second place came the U.S., down 8% at \$797 million, and Europe was third, climbing 14% to \$443 million.

**FIGURE 49. SOME OF THE LARGEST VC/PE EQUITY RAISINGS IN RENEWABLE ENERGY IN 2019, \$M**

Company	Location	Sector	Type	Business model	\$m
Greenko Energy Holdings	India	Solar	PE - Expansion capital	Project developer	824
ReNew Power	India	Wind	VC - Series A / First round	Project developer	300
Madison Energy Investments	United States	Solar	PE - Expansion capital	Project developer	200
Hero Future Energies	India	Wind	PE - Expansion capital	Project developer	150
Avaada Energy	India	Solar	VC - Series A / First round	Project developer	144
SSP BV	Spain	Solar	PE - Expansion capital	Project developer	110
Bioenergy Development Group	United States	Biomass & Waste	PE - Expansion capital	Anaerobic digestion	106
AMP Americas	United States	Biofuels	VC - Series B / Second round	Biogas for transport	75
GaN Systems	Canada	Solar	VC - Further / Pre-IPO round	Semiconductors	67
Yellow Door Energy Equipment Leasing	United Arab Emirates	Solar	VC - Series A / First round	Solar leasing	65
iLNG BV	Netherlands	Biofuels	PE - Expansion capital	Biomethane for transport	61
Enerkem	Canada	Biofuels	VC - Series A / First round	Waste-to-fuels	57

The table shows the largest deals with disclosed values. Other deals might have got onto this list, if their values had been disclosed. Source: UNEP, Frankfurt School-UNEP Centre, BloombergNEF

India secured four of the five largest deals, two each in wind and solar, as shown in Figure 49, several of which attracted foreign investors. In the year’s biggest VC/PE deal, worth \$824 million dollars, the wind, hydro and solar developer Greenko Energy Holdings was bought out by GIC, Singapore’s sovereign wealth fund, and the Abu Dhabi Investment Authority. In the next largest, Canada Pension Plan Investment Board, the Abu Dhabi Investment Authority and Goldman Sachs acquired a minority stake in ReNew Power, a wind and solar generator, for \$300 million.

Abu Dhabi also acquired a minority stake in Hero Future Energies, a wind and solar operator, paying \$150 million via the state-owned Masdar Capital.

In the fourth big Indian VC/PE deal, Avaada Energy, a wind and solar operator, raised \$144 million from European investors including a Dutch development bank.

In the U.S., solar developer Madison Energy Investments raised \$200 million in expansion capital from the private equity firm Stonepeak Partners. In the second-largest U.S. deal, Bioenergy Development Group, which builds and operates anaerobic digestors, raised \$106 million by selling a minority stake to Newlight Partners. In Europe’s only big deal with disclosed size, SSP, a Spanish

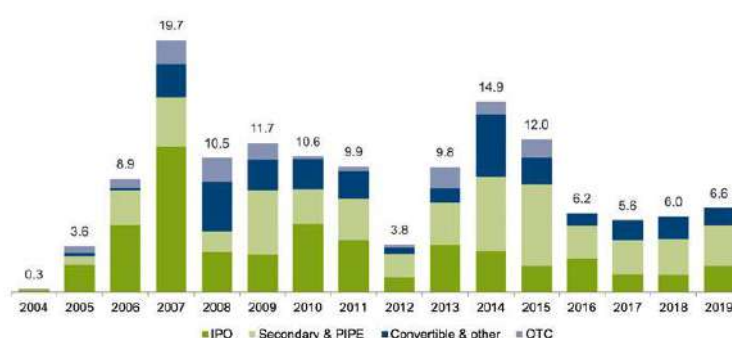
solar developer that trades as Soto Solar, raised \$110 million from a Singaporean investor.

**PUBLIC MARKETS**

In public markets, investment in renewable energy companies grew 11% to \$6.6 billion, just a third of the peak reached in the boom year of 2007, as shown in Figure 50. Public markets are quieter these days because the main sectors, solar and wind, are now dominated by well-established global companies with less need to tap investors.

The amount of money raised through IPOs jumped 47% to \$2 billion, but again, this was scarcely a sixth of its 2007 peak. Investment in secondary and PIPE offerings inched up 4% to \$2.9 billion, while that in convertibles fell 6% to \$1.7 billion.

