Industrials | December 2024

RENEWABLE ENERGY DEVELOPERS CREATING VALUE FOR INVESTORS

THEMES

As one of the largest issuer-sponsored research firms, we are known for our bottom-up work on individual stocks. However, our thinking does not stop at the company level. Through our regular dialogue with management teams and investors, we consider the broad themes related to the companies we follow. Edison themes aims to identify the big issues likely to shape company strategy and portfolios in the years ahead.

ANALYST

Michael McNamara

CONTACT

edisongroup.com
+44 (0) 20 3077 5700
industrialsedisongroup.com

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Renewable energy developers

Creating value for investors

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6 December 2024

Renewable energy developers must use proprietary skills and experience to overcome a range of critical challenges on the development pathway. As they overcome these challenges and deliver new projects, they are being rewarded with rising returns on these new projects. In this report, we intend to show how successful developers overcome a myriad of challenges to secure critical permits while simultaneously maximising value to shareholders.

Project returns are rising

Returns on projects in the development pipeline are improving, driven by higher energy prices and, in the case of solar, falling panel prices. This improvement is remarkable given that higher wind turbine prices and higher interest rates have increased the long-term cost of renewable energy for the first time in 20 years.

Experience is king

Experienced developers promote renewable energy projects from greenfield to fully permitted status more efficiently and at the lowest cost possible. In addition, they are adept at identifying those early-stage projects that are unlikely to materialise and channel resources towards more promising ones. Along with rising project returns, this acts as a further tailwind for these developers.

Local presence is vital

Renewable energy development is an intensely localised industry. Land access, grid connection, permitting and a range of other critical steps on the development pathway are handled at a local level. Developers must establish a local presence to bring their development expertise into play.

Grid connection is a global challenge

Developers must know where and at what cost grid access is possible and which regulatory criteria are necessary. Proven ability to secure grid access in a developer's target market(s) is an absolute must for developers.

PPA/offtake agreements

Developers must be able to provide power purchase agreements (PPAs) as part of the project development pathway. This is becoming an increasingly important and complex role as the world shifts away from feed-in tariff (FIT) regimes for standalone renewable projects towards competitive PPAs combined with hybrid renewables plus storage projects. Some large purchasers of renewable projects have their own PPA channels, although they remain a minority of buyers.

Storage will play an increasingly important role

As penetration of intermittent renewable energy rises and increases stress on grid stability, storage is fast becoming mandatory in many developed markets. The integration of storage boosts the attractiveness of projects to grid operators and may lead to higher returns in some cases. Developers must know how to integrate storage, not only in the project itself but also in the prevailing regulatory regime.

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Companies in this report

ABO Energy
Emeren Group
MPC Energy Solutions
Polaris Renewable Energy
Premier Miton Global Renewables Trust*
Schroders Greencoat

*Edison Investment Research client.

Analyst

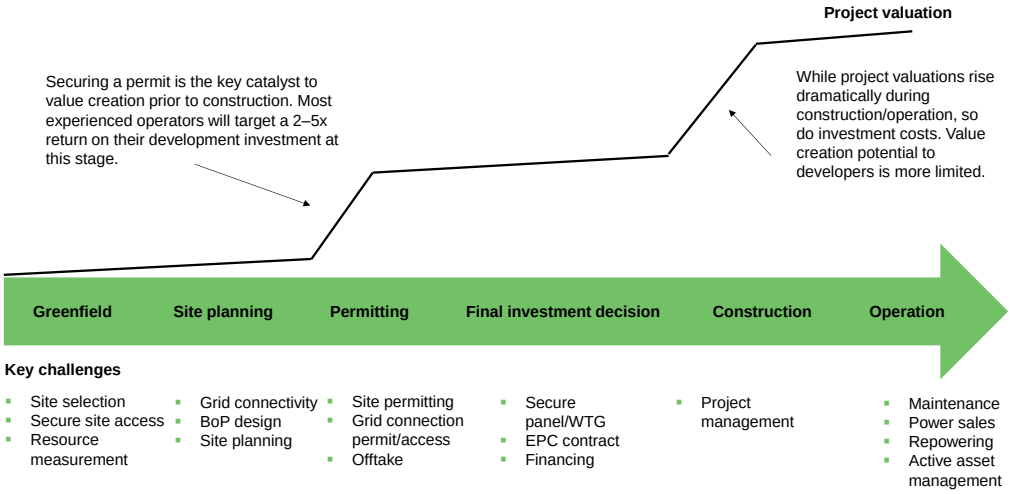
Michael McNamara +44 (020) 3077 5700

industrials@edisongroup.com

Introduction to the project development pathway

We believe investors will benefit from a detailed review of the renewable energy project development pathway to illustrate the critical challenges developers face in transforming a greenfield site into an operating renewable energy project. To illustrate the key challenges developers face, please refer to the chart below, which highlights the development pathway from greenfield site to operating project (please note that the project valuation line is illustrative and not to scale).

