NORGES BANK
INVESTMENT MANAGEMENT

04|2015

RENEWABLE ENERGY INVESTMENTS

DISCUSSION NOTE

The market for renewable energy investments has grown markedly over the last ten years, and is a market in constant change. In this note we look closer at infrastructure investments in renewable energy. Our objective is to provide an overview of the opportunity set, key risks and return drivers from the perspective of an institutional investor.

Date 08/12/2015
ISSN 1893-966X

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SUMMARY

Renewable energy is an important part of the green infrastructure market. Green infrastructure can be defined as the essential physical infrastructure systems that underpin development of a low-carbon society. There are substantial investment needs in energy supply infrastructure and energy efficiency systems globally. Climate change concerns have inspired efforts to increase the share of power produced from renewable energy.

In many OECD countries, investments in renewable energy replace other more conventional types of energy, whereas in emerging markets, these investments often come as a response to a growing demand for energy. Many governments have renewable energy support policies in place to reduce the cost of capital for these low-carbon investments. In addition, the cost of renewable energy technology has fallen markedly. Technologies such as onshore wind and solar energy production are already the cheapest form of new power generation in several markets.

Infrastructure investments generally expose investors to a number of different risks, including demand, construction, operational and social risks. There are also specific risks that apply to renewable energy investments, of which the risk of a sudden or unpredictable change in policy and regulatory frameworks is the most important. In addition, there is a technology risk in some projects, as low-carbon projects are not always based on well-proven technology. For renewable energy projects, there is also volume risk related to the amount of wind or sunshine available at the plant, which determines how much energy the installation will produce.

The market for renewable energy investments has grown markedly over the last ten years, and developments in technologies and costs make it a market in constant change. This can create interesting investment opportunities for an institutional investor. The bulk of these opportunities is expected to materialise as unlisted investments. Unlisted renewable investments are illiquid and require a particular set of in-house skills on the part on the investor. The return from investing directly in these assets can be high, but the investment opportunities are heterogeneous and available return data is scarce. This implies that any generalisation of risk and return is difficult.

Introduction

Infrastructure covers a set of heterogeneous investment opportunities. The OECD defines infrastructure as the system of public works in a country, state or region, including roads, utility lines and public buildings. Infrastructure investments are direct or indirect stakes in businesses that own or operate these assets. Infrastructure assets are often grouped according to physical characteristics, cash-flow properties, contractual approach, maturity of the asset, or stage of market development.

Demand for capital to fund infrastructure generally arises from a need to renew ageing infrastructure assets in mature economies, and a need to expand capacity in emerging markets. At the same time, government capability to supply the necessary capital is limited. The result has been widespread recognition of a significant infrastructure funding gap. Investors considering investing in infrastructure assets can choose from a wide spectrum of investment vehicles.

Green infrastructure is also often referred to as low-carbon infrastructure. The OECD defines low-carbon infrastructure as "the essential physical infrastructure systems that underpin development of a low-carbon society". Examples of green or low-carbon infrastructure include power generation from solar, wind, small hydro, geothermal, marine, biomass and waste energy sources. There is a major debate about what sources should be considered clean energy. Renewable energy is defined as an energy source that can regenerate and replenish itself indefinitely. Nuclear energy is also considered a green energy source by some parties. However, the International Renewable Energy Agency (IRENA) does not support nuclear energy programmes "because it's a long, complicated process, it produces waste and is relatively risky". The focus in this note will be on investments in commercially scalable renewable electricity generation projects, as this is where the majority of institutional investment activity is occurring. We will discuss economic, financial, political and technical aspects of investing in the renewable energy field from an institutional investor's perspective. The note is part of a wider assessment of infrastructure investments for long-term investors[1].

Concerns about climate change have inspired efforts to increase the share of energy produced from renewable energy sources. The International Energy Agency (IEA) estimates that 53 trillion dollars in cumulative investment in energy supply and energy efficiency is required over the period to 2035 in order to keep global warming below 2 degrees. These projections imply annual investments of roughly 2 trillion dollars, or 2 percent of global GDP per year up to 2030. Although the amount invested has increased over the past few years, the actual invested volume of 1 trillion dollars still falls short of what is deemed necessary. Based on this, one could argue that there is a climate investment gap of 1 trillion dollars per year.

It is widely expected that government budgets alone will not be sufficient to close the climate investment gap. First, the pledged amount of 100 billion

1 *Discussion Note 2-2013 "Infrastructure investments", Discussion Note 5-2015 "Infrastructure investments in less mature markets".*

dollars per year for mitigation and adaptation actions[2] in developing countries is only a fraction of what is required. Second, in the aftermath of the global financial crisis, industrialised countries have been confronted with budget constraints at home. Against this backdrop, governments and international finance institutions have launched a number of initiatives that aim to "crowd in" private capital. Countries have adopted a variety of mechanisms to produce the policy mix best tailored to their national circumstances. In early 2015, 164 countries had renewable energy targets, and 144 countries had renewable energy support policies in place aimed at reducing the cost of capital for low-carbon investments[3].