**FIGURE 50. PUBLIC MARKET NEW INVESTMENT IN RENEWABLE ENERGY BY STAGE, 2004-2019, \$BN**

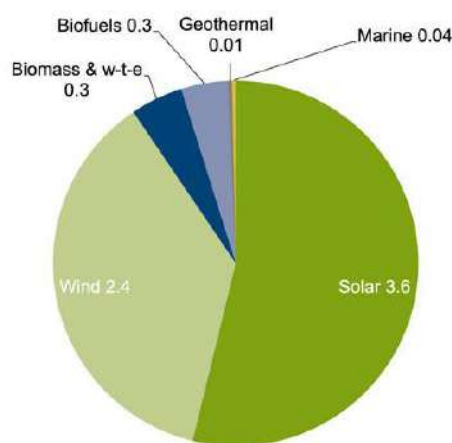


PIPE = private investment in public equity, OTC = over-the-counter. Source: UNEP, Frankfurt School-UNEP Centre, BloombergNEF



As usual, solar received the most public market investment, up 19% to \$3.6 billion, and wind the second largest, up 63% at \$2.4 billion, as shown in Figure 51. Biofuel investment more than trebled to \$306 million, while small hydro also jumped thanks to a single IPO in which the Indonesian hydro-power generator Kencana Energi Lestari raised \$21 million.

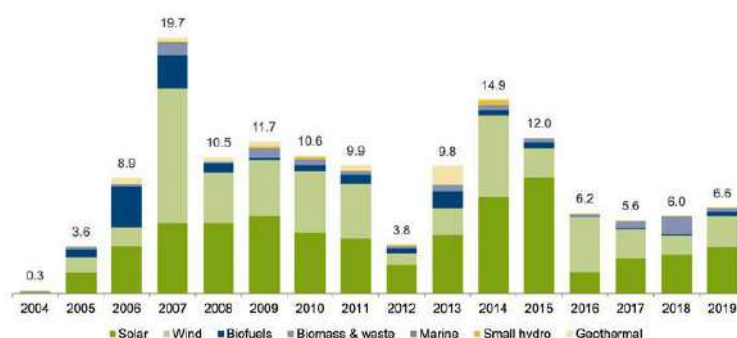
**FIGURE 51. PUBLIC MARKETS NEW INVESTMENT IN RENEWABLE ENERGY BY SECTOR, 2019, \$BN**



Source: UNEP, Frankfurt School-UNEP Centre, BloombergNEF

Figure 52 puts last year's numbers in their historical context, and shows that public market investment in each sector peaked some years ago: 2007 for wind, 2006 for biofuels and 2015 for solar. Wind, in particular, is now dominated by big companies that can finance new investments from retained profits or from borrowing, while the biofuel sector is struggling to make progress on second-generation fuels as quickly as hoped.

**FIGURE 52. PUBLIC MARKETS INVESTMENT IN RENEWABLE ENERGY BY SECTOR, 2004-2019, \$BN**



Source: UNEP, Frankfurt School-UNEP Centre, BloombergNEF



FIGURE 53. BIGGEST PUBLIC EQUITY RAISINGS IN 2019, \$M

Company	Location	Sector	Business model	Type of share issue	\$m
Greencoat UK Wind	United Kingdom	Wind	Quoted fund	Secondary & PIPE	488
Xinyi Energy Holdings	China	Solar	Developer	IPO	466
Sterling & Wilson Solar	India	Solar	Installer	IPO	414
China Ruifeng Renewable Energy Holdings	Hong Kong	Wind	Renewable energy generator	Convertible & Other	314
Northland Power	Canada	Wind	Developer	Secondary & PIPE	264
TerraForm Power	United States	Solar	Yieldco	Secondary & PIPE	251
Neoen	France	Solar	Developer	Convertible & Other	222
GCL System Integration Technology	China	Solar	Module manufacturer	Secondary & PIPE	213
Ming Yang Smart Energy Group	China	Wind	Blade manufacturer	IPO	207
US Solar Fund PLC	United Kingdom	Solar	Quoted fund	IPO	200
The Renewables Infrastructure Group	Guernsey	Wind	Quoted fund	Convertible & Other	196
Longyan Zhuoyue New Energy	China	Biofuels	Biodiesel maker	IPO	191
SunPower Corp	United States	Solar	Module manufacturer	Secondary & PIPE	177
The Renewables Infrastructure Group	Guernsey	Wind	Quoted fund	Secondary & PIPE	174
Aquila European Renewables Income Fund	United Kingdom	Wind	Quoted fund	IPO	173

The table shows the largest deals with disclosed values.  
 Source: UNEP, Frankfurt School-UNEP Centre, BloombergNEF

The biggest public market deals of 2019 are shown in Figure 53. Among the fifteen largest, six were secured by investment funds and yieldcos, with U.K.-quoted wind funds prominent among them. In the largest deal, Greencoat UK Wind raised \$488 million in a secondary offering. Another U.K.-quoted fund, The Renewables Infrastructure Group, or TRIG, found its fundraising three times over-subscribed, and raised almost twice as much as originally expected. It ended up launching two issues – one secondary, one convertible – and raised a total of \$370 million. Yet another U.K.-quoted fund, Aquila European Renewables

