

THE CURRENT STATE OF CLEAN ENERGY COST, TECHNOLOGY AND FINANCE

February 2019

“After decades of investment and technological improvements, renewable energy has become economical, reliable and investible. Many renewable technologies are less expensive than fossil fuel, and the clear trend is costs will fall further. Renewables are now attracting investment from pension funds, insurance companies, banks and other investors on an unprecedented scale as investors increasingly understand renewables and grasp the investment opportunities.”



Expert Advice for Institutional Investors in Global Energy Infrastructure

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INTRODUCTION

After decades of investment and technological improvements, renewable energy has become economical, reliable and investible. Many renewable technologies are less expensive than fossil fuel, and the clear trend is costs will fall further. Renewables are now attracting investment from pension funds, insurance companies, banks and other investors on an unprecedented scale as investors increasingly understand renewables and grasp the investment opportunities.

Following the oil crises of the 1970s, many OECD countries, especially the United States and Western Europe, began encouraging renewable energy investment. Following the 1992 United Nations Framework Convention on Climate Change and the 1997 Kyoto Protocol, efforts redoubled in OECD countries to deliver renewable energy, especially in the EU which became the largest renewable energy market in the early 2000s. In about 2005, China began its big push for renewable energy. This combination of US, EU and China-led growth, albeit at high cost to electric users, allowed the industry to scale-up and reduce costs. These countries financed a steep learning curve, through which technology was improved and costs lowered, from which the world now benefits.

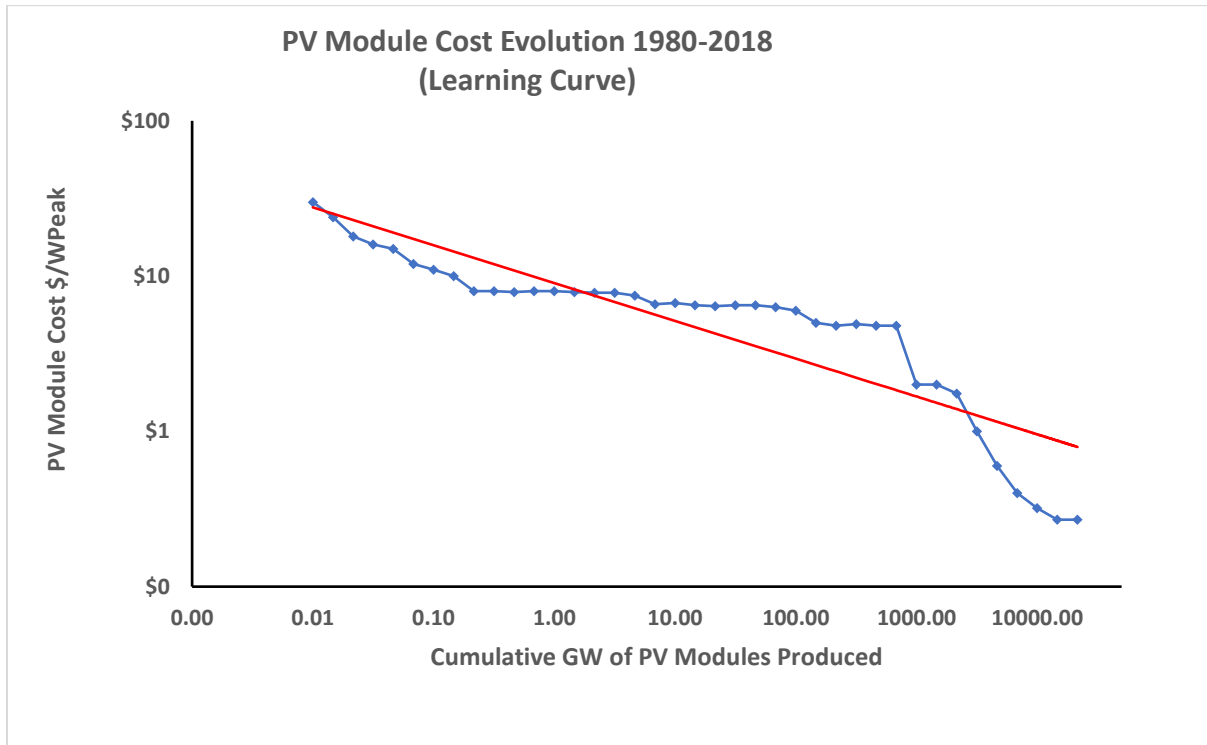
In so doing, financial investors learned about the sector, and a body of investment performance was built up, lowering the cost of capital for renewable energy. The result is that clean energy has become competitive, investors are willing to invest and governments and energy users can now choose clean energy over fossil fuels without any significant economic burden on consumers or industry while calling into question the economics and wisdom of fossil fuel investments

Falling Costs Make Renewables a Compelling Competitive Option

Over the last 25 years, renewable energy costs have fallen dramatically as the industry scaled-up and performance improved. For example, in 2002 the most common onshore wind turbine had a capacity of 750KW-1.0MW with blades of 40-50-meter diameter (the diameter is a main component of determining efficiency). Today onshore wind turbines are routinely 3.5-5.0MW and have diameters of 120+ meters, resulting in 30-50% more production from the same site.

The cost savings can be seen in the “learning curves” for solar PV modules, the principal costs of any solar installation, and onshore wind. Learning curves show the impact of increased manufacturing on cost – that is the more of a product is made, the cheaper it generally becomes. This is a well-known effect, from computer chips to LED TVs.

FIGURE 1: Solar PV Module Learning Curve

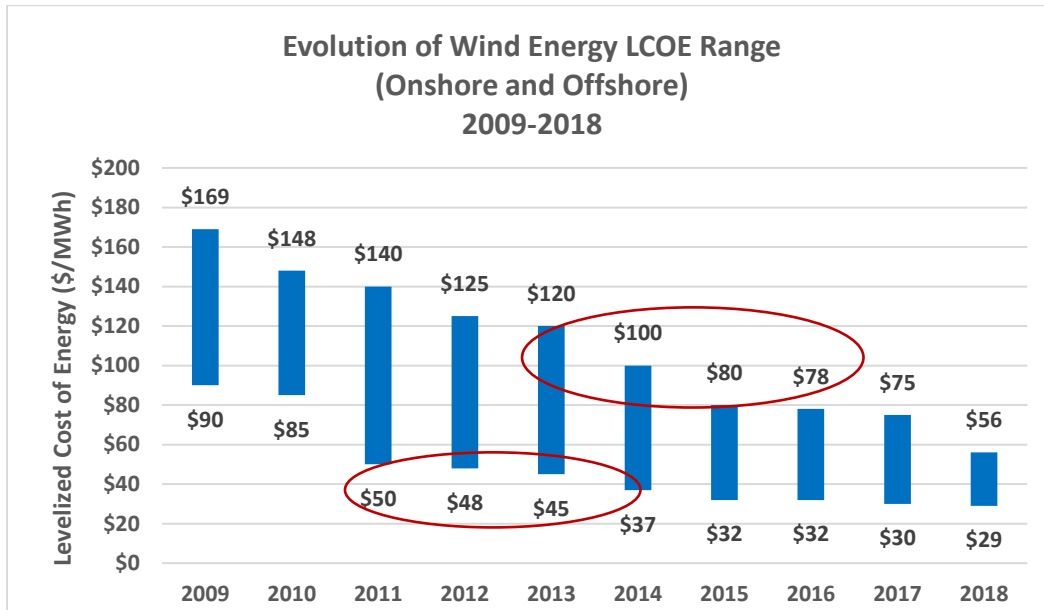


Source: Fraunhofer Institute for Solar Energy, Bloomberg New Energy Finance, U.S. National Renewable Energy Lab (DOE).