Many of the more developed markets have established subsidies – feed-in tariffs[4], green certificates[5] or tax incentives. These structures have historically provided a high degree of certainty over the future revenues of renewable energy projects and have therefore helped to reduce financing costs, and thereby also the total cost per megawatt-hour (MWh) of wind and solar. It is worth noting that, despite these efforts, fossil fuels continue to receive subsidies, through both direct and indirect channels. Globally, the value of fossil fuel consumption subsidies amounts to around four times the value of subsidies to renewable energy[6].

The market for green infrastructure investments

The United Nations Environment Programme (UNEP) identifies three different types of projects for green investment[7]:

I. Energy efficiency improvements in corporate operations and production processes

II. Projects that climate-proof existing infrastructure

III. Large-scale renewable energy infrastructure projects, similar to many other large infrastructure projects

Energy efficiency-type projects have traditionally been financed on-balance-sheet and are financially distinct from the more capital-intensive conventional infrastructure investments. Energy efficiency projects are often fragmented, with many small-scale projects each requiring funding. In practice, the opportunity for institutional investors to commit significant amounts

2 The commitment made by industrialised countries at the United Nations Climate Change Conference (COP 16) to provide 100 billion dollars per year from 2020 onwards for mitigation and adaptation actions in developing countries.

3 REN21 (2015).

4 A feed-in tariff provides developers with long-term purchase agreements with a specified price for the electricity produced from renewable energy sources.

5 A tradable commodity proving that certain electricity is generated using renewable energy sources. One certificate represents generation of, for example, 1 MWh of electricity.

6 IEA (2015a).

7 UNEP (2014).

of capital to such projects will be limited. For the second group of projects, "climate-proofing" of existing infrastructure, it may be challenging monetising any "climate-proofing" benefits into cash flows. When the infrastructure is publicly owned and publicly managed, governments usually provide financing obtained from fiscal revenue or commonly used debt instruments such as municipal bonds.

For an institutional investor, large-scale renewable energy infrastructure projects are the most relevant type of projects to commit funds to. These projects potentially offer many of the attributes of "core" infrastructure assets such as downside protection, steady cash flows and long duration. From a liability-hedging perspective, the inflation-linked payment streams that renewable projects with power purchase agreements (PPAs) can provide may be particularly attractive. As with other major infrastructure investments, these investments are capital-intensive and often financed as standalone projects.

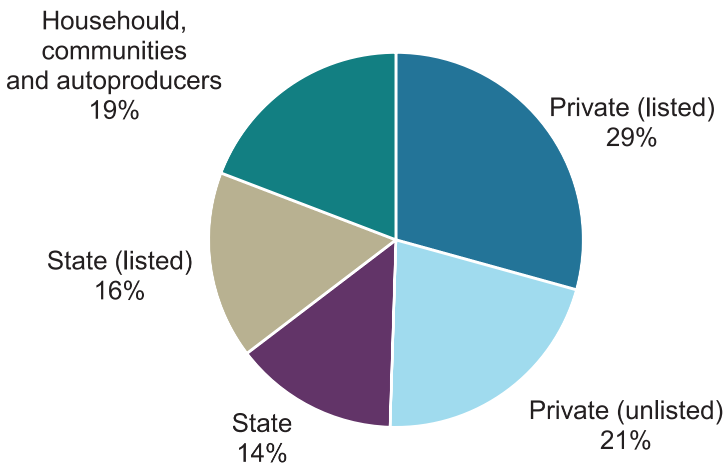
There are two main ways to fund these large projects: on-balance-sheet financing of projects by utilities, independent power producers and developers, and off-balance-sheet financing through the use of project finance. These structures refer to equity and debt, including loans, for large infrastructure projects that are repaid from the cash flows generated solely by the project. In project finance, equity investors, banks and other lenders invest money in a single infrastructure project. This single project is incorporated in a special-purpose vehicle (SPV). On the equity side, a project is financed off-balance-sheet by industrial developers, public entities and other providers of capital (known as project sponsors), while debt is provided on a non-recourse or a limited-recourse basis. The assets of the SPV become collateral for the loans, although they play a secondary role compared to the project cash flows. Investors interested in a specific project can therefore focus their valuation on just one given transaction. Still, an investor needs to be of a certain scale, as transaction costs can be high, and investing directly requires significant resources and specialisation. Because of high transaction costs, project finance deals should have a minimum size to be considered economic. High transaction costs also require a long holding period. In 2014, non-recourse project finance made up around 50 billion dollars of the 170 billion dollar market for utility-scale renewable energy projects (projects larger than 1 MW).

Current investment trends

The evolution of power sector investments over the last decade has varied considerably by region, reflecting differences in electricity demand growth, resource endowments, policies and competition between technologies. In non-OECD countries, power sector investment, including renewables, has been driven mainly by the need to meet fast-rising electricity demand, which has grown at an average annual rate of 6.5 percent over the past decade. This strong growth in demand for electricity stands in stark contrast to circumstances in OECD countries, where demand growth for electricity has been sluggish, at around 1 percent per year over the past decade. In OECD countries, policies to support investments in renewables were designed to support a transition towards cleaner sources of energy.