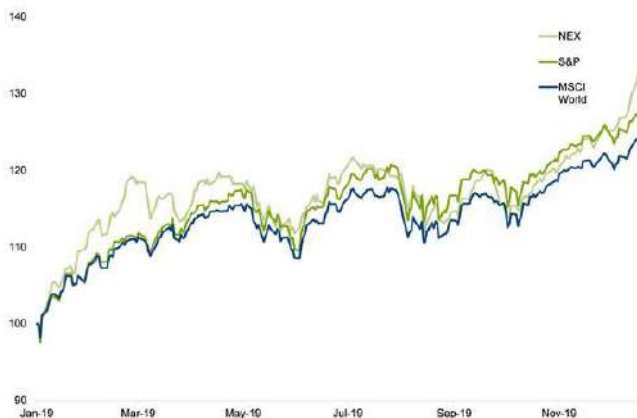
Income Fund, raised \$173 million through an IPO. Terraform Power, the U.S. ‘yieldco’ now controlled by Brookfield Renewable Partners, raised \$251 million through a secondary offering.

Project developers, which tend to need regular injections of capital, were also prominent. The largest of these was a \$466 million IPO by Xinyi Energy Holdings, which builds and operates solar plants. The next largest was another IPO, in which the Shapoorji Pallonji Group of India floated its subsidiary Sterling & Wilson Solar, raising \$414 million.

Renewable energy stock prices performed unusually well in 2019. The NEX Index – which covers the broader ‘clean energy’ sector, including renewables, electric vehicle manufacturing and energy efficiency – rose by just under 60 points during 2019 to end the year at 221.76. The NEX’s gain of 37% outstripped the S&P500 Index by eight percentage points and the MSCI World Index by 11, as shown in Figure 54. This outperformance over one year contrasts with the record over the last decade, when the NEX fell by roughly 13% but the S&P500 gained 187% and the MSCI World Index doubled in value.

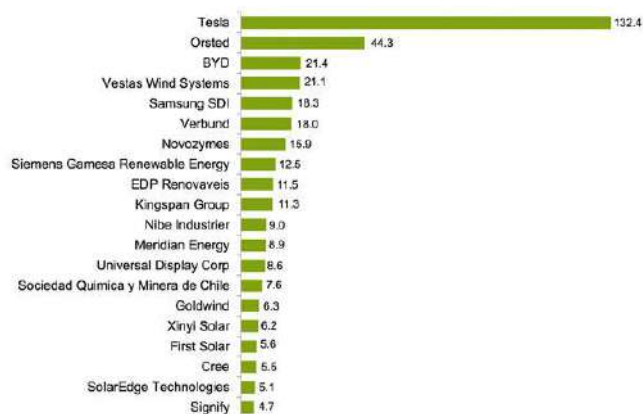
This longer-term underperformance has come despite the robust growth of renewable energy over the same period, during which investors poured \$2.4 trillion into wind and solar capacity (see Chapter 1). But the sheer weight of investment may have been part of the problem. In solar, for example, the influx of \$1.4 trillion over the last decade has led to persistent overcapacity, meaning it is still hard for manufacturers to turn a profit. In Figure 55, it is notable that the three solar manufacturers that made it into the NEX’s top 20 companies on February 6 were valued at between \$5.1 billion and \$6.2 billion, less than one twentieth of the most valuable stock in the index.

**FIGURE 54. NEX VS SELECTED INDICES, 1 JANUARY 2019 TO 17 FEBRUARY 2020**



Source: UNEP, Frankfurt School-UNEP Centre, BloombergNEF

**FIGURE 55. LARGEST COMPANIES IN THE NEX INDEX, BY MARKET CAPITALIZATION, \$BN**



Top companies as of February 6, 2020

Source: UNEP, Frankfurt School-UNEP Centre, BloombergNEF

Nevertheless, the NEX rose in 2019 because gains strongly outweighed losses overall. Among the renewable energy stocks that were strong gainers during the year, PV manufacturer JinkoSolar rose 129%, inverter maker SMA Solar Technologies 108% and PV installer Vivint Solar 94%. Developers also did well: for instance, Orsted, the Danish former oil and gas producer that abandoned fossil fuels for wind projects and wants to become the first ‘green energy supermajor’, jumped 61% during the year, and Canada’s Boralex 50%.