Exhibit 1: The renewable energy development pathway



Source: Edison Investment Research

A cursory glance at the pathway leads to the obvious and previously discussed conclusion that securing critical permits is the catalyst to value creation. Next, we will examine the key challenges faced and the necessary skills experienced developers must have to overcome these challenges and generate value for investors. To do this, we have relied on the author's nearly 20 years' experience in renewable energy investments, as well as detailed interviews with a wide range of renewable energy developers and operators. This report shares these combined insights with our readers.

We will highlight the key themes and challenges in each section. While we will follow the pathway set out in Exhibit 1, we stress that often these challenges are addressed simultaneously and each will have a holistic impact on the eventual project. We will include our contributing developers and operators at the end of this report.

Project returns are rising

A consistent theme mentioned by interviewees is that returns on renewable energy projects are increasing even before the expectations of falling interest rates are incorporated. Compared to before the COVID-19 pandemic, we estimate that renewable energy project returns have improved by 100–400bp since 2020.

This has been driven by:

- higher prices for renewable energy,
- technological improvements (ie better wind turbines and photovoltaic (PV) panels), and
- improvements in renewable energy project development.

'Investee companies in the fund have talked about 200–300bp higher returns on new photovoltaic project returns driven by higher energy prices, greater value provided to customers through incorporation of storage and falling panel prices.' – James Smith, fund manager of Premier Miton Global Renewables Trust

'Corporate net zero and/or decarbonisation efforts are generating demand for 'green electrons' which is leading some PPAs to be priced at premiums to the forward [energy price] curve.' – John Musk, head of IR for Greencoat UK Wind and Greencoat Renewables

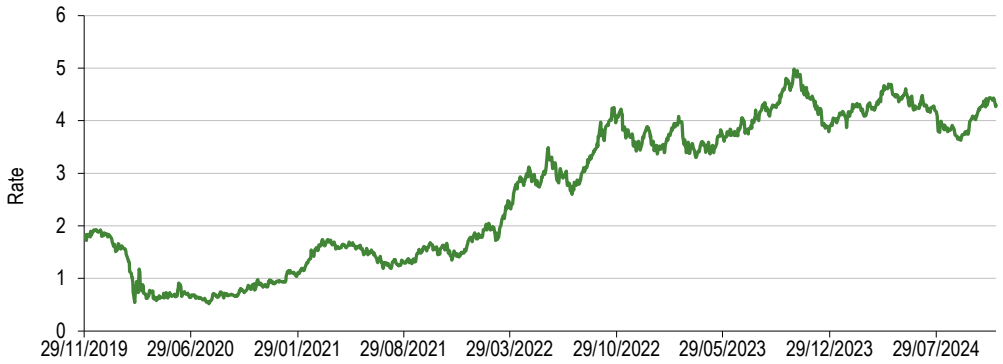
Most developers look to make a minimum 2–3x profit on their development costs when fully permitted projects are sold. Higher project returns could allow for higher project prices and, if development costs are kept under control, potentially higher profits for developers. Please note that there are different developmental models that can lead to different profit and risk profiles, but this point is beyond the scope of this report.

Despite higher long-term cost of energy

The improvement in renewable energy project returns is remarkable given the significant headwinds in recent years. The global energy marketplace has been shaken over the past few years by the COVID-19 pandemic, higher interest rates to fight off inflation and the impact of the Russian invasion of Ukraine on energy prices.

The combination of higher interest rates and price increases for some key components has caused the long-term cost of both solar and wind energy to rise over the last two years (2022–23), representing the first increase in nearly 20 years.

