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In Sight of the Clean Trillion

UPDATE ON AN EXPANDING LANDSCAPE OF INVESTOR OPPORTUNITIES

May 2018

IN SIGHT OF THE CLEAN TRILLION: UPDATE ON AN EXPANDING LANDSCAPE OF INVESTOR OPPORTUNITIES

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About Ceres

Ceres is a sustainability nonprofit organization working with the most influential investors and companies to build leadership and drive solutions throughout the economy. Through powerful networks and advocacy, Ceres tackles the world's biggest sustainability challenges, including climate change, water scarcity and pollution, and human rights abuses. For more information, visit **ceres.org**.

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LETTER FROM THE PRESIDENT

When Ceres coined the moniker "The Clean Trillion" in 2014 and began drawing attention to the need for global clean energy investment to scale up by an additional trillion dollars per year on average through 2050, many cautioned at the daunting scale of the challenge. Yet the Clean Trillion was, and remains, directionally correct — illuminating the tremendous need for, and opportunities inherent in, the requisite large-scale shift in capital from high carbon to clean energy to enable global transition to a low carbon economy. Nothing less than a sustainable future for people and planet is at stake.

In the years since, investment in clean energy has increased modestly — approximately $333 billion globally in the most recent annual accounting — yet has lagged significantly behind the necessary Clean Trillion trajectory. Clearly, there is a need to pick up the pace if we are to achieve the Paris Agreement's objectives of "holding the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C," as we must.

The good news is that clean energy costs have continued to decline, and clean electric generation such as wind and solar increasingly are out-competing traditional high-carbon energy resources around the world. Battery energy storage is on a similar cost-competitiveness pathway, including in the transportation sector where Low Emissions Vehicles, such as Electric Vehicles, make up a significant proportion of anticipated global clean energy investment over the decades to come. Clean energy has gone mainstream, and achieving the Clean Trillion is eminently feasible.

Just as clean energy has gone mainstream, so have opportunities for clean energy investment expanded across asset classes and sources of capital. Major corporations are moving to source their electric needs from 100% renewable energy, some of the largest commercial banks have been making and actualizing $100+ billion commitments to invest in clean energy and other climate solutions, and a growing number of institutional investors are materially increasing their clean energy investments, capturing expanding opportunities that match their risk-return requirements. These trends are encouraging, yet still far from enough.

Against this backdrop, I am pleased to introduce *In Sight of the Clean Trillion: Update on an Expanding Landscape of Investor Opportunities*. This report provides an overview of key clean energy market developments and increasingly diversified investment opportunities. As discussed herein, investment fundamentals, including long-term risk diversification, are driving clean energy investment, and there is a broad range of clean energy investment vehicles now available that match investors' risk-return requirements. To take advantage of clean energy investment opportunities, investors should reassess their strategic asset allocation, acquire the right skills and capacity, engage with relevant service providers to ensure they are better attuned to the clean energy investment landscape, and take a fresh look at a broad range of clean energy investment vehicles. In doing so, investors can promote the resilience of their portfolios and capture appropriate investment opportunities tied to a global clean energy transition that is irreversible, unstoppable, and crucial to a sustainable future.

Mindy S. Lubber
President, Ceres

EXECUTIVE SUMMARY

In January 2014, Ceres released *Investing in the Clean Trillion: Closing the Clean Energy Investment Gap*. That report drew awareness to the need for an additional $1 trillion per year, on average, investment in clean energy through 2050 in order to limit global temperature rise to no more than 2 degrees Celsius. Less than two years later, 195 countries came together in late 2015 to adopt the Paris Agreement, an historic global accord which for the first time set a goal of "holding the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels." Ceres' subsequent analysis together with Bloomberg New Energy Finance, *Mapping the Gap: The Road from Paris (2016)*, looked at business-as-usual global investment in clean energy in the electric power sector through 2040 as compared to the levels of investment required even to reach a 2°C scenario. That analysis identified a projected multi-trillion dollar gap — and corresponding investment opportunity — in the electric power sector alone, that would need to be met via policy and other interventions to catalyze scaled-up deployment of diverse sources of clean energy investment, from public finance to corporate balance sheets as well as institutional investors.

This new report, *In Sight of the Clean Trillion*, takes stock of the updated context and landscape in which clean energy has gone mainstream, and includes the following key findings.

Setting the Context: In Sight of the Clean Trillion

- **The scale of global clean energy investment opportunity is significant.** In order to stave off the worst impacts of climate change and meet the Paris Agreement's objectives, the global clean energy transition will generate tens of trillions of dollars of clean energy investment opportunities through 2050. As clean energy markets have shifted, driven increasingly in recent years by underlying market fundamentals and elevated attention to risks inherent in conventional energy sources, the transition to a clean energy future already cuts across many sectors and is engaging diverse sources of capital.
- **Achieving the "Clean Trillion" is eminently feasible.** In the context of global investment flows and the evolving energy market, scaling low-carbon investment at the pace and scale required is achievable via a broad and expanding range of investment opportunities that can match investors' risk-return requirements across an array of asset classes.
- **A significant proportion of global clean energy investment is anticipated to be deployed in the transportation sector, in particular for Low Emissions Vehicles (LEVs).** As the area of low-carbon investment anticipated to have the highest level of aggregate global capital requirements, LEVs such as Electric Vehicles (EVs) are dominant and are anticipated to tap into well-known financing models.

The Clean Energy Landscape Today — Investing in a Trillion Dollar Market

- **Energy market dynamics have shifted in favor of clean energy such as wind and solar, which increasingly out-compete new fossil fuel and nuclear power sources, and the advanced and clean energy market has surpassed US$ 1.4 trillion globally.** In recent years, dramatic reductions in cost, increases in scale, and technology improvements have rapidly changed the clean energy market.
- **As clean energy matures and expands to a mainstream, large-scale market, it is important for investors to understand increasingly diversified investment opportunities.** Such opportunities include investment in clean energy infrastructure (such as wind and solar projects) which can deliver stable, long-term, bond-like cash returns and a predictable stream of cash flows; storage infrastructure and technology, one of the highest growth areas; and early stage digital energy technology with risk-return profiles that can mirror those of venture capital investment.

Investor Opportunities

- **Clean energy investment increasingly is driven by underlying investment fundamentals and quality of opportunity.** Environmental and climate goals, previously seen as the primary drivers for low carbon investment, have been eclipsed by the growing diversity of investment opportunities that match investors' risk-return requirements as the clean energy market has become increasingly competitive, matures and grows.
- **Investors are most likely to become involved in primary market clean energy investment in the following ways:**
  - Investing in infrastructure or private equity funds;
  - Direct project-level investment — e.g., infrastructure equity, project loans, bonds — principally by large investors;
  - Buying securitized bonds or equity;
  - Investing in green buildings — e.g., energy efficiency bonds;
  - Funding the balance sheets of corporate developers — debt and equity.
- **Institutional investors' fiduciary obligations demand consideration of climate-related risks and climate solution opportunities across investment portfolios.** Responsible investment, ESG and climate related governance are increasingly important areas of assessment for institutional investors. In order to meet this challenge and tap related opportunities, investors should reassess their *strategic asset allocation, acquire the right skills and capacity* to evaluate low-carbon investment opportunities; and *engage with relevant service providers, including investment consultants and credit ratings agencies.*
- **Institutional investors should require their consultants to improve and accelerate the integration of climate factors — both risks and opportunities — into their strategic asset allocation and investment strategy reviews and recommendations.**
- **Investors should carefully assess their long-term views on the wider energy and infrastructure market, taking into account climate-related risks and opportunities, and should increase allocation to low carbon assets consistent with the well-established principle of long-term risk diversification.** This will help avoid the kinds of losses experienced in the recent past via exposure to high carbon assets, such as in the coal sector. On the opportunity side, we recommend consideration of opportunities in new asset creation in clean energy infrastructure where investors commit long-term capital into the development and construction stages of the asset life cycle, providing distinct collateral benefits in carbon reduction as well as jobs and economic growth.
- **Investors should consider setting a target and/or investing at least 1% of their total assets under management into lower carbon and renewable energy infrastructure** consistent with the call to action issued in 2017 by the former head of the UN Framework Convention on Climate Change and architect of the Paris Climate Agreement, Christiana Figueres, through her organization Mission2020. Consideration of investments counted toward such a 1% target should encompass newly developed and constructed infrastructure investments that produce *additional* carbon mitigation.
- **19 of the world's largest asset owners have invested more than 5 percent of their total assets in low-carbon investments, adopting a broad, long-term time horizon rather than focusing on short-term return requirements and incentives.** Still, most investment consultants have been slow to incorporate climate-related considerations as standard across their client base, and many among this influential cohort still need to update their risk profiles related to low-carbon opportunities, such as, for instance, the risks and returns associated with renewable energy, in light of the increasingly fast path to revenue for many renewable projects.

Investment Approaches for Institutional Investment in Clean Energy

- **A broad range of clean energy investment vehicles is available to meet investors' risk-return requirements.** To help navigate the diversity of opportunities, this report provides an overview of prominent investment vehicles for clean energy by asset type, investment strategy objective, indicative investment scale, target returns (including returns by clean energy sub-sector), standard investment period, type of investors and key risk mitigation mechanisms, as well as an overview of general transparency, liquidity, control, diversification and other attributes. Section IV also highlights comparisons of key financing structures, including fund and co-investment, direct project investment, yieldcos, green bonds and securitized project debt.
- **Investors should take into account key differences between clean and conventional energy infrastructure, which increasingly favor clean energy as the sector matures.** These factors include pre-construction timelines and investment opportunities, construction staging, technology maturity, and coal or nuclear power risk mitigation.
- **Investors should consider opportunities to "avoid the crowd" by exploring rising opportunities in "Greenfield" (i.e., pre-construction, development-stage project) investment; dispatchable clean energy; and direct loans to project finance.**
  - *Greenfield investments* have become more attractive as earlier-stage risks have become better understood and mitigated;
  - *Blending greenfield-stage exposure with operating assets in a diversified portfolio* may assist investors in making their first move into the sector;
  - *Dispatchable clean energy is a key market gap*, with technologies such as battery storage seeing significant cost reductions and increasing market competitiveness.

The Potential for Green Banks to Drive Investment Opportunities: A Focus on Energy Efficiency

- **Green Banks hold tremendous promise for catalyzing investment in energy efficiency, one of the cleanest and lowest cost clean energy resources.** The world's largest green bank — the Australian based Clean Energy Finance Corporation (CEFC) — has demonstrated this potential by directing approximately half of its AU $5.8 billion in investment commitments toward energy efficiency, leveraging more than double its investment via co-financiers and investors.
- **As demonstrated by the CEFC, green banks can deploy multiple levers to drive energy efficiency and other clean energy investments, including via pulling the market along with the demonstration effect of market-leading projects and crowding-in of private equity.** They also can create **aggregation programs** to tap smaller-scale clean energy investment opportunities (including energy efficiency and EVs) while minimizing transaction costs.

Policy Design — Toward a Post-Subsidy World

- **Despite the fact that global subsidies for clean energy are a small fraction of those provided for fossil fuels, falling costs increasingly have enabled clean energy to be competitive on an unsubsidized basis.** Even as subsidies are phased out in some areas, however, underlying policy design is still critical to support a strategic, sustainable, and smooth transition to an economically inclusive clean energy future.
- **Dispatchable clean generation and energy efficiency are expected to feature centrally in the next critical stage of growth and policy design.** This includes battery energy storage and "smart grid" technology as key elements for creating reliable, stable energy supply.
- **Setting specific carbon reduction and clean energy generation targets, combined with placing a price on carbon, is one of the cheapest, most effective means of driving clean energy deployment.** To level a playing field that has been distorted by extensively subsidized fossil fuel resources, to send a strong market signal, and to provide greater certainty for investors, effective prices on carbon are required.

Today, as market realities demand investors focus attention on climate-related financial risks and investment opportunities, this report provides insight into market trends and key considerations, particularly for institutional investors. As the world grapples with reaching the pace and scale of clean energy transition required to meet the objectives of the Paris Agreement, the expanding landscape of clean energy investment opportunities places us now, more than ever before, in sight of the Clean Trillion.

1. SETTING THE CONTEXT: IN SIGHT OF THE CLEAN TRILLION

Key Findings

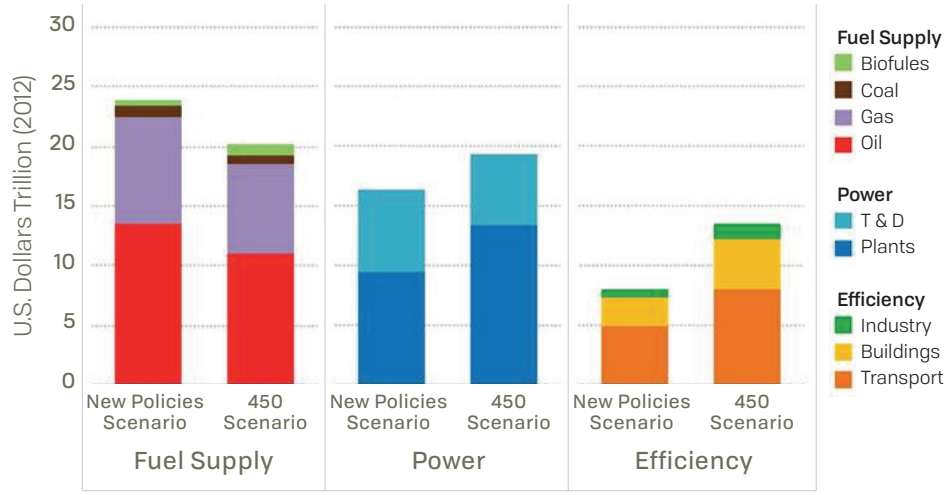
- **A global clean energy transition at the speed and scale required to meet the objectives of the Paris Agreement will generate tens of trillions of dollars of clean energy investment opportunities through 2050.**
- **These opportunities cross many sectors, particularly energy and transport markets, where investment historically has run in the trillions, around 2% of global GDP. By way of further context, overall fixed capital formation in global economies averages 20-25% of GDP.**
- **Sources of capital available for clean energy investment are highly diverse — including company balance sheets, financial intermediaries and investors, in addition to public finance.**
- **While incremental costs of limiting global temperature rise to well below 2 degrees Celsius over pre-industrial levels — i.e., a "2 Degree Scenario" (2DS) — may run to trillion of dollars, these amounts are not extraordinary in a global capital investment context, even before considering that these costs are expected to be eclipsed by the economic benefits (inclusive of externalities). In addition, as technology costs continue to fall, these incremental costs are likely to fall as well.**
- **As the area of low-carbon investment anticipated to have the highest level of aggregate global capital requirements, Low Emission Vehicles (LEVs) such as Electric Vehicles (EVs) are dominant and are anticipated to tap into well-known financing models.**

Investment Needs — and Opportunities — Tied to Global Clean Energy Transition

In 2014, Ceres published *Investing in the Clean Trillion, Closing the Clean Energy Investment Gap*[1] against the backdrop of the 2012 International Energy Agency (IEA) Energy Technology Perspectives (ETP), which illuminated a need for an **incremental $1 trillion low-carbon technology investment on average per year** from 2013-2050 to limit global temperature rise to no more than 2 degrees Celsius and avoid the worst effects of climate change. According to these analyses, the absolute level of global energy investment needed to limit temperature rise to no more than 2°C equated to $3.5 trillion (tn) a year on average through 2050. Achieving such levels of investment requires a powerful escalation in annual increased low carbon investment, directed in great part to clean energy (including energy efficiency) in the electric power sector initially, and then increasingly to decarbonisation of transport.

Later in 2014, the IEA released the World Energy Investment Outlook (WEIO)[2] which specifically addressed investment flows. Under the WEIO baseline "New Policies Scenario" (NPS), investment is stimulated at a level of $48tn from 2014-2035 or an average of $2.4tn per annum (p.a.), and a scenario where atmospheric carbon dioxide (CO_2) concentrations are limited to 450 parts per million ("450 PPM" scenario) with a 50% probability of limiting temperature rise to 2°C would require $53tn through 2035, or $2.75tn p.a.

Figure 1-1. World Cumulative Investment in Energy Supply and Energy Efficiency by Scenario, 2014-2035



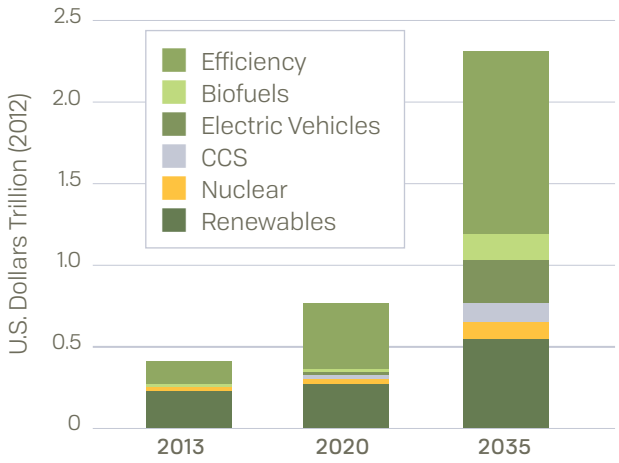
Source: IEA WEIO (2014)

The WEIO notably also showed that investment in fossil fuels would fall by $4.3tn from 2014 to 2035, thus lowering the total "cost" of the 450PPM scenario. How this would be intermediated — e.g., by energy companies diversifying their business models, reducing their size and/or paying out dividends to shareholders — is an important issue.

WEIO also notably pointed to the need for energy efficiency (EE) investment to scale up significantly, in line with a six-fold increase from the base figure.

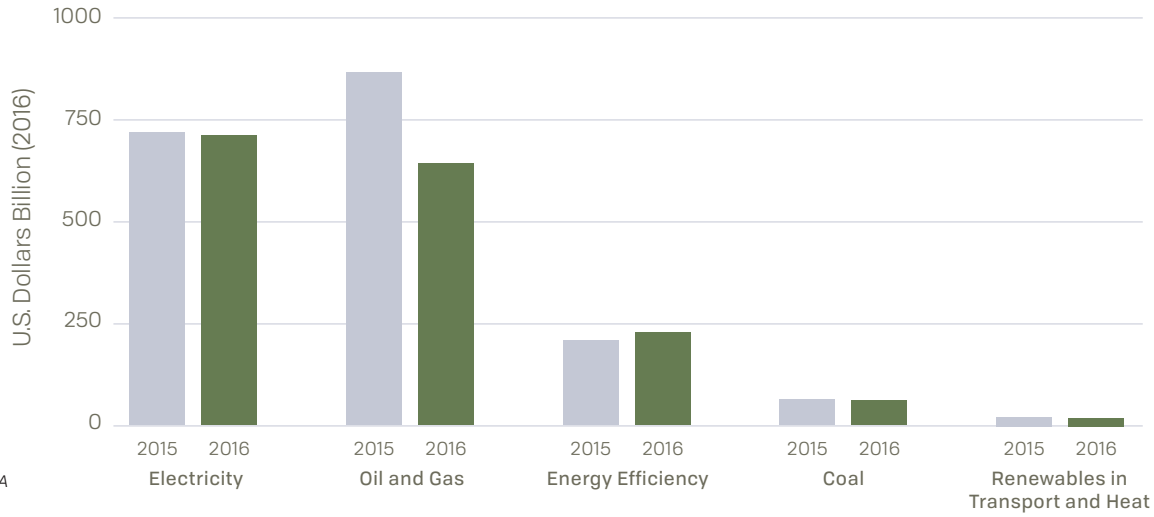
The total spend on low carbon energy (including incremental costs of electric vehicles) was expected to be $750 billion (bn) p.a. by 2020, rising to over $2tn p.a. by 2035.

Figure 1-2. Global Investment in Low-Carbon Technologies and Energy Efficiency in the 450 Scenario.



Source: IEA WEIO

Figure 1-3 Energy Investment by Sector in 2016.



Source: OECD/IEA

A more recent study by the World Bank Group, Ecofys and Vivid Economics, *State and Trends of Carbon Pricing 2017*,[3] suggests that much of the $2.6tn in planned annual investment in energy systems would need to be *reallocated* to low-carbon infrastructure and technologies, and an annual incremental clean energy investment gap of $700bn would need to be bridged by 2030, to achieve a 2°C target.

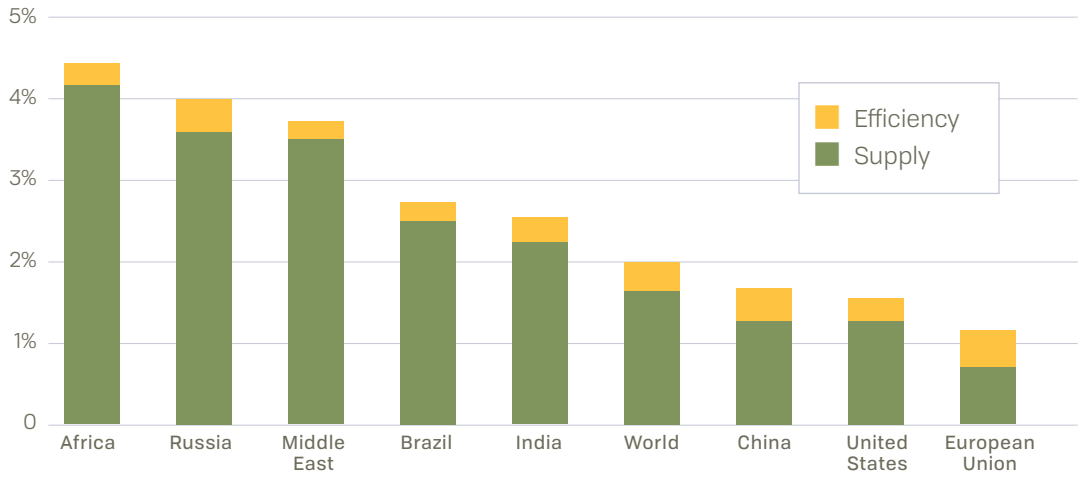
While these global low carbon investment figures are considerable, they should be viewed in the context of actual expenditure on energy markets in 2016, equating only to around 2.2% of global GDP.[4]

However, investment requirements and opportunities consistent with achieving a 2°C target are not uniform across global geographies. Even pursuant to the IEA's conservative analyses, as illustrated by NPS requirements in **Figure 1-4** below, a much greater change in average annual clean energy investment is required in non-OECD jurisdictions, excluding China, than in OECD countries.

In any case, aggregate and incremental low carbon investment needs and opportunities described above represent a significant escalation from existing investment figures yet are still modest and achievable when taken in the context of gross fixed capital expenditure globally across all sectors, which routinely exceeds $20tn p.a. and reaches 20-25% of GDP.