It is always possible that the performance of clean and renewable energy stocks in 2019 will prove to be yet another false dawn, but some investors believe that this time the change is structural. It was, after all, a year of climate disasters and sweeping change in public opinion. In January 2020, Larry Fink, CEO of BlackRock, which manages investments of \$7 trillion, warned all his firm’s investee companies that climate change was now the defining factor: “In the near future – and sooner than most anticipate – there will be a significant reallocation of capital.”<sup>33</sup>

<sup>33</sup> <https://www.blackrock.com/corporate/investor-relations/larry-fink-ceo-letter>

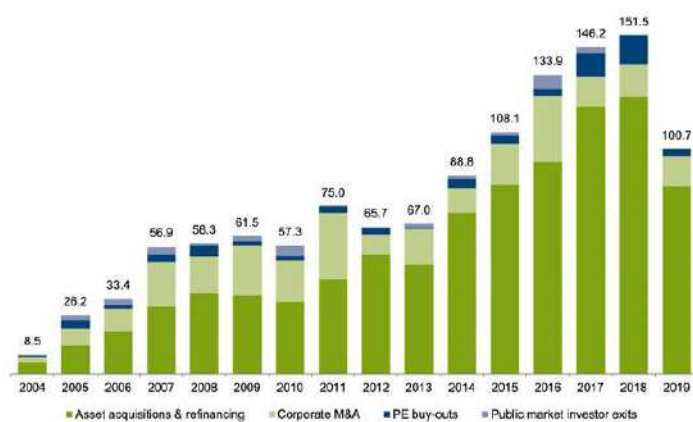
# ACQUISITION ACTIVITY

- The value of renewable energy acquisitions and refinancings fell sharply in 2019, ending a five-year run of strong growth. The \$100.7 billion of deals was 34% down from the historic high of \$151.5 billion in 2018.
- Less money changed hands in every asset class: public market exits were non-existent, private equity buy-outs dropped from \$13 billion to \$3.2 billion, and there was \$40 billion less in asset acquisitions.
- The volume of corporate M&A held up better, however, dropping just 6% to \$13.7 billion. The biggest deal saw RWE acquire E.ON Climate & Renewables for \$3.9 billion.
- As in previous years, most acquirers bought power generators and developers rather than equipment manufacturers or service providers.
- Wind and solar deals accounted for almost 97% of the total. But while wind stayed relatively strong, solar plummeted 59% to \$24.5 billion, its lowest level since 2013.
- In the U.S., asset acquisitions fell 49% to \$23.3 billion, but they remained high in Europe at \$44.2 billion. Some of the biggest targets were offshore wind farms in Germany, the Netherlands and the U.K.

The value of acquisitions fell sharply in 2019, ending a five-year run of strong growth. Deals worth \$100.7 billion were recorded globally, down 34% from the peak of \$151.5 billion in 2018.

All asset classes saw declines, but to varying degrees: public market exits disappeared altogether, while private equity buy-outs shrank by 76% to just \$3.2 billion (see Figure 56), having peaked the previous year at \$13 billion. Less precipitous but nonetheless significant was the 32% drop in asset acquisitions to \$83.8 billion, which was \$40 billion less than in the previous year.

**FIGURE 56. ACQUISITION TRANSACTIONS IN RENEWABLE ENERGY BY TYPE, 2004-2019, \$BN**



Total values include estimates for undisclosed deals.

Source: UNEP, Frankfurt School-UNEP Centre, BloombergNEF

In contrast, the volume of corporate M&A deals remained relatively high – at \$13.7 billion, it was only marginally lower than the \$14.6 billion seen in 2018. Further discussion of activity in each deal type follows under the section headings below.

As in previous years, most acquirers bought power generators and developers rather than equipment manufacturers or service providers.

Indeed, acquisitions of generating assets accounted for 83% of all money changing hands – despite the dramatic reduction in volume in 2019 – while generators or developers were the target in eight of the 10 largest corporate M&A deals. The year’s two largest private equity buy-outs saw investors buy a major Spanish wind developer and a German offshore wind farm.

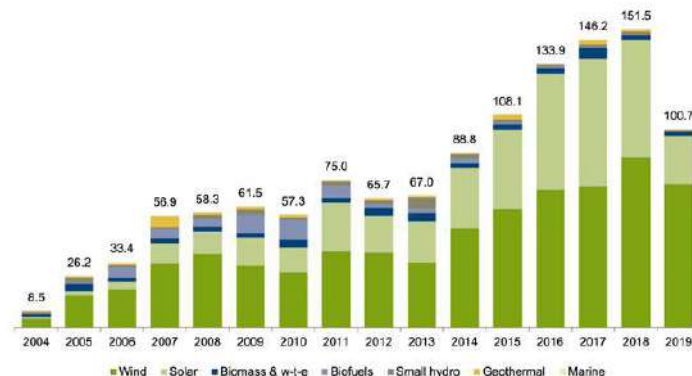
The decline in renewable energy acquisitions took place amid global economic uncertainty and after sharp sell-off on stock markets in late 2018, partly due to worries about a possible trade war between the U.S. and China.