Over the past decade, private investors have replaced governments as the most important source of capital for renewable energy projects, see Chart 1. This growth is the result of two factors: technological improvements that have led to increased reliability and declining costs, and renewable energy policies that have created new market opportunities, which in turn have spurred private sector investments. Utilities and other power companies are well placed to invest in large renewable ventures such as hydropower projects, offshore wind farms or large-scale solar parks. They have the opportunity to raise capital for their entire portfolio of operations and investments, rather than for an individual project. The expansion of distributed renewable energy capacity such as rooftop photovoltaic (PV), small hydro or small onshore wind farms has also provided opportunities for new investors such as project developers, households, small businesses and specialised power companies to deploy capital. Particularly in Europe, the ownership of non-hydro renewables by municipalities, small businesses and households is high, while in the US and China, expansion of renewables has mainly been driven by established utilities.

Chart 1 Ownership of renewables



Source: IEA World Energy Investment Outlook (2014)

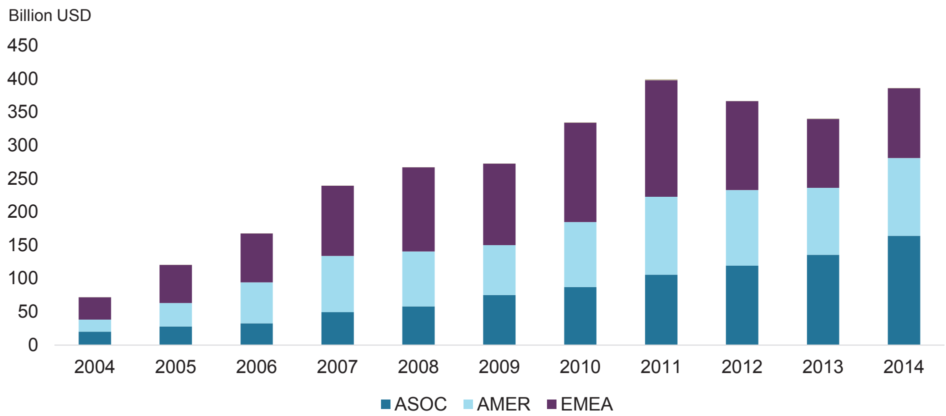
Renewable energy investments constituted only a small part of total energy investments until the early 2000s. The adoption of the Kyoto Protocol in early 2005 triggered a growth in mainstream renewable energy investment around the world. This investment growth took place in the 2000-2007 period, which has been described as a golden age for alternative assets[8]. Institutions looked for investment opportunities to help offset weak equity markets and low interest rates, combined with ample availability of credit. The global financial crisis in 2008 seems to have had a limited overall impact on the renewable energy investment market globally, as these investments recovered as early as 2009 and continued to do so until 2011. In 2010, global investments in new renewable energy projects exceeded investments in new fossil fuel-based plants for the first time. In total, renewable energy represented approximately 59 percent of net additions to global power capacity in 2014, with significant growth in all regions. Wind, solar PV and hydro dominate the market. Globally, the market for renewable energy have ranged from

8 *WEF (2014).*

350 to 400 billion dollars per year in recent years, as seen in Charts 2 and 3. These numbers include new investments in renewable energy (ranging from 270-320 billion dollars since 2011) as well as acquisition transactions (ranging from 70-90 billion dollars since 2011).

Chart 2 shows that investments in Europe, the Middle East and Africa (EMEA) have been falling in recent years. Investments in Europe more than halved between 2011 and 2013, as the effects of policy uncertainty and retroactive tariff changes in some countries took effect. Recent years have seen China outweigh Europe for the first time as a centre for renewable energy investment. China is the largest installer of wind capacity in the world, and China's solar manufacturing sector has been the largest in the world for several years. However, it has only been since 2010 that China's own use of solar power has taken off.

Chart 2 Investment trends by region.



Source: Bloomberg New Energy finance (BNEF) database

Investments in renewable power and fuels are dominated largely by wind and solar. Globally, wind power has maintained a stable share of clean energy investments whereas solar energy has seen a sharp rise in its share of total investments, as seen in Chart 3. Most solar capacity investment in 2014 occurred in developed economies, while developing economies had the largest share of spending on wind power projects.

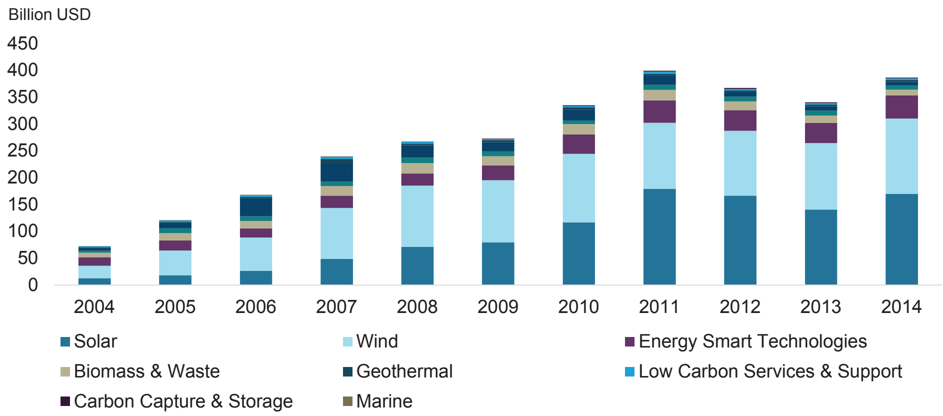
Onshore wind and solar PV are the technologies closest to being competitive with other sources of energy without subsidies. In the five-year period to 2014, the worldwide average levelised cost of electricity (LCOE)[9] declined by 53 percent for solar PV systems, and by 15 percent for onshore wind turbines. Wind has become the most competitive new power-generating capacity in an increasing number of markets, and new markets continue to emerge in Africa, Asia and Latin America. The leading countries for total wind power capacity per inhabitant are, however, still European countries[10]. Wind is already the cheapest form of new power generation capacity in Europe, Australia

9 LCOE is a summary measure of the overall competiveness of different generating technologies. It represents the cost per kilowatt-hour (in real dollars) of building and operating a generating plant over an assumed financial life and duty cycle (EIA definition).

