May 2020 I 55th edition

Renewable Energy Country Attractiveness Index

RECAI

In the wake of a human crisis do climate goals take a back seat?

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Contents

Introduction

The response to COVID-19 has brought much of the global economy to a halt, with consequent shocks to energy demand, global supply chains and capital markets. While the contours of a post-pandemic economy are not yet clear, there is reason to believe the renewable energy sector will prove resilient.

Certainly, renewable energy is not immune to the economic disruption being wrought. Some projects under construction are struggling to source equipment. Operating and maintenance teams are harder to move around. Lower power prices will squeeze margins. The collapse in oil prices will raise questions about the ability of oil and gas companies – recent converts to the attractions of clean energy – to continue to invest in the sector.

But many of these effects are likely to be short-term. Already, manufacturers in China and Europe are restarting production. Utilities have worked hard to keep generation going in difficult circumstances. And power demand will rebound as economies get back to work.

The investors involved remain confident about the long-term picture for clean energy. Climate change isn't going away. The need, after the pandemic, to ensure greater economic and social resilience will work in favor of distributed power sources, such as wind and solar, and the applications offered by battery storage. Large companies will be keen to demonstrate that they are responsible corporate citizens, encouraging them to source clean energy.

This issue of RECAI touches on some of these themes: the rise of utility-scale energy storage as an enabler of the low-carbon transition; and the growing concern among investors about environmental, social and governance (ESG) issues. Both of our country deep dive articles – focusing on the US and Spain – find renewable energy sectors well placed to resume growth once COVID-19 is behind us.

None of this is to diminish the profound challenges caused by a pandemic, the like of which none of us has experienced before. But it is important to recognize the central role that clean, low-carbon energy generation will play in the global economy of the future.

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Renewable Energy Country Attractiveness Index

recai

May 2020

Methodology
The Index was recalibrated in April 2020, with all underlying datasets fully refreshed. To see a description of our methodology, visit **ey.com/recai**.

LEGEND

- Increased attractiveness compared with previous Index
- Decreased attractiveness compared with previous Index
- No change in attractiveness since previous Index
- **Current ranking is in bold**
- (Previous ranking is shown in brackets)

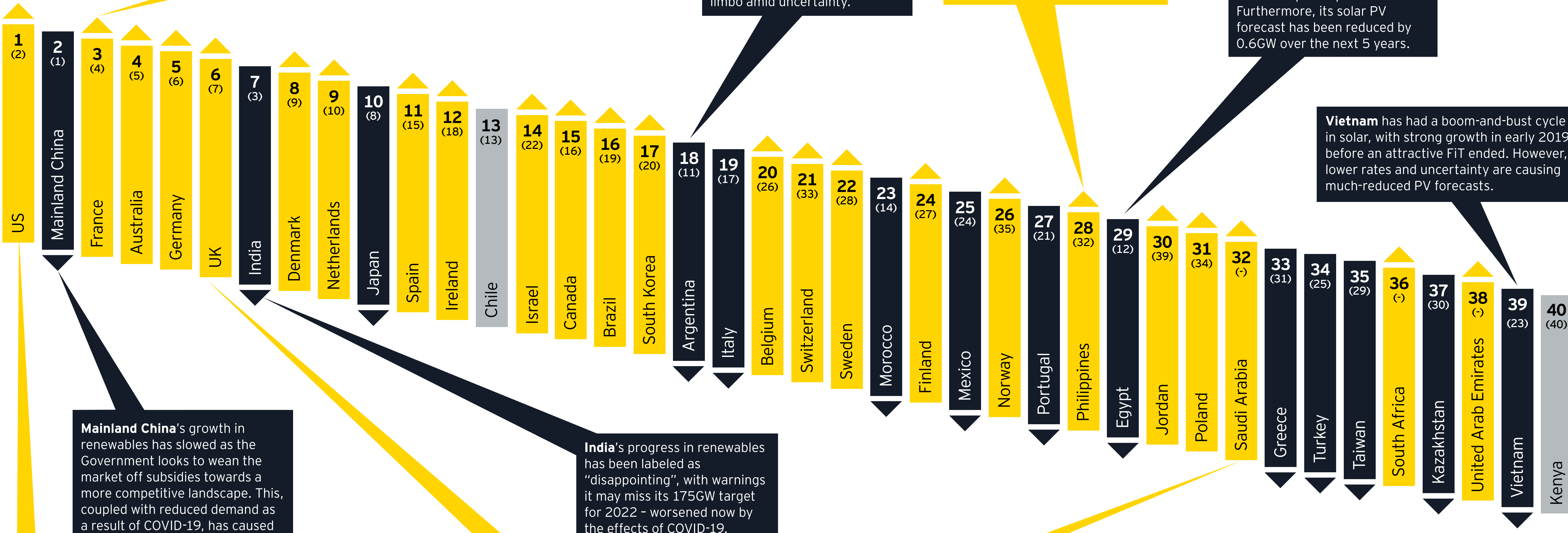
France has moved from fourth to third, securing strong power prices and awards of 1.4GW for wind and solar developers in its latest auction, as it gradually weans its grid off nuclear power.

Argentina's political turmoil has caused its renewables agenda to suffer, with pipeline projects in limbo amid uncertainty.

In February, the **Philippines** Government announced plans for a 2GW auction under a green energy tariff program to attract more than US$2b of initial investment, progressing towards 15GW of renewables by 2030.

In addition to COVID-19, **Egypt** has been hit hard by low industrial power price forecasts. Furthermore, its solar PV forecast has been reduced by 0.6GW over the next 5 years.

Vietnam has had a boom-and-bust cycle in solar, with strong growth in early 2019, before an attractive FiT ended. However, lower rates and uncertainty are causing much-reduced PV forecasts.



Mainland China's growth in renewables has slowed as the Government looks to wean the market off subsidies towards a more competitive landscape. This, coupled with reduced demand as a result of COVID-19, has caused mainland China to drop to second in our index, but forecasts remain optimistic for long-term growth.

India's progress in renewables has been labeled as "disappointing", with warnings it may miss its 175GW target for 2022 – worsened now by the effects of COVID-19.

For the first time since 2016, the **US** has secured top position. This is largely because of a short-term extension to the PTC and long-term growth in offshore wind, with plans to invest $57b to install up to 30GW by 2030.

The **UK** made a milestone proposal to re-include onshore wind and solar projects in the next contracts-for-difference auction, encouraging greater and more diverse renewable energy development.

Despite being an oil-centric nation, **Saudi** is placing increasing importance on renewable energy, with plans to generate 25GW in the next five years and 60GW in the next decade – 40GW of which will be in solar.

COVID-19 correction parameter
A new COVID-19 correction parameter has been added to the RECAI to reflect the impact of the pandemic, which we believe will have a short-term dampening effect on the renewable energy transition. The intention is to gradually reduce the weight of the parameter in future RECAI issues as the data feeding into the RECAI begins to reflect the impact of COVID-19.

The new COVID-19 correction parameter is centered on three criteria, for which the market is given a score. The criteria are:

1) the strength of the market's healthcare system
2) the size of the population at risk based on demographics
3) economic vulnerability

At this time, the parameter does not incorporate COVID-19 data (i.e., tests performed, cases and deaths reported). The inconsistent approaches to testing and reporting on the pandemic across different markets impairs direct comparability.

Key developments

Renewable energy is set to play a central role in the post COVID-19 economic recovery but, as issue 55 of the Renewable Energy Country Attractiveness Index (RECAI) demonstrates, the global picture is mixed.

China's renewables sector stumbles

China has lost its spot at the top of the RECAI index for the first time since October 2016, slipping to second place behind the US, as it seeks to cut the cost of its renewable energy subsidy regime. Disruption caused by COVID-19 will also crimp the development pipeline, although China is continuing to invest heavily in the clean-energy supply chain.

The Government has been gradually lowering the subsidies paid to onshore wind and solar projects — which currently support around 210GW of wind capacity — as it tries to reduce the RMB100b (US$14b) deficit of its Renewable Energy Development Fund. According to Wood Mackenzie, the Ministry of Finance has budgeted just RMB5b (US$700m) to subsidize new renewables in 2020, which is expected to support 8GW–10GW of new onshore wind capacity.

As a result, the Government is incentivizing wind projects that are currently receiving feed-in tariffs to switch to an unsubsidized system, whereby they would be offered long-term power purchase agreements and the preferential payment of unpaid subsidies. Wood Mackenzie calculates that around 60GW of older capacity, which will have recouped its initial investment, can maintain current yields by making the switch, potentially eliminating RMB291b of subsidies.

Despite these challenges, Wood Mackenzie is forecasting that yearly onshore power additions, after dipping to 18.8GW in 2021, will rise to almost 23GW by 2028. However, it warns that growth in the offshore wind market is set to be hampered by political uncertainty, a limited subsidy quota, and disruptions caused to supply chains by COVID-19. Its base case sees total installations reaching 14.5GW by the end of 2021, with new additions falling to just 2GW the following year before recovering to 5GW in 2025. Worst case, China could reach 11GW by the end of next year, followed by less than 0.5GW awarded each year for the rest of the decade if the sector is not supported by provincial governments, and if low demand fails to prime local supply chains.

While the near-term picture for domestic capacity additions looks cloudy, Chinese companies are continuing to invest and position themselves for the global low-carbon transition. Solar maker GCL System Integration Technology is investing RMB18b (US$2.5b) in a solar-module factory in Hefei, Anhui Province, that will have capacity to produce 60GW of modules — the single largest production site in the world, able to supply around half of current global demand for solar modules.

Greek energy market reforms herald renewables boost

Greece has submitted a plan for renewables to supply 35% of final energy consumption by 2030, with renewables meeting 61% of power demand by that date. Its National Energy and Climate Plan, drawn up in late 2019, mandates 7.7GW of cumulative solar PV capacity by 2030, up from approximately 2.7GW of installed capacity at present. Wind is expected to account for 7.05GW of capacity, up from 3.6GW at present.

The plan envisages €9b (US$9.8b) of investment in renewables by that date, alongside €11b of investments in energy efficiency.

This follows an announcement last year that the Government plans to phase out the use of lignite coal for power generation, closing down around 4GW of coal-fired capacity between 2019 and 2023.

To enable the transformation of the country's energy sector, the Greek Parliament approved a package of market reforms late last year. These include changes to wholesale electricity market operations, and a suite of measures to speed up renewable energy permitting and approval processes.

Other reforms encourage renewable energy generators to participate directly in the wholesale market, rather than relying on the transmission operator, potentially incurring balancing costs. They can do so on their own or by pooling their assets with an aggregator; such pooling would help to reduce these balancing costs.

The market reforms are also set to enable generators and private offtakers to structure power purchase agreements (PPAs), which are not permitted under current regulations. The first such deals are expected in 2021.

Chile postpones 2020 auction

A drop-off in projected energy demand has led Chile's National Energy Commission (CNE) to delay a planned electricity auction. The decision — which predated the COVID-19 pandemic — will result in the auction being held in December rather than June, with bids now due by 18 November.

The CNE's delay was prompted by downward revisions to GDP, which is partly attributed to civil unrest in the country in late 2019, and an associated 6% drop in projected power demand. However, the CNE is sticking to its original target of auctioning 5.6TWh of electricity through 15-year PPAs, which will begin in 2026.

The last auction took place in 2017, when Enel Generación Chile bid the lowest power price of US$21.48/MWh, from a solar project. Around 600MW of renewables won PPAs under the auction, which saw average prices of US$32.5/MWh.

Despite the delay to the latest auction, renewable energy projects are continuing to move forward in the country. Renewables developer Atlas, for example, is planning to build a large-scale solar project in the north of the country. Its proposed 854MW Alfa Solar farm is expected to cost around US$450m.

Corporates flock to Finland's PPA market

Finland's wind-energy market is increasingly attracting corporate energy buyers, as they take advantage of cost reductions and a healthy wind resource in the Nordic country.

In one of the largest recent deals, Finnish pulp and paper firm UPM bought 4TWh of power from the Karhunnevankangas wind farm in western Finland, under development by German developer WPD. The 192MW wind farm is expected to be operational in 2022. Announced in February, the PPA will enable UPM to cut its carbon dioxide emissions by 5%.

Also in February, Lundin Petroleum struck a PPA to take power from the planned 132MW Metsälamminkangas wind farm in northern Finland, developed by OX2. The project is due to be completed by the end of 2021.

The following month, Norway-based energy trader Statkraft and Finnish chemical company Kemira signed a 10-year PPA for the latter to take around 44GWh of power each year from Statkraft's 1.06GW Fosen Vind complex. In addition to physical power, the deal includes the sale of guarantees of origin.

Finally, in January, IKEA announced it has bought the 30MW Ponsivuori wind farm in the country from local developer OX2. It followed a 2018 agreement under which the home-furnishing giant agreed to buy four projects — Ponsivuori, Verhonkulma, Långmossa and Ribäcken — totaling 107MW, once they are completed. Those four farms represent one of the largest subsidy-free platforms in the region.

Japan's wind sector takes to the seas

The first offshore wind farm complex in Japanese waters has reached financial close, as sector participants prepare for the country's first offshore wind auction.

In January, a Marubeni-led consortium closed a JPY100b (US$928m) financing to build a 55MW wind farm at Akita Port, and another 84MW project at Noshiro Port, off Akita Prefecture. The projects are expected to become operational in 2022.

This comes ahead of an auction for an anticipated several hundred megawatts of offshore capacity for the Choshi area, in northern Japan, expected in the second half of this year. Danish offshore wind giant Ørsted has formed a joint-venture with Tokyo Electric Power to bid in the auction.

Last July, Japan's Government identified four potential development sites, including two in Akita Prefecture, Choshi City in Chiba Prefecture, and Goto City in Nagasaki Prefecture. It expects surveys, environmental impact assessments and project design to take around five years, and construction approximately three years.

Onshore, growth in solar capacity is expected to slow, according to BMI Research, which notes the disappointing results of recent auctions, where allocated capacity has been much lower than the size of the auctions. Prices are high in international terms — the average accepted bid in the January auction was Y12,570/MWh (US$117/MWh) — and just 40MW was allocated out of a targeted 416MW. BMI Research expects year-on-year growth rates to fall from above 10% in 2019 to around 5% for the rest of the decade.

Japan has also disappointed environmentalists by declining to increase the 2030 emissions target it proposed ahead of the 2015 Paris Agreement. The UN is calling for countries to increase the ambition of their targets, to reflect the latest climate science and declining costs of low-carbon technologies — collectively, current Nationally Determined Contributions (NDCs) would result in more than 3°C of warming by the end of the century. In its submission, Japan is continuing to target a 26% reduction in greenhouse gas emissions by 2030 and a "decarbonized society" by 2050.

Ireland unveils new renewables support scheme

The Irish Government has announced details of the first round of auctions under its new Renewable Electricity Support Scheme. In mid-2020, it anticipates holding the first of a series of auctions designed to help Ireland reach its target of sourcing 70% of its electricity from renewables by 2030, up from 33% in 2018.

In the first auction, the Government anticipates entering into contracts-for-difference (CFD) for between 1,000GWh and 3,000GWh of power, to be delivered for a period of up to 15 years. While the auction will be technology neutral, it will include a solar category — of up to 10% of the overall auction — as well as a community-led category for up to 30GWh of power. The auction program is subject to state aid approval from the EU Competition Authority.

The original timetable required projects to be registered by 2 April, but that date was pushed back to 30 April on account of COVID-19.

Meanwhile, interest in offshore wind continues to grow strongly. In February, France's EDF announced it has acquired a 50% stake in a planned 2GW project on Codling Bank, from developer Hazel Shore. In the same month, Statkraft announced that it has applied for licenses to survey for a planned 530MW wind farm in the Irish Sea. It follows Statkraft's acquisition, in 2018, of developer Element Power, which had a 1.3GW pipeline of offshore Irish projects.

France awards 1.7GW of wind and solar in latest tender

The French Government has awarded contracts to 750MW of onshore wind projects and 650MW of ground-based solar in its latest tender round. It has also relaxed completion dates and pushed back the next round of tenders from July to November, in response to COVID-19.

The onshore wind tender was oversubscribed, with 750MW awarded to 25 projects at an average bid of €62.90/MWh (US$67.9/MWh). The low prices that were bid allowed for more than the allotted 650MW to be awarded.

However, the ground-mounted solar tender was undersubscribed at 650MW, falling short of the 850MW on offer. Here, bids averaged €62.11/MWh. An additional 312MW of solar capacity was awarded in specific tenders, including 94MW to compensate for the closure of France's oldest nuclear power plant.

France plans to tender 28GW of wind and solar projects over the next five years, comprising 10GW of ground-based solar, 4.5GW of rooftop solar, 9GW of onshore and almost 5GW of offshore wind. According to Platts, France currently has 17GW of onshore wind and 10GW of solar capacity installed.

Italy awards 500MW in renewables auction

Italy has awarded contracts of 500MW in renewable energy capacity in the first of a series of renewables auctions. Nineteen onshore wind projects won the majority of the capacity, at 495MW, with one 5MW solar plant also securing a 20-year CFD.

The auction — the first in a series of seven that Italy plans to hold in 2020 and 2021, for around 4.7GW of capacity — involved developers bidding for discounts to a reference price of €70/MWh (US$76/MWh). Successful bids ranged from €48.65/MWh to €66.5/MWh.

Successful bidders included EDP Renováveis, which won contracts for three wind plants with a combined capacity of 109MW. The lowest cost power is to be delivered by CEA's 84MW Ariano wind farm, which won a CFD struck 30% below the reference price.

The next round will also award 500MW of CFDs, while the following three rounds are expected to allocate 700MW of contracts each, and the final two 800MW of CFDs each.

Why investors are putting sustainability at the top of the agenda

Institutional investors are asking tough questions about corporate ESG performance and expect answers to be embedded in corporate strategy.

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When some of the world's largest shareholders start asking questions about environmental, social and governance (ESG) issues at the companies they own, corporate directors need to have the right answers. In the past 18 months, responsible investment has reached a tipping point, as concerns about sustainability challenges – especially climate change – have come front and center for many institutional investors.

Perhaps the most high-profile recent announcement came from BlackRock, the US$7tn asset manager, which announced in January that it is to accelerate the integration of sustainability into its business. In his annual letter to CEOs, its chairman and chief executive, Larry Fink, wrote that "climate change has become a defining factor in companies' long-term prospects … I believe we are on the edge of a fundamental reshaping of finance."

This is just the latest intervention from Fink, who has been one of the most high-profile voices from the investment world arguing for companies to embrace more responsible capitalism. In 2018, he said: "To prosper over time, every company must not only deliver financial performance, but also show how it makes a positive contribution to society."

This trend is visibly illustrated by the growth of the Principles for Responsible Investment (PRI), which brings together 2,300 institutional investors, managing more than US$80tn in assets – perhaps half of all professionally managed money globally. Its signatories pledge to integrate ESG factors into investment decision-making, because they believe such integration can reduce risk and increase returns, particularly over the longer term.

On the opportunity side of the ledger, "investors, consumers and technology are aligning" to accelerate the low-carbon transition, says Serge Colle, EY Global Energy Advisory Leader, creating the potential for outperformance by companies involved in the green economy.

On the risk side, "more and more investors are trying to move away from carbon-related investments," he says. The recent experience of the German utility sector illustrates why: the impact of the growth of renewables on the wholesale power market (in eroding price peaks that generators relied on for profitability) has led to more than €150bn in asset write-offs in the past six years.

> "
> Investors are looking for reassurance that companies understand the linkages between the non-financial performance of the business and the successful delivery of the business strategy.
>
> **Doug Johnston, Lead, Climate Change and Sustainability Services in the UK.**

"The fundamental ESG narrative is that climate change and other key ESG issues are now recognized as key determinants of future value creation," says Doug Johnston, who leads EY Climate Change and Sustainability Services in the UK. "Investors are looking for reassurance that companies understand the linkages between the non-financial performance of the business and the successful delivery of the business strategy."

Those linkages are likely to become even more important in the wake of the Covid-19 pandemic, Johnston believes. "Businesses will rethink how they build resilience to extreme threats – with an undoubted focus on preparedness for the worst effects of climate change, among other global issues," he says. "Increasingly, investors will want to understand the scenarios used to assess climate risk and the specific action taken to build resilience in business strategies."

How investors are thinking about ESG

Investors are adopting a range of strategies. Some exclude (or divest from) companies or industrial sectors they consider to be high risk, or that breach norms such as the UN Global Compact. Some tilt portfolios towards companies that score better on ESG metrics or invest in sustainability-themed portfolios, such as companies specializing in climate solutions or clean water. Some stress active ownership, engaging with company management to encourage them to improve ESG performance, while others are seeking "impact" investments that deliver social or environmental outcomes as well as – or in favor of – financial returns. Many use a combination of approaches.

Certainly, the messages from investors to companies are increasingly clear. For example, Climate Action 100+ – an alliance of investors who manage more than US$40t, coordinated by five global investor networks, including the Institutional Investors Group on Climate Change (IIGCC) – is asking for companies to curb emissions, enhance governance and improve climate-related disclosures. It is engaging with 100 "focus companies" in the MSCI ACWI global equity indexes with the highest direct and indirect emissions, and an additional 61 firms that present high levels of climate risk or opportunity.

"Climate change is one of the most significant long-term risks facing investors," says Stephanie Pfeifer, CEO of the IIGCC and a member of the global Climate Action 100+ steering committee. "We believe investors have a vital role to play in driving the low-carbon transition across the global economy. Investors can use collaborative engagement as a means of influencing positive change and protecting the long-term value of the assets they invest in on behalf of their beneficiaries."

Investor engagement has also resulted in a number of companies reviewing their lobbying practices on climate change, whether through their trade associations or their direct advocacy with policymakers, says Pfeifer.

Specifically, the Climate Action 100+ initiative aims to fundamentally change corporate behavior, and can point to commitments secured from some of the world's largest oil, gas and mining companies, which have agreed to enhance their climate change commitments in response to engagement campaigns by the initiative.

Allianz Global Investors is one of many investors calling on investee companies to disclose information about their approach to climate change using the framework proposed by the Task Force on Climate-related Financial Disclosures (TCFD). It says companies should report on their governance of climate risk, the metrics and targets they use, and how climate change is integrated into their strategies, among other things.

"Disclosure is often where companies fall down; they might be doing good things, but as an investor, if they're not reporting on it, it's hard to take a view," says Kimon Demetriades, an ESG analyst at the investment arm of the German financial services group. The TCFD provides a "great framework" that encourages companies to publish consistent, comparable information, he adds.

A changing paradigm for corporate ESG reporting

The approach taken by the TCFD is emblematic of a shift in how leading investors are thinking about ESG, argues Johnston at EY. Rather than using ESG data as a "risk lens", which paints an essentially backward-looking picture of performance against ESG key performance indicators (KPIs), investors are instead using it "as a lens to think about value creation … about how it enables an organization to deliver and sustain its business strategy and its value".

"What we're seeing is a shift from KPIs that talk about ESG performance – how well a company is doing in reducing its carbon footprint or at managing water scarcity, for example – to those KPIs that enable investors to understand how resilient a business is, or whether it is able to deliver its strategy," Johnston says.

This means that companies have to take a broader view of KPIs, and look to track and disclose those that link the ESG agenda to the financial performance of the business, he continues. For example, KPIs should aim to demonstrate the value at risk from disruptions to the business from extreme weather or disrupted supply chains or pandemics, and should attempt to quantify the likely changes in demand for products and services as we shift to a more resilient low-carbon economy.

"Organizations need to select these scenarios based on where the risks and issues are within their business," says Johnston.

This is a challenging process in two regards, says Johnston. First, companies are "universally" grappling with how to identify the most meaningful scenarios of how ESG issues are likely to shape corporate strategy. These scenarios need to capture future regulation and physical exposures from ESG risks, as well as changes to their markets.

Second, it can be challenging to translate non-financial indicators into financial metrics that companies can disclose. For example, a company may need to invest to reduce its carbon emissions to protect its operations against future carbon regulations. Alternatively, it could use that capital investment to improve the profitability of a product. "How do you compare those two capital investments?" Johnston asks. "There are ways to do so, but they require new approaches."

Climate change and the corporate response

While companies face an often-daunting range of ESG challenges, climate change is at the top of the agenda for many. Certainly, repeated surveys of signatories to the Principles for Responsible Investment have identified climate change as the No 1 ESG concern.

The Brunel Pension Partnership, a £30bn (US$37b) pool that manages the investments of 10 UK local authority pension funds, recently published a new climate change policy, which sets out its expectations for its investment managers and investee companies. It states that: "We want the companies and other entities in which we invest and contract with to support the transition to the low-carbon economy, and to ensure that they are resilient to the unavoidable impacts of climate change."

Brunel is a member of the Transition Pathway Initiative, a global effort by investors to assess how well companies are prepared for the transition to a low-carbon economy. "That provides companies with a very clear framework of what investors need," says Faith Ward, Brunel's Chief Responsible Investment Officer. It sets out expectations regarding disclosure, governance and target setting.

In big-picture terms, "we want to see there's an acknowledgement of business risk — and emission-reduction targets are a first step," she says. "Ultimately, we want to see that climate change is deeply embedded in business strategy … we want companies to show how long-term targets are integrated in the business, in capex plans, etc."

Exactly how companies seek to address climate risk in their strategies will depend on the sector or sectors in which they operate; the approach taken by an energy-intensive industry will differ from that taken by a fast-moving consumer goods company, notes Johnston.

For some, a focus on energy use and sourcing can deliver steep emission reductions, through investments in energy

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>
> **Faith Ward, Chief Responsible Investment Officer, Brunel Pension Partnership**

efficiency improvements and decisions to source power from renewable energy. Some companies will be looking to carbon capture and storage to eliminate emissions from industrial processes. There is considerable potential to decarbonize transport fleets by switching to electric vehicles or hydrogen fuels.

For other companies, the focus will be on working with their supply chains to encourage suppliers to reduce their carbon intensity. While other firms are exploring investing in nature-based solutions to offset the emissions that remain after all cost-effective mitigation investments have been made.

However, companies should also consider how the response to climate change will refigure their markets, says Johnston. He gives the example of oil and gas companies whose climate strategies involve, among other things, a pivot towards renewable energy. This will result in deep-pocketed industrial giants joining a market hitherto dominated by a large number of small participants. "It will drive change in terms of partnerships, transactions, and different sources of finance for R&D," he says.

How institutional investors are turning to renewables

Institutional investors around the world are increasing the volume of capital they are allocating to renewable energy infrastructure as a means to hedge their climate exposure, according to investment managers.

In a report published last year, institutional investors surveyed by Octopus Investments said they planned to increase significantly the allocations of capital they direct to renewable energy, from 4.4% to 7.4% — representing US$210b. Among these investors, which, collectively, manage US$6.8t, 58% gave investing in line with ESG factors as the motivation to increase their investments in renewables.

"There is a lot of pressure coming from underlying beneficiaries to divest from fossil fuels and to reallocate this capital somewhere useful, such as towards clean energy," says Henry Morgan, a sustainable investment associate at Foresight Group, a UK-based infrastructure and private equity investment manager. He also observes legal and regulatory pressure building on institutions to invest prudently, noting the growing risk attached to high-carbon investments.

"This pressure is continually increasing … and investors are beginning to understand the risk they face from stranded assets," Morgan adds.

> "There is a lot of pressure coming from underlying beneficiaries to divest from fossil fuels and to reallocate this capital somewhere useful, such as towards clean energy.
>
> **Henry Morgan, Sustainable Investment Associate, Foresight Group**

In addition, the stability of returns that can be generated by real assets such as renewable energy infrastructure is proving compelling, he says. "The investment case around infrastructure has become more and more attractive. It has caused large institutions to reassess their fundamental asset allocation and, within real assets, the fact that renewables are low carbon and offer contracted revenues has resulted in increased investment in the space."

Ward, at the Brunel Pension Partnership — which committed to make at least 35% of its £500mn of first-cycle infrastructure allocations to renewables — says there is a high level of interest in the asset class from the pool's member pension funds, which dictate Brunel's asset allocation. "It's about them looking to make a positive contribution to the energy transition in an economically sustainable way," she adds.

In addition to this "top down" demand from clients, however, investments in renewables and related infrastructure — such as energy efficiency investment, power networks and low-carbon transport — are attractive from a more fundamental point of view, says Ward. "We see these as very good investments … and there's been a strong robust pipeline of opportunities. It's been a win-win."

Why battery storage must be at the heart of the low-carbon transition

As electricity grids decarbonize, utilities and developers are ramping up investment in large-scale batteries for storage — but will capacity be there when it is needed?

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The growing reliance on energy sources such as wind and solar to decarbonize electricity grids brings with it a particular challenge: the need to match demand with intermittent supply.

Around the world, utilities, regulators and investors are pursuing an "all of the above" approach to building up the flexible capacity needed to meet demand: encouraging distributed solar and behind-the-meter batteries; looking to electric vehicle fleets as a source of flexible demand and supply; and encouraging investment in demand-side response technologies that can power down non-essential equipment at times of high system load or power up standby generation when grid prices peak.

A critical piece of the flexibility jigsaw, however, will be utility-scale storage. Energy storage at the multi-megawatt scale is needed to meet residual demand peaks, give incremental energy output, shift energy across time and locations, and provide real-time grid balancing.

"At the moment, electricity systems are reasonably well able to manage volatility in the energy market introduced by the current level of deployment of renewables," says Ben Warren, a partner at EY member firm in London. "As we move towards zero-carbon electricity systems, a cliff edge is approaching where we will need very large volumes of storage capacity to manage that intermittency.

"The challenge is that there are not sufficient economic signals today to incentivize investment in the volume of energy storage we will need in the future."

Uptake of the technology has been driven by dramatic cost reductions. Bloomberg New Energy Finance calculates that the cost of lithium-ion batteries fell by 85% between 2010 and 2018, and costs are expected to fall a further 50% by 2030. This will underpin growth in capacity from 9GW/17GWh in 2018 to 1,095GW/2,850GWh by 2040 — a 122-fold increase. This growth will require investment of US$662b.

In the near term, the COVID-19 pandemic and any subsequent recession will crimp that growth, according to research by Wood Mackenzie. It is now forecasting the installation of 12.6GWh of battery storage this year, down from a pre-COVID-19 forecast of 15.6GWh. This would still make 2020 a record year for energy storage growth, however, and the company still expects to see a 13-fold increase in capacity, to 230GWh by 2025.

While there are a number of long-standing storage technologies, such as pumped hydro, and some emerging technologies, such as compressed air or stacked concrete blocks, the majority of investment to date has been directed towards large-scale lithium-ion batteries, such as those found in electric vehicles, mobile phones and laptops.

But the successful development of the volume of utility-scale storage needed will be challenging, says Warren. It will require the right market conditions and, particularly, for the various functions that each individual battery can perform to be incentivized, valued and monetized properly, he adds.

The functions that battery storage perform fall under four main categories.

Batteries can offer **ancillary services**, such as regulating the frequency and voltage of power grids. These services used to be provided by thermal power plants and can't be supplied by renewable energy capacity. Providing these services can be lucrative; the UK's frequency-response market helped to incentivize the significant growth of batteries in 2018, when 460MW of battery storage was commissioned.

However, these markets tend to be shallow, notes Richard Braakenburg, Managing Director, Investments, at Switzerland-based investment manager SUSI Partners, which manages a €252mn energy-storage fund. "They can be quite quickly saturated and subject to price cannibalization", as was seen in Germany's frequency reserve market, the Pennsylvania-New Jersey-Maryland Regulation Market, and in the UK.

"The challenge is to build up a revenue model that provides for access to deeper and more liquid markets, and has some form of downside protection," Braakenburg says.

Some of that protection can be found by installing batteries alongside **renewable energy plants**, allowing the project to store generation when demand is low, and dispatch it at times of higher prices. Such hybrid projects can improve the economics of both the battery and the generating capacity.

"Combining renewables generation with energy storage means that each component balances out the weaknesses of the other," says Toddington Harper, CEO of Gridserve, a developer, builder, owner and operator of solar and battery hybrid systems.

Batteries can be also used in place of expensive **peaking plants**, providing short-run capacity at times of high demand. Last year, for example, utility Southern California Edison announced that it was to replace a 262MW gas peaker plant with a portfolio of 192MW of lithium-ion battery projects. They can also be used to defer or avoid expensive upgrades of transmission and distribution capacity, at locations where the grid is constrained.

Finally, batteries can provide **bulk energy services** — allowing traders to arbitrage between periods of high and low power prices, and, ultimately, managing the longer-term shifting of supply from renewables from periods of high supply and low demand to times when demand is high.

I'm not aware of any market that is sophisticated enough to incentivize properly, on an economic basis, the development of storage when and where it is needed.

In most advanced markets, batteries are being deployed that can deliver against one or more of these objectives.

In most markets, however, development is taking place on an ad hoc, opportunistic basis, says Warren, at EY. This makes it difficult for the owners of individual batteries to be compensated for all the services that each battery can deliver.

"I'm not aware of any market that is sophisticated enough to incentivize properly, on an economic basis, the development of storage when and where it is needed," he says "Regulatory regimes are not sophisticated and open enough to enable a battery owner to pull and push the levers of operating a battery in a way that enables them to fully optimize the value of their assets."

A starting point for regulators is to set out how much storage will be required in an energy market to create the necessary system stability, and by when. "That required deployment curve will be driven by factors including the retirement of thermal power generation and the penetration of new renewables," says Warren. Some US states have started on this process; seven US states have set out targets that add up to 7.6GW by 2030, according to the Energy Storage Association.

"The long-term market for batteries is something that investors are still trying to get their heads around," says Barney Wharton, Director of Future Energy Systems at trade association RenewableUK. "The challenge that developers face is that there is not sufficient clarity of revenues — while they see opportunities today, there is really no visibility of what the market will support beyond the next five years."

Regulators also have to be clear about which of the functions, above, specific battery-storage assets will be required to meet, adds EY member firm Partner, Warren.

"It's a bit like the smartphone," says Warren. "Manufacturers knew that people would pay to make calls on them, but they had no idea of the actual value they could generate once an entire ecosystem of apps and new business models had emerged."

The difficulty here is that, although there is a clear market price now for some of the services batteries can provide — such as grid balancing, fast frequency response and short-term capacity provision — other elements of their value are not evident, or at least not given an economic value.

To try to address some of this uncertainty, "governments should look to set up infrastructure storage programs on a public-private-partnership basis," Warren adds. Such partnerships would allow grid operators to use the infrastructure procured to meet their needs in future, "rather than asking developers to develop assets on spec".

Another element that would support battery rollout is "priced locational signals", says Mark Simon, CEO of Eelpower, a developer, owner and operator of battery storage systems. "We need two things from grid operators: to be told where the pressure points are, and to be appropriately incentivized to put batteries there." Such targeted charging can relieve pressure on electricity grids that, in the past, would have been alleviated by transmission operators putting in additional power lines "at enormous cost. Now, we can put in a battery that can balance that part of the grid second by second."

Others, however, argue that the best thing for the market would be for regulators to simply level the playing field and step away. "Constant change in the market is difficult," says Harper, at Gridserve, noting that, in the UK, the regulator Ofgem "constantly reviews and often implements new regulatory approaches, which means developers and investors are forced to constantly review, and sometimes reinvent, business models, and this often leads to delays in delivering projects".

Certainly, utilities and power traders are finding novel ways of generating value from batteries in existing markets. For example, utilities are turning to batteries to trade in very short-term balancing markets.

"The advantage we have now is that batteries are low cost and renewables are low cost," he continues. "If you combine the two, you should be able to outcompete more carbon-intense alternatives … We can get to net zero by 2050, provided we can keep delivering, and provided market distortions are removed."

"The 15-minute window before delivery is the area where batteries can arbitrage power prices, selling power at times of high pricing, but also getting paid to take power at times of high supply and negative pricing. That's where we're seeing the emergence of sophisticated, software-driven platforms that look to optimize battery assets," says Grant Brennan, Assistant Director, EY UK&I Corporate Finance.

This is where Braakenburg, at SUSI Partners, sees the opportunity for utility-scale batteries. Participating in very short-term merchant power markets gives batteries access to "gigawatt, as opposed to megawatt, hours of liquidity", with transparent pricing compared with the "black-box processes for determining capacity or frequency response market prices", long-term pricing history, and multiple offtakers, including utilities, power traders and, increasingly, oil and gas companies diversifying into power markets.

Simon, at Eelpower, sees portfolios of batteries being aggregated and operated to give grid-level balancing services. "There is a great opportunity for aggregators to bring together large platforms of batteries that they own, manage and optimize, lending those batteries into the marketplace to deliver the balancing services necessary," he says.

The risk here, however, is that the market does not build capacity at the rate needed to match longer-term need. "The problem with market forces [alone] driving the battery storage market, is that it's currently an inch at a time," says Brennan, at EY.

He adds that this is the dilemma faced by the growing number of established renewable energy investment funds that are eyeing investments in the market, partly as a hedge against the future cannibalization of power prices that might be caused by growing volumes of low-operating cost renewables coming to market: "However, the question is, when is that power-price inflexion point? When will the economics stack up enough for them to make the returns they will need to justify the investment?"

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> Every country is different regarding the battery business model. With solar, 90% of the things you learn in Germany, you can apply to the Netherlands. With batteries, it's more like 50%.
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> **Sebastian Gerhard, Director, Batteries, Vattenfall**

Regulatory tweaks could help spur faster growth, argues Sebastian Gerhard, Director, Batteries, at Sweden-based power and heat utility Vattenfall. One of the most significant would be to incentivize – or mandate – data centers to use batteries rather than diesel generating sets to provide back-up power. Doing so would reduce these data centers' annual carbon emissions by at least 50%, Gerhard says.

"The problem is that reliability is key for them; they are very used to using diesel gensets, and no-one wants to take the first step," Gerhard says. "But data centers are growing dramatically, with 20GW of new-build data centers in Europe over the next five years. You could easily require them to use batteries and reduce their carbon footprints."

Given that these data centers need back-up capacity at least equal to their total usage (some also factor in significant redundancy), this would create a substantial additional market for batteries.

International players such as Vattenfall face additional challenges in working with different regulatory regimes that share far fewer characteristics than other clean-energy schemes. "Every country is different regarding the battery business model," Gerhard says. "With solar, 90% of the things you learn in Germany, for example, you can apply to the Netherlands. With batteries, it's more like 50%."

He concedes that regulators, too, have to learn quickly. "Power-market regulators used to be able to take five to 10 years to make progress. With batteries, it needs to come much faster.

"Governments are getting quicker, and they are working more closely with industry – but, with batteries, we're still on the edge of innovation."

Why US renewables are looking beyond subsidies

COVID-19 is disrupting the sector, but declining costs, technological advances and financial innovation are set to propel its long-term growth.

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In January, the US Government's Energy Information Administration (EIA) was forecasting a record year for wind and solar in the US in 2020, with 18.5GW of wind and 13.5GW of utility-scale solar expected to begin commercial operations. COVID-19 will inevitably complicate or even delay some of these installations. However, the pandemic is likely to present a temporary – albeit significant – disruption to the trend of ever-growing penetration of renewable energy across US power markets, while the renewable energy ownership and investment landscape is set to be transformed.

Last year was the third-strongest for wind energy capacity additions in the US, at 9.1GW, according to the American Wind Energy Association (AWEA), bringing the total to 105.6GW. While the Solar Energy Industry Association (SEIA) recorded 13.3GW of solar entering operation, the second-highest total after 2016, bringing total solar capacity to 77.7GW. Together, the two sources accounted for two-thirds of new US power-generating capacity in 2019, according to the SEIA, with natural gas making up most of the remainder.

The forecast surge in 2020 installations, particularly wind, is largely a result of projects that began construction in 2016 and need to be operational by year end to qualify for the full Production Tax Credit (PTC) under safe harbor rules. This key federal tax incentive is worth around $24/MWh for 10 years.

For solar, the Investment Tax Credit (ITC) began tapering for projects starting construction as of this year. A similar surge in solar installations is likely to occur in 2023, the last year in which projects must be placed in service to claim its full value (worth 30% of the project's qualified costs) under similar safe harbor guidelines.

Near-term disruption, longer-term optimism

The shutdown of the economy in response to COVID-19 may not have a material impact on the long-term outlook for renewables in the US, but it is certainly causing disruption in the near term. In April, the EIA revised down its 2020 forecasts for wind and utility-scale solar capacity additions, by 5% and 10% respectively.

As noted above, many wind projects are operating to tight timetables to qualify for the PTC. Difficulties caused by the pandemic, such as sourcing or moving equipment through battered supply chains and crew working issues, could hold up projects, potentially affecting their ability to qualify for PTC or ITC credits. The risks presented by a delayed installation, which puts a project outside of these safe harbor rules, are driving the sector to seek guidance from the Government on whether COVID-related delays could be an exception to the rule.

Looking ahead, some in the industry are concerned that an economic downturn triggered by the pandemic will reduce the appetite of tax equity investors for tax credits. These buyers – typically investment banks – are likely to have lower tax receipts in the near term against which to offset these credits. However, signals so far from investors are that they will remain in the market.

While the COVID-19 pandemic presents near-term headwinds to renewables, the longer-term prognosis remains favorable. One