In theory, this fragility helped to create a more deal-friendly environment as over 30 central banks around the world cut interest rates in 2019 in a bid to shore up their economies. Given that most acquisitions involve debt in one form or another, cheaper borrowing would have been welcome news for acquirers considering taking the plunge. However, the multibillion-dollar deals that helped to produce an acquisition record in 2018 were thinner on the ground in 2019.

Sector-specific factors such as falling wind and solar development costs together with ongoing reductions in subsidy levels may have acted as a brake on acquisition values. The average global price of wind turbines per MW fell 3% between the second half of 2018 and the equivalent in 2019, while capex for PV projects in China, the world’s largest solar market, fell 7% in the same period.<sup>34&35</sup>



**FIGURE 57. ACQUISITION TRANSACTIONS IN RENEWABLE ENERGY BY SECTOR, 2004-2019, \$BN**



Total values include estimates for undisclosed deals.  
Source: UNEP, Frankfurt School-UNEP Centre, BloombergNEF

In recent years, activity has become increasingly concentrated in wind and solar (see Figure 57). In 2019, they took almost 97% of the total, which was a slight increase on the year before. Among the remainder, slightly less than \$2 billion was recorded in biomass and waste-to-energy, a record low for that sector, while less than \$1 billion was seen in geothermal, small hydro and biofuels. The marine sector has seen very little acquisition activity in recent years.

<sup>34</sup> BloombergNEF: 2H 2019 Wind Turbine Price Index. <https://www.bnef.com/insights/21979>

<sup>35</sup> BloombergNEF: 1H 2019 LCOE Update. <https://www.bnef.com/insights/20423>

There was a clear contrast between the two biggest sectors in 2019: while wind activity remained high at \$73 billion, down only 15% on 2018 and higher than in 2017, solar plummeted 59% to \$24.5 billion, its lowest level since 2013. The big solar deals that characterised 2018 – such as the U.S. PV capacity acquisitions by Clearway, ConEdison Development and Capital Dynamics – were absent in 2019.

### CORPORATE TRANSACTIONS

In contrast to the declines in asset acquisitions and PE buy-outs (see sections below) the volume of corporate transactions was more resilient, dropping just 6% to \$13.7 billion in 2019. This was slightly up on 2017 but a small fraction of the \$29.5 billion trade in companies that took place in 2016. As in previous years the targets were mostly renewable energy developers or generators, but in a break with the past more than half the deals took place in Asia.

In the biggest deal of the year, RWE acquired E.ON Climate & Renewables and its 5GW of renewable generating capacity for \$3.9 billion (see Figure 58). The transaction formed part of a wider \$27 billion asset swap between two German utilities that are pursuing very different strategies – RWE has divested from downstream areas to concentrate on generation of all types, while E.ON has chosen to focus on downstream distribution and retail. The deal is further evidence of the growing trend towards specialization among European utilities.

A larger renewable generation portfolio for RWE could bring advantages such as lower financing, development and operating costs and enable RWE better to compete with other European renewable energy majors, such as Iberdrola and Enel. The rationale for vertical integration had been that a combination of generation and retail provided power utilities with a market hedge. However, wholesale power market dynamics have been changing, due to the rise of fuel switching and growth of renewables.

Generating assets were the target in two further European corporate transactions: the purchase by French independent power producer Total Eren of Novenergia and its 669MW of operating assets in Portugal, Italy, France, Spain, Poland and Bulgaria for \$1.1 billion, and the acquisition by Italian utility Edison of EDF EN Italia and its 77MW of solar and 256MW of wind assets, for \$194 million. The latter deal makes Edison Italy's second-largest wind plant operator.

One of China's largest PV module makers, JA Solar, was the target in the second-largest corporate deal of 2019, a \$1.6 billion takeover that paved the way for the company to list on the Shenzhen Stock Exchange in December. Frustrated by its valuation on Nasdaq, JA Solar delisted its American depository receipts in July 2018 and saw itself acquired by Shenzhen-listed Qinhuangdao Tianye Tolian Heavy Industry Co.