Solar PV module costs fell over 80% between 2005 and 2018, and 45% since 2010. Module costs are below \$0.30 per watt, and with continued expansion will fall below \$0.25 per watt. Similar trends can be seen in onshore wind. This is also referred to as learning curve, which measures the fall in cost of any product each time production doubles. PV modules have sustained a 24% learning curve since 1980.

The same trend can be seen in the costs of wind energy, especially since 2009 when dramatic technical increases in the efficiency of wind turbines began. The costs below are expressed as the “levelized cost of energy” or LCOE, which reflects the cost of electricity per MWh necessary to pay operating costs and to repay capital costs plus a reasonable rate of return. The LCOE of wind energy depends greatly on the strength of the wind resource, hence there is a wider range of costs. The chart below reflects not only the cost range based on wind strength, but the costs of onshore and offshore wind. Offshore wind generally accounts for the high end of the range and onshore wind represents the low end of the range. Increasingly, onshore wind is located at the low end of the range, with similar pricing being observed in many countries, ranging from Norway and Sweden to Chile, Mexico and Brazil.

FIGURE 2: Wind LCOE Learning Curve (Onshore and Offshore)



Bottom –
Next Generation
Onshore Wind
Turbines
Introduced

Top –
Next Generation
Offshore Wind
Turbines
Introduced

Source: Lazard, Bloomberg New Energy Finance, Two Lights Energy Advisors

This shows that since 2009 the cost of both onshore and offshore wind has fallen by over 60%, making onshore wind one of the least cost energy sources in the world, and offshore wind, which is increasingly large scale, now cheaper than new nuclear plant.

This data is also confirmed by the results of competitive tenders, especially in emerging markets, for wind and solar projects, in the last few years. The following chart shows the cost of energy bid by winners of tenders in several countries.

FIGURE 3:
Tariffs and Winning Tenders Onshore Wind

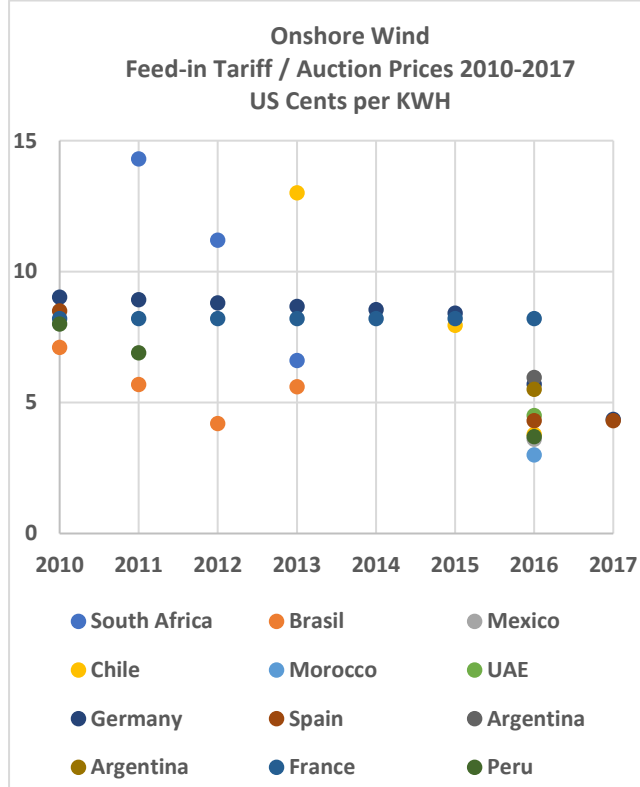
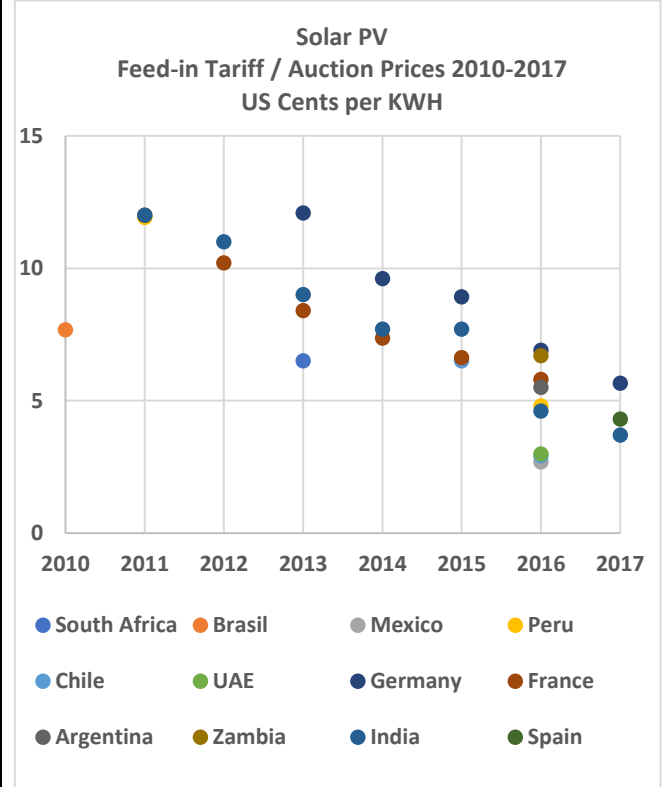


FIGURE 4:
Tariffs and Winning Tenders Solar PV

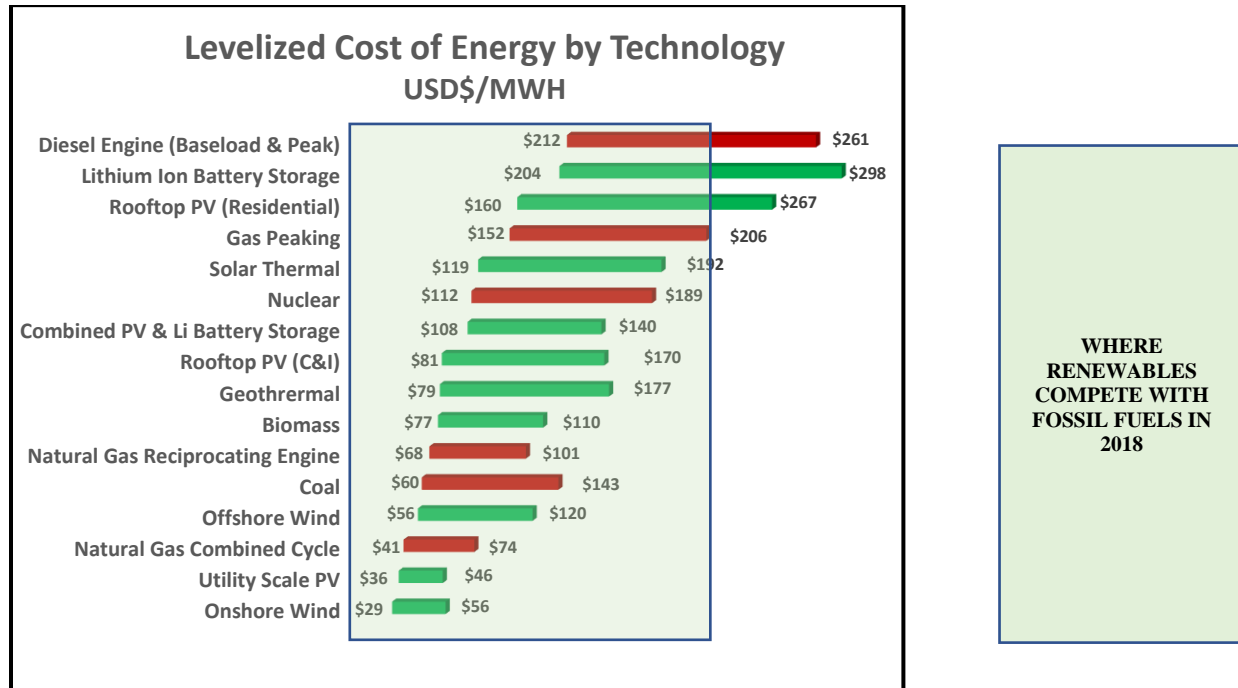


Source: IRENA, Bloomberg New Energy Finance, Two Lights Energy Advisors, Mercom Capital, Inspiratia

This data clearly shows a decline in the cost of renewable energy. But what of the costs of renewables compared to conventional power today?