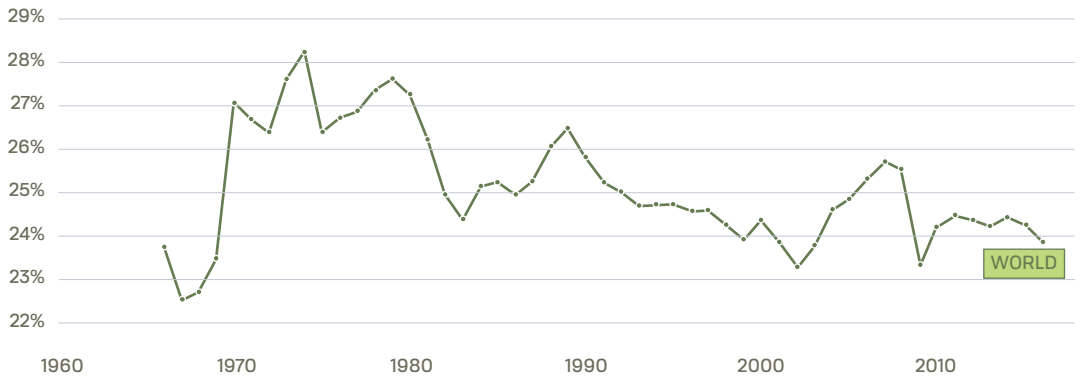
In effect, achieving the "Clean Trillion" should be viewed as eminently feasible in the context of global investment flows as well as the evolving energy market context (discussed in the Landscape Section below). Scaling low carbon investment at the pace and scale required to stabilize the climate and avoid the worst effects of climate change is achievable via a broad and expanding range of investment opportunities that match investors' risk-return requirements across a range of asset classes.

Figure 1-4. Cumulative Energy Investment as a Share of GDP in the New Policies Scenario, 2014-2035.



Source: IEA WEIO

Figure 1-5. Gross Capital Formation (Percent of GDP)



The Importance and Scale of Financing Low Emissions Vehicles, Such as Electric Vehicles

Achieving the Clean Trillion entails investment opportunities across a spectrum of low-carbon technologies and infrastructure transcending diverse sectors. One area that merits focused attention is the transportation sector, and in particular the tremendous capital flows into Low Emissions Vehicles (LEVs) that are anticipated under any credible climate stabilization scenario.

According to analysis recently published by the OECD,[5] LEVs are by far the largest financing requirement — up to 70% of total low carbon investment required from 2015-2035. Based on experience with traditional vehicle finance, LEVs are expected to be financed through a combination of equity and loans, with opportunities for loans to be securitized into asset-backed bonds. The required scale-up in LEV financing is projected to start in earnest in the 2020s, reaching $1.7tn p.a. by the 2030s.

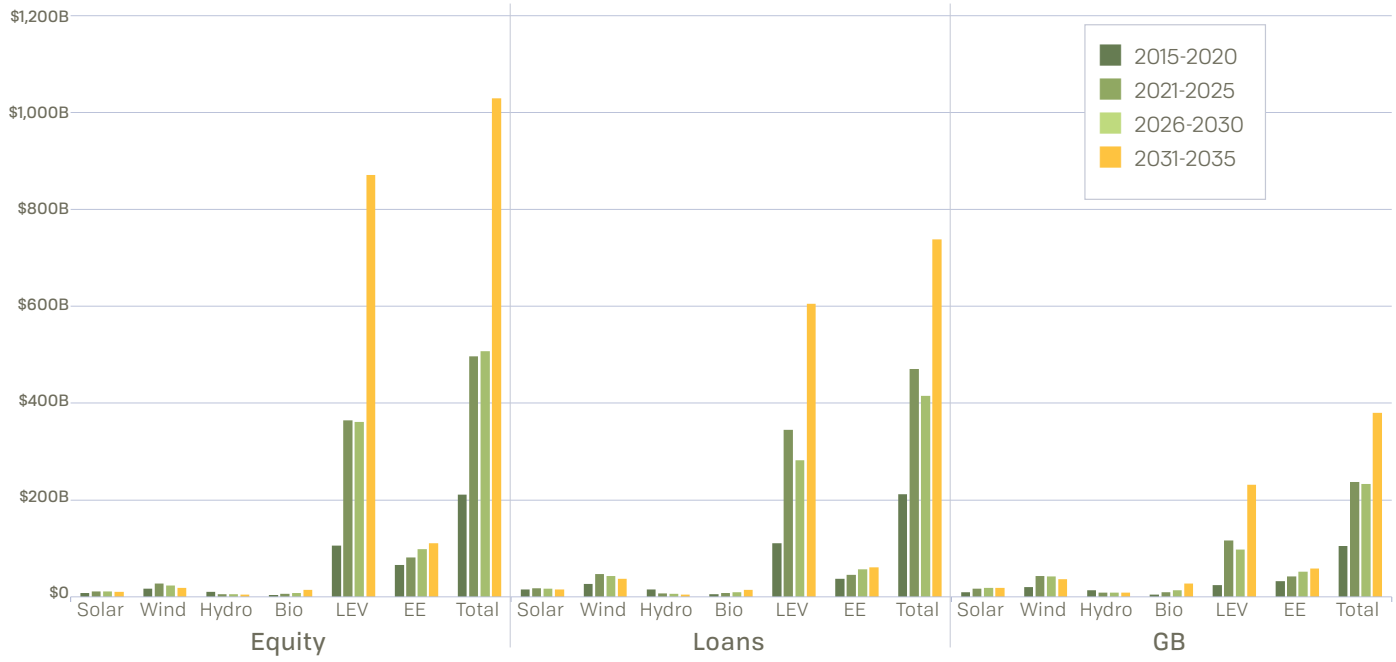
While *incremental* costs of LEVs, particularly EVs, are expected to decline considerably as economies of scale grow and battery costs continue to decrease, the sheer magnitude of the aggregate LEV investment opportunity is at once quite large yet readily absorbed in capital markets via existing finance mechanisms. **Indeed, EV financing should prove to be reasonably standard, with opportunities to fine-tune lease agreements to account for the mix of incremental upfront costs and lower operating and maintenance costs.** Data compiled by Bloomberg New Energy Finance for the U.S. show that the auto loan market is simply massive already.[6] It is now a question of switching the vehicles — and their corresponding finance — to low carbon.

In short, one of the most substantial areas of anticipated low carbon investment growth through 2035 and beyond in order to achieve a 2 Degree Scenario is not expected to necessitate major new finance innovations. Existing tools can be adapted to meet the need.

As discussed below, markets and technologies are evolving in ways that support significant growth in low carbon investment opportunity. Investors — including companies, financial institutions and institutional investors alike — have an increasing array of opportunities to tap low carbon investments that meet their risk-return requirements, and also can play a role spurring acceleration of, and expanded access to, such opportunities.

Even as the pace and scale of clean energy transition lags global ambition to meet the objectives of the Paris Agreement, and some further policy interventions are needed (as discussed in the Policy Section below), now more than ever before we are in sight of the Clean Trillion.

Figure 1-6. Issuance Breakdown by Type of Instrument



Source: Vivid Economics based on data from the IEA, OECD, BNEF

Section 1 Endnotes:

1 Mark Fulton and Reid Capalino, *Investing in the Clean Trillion: Closing the Clean Energy Investment Gap*, Ceres, January 15, 2014. Available at https://www.ceres.org/resources/reports/investing-clean-trillion-closing-clean-energy-investment-gap

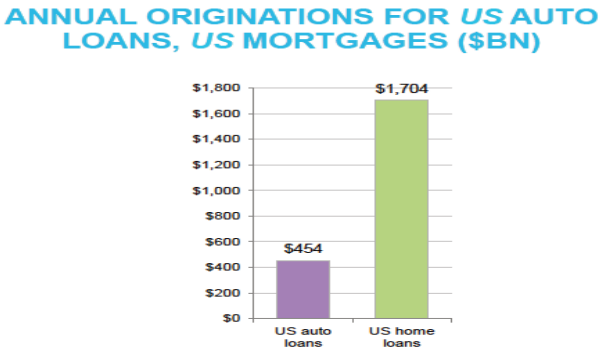
2 International Energy Agency (IEA), *World Energy Investment Outlook*, IEA/Organisation for Economic Co-operation and Development (OECD) 2014. Available at http://www.iea.org/publications/freepublications/publication/WEIO2014.pdf

3 World Bank, *State and Trends of Carbon Pricing 2017*, World Bank, Ecofys, and Vivid Economics, November 2017. Available at http://documents.worldbank.org/curated/en/468881509601753549/pdf/120810-REVISED-PUB-PUBLIC.pdf

4 International Energy Agency, *World Energy Investment 2017*, IEA, July 11, 2017. Available at https://www.iea.org/publications/wei2017/

5 OECD, *Mobilising Bond Markets for a Low-Carbon Transition*, Green Finance and Investment, OECD Publishing, 2017. Available at http://dx.doi.org/10.1787/9789264272323-en

6 Ethan Zindler, Ken Locklin et al., *Mapping the Gap: The Road from Paris*, Ceres and Bloomberg New Energy Finance & Ceres, January 27, 2016. Available at https://www.ceres.org/resources/reports/mapping-gap-road-paris



Source: BNEF/Ceres, *Mapping the Gap* (2016)

2. THE CLEAN ENERGY LANDSCAPE TODAY — INVESTING IN A TRILLION DOLLAR MARKET

A Tipping Point: Recent Fundamental Shifts in Clean Energy Markets

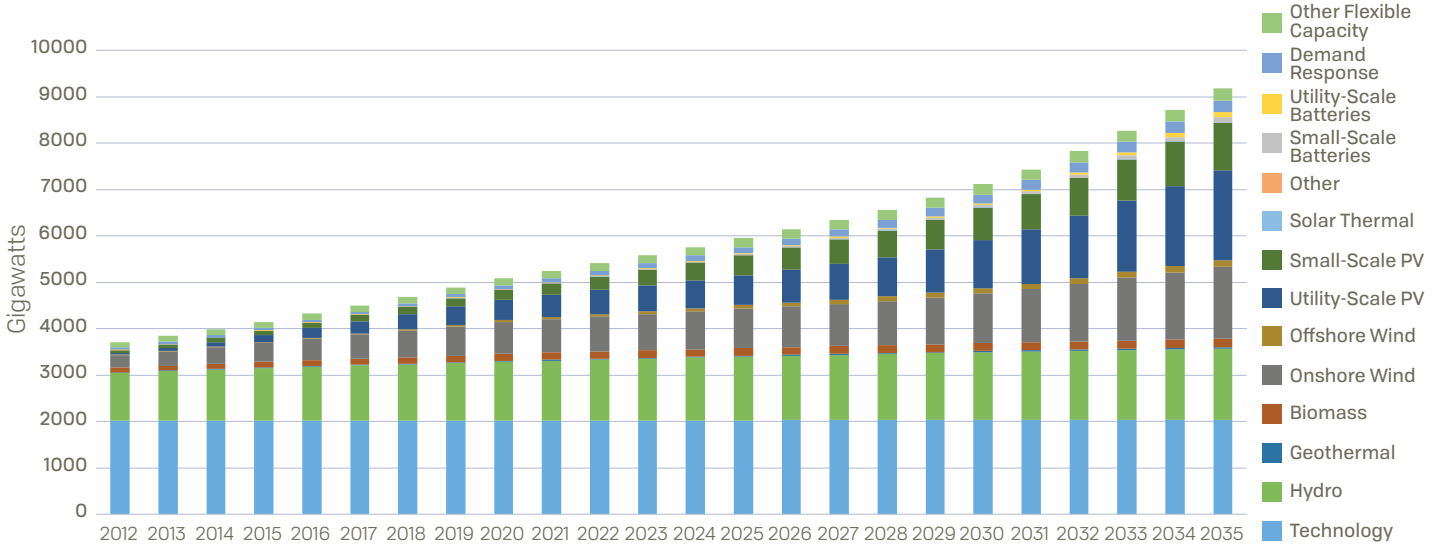
In recent years, dramatic reductions in cost, increases in scale and technology developments have rapidly changed the clean energy market. As summarised by Michael Liebreich, chairman of the Advisory Board for Bloomberg New Energy Finance:

> *"The question always used to be 'will renewables ever be grid competitive?'...*
>
> *Well, after the dramatic cost reductions of the past few years, unsubsidised wind and solar can provide the lowest cost new electrical power in an increasing number of countries, even in the developing world — sometimes by a factor of two. It's a whole new world"*[1]

Today, the advanced and clean energy market has surpassed US$ 1.4 trillion globally.[2] In 2017, global investment exceeded US$ 333 bn,[3] compared to only US$ 144 billion power sector investment in conventional fossil fuels and nuclear. As clean energy technology has matured and gained greater efficiencies, this investment has increased its impact per dollar invested, in many regions proving to be more competitive than nuclear power or fossil fuels. While annual investment in 2017 was slightly lower than the record levels set in 2015, due to the rapid cost reductions, the actual capacity installed has increased by over 15%.[4]

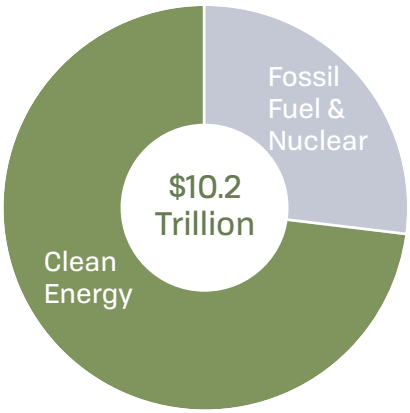
Clean energy is the fastest-growing source of electric generation globally, and by 2040 it is expected that the clean energy market will make up almost 50% of installed capacity.[6] New investment is expected to exceed US$ 7.3 trillion, far outweighing investment in fossil fuel-fired power generation and nuclear power. In addition to this, the electric vehicle market is expected to continue to

Figure 2-1. Historical and Forecast Global Energy Capacity, 2012-2035[5]



grow at a compound annual rate of over 20% p.a.,[7] further supporting the growth and efficiency of battery storage technology and non-fossil fuel electricity demand.

Figure 2-2. Forecast Global Energy Investment Market for Clean Energy vs Fossil Fuels, 2017-2040[8]



Source: BNEF

In 2017 we saw the clean energy industry reach a critical turning point as the rate of growth, technological efficiency and cost reductions have repeatedly far exceeded most forecast expectations. This indicates that growth and cost reductions in the sector have far surpassed expectations based on policy alone.

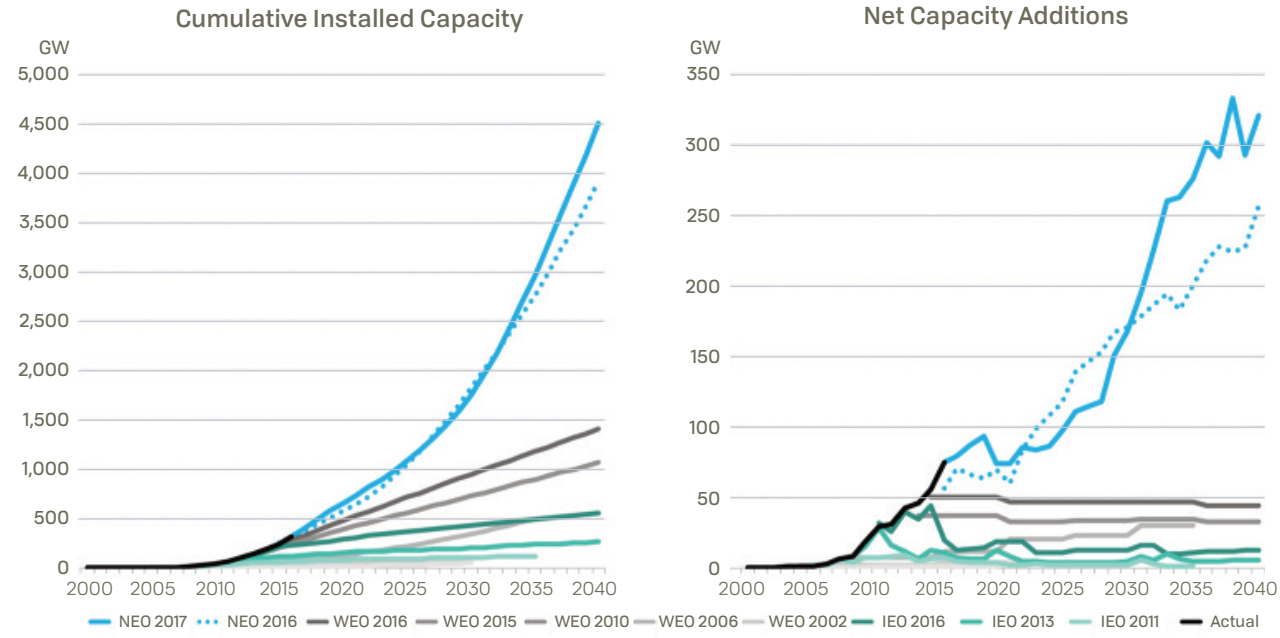
Changing Drivers: From "Green" to Fundamental Economics

One of the biggest drivers for this rapid growth in clean energy has been a shift in fundamental market dynamics and a changing perception of risks with regard to company valuations and performance.

Many corporations identify that their primary drivers to shift to clean energy are economic and include: cost benefits from enhanced economies of scale as well as improved technology and manufacturing; energy security and independence; energy availability and reliability (for example at mine sites or in rural or developing regions with poor access to reliable grid networks); hedging against risks of volatile fossil fuel prices; pollution costs; and reduced reputational risk.

Falling costs are one of the primary drivers. In an increasing number of markets this has enabled clean energy to be quite competitive, even on an unsubsidised basis, removing significant amounts of regulatory risk. For example, installed costs of utility-scale solar PV projects have fallen over 70% (approximately 14% each year) since 2010.

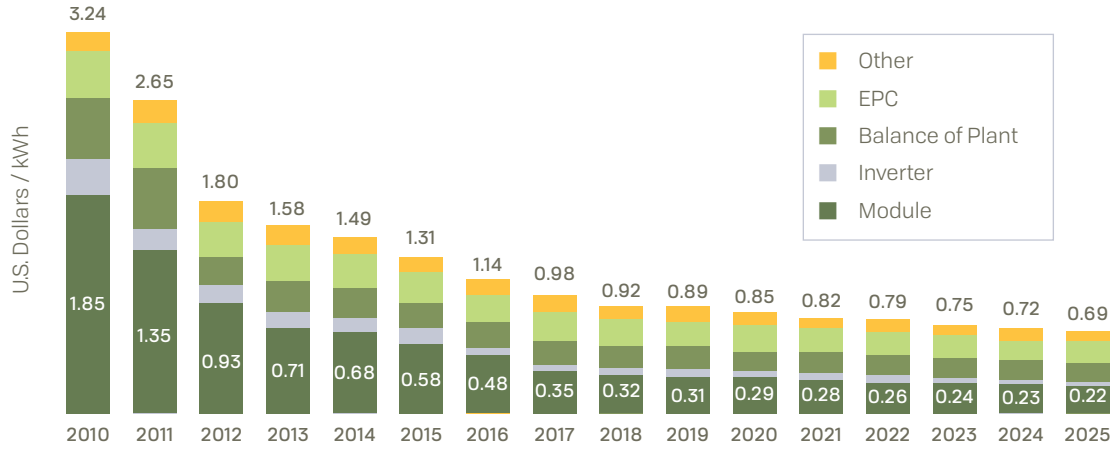
Figure 2-3. Historical Clean Energy Forecasts NEO vs WEO vs Actual[9]



Source: Bloomberg New Energy Finance, IEA.

Note: WEO 2002 & 2006 is Reference Scenario; WEO 2010-2016 is New Policies Scenario; solar includes utility-scale, small-scale PV and solar thermal.

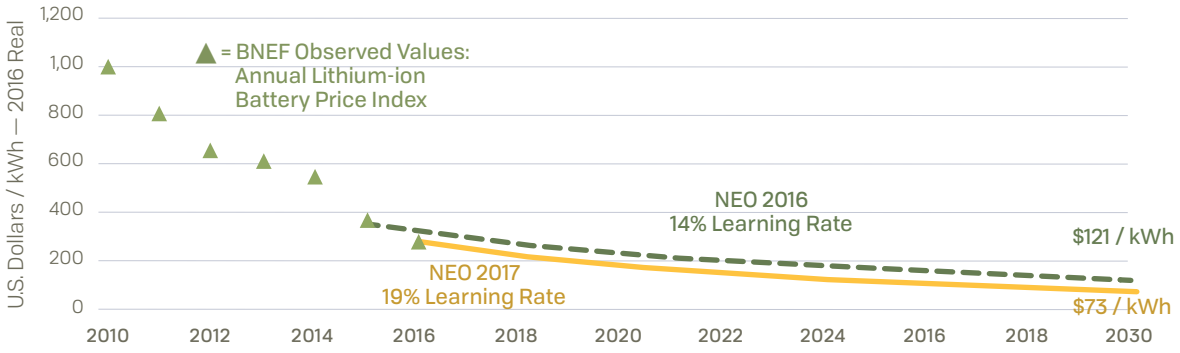
Figure 2-4. Utility-Scale Solar PV Cost Curve 2010 — 2025[10]



Source: Bloomberg New Energy Finance.

Note: "Other" refers to developer fees, land acquisition fees, finance arrangement, contingency and other miscellaneous costs.

Figure 2-5. Lithium-Ion Battery Cell Cost Curve 2010 – 2040[11]



Source: Bloomberg New Energy Finance.

Wind projects in some regions, in particular the U.S., UK and Europe, have proven to be cheaper alternatives to new-build fossil fuel or nuclear power generation. The result of this has been seen in Germany, for example, where wind projects have been bid entirely on a market basis, without any reliance on subsidies.

Similar cost reductions in battery storage have occurred to date, however, this has slowed as the costs of raw materials and demand have rapidly increased over the last few years. Deployed together with emerging smart grid technology, battery storage is an important element for improving the competitiveness of intermittent renewable energy and to support energy demand response, grid balancing and providing electricity when it is in highest demand. Various battery technologies are available and, when commercially competitive, they may potentially reduce reliance on lithium-ion technology for commercial or grid-scale applications.

While these cost reductions do not yet diminish entirely the need for policy support — in particular, in helping to level the playing field for renewable energy as compared to more carbon-intensive energy solutions — they do provide support and significantly reduce some of the longstanding barriers to entry in clean energy investment. Overall, in recent years, these shifts have fundamentally changed the perception of clean energy as well as the risks attributed to fossil fuels and the real potential for long-term reliance on clean energy to supply global energy needs.

Reassessing Risk: Trends in Risk Assessment and Mitigation

There is growing emphasis on the correlation between "green" credentials, valuation and performance. It is an investment shift that is focused on a long-term view that *"physical risk, not regulatory risk, is the exposure that companies may need to worry about".*[12]

Alongside the growth in institutional investment, many utilities are increasingly looking to shift to business models that are focused on clean energy generation and increasingly embrace virtual power networks, behind-the-meter generation and more "prosumer"-centric models (i.e., where consumers are also producers). Meanwhile, major global corporates, such as Apple, Amazon, Google, Walmart, IKEA, several major commercial banks and others are increasingly moving to 100% renewable energy supply in order to hedge against rising power prices and fuel or electricity price volatility,[13] and to protect company valuations, or even director liabilities, against climate-related risks.

The MSCI has indicated that indices comprised of businesses that actively avoid environmental, social and governance (ESG) risks (including but not limited to climate risks) have been shown to outperform the wider market.[14] McKinsey, PwC and KPMG each publish widely on the impact of climate on company valuations, with McKinsey assessing that over 60% of company earnings may be at risk due to sustainability issues, including carbon costs, water scarcity, or reputational damage. The World Economic Forum has highlighted weather, carbon and climate risks as some of the most significant risks over the next 10 years.

Climate-related impacts already are affecting companies, for example through extreme weather damages, water scarcity, reputation damage and director liability risk. In January 2018, New York City, echoing similar actions in 2017 in California, announced a lawsuit against BP Plc, Chevron Corp, ConocoPhillips, Exxon Mobil Corp and Royal Dutch Shell Plc seeking billions of dollar for damages from rising sea levels due to climate impacts.[15] Insurance companies can be another indicator of the active change in the market, in some cases refusing to take the risk of rising sea levels or intense storms.