FIGURE 58. LARGEST CORPORATE M&A DEALS IN RENEWABLE ENERGY IN 2019, \$M

Acquirer	Target	Country of target	Sector	Business model	\$m
RWE	E.ON Climate & Renewables	Germany	Wind	Renewable energy generator	3936
Qinhuangdao Tianye Tolian Heavy Industry	JA Solar	China	Solar	Solar manufacturer	1580
John Hancock	Duke Energy Renewables	United States	Wind	Renewable energy generator	1250
Total EREN	Novenergia Holding	Luxembourg	Wind	Renewable energy generator	1126
Shanghai Alko Solar Energy	Guangdong Alko Solar Energy Technology	China	Solar	Solar manufacturer	968
American Electric Power	Sempra Renewables	United States	Wind	Renewable energy generator	894
ORIX Corp	IL&FS Wind Energy	India	Wind	Renewable energy generator	675
Petroleum Nasional	Amplus Energy Solutions	India	Solar	Renewable energy developer	388
Jarvami	Magma Energy Sweden	Sweden	Geothermal	Renewable energy generator	300
Xinyi Energy Holdings	Xinyi Solar Farm Group 1	Hong Kong	Solar	Renewable energy developer	261
Zhejiang Energy Group	Zheneng Jinjiang Environment Holding	China	Biomass & Waste	Waste-to-energy generator	231
Shenzhen Keenstar	EGing Photovoltaic Technology	China	Solar	Solar manufacturer	207
Edison	EDF EN Italia	Italy	Wind	Renewable energy generator	194
Enviva Partners	Enviva Wilmington Holdings	United States	Biomass & Waste	Pellet producer	170

The table shows the largest deals with disclosed values. Other deals might have got onto this list, if their values had been disclosed. Some deals were for partial control only.

Source: UNEP, Frankfurt School-UNEP Centre, BloombergNEF





By moving assets into an already-listed stock, a so-called 'backdoor listing', JA Solar was able to sidestep the lengthy waiting times and costs associated with a conventional initial public offering on an exchange in China. Another giant of the Chinese solar industry, Shanghai Aiko Solar Energy, performed a similar move, in a deal valued at \$968 million that enabled it to list on the Shanghai Stock Exchange at the end of 2019. Both Aiko and JA Solar have since said they plan to make substantial investments in new manufacturing capacity in China.

Shares in Chinese solar company Hanergy Thin Film Power Group were acquired by a related company, Hanergy Mobile Energy Holding, for an undisclosed amount. This deal has not been included in the acquisition figures for 2019 shown in this report, due to the lack of information. Once the world's most valuable solar company, Hanergy Thin Film's shares were suspended in 2015 after questions over its finances prompted a one-day sell-off that erased almost half of its \$40 billion value.

In the largest U.S. deal, Duke Energy Renewables, the renewables arm of utility Duke Energy, sold a minority share of its wind and solar portfolio, amounting to 1.2GW of generation capacity, to insurer John Hancock for \$1.25 billion. The sale enabled Duke to unlock capital that will help it to realise its development pipeline and take advantage of the federal Investment Tax Credit (ITC) and Production Tax Credit (PTC) incentives before they expire.

Appetite for generating capacity drove another U.S. utility, American Electric Power (AEP), to buy Sempra Renewables and its 724MW of operating wind generation and battery assets for \$894 million. The purchase, which includes all or part of seven wind farms and one battery installation in seven states, brings AEP's renewable generation portfolio to 1,075MW. A separate agreement to purchase a 75% interest in the Santa Rita East Wind Project currently under construction in Texas will add a further 227MW.



### PRIVATE EQUITY BUY-OUTS

PE buy-outs fell to nearer long-term average levels in 2019 after two years of exceptionally high investment volumes. Some \$3.2 billion was recorded, just a quarter of the \$13 billion seen in 2018 and a third of the \$10.6 billion the previous year. As with corporate transactions, the main focus was on wind rather than solar and on generating assets or companies instead of manufacturing businesses.

About half of all investment was accounted for by one large deal – the acquisition of more than 90% of Spanish wind-power developer Eolia Renovables de Inversiones by Alberta Investment

Management Corp (AIMCo) for \$1.6 billion. With 669MW of renewable assets, the purchase beefs up AIMCo's infrastructure holdings and coincides with a move by Alberta, home to most of Canada's oil industry, to get 30% of its energy from renewables by 2030.

Another notable PE deal was the purchase by Macquarie Infrastructure and Real Assets of Ocean Breeze Energy, owner of the 400MW Bard Offshore 1 wind farm in the German North Sea. The project was developed by Bard Engineering but ownership was transferred to Italian bank Unicredit when the developer was declared bankrupt in 2013. Macquarie's Green Investment Group was also active in acquiring offshore wind projects in 2019.