10 Denmark, Sweden, Germany, Spain and Ireland.

and Brazil. There are, however, variations in this picture: even within the same country, specific issues such as grid connection costs and availability of existing infrastructure impact the competitiveness of different technologies. The quantity of the renewable resource itself can also vary greatly from site to site.

Chart 3 Investment trends by sector.



Source: Bloomberg New Energy finance (BNEF) database

For offshore wind, the vast majority added (88%) was in Europe[11]. The offshore wind industry differs technologically and logistically from onshore wind. Most offshore wind construction is still led by utilities. Still, some developers are now prioritising offshore wind and leveraging expertise to develop a series of projects. The cost of installation and grid connections for offshore wind projects, coupled with the ability to build large-scale projects without land constraints, means offshore projects gain substantial economies of scale. This explains the large average size of projects in this segment. Europe saw seven projects in excess of 1 billion dollars reaching the "final investment decision" stage during 2014; among them a 3.8 billion dollar project, the largest for a renewable energy plant anywhere in the world[12]. The main challenge for the offshore wind industry is reducing costs, as they are generally about 50-60 percent higher than for onshore wind. However, over the last 20 years, offshore wind has moved from a relatively experimental venture to a more mature industry.

Trends going forward

The market for renewable energy investments has grown markedly over the last ten years, and renewables are playing a growing role in the global power mix. Projections[13] suggest that over 54 percent of power capacity in OECD countries will be renewable energy capacity in 2040, up from one-third today.

The IEA[14] predicts that most developed countries will have moderate or even negative power demand growth due to energy efficiency and a weaker link between economic growth and electricity consumption. On the other hand,

11 REN 21 (2015).

12 Excluding large hydro projects.

13 BNEF (2015b).

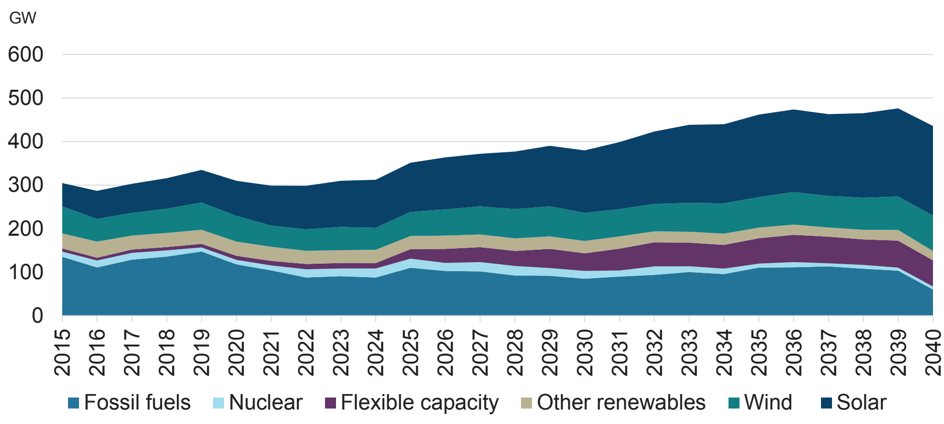
14 IEA (2014b).

developing countries will add nearly three times as much new capacity as developed nations, and around half of the additions will come from renewable technologies. The main driver behind power capacity additions in these markets over the next 25 years will be consumption growth, which stems from their current low electrification rates, growing population and economic expansion. Projections with this time horizon are, however, associated with considerable uncertainty.

Today's government support for renewable energy is split between systems that give direct support, such as feed-in tariffs, and market-based mechanisms, such as auctions and green certificate schemes. Going forward, supportive policies are likely to be replaced gradually by competitive market-based tenders, as costs are expected to decline further. According to Bloomberg New Energy Finance (BNEF) projections, project costs will come down by an average of 32 percent for wind and 48 percent for solar by 2040. BNEF also predicts that solar will dominate new-build power capacity around the world. The main driver behind this is its increasing cost competitiveness. As seen in Chart 5, the cost of solar is projected to continue to fall over the period 2014-2040.