Investors are increasingly seeking to mitigate their exposure to investments with high physical and environmental risks, such as water scarcity, emissions, other pollution or other costs related to climate change.[17] This, in turn, favours clean energy, which tends to be far less vulnerable to climate impacts than conventional baseload power generation and associated infrastructure.

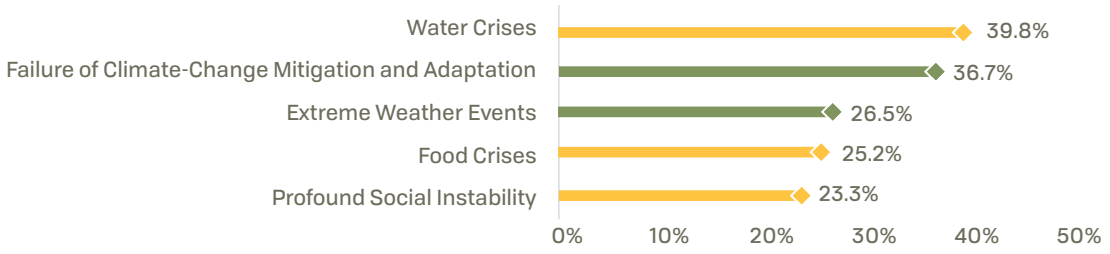
A Diversified Market: Understanding the Scope of Clean Energy Risk and Return

As clean energy matures and expands to a mainstream, large-scale market, it is increasingly important for investors to understand the growing diversification across the sector — from new digital energy technology (such as virtual power plants, digital ledgers and peer-to-peer trading platforms) and electric vehicles, to the enormous market opportunity for mature clean energy generation, such as onshore wind.

For example, "clean energy" can include:

- **Clean energy infrastructure (e.g. wind and solar).** Hydropower, geothermal, solar and wind generating assets generally represent the most mature assets in the sector and make up the majority of the overall clean energy investment opportunity. These investments are in highest demand from pension or insurance investors and are commonly expected to deliver stable, long-term, bond-like cash returns and a predictable stream of cash flows,[18] providing attributes similar to those investors are familiar with in conventional infrastructure, energy and property assets. However, return and risk expectations can differ even within this group. Recent European offshore wind assets with government-backed, inflation-adjusted revenues have seen the cost of capital in 2017 fall as low as 2%, while solar PV projects have been reported to have returns around 4-10% on an unlevered basis, depending on the region of investment, or in some instances, even above 12-15% when invested in at earlier greenfield stages and supported with leverage and scaled, aggregated portfolio sales;

Figure 2-6. Potential EBITDA Value Impact at Stake from Sustainability Challenges[16]



- **Storage infrastructure and technology**, which has emerged as a critical element of the market, supporting the competitiveness of clean energy generation with variable output, such as wind and PV solar. This is expected to be one of the highest growth areas, emulating the cost curve reductions experienced in solar PV and expected to expand by more than 20%[19] CAGR over the next 12 years;[20]
- **Early stage digital energy technology**, which is an expected high growth market where segments such as digital energy flexibility are expected to grow up to 40% CAGR to 2025.[21] Return and risk profiles can mirror those of venture capital investment or early stage tech;
- **Digital energy technology and advanced transport**, which is one of the fastest projected growth areas of the clean energy market and plays a critical role in the efficiencies, manufacturing scale, technological development and cost declines expected in battery storage. However, the investment opportunity is often accessed through investment in traditional or advanced transport companies (such as Volvo, BMW or Tesla) which in some cases may have limited correlation to the broader clean energy sector.

Often these are grouped under the general term "clean energy." However, these different segments offer very distinct growth, risk and return attributes, potentially with very limited correlation. This is particularly important when investing through indirect investment (such as corporates, green bonds, or through index funds) where investors need to increasingly and critically address the level of transparency and exposure they have to the specific area of clean energy that they require.

Geography, local policy, government and regulation can also play key roles in risk and return. When assessing regions with strong clean energy policy support, fundamentals such as lack of oil and gas reserves, physical isolation, and energy security can be key drivers alongside emissions-related goals. As a result, in 2017, regions like Scandinavia and the U.K. as well as countries like Morocco led global policy support for clean energy.[22]

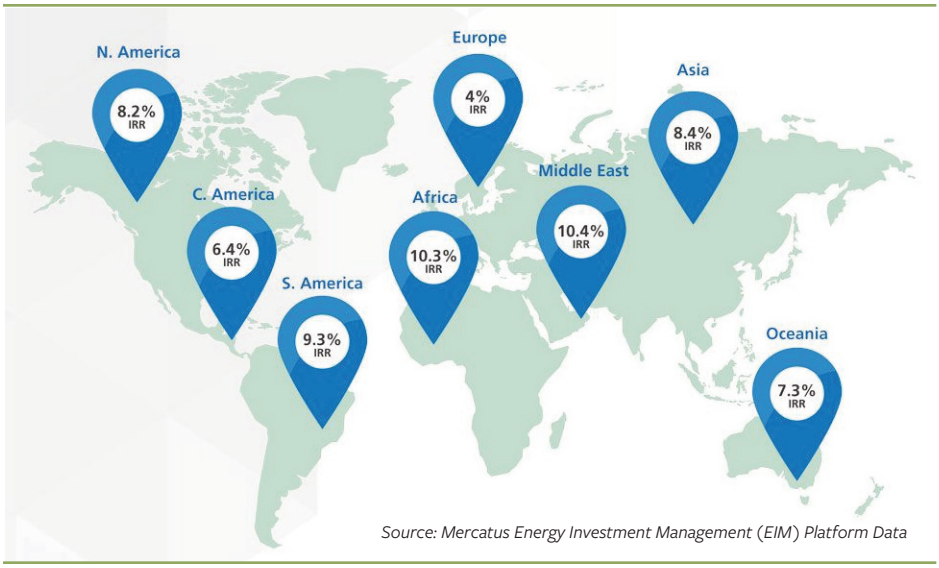
Lowering Barriers to Entry

As a result of rapid increases in scale, reductions in risk and declines in cost, as discussed above, clean energy investments that, traditionally, may not have been a major target for some investors are now in higher demand.[24] Such investments also are proving to be a means of mitigating wider energy or climate risk and a source of scale, diversification and growth within broader utility, infrastructure, energy, sustainability, impact and ESG allocations.

As the industry becomes a mainstream market, previous barriers to entry, including scale, diversification, technological and regulatory risk are falling away. Even off-shore wind, traditionally seen as one of the riskier investments in clean energy, has seen the cost of capital fall to as low as 2% as technology maturity and developer experience increase and costs decline.[25]

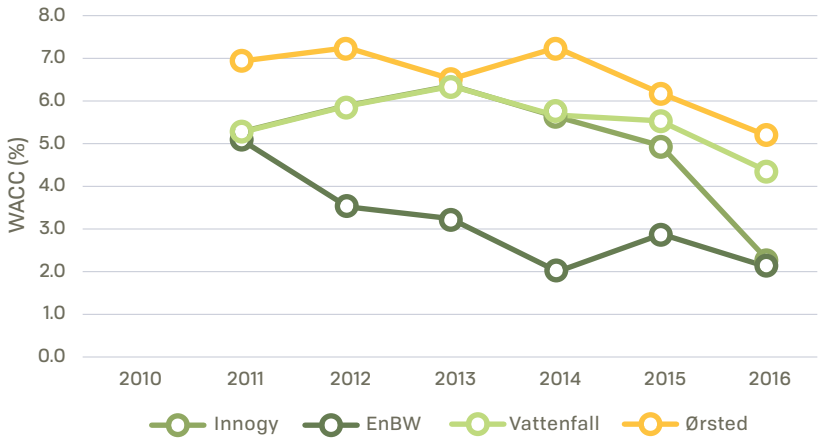
Figure 2-7. Solar PV Asset Returns Across Geographic and Political Regions[23]

Average Unlevered IRR (%)



Source: Mercatus Energy Investment Management (EIM) Platform Data

Figure 2-8. WACC for Utilities Building Off-shore Wind[26]



While **Figure 2-8** illustrates one extreme end of the market, and highlights both benefits and risks to investment as costs of capital for some projects fall below those at which some institutional investors may be willing to invest, it provides an indication of increasing alignment between clean energy assets and more typical institutional investor risk thresholds.

Overall, the combination of lower cost, lower regulatory risks, improved technology and rapid growth and uptake of clean energy creates a very different clean energy investment future and significant, scaled investment opportunities as compared to what we have historically seen. With the growing diversity of resources and opportunities, the advent of digital energy technology, EVs and overall industry growth, investors should now carefully assess which areas of the increasingly diversified sector best suit their investment needs.

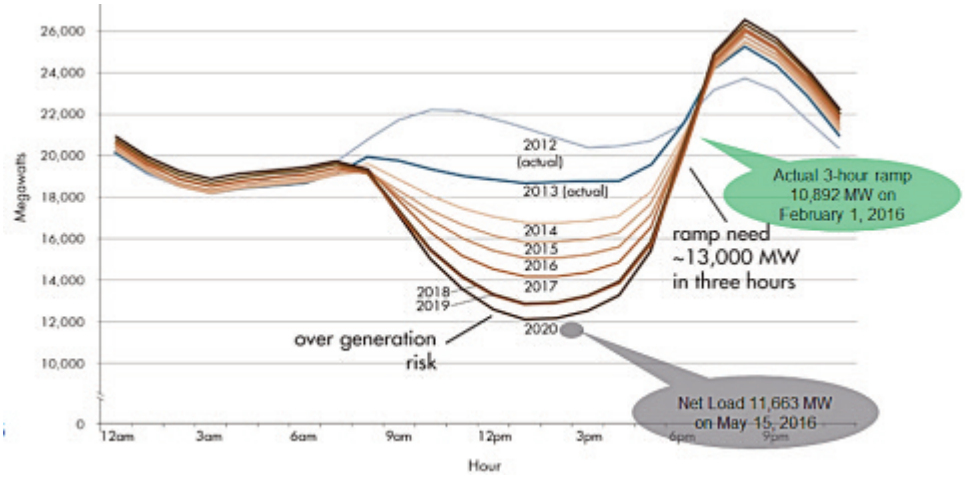
Looming Market Gap: Dispatchable Energy Supply

All of the above factors have driven growth in variable output generating capacity (e.g., wind and solar). This is expected to continue, as clean energy is forecast to contribute at least 50% of the overall energy mix by 2040.

With this comes a critical need for dispatchable and flexible grid balancing technologies (such as battery storage) that can reliably supply energy in periods of peak demand, while minimising and managing potential oversupply of electricity into markets during peak clean energy production.

As variable-output clean energy like wind and solar gain market share, it is critical that continued growth in clean energy storage or other low carbon dispatchable technologies are supported, in order to fulfil social, economic and environmental demands.

Figure 2-9. Illustrative Power Supply "Duck Curve" on a Typical Californian Spring Day[27]



Overall, the clean energy sector has undergone significant shifts in the last few years, repeatedly outpacing growth and cost curve expectations and emerging as a viable means of supporting global energy demand. With this increasingly scaled market and opportunity, there comes an increasing need for investors to better assess and understand the different aspects of clean energy, relevant risks and returns, changing dynamics and fundamentals, and risk mitigation methodologies, as well as the broader significant impacts that energy and climate may have — directly and indirectly — on global company, portfolio and project value.

Section 2 Endnotes

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3. INVESTOR OPPORTUNITIES

Overview of Investor Opportunities and Recommendations:

- Since 2014 we have seen the role of investors in low carbon investment transition from one based primarily on environmental or climate goals to one driven increasingly and predominantly by underlying investment fundamentals and quality of opportunity. As summed up by two well known, global institutional investors, we are in the *"early innings of an economy wide transition,"*[1] and *"renewables, infrastructure and technology"* are assessed to be the *"best money-making opportunities in the years ahead"*.[2]
- Complimenting these underlying growth drivers, Institutional Investors have the collateral opportunity through clean energy and other low carbon infrastructure investment to support responsible and ESG-focused investment objectives, the United Nations Sustainable Development Goals and impact strategies; to better manage asset valuation and risk concerns related to climate resilience and reputational integrity; and to fulfill their growing client and community expectations and demands[3] — all while respecting basic fiduciary duties. Indeed, in light of recognized systemic climate-related risks to capital markets, institutional investors' fiduciary obligations necessitate **consideration of climate-related risks and climate solutions opportunities** across investment portfolios.
- **Specific product and strategy opportunities** to support these new or increased infrastructure allocations are outlined in Section 4. These include "greenfield" (i.e., development-stage project) investments that have become more attractive as earlier stage risks have been better understood and mitigated[4] and as investor familiarity has increased. **Blending greenfield-stage exposure with operating assets in a diversified portfolio** is also an interesting approach that may assist investors in making their first move into the sector. **Dispatchable low carbon and renewable power and smarter grid support technologies are a key market gap** at the moment and an expected area of high capital demand over the next 10 years.
- **Direct loans to project finance** are also a growing area for institutional investors.
- To progress these strategies and take advantage of relevant opportunities, Asset Owners should prioritize the **development and implementation of targeted low carbon investment mandates with Asset Managers.** In parallel, Asset Managers should be actively developing their own relevant strategies for consideration by Asset Owners.
- Institutional Investors, particularly Asset Owners, should **require their consultants to improve and accelerate the integration of climate factors — both risks and opportunities — into their strategic asset allocation and investment strategy reviews and recommendations.**
- Historically, Institutional Investors have had significant impact in driving profound change in investment priorities and allocation strategies in particular asset classes — for example, in devising principles to uniformly assess the environmental performance and impact of real estate investments, which today is an acknowledged value driver. Recognizing this crucial role, institutional **investors should consider articulating shared principles for climate-related performance in key asset classes.**

- The Financial Stability Board (FSB) — an international body specifically charged with identifying and recommending measures to protect against systemic risks to capital markets — has highlighted that ratings agencies are critical in the reduction of ongoing systemic risks. The FSB separately notes the systemic nature of climate risks, underscoring that institutional investors should, therefore, more robustly **engage with ratings agencies** around the analytical assessment of financial risks from climate change together with a commitment to improve their respective skills, capability and research in this critical area.
- In terms of risk and return, **investors need to carefully assess their long-term view on the wider energy and infrastructure market, taking into account climate-related risks and opportunities.** For example, valuations of many utilities[5] exposed to traditional fossil fuels have been decimated by concerns over the combined impacts of physical risks (climate, weather, water), regulatory and policy risks, reputational risks and exposure to transition risks from increasingly cost-competitive renewable energy and new technology shifts such as battery storage.
- Confronting long term risks such as the most significant risks associated with climate change can lead some investors to recognize that they suffer from the "Tragedy of the Horizons," where undue focus on short-term risks and opportunities leads to investments that, in aggregate, significantly worsen portfolio-wide risks associated with climate change over the long term. In simple terms, a core argument in favor of increased allocation to low carbon assets is the well-established principle of **long term risk diversification.**
- Investors should **consider setting a target and/or investing at least 1% of their total assets under management into lower carbon and renewable energy infrastructure** consistent with the call to action issued in 2017 by the former head of the UN Framework Convention on Climate Change and architect of the Paris Climate Agreement, Christiana Figueres, through her organization Mission2020. Consideration of investments counted toward such a 1% target should encompass newly developed and constructed infrastructure investments that produce *additional* carbon mitigation.
- In this context, we recommend **consideration of opportunities in new asset creation in low carbon and renewable energy infrastructure and new energy technology adoption where investors commit long term capital into the development and construction stages of the asset life cycle.** Educating investors and demonstrating the attractive risk and return characteristics of this stage of infrastructure investing is critical to mobilizing the volume of investment needed to fully realize the opportunities inherent in meeting the objectives of the Paris Agreement. In terms of current allocation categories, investing at these earlier stages falls into the "value-add" or opportunistic categories of infrastructure investing and resides higher on the risk/return curve. Only capital investment in new infrastructure asset creation can achieve the parallel objectives of *incremental* carbon reduction, and tangible ESG impacts (job creation, GDP contribution, regional economic stimulus, community benefits) while also providing opportunities for higher returns commensurate with acceptable risks.
- "Greenfield" and "brownfield" stage investing do carry higher risks, and there is a pressing need for investors who have not been significantly exposed to these strategies in the past to improve their **understanding and comprehension of effective risk mitigation techniques** in this critical area of infrastructure. We believe that many investors' perceptions of risks at the development and construction stages are unduly pessimistic, and that the residual risks can be well justified by the higher return targets these assets seek to generate through both ongoing cash yield as well as capital appreciation, as well as by the de-risking of the underlying projects themselves.[6]

Investors should carefully assess their long-term view on the wider energy and infrastructure market, taking into account climate-related risks and opportunities.

The need for more specialized investment skills and capability by all investors, not just large-scale leaders, has expanded acutely in recent years due to the huge growth of the low carbon economy. This requires more sophisticated models and techniques to understand increased low carbon/clean energy investment scale, jurisdictional scope, policy drivers, asset class breadth, sector breadth and opportunities. Investors should meet this challenge and accelerate their investment in that much needed capacity.

Investors are most likely to become involved in primary market climate financing in the following ways:

1. Direct project-level investment — infrastructure equity, project loans or bonds
2. Buying units in infrastructure or private equity funds
3. Buying securitized bonds or equity
4. Investing in green buildings, particularly energy efficiency (e.g., energy efficiency bonds)
5. Funding the balance sheets of corporate developers — debt and equity

Product development based on innovative strategies is crucial for investing institutions. This is covered in terms of clean energy in Section 4 below. In order to overcome financial market barriers, the asset owners, their capital market agents, service providers and other financial market participants will have to respond with projects and products to allow investors to gain access to the underlying low carbon investments. At the most fundamental level these will have to incorporate an attractive relative risk and return profile either historically or on a forward basis.

There are three key areas investors need to focus on to get increasing exposure to these low carbon strategies and products consistent with their governing mandates, particularly around active/passive and real asset holdings:

1. Strategic asset allocation
2. Acquiring the right skills and capacity
3. Engaging with all the relevant service providers

Each of these areas is discussed in further detail below.

Strategic Asset Allocation

Strategic asset allocation is a crucial starting point for investors looking to tap clean energy and low carbon investment opportunities. From basic principles of risk diversification to understanding the range of relevant asset classes, the following provides a high level overview of key considerations for investors seeking to tap low carbon investment opportunities consistent with their risk/return requirements.

- The former head of the UN Framework Convention on Climate Change and architect of the Paris Climate Agreement, Christiana Figueres, through her organization Mission2020, has called on investors to commit to investing 1% of their total assets under management into lower carbon and renewable energy infrastructure investment by 2020. By Mission2020's calculation, such a commitment would lead to over a trillion dollars being put to work each year in the further reduction of carbon emissions and catalyze efforts towards limiting global temperature rise to well below 2 degrees Celsius. This ambition mirrors commitments by leading global corporations to set science-based targets for greenhouse gas emission reductions and to meet 100% of their electricity demands from renewable energy. Whether investors specifically set and meet such a 1% allocation target or simply increase their allocations in line with this target based on sound investing principles untethered from a target, consideration of investments counted toward the 1% target should encompass newly developed and constructed infrastructure investments that produce *additional* carbon mitigation by displacing higher carbon infrastructure, even as investment into existing renewable energy assets (i.e., those that will not directly produce such additional carbon mitigation) continues to have merit in terms of both investment opportunity and, indirectly, growing the market.
- Some of the world's largest asset owners are allocating significantly to low carbon investments and already have exceeded the 1% investment target noted above. For example, recent data reflect that 19 asset owners among the largest 500 already have in excess of 5% of their total assets invested in low carbon investments.[7] The New York State Common Retirement Fund recently allocated an additional US$2bn to a low carbon emissions index fund — bringing the total investment to US$4bn,[8] CalSTRS has US$2.5bn in a low carbon index, and Legal and General's flagship climate fund based on the FTSE Index now has US$6.5bn under management. European Pension giant ABP has over US$3.5bn in renewable energy alone, and 6.1% of total AUM in low carbon investments with a target of US$6bn by 2020. In addition, La Caisse de dépôt et placement du Québec (CDPQ) has over US$16bn in low carbon investments, and a commitment to increase such investment by more than $US8bn by 2020.[9]
- In some funds there has been a shift away from traditional asset allocation and more towards a risk allocation budget which could favor thematic investing in low carbon assets as the climate risk driver is common across asset class boundaries.[10]

Risk Diversification — Back to Basics

- Perverse short-term incentives and return requirements can prevent investors from taking a broader long-term view that would more significantly favor low carbon investments. Asset managers may be focused on those short-term incentives and requirements in a manner that leads to exclusion of investments that are likely to succeed in the long term (e.g. clean energy projects) but for which some near-term volatility is likely. This time horizon issue has been examined by several organisations and highlighted by Bank of England Governor and Financial Stability Board Chair Mark Carney.[11] To overcome this, some leading asset owners have restructured their asset manager mandates to focus more on the long term, and leading investors are continuing to drive corporates to shift business and investment plans to a longer time horizon.
- As a result, many investors have not yet fully understood the full range and unique combination of risk attributes pertaining to climate risk that demand a hedging and diversification strategy. Climate risk is mostly medium to long term, high impact, multi-asset class, multi-sector, high physical certainty but with high transition uncertainty[12]. The wide range of asset classes and sectors exposed make the screening of climate-exposed investments very difficult and the addition of low carbon investments to hedge this portfolio risk also has some significant challenges.
- Investors mainly use historic data to predict future trends, and the relatively short and bumpy history of risk and return on low carbon investments has posed some challenges (see Section 4). This has been a key hurdle for many investors.
- On the other side of the equation, high carbon assets have struggled, as evidenced in the U.S. coal industry and European utilities.

The reduction in risk profile of renewable energy projects should enable investors to assumer greater exposure to those assets in both equity and debt.

- Meanwhile, as discussed in the "Investment Approaches" section below, construction and pre-construction risk for clean energy projects has shrunk enormously, but this has not yet been reflected in institutional risk premiums or in fund strategy. This opens the possibility of blended development and operating returns on a longer-term basis. The reduction in risk profile of renewable energy projects should enable investors to assume greater exposure to those assets in both equity and debt.
- Historical data for risk and return is generally out of date. Looking forward, since climate risk is pervasive across a typical portfolio, diversification from high to low carbon assets should lower overall long term portfolio climate risk. Relative to high carbon assets, this should lead to an increase in asset allocation to low carbon investments.
- Leading funds have often successfully managed their risk/return profiles and often use forward judgment to invest in these assets.
- Insurance companies in particular are well situated to increase their exposure to low carbon investments, as many insurers are long-term investors looking for the longer time horizons that these assets can provide. Such investments also incrementally reduce risks associated with climate impacts, thereby collaterally serving insurers' interests in reduced exposure to liabilities associated with climate-fueled disasters.
- The scale of low carbon investments in some sectors is still very small compared to their high carbon counterparts, and this has implications for some investors who have minimum deal size requirements (e.g., on the order of US$100m for large U.S. pension funds). This implies the need for programs to aggregate smaller transactions (see Section 5 on the CEFC and green bank crowding in). This however is less the case in energy generation, where the flow of funds is already higher in clean energy than in fossil fuel-based generation.
- Aside from exposure to energy efficiency in property investments, which has been productive for investors, access to investment in energy efficiency — often characterized as the cheapest and cleanest energy resource available — can be difficult. This difficulty in accessing efficiency investment opportunities has occurred even for sophisticated investors, since efficiency programs are often corporate-driven and built into other asset models. Additionally, data around energy efficiency is not easy to obtain, although investors have compensated for this by overweighting property which has driven much of the energy efficiency benefits.