## ASSET TRANSACTIONS

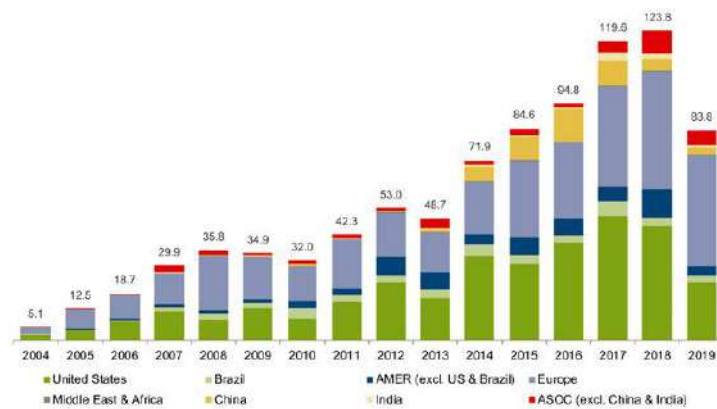
After five consecutive years of growth, culminating in \$123.8 billion of asset acquisitions in 2018, the volume of asset purchases and refinancings fell sharply in 2019 to \$83.8 billion (see Figure 59). Solar, having featured prominently the previous year, was confined to a smaller clutch of deals, the largest of which was the 807 million-euro (\$899 million) debt refinancing of French developer Teneq's 255MW Phoenix V PV portfolio. It is possible that more transactions for 2019 will come to light in the coming months, in which case these numbers will be revised.

The frenzy of deal-making in 2018 clearly illustrated that there was a big pool of investors interested in newly developed renewable assets with long-term power purchase agreements. While there were projects for sale in 2019, the market appeared to have peaked and was beginning to bear the hallmarks of an asset bubble: for example, the average U.K. solar M&A price rose 19% in 2018 compared with the year before. And despite the squeeze on equity returns, demand remained high with investors reportedly looking to increase their risk to get higher returns.

Activity in the U.S. was hardest hit, falling by 49% to \$23.3 billion. Solar deals completely disappeared while the wind market faced pressures from the scheduled phase-out of qualification for the PTC by the end of 2019. With developers scrambling to qualify their projects, either by starting construction or by spending 5% of total project capex, 2019 would have been "an abnormal time" to dive into the sector, a senior executive at Sustainable Power Group, told an audience at the S&P Global Platts' Global Power Markets conference in Las Vegas.

The volume of asset acquisitions in Europe, in contrast, remained high at \$44.2 billion, down just 5% from 2018 (see Figure 59). Some of the biggest acquisitions were of wind farms in the seas off Germany, the Netherlands and the U.K. These included the 2.5 billion-pound (\$3.1 billion)

**FIGURE 59. ASSET ACQUISITIONS AND REFINANCINGS BY REGION, 2004-2019, \$BN**



Total values include estimates for undisclosed deals.

Source: UNEP, Frankfurt School-UNEP Centre, BloombergNEF

purchase of 40% of the 714MW East Anglia One Offshore Wind Farm by Green Investment Group, the renewable energy investment arm of Australian group Macquarie.

Deals in German waters included the acquisition of an 80% stake in the 402MW Veja Mate offshore wind farm for an estimated \$1.9 billion by INGKA Holding, the group that controls IKEA, together with CommerzReal, WPD Invest and KGAL Group. In addition, The Renewables Infrastructure Group and Glennmont Partners each bought 25% of the 330MW Gode Wind I project, in deals worth \$495 million apiece, while Credit Suisse Energy Infrastructure Partners acquired a 25% stake in the 385MW Arkona Becken Sudost Offshore Wind Farm for \$553 million.

There were heavy falls in acquisition and refinancing activity in Asia. The volume in China fell to \$3.2 billion from \$4.7 billion, and elsewhere in the region (excluding India) it declined by an even greater extent, ending the year at \$5.6 billion, down from \$9.2 billion in 2018. As in Europe, some of the largest deals targeted offshore assets: Electricite de France, for instance, bought 35% of the 502MW Dongtai offshore wind farm phases IV & V in China's Jiangsu Province for \$663 million, while Japanese power utility JERA acquired a 49% stake in the 376MW Formosa II Miaoli offshore wind farm off Taiwan.