The accepted method to compare the cost of various energy technologies is Levelized Cost of Energy, or LCOE. LCOE expresses the price per unit of electricity (megawatt hour or MWH) required for an energy technology to repay operating costs and the original capital investment plus a reasonable rate of return over the useful life of the technology, usually 20-30 years. The following table shows the LCOE for a variety of renewable and conventional energy technologies, expressed as the wholesale cost per MWH. Wholesale electricity costs generally account for 50-60% of the total electric bill, with transmission and distribution costs and taxes accounting for the balance. Each technology is shown as a range of prices. For example, the cost of building a solar project in the UK and Spain will be largely the same, but because of sunlight and climate, the Spanish installation will likely produce 40% more energy than the UK project, lowering overall costs. In a fossil fuel project, the cost of fuel will be the primary variable.

FIGURE 5: 2017 Levelized Cost of Energy of Renewables and Main Conventional Technologies

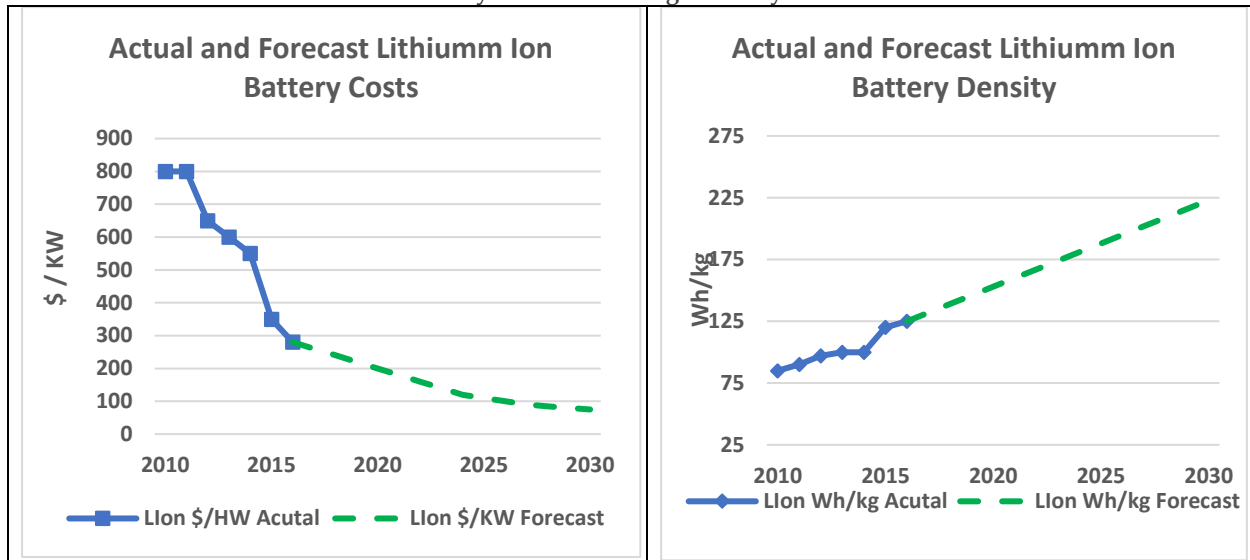


Source: Lazard, Morgan Stanley, Bloomberg New Energy Finance, Two Lights Energy Advisors

These costs do not reflect external costs and benefits, such as pollution and CO2 emissions from conventional power, back-up power costs for renewables intermittency or the costs of building transmission grids in emerging markets to accommodate new power. Nevertheless, the data clearly shows that renewables, especially onshore wind and solar PV are increasingly the least cost options for new generation, a position traditionally held by natural gas combined cycle plants. What is also interesting is the competitiveness renewables, including offshore wind vis-à-vis coal and nuclear generation. Coal is a proven, fully mature technology with known costs. Renewable technologies, even though proven, are scaling up and are falling in costs, but even without further gains these other renewables compete favourably with coal and nuclear.

The other interesting development is the Combined PV and Lithium Ion (Li) battery storage costs. The chart above was static in its categories for the 4-5 years. In 2018 Lazard added the PV / Li combination. With the intermittency of renewables an issue, the combination of solar (or wind for that matter) with storage is an interesting development, and it appears to be competitive in some applications. We do know that Li battery costs have fallen dramatically in the last three years, as that industry starts to scale-up like the solar PV industry did a decade ago. At the same time the performance of the batteries is increasing. See Figure 6 below. We can expect that battery technology will continue to advance in cost and performance and has the potential to be priced at levels equal to or near onshore and offshore wind and PV.

FIGURE 6: Evolution of Lithium Ion Battery Costs and Storage Density:



Source: Bloomberg New Energy Finance

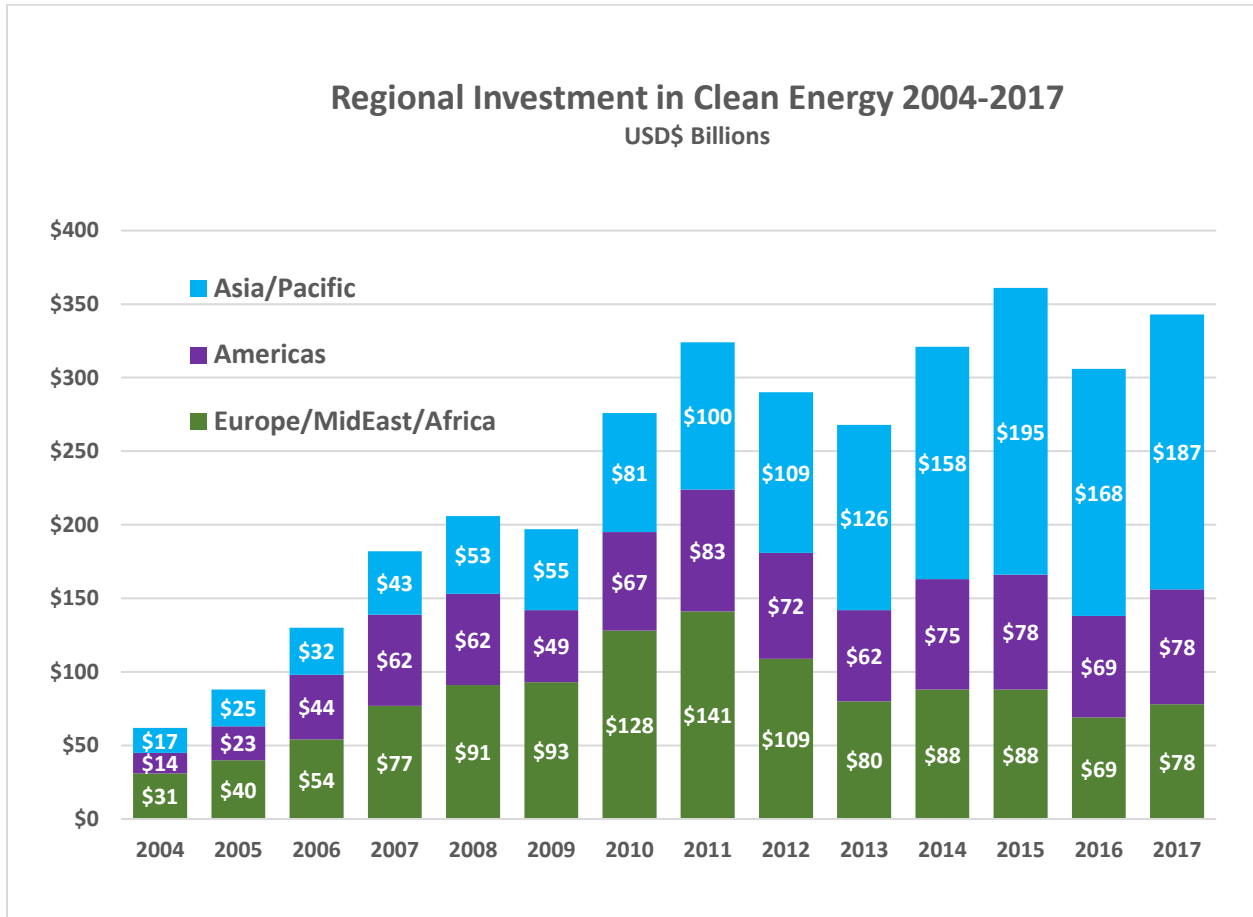
CLEAN ENERGY INVESTMENT IS MAINSTREAM

Since 2004 clean energy investment has moved from a few specialist funds and investors to a global phenomenon, attracting hundreds of global investors who are committing on average more than \$300 billion per year and have established track records of successful investment. In the global electric utility sector, global annual clean energy investment exceeds global annual investment in fossil fuel power projects.

The cost effectiveness of clean energy options is the product of massive investment in clean energy projects, technologies and companies since 2000. Once a niche investment industry populated by a relative small number of specialist fund investors, it has gone mainstream, attracting hundreds of global investors, including many of the world’s largest pension funds, insurance companies and sovereign wealth funds alongside an increasing number of listed and unlisted investment funds, family offices and wealth management firms. During the same period, investment performance has improved, though many investors remain coloured by poor investment experience dating from the mid-2000s, which is discussed below.

Overall growth has been staggering. Since 2010 global clean energy investment averaged \$300 billion per year, almost five times the global clean energy investment level of 2004, as shown by the global investment data compiled by Bloomberg New Energy Finance, a leading consultancy and data source for clean energy investment.

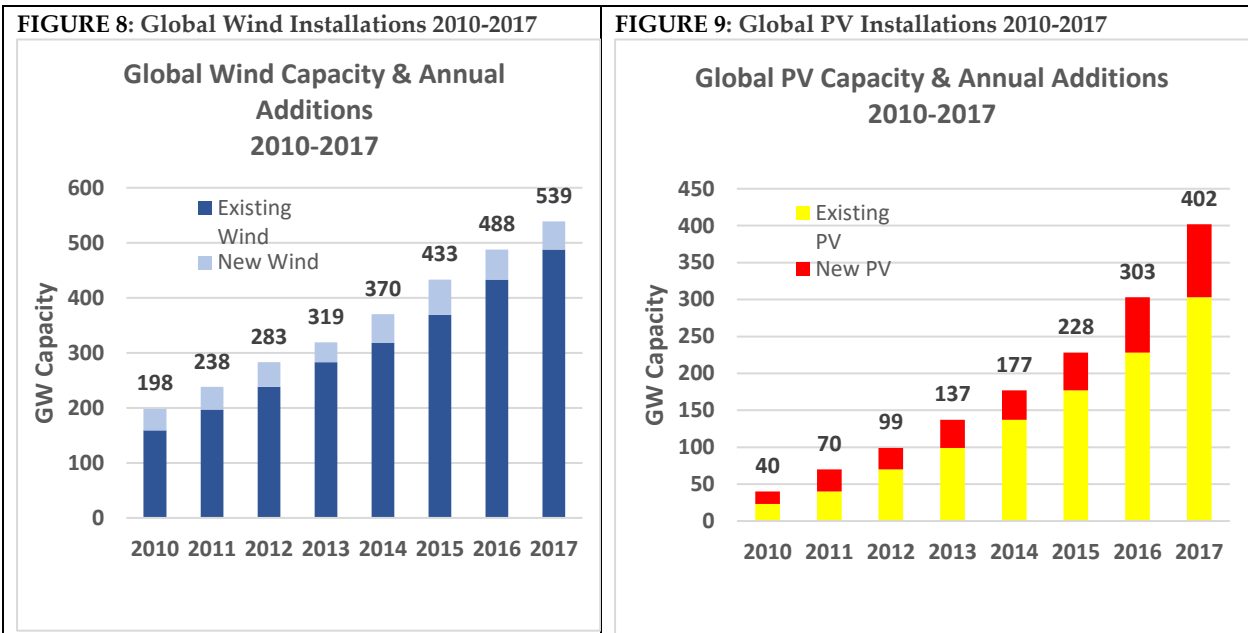
FIGURE 7: Global Investment in Clean Energy 2004-2016



Source: Bloomberg New Energy Finance, Clean Energy Investment End of Year 2016, January 2017

This global investment consists primarily of investment in renewable energy projects – primarily wind, solar and biomass – but also includes venture investments in new technologies, investments in new renewable energy manufacturing facilities and public offerings project companies and manufacturers.

Some observers cite concern over the relatively flat levels of investment since 2011, but this does not reflect falling investor appetite, rather it reflects falling cost, as the actual deployment of renewable capacity continues to increase. Recall from the wind and solar “learning curves” discussed above. These technologies account for the vast majority of reported investment. Since 2010 the cost of solar panels has fallen by nearly 50%, and the LCOE of onshore wind has fallen by nearly 60%. This means, on average for wind and solar, the same amount of invested capital delivers 50% more installations than in 2010. So, the sector is actually growing. This can be seen in the following charts tracking global wind and solar PV installation since 2010.



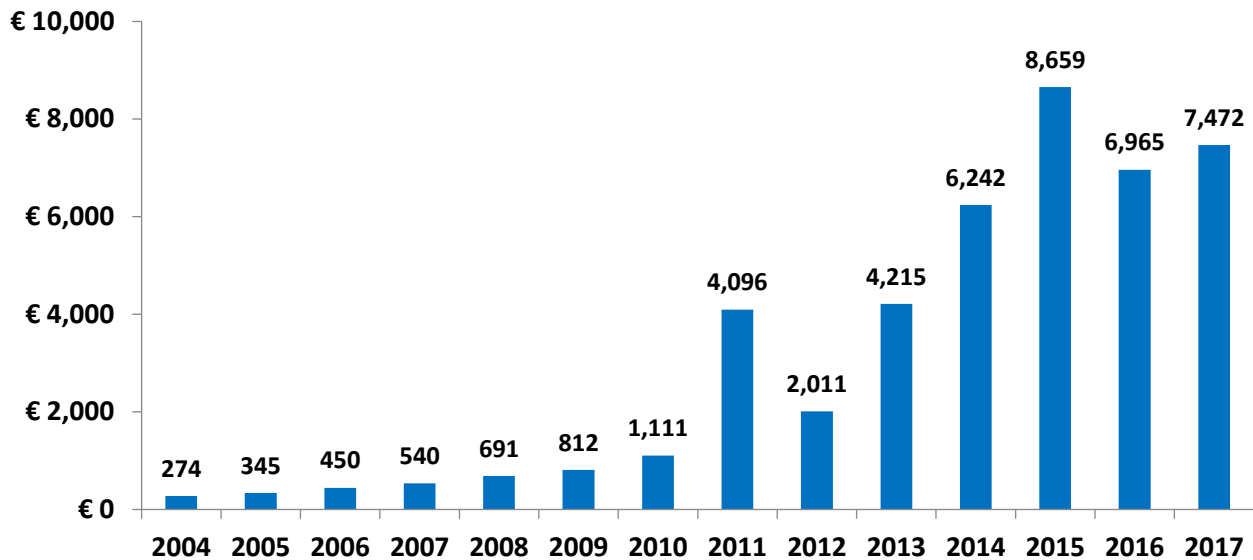
Source: REN21, *Renewables 2018, Global Status Report*, 2018

And the growth has been global. In the early 2000s, Europe, as the pioneer, accounted for most of the investment. With Europe now close to meeting its 2020 renewable targets (and in so doing acting as the cost-cutting laboratory for the rest of the world) and the rest of the world rapidly turning to more cost-effective renewables.