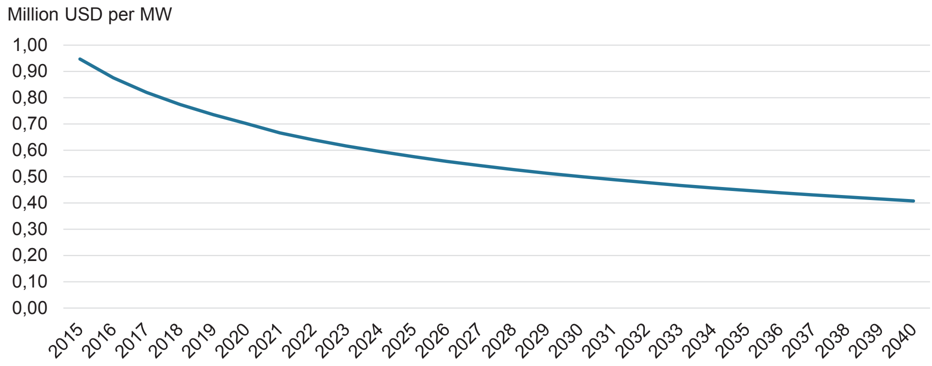
Over the next 25 years, BNEF forecasts that around 12.2 trillion dollars will be invested in new power-generating capacity worldwide. This is an average of 469 billion dollars a year, and the projections suggest that two-thirds of these funds will go to renewable energy, as seen in Chart 6. Asia Pacific is expected to be the major driver of growth, adding more capacity over the period 2015-2040 than the rest of the world combined. Thanks mainly to China and India, the region will account for 55 percent of new solar, 63 percent of new wind and two-thirds of new nuclear capacity in the period to 2040. According to BNEF, the rest of the world, which includes Russia and Eurasia, will not see the same degree of renewables growth as in other regions. Instead, nearly three-quarters of new generating capacity will be based on coal and gas as these countries seek to exploit domestic resources.

Chart 4 Projected annual capacity additions 2015–2040.



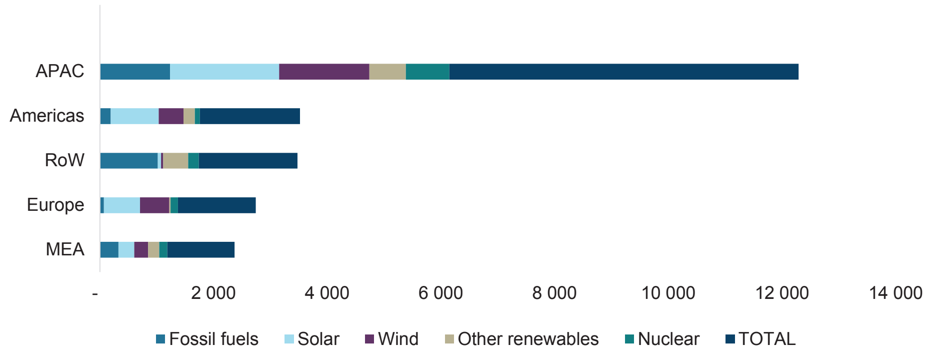
Source: Bloomberg New Energy finance (BNEF) database

Chart 5 Projected cost solar PV equipment 2015–2040.



Source: Bloomberg New Energy finance (BNEF) database

Chart 6 Capital investment by region and by technology Forecast 2015–40 (USD bn, real)



Source: Bloomberg New Energy finance (BNEF) database

Enabling a shift in the energy mix

The growth of renewable power generation faces a mixture of old and new barriers in the electricity systems. Some of the issues arise because of the intermittency of renewable energy. When the sun is not shining or the wind is not blowing, energy needs to come from other sources. The power system will need to adapt to a growing share of variable electricity production while ensuring a stable electricity supply. A larger share of renewable energy will require more flexible capacity, such as demand response, storage, firm capacity or greater interconnection, in order to guarantee grid stability. Natural gas and hydro power are the most likely replacements, as both nuclear and coal plants require more time to start up and shut down, and also at higher costs. In contrast, when the sun is shining at peak times or wind capacity is fully utilised, demand must increase to match the excess supply of power to balance the grid. Due to the high cost of cutting base demand, and the priority given to renewable energy, prices can turn negative at times with high renewable utilisation.

The intermittency of renewable energy and its increasing share in the power mix will drive the development and commercialisation of energy storage. This could be in the form of batteries for overnight, hydrogen and pumped hydro for seasonal, and (renewable) gas for long-term storage. The electrification of transport could further accelerate the development of storage, facilitating an increasing share of renewable energy in the power mix. The market for these technologies is still limited, but the increasing share of renewables could lead to commercialisation of these technologies. There is likely to be a positive feedback loop between utilities requiring more storage and electrification of transport lowering the cost of storage.

Wind projects are usually situated in windy locations, and some of these may be along coasts or up on mountains, far from main population centres or the existing electricity network. Utility-scale solar projects may be located in deserts or other dry areas inland, also far from cities or existing transmission hubs. The cost of linking these projects to the main grid could be substantial. Although rooftop PV projects now produce power at prices competitive with residential electricity prices in some countries, their owners rely on the main grid to provide power when the sun is not shining. In some areas, the main grid is simply not capable of supporting the growing share of energy from renewable energy sources. The EU's energy infrastructure, for example, is not suited to support a large-scale deployment of energy from renewable sources in its current state, and the development of new energy transmission infrastructure in Europe will require investments of about 140 billion euros in electricity and at least 70 billion euros in gas[15].

The enablers for a shift in the energy mix to more renewable energy could present some interesting investment opportunities.

Risks to investing in renewable energy projects

The risks associated with a specific infrastructure project arise from the nature of the underlying asset itself and the environment in which it operates. Investors' exposure to these risks depends on the design of the contract, which part of the capital structure the investor has invested in, and how this exposure is structured. Another important risk for investors is the inherent illiquidity of the investment.