# GLOSSARY<sup>36</sup>

<b>ASSET FINANCE</b>	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 or may not be commissioned in the same year.
<b>CAPACITY INVESTMENT</b>	All investment in new renewable energy capacity, whether asset finance of utility-scale projects, or financing of small-scale solar.
<b>CAPITAL EXPENDITURE</b>	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.
<b>CORPORATE POWER PURCHASE AGREEMENT</b>	A transaction by which a company agrees to buy its electricity from a renewable energy project. Usually involves a set price, or a set amount of electricity per year, for a set period (eg 10 years).
<b>FEED-IN TARIFF</b>	A premium rate paid for electricity fed back into the electricity grid from a designated renewable electricity generation source.
<b>FINAL INVESTMENT DECISION</b>	Moment at which the project developer, or group of investors and lenders, decide that the investment will definitely go ahead. The asset finance figures in this report are based on money committed at the moment of final investment decision.
<b>INITIAL PUBLIC OFFERING (IPO)</b>	A company's first offering of stock or shares for purchase via an exchange. Also referred to as "flotation".
<b>LEVELIZED COST OF ELECTRICITY (LCOE)</b>	The all-in cost of generating each MWh of electricity from a power plant, including not just fuel used but also the cost of project development, construction, financing, operation and maintenance.
<b>MARKET CAPITALIZATION</b>	Value placed on a quoted company by the stock market. It is equal to the number of shares in circulation, multiplied by the prevailing share price.
<b>MERGERS &amp; ACQUISITIONS (M&amp;A)</b>	The value of existing equity and debt purchased by new corporate buyers in companies developing renewable technology or operating renewable energy projects.
<b>NON-RECOURSE PROJECT FINANCE</b>	Debt and equity provided directly to projects rather than to the companies developing them.
<b>ON-BALANCE-SHEET FINANCING</b>	Where a renewable energy project is financed entirely by a utility or developer, using money from their internal resources.
<b>PUBLIC MARKETS</b>	All money invested in the equity of publicly quoted companies developing renewable energy technology and generation.
<b>VENTURE CAPITAL AND PRIVATE EQUITY (VC/PE)</b>	All money invested by venture capital and private equity funds in the equity of companies developing renewable energy technology.

<sup>36</sup> 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.

## UN ENVIRONMENT PROGRAMME

The UN Environment Programme is the leading global voice on the environment. It provides leadership and encourages partnership in caring for the environment by inspiring, informing and enabling nations and peoples to improve their quality of life without compromising that of future generations. UN Environment Programme works with governments, the private sector, the civil society and with other UN entities and international organizations across the world. To ensure its global effectiveness, UN Environment Programme supports six regional offices, a number of sub-regional and country offices and a growing network of centres of excellence. Visit [www.unep.org](http://www.unep.org)



## FRANKFURT SCHOOL OF FINANCE & MANAGEMENT

Frankfurt School of Finance & Management is a research-led business school accredited by EQUIS, AMBA and AACSB International. Frankfurt School offers educational programmes covering financial, economic and management subjects. In their research, the members of Frankfurt School's faculty explore topical aspects of business, management, banking and finance. Frankfurt School experts also manage advisory and training projects on financial matters in emerging markets and developing countries, especially on topics related to microfinance and renewable energy finance. It is a globally connected business school with over 125 partner universities. For more details see [www.frankfurt-school.de](http://www.frankfurt-school.de)

## FRANKFURT SCHOOL-UNEP CENTRE

The Frankfurt School – UNEP Collaborating Centre for Climate & Sustainable Energy Finance is a strategic cooperation between Frankfurt School of Finance & Management and UN Environment. The Centre is committed to facilitate the necessary structural change of energy supply and use around the globe by helping to catalyse private sector capital flow towards investments in sustainable energy and climate change mitigation and adaptation. A primary objective is to bridge the public-private sector gap through think-tank activities combining research, education and project implementation. A key part of this process is to enable the public sector to put in place policies, regulations and initiatives that overcome existing or perceived investment risks and other barriers seen by the private sector due to unfamiliarity with clean energy initiatives, particularly in developing countries. Together with partners in different institutions, the Centre is elaborating and field-testing new financial instruments and implementing cutting-edge projects that serve the growing markets for energy-efficient and clean energy production.



## BLOOMBERGNEF

BloombergNEF (BNEF) is a leading provider of primary research on clean energy, advanced transport, digital industry, innovative materials, and commodities. With a team of experts spread across six continents, BNEF leverages the world's most sophisticated data sets to create clear perspectives and in-depth forecasts that frame the financial, economic and policy implications of industry-transforming trends and technologies. Available online, on mobile and on the Terminal, BNEF is powered by Bloomberg's global network of 19,000 employees in 176 locations, reporting 5,000 news stories a day. Visit <https://about.bnef.com/> or request more information.

# BloombergNEF



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

**Frankfurt School – UNEP Collaborating Centre  
Frankfurt School of Finance & Management**

Adickesallee 32-34  
60322 Frankfurt am Main  
<http://fs-unep-centre.org>  
[www.frankfurt-school.de](http://www.frankfurt-school.de)  
E-Mail: [fs\\_unep@fs.de](mailto:fs_unep@fs.de)  
Phone: +49 (0)69 154008-647  
Fax: +49 (0)69 154008-4647

Supported by the Federal Republic of Germany



Federal Ministry  
for the Environment, Nature Conservation  
and Nuclear Safety