Exhibit 2: US 10-year treasury yield, November 2019 to present (%)

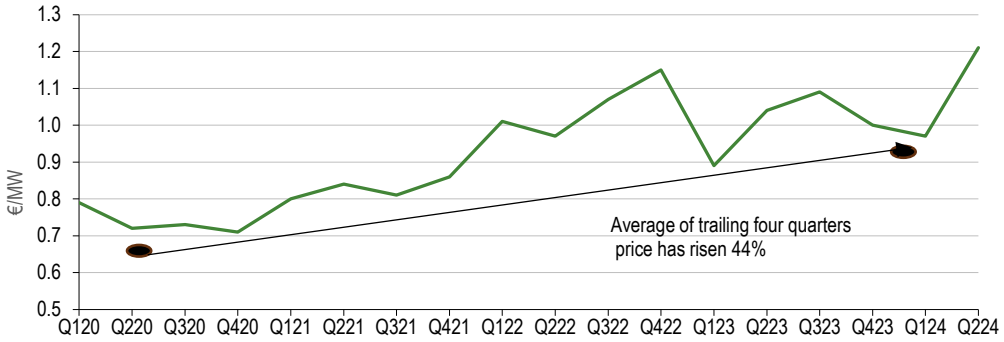


Source: LSEG Data & Analytics

Inflationary pressures have not only raised the cost of capital but also led to price increases in parts of the solar and wind supply chains, which has raised prices of some key generating and balance of

plant components. This is illustrated by the 44% increase in wind turbine pricing by industry leader Vestas over 2020–24.[1]

Exhibit 3: Vestas turbine price trends



Source: Vestas company reports, Edison Investment Research

Permitting is accelerating in certain markets

In our discussions with ABO Energy, we learned that the permitting process has become both markedly simpler and more rapid in key European markets. Both Germany and Finland were named as countries that have ramped up the approval of renewable energy projects since the Russian invasion of Ukraine, which led many countries to block or severely curtail imports of Russian natural gas. It is reasonable to speculate that other countries reliant on Russian natural gas could follow suit. According to the BP Statistical Review of World Energy 2022, the biggest consumers of Russian pipeline gas in 2021 were Germany, Italy, Turkey and the Netherlands, while Russia accounted for 45% of EU natural gas imports in 2021.

Experience is king

Managing the pipeline

Experienced developers can anticipate issues relating to potential projects and either find solutions to overcome them or, equally important, accept that the project is not viable and move on quickly without investing significant time and resources into dead-end projects. This ability allows developers to focus time and investment on projects with a higher probability of success and often increases company-level returns as expenses on stranded projects are limited, which translates into higher returns on successful projects.

Relationships with developers and buyers are vital

Relationships can be key to a successful developer. It does no good if a project is brought all the way to 'shovel ready' but an attractive buyer cannot be located to allow the developer to crystallise value.

Developers fall into two categories: pure-play developers, which sell 100% of their projects at different stages of the development pathway, or those who will build, operate and own some or all of their development projects. For those developers looking to sell assets, reputation is key as asset owners look to de-risk their operating portfolios and one of the best ways to do this is to acquire high-quality assets from developers with a proven track record of delivering fully permitted

[1] Average prices are an average of the first and last four quarters in the period. Note that contract type can have an influence on pricing, so this should be considered illustrative only.

projects on time and on budget (if engineering, procurement and construction is handled by the developer).

'Why do people select us [Emeren] Because we have full quality control of our entire development process…The two keywords in our company are de-risk and optimise. Smart developers find a way to de-risk projects and optimise production to maximise returns for buyers.' – Yumin Liu, CEO of Emeren Group

At the other end of the spectrum are the pure-play operators looking for low-risk projects that will provide an attractive return to their investors. These buyers can enter into framework agreements with developers to deliver a set number of projects over a specific timeframe. Alternatively, they will establish relationships with developers that are built on trust. With these relationships, the operators can peer into the developer's pipeline to secure options to acquire attractive projects as they move along the development pathway.

'Generally, we are pretty agnostic around who we're buying from. We carry out in-depth due diligence on any transaction and typically we are [currently] buying from larger developers.' – John Musk, head of IR for Greencoat UK Wind and Greencoat Renewables

Project design

Proper site selection and planning are critical for all forms of renewable energy development and can go a long way towards maximising project returns.

Wind developers must take accurate resource measurements and undertake detailed topography studies to best determine the layout of the project and identify which turbines are best suited to site-specific conditions (eg average wind speeds, site access, etc). This is coupled with their grid connection plans to allow for the highest energy production at the lowest project cost.