- The clean transport sector is in its infancy, and despite record investment in companies like TESLA and encouraging strategic signals from some auto manufacturers, investors will also be able eventually to enter via securitized vehicle loans.

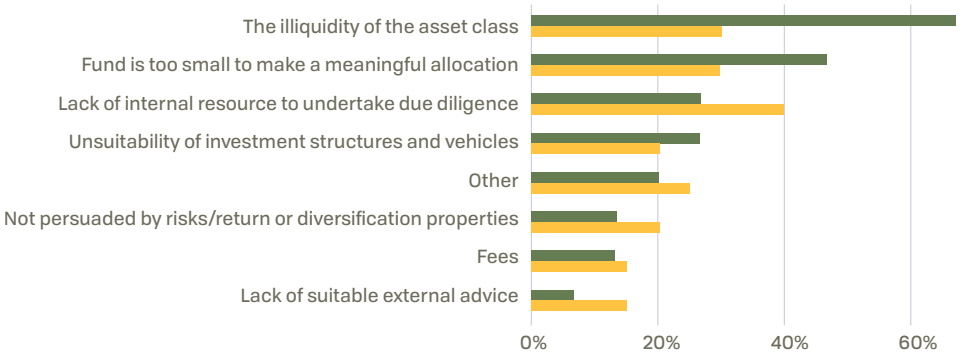
Infrastructure — Direct and Fund Vehicles

Investing in clean energy infrastructure is an increasingly prevalent approach for investors looking to tap opportunities associated with climate solutions. The barriers to infrastructure investment are well known and shown in **Figure 3-1** below.

At the same time, opportunities to surmount these barriers continue to expand, as summarized below.

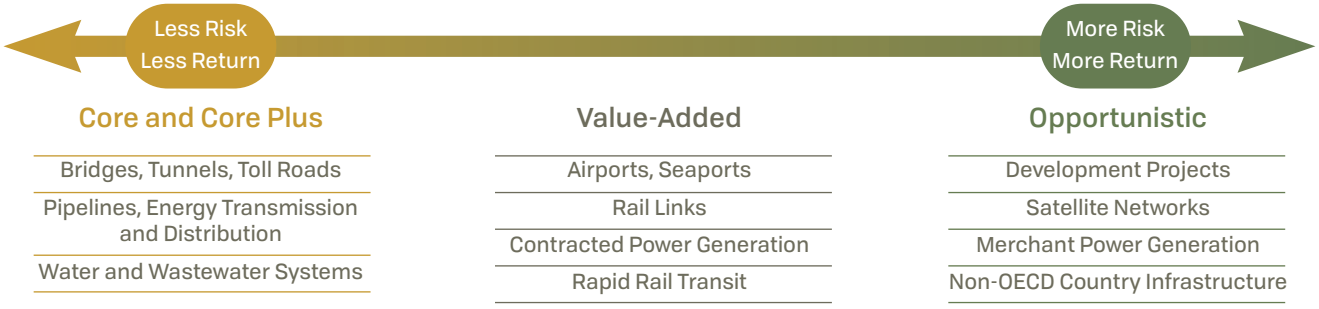
- As discussed in Section 4: Investment Approaches, there are limitations for investing in the infrastructure asset class either directly or via unlisted funds; these can include illiquidity, high fees, and valuation complexity. Nonethless, many leading investors — recognizing the advantages of low carbon infrastructure investments — have sought increased exposure.
- At an asset allocation level, there has at times been confusion as to whether a clean energy project is core infrastructure, core-plus infrastructure, value-add infrastructure, opportunistic infrastructure or even private equity. A lot of this comes down to what risk/return profile is being offered either by a project or a fund and how it corresponds to the relevant asset class and portfolio manager's objectives, as well as an understanding of development risk as opposed to operating risk. Service providers need to work with investors and consultants to be clear.
- The Value Add and opportunistic "buckets" allow for newer and more innovative strategies and products which currently can suit low carbon infrastructure.
- In some jurisdictions — notably the United States — allocating assets into infrastructure is relatively new. The immaturity of non-standard clean energy infrastructure investment vehicles has been a barrier given the requirements of many investors and asset consultants to have 3 or more years track record. Leading investors will be more open to newcomers. Using the more innovative asset allocation "buckets" of Value Add and Opportunistic can also help

Figure 3-1. Survey — Main Barriers to Infrastructure Investment



Source: Investment and Pensions Europe. IPE Real Assets Institutional Infrastructure Survey 2016. Investors were asked why they were not active in infrastructure. Liquidity was the biggest factor, with 66.7% of investors citing it as a reason, more than double the proportion in 2015.

Figure 3-2. Risk/Return in Core, Core Plus, Value-Added and Opportunistic Infrastructure Investments[13]



Source: JP Morgan Asset Managemen

- As a reflection of many of the above issues, according to the OECD Large Pension Funds 2015 Survey,[14] most funds with a target allocation to infrastructure reported an actual allocation of just over half of the target level. At least two conclusions from these dynamics have been drawn by Climate Policy Initiative:

  a. While institutional investor investment potential in renewable energy infrastructure has not changed materially, many more investors have set targets to increase their infrastructure allocations.

  b. Achieving this target allocation has been more difficult — both because of a lack of suitable assets and because existing investment vehicles are not ideally suited to meet the requirements of institutional investors.[15]

- Leading investors are engaging with the market to help spur the development of new and innovative products to help overcome these barriers, as discussed in Section 4.

Equities and Corporate Balance Sheet Support

- Listed companies across several sectors such as utilities and transportation provide a way for investors to gain exposure to low carbon investments via primary issues of both debt and equity. However, in sectors like electric power these companies may be transitioning quickly but are not pure play clean energy companies. For example natural gas and electric power company AGL is the highest CO2 emitter in Australia, but also the largest clean energy investor. A key issue is whether or not supporting general bond issues from such transitioning companies will necessarily support further clean energy investment; more work around data, transparency and a set of common "rules" is needed by service providers.
- From the company side, some are looking to implement low carbon investment strategies and make it easier for investors to reward them for those strategies, and are separating their low carbon and high carbon assets (e.g., BHP/South32, RWE, E.ON). There is also movement from some of the oil supermajors; for example, Statoil and TOTAL are shifting significant investment into renewable energy sources.
- Through their engagements with companies, investors, particularly universal owners such as pension funds, are driving energy diversification in the direction of low carbon solutions. They are using the engagement process and moving companies to use their corporate position to drive clean energy capital.

Through their engagements with companies, investors — particularly universal owners such as pension funds — are moving companies to use their corporate position to drive clean energy capital.

- Some financial institutions have issued green bonds using their corporate balance sheets, although the use of these funds is not always transparent. Demand for corporate green bond issuances currently far outpaces supply.

Fixed income — Loans, Bonds and Securitisation

Direct loans are becoming more popular for institutional investors, particularly insurance companies. As shown in Section 4 they are fast emerging as the largest source of low carbon infrastructure funding.

Further, as discussed in Section 4, climate bond finance can emerge as specific bonds, such as project bonds, or by securitized bonds / asset backed securities. There has been a movement to label these as green bonds, which has created significant interest in low carbon opportunities among mainstream investors.

- The labelled green bond market[16] has emerged with a use-of-proceeds specific project focus, mostly in Sovereign and IFI markets. Even as the green bonds market has taken off globally, corporate issuance of green bonds has lagged. There is a strong desire to see ABS issuance and more corporate activity; this is a challenge to originators.
- More specific aspects of related technology and policy barriers are tackled in Section 4. Other aspects are implicit in the risk and return discussions here, as well as below in the behavioral finance section.

Property

- Property — both real and in funds — can be a significant part of a portfolio for some institutions.
- Property has been a focus for energy efficiency for direct and indirect investment. Understanding the nature of the low carbon element of real property often depends on rating systems such as LEED. In addition, for some investors, there is an asset allocation constraint restricting investing in property or outside certain asset classes.

Key Service Providers

There has been progress throughout the investment chain as service providers are also being forced to respond to demand from Asset Owners as Asset Managers, index providers, asset consultants and ratings agencies all look to build services that encompass low carbon investing.

Asset Managers

- Asset Owners essentially drive Asset Managers through mandates. Therefore, developing low carbon mandates for Asset Managers is a critical element.
- The capacity building by Asset Owners is having a knock-on effect on the Asset Managers, who therefore are being driven by the Asset Owners to build their own skills and capability in order to execute the new demands of mandates to manage climate risks, align portfolios with low carbon transition, and/or target low carbon investments.
- If Asset Owners seek a mandate for new low carbon strategies and products, individually and/or collectively, leading Asset Managers are far more likely to offer these.

Asset Consultants

- Within the strategic asset allocation process, there has been some good but insufficient progress. There is no evidence that leading asset consultants have yet incorporated climate-related considerations as standard across their client base. A 2017 disclosure request by AODP for the asset consultants was only responded to by one of the major consulting firms.
- With regard to consideration of Environmental, Social and Governance (ESG) issues more broadly, consultants are looking to be proactive, and some have even produced climate risk studies (e.g., Mercer 2015[17]) — but this has not fed down to the material levels of engagements with large numbers of mainstream clients. Most consultant models do not materially address climate risk, resulting in undue inertia (even amid a rapidly changing landscape) as asset owners assert the need for guidance from their consultants.[18]
- Asset consultants were not included in the scope of financial organisations called upon to report under the TCFD recommendations. However, asset consultants remain tremendously influential as advisers to Asset Owners, and there is a need for Asset Owners to require their asset consultants to possess understanding, skills and capability around low carbon investing.
- Infrastructure as an asset class has grown significantly in the last five years. This is because of several factors, including the search for yield in low interest rate environments — but it also aligns with the recommendations of Mercer in its reports of 2010 and 2015 regarding exposure to asset classes that facilitate low carbon investments.[19,20]
- Service providers including asset consultants may now be subjected to legal risk if they do not incorporate climate risk into their analysis and recommendations. This will impact high carbon risk adjustment, and thus positively impact low carbon investment.[21]
- There is no evidence that asset consultants have fully recognized the reduced pre-construction risk for renewable energy projects in recent years, and the correspondingly fast path to revenue for many renewables projects. They should ensure this updated risk profile is reflected in recommendations to investors.
- It is worth noting that actuaries are also heavy influencers of long term investors such as pension funds and have increased their role and begun to present a case for consideration of a longer time horizon for investor risk analysis that would encompass climate change.[22]

Index and Benchmark Providers, and Reducing High-Carbon Holdings

Index providers can be important for both active and passive funds;

- Active funds might ask for specialized low carbon indices to then track their active strategies against.
- Importantly for passive equity investors, only by asking for benchmarks that adjust for carbon risk and getting those agreed in terms of mandates can such an investor implement a low carbon listed equity strategy.
- At the far end of the spectrum, this can lead to full divestment of some or all high carbon sectors — e.g., coal and oil sands.

There are many service providers now working in this area.

Ratings Agencies

Ratings agencies will continue to play a key role, as fixed income is a critical asset class for green investment. All three major credit ratings agencies are now producing regular market reports, and are building skills and capability to better reflect climate risk in their ratings. However, it is likely that the sophistication of ratings models incorporating climate risk has not yet matured

compared to other factors, and disclosure of how many ratings have been adjusted because of climate risk is still low. Nonetheless, some broad ratings warnings have been issued, and ongoing improvements are anticipated.[23]

Skills and Capacity

- Internally within investor organizations, there is significant variability in the skills and capabilities required to vet, buy, sell and manage low carbon investments, yet particularly within larger organisations the trend is toward increased capacity. The process leading up to the Paris Climate Agreement in 2015 played a significant role in driving the awareness and need for such capacity, as the Agreement was supported by many large investors with board level sponsorship that provided impetus and leadership for their own and peer firms.
- This is reflected in data indicating that 88, or nearly 20%, of the largest 500 investors in 2017 had a role with some kind of specific climate change capability within their organization. Of these, 22 institutions have staff within their investment or risk teams dedicated to integrating climate risk management into the investment process. These 88 funds had a combined 223 staff with climate expertise. This is a rise of 87% since 2014.[24,25]
- A significant source of investor skills and capability has been that provided to investors in the form of publicly disseminated research and analysis by NGOs funded largely by philanthropic foundations. Examples of these include Ceres' guidance and analyses including the *Ceres Blueprint for Sustainable Investing*[26] and *Investing in the Clean Trillion*,[27] portfolio work by 2 Degrees Investing Initiative, fossil fuel exposure analysis by Carbon Tracker Initiative, emissions and strategy data from CDP and data on leadership and best practice from AODP.[28]
- The FSB TCFD recommendations hold tremendous potential for enabling investors to more comprehensively identify and manage climate risks and illuminate opportunities in low carbon investments. Yet banks, insurance companies, fund managers, and asset owners will need additional skills and capabilities — whether internally or externally — to fulfill their scenario analysis and reporting needs under the recommendations, if they are to realize their benefits.[29]
- Structural trends are also favoring the building of climate finance competencies as Asset Owners are becoming more internally managed, which in turn — free of the asset consultant limitations — allows more thematic investing favoring low carbon investment.[30]

The TCFD recommendations hold tremendous potential for enabling investors to more comprehensively identify and manage climate risks and illuminate opportunities in low carbon investments.

There are many barriers for investors building skills and capacity. Cost is often an issue within large Asset Owners who tend to outsource their investments and services. Climate change more than any other risk has driven some to invest in skills and capacities even just to understand the barriers between them and their agents when it comes to managing the risks. There is a strong crossover here into the governance issue, as the TCFD has clarified the need for climate risk to receive appropriate board and management attention and to ensure that the right structures are in place to deal with it. This often requires an injection of new knowledge and skills into the organisation.

Behavioural Barriers

There are a large number of behavioural barriers in investing generally, and many of them are present when it comes to investing in climate solutions. Indeed, the unique attributes of climate risk (long term, non-diversifiable, high uncertainty) highlight these barriers and enforce the need to overcome them. These barriers relate to various cognitive biases that exist amongst investors, particularly laggards. In effect they can only be overcome through:

- Leaders concluding that these are behavioral biases and not market- or logically based
- Market risk and return confirming a positive outcome
- Continued education

Examples of relevant potential behavioural finance issues and cognitive biases in this area include:

- Outdated perceptions that are based on stale data regarding clean energy project risk/return exist and persist for longer than is desirable. This is partly behavioral, partly related to the data lag, and partly a capability issue. As discussed in the Investor Approaches section, a good example of this is the shorter pathway to cash (often 6 months) that now exists for many renewable energy projects where the asset class itself generally has a much longer pathway.

- There is a behavioral and sometimes cultural resistance to moving away from historically solid high carbon returns looking back over 20 years or more. Even as these returns have now suffered considerably in most jurisdictions and markets, some investor perceptions can tend to remain for a longer time — maintaining resistance to off-loading those investments.
- Investments based on policy incentives are treated by some as more uncertain than investments in areas that do not enjoy such incentives, ostensibly due to risks associated with changing politics and policy longevity — yet actual investment uncertainties tied to such factors are hard to demonstrate in fact. However, any uncertainties associated with potential phase-out of incentives are decreasing as clean energy becomes ever more cost-effective even in the absence of incentives.
- Identifying an investment as "green or clean" might send a signal that the expected risk/return trade-off is not competitive and unintentionally cause a negative cognitive bias. Indeed, cultural and political bias makes some investors emotionally biased against "green," just as such labeling is a draw for other investors.
- In recent years, investors have better understood the risks associated with high carbon investments at all levels of the supply chain.[31] However, there is a time lag between allocating new high carbon risk premiums and transferring these to low carbon investments in the form of reduced risk premiums. This captures a number of cognitive biases causing a delay in adapting to a new reality in clean energy investments.
- There is consistent underestimation of reductions in clean energy costs, increases in clean energy deployment and growth, and progress in commercializing new clean energy technologies by forecasters. These shortcomings in adjusting to a dynamically changing energy landscape[31] hamper investor decisions.
- There is a behavioral bias to the time horizon issue — specifically, a tendency to prefer short term focus. In this context, it can be particularly challenging to tackle long term issues with no historical precedence, engendering reluctance to use forward judgment.
- Some investors are said to exhibit a collective or "herd" mentality, which discourages leadership and encourages a "follow the pack" mindset that can inhibit paradigm shifts — such as what is currently called for in the context of global low carbon transition.

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4. INVESTMENT APPROACHES FOR INSTITUTIONAL INVESTMENT IN CLEAN ENERGY

Today, as investors focus attention on climate-related and other ESG financial risks as well as climate investment opportunities and solutions, the following trends are key considerations for institutional investors:

- In recent years the core clean energy investor base has expanded: from traditional banks, developers and utilities, to insurance companies, pension funds, investment banks and corporates — remarkably even traditional oil and gas companies — playing an increasingly important role.[1]
- Today, rapidly decreasing costs of clean energy infrastructure and more efficient technologies have driven the increasingly competitive pricing of dispatchable clean energy supply (e.g., when variable-output renewables are integrated with rapid response storage) and enabled the sector to gain considerable scale. Investment in clean energy has overtaken fossil fuels for the first time and become the most serious contender as the future primary source of reliable, on-demand power supply.
- This cost competitiveness, maturity and scale have been central to attracting investor attention and driving new investment products in diversified investment opportunities that have enabled institutional investors to deploy capital in the billions.
- Investors are also increasingly seeking clean energy investments as a hedge against emerging physical risks, fossil fuel price volatility, liability risk and growing regulatory risks from carbon emissions policies and to fulfil ESG and responsible investment demand.
- In general, there has been an increasing trend in estimated returns from the clean energy space, with nearly one in four funds generating a net IRR greater than 10%.[2] Returns are comparable to or better than traditional infrastructure, private equity and real estate. However, there has been greater diversity in clean energy returns, dragging down the median and reinforcing the need to target upper quartile funds or higher performing companies, understand risk mitigation mechanisms, and secure experience in the sector.[3]
- The clean energy sector has also broadened — from mature renewables such as solar PV and on-shore wind, to much-needed storage, dispatchable technology, early-stage digital energy and "smart grid" technologies. Each promises huge growth along with electric vehicles (EVs) as the energy landscape changes. Due to very different maturity, risk and return characteristics, it is important to assess each diversified sub-sector independently and not as a whole.
- Overall, asset finance remains the dominant mode of investment in clean energy. However, there are a number of growing product segments including:
  - direct project equity, debt securitisation, mezzanine and senior debt and other vehicles supporting the >US$333 billion per annum clean energy asset finance market;
  - unlisted funds including over US$ 12.6 billion raised globally in 2016[4];
  - US$163 billion green bond market (including US$25 billion in asset backed securities) — a material portion of which is allocated to clean energy — has exhibited over 60% CAGR since 2013;
  - increasing availability of ETFs and other listed investment vehicles targeting low-carbon or fossil fuel-free investment, in response to growing investment demand from the estimated US$ 10 trillion[5] ESG-focused investment sector;
  - direct loans to project finance which are also a growing area for institutional investors.
- Investment opportunities include "greenfield" (i.e., development stage project) investments that have

become more attractive as earlier stage risks have been better understood and mitigated[6] and as investor familiarity has increased. Blending greenfield-stage exposure with operating assets in a diversified portfolio is also an interesting approach that may assist investors in making their first move into the sector.

- Dispatchable low carbon and renewable power as well as smarter grid support technologies are a key market gap at the moment and an expected area of high capital demand over the next 10 years.

Accessing the Clean Energy Sector

There are three primary means for investors to gain access to the clean energy space: corporate, fund and direct project investment. These are accessible through a broadening range of products, from unlisted managed investment funds investing pooled equity or debt directly into projects and direct investment of equity and debt by institutions, to a widening range of "fossil fuel free" or ESG-focused ETFs, listed clean energy focused "yieldcos", asset backed green bonds, or, more indirectly, through listed equity investments in energy-focused corporates and utilities.

The **Figure 4-1** illustrates some of the available financing structures in renewable energy and projects the scale of opportunity for each (recorded in $US trillions of dollars) in the electric power sector alone through 2040 under a 2-degree scenario. Each offers very different levels of direct or indirect exposure, investment transparency, risk and return expectations, passive/active control, diversification and scale characteristics.

In addition to the asset or project based alternative illustrated above, there is significant scope for institutional investment through a range of private equity and venture capital structures in broader "clean energy" subsectors, such as digital energy technologies, EVs, renewable power equipment manufacturing, clean technology and energy efficiency businesses. Each subsector can offer significantly different levels of maturity and fundamental risk and return characteristics.

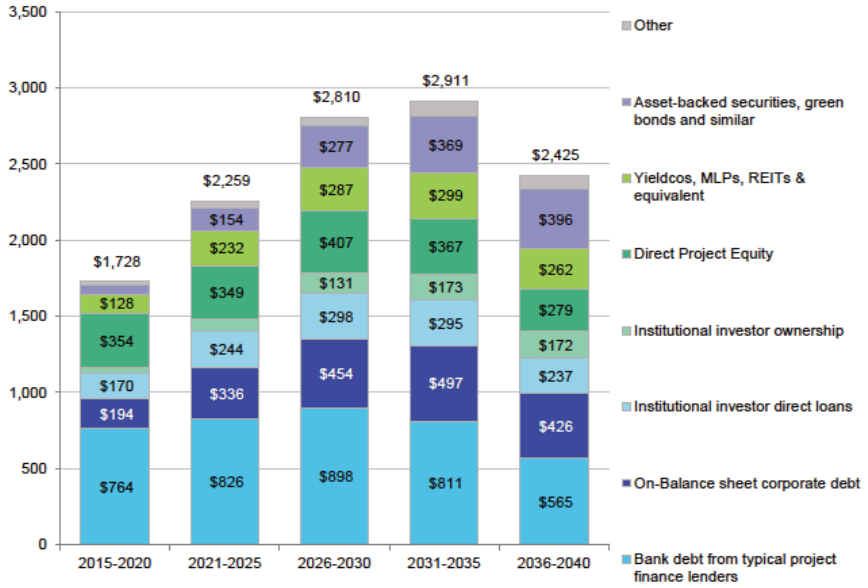
Popular Clean Energy Investment Vehicles and Return Estimates

Below we summarise the key aspects of the more prominent investment vehicles for clean energy, identifying:

- Asset type
- Investment strategy objective
- Indicative investment scale
- Target returns
- Standard investment period
- Type of investors
- Key risk mitigation mechanisms

An overview of general transparency, liquidity, control, diversification, fee costs and other attributes is also provided. Due to the diversity that exists within each segment, these are generalised statements and may not be relevant to specific projects or structures.

Figure 4-1. Renewable Energy Projected Financing Sources Required 2015-2040



Source: Bloomberg New Energy Finance, Ceres-BNEF Mapping the Gap (2016).