This increase in overall renewable energy investment has been accompanied by increases in institutional investment in clean energy, especially infrastructure investments in global renewable energy projects. Unfortunately, the existing main databases on renewable energy investment do not adequately break out sources of investment between banks, utilities, MDBs, investment funds and institutional investors such as pension funds, insurance companies, family offices, foundations, endowments and sovereign wealth funds. However, a private database that tracks equity investments in EU renewable energy projects by institutional investors provides an insight into the attractiveness of the sector to financial investors.

In 2004 there were less than 10 active institutional investors investing providing equity for EU renewable energy projects. These investors were mostly specialist unlisted investment funds. They accounted for less than 2% of capital invested. By 2010, with costs coming down, the number of institutional equity investors and the capital they committed started to increase, and now they are among the largest sources of capital for EU renewable energy projects; and many of those investors are starting to move to emerging markets.

FIGURE 10: Institutional Investor Equity Investment in EU Renewable Energy Projects 2004-2017
(€ Millions)



Source: Two Lights Energy Advisors, HgCapital, Asper Investment Management

As a result, institutional investors moved from accounting for less than 2% of all EU project investment – both debt and equity – in 2004 to 14% today. But this underestimates the shift. As renewable projects are typically financed with large amounts of long-term debt, institutional capital’s share of the EU renewable project equity market is estimated at 40-50%.¹

Investor interest is expanding. According to Preqin, the private equity and infrastructure investment and performance database, there are over 675 global pension funds, insurance companies, family offices, endowments and sovereign wealth funds now list renewable energy as a preferred investment area.² It also appears that the European model is expanding. Africa, Asia, India and Latin America are now seeing substantial institutional investment, especially equity, alongside multilateral investment agencies. As with Europe 10 years ago, the bulk of the investment to date has been made via specialist investment funds, such as Actis, Denham Capital and Brookfield.

Not only has investment grown, but that investment has generated attractive returns for investors. As noted above, for many years renewables investment was the province of a small number of specialist investors, and investment returns have been mixed. In recent years, however, returns more investment performance data has become available, which show that clean energy investments are delivering attractive returns, yet many investors still shy from renewables based on experiences in the last decade.

Around 2004, clean energy investing – ranging from infrastructure investments in renewable energy projects to venture capital investing in new technology start-ups – grew rapidly. Much of the capital flowed into private equity, venture capital and infrastructure funds and the experience of fund managers and investors was limited. Some investment strategies – mostly those based on infrastructure projects – performed well but others – especially VC investments – did not. The well-publicised losses in companies like Solyndra (promising technology that was eclipsed by solar PV) and sectors like biofuels that were subject to substantial commodity price exposure turned many investors against the sector. Similarly, Spain’s retroactive reductions in renewable energy tariffs affected over 30 leading investors, causing losses in those investments and eclipsing strong returns in other countries. But the sector has learned from its mistakes, and there is a growing body of evidence that renewables offer good risk-adjusted returns.

¹ Two Lights Energy Advisors LCC estimate based on proprietary research.

² Preqin online database search, August 2017.

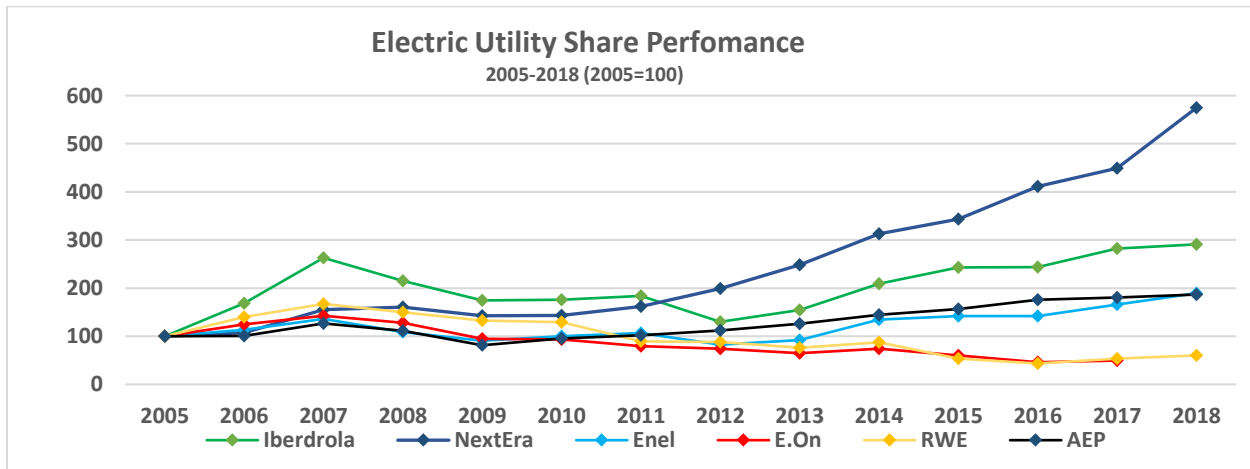
Because renewable and clean energy investment covers such a large spectrum – solar panel and wind turbine manufacturing, renewable energy projects, listed utilities with large renewable portfolios, venture capital for new technologies and new business models like distributed generation – renewable energy performance compared to fossil fuel investment can be difficult, but a few comparisons illustrate the growing trend:

- Since its peak in 2008 at over 700, the Dow Jones US Coal Index of US coal companies has fallen to 62, a 90% fall in value to largely to falling coal prices resulting from falling demand, especially in the US where natural gas and renewables are displacing coal fired generation
- Since 2008, the share price of Vestas, the world’s largest wind turbine maker, and Siemens, which makes wind turbines and other renewable energy components, have more than doubled
- Since its listing in 2012, the London based listed wind energy fund Greencoat has paid an annual dividend of 8% and has currently trades at a 35% premium to its listing price.

This can also be seen in the performance of some large listed utilities. The following chart compares the share price performance of four EU and two US electric utilities between 2005 and 2017:

- E.On and RWE of Germany and AEP of the United States, which are primarily fossil fuel based utilities with large fleets of coal plant; and
- Iberdrola of Spain, ENEL of Italy and NextEra of the United States, which were early and strong movers in renewable energy (Iberdrola and NextEra remain two of the largest renewable operators in the world)

FIGURE 11: Share Price Performance of 6 Electric Utilities 2005-2018



Source: Yahoo Finance

Three principal points can be taken from this chart:

1. In 2005 and 2006 during the first renewable boom, Iberdrola and NextEra outperformed the more conventional utilities.
2. Following the financial crisis through 2015, the more renewable focused utilities saw stronger share price recovery and have outperformed their more fossil fuel weighted brethren.

3. The recovery in share price by E.ON and RWE since 2015 coincides with their announcement that they would move their fossil fuel plants to separate business units which were spun off and henceforth would focus on renewable assets. AEP's improved performance coincides with its increasing embrace of renewable technologies since 2010 and its substantial retirement of coal-fired generation.