Risks also vary across the life of the project. Some risks are important only early on in the bidding process, while other risks will be present until the end of the project. The three distinct periods that affect risk in infrastructure projects are as follows:

- Project development phase (before bid submission and between bid submission and financial closing of the deal)
- Construction phase (greenfield investments)
- Operational phase (brownfield investments)

Infrastructure investments expose investors to a number of different risks, including demand, construction, operational and social risks. Examining these project-specific risks requires dedicated resources in the form of experienced infrastructure investors. Capital-intensive infrastructure projects have a number of distinctive features: (i) they require significant upfront capital

15 https://ec.europa.eu/inea/en/connecting-europe-facility/cef-energy.

and take many years to turn a profit; (ii) output is typically sold on the basis of long-term contracts; and (iii) regulatory risk, for example when it comes to permits, can be significant[16].

The risks specific to renewable energy investments need to be addressed. The policies implemented to compensate for the risk-return imbalance for many renewable technologies compared to conventional sources of energy, is a source of risk in itself. Uncertainty about this policy risk and regulatory frameworks will directly affect business opportunities, costs, risk and returns on investment. The long time frames required for infrastructure project development leave businesses and investors particularly vulnerable to policy or regulatory changes over the investment lifetime.

Policy uncertainty and overall market framework instability are perceived by developers and financial investors as the main risk in the development phase of projects. Any unexpected changes in subsidy regimes could jeopardise the profitability of the investment (e.g. retroactive support cuts). Spain is a frequently used example of the government significantly reducing its feed-in tariff (FIT) a year after the programme's start. It moreover suspended the FIT altogether in 2012 to contain costs to the government and other utility customers. This hit investors hard. The sustainability and predictability of the regulatory framework is a fundamental element of the risk assessment of any energy investment process. Subsidy regimes are often crucial to returns and apply to all stages of the project.

There is a history of unstable and unpredictable regulatory changes in many developed and developing countries alike. In general, governments retain the ability to change legal, regulatory or tax provisions at any time in ways that may substantially affect a project's financial viability. Policy interventions, sometimes in the form of regulation, may also greatly influence the way that markets and relative prices evolve. De-risking green investments to levels that are acceptable to investors can partially be achieved by using guarantees and innovative insurance products. Political-risk guarantees are particularly useful in developing and emerging markets. Policy-related risks can be mitigated through regulatory risk insurance or guarantees. The World Bank Group's Multilateral Insurance Guarantee Agency (MIGA) is one example of a political-risk insurance guarantee provider. Also, the US Overseas Private Investment Corporation (OPIC), for example, provides US investors with financing, guarantees, political-risk insurance and support for private equity investment funds to help mobilise private capital. OPIC also offers regulatory risk coverage specific to renewable energy projects. The aim of this type of insurance or guarantee is to reduce the risk inherent in investing in non-conventional technologies, in non-conventional regions, and to create a level playing field for alternative investment choices. Examples of risks covered could include material changes to feed-in tariffs, or revocation of the licences and permits needed to operate a project.

For renewable energy projects, the price risk is often mitigated by the regulatory framework or long-term contracts. Volume risk, in terms of how much energy the installation will produce, is then an important driver for income.

16 World Bank (2012).

For example, the amount of energy from a wind farm will depend on the weather conditions on site. Changes in these conditions may result in both higher revenue volatility and lower energy production than expected. The income stream from a specific project can also be affected by downtime at the plant (technical availability that is lower than expected), as well as electrical and grid losses. When the guaranteed feed-in period or power purchase agreement ends, the plant may still have some residual value, for example additional cash flows from the plant's remaining life. The value will also depend on land lease terms such as renewal options, and whether permits are still valid. In addition, there may be requirements that the plant has to be dismantled and the land restored to its original state. This could entail substantial costs and must be taken into account by the investor.

Technology can also be a barrier for large institutional investors financing clean energy projects. Technology risk is the risk of an installed system not working as specified. For existing electric utilities, this risk is mitigated by extensive experience in building power plants, and by performance guarantees issued by engineering and construction firms. Existing infrastructure is based on old, well-proven technology, usually deployed on a large scale. Low-carbon projects are quite different. In many cases, there is little data about the long-term performance of these systems: they are not always "utility-scale", their value is uncertain, and they are therefore perceived to be risky. This is obviously the case with technologies still in the development stage (such as wave and tidal power) but applies in some cases even to clean energy projects such as wind and solar, the ones that are close to cost parity with conventional technologies.

How can long-term institutional investors build exposure to the renewable energy sector?

An investor can build exposure to renewable infrastructure through a wide variety of channels. Investment could be in debt or equity, indirect corporate investments through stocks and bonds, direct project investments, or investments through funds.

Debt instruments

Due to liability-hedging requirements, bonds have traditionally been the asset class favoured by OECD pension funds and insurance companies, which in 2013 invested on average 53 percent and 64 percent, respectively, of their portfolios in bonds[17]. As a consequence, efforts have been focused on developing fixed-income instruments such as bonds, to encourage greater institutional investor participation in sustainable energy infrastructure investments. One approach has been the development of bonds labelled "green" bonds. These are broadly defined as fixed-income securities issued by governments, multi-national banks or corporations in order to raise capital for a project which contributes to a low-carbon, climate-resilient economy. They may be asset-backed securities tied to specific green infrastructure projects, or bonds issued to raise capital that will be allocated across a portfolio of green projects. The securitisation of an asset can turn an initially illiquid investment into asset-linked green bonds that are easier to trade.