Figure 4-2. Primary Vehicles for Institutional Investment in Clean Energy — Globally[7]

Asset Type	Corporate		Fund		Project	
	Equity	Debt	Equity	Debt	Equity	Debt
Description	· Publicly listed equity · ETFs · Private placement · Private company investment	· Corporate bonds · ABS · Green bonds · Mezzanine finance · Securitised Corporate Debt	· Investment in private or listed pooled infrastructure funds · Private Equity · Venture Capital	· Senior term loans · Mezzanine, debt or hybrid debt funds · ABS · Bonds	· Direct co/investment in unlisted project equity · Listed yieldco, · PPPs	· Senior term loans · Bridge loans · Project bonds · Mezzanine debt · Securitised project debt
Indicative Investment Scale[8]	· US$12.1 billion of listed clean energy investment in 2016 · Labelled green bond issuances >US$163 bn[9] in 2017 with asset backed and mortgage backed securities >US$25 bn.		Over US$ 12.6 Billion was raised in private equity and other funds in 2016[10]		Asset finance exceeded US$333bn in 2017 (including M&A plus new investment)	
Target Returns[11]	5-20%	3-6% Public debt and green bonds 12-15% Mezz	7-20% (Infra/PE) >20% (VC)	3-10%	8-18%	3%-10% from senior to mezzanine
Standard Investment Period	Variable		5-12 years (open ended Funds may be longer)		5-40 years	
Standard Investment Range	>$0 - $500 Million		$10 - $500+ Million		$50 Million - $5 Billion	
Types of Investors	Diversified equity investors (institutional and retail)	Fixed Income investors	Institutional investors incl. Sovereign Wealth Funds, pension funds, insurance, high net worth	Pension Funds/Insurance companies	Project developers, sovereign wealth, utilities, oil & gas companies, large-scale pension funds and other asset owners	Banks and other financial institutions and, insurance companies and lenders
Common Potential Risks (please also refer to Figure 4-3)	Control, long-term alignment, transparency, governance, volatility (listed entities), establishing diversification can be an issue outside of index funds without a dedicated team		Lack of liquidity, control, potential transaction, management or deal costs, governance		Lack of liquidity, diversification, demand for scaled investment, upfront transaction and specialised team and knowledge costs and requirements	
Risk Mitigants	Diversification, liquidity, reporting, stringent regulations, selection	Securitisation, Loan guarantees, asset security	Diversification, Performance guarantees, Insurance, Contractual operational or development alignment	Securitisation, Loan guarantees, asset security	Performance guarantees, Insurance, Contractual operational or development alignment	Collateralised, secured mortgage Subordination, Loan guarantees

Figure 4-3. Comparison of Key Benefits / Attributes of Primary Vehicles for Institutional Investors

Asset Type	Corporate		Fund		Project	
	Equity	Debt	Equity	Debt	Equity	Debt
Level of Clean Energy Exposure	Indirect / Diversified May be diluted with other corporate activities*		Partly Direct / Medium-High Higher if invested in Funds that offer co-investment and/or directly invest in projects. Some control and generally specified investment mandate		Direct / High Direct exposure and asset management and control, subordinated to debt. Debt investments may be unsubordinated.	
Time and Resources Required	Low-medium. Lower initial due diligence may be required in some instances. Can be high in order to achieve required diversification and adequately track underlying investment activities		Low-medium. Initial relatively high levels of time and due diligence required. Lower time required to achieve diversity, ongoing portfolio management, and lesser in-house expertise to transact and track long-term alignment with initial mandate requirements		Can be very high at initial transaction and ongoing management and requires expertise in-house	
Transparency	Usually high; Regulatory disclosure; Public markets		Generally high. Reliant on selected Fund disclosures		High. Full transparency to underlying project and operations	
Liquidity	Variable (from highly liquid listed stocks to unlisted corporate debt)		Limited. Investors need to match Fund duration to preferences.		Low. Duration up to 40 years and investor replacement may be expensive	
Control	Limited control and investment mandate may shift		Medium–High. Wide range of fund mandates to suit portfolio requirements. Co-investment can increase exposure to preferred areas of investment		High. Ability to control investment structure, gearing, planning and ongoing strategy	
Scale	Low-High		Medium-High		High	
Diversification	Low-Medium unless investing through highly diversified vehicles (e.g. ETFs)		High. Mandates can be selected to match investor preferences where possible		Generally low but can be suitable for highly scaled investors	
Track Record	Generally, access to analytical work, real-time and historical data (namely for listed entities or comparables)		Limited public data. Older data can be limited in relevance due to changes over time (e.g. key drivers subsidy - market)		Limited public data. Older data can be limited in relevance due to changes over time (e.g. key drivers subsidy - market)	
Fees and Other Costs	Variable. Corporate overhead/expenses; Write downs/losses; Generally lower transaction costs and fees (upfront/ transactional basis).		High (management, carry, transaction and other costs)		Low-Medium. No external management fees. Upfront due diligence, structuring and exit fees. Break fees or failed investment costs	
Volatility	High. For listed entities, in line with equities markets		Low–medium; Periodic "fair value" assessments; Independent audit		Medium-low. Potentially relatively stable, lower risk "bond-like" cash flows	
Overall Ease of Investment	· High/Medium · Low transaction costs · However, need to select corporates that are acting in line with intended investment thesis · May limit scale or require higher amounts of time to assess corporate changes or exposure over time		· High/Medium · Limited historical performance data available · Easy access to scaled, diversified portfolios · Commonly requires minimum commitments and terms · Investment may be enabled through co-investment platforms		· Low, but very well suited to some scaled investors · Significant in-house expertise, time and expensive due diligence · Can be resolved through JV, co-investment structures, passing project management to asset managers · Fairly illiquid investment with limited diversification	

* Note that this is only a general observation. Specific investments may provide high level of clean energy exposure or more direct exposure. For example, Use of Proceeds Green Bonds.

Understanding the Scope of Products, Risks and Returns

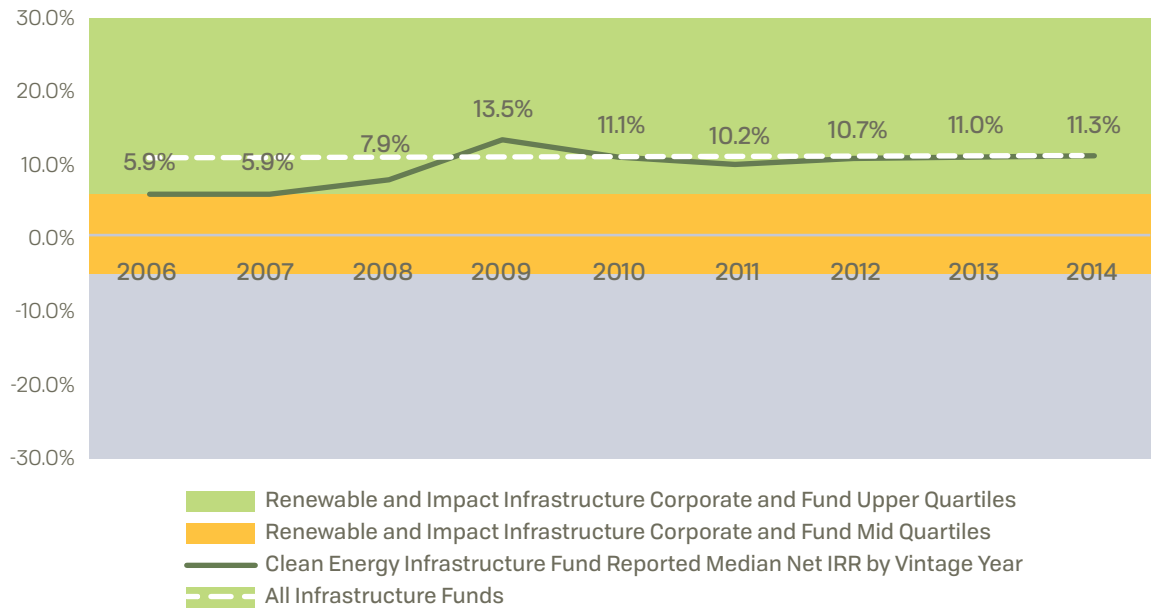
With growing institutional investor interest and demand, and a widening array of investment products, sub-sectors and methods of making investments in clean energy — as illuminated in part by **Figures 4-2 and 4-3** — investors generally can now target specific risk/return preferences by investment, even in the absence of extensive historical data, through:

- Highly tailored financing structures or products across corporate, fund or direct investment options ranging from equity across the spectrum to debt;
- Specific sub-sectors (e.g. equipment manufacturing, "clean technology", early stage digital energy technologies to mature generation projects); or
- Selected stages of asset life (e.g. greenfield projects, meaning assets under development stages or prior to completion of construction; "brownfield", meaning established assets or land in need of improvements or expansion; remediation of distressed/underperforming assets; or M&A of operating assets/businesses).

To date, many clean energy infrastructure assets have been held in unlisted or private vehicles, with limited publicly available return data. Listed companies or indices, such as the NEX (WilderHill New Energy Global Innovation Index) have offered greater insight into returns of information technology or industrial business; however, these areas of investment may be less relevant to the broader institutional investor base seeking exposure to clean energy infrastructure opportunities. Below, we look at some of the available returns data and the differences in the clean energy market today, highlighting areas where specific analysis should be applied to better seek to understand more recent market dynamics, risks and returns.

Some recent reports suggest a trend of rising relative returns from clean energy investment with returns achieved comparable to those targeted by wider private equity. Nearly one in four funds targeting impact infrastructure (primarily renewable energy) have been reported to generate net IRRs greater than 10%.[12] However, for mid and lower quartiles, there is evidence of a greater diversity of returns from clean energy generally leading to a lower overall median, depending upon the particular sub-sector focus, strategy, market, vintage/timing and asset managers involved. This reinforces the need to target specific sub-sectors that match investor risk/return targets, to seek out upper quartile performing funds or companies, and to specifically understand the long-term experience of companies or fund managers, the different strategies

Figure 4-4. Reported Clean Energy Infrastructure Median Net IRR by Vintage Year vs Wider Renewable Energy Infrastructure[14] *



* Based on data from Cambridge Associates classified as impact infrastructure corporate and fund performance. Note that a large proportion of assessed entities were focused on investment in renewable energy; however, the data includes a broader range of "impact" assets than renewable energy alone.

and the risk mitigation mechanisms being employed. These characteristics, approaches and experience differ vastly within the sector, particularly as interest in the industry grows.[13]

Overall, it needs to be appreciated that for clean energy as an investment category, due to dramatic changes in the overall energy market in recent years, historical returns should be assessed with reference to significant market shifts and experience curves in the sector, as well as associated reductions in project risks. Recent material changes include the relative dominance of market revenue drivers, clean energy cost reductions, emergence of competitive dispatchable clean technologies and the growing obsolescence and lack of competitiveness of traditional fossil fuel and nuclear technologies (please refer to Section 2 for further details of the changing landscape). This makes it critical for investors to carefully assess future market developments, technology changes, contractual structures, risk mitigation techniques or other aspects of individual investment.

For example:

- Significant reductions in project costs have occurred in the sector and could potentially support higher returns;
- Maturity and experience in the sector can enable investors and/or developers to better mitigate long-term risk (e.g. greater access to insurance products, delayed payment mechanisms, etc.);
- Revenue previously driven by policy mechanisms such as feed-in tariffs (FITs) or RECs is increasingly driven by market dynamics or growing demand for long-term Power Purchase Agreements (PPAs), in particular in the U.S., as corporates seek hedges against volatile fossil fuel and energy pricing;
- Dispatchability of clean energy (e.g. through pairing variable-output renewable energy with battery or pumped hydro storage) is expected to be a key driver to long-term returns, enabling clean energy to target higher pricing during peak periods or to better supply PPAs;
- Some pure-play clean energy companies are reaching scale and maturity, making the M&A space more attractive to a larger scope of investors, but also driving more competitive auctions or transactions.

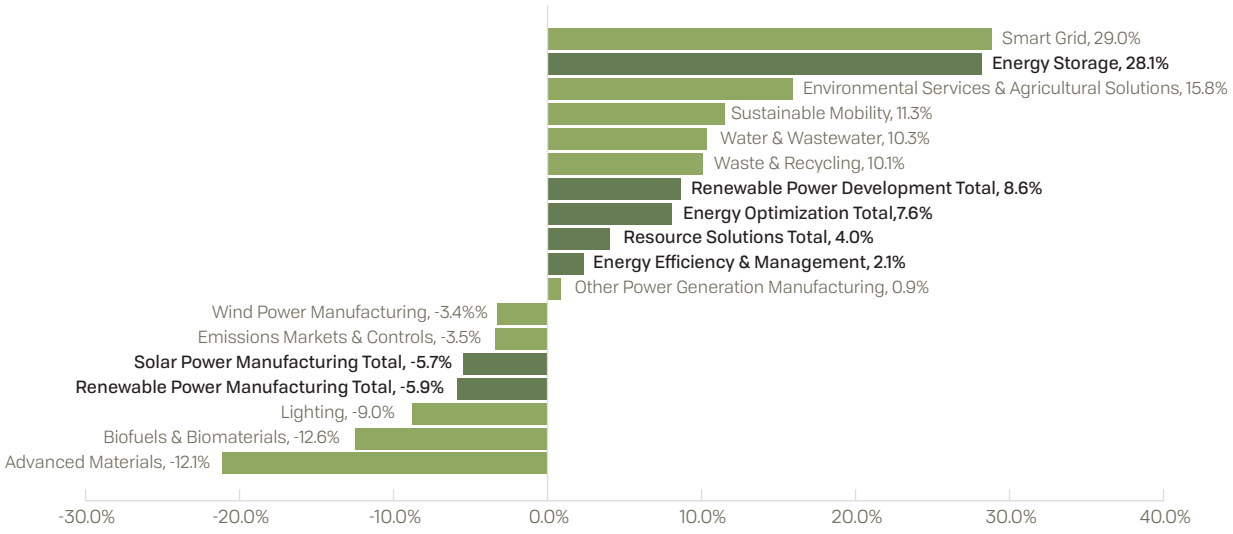
Risk mitigation can be further supported by the growing range of instruments, structuring and contract mechanisms[15] that are available as the industry has scaled.

These risks also should be considered against the increasing evidence of comparative risk exposure of conventional fossil fuel or nuclear energy investments, in particular those with potential exposure to de-carbonisation regulation, fuel price volatility or other climate-related risks. Recently, these risks have been seen in relation to oil and coal companies subject to de-carbonisation regulation in the U.K. and Europe, increasing risks due to concerns over increasing insurance claims in relation to climate change[16] or considerable risk of material company or Director liability in relation to climate-change.[17]

Returns by Sub-Sector

It is important to note that returns are highly diversified across each sub-sector. **Figure 4-5** below presents one recent analysis that is illustrative of this range of IRRs across sub-sectors.

Figure 4-5. Gross Corporate and Fund IRR by Clean Tech Subsector, 2000-2014[18]



As a result, unlike more traditional infrastructure or energy, performance of any individual or mixed sub-sectors should not be used to evaluate or forecast the whole.

With increasing focus on ESG integration, management of climate and carbon-asset risk exposure, and responsible investment has come a growing range of ETFs targeting the space. ETFs such as those based on Wilderhill New Energy Global Innovation Index (NEX) are often quoted as a proxy of clean energy sector performance. However, investors need to carefully assess if the underlying investment mix in a specific ETF meets their investment goals. For example, the Global Innovation Index (NEX) is currently diversified over 25% each to industrials, utilities and IT (with limited clean energy generation) while the PowerShare Wilderhill Clean Energy Portfolio — based on the WilderHill Clean Energy Index (ECO) — is currently comprised of over 40% IT companies and not "clean energy" supply infrastructure. This means that returns for funds such as this should perhaps be considered more in comparison to technology companies rather than infrastructure investments. It is clear that the WilderHill Clean Energy Index, notwithstanding its name, is not representative of the clean energy infrastructure sector at large. The risk/return attributes of the underlying portfolio companies making up the Index are likely to have limited correlation to the actual performance of clean energy infrastructure asset investments.

Figure 4-6. 1 Year Relative Performance of WilderHill New Energy Global Innovation Index (orange) vs S&P 500 (blue) vs PowerShares WilderHill Clean Energy Portfolio Fund (ETF) (red)[19]

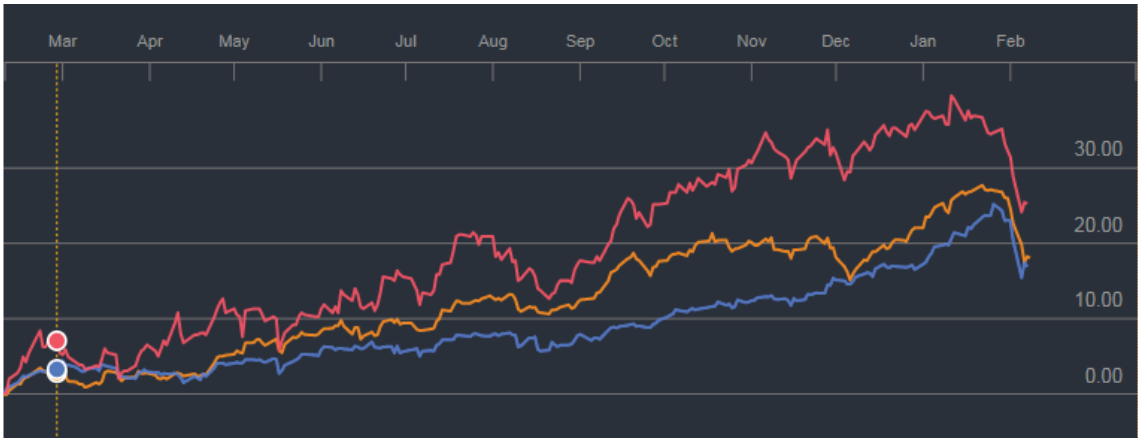


Figure 4-7. 5 Year Relative Performance of WilderHill New Energy Global Innovation Index (orange) vs S&P 500 (blue) vs PowerShares WilderHill Clean Energy Fund (ETF) (red)

Return Expectations by Stages of Asset Life

Return expectations and targets can also vary depending on the stage of the asset life-cycle in question and, where applicable, the level of revenue contracting that a project has secured.

For example, the below chart depicts a wide range of institutional investor return expectations, dependant on the stage of asset maturity from "greenfield" to "brownfield".

"Contracted Infrastructure" refers to projects which have long term sales contracts in place with buyer counter-parties that mitigate revenue volatility through firm pricing via long-term binding purchase commitments. "Merchant Infrastructure" refers to projects with non-contracted revenues which are subject to market variability and inherently more volatility in revenue streams.

While the investor expectations above relate to the conventional infrastructure asset class, it provides some guidance in relation to clean energy infrastructure which exhibits both "brownfield" and "greenfield" types as well as contracted and merchant revenues. Also, short or staged construction periods (reducing timing and cash flow risk) are common and, in recent years, lower risk at late development stages. This has been evidenced in recent offshore wind transactions, historically seen as one of the riskiest investments in "greenfield" and "brownfield" clean energy infrastructure, where the implied investor cost of capital has in some cases now fallen to as low as 2%. This is enabled by experience, scale, lower costs (removing subsidy risks as fundamental pricing is competitive with the overall market), availability of long-term, investment grade counterparties and increasing technological efficiency and sector maturity.[21]

Figure 4-8. Investor Infrastructure Equity Return Expectations[20]

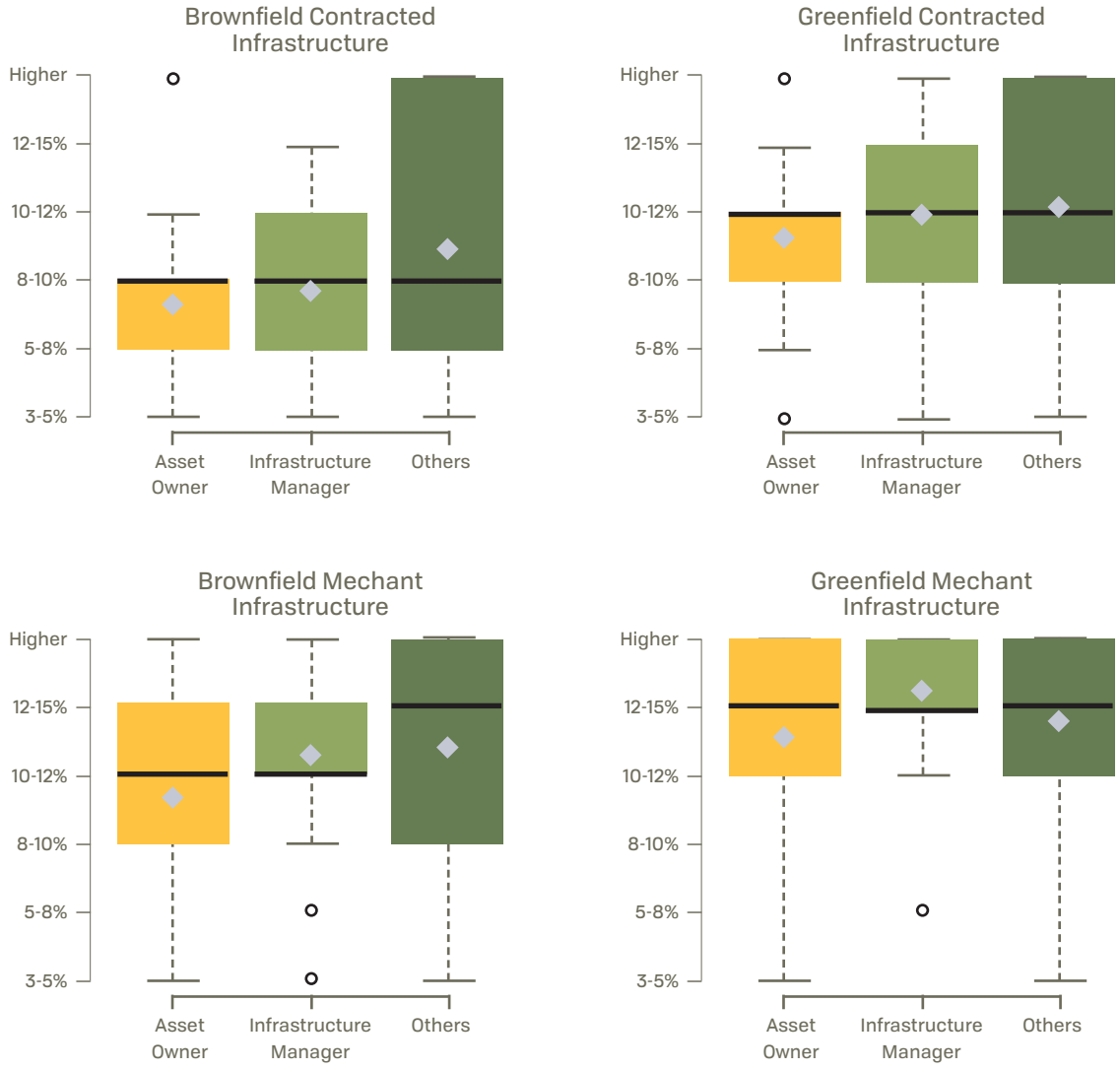
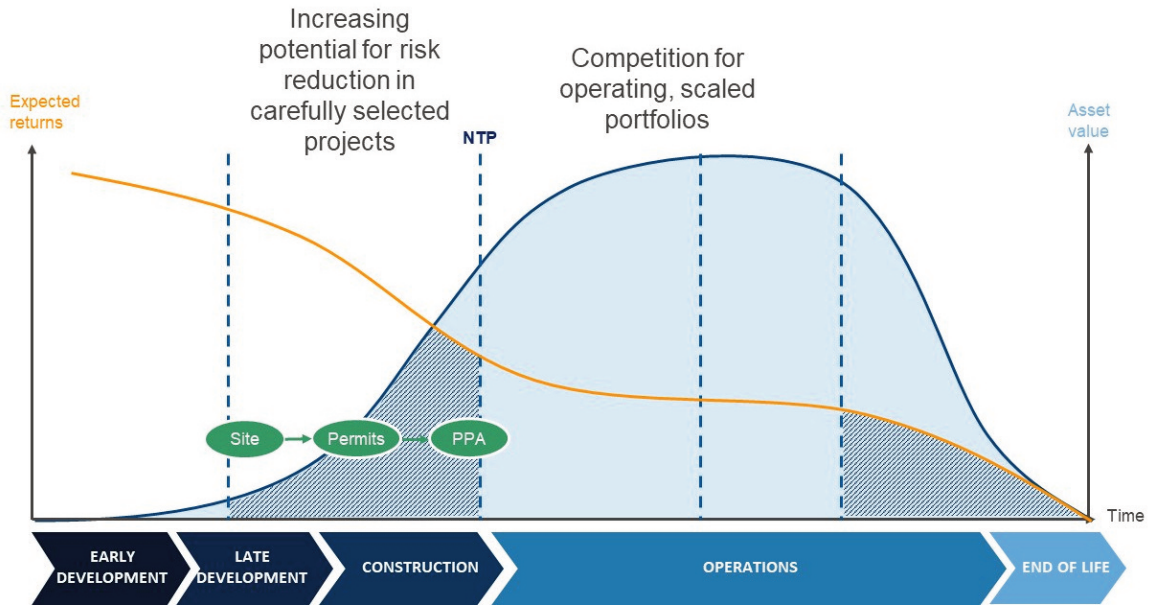


Figure 4-9 shows a similar progression in generalised investment return expectations across the life of a clean energy generation asset.