These advances coincide with an ongoing low interest rate investment environment in which long-term investors, especially pension funds, insurance companies and sovereign wealth funds, are increasingly investing in infrastructure assets that provide stable, low volatility, long-term returns. Utility scale renewables possess these characteristic, as discussed below in "Sources and Trends in Clean Energy Investment."

The objective evidence increasingly demonstrates that the historic barriers to large scale renewable energy investment – technology, cost, investor inexperience have been largely overcome, and the cost trend suggests that cost objections should be eliminated in 3-5 years, making renewables the least cost alternative. This means that the obstacles facing renewables will be no different than those affecting conventional power deployment, especially for utility scale renewables.

THE RAPIDLY EXPANDING GLOBAL SOURCES OF CLEAN ENERGY INVESTMENT

Not only has the annual volume of clean energy investment grown six-fold since 2004, so too have the sources of clean energy investment, with hundreds of global investors now active. Further, the renewable technological and cost revolution coincides with increased demand for ethical and sustainable investments, which is creating new investment demand and new investment vehicles, such as green bonds and renewable energy "Yieldcos", increasing the amounts of capital across the capital spectrum.

Introduction

Since 2010 there have been remarkable, indeed unprecedented advances in renewable energy finance. As noted above, global annual clean energy investment grew from \$63 billion to averaging over \$300 billion since 2011, six-fold increase. Alongside the overall increase in investment, there has been a tremendous growth in institutional investment – pension funds, insurance companies, endowments, sovereign wealth funds – committing more and more capital to the sector. And new investment vehicles have emerged. This growth in investment appetite has been greatest in utility scale renewable energy projects, which account for the substantial majority of institutional debt and equity investment.

This growth, especially growth in equity investment, is the result of three factors:

1. The increased reliability and cost competitiveness of renewables already described, reducing the need for government subsidies;
2. The increase in demand for sustainable and environmentally friendly investments, as part of the larger ESG, sustainability and fossil fuel divestment movements
3. The low interest rate environment which has spurred global demand by institutional investors for long-dated infrastructure assets, which provide risk profiles similar to government bonds and which provide long-term stable cash flows that pension funds and insurance companies desire to match against their long-term liabilities.

Factor 1 above is already covered, and factor 2 is well covered in other investment literature. The impact of low interest rates, however, has been critical in delivering more investment at lower cost. Simply put, pension funds and insurance companies historically invested large portions of their portfolios in "investment-grade" corporate and government



bonds that generated long-term interest and principal payments with low risk. Global central bank response to the 2008 financial crisis focused on lowering interest rates to stimulate investment and growth. This has resulted in zero or near-zero interest rates (and in some cases negative interest rates), which reduces income to these investors and challenges their ability to meet their long-term obligations to their beneficiaries.

To offset the reduced income, long term investors, like pension funds, insurance companies, sovereign wealth funds, university endowments and foundations have been seeking to replace the lost income with low-risk, cash generative investments. Infrastructure has been the primary beneficiary, as infrastructure assets are long-lived, provide essential services, are protected through regulation and are highly cash generative.

There has been some discussion among investment professionals whether investor interest in renewables in particular and infrastructure in general will continue if interest rates rise. That is, will investors switch from renewables and infrastructure back into government and corporate bonds as interest rates rise? It is a fair question, and it might happen, but there are good reasons for this not to happen:

- Rising interest rates are generally a response to rising inflation. By contract or regulation, infrastructure revenues and tariffs are often tied to inflation, making infrastructure a good investment in inflationary times. Similarly, the value of infrastructure assets and their replacement costs tend to rise with inflation (just like housing price). In contrast, most bonds offer fixed interest rates and inflation erodes the value of bond principal.
- Debt and equity capital markets are volatile, and the value of stocks and bonds fluctuates daily and moves with economic cycles. Infrastructure tends to be unlisted, and is used regardless of economic cycles thus offers less volatility.
- Infrastructure is an established asset class, and there is no precedent for turning away from an established asset class. From the 1920s through the 1970s most institutional capital was invested in listed stocks and bonds and real estate, with stocks and bonds accounting for about 90% of investment. The private equity or “alternative” investment world did not exist at any scale. Today, private equity and venture capital investments typically account for 5-10% of pension fund and insurance company portfolios, and allocations are growing. In 2000 infrastructure funds were classed with private equity funds and investors did not have infrastructure allocations. Today it is not unusual for pension funds and insurance companies to allocate 5-10% of their portfolios to infrastructure, in addition to similar allocations to private equity and venture capital.³
- The growing global demand for infrastructure, whether new or replacement for ageing existing infrastructure.

The search for cash yielding investment coincides with the rise of sustainable and ethical investment objectives, including the growing fossil fuel divestiture movement. The confluence of these two trends has dramatically increased investor appetite for clean energy investment

Renewable energy projects, especially utility-scale renewables, and related infrastructure such as transmission lines and distribution grids squarely fit with global investors desire for cash generative low risk investments, as they:

- Employ proven technology
- Provide an essential service
- Are supported by long-term contracts or tariffs (which are often linked to inflation) that provide an assured revenue stream
- Pay regular and predictable dividends that are good match for pension and insurance obligations
- Offer returns superior to bonds with a low risk profile
- Are supported by favourable regulation

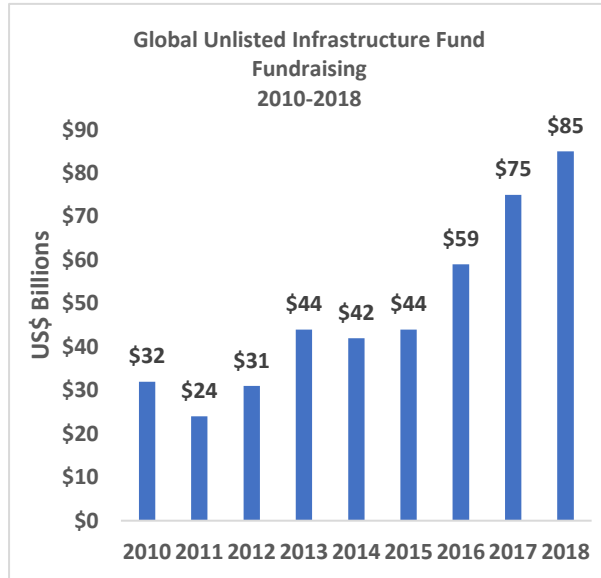
³ Source: Prequin, Infrastructure Investor, Two Lights Energy Advisors

- Are increasingly subsidy free
- Meet sustainable and ethical investment criteria

Renewable Energy Investment Growth Covers the Entire Capital Spectrum

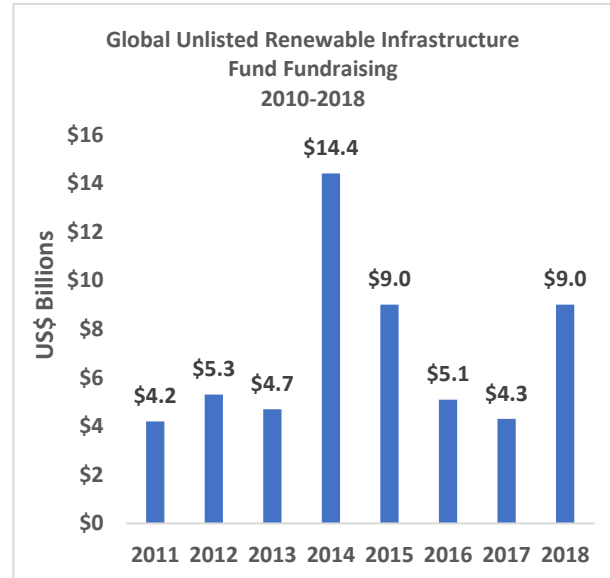
This growth in investor appetite for sustainable investment and renewable energy covers the entire capital spectrum – from green bonds and bank loans, to infrastructure funds that invest in renewable energy and new investment vehicles such as the renewable energy “Yieldco”. The following charts show sustainable and clean energy investment growth in listed and unlisted debt and equity markets, bank project finance and multilateral development banks.