Solar developers face slightly different challenges. While solar panels are more commoditised than wind turbines, they are not entirely homogenous and certain panel types suit some conditions better than others.[2] In addition, mounting systems for utility-scale ground systems can play a key role. Single-axis tracking systems are more expensive to install than fixed-tilt options but generate more energy over the course of the day. According to data published by the Lawrence Berkeley National Laboratory in 2024, single-axis tracking systems represented more than 90% of utility-scale installations in the US over the past three years. Fixed tilt is often the preferred choice in US sites with challenging terrain or weather (ie windy) and many are angled to face south-west rather than directly south to maximise evening generation when energy prices are higher.

Renewable asset management

Experience counts in all steps of the development pathway, even after the project has been commissioned. Returns on fully operational renewable energy plants can be enhanced through a variety of means including, but not limited to:

- regular maintenance designed to maximise availability/reduce downtime of assets;
- software improvements that can lead to boosting output;
- active management of offtake/PPAs; and
- repowering/project life extension.

[2] For example, monocrystalline panels tend to outperform polycrystalline and thin film panels in hot climates.

Local presence is vital

The importance of a local presence was hammered home by every developer we interviewed. The importance only increases when addressing less developed renewable energy markets. Landowners and local stakeholders are as a rule more comfortable dealing with developers from a similar region, heritage or language. Local governments are often vital for important land use permits and generally prefer to work with developers operating within their jurisdiction. National governments may be important if a national renewable energy support such as FITs or lower tariffs are on offer.[3] Finally, all-important grid access is both a local and a regional issue.

'If you want to develop a project, what you need is a local presence. If you want to secure land or interconnections you are sometimes working in very remote areas…and you had better speak the right dialect…there is only so much you can do with Google Maps.' – Stefan Meichsner, CFO of MPC Energy Solutions

Grid connection is a global challenge

Securing grid connection for a renewable energy project is critical and success will depend on the developer's skill in site selection, grid analysis expertise, engineering know-how and local knowledge. The developer must quickly ensure that a potential project can access the grid and at an acceptable cost. To illustrate the difficulties and importance of this challenge, we note that from 2007–23, only 20% of projects requesting grid interconnection in the US reached operation, while the remaining 80% were cancelled or delayed.

'Grid connection remains a key challenge in most markets. At ABO Energy we employ experienced in-house grid engineers who can assess the likelihood of securing grid access and design the most cost-effective solution to connect our project to the local grid access point. We view this as a key competitive advantage.' – Dr Karsten Schlageter, managing director of ABO Energy

Some jurisdictions require developers to put down a (potentially non-refundable) deposit with the grid operator to secure grid access. One reason for this is to ensure that the grid connection queue is not clogged up with uneconomic projects that will never see the light of day. These deposits are both an economic challenge and an opportunity for experienced developers. While they represent a potential cost, they also present a potential opportunity to partner with smaller, local 'mom-and-pop' developers that may have an attractive project but lack the resources to make the grid-access deposit.

Optimising the project to grid capacity

Once a site[4] is identified, the developer must immediately assess the available capacity in the local grid to accept incoming power. Generally speaking, the developer will rely on in-house expertise to model grid performance although a smaller developer may have to lean on third parties for this service. It is critical to know the capacity available to allow the developer to optimise the project to match the maximum capacity available.

[3] MPC Energy Solutions highlighted an issue with government approvals for renewable energy tax breaks and/or tariff advantages versus renewable energy project development pathways. One may operate on a very different timeline from the other.

[4] Alternatively, a developer may identify available capacity in a local grid and then search for an appropriate site.

Negotiating with grid operators

In order to secure grid access, the developer must negotiate with the grid operators, commonly known as transmission system operators (TSO) or distribution system operators (DSO), although terminology will vary by market. The purpose of these negotiations is to determine the best site for interconnection as well as ensure the new project will interact seamlessly with the existing grid. The grid operators will assess the application to ensure that it meets all regulatory criteria and does not affect the performance of the grid.

Grid connection costs analysis

The costs associated with grid connection can affect overall project costs and thus potential project returns. The key variables that a developer must consider include, but not limited to:

- distance from project to grid access point;
- terrain, obstacles along the route (eg mountains and rivers are more expensive to cross than an open prairie); and
- voltage demands at grid access (eg does output need to be stepped up to a higher voltage for a transmission grid or stepped down to a lower voltage for a distribution grid – all done via transformers).