Figure 4-9. Illustrative Investor Return Expectations Across the Asset Life-Cycle[22]



Key Differences Between Clean and Conventional Energy Infrastructure

While each form of energy infrastructure shares many similarities, enabling familiar and well-understood financing structures such as project finance, regular cash flow and returns, there are a number of key differences:

- **Pre-construction timelines and investment opportunities.**
  Many renewable energy infrastructure projects, such as solar PV and onshore wind, have shorter project timelines from commencement of development and construction through to operations. Importantly, as the number of precedent transactions and investments have grown, perceptions of development and construction risk have matured and the shorter period to revenues has increased investor appeal.

- **Construction staging**
  One feature of certain renewable energy assets is their ability to be constructed in incremental stages which can be much easier to undertake than conventional utility scale fossil fuel infrastructure. This can shorten the time between investment and receipt of first cash flows. Onshore and offshore wind farms, and solar PV assets can offer this attraction.

- **Technology maturity**
  A historical difference between conventional fossil fuel energy infrastructure and clean energy was the perceived technology risk associated with new forms of clean energy generating infrastructure. Over the past 10 years we have seen mass proliferation of solar PV, onshore wind and offshore wind with improving reliability, performance and warranties from manufacturers. With these now proven technologies, a raft of contractual protections has emerged including extended warranties, insurances, structuring and other risk mitigation techniques that have enabled investors to gain exposure to lower risk and mature infrastructure assets.

Avoiding the Crowd

As clean energy infrastructure has matured as an "investable" asset class for institutional investors, so too has the competition amongst them for access to high quality projects and portfolios of assets. Improved understanding of investment risks and mitigation mechanisms has also enhanced investor comfort to the point where clean energy is now commonly featured in the infrastructure investment strategy of many institutional investors all over the world.

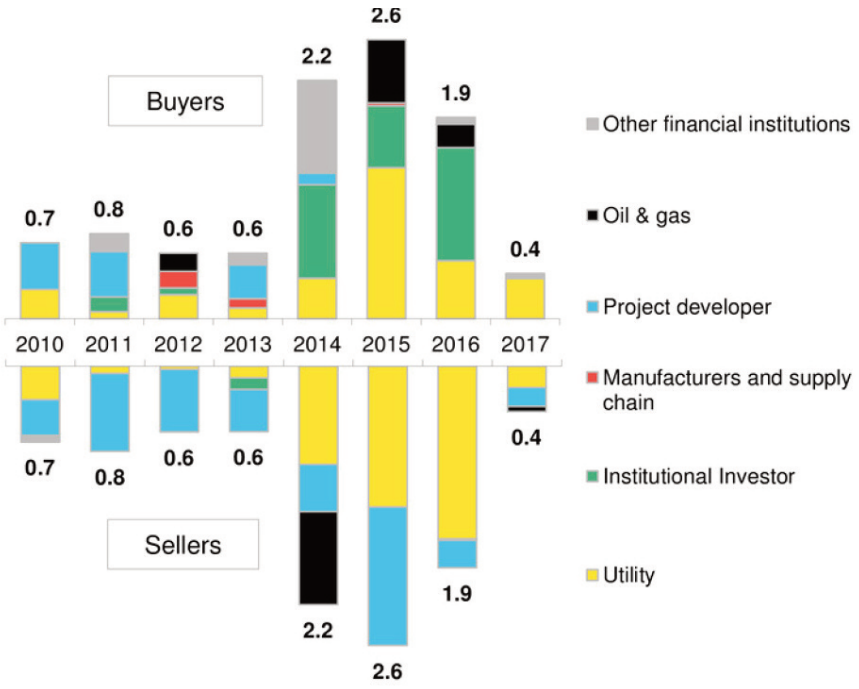
Recent prices paid in competitive auctions, and resulting high valuations, have prompted certain investors to seek out segments of the clean energy infrastructure market that are less crowded and which offer the opportunity for bilateral deal-making outside of competitive auction processes.

The following key areas highlight several of the more prominent investment gaps, differentiated products or financing structures;

1. Rising Opportunity in Greenfield Investment

Greenfield investment: Today, greenfield investing is an increasing area of focus for clean energy investors. This is driven, in part, by pricing competition for later-stage operating assets,[23] combined with improved levels of risk management available in greenfield projects, driven by increasing scale and experience in the sector. These risk management tools include contractual, structural, insurance and other mechanisms, often designed to place greater risk responsibility on developers or other early-stage parties. In 2017, such risk management tools have combined with record levels of appetite from corporate investors for long-term power purchase agreements, increasingly replacing the need to rely on support in the form of policy-driven incentives (please refer to Section 6).[24] In contrast, there has been increasing emphasis on the risks of conventional energy projects,[25] leading a broadening range of investors to re-think their position on greenfield investment. As the clean energy sector has matured, greater institutional investor comfort and a changing attitude toward development and construction risk has emerged. One example of this has been seen in the widening pool of investment sources in pre-commissioned offshore wind assets, with institutional investors taking a significantly greater role over the last three years.

Figure 4-10. Sellers and Buyers of Pre-Commissioned European Offshore Wind Projects by Investor Type[26]



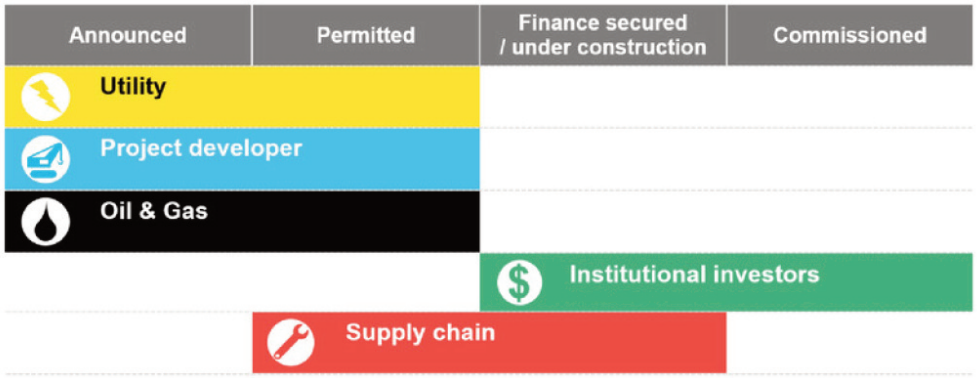
Source: Bloomberg new Energy finance. Note: 'Other financial institutions' includes private equity, governments, and sovereign wealth funds.

Historically, offshore wind assets have been viewed as some of the highest risk clean energy investments — yet in recent years, the risk profile has reduced significantly.[27]

Overall, investors are gaining a better appreciation of the fact that operational, maintenance and other risks can be effectively managed or shared. Developer and investor experience has improved and cost reductions have reduced or removed reliance on government subsidies while also reducing risks of policy changes. Beyond this, investment in new infrastructure asset creation can achieve the parallel objectives of incremental carbon reduction, tangible ESG impacts (job creation, GDP contribution, regional economic stimulus, community benefits) and higher returns commensurate with acceptable risks.

As a result, investing in assets at later "greenfield" stages (for example, post permitting yet prior to construction), has proven a successful strategy for investors and is a growing area of interest in the institutional investor market. In 2017 this was reflected, for example, in Quinbrook Infrastructure Partners' acquisition of renewable energy developer Scout Clean Energy and its 1.6 GW asset pipeline, as well as the US$ 5 billion Global Infrastructure Partners (GIP) acquisition of renewable energy development company Equis Energy, the largest clean energy investment to date. This strategy is followed by other investors in the market who have significant experience and capability to complete greenfield projects. Greenfield investment is also an area where institutional investors now play a crucial role and are increasingly willing to invest.

Figure 4-11. Timing of Investments by Investor Type in Offshore Wind Farms[28]



Source: Bloomberg New Energy Finance

Diversified operating and greenfield investment: Combining greenfield investment with an operating investment strategy, investors seeking both immediate cash yield and the potential for higher returns from greenfield assets can seek investment in aggregated funds or investment vehicles that offer access to both operating assets and assets at later stages of development. This can reduce the risk curve for investors.

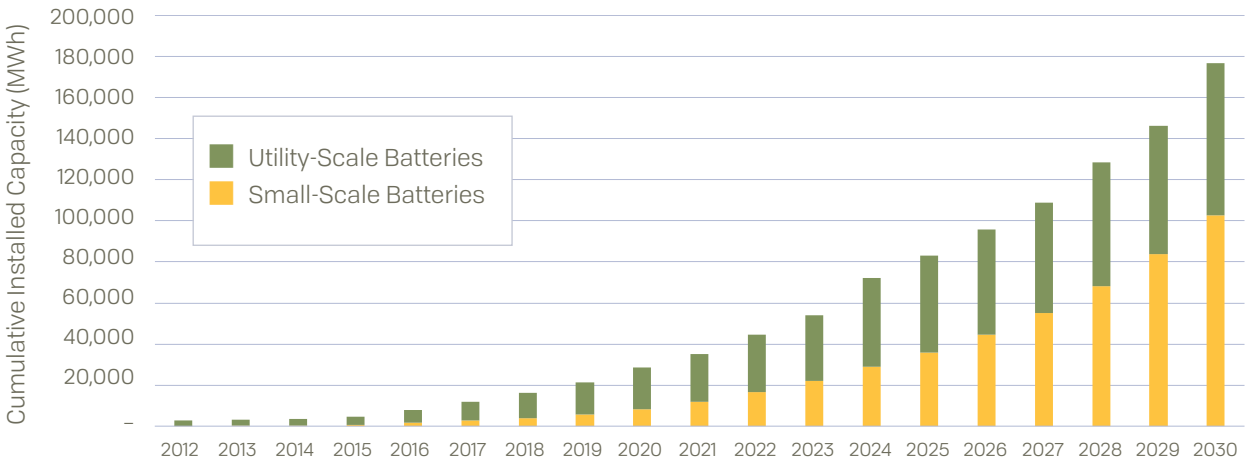
Accessing the full life cycle: open-ended funds: Finally, there is further opportunity for investors to access returns across the full asset life, by targeting hold-to-maturity assets, gaining both initial uplift in value, and long-term, risk-adjusted returns, without exit in the medium term. Blending greenfield stage exposure with operating assets in a diversified portfolio is also an interesting approach that may assist investors to make their first move into the sector. This can offer greater control, long-term exposure and scale for investors, as well as greater potential upside than is generally available in the more competitive acquisition and hold-to-maturity market, post completion of construction.

2. Dispatchability: Targeting a Critical Market Gap

As clean energy generation has rapidly grown and achieved ever-greater degrees of market penetration, increased focus has turned to ensuring reliable energy supply, including dispatchable supply. Conventional thermal or nuclear plants, no longer able to remain competitive, have closed or threatened closure, while in most markets clean energy is not yet able to adequately supply peak periods of electricity demand. This leaves a considerable gap in the market that many governments and regulators are currently trying to resolve: providing reliable, clean energy, on demand. Solutions that have emerged include integrated battery storage (with some estimates that electric vehicles will further support this) and pumped hydropower storage.

The case for storage: Battery or hydro storage facilities are central to the future of clean energy. As the costs of underlying clean energy generating assets fall, storage infrastructure supports grid reliability, frequency controls and enables cheaper daytime or evening clean energy to be stored and used during peak periods. It is an area that government tenders often promote and a market that is set to grow at a compound rate of over 20% in the next 12 years. Analysis of levelized costs of energy highlight that solar PV or other clean energy generation, even when integrated with batteries, can be competitive with coal or, increasingly, gas. Moreover, the cost of batteries has to date followed cost curve reductions similar to those that we have seen in recent years in the solar PV space, considerably changing the feasibility of dispatchable, clean energy supply over the next 10-15 years.

Figure 4-12. Growth in Battery Storage Capacity, 2012 – 2030

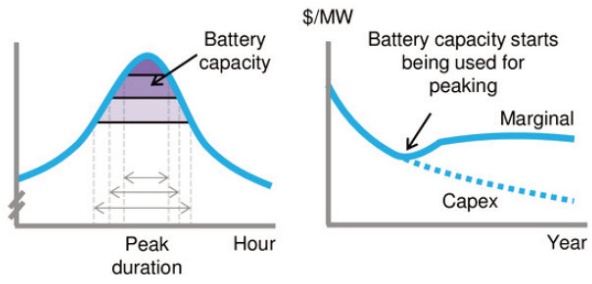


Boosted by growth behind the meter: Behind-the-meter generation is rapidly gaining in popularity, driven in part by demand in areas currently poorly serviced by existing grids (e.g. rural areas of India, isolated mine sites etc), preferences for energy independence or security, affordability and price certainty, or due to rising network costs. As behind-the-meter generation increases, it is expected to further drive demand for battery storage to enable independent energy generation, storage and rapid, dispatchable supply.

Within this context, investors can also explore investment in differentiated markets (in particular India, South America) or other regions where the need for energy access, independence and security are driving clean energy demand, such as in Africa.

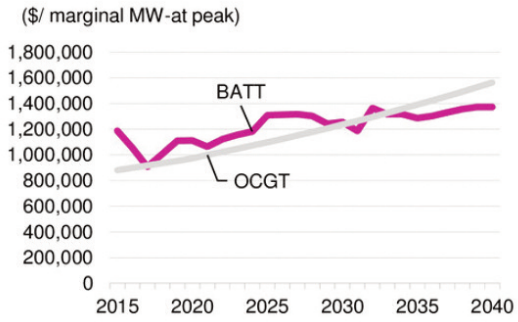
Figures 4-13 and 4-14

Contribution of Batteries to Peak Demand Reduction



Source: Bloomberg New Energy Finance

Meeting Peak with New Batteries vs. New Gas



Source: Bloomberg New Energy Finance

3. Harnessing (or Avoiding) Distress

Distressed assets: Finally, a key emerging trend across various asset classes, as inflationary pressures drive rates upward, is the expectation of increasing distressed opportunities on the market. While clean energy assets generally are not as highly leveraged as more regulated infrastructure classes, and thus tend to be at lower risk of becoming distressed, over-leverage of clean energy assets can be a key issue for which investors should be on the lookout. Investment motivations for identifying assets that are actually, or at risk of becoming, distressed range from avoidance, at one end of the spectrum, to capturing opportunity if distressed situations arise that can be refinanced and upside returns secured.

Key contributors could include:

- 2017/2018 tax and solar tariff changes leading to stress in some projects or re-emerging competition from fossil fuels
- Signs of rising inflation and expected increases to central bank rates expected to cause covenant stress and default for highly leveraged projects
- Record low energy auctions, impacting viability of some early stage projects that have not sufficiently assessed long-term revenue and risks or have high exposure to merchant risk.

This again highlights a key area where experience in clean energy investment is critical to better understand longer-term investment cycles, risk mitigation mechanisms and key areas of susceptibility to risk.

It is expected that increasing prevalence of distressed vehicles may arise, with recent changes in the market and growing scale of less experienced investors in the space.

Comparisons of Key Financing Structures

The following focuses on comparisons of key financing structures that are dominant or have been common focal points within the clean energy space:

Fund and Co-Investment vs Direct Project Investment

- In 2017 there has been rapid growth in interest in clean energy investment from pension funds (in Funds or project equity), investment banks (across debt and equity) and insurance companies (the latter particularly in direct debt investment), each seeking long-term returns well matched to cash flow demands and diversified energy opportunities as investors move rapidly away from assets exposed to coal and growing fossil fuel risks.[29]
- While leading institutions have built up in-house expertise, many investors are not currently in a position to invest directly in projects, due to the skill, time and due diligence requirements. Clean energy is a unique sector that requires specific experience and skills, very different from those employed in traditional infrastructure, energy or property investment.
- Resolving some of the above direct project investment issues, co-investments or individual managed accounts are a popular means for institutional investors to secure levels of control and allocation certainty that can mirror those of direct investment, with scale, lesser time commitments and potentially, a dilution in overall fees. This is often a crucial point for investors and one factor that can compel investors to seek to invest directly instead of through a pooled fund. Through co-investment structures, investors can gain the scale that otherwise may be challenging to achieve, in single assets or across aggregated platforms that achieve the scale required by many institutional investors.
- Alternatively, larger scale investors may be able to seek direct investment. For example, in November 2017, Pension Insurance Company provided GBP 1.3 bn in senior secured debt for the UK-based Walney Offshore Wind Farm, seeking access to debt-maturity-matching, CPI-linked revenue, ensured through a government-backed Contracts for Difference (CfDs).[30] Equity for the project was provided by Danish Pension Funds PKA and PFA and former oil and gas company, Ørsted.

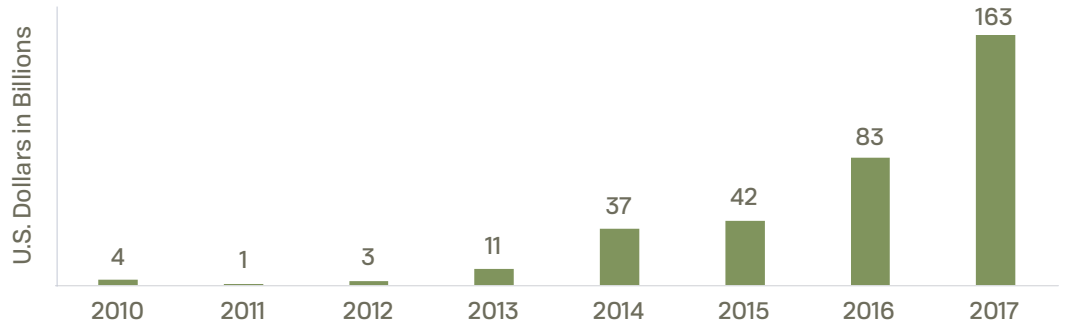
Yieldcos

Yieldcos. From 2013 to 2015 yieldcos — listed companies holding operating renewable energy assets that developers had built or acquired, with a focus on producing dividends and recycling capital to fund new development projects — were a significant source of clean energy funding, raising $7.9 billion in public equity. Unfortunately, due to a range of factors including poor governance and unsustainable growth targets that were priced into shares, a number of the leading yieldcos underperformed significantly following IPO, and added new investments within platforms that may not have had the return profiles initially expected by investors. This was compounded by other factors, including rising interest rates, and rapidly led to investor apprehension and value declines. From 2015 to mid-2017 only a further $1 billion in yieldcos was raised.[31] There remain opportunities for successful yieldco models, even as transparency and asset exposure remain key considerations for investors. With greater familiarity with the sector has also come increasing opportunity for investment managers and institutional investors to more selectively invest in earlier stage assets, seeking to reduce risk through greater levels of individual project or asset knowledge and freeing capital for developers to recycle into new, early development projects. While this would not offer the ease, diversification and liquidity of a listed yieldco investment, it could resolve some of the issues that investors experienced, such as transparency and clarity over project assets and target returns. In addition, other emerging and proposed alternative approaches hold potential for addressing some of the challenges experienced with yieldcos — e.g., the Clean Energy Investment Trust (CEIT), proposed by the Climate Policy Initiative, would acquire and hold a fixed portfolio of clean energy assets over time.[32]

Green Bonds and Securitised Project Debt

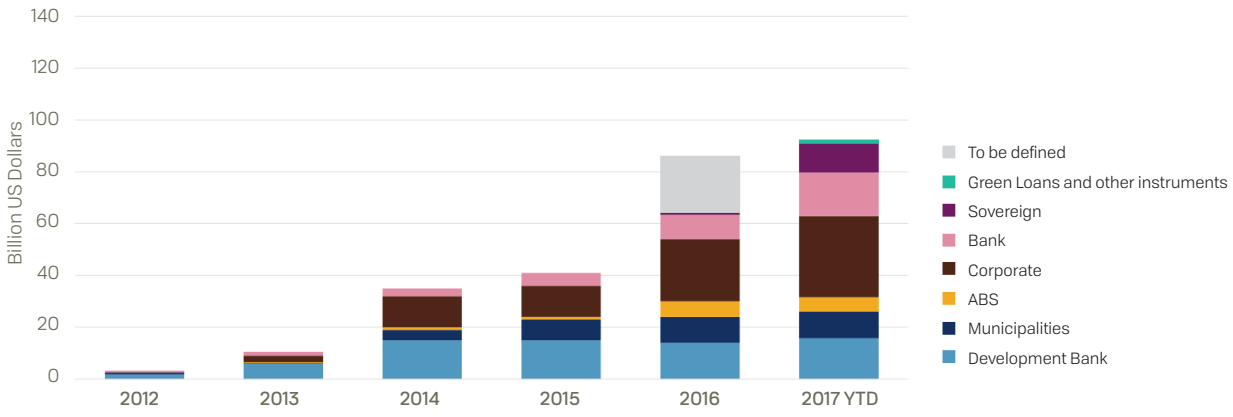
Green Bonds provide a more liquid means of accessing debt in the clean energy sector, where the end use of funds is directed toward broader environmental benefits, or in the instance of "Climate Bonds," specifically climate impact and clean energy. Since 2013, the issued market has grown by 60% CAGR to over $163 billion. Within this, asset backed securities (such as solar backed securities) have grown to over $25 billion. While this growth is highly beneficial to supporting environmental company and project strategies, with it has come increasing focus on the use of funds and scope of investments that are housed under the overall "green bond" banner, spanning from "unlabelled" (meaning issuances linked to projects that broadly produce environmental benefits) to "labelled" (meaning bonds that are certified as being green such as by the Climate Bonds Initiative) and more direct "climate bonds". The latter is the more commonly quoted market in the U.S. and Europe. As the performance of green bonds has risen, illustrated below in the S&P Green Bond Select Index, so has scrutiny of labelling and assessment of fund use.