FIGURE 12:



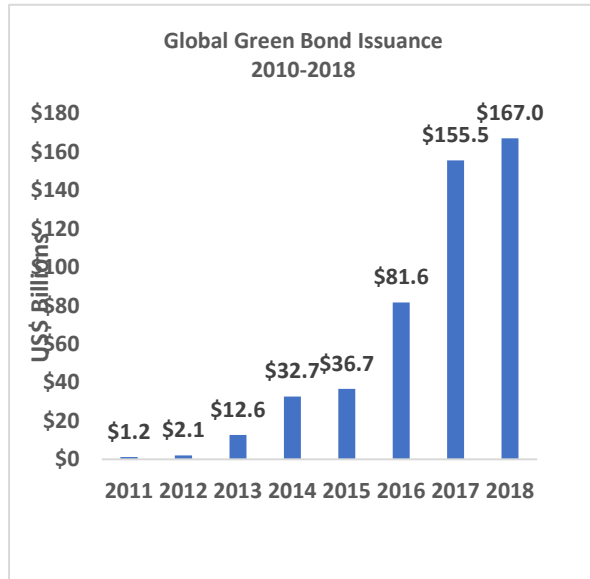
Source: Preqin

FIGURE 13:



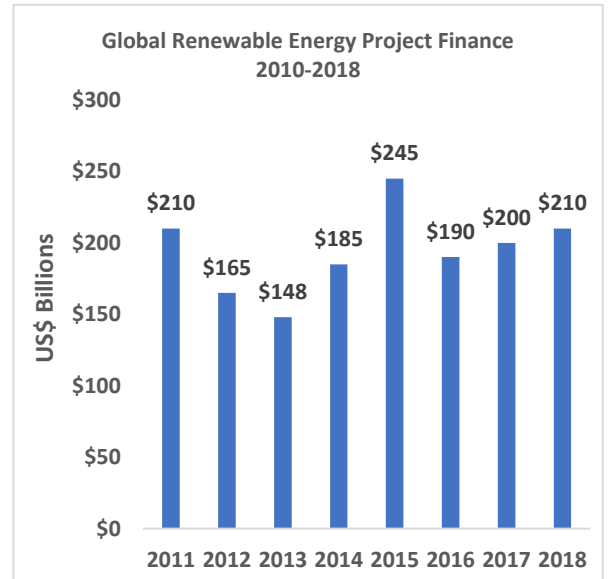
Source: Preqin

FIGURE 14:



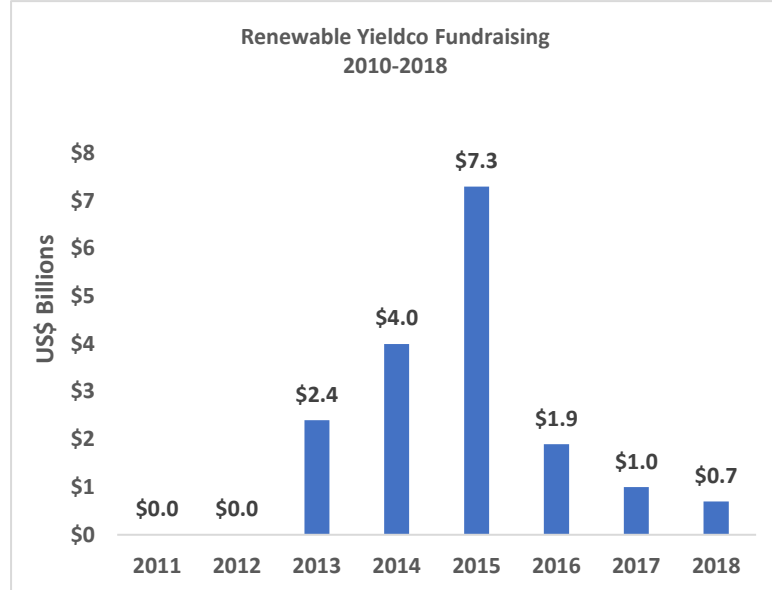
Source: Clean Energy Pipeline, Climate Bond Initiative, RBC Capital

FIGURE 15:



Source: Bloomberg New Energy Finance, Clean Energy Pipeline

FIGURE 16:



Source: Marathon Capital, Climate Policy Group, Bloomberg New Energy Finance

The key takeaway from these charts is that the appetite for renewable energy and clean investment has increased across the entire capital spectrum - debt and equity, listed and unlisted, retail and institutional – and that capital is flowing to countries around the world. In short, there has never been more interest and appetite for renewable energy finance.

Some insights behind the figures:

Unlisted General and Renewable Infrastructure Funds. Between general infrastructure funds and dedicated renewable energy funds, for the last few years renewable energy investments have accounted for more infrastructure investments than any other global infrastructure sector. ⁴The principal investors in these funds are pension funds, insurance companies, family offices, endowments, foundations and sovereign wealth funds. But their commitments to funds are only part of the story. Many of those same institutional investors are making investments in renewable projects and companies directly, bypassing funds. For example:

- Allianz and Munich RE have established dedicated renewable investment teams and have collectively committed over \$5 billion to EU and US Renewable Energy Projects
- Dutch Pension Fund APG has committed made direct investments in more than \$1 billion of EU renewable energy projects
- Danish pension funds PKA Pension and PensionDanmark have invested over \$1 billion in EU offshore wind and biomass projects
- Canadian Pension Funds CDPQ, PSP, OMERS and several others have collectively invested more than \$1 billion in investments in US and EU renewable projects.

Green Bonds Although most green bond issuances are refinancing existing debt of renewable projects and companies rather than financing new installations, their rapid growth demonstrates a growing appetite for sustainable

⁴ Prejin online infrastructure database

investments by many global institutional investors. Some of the capital released by green bond refinancings is being reinvested in new renewable energy projects. 2019 green bond issuance is expected to exceed \$150 billion.

Project Finance. Project finance consists mainly of long-term loans from commercial banks, and increasingly from pension fund and insurance companies. There are over 50 global commercial banks, such as Mitsubishi UFJ, Barclays Bank, Bank of America, KfW Bank, Rabobank, NordLB, DNB Nor, BNP Paribas, Deutsche Bank, Key Bank, HSBC, Mizuho, Sumitomo, Investec and Rabobank who are actively lending to renewable projects. Like equity investors, they are attracted to the proven technology and low risk of renewables.

Yieldcos. Yieldcos sprang onto the scene in 2013. The Yieldco concept was modelled on listed real estate investment trusts (REITs) and Master Limited Partnerships, which are used in the United States to hold low risk infrastructure assets. They were conceived as low risk, income producing investment vehicles that pay regular annual dividend from operating renewable energy assets. In the UK, which still boasts a strong Yieldco market, they were sold as very low risk, income producing investments; and they have delivered. In the US, they were sold as a mixed growth and cash yielding investment. Unfortunately, in the US, some of the Yieldcos were too aggressive and lacked poor governance, resulting in poor performance which became apparent in 2015. For now, the US market is closed to new Yieldcos, But the more conservative UK market has proven to be durable, and continues to bring renewable energy

RECENT TRENDS IN RENEWABLE AND CLEAN ENERGY INVESTMENT

The emergence of renewable energy as mainstream investment coupled with the increased investment demand for long-term, cash generative infrastructure investments, is creating new trends in investment, in particular the emergence of pension funds, insurance companies and sovereign wealth funds as long-term investors, looking for sound investments not subject to the volatility of listed equities driven by the next quarterly earnings report.