PPA/offtake agreements

The developer must ensure there is an offtake agreement for the project as well as optimising the project to meet the specific requirements of the offtake agreement. Ensuring an attractive price for the energy produced and designing the project to best meet these requirements is vital for developers to achieve attractive returns for their project pipeline.

Offtake agreements generally happen through a FIT or a PPA with a utility or corporate buyer:

- Under a FIT regime, the developer must ensure that the project meets all regulatory criteria to qualify for the FIT. Once this is secured, the grid operator is required to buy the energy at a pre-agreed price.
- Corporate or utility PPAs are negotiated between the developer and the consumer, where the consumer indicates not just the price and quantity of power (MWh) but often the specific delivery time, which could lead to the developer incorporating storage into the project.

Note that some larger buyers of renewable energy projects may have their own PPA pipeline or prefer to operate the projects on a merchant power[5] basis. While this means the developer is not required to produce an offtake agreement in order to sell the project, this applies to a minority of projects.

‘PPA is a [value] ‘adder’ as a developer. We are fully capable of sourcing PPAs in Europe and we have experience in sourcing or auctioning PPAs in the US. (However) the big investors may have their own PPA channel and can source PPA themselves.’ – Yumin Liu, CEO of Emeren Group

Storage will play an increasingly important role

Storage, generally speaking in the form of lithium-ion batteries, will play an increasingly important role in renewable energy projects and developers will require the skills and experience to incorporate storage into new and existing projects. Most of the developers we spoke with indicated

[5] A merchant power renewable energy project sells its power directly to the grid at the prevailing market price. This can happen at the time of generation or the power can be stored and sold when grid pricing is higher (typically, but not always, early evening when demand is high and solar power production is low).

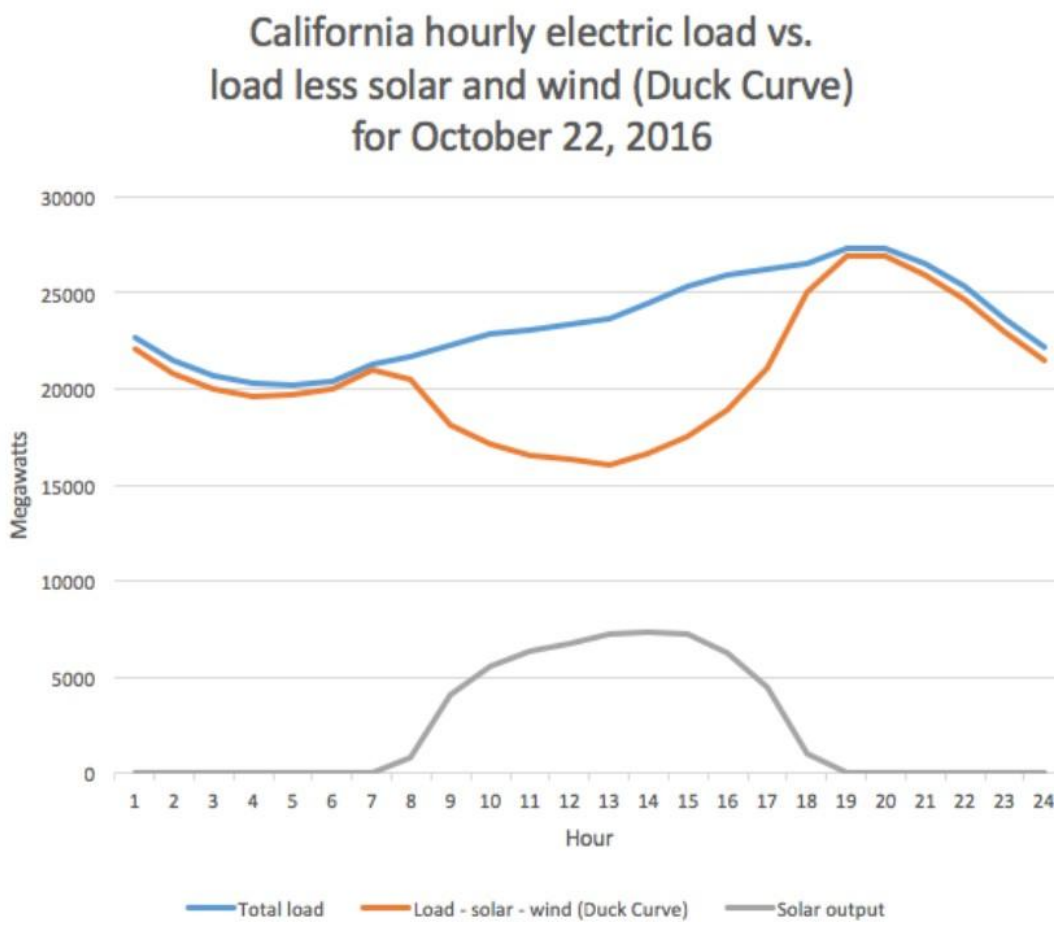
that, in more developed markets with higher renewables penetration, storage is quickly becoming mandatory. Grid operators are simply not accepting grid connection applications unless the projects can shape their power output curves to supply energy to the grid at all hours of the day and not just when the sun is shining or the wind is blowing. That said, storage is best suited for solar, which is characterised by more predictable and concentrated output peaks than wind.

Storage required for grid stability

The ability to harness storage to 'time shift' (ie dispatch power to the grid at any time) will become increasingly important. Exhibit 4 shows the now infamous 'duck curve', which highlights the imbalance between solar power generation and peak demand in California. As shown, when solar generation rises (the grey line), the need for dispatchable power (the orange line) falls and then surges in the early evening as solar generation falls away. The inclusion of storage would allow the grid operator to flatten out both the solar power and dispatchable power generation curves and ease pressure on the grid. Note that this example is dated to 2016 when California had approximately 18GW of solar capacity, compared to nearly 47GW in 2023.

'Hybrid energy, solar plus storage, has become mandatory in most states in the US. When you don't have storage attached to solar, you don't have a project.' – Yumin Liu, CEO of Emeren Group

Exhibit 3: Solar supply versus demand



Source: Arnold Reinhold based on data from caiso.org (CC BY-SA 4.0)

Storage can improve project returns

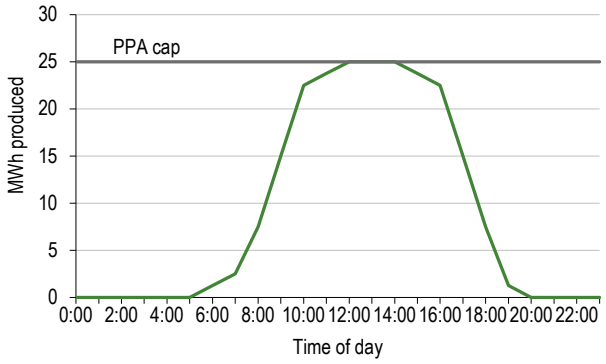
Storage can allow operators to charge their batteries with non-contracted power[6] during the midday generation peak when power prices are low and then supply the grid in the evening when solar generation is offline. To illustrate the potential involved, over 2023, the evening peak wholesale energy price in California was 3x higher than the midday wholesale energy price. We expect this spread will decrease as storage penetration rises and increasing amounts of midday generation are diverted to the evening peak.

We note that developers do not believe that grid operators and corporate customers will pay a premium for storage. The advantage lies in the ability to provide power when needed and is thus a critical requirement in developed renewable energy markets.

'Storage does not necessarily lead to higher sales prices but the time shift [from mid-day peak to evening] can be rewarding as well as supporting grid stability.' – Dr Karsten Schlageter, managing director of ABO Energy

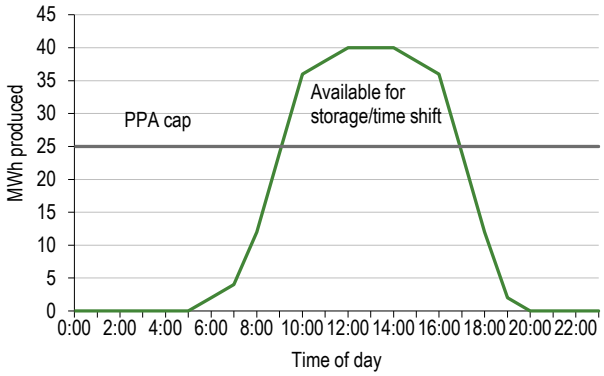
In Exhibits 5 and 6 below, we illustrate the impact that 'over-powering' and storage can have on project generation yield.

Exhibit 5: Solar output over time versus PPA cap



Source: Edison Investment Research

Exhibit 6: Solar output over time with excess production and storage versus PPA cap



Source: Edison Investment Research

In our examples, we assume a PV project contracted to deliver a maximum of 25MWh to the grid. In Exhibit 5, the project is perfectly optimised with 25MW capacity and will produce exactly 25MWh at the midday peak with no power curtailment needed (ie no excess production). In Exhibit 6 the project is oversized to 40MW and will produce a significant surplus at peak time as well as more power produced at the 'shoulders' of the power curve. The net impact is illustrated below:

Exhibit 7: Energy output measured in MWh

PPA cap (MW)	25	25
Installed capacity (MW)	25	40
Production (MWh)		
Net output	218	255
Storage	0	93
Total	**218**	**348**

Source: Edison Investment Research

The outsized project will produce 37MWh or 17% more power during normal operations. Assuming the full 'excess' production can be stored and dispatched later in the day, the increased production will total 130MWh, representing a 60% increase in output.

[6] This refers to merchant plant operations or any power produced that is not sold via an existing offtake agreement.

Another important element of the rising storage market is the need for governments to provide a regulatory framework that incorporates the role and impact of large-scale energy storage. The US and certain European governments are at the cutting edge of regulatory oversight and other markets are largely looking to these markets for guidance.

'Storage is a whole new asset class. Governments and regulators are trying to get their heads around it.' – Marc Murnaghan, CEO of Polaris Renewable Energy

Other opportunities for value creation

Repowering opportunities

The rapid decline in PV panels combined with equally rapid improvements in panel efficiency could create opportunities for operators to re-power their projects. Re-powering refers to replacing existing assets with newer, more efficient assets and potentially adding storage capabilities to allow production to be stored and then dispatched to the grid when electricity prices are higher. As we illustrated in Exhibits 5 and 6, an existing project could be re-powered and storage incorporated to increase power output by 60%.

This re-powering could generate excellent returns to project operators as much of the balance of plant costs related to the generation facilities are already in place and the permitting process already secured through the original project. It is important to note that the operator must work closely with the offtaker, as the two parties need to balance out the buyer's willingness to pay for more often higher-cost renewable energy with the offer to utilise storage to deliver that renewable energy when needed[7] and assist the local grid with de-carbonisation efforts.

Hydrogen is a long-term option

Green hydrogen remains an attractive opportunity for renewable energy developers, as any large-scale deployment of green hydrogen production would require vast amounts of renewable energy and thus demand for developers' skill sets.

Even if some of the previous hype around green hydrogen has faded, we believe there will be significant opportunities. Green hydrogen is likely to be produced via electrolysis where water is split into oxygen and hydrogen through a catalyst powered by renewable energy. Early adoption of green hydrogen would likely be limited to small-scale industrial applications, although there is potential in the longer term for green hydrogen to displace fossil fuels such as natural gas. However, we do not see hydrogen playing a meaningful role in renewable energy project development until late in the decade at the earliest.

Conclusions

Renewable energy developers must deploy a range of skills to progress projects along the development pathway, from greenfield to being fully permitted and operational. Rising project returns and strong demand for high-quality renewable energy projects are a significant tailwind for developers as the global economy looks to them to deliver renewable energy and de-carbonise the economy.

[7] Note that the early evening peak demand is often met by fossil fuels, as PV will obviously not work without sunlight and wind generation may not be available to meet that specific need. The use of stored renewable energy could thus significantly reduce the need for stand-by fossil fuel generation to fill the gaps in intermittent renewable energy supply.

Contributing renewable energy investment companies

ABO Energy

Ticker: AB9 Market cap: €345m

ABO Energy was founded in 1996 in Germany and is a pure-play developer of renewable energy assets. The company has 35 regional offices worldwide, with 13 in Germany alone. ABO Energy has a total renewable energy pipeline of 24.8GW (60% wind, 30% solar and 10% storage) spread across 16 countries, of which c 6.8GW is in the mid-to-late stages of development. In addition to this renewable energy pipeline, ABO Energy also has a 20GW portfolio of green hydrogen projects although these are at an early stage of development.

ABO Energy's strategy is to develop and construct renewable energy projects to be sold to third-party investors. Over its nearly 30-year history, ABO Energy has completed 4.4GW of wind projects, 1GW of solar projects and 100MW of storage projects.

Emeren Group

Ticker: SOL Market cap: US$95m

Emeren Group is a leading renewable energy company and a global solar project developer, owner and operator, with a pipeline of solar and independent power producer assets totaling about 8GW, alongside a storage pipeline of nearly 8GW across Europe, North America and Asia. The company specialises in developing and selling solar power projects or project special purpose vehicles, providing engineering, procurement and construction services, owning and operating solar power plants to sell electricity, and expanding its development services agreement business in solar and battery energy storage systems (BESS). Emeren has operations in nine countries (the US, Poland, Hungary, Spain, France, the UK, Germany, Italy and China) and additional markets in development. Emeren sold over 850MW of projects in 2023 and currently owns and operates over 300MW of solar PV and BESS assets. Historically a vertically integrated solar manufacturer, the company pivoted to focus on downstream project development, targeting small-scale projects in markets with attractive economics.

MPC Energy Solutions

Ticker: MPCES Market cap: NOK210m

MPC Energy Solutions (MPC) is a fully integrated developer and operator of renewable energy projects. MPC currently operates 79MW of installed capacity (virtually all solar) in Mexico, Puerto Rico, Colombia and El Salvador and the company is constructing a 65MW solar plant in Guatemala expected to come online in mid-2025. The project portfolio PPAs have an average remaining tenure of 15 years and the revenue is 80% in US dollars. Looking forward, MPC intends to focus its development and investment efforts in the Central American markets of Panama, El Salvador and Guatemala. In Guatemala, MPC has a relationship with Ingenio Magdalena (IMSA), the leading producer of sugar in the country. IMSA is the off taker for the 65MW San Patricio project energy as well as supplying the land for the project and is building the substation to connect the project to the grid.

Polaris Renewable Energy

Ticker: PIF Market cap: C$274m

Polaris Renewable Energy is a renewable energy developer and operator present in Central and South America, as well as the Caribbean. It currently operates 156MW of geothermal, hydroelectric and solar plants, with 98% of energy production fully contracted in US dollars with government entities and an average remaining term of over 13 years. Historically, Polaris had acquired operating or near-operating assets on an opportunistic basis but is shifting its focus towards more early-stage renewable energy assets. Polaris intends to focus its near-term organic development efforts on increasing capacity and adding battery storage to its solar project in the Dominican Republic. Management is also open to an incremental acquisition strategy aimed at increasing both its exposure to earlier-stage development pipelines as well as increasing end markets within its core operating region.

Premier Miton Global Renewables Trust

Ticker: PMGR	Gross assets US$38.9m

Premier Miton Global Renewables Trust's investment objectives are to achieve a high income from its portfolio and realise long-term growth in the capital value of its portfolio. The company seeks to achieve these objectives by investing principally in equity and equity-related securities of companies operating primarily in the renewable energy sector, as well as other similar infrastructure investments. As of 30 June 2024, the portfolio exposure to renewable energy developers and operators was just over 69%, with Greencoat UK Wind, NextEnergy Solar Fund, Enefit Green and Grenergy Renovables as examples of its exposure to renewable energy developers and operators.

Schroders Greencoat

Greencoat UK Wind, ticker: UKW	Market cap: £2.8bn
Greencoat Renewables, ticker: GRP	Market cap: £968m

Schroders Greencoat is one of the largest pure-play renewable infrastructure managers globally, with a presence in the UK, Europe and the US. Schroders Greencoat has c US$12bn in assets under management, with c 50% accounted by the listed Greencoat UK Wind and Greencoat Renewables and the remaining 50% in unlisted mandates. The company does not typically develop projects itself but acquires operating assets from trusted third-party developers.

Greencoat UK Wind owns 49 wind farms in the UK, with a net generation capacity of 2.0GW. Greencoat Renewables owns 1.5GW in six European markets, with Ireland representing 59% of capacity. Onshore wind is the largest share of the fleet, representing 75% of capacity, with offshore wind representing 22%. Solar and storage make up the remaining 3%. Schroders Greencoat is the largest owner of UK solar assets, although these are not held in either of the listed vehicles.

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London | New York | Frankfurt
20 Red Lion Street
London, WC1R 4PS
United Kingdom