Figure 4-15. Green Bond Issues 2010-2017[33] (US$ Billion)



Green bonds are dominated by large-scale institutional investors such as Zurich Life Insurance, which has committed a reported US$5 billion to impact investment (to date, largely through green bond investment). The asset class spans from project bonds (the most direct clean energy exposure and considered the "greenes" of bonds) to asset backed securities, and use-of-proceeds bonds (with high levels of transparency and dedicated green activity financing), as well as more general corporate purpose bonds, which typically offer a less direct and less transparent means of investing in clean energy and environmental projects.

Figure 4-16. Annual Green Bond Issuance by Issuer Type[34]

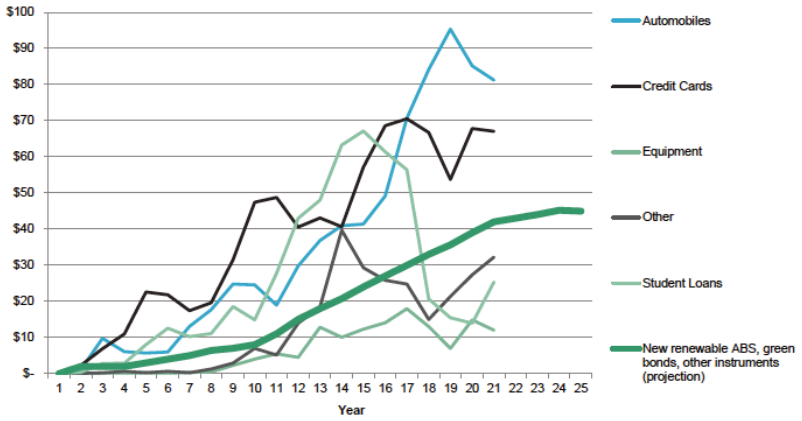


YTD - Year to Date. Source: Climate Bond Initiative

While green bonds are a rapidly growing market with significant potential, to the extent they are purchased in order to meet investors' climate, clean energy or "green" demands, investors should scrutinize the actual use of funds to ensure they adequately meet these demands. The needs for transparency and accountability are a key focus.

Securitised project debt. This is an emerging structure in the clean energy financing space, more commonly used for financing solar projects. As the clean energy market grows, there is an increasing focus on smaller-scale, distributed generation (for example, residential or community scale solar), and asset-backed securities are intended to provide a lower cost means of aggregating and financing these projects. The OECD study cited in Section 1 shows securitised project debt projections of hundreds of billions of dollars in the next few decades when EVs are included. In terms of clean energy, BNEF points out the following:

Figure 4-17[35]



The financial markets have employed asset-backed securities (ABS) for over two decades to securitize credit obligations. ABS have allowed investors to benefit from the cash flows generated from loans outstanding to consumers on cars, equipment, student loans and credit cards. ABS for each of these separate sectors were launched in different years. The figure above charts the rate at which investment poured into each sector from its initial year as an investable option.

Under the MTG projection, ABS *and* green bonds fundraising for new renewables would rise from near zero $ now to approximately $45bn/year 25 years from now. This is not an unreasonable projected growth path, considering the rate at which ABS use has grown in the financing of other assets. Some recent projections of significantly higher future levels of ABS financing in the new renewables space, if achieved, would only serve to enhance the cost competitiveness of the sector.

One of the major cautions of securitisation is the risk of widening spreads and higher yields in higher rate environments that can have a greater impact on smaller-scale projects that are commonly bundled for securitisation products.[36]

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SECTION 5. THE POTENTIAL FOR GREEN BANKS TO DRIVE INVESTMENT OPPORTUNITIES: A FOCUS ON ENERGY EFFICIENCY

Energy efficiency (EE) is one of the cleanest and lowest cost approaches for meeting decarbonisation objectives, and massively scaling EE deployment is crucial for achieving climate stabilization. While investing in EE can pose a range of challenges, solutions have been proliferating. Green banks hold particular promise for catalysing investment in EE and other clean energy, both directly and by creating opportunities to drive in private capital. This section looks at how the world's largest green bank, the Australian based Clean Energy Finance Corporation (CEFC), is approaching and surmounting challenges to investment in EE and other clean energy solutions — a successful model that can be replicated elsewhere and deliver expanded opportunities for institutional investors to access EE and other climate solutions investments.

Challenges in investing in EE are well-documented. While EE investments are often economic and make good business sense, there can be complex decision-making barriers, and lack of awareness of efficiency benefits. Barriers to financing EE investment include:

- the diverse nature of the opportunities
- split incentives between owners of assets and tenants
- understanding how to finance energy efficiency against cash flows
- small transaction sizes with high transaction costs

The experience of the CEFC, among others, demonstrates that these challenges are surmountable through approaches such as aggregation programs, structuring funds to crowd in private capital, and strategically amplifying successful examples of EE finance to spur follow-on investment activity.

About the CEFC:

The Clean Energy Finance Corporation (CEFC) was created in 2012. It has legislated access to AUD10 billion to invest in projects to lower Australia's CO_2 emissions. It is now the world's largest "green bank".

The CEFC provides debt and equity finance for transactions, with all investments required to make a commercial return for the taxpayer. Whilst the CEFC can make concessional loans, generally the financing is at market rates, and stretches the market in terms of tenor and risk tolerance.

From inception to the end of calendar year 2017, the CEFC has made investment commitments of AUD5.8 billion, across some 85 transactions, in projects valued at AUD14 billion. At the end of 2017, the CEFC portfolio stood at AUD4.8 billion.

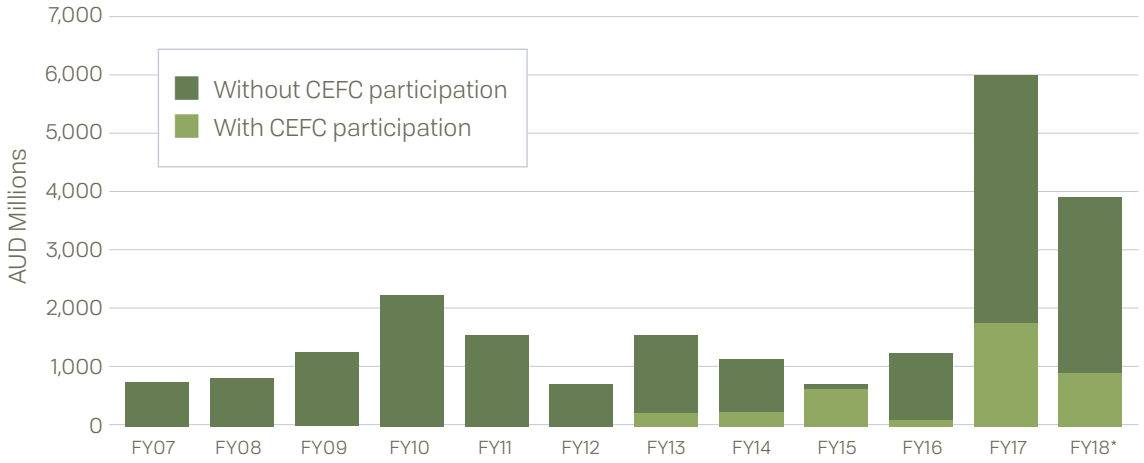
Energy efficiency has accounted for approximately half of all investments since CEFC's inception. In financial year 2016-2017, CEFC EE investment commitments included AUD611m in the property sector, AUD155m in agriculture, AUD150m in each of the infrastructure and the government and not-for-profit sectors, AUD102m in vehicles and biofuels, and AUD60m in the manufacturing sector.

Those investments financed EE projects that are estimated to achieve annual abatement of almost 7.3 million tonnes CO_2-e, or more than 121 million tonnes CO_2-e over the lifetime of these projects.*

The cumulative leverage across the portfolio was more than double, with each AUD1.00 of CEFC investment since 2013 helping catalyse an additional AUD2.10 in investment from the private sector. Across its portfolio, the CEFC is investing alongside more than 150 domestic and international co-financiers and investors, including all the major Australian banks.

*Assuming all investments reach financial close, are constructed to design and are fully operational.

Figure 5-1. Large-Scale Renewable Energy Investment With and Without CEFC Participation, AUD Million



Source: Bloomberg New Energy Finance

Note: Large-scale renewable energy asset financing only; CEFC commenced investment commitments on 28 June 2013

Economy-wide data on energy-efficiency investments has not been compiled to date, but the important role of a green bank in clean energy investments more broadly can be seen in the data relating to large-scale renewable energy financing, (**Figure 5.1**). The CEFC has been involved in transactions representing up to 90% of annual new investment in large-scale renewable energy financing in Australia since its inception in 2013.

The "demonstration effect" of financing flagship EE projects with the leading and most visible companies in a sector can spur similar EE finance activity across the broader market.

1. Demonstration Effect

The **"demonstration effect"** of financing flagship EE projects with the leading and most visible companies in a sector can spur similar EE finance activity across the broader market.

The demonstration effect of a best-in-class innovative investment supports the development of an ecosystem of expertise in supply chains, contractors, developers, etc. to push those EE solutions in projects with other clients. Similarly, encouraging a large company to make innovative EE investments in one project can build internal competencies that embed those EE solutions in the balance of the company's portfolio.

Best-in-class EE investments can also be used by advocates to make the case for stronger regulations and policy, which can be powerful levers to drive economy-wide clean energy investment. In this way, even a single EE investment can create an example that can be used to influence many other actors in a sector.

Accordingly, a green bank financing package for EE can have greater impact with a requirement to share the learnings with other investors. The largest and most advanced actors in a sector are watched closely by the rest of the sector, creating opportunities to deepen the maturity of the EE market. There are conferences, sector-specific publications, industry bodies and other communication channels that can be used to share best practice EE technologies and investments, and enhance ESG credentials.

Crowding-in of Private Debt Financiers. The involvement of a specialist expert clean energy financier such as the CEFC provides private co-financiers with a level of comfort to invest, and is an important driver in increasing the credit available for clean energy projects. This **"crowding-in"** creates a multiplier effect of green bank financing, leveraging the financing to increase the total amount of investment in EE. Having multiple co-financiers in a project allows smaller debt investments to be made by each financier and the risk to be spread over more parties.

It is recognised that private sector investments and financing will be required to meet the bulk of the decarbonisation financing challenge. Crowding-in allows private sector financing to build relevant competencies in EE investments to increase their exposure to this investment class.

CEFC's Experience Building Green Credit Markets

The CEFC has played a pivotal role in building Australia's green credit markets. In addition to co-investing alongside 150 domestic and international co-financiers and investors, including all the major Australian banks, the CEFC has financed innovative green credit solutions such as the peer-to-peer lending platform Ratesetter.

The Ratesetter online platform allows investors to lend directly to creditworthy borrowers looking to buy or install an approved "green" product. Through the online platform, investors can nominate the amount they wish to invest, the interest rate they are prepared to accept, and their request can then be matched to approved borrowers. Borrowers can then access this finance to invest in eligible clean energy assets. Eligible assets include solar PV, energy storage equipment, and energy-efficient and low-emission equipment.

2. Multiple Levers

There are multiple levers a green bank can use to drive EE and other clean energy investments, including via reduced interest rate financing, i.e. lending at rates lower than those available in the market. There are, however, many other techniques that are just as important, and allow the use of concessional rate lending to be used sparingly, including:

- Offering other loan features that are not available in the market, such as longer tenors, e.g. CEFC provided a longer-dated debt of 10 years to SCGH for the construction of highly energy efficient community housing.[1]
- Lending to projects and counterparties that cannot access commercial financing for various reasons, such as:
  - **Projects exposed to policy or regulatory risk:** for example, as energy retailers have periodically reduced demand for power purchase offtake agreements, the CEFC has developed sophisticated merchant energy price risk guidelines that have allowed it to finance partly or fully merchant (uncontracted) renewable energy projects to avoid disruption to the development pipeline.[2]
  - **Projects and companies without a proven track-record:** The CEFC supports innovative companies in many parts of the clean energy value chain, from lightweight energy efficient carbon fibre wheels, to new technology which integrates distributed energy resources, and Australia's first peer-to-peer green lending platform.[3] CEFC finance supports companies from start-up to commercialisation and export, helping to position Australian companies to take advantage of the global shift to clean energy.[4]
  - **Projects of higher complexity:** Because the CEFC targets clean energy policy outcomes in addition to financial returns, in some cases the CEFC is willing to incur higher costs in structuring more complex transactions. The CEFC may, in some cases, work on small investments where transaction costs tend to represent a larger share of the overall transaction size than would be acceptable for the commercial banking sector.
- In some instances, CEFC finance commitments directly catalyse capital from other financial institutions without ultimately requiring CEFC investment. For example, in the case of Sundrop Farms' innovative solar thermal greenhouse project in South Australia, the CEFC's early commitment to cornerstone debt finance helped Sundrop Farms secure private sector growth capital from a global private financial institution.[5]

Crowding-in of Private Equity Financiers

Investments in equity funds allow the CEFC to seek improvements in the energy efficiency of assets in a fund's portfolio. This is achieved via agreement on conditions that a fund must meet in order for CEFC to invest, such as:

- Agreement for the fund to adopt science-based emission reduction targets across its whole portfolio, and to promote the adoption of science-based targets as well as the lessons learned in the adoption of such targets across the industry via relevant industry fora and events;
- Improvements to the ESG strategy of the group via side agreements attached to each CEFC investment, which push the fund to improve the energy efficiency of its entire portfolio and embed more stringent ESG considerations along the fund's investment origination and acquisition process as well as the ongoing asset

management process. The funds are requested to provide a roadmap on how they expect to reach the agreed EE targets;

- Create a sustainability committee involving the fund, relevant independent industry research organisations and universities. This committee can consider sustainability initiatives for the fund, as well as the sector, such as guiding investments and reporting progress in relation to an Energy Efficiency Ratio and an Emissions Efficiency Ratio relevant to the sector. These insights can influence the creation of benchmarks and targets that can be adopted by the sector.

What the funds get:

- A cornerstone investment from an expert clean-energy financier with a strong brand;
- The expertise of an experienced clean-energy financier to assist in updating investment procedures to align with low-carbon investing;
- A differentiated product offering when raising capital, in markets where there is often a lack of clean energy investment products available for institutional investors.

The benefits to the sector and emissions reduction are driven by:

- The fund managers need to compete for institutional capital, which provides the institutional investor with a significant voice when it comes to influencing how the manager approaches climate-based ESG requirements;
- A climate-focused investor has the ability to influence and educate the entire investor base in any particular fund;
- Institutional investors' preference for a co-investor to take a leadership position on climate-related ESG issues;
- Fund managers seeking to exert a positive bias towards superior climate-based ESG outcomes can achieve significant outcomes via a serious, focused ESG effort.

3. Aggregation Programs

The diverse, dispersed and often smaller size of EE investment opportunities make it impractical for a wholesale financier such as the CEFC to engage directly with individual borrowers. These barriers can be overcome via **aggregation programs**, which use commercial banking intermediaries to deliver smaller-scale investments in clean energy to their business customers.

How it works: a green bank provides a loan to a large commercial bank or financier ("the aggregation partner"). The aggregation partner offer customers a discount on the loan, financed by the green bank where they choose equipment with a higher level of energy efficiency.

For example, if a farmer goes to their local bank and wants a loan to purchase a new tractor, they can get a rate of 4% to purchase any tractor they want. Alternatively, the farmer can get a loan rate of 3.3% if they choose a tractor at a specified higher level of EE, with the difference between the standard 'market' rate of 4% and the lower EE rate provided by the concessional financing from the green bank. Aggregation programs similarly can influence buying decisions in lighting upgrades, variable speed drives, upgrades to heating and cooling, rooftop solar PV, and a range of other assets which meet the mandate of the relevant green bank.

The diverse, dispersed and often smaller size of EE investment opportunities can make it impractical for a wholesale financier such as the CEFC to engage directly with individual borrowers. These barriers can be overcome via aggregation programs, which use commercial banking intermediaries to deliver smaller-scale investments in clean energy to their business customers.

Deeper Dive: Aggregation Program Financial Structures

The CEFC's Aggregation Programs use a Credit Intermediated Asset Funding (CIAF) Facility structure. The benefit to the CEFC is the ability to leverage the vast networks of customers of the Lender and offer a product which incentivises decisions to switch to technologies within the CEFC mandate — e.g., energy efficient equipment. The CIAF Facility operates as follows:

1. The CEFC purchases a tranche of the Lender's senior unsecured bonds at market pricing and on market terms under the Lender's existing bond program.
2. The Lender notionally allocates this funding capacity to a specific "Energy Efficiency/Clean Energy" program.
   a. The program incorporates a specific list of eligible clean energy technologies that are pre-qualified by CEFC for deployment under this program.
   b. Any other technologies that fall outside the Eligibility Criteria may be raised with the CEFC for consideration on a case-by-case basis.
3. The Lender retains the credit exposure to the customers and undertakes sales, marketing, credit assessment and customer servicing processes.
   a. Customers are approved to access the finance if they have passed the Lender's credit assessment and fall within the Eligibility Criteria.
   b. A pre-agreed basis points discount (Concessionality Rate) to the Lender's lending rate is passed on to the customer. This discount is financed by the CEFC and is passed on in full to the customer.
   c. The Lender's credit exposure to the customer and credit approval remains the Lender's process and risk.
4. CEFC receives the Lender's bond coupon payment less the applicable Concessionality Rate discount applied under the Program. This discount is functionally generated through a periodic rebate mechanism transferred from the CEFC to the Lender.

   The key benefits to the Lender include:

   - The ability to offer a discounted loan product to customers with the discount funded by the CEFC; and
   - Co-branding with the CEFC to enhance its sustainability positioning in the market.

Aggregation programs are effective because they use the reach, marketing channels and customer relationships of the aggregation partners to reach smaller-scale investments. Aggregation partners inform their customers of the reduced-rate financing opportunity through their normal marketing channels, by training the bank managers who are in direct discussions with the borrower, and via information in industry-specific publications and conferences. As such, aggregation programs have a direct influence at the finance decision-making point.

Once the model is proven, it is repeatable — and in the presence of concessional financing, aggregation programs can be rolled out across multiple sectors and with multiple co-financing partners to target multiple technologies. Once in place, programs can be amended to reflect evolving preferences for borrowers, evolving areas of focus for the CEFC, and evolving needs of intermediaries, and thereby can be adjusted to target the highest impact EE or other clean energy investments. Since the CEFC's inception through to December 2017, the CEFC has deployed more than AUD460m through its aggregation programs on EE investments, alongside nine co-financing commercial banks, covering almost 4,000 individual investments.

An example of the program is the AUD100m that the CEFC committed in 2017 to the financing of more efficient vehicles with Macquarie Leasing. Macquarie Leasing is making the discounted finance available to customers through its existing relationships with car manufacturers. The program offers a 0.7 per cent discount on finance for electric vehicles (EVs), as well as plug-in hybrid EVs, and a range of eligible energy efficient and renewable energy equipment. Customers who choose eligible lower emissions passenger vehicles can also benefit from the program, with a 0.5 per cent finance discount. As of the end of 2017, the CEFC program with Macquarie Leasing had financed the purchase of over 200 EVs, a material number in the very nascent EV market in Australia. This could not have been achieved in the absence of an aggregation partner, in light of the small investment amounts associated with individual EVs that would make direct customer access by the CEFC impractical.

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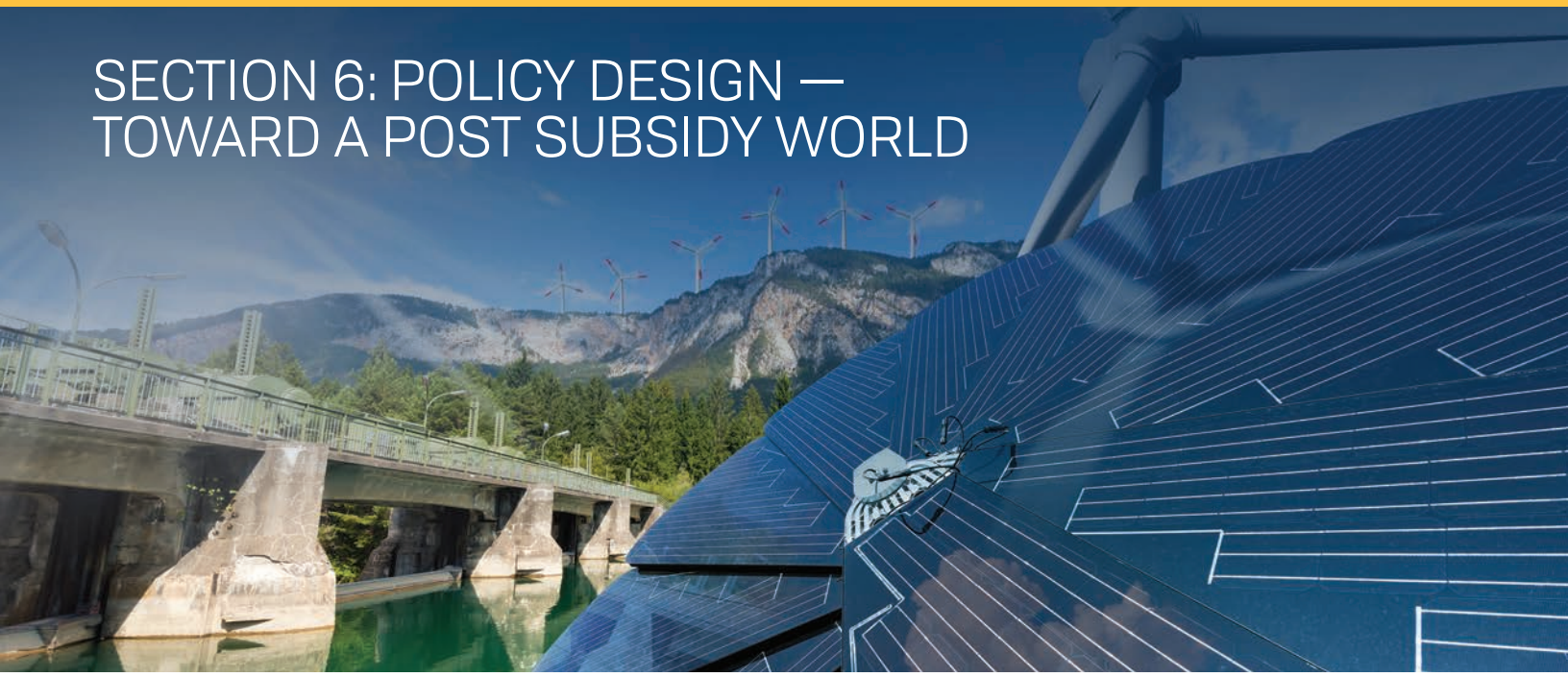
SECTION 6: POLICY DESIGN — TOWARD A POST SUBSIDY WORLD



Global Energy Policies and Subsidies Today

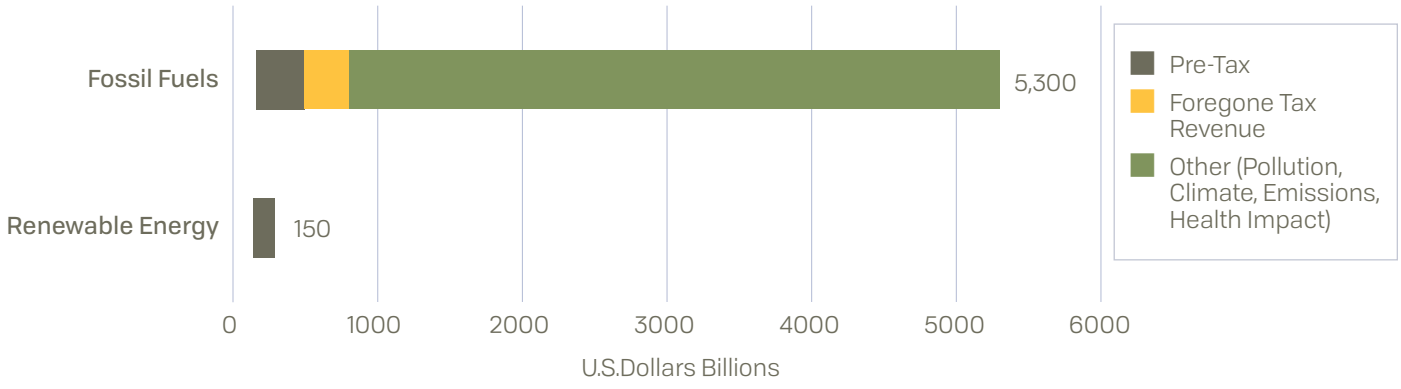
Fossil fuel, nuclear and clean energy generation projects have commonly drawn on government policies and subsidies to encourage investment and to achieve the scale required.

Studies undertaken by the International Monetary Fund (IMF), Organization for Economic Cooperation & Development (OECD) and International Energy Agency (IEA) have independently estimated that global subsidies for clean energy in 2015 were a fraction of those provided for fossil fuels in the same year.[1]

Historically these subsidies provided significantly more useful energy output per dollar directly spent on fossil fuel capacity. It is also worth noting that the majority of pre-tax fossil fuel subsidies are in the Middle East and Russia. However, it has become increasingly important in government and company reporting and assessment to better understand the overall costs of fossil fuels on health, pollution and foregone tax revenue. Understanding these risks (from acute to long-term) and costs should remain central to any policy debate.

However, as renewable energy costs have continued to decrease and technological efficiencies have improved, subsidies for renewable energy, in many instances, may now produce comparable energy output benefits as compared to fossil fuel subsidies. Importantly, this viability may also stand for select renewable energy projects even when coupled with battery storage,[2] enabling power to be distributed on demand.

Figure 6-1: Estimated Range of Global Energy Subsidies 2015



This has translated into commercial transactions. In 2017, auction processes resulted in major offshore wind and solar projects receiving 15-year Contracts for Difference (CfD) priced at record lows — significantly below that of conventional fossil fuel energy projects and that of projected pricing for new gas-fired power generation[3] or projects reliant solely on market prices.

In contrast, instances of both coal and nuclear projects in the UK, Australia, Europe and the U.S. have been questioned over whether they are able to compete with renewable energy following significant renewable energy cost reductions in the last two years.[4] A key new nuclear project, Hinkley Point C in the UK, has suffered from higher than expected pricing, significant construction delays, and contract pricing that today is significantly above the market — including pricing now achievable by offshore wind. Similar issues have arisen with two new nuclear reactors under construction as part of the Vogtle Project in the southeastern U.S.

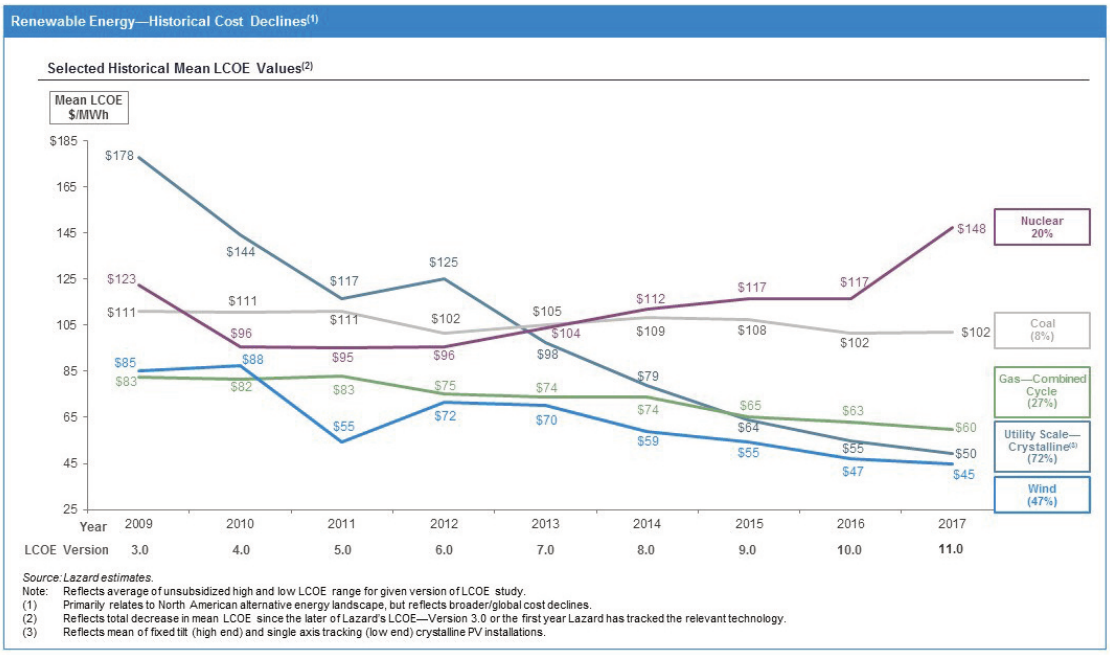
Following this dramatic renewable energy cost decline, where in many markets renewable energy is not only the lowest carbon but also the more affordable energy option, we are now entering a world where new incentives for renewable energy are being phased out over time. As these reductions continue, it is critical that policies continue to support the growth of clean energy and supporting, on-demand infrastructure to enable a decisive, strategic, sustainable and smooth transition to an economically inclusive clean energy future.

Long-term, stable, underlying policy design is still critical to:

- accelerate clean energy growth and provide a more affordable, reliable, equitable energy supply;
- create an even playing field by attributing real costs of pollution to its sources, and removing fossil fuel subsidies;
- boost sustainable, economic activity — enabling energy affordability and reliability, as well as capturing clean energy export and manufacturing potential;
- support key Sustainable Development Goals and simultaneously sustainable investment value. Pollution, climate and carbon exposures are highlighted as key risks to communities and have a measurable impact on business valuation or GDP (e.g., health, well-being, water supply, food security) and issues such as pollution significantly impacting GDP.[6]

In addition, it has become evident that some regions that have historically lagged in creating leading, long-term clean energy policies are now also dealing with significant energy market concerns. One example of this is in Australia,[7] where electricity prices are now some of the highest in the world,[8] reliability and affordability are major concerns and instances of severe blackouts have occurred. Owners of aging coal plants, finding them increasingly uneconomic, have closed or threatened closure of plants, acknowledging that renewables are more economic and are the best means of providing required, affordable power capacity, reducing carbon and pollution *and* are in the best interests of shareholders

Figure 6-2: Unsubsidized Levelized Cost of Energy Comparisons[5]



and company value.[9] In the face of these ongoing issues, many Australian sub-national governments are now moving independently to advance their own clean energy targets and putting in place large-scale tenders, some the largest in the world-to-date, to spur deployment of sufficient clean energy supply and storage to support increasing energy demands.

This is a key turning point for clean energy, but also highlights the importance of forward planning in policy design, to ensure that sufficient energy generation and storage capacity is in place to meet actual energy demands.

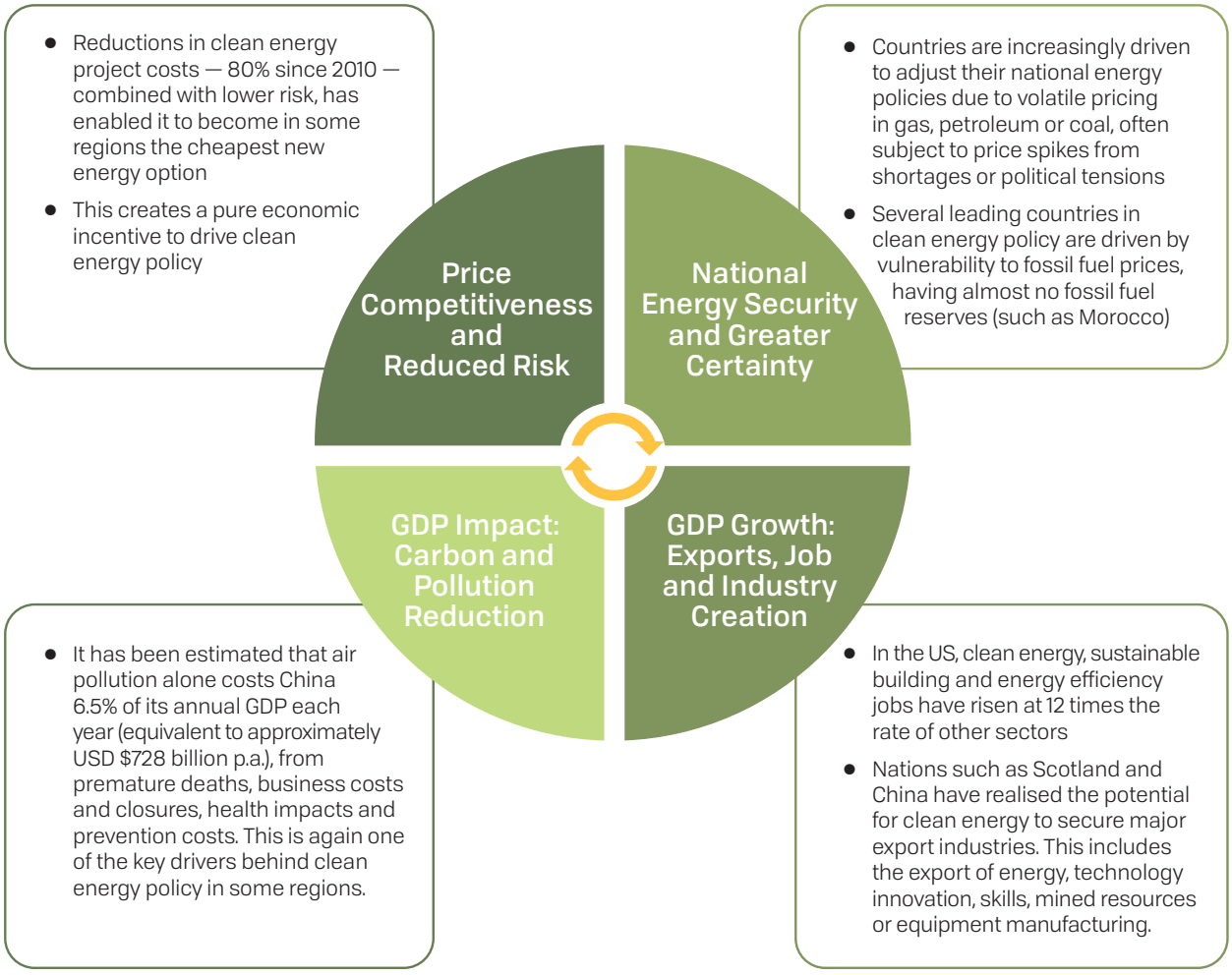
Underlying Economic Drivers for Clean Energy Policy

Unexpected policy changes, particularly retroactive changes to clean energy incentives, historically have undermined investor confidence. As clean energy costs decline, there has been a shift toward phasing out clean energy incentives, and the influence of policy uncertainty around incentives has correspondingly diminished. Increasingly, leading policies supporting clean energy generation, storage and distribution tend to focus less on direct economic incentives for reducing carbon pollution and more on enabling a smooth transition to a "clean energy future" with greater on-demand energy security, affordability, independence and pollution reduction. Key policy drivers, in addition to carbon reduction, include those laid out in **Figure 6-3** below.

Policy Design and Energy Storage: Tackling Reliability

In September 2017 The Netherlands, part of an alliance of 19 countries targeting a phase out of coal by 2030, announced its policies to enable this target, alongside a commitment to phase out all new, non-electric vehicles

Figure 6-3: Underlying Clean Energy Policy Drivers[10]



by 2030. Taking account of this policy ambition, the Institute for Energy Economics and Finance Analysis (IEEFA) recently concluded,

> *"[N]ew [Dutch coal] power plants are uneconomic under a wide range of plausible policy or market scenarios. It suggests that the investment logic that put them online in 2015 would not hold today, without government subsidies in the guise of capacity-market supports. We see gas-fired power as a more flexible and less carbon-emitting backup option than coal; renewables as more competitive."*[11]

As nuclear and coal facilities face ongoing closures due to lack of economic feasibility, and as supplies of variable-output clean energy increase, dispatchable generation and energy efficiency are expected to feature centrally in the next critical stage of growth and policy design. This includes hydro, pumped storage, battery energy storage, grid technology and energy trading technology, which enable variable-output sources of energy (such as solar PV or wind) to be responsive, optimised and dispatchable, available as and when energy is in demand.

Creating reliable, stable supply of energy at peak periods and during contingency events is a critical part of successfully transitioning to a clean energy future and has become a key focus in energy markets as renewable energy penetration has scaled up. Importantly, renewable energy — even when coupled with storage — has been shown to be competitive with traditional baseload fossil fuel generation. As such, policies that set increasingly higher clean energy targets (including targets for renewable energy and storage) are situated to spur more rapid clean energy transition at competitive cost.

Policy Design Post Subsidy: Simpler, More Competitive, Market-Based Support

As we move forward, it is critical that policies seek to support the best low and zero-carbon flexible solutions at competitive price, providing:

- a simplified, even playing field that rewards low-cost, low-carbon energy supplies measured across the life of assets as incentives and subsidies are phased out;
- lowest risk projects that can commence generation with minimal delay;
- scaled, secure, reliable, dispatchable forms of energy supply;
- integrated supporting infrastructure and energy usage reduction or optimisation technologies such as storage, digital metering and controls, grid and communication technologies to enable not just low cost energy — but low cost energy available when and where it is most needed; as well as
- support for a smooth transition, including for the communities and workers who rely on existing conventional forms of energy.

While mechanisms such as feed-in-tariffs have historically provided transparent, simple mechanisms to support the scaling of clean energy, new policies are tending toward design that enables better, competitive price discovery, is technology-agnostic and matched to asset longevity, and remains available to the widest pool of capital and stakeholders. Supporting this is a major trend in the form of significant growth in global auctions and competitive bidding for new energy projects,[12] a trend enabled by the scale and cost reductions in renewable energy projects over the last 10 years.

Figure 6-4: Key Global Clean Energy Policy Mechanisms

Low Carbon Energy Infrastructure	Energy Smart Technologies	Advanced Transport	Carbon and Pollution Reduction
e.g. Onshore Wind	e.g. Battery Storage	e.g. Electric Vehicles	e.g. Toxic Air Pollution
• Debt/equity financing initiatives • Feed-in-tariffs • Green credits • Net metering • Targets • Tax incentives • Auctions	• Grants and R&D support • Regulatory support • Tax incentives • Auctions	• Grants and R&D support • Upfront or ongoing cost incentives (e.g. toll reductions) • Regulatory support, including mandates for the phase-out of sales of internal combustion engine vehicles by a date certain • Tax incentives	• Emissions trading • Reduction targets • Carbon taxes • Testing and penalties • Mitigation infrastructure requirements

More complex mechanisms, such as renewable energy credits or tax equity programs, have been central to the growth of clean energy in the U.S., which in turn has boosted manufacturing and cost declines across the sector. Such mechanisms can require significant experience, relationships, upfront cost and knowledge to understand, mitigate risks and execute. This can be inhibitive to smaller projects, requiring continuing emphasis on specific incentives for small-scale or community based clean energy investment.

Policy Focus: Carbon Reduction Targets and Trading. Putting a Price on Health Impacts, Pollution and Carbon

Setting specific carbon reduction and clean energy generation targets, combined with placing a price on carbon and related pollution, has been assessed to be one of the cheapest, most effective means of driving lower-carbon energy production.[13] The aim is to quantify the impact and cost that carbon polluting forms of energy have on our overall economy and environment — from carbon-related climate change, to various forms of air pollution, health impacts and other issues.

To provide greater certainty for investors, effective prices on carbon and more robust, long-term policies are required. The success of effective carbon pricing in driving clean energy investment has been evident in the rapid decarbonisation of the UK, Sweden and the Netherlands, with California on a similar track. More broadly, however, improvements in global carbon pricing, beyond road and transport taxes (where taxes are often in relation to air pollution and congestion[14]), are needed to support a more level playing field.

To achieve carbon reduction goals, taxes and cap-and-trade systems can be effectively put in place. It is critical that the means of achieving these goals is realistic and works in line with other national goals. For example, some countries are relying heavily on carbon capture and sequestration (CCS) to achieve their carbon reduction targets, which, at this time, has been assessed to be highly costly and unrealistic.[15] Policies that instead support reductions in carbon emissions through energy efficiency, overall energy usage reductions and switching to greater clean energy supply to reduce carbon emissions in the first instance, are required.

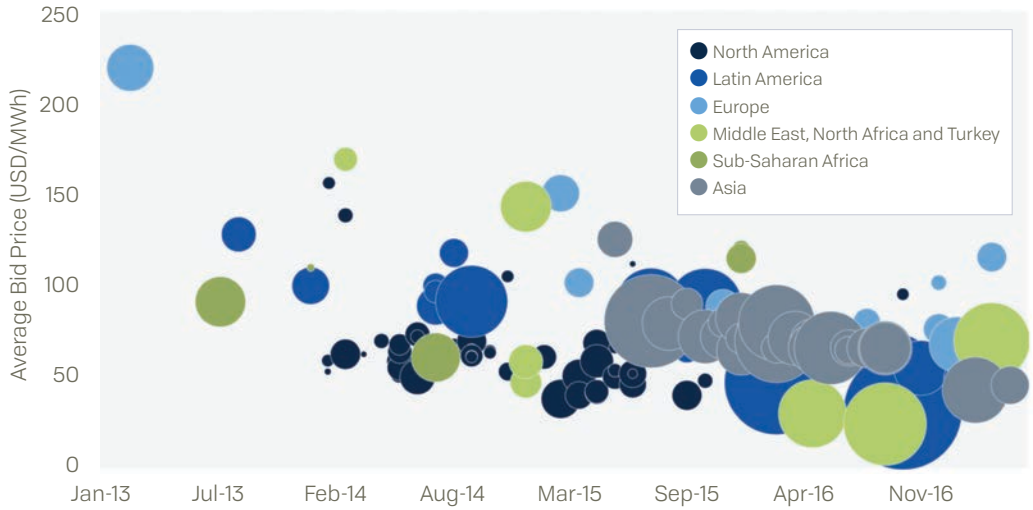
More complex mechanisms, such as renewable energy credits or tax equity programs, have been central to the growth of clean energy in the U.S., which in turn has boosted manufacturing and cost declines across the sector.

Policy Focus: Reverse Auctions. Enabling Competitive, Scaled Clean Energy Growth

Reverse auction processes have emerged as an effective means of driving selective and competitive energy build-out. Reverse Auction processes can optimally enable Governments to select energy generation projects that provide:

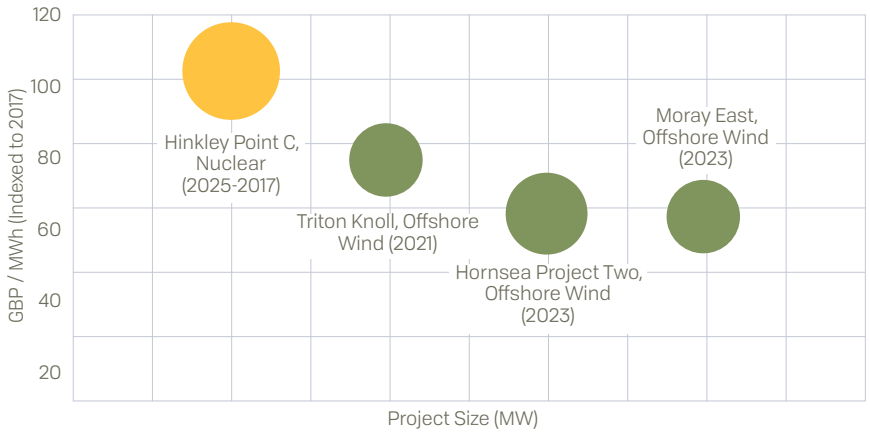
- the lowest cost energy solution;
- energy solutions with the lowest construction, timeline and delivery risk;
- reliable, efficient, rapid-response, flexible energy production;
- long-term inflation-linked contracts with investment grade utility or government counterparties;
- benefits of accelerated interconnection, leasing or other support.

Figure 6-5. Global Tendered Projects by Bid Price and Capacity, 2014-2016



Source: Green Tech Media, Global Solar Monitor Q2 2017. https://www.greentechmedia.com/research/report/global-solar-demand-monitor-q2-2017

Figure 6-6. UK 2017 Energy Pricing Auction Results



In 2017, auction prices have declined even further and this trend has accelerated. In just the first half of 2017, Europe auctioned four times as much capacity as in 2016.

While reverse auction processes effectively drive prices down, ultimately benefiting consumers and reducing the required subsidy support, it is also essential that steps are taken to mitigate the risks of under-bidding or delays, through bid conditions that require proven levels of experience, funding, feasibility and deliverability of projects.

Looking Ahead: Policies to Support Storage, Grid and Technology Infrastructure

Today, new policies must also support a range of new technologies that will enable clean energy to more completely and reliably provide global energy needs. Increasing policy support is still needed for distributed energy generation and technologies that support integration of behind-the-meter "prosumer" (producer-consumer) generation. This includes incentives for investment, research, development and regulatory support for the continuing development and improvement of peer-to-peer trading, energy usage optimisation and forecasting, and technology driven energy efficiency and metering.

Key areas of policy should include:

- Targets and incentives for deployment of energy storage, such as pumped hydropower and battery storage, to support the flexible, on-demand delivery of clean energy;
- Regulatory reforms to spur uptake of smart grid technology, ensuring that grids can sustain the speed, flexibility and changes in electricity flows as energy supply increasingly is affected by weather patterns or is produced behind the meter. Additional beneficial measures would include support for newer technologies that aid supply and demand forecasting, communication and trading, including regulation that enables micro-networks and peer-to-peer selling;
- Targets and incentives to increase investments in energy efficiency, one of the most effective means of addressing energy demand; and
- Electric vehicle incentives, to accelerate clean energy transition in the transportation sector — reducing petroleum and diesel use while improving development, technology, efficiencies and scale in battery storage, which in turn benefits overall energy supply.

Globally, clean energy is now becoming the most cost-effective energy solution, providing benefits from utility and grid scale down to community or micro/behind-the-meter projects. As many countries face increasing energy challenges, including supporting energy access for those who currently lack it, increasing numbers of disruptive extreme weather or contingency events, and inadequate energy infrastructure (particularly in emerging markets and non-metro regions), it is critical that policies continue to support a level playing field for clean energy supplies and provide simple, long-term, stable solutions to smoothly scale clean energy infrastructure while effectively addressing ongoing issues in energy security, pollution, carbon intensity and supply.

While we have seen significant successes in the underlying competitiveness of clean energy in recent years, providing a key tipping point for the industry, it is critical that regulatory support mechanisms adequately account for the increasingly apparent costs and real risks of coal, oil, gas and nuclear-fueled technologies[16] while supporting the long-term build out of clean energy.

It is critical that policies continue to support a level playing field for clean energy supplies and provide simple, long-term, stable solutions to smoothly scale clean energy infrastructure while effectively addressing ongoing issues in energy security, pollution, carbon intensity and supply.

Section 6 Endnotes

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