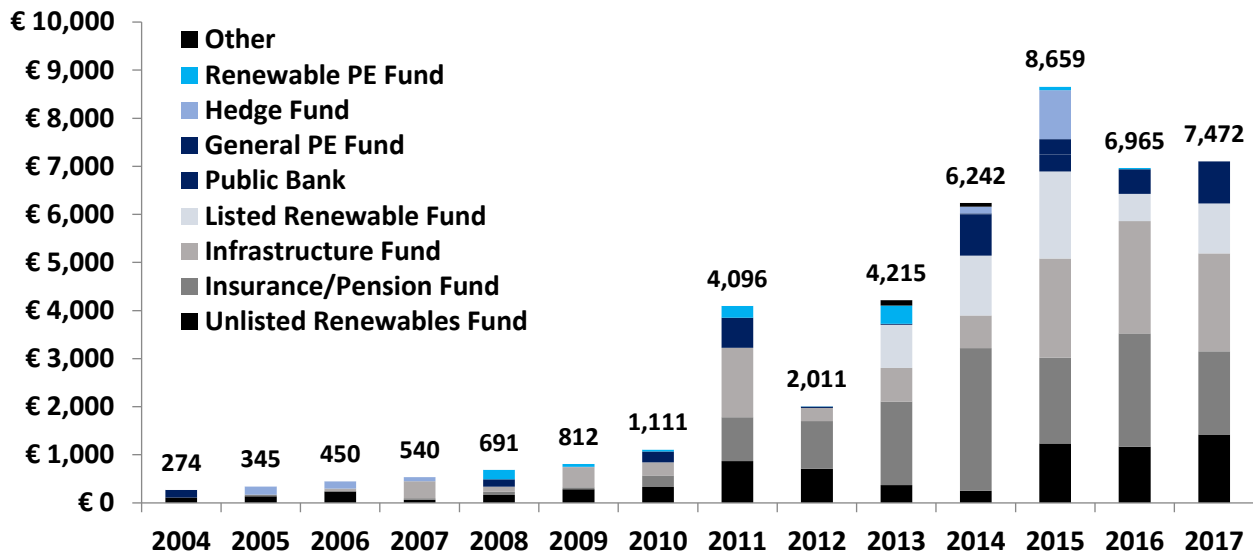
Increasing Number of Long-term, Yield-Seeking Investors

The evolution of institutional equity investment in EU renewables illustrates several trends, the most important of which is the increase in long-term investors. The following chart shows the overall institutional equity investment in EU renewable energy projects shown above at Figure 10, but broken down here by the types of investors.

This chart reflects institutional investor equity capital for EU renewable energy projects. Most of these projects were also financed with bank project financing, which means that the total investment supported by that equity was, on average, 100-150% greater than the equity invested. Before 2004 and continuing through 2010, most of the capital for the sector came from debt project finance with equity coming from utilities and frequently individual investors through tax-advantaged schemes marketed to high net worth individuals. As the average wind or solar project at that time was relatively small, this worked to deliver those projects.

However, during the second half of the 2000s the size and volume of projects increased, and the high net worth markets were saturated. At the same time, Europe's electric utilities began to suffer economically due to falling demand from the financial crisis, over-levered balance sheets from ill-advised acquisition sprees and falling power prices. The lack of appetite from traditional investors coincided with institutional investors broadening their infrastructure investment mandates in light of low interest rates and a growing track record of successful renewable energy investments proving the renewable investment case. The following table shows the result:

FIGURE 17: Institutional Investor Equity Investment in EU Renewable Energy Projects 2004-2017
By Investor Type (€ Millions)



Source: Two Lights Energy Advisors, HgCapital, Asper Investment Management

In 2004-2006, there were fewer than 10 active EU institutional equity investors, most of which were private equity-style funds seeking high returns and focused on holding investments for 3-5 years and then selling for a profit. On 2006 Allianz became the first institutional investor investing directly for long term income. This remained the market configuration through 2010, when Munich Re joined Allianz as a long-term investor. That year also saw general infrastructure funds increase their activity, but these funds also were not long-term investors.

Looking at the red bar, starting in 2011 long-term pension funds began to step up their activity, becoming half of the market by 2014. In 2013 the long-dated Yieldcos came on the scene, as did the UK Green Investment Bank (listed above under Public Bank), another long-term investor. In 2015 the first true long-term general and renewable infrastructure funds (compared to the earlier limited life private equity type funds) came on the scene. By 2016 there were over 55 active long-term investors in EU renewable energy projects, accounting for over about 40% of the total project equity market. These trends are being replicated globally

This growth in investors had led to competition for deals which has lowered capital costs. Further, as long-term investors seeking yield instead of capital gains, they have further lowered the cost of capital. There is little published data on investor return expectations, but expert observers and bankers believe that the cost of equity fell, on an ungeared basis, from 12-15% in 2004 to 6-8% today. This reflects not only the amount of capital seeking to invest, but also the recognition that the risks associated with renewable have fallen dramatically.



TWO LIGHTS ENERGY ADVISORS

Two Lights Energy offers investors and project sponsors a wide range of investment and strategic advice in the global energy infrastructure sector, with a focus on renewable energy and conventional power investments. Two Lights Energy is uniquely positioned to provide the increasing number of pension funds, insurance companies, infrastructure funds, family offices and other investors making direct and indirect infrastructure investments. We provide a full suite of advisory services to projects and investors, however, focus on augmenting internal and external investment teams and investment and credit committees, by acting as a knowledgeable “independent investment committee” member; bringing to bear 25+ years of experience from reviewing and executing hundreds of renewable energy and conventional power investment opportunities across multiple technologies, geographies and business and commodity cycles.

TOM MURLEY

Tom is one of the most visible faces in European and global renewable energy investing and is a leading advocate for increased institutional investment in energy projects and infrastructure. He has participated in the financing and acquisition of over \$10 billion in energy projects. Tom’s 25 years of leadership and experience covers the entire range of infrastructure and renewable energy investment; from raising capital for infrastructure investment funds, originating and executing equity and debt investments in renewable and conventional energy projects, managing and selling operating renewable energy portfolios, serving on investment committee and portfolio company boards, to advising European governments on renewable energy and infrastructure policies to maximize private sector investment. Tom’s experience includes:

- In 2004, he founded the renewable energy fund business for HgCapital one of Europe’s leading private equity houses, marking HgCapital as one of the first European private equity firms to invest in renewable energy infrastructure.
- In 2012 he was appointed to the inaugural board of directors of the UK Green Investment Bank, the world’s first green investment bank. Tom served on the board and the investment committee until the bank was privatized in August 2017.
- In October 2016 he was appointed to the board of Ameresco, a NYSE listed diversified energy services company and developer of renewable and combined heat and power projects in the United States and Europe.
- In May 2018 he was appointed to the board of the newly formed Gore Street Energy Storage Fund, the world's first listed fund for battery storage projects.

Tom is also an expert on the intersection of renewable energy and infrastructure investment trends and renewable energy policy, renewable energy subsidies and energy market design and regulation. He has advised the European Union, the UK Government and several other governments on structuring energy investment policies to attract institutional investment, including testifying to the UK Parliament’s Climate Change Committee on the state of institutional investment in renewable energy projects. He has been a frequent speaker at European Union, United Nations and other energy seminars and conferences. Tom is active in industry and investor organizations. He has served on the boards of the Institutional Investors Group on Climate Change and the Norwegian Wind Energy Association. He has chaired the Sustainable Energy and Environment Committee of the British Venture Capital and Private Equity Association and has served on finance committees of WindEurope, the Swedish Wind Energy Association and Renewables UK.

Tom also teaches a practical course in Project Finance Law in the Master of Banking and Finance Law program at Boston University School of Law in Boston, Massachusetts.