A consortium of banks, representing eight of the top ten corporate bond underwriters, released its Green Bond Principles in January 2014. These principles establish voluntary guidelines on what constitutes a green bond, the potential types of bond, the issuance process, and the need for companies to detail their plans for the proceeds. However, the principles for green bonds are voluntary, and theoretically, any bond could be labelled a green bond at the discretion of the issuer. Green bond issuance reached a record high in 2014 of 39 billion dollars.

Institutional investors can also finance sustainable energy projects by providing private debt to projects (loans or bonds) or by purchasing privately-placed asset-linked green bonds. Loans for infrastructure projects are in many cases extended by a syndicate of banks rather than a single bank. Syndicated loans are common for the debt-financing of larger projects, as they allow the diversification of the large risk of a single project across a group of banks. Compared to syndicated loans, project bonds present some features that make them more attractive to institutional investors. Bonds are more standardised capital market instruments and show better liquidity if the issue size is sufficiently large to generate enough floating securities. Bonds can also be issued for longer maturities than the tenors of syndicated loans that banks normally accept. A project bond can be a straightforward bond whose creditworthiness depends on the cash flow performance of the special-purpose vehicle (SPV), or a secured bond assisted by credit enhancement mechanisms. As-

17 OECD (2015).

set-linked green bonds have credit ratings that are linked to the risk that the asset does not provide the expected levels of return on investment.

For a number of institutional investors, an investment-grade rating will be a requirement for investing. The limited performance history of revenues from sustainable energy projects can make it difficult to arrive at an appropriate rating of a project. Policy makers have addressed this challenge by providing publicly funded subordinated debt or loan-loss reserve facilities. An example is the EU's Europe 2020 Project Bond Initiative, where the European Investment Bank provides eligible infrastructure projects with a Project Bond Credit Enhancement (PBCE) in the form of a subordinated instrument to support senior project bonds issued by a project company. Hence, the credit rating of senior project bonds is lifted to a level that enables institutional investors to invest. It is designed to provide an alternative to financing projects through bank loans or public sector grants.

To account for the increased interest of institutional investors, a number of new trends have emerged in financial markets[18]. The available evidence on these trends indicates three alternative structures:

In the *partnership/co-investment model,* an institutional investor invests in infrastructure loans originated by a mandated lead arranger (MLA) bank. An MLA bank organises a syndicate and keeps part of the loans on its books, while selling the remaining portion to institutional investors. With this approach, an investor is able to build a portfolio of infrastructure loans and can rely on a deal flow provided by the originating bank.

The *securitisation model* is based on the creation of an SPV that purchases from banks' pools of infrastructure investments that become collateral for bond investors. The investors then buy asset-backed securities issued by the same SPV. The advantage of this model is that these kinds of loans structured as bonds can be tailored to the specific needs of institutional investors.

In the *debt fund model*, an institutional investor provides capital to a fund (resource pool) overseen by a manager that acts as a delegated agent for the investor with full responsibility for the selection and monitoring of the investments. This solution is, according to OECD, probably the easiest way to approach the infrastructure market for less experienced institutional investors that do not have dedicated investment teams for infrastructure assets.

Listed equity

Listed equity investments are the easiest way of getting exposure to renewable energy for most institutional investors. However, in many cases these investments have limited connection with the underlying infrastructure assets. Hence, this investment route does not necessarily provide the targeted risk-return characteristics such as bond-like returns, diversification and inflation protection. In addition, even though a large share of new investment projects are financed on corporate balance sheets, there are not many listed environment-related companies with a single business focus. There are a limited number of indices available in the listed market, such as the FTSE

18 OECD (2014).

Environmental Markets and MSCI Global Environment series. The companies in these indices provide products and services along the whole value chain of renewable and alternative energy, and also include many technological companies. The investable market capitalisation of relevant companies is relatively small.

The formation of yieldcos in the US has offered investors a more direct public route to infrastructure assets, although the number of yieldcos is still limited[19]. A yieldco is a publicly traded company that is formed to own operating assets that produce a predictable cash flow. In the UK there is a similar concept called listed project funds. The idea behind yieldcos is borrowed from the conventional energy industries: the oil, gas and coal industries in particular have utilised a similar concept with master limited partnerships (MLPs) for years. In the real estate industry, real estate investment trusts (REITs) offer a similar structure. With regard to yieldcos, existing power plants and projects are placed into a listed subsidiary. The power projects in the new subsidiary are tied to long-term and predictable power purchase agreements. The model offers developers cheap capital to build renewable energy projects, and – as interest rates have declined – the high-yield dividends promised by these vehicles have drawn the attention of both institutional and retail investors. Yieldcos vary by the portion of incoming cash flow that is paid out to investors and also by the extent to which they use leverage to acquire further assets. Hence, the yieldco label covers companies with significant differences in strategy and business risk.

Unlisted equity

In the unlisted space, an investor can choose a direct investment in the asset or invest indirectly through unlisted funds. Direct investments in renewable energy projects can offer stable and predictable cash flows, as renewable energy is not subject to fuel price volatility and often will be backed by long-term contracts with investment-grade counterparties – at least in developed markets. Direct investments give investors control over their infrastructure exposure. Investing directly in projects implies high transaction costs and requires a significant level of effort and specialisation on the part of the investor. The investor needs the ability to develop and maintain a team with experience in direct investing and knowledge of the sector. Most deals are bespoke and not traded on public markets, and the investors need to undertake the investment appraisal, analysis and due diligence themselves. In addition to the costs related to the direct investment team, there are transaction costs, legal fees, consultant fees and deal-sourcing expenses. The high fixed costs of having a direct investment capability imply that the direct investment portfolio must be of a certain size, or that the organisation will need to benefit from synergies with other investment activities. Thus, this route is relevant for large institutional investors only. Climate Policy Initiative (CPI) indicates[20] that a portfolio of at least 50-100 billion dollars is required for direct investing. These numbers are a result of project finance deals having to be of a certain size to be considered economic (around 100 million dollars has been suggested). CPI suggests that there are probably around 45 pen-

19 Since the first yieldco came to market in 2013, yieldcos have raised a total of 5.2 billion dollars through IPOs.

20 CPI (2014).

sion funds and 70-100 insurance companies worldwide that are large enough for direct investing in infrastructure.

There are alternative routes to making an investment that do not require the same size or experience in the sector. An investor can go into a partnership or form a joint venture with a more experienced investor – another institutional investor or a bank, infrastructure manager or industrial player. Partnerships mean that investors can pool some investment costs while retaining control over the investment decision. Another alternative is a co-investment, where a fund manager allows fund investors to invest directly in the fund's underlying assets. Surveys suggest the majority of institutional investors have used co-investing as an alternative to solo direct investment. For smaller investors with liquidity or diversification constraints, the indirect route through funds could be a more viable way of approaching infrastructure investments. Pooled investment vehicles or investment funds can aggregate smaller-scale projects to a size where they become attractive to investors with minimum investment requirements.

Expected returns

The performance history of infrastructure investments is limited, and performance data are to a large extent private. The high degree of heterogeneity makes comparisons across projects, structures and jurisdictions challenging. Academic studies of infrastructure investments are few, and the approaches taken to deal with the shortcomings in the available datasets vary widely. It is therefore challenging to draw general and firm conclusions based on these studies.

Infrastructure investments can exhibit bond, real estate or equity characteristics. The risk-return profile of an infrastructure investment generally arises from the nature of the underlying asset itself, the environment in which it operates, and the choice of investment vehicle. Different investors have different goals for their infrastructure investments, which leaves no "right" way to benchmark such investments.

Both direct investments and investments through funds have the potential to deliver attractive risk-adjusted returns for an institutional investor. The debt side is typically the less risky tranche of the investment, and the investment risk is primarily default risk. Equity investments are also accompanied by greater volatility and risk, in particular when there is added leverage.

As described earlier, the risk an investor should be compensated for in a project varies across geographies, technologies and stages of the project. In OECD countries, the growth in renewable energy investments has been largely driven by government policies and incentives. This creates more policy risk in otherwise stable markets. In less mature markets, however, investments in renewable energy have been driven by growth in demand for energy. This lessens the subsidy risk that is one of the specific risks associated with renewables. Investing in less mature markets does, however, introduce a new range of risks to an investor, such as sovereign risk.

Currently there is little systematic collection of industry return data on investments in the green infrastructure space and infrastructure generally. This means there is a shortage of objective information and data to assess transactions and underlying risks. Without transparent information and data which can act as a signal to investors, there are significant barriers to entry into a sector. In its report on long-term investing, the World Economic Forum (2011) put forward infrastructure as among the least liquid and longest-term asset classes available. However, illiquid investments have several potential benefits for asset owners:

I. *Accessing structural risk premia*: Investors may be paid a premium for accepting intermittent asset price volatility and for accepting the liquidity risk inherent in long-term investment markets.

II. *Accessing opaqueness and complexity premia*: The low volume of deals in illiquid markets makes it difficult for most investors to assess the correct market price. Conversely, it may reward investors who have the skills to structure a viable deal based on their expertise in the asset class.

III. *Timing advantages:* Long-term investors can wait more patiently for market opportunities before investing or selling, and invest early in broad trends (e.g. growth in emerging markets, growing middle class, etc.) even when the timing of the impact of specific investment trends remains uncertain.

IV. *Avoiding buying high and selling low:* Long-term investors have the mindset and structure to stay in the market and avoid the potential losses from buy and sell decisions driven by short-term pressures.

For illustrative purposes, we include a table with return numbers from the OECD[21].

Table 1

Type of investment	Corporate investment (indirect)	Investment fund/ vehicle (semi-direct)	Project investment (direct)
Description	Publicly listed equities/corporate bonds, funds, privately placed corporate bonds/ mezzanine finance	Investment in pooled vehicles such as infrastructure funds that invest in companies or projects; asset-backed securities, covered bonds, etc.	Direct investment in unlisted green infrastructure projects through equity, debt or mezzanine; PPPs and export order facilities
Target return range	Equity target return: 5-20% Debt: 3-6% Actual returns: n/a	Infrastructure fund target return: 7-20%+ Actual returns: -51% to 106%	Project equity target return: 12-18% Debt: 6-10% Actual returns: -13% to 21%

21 Kaminker, C. et al. (2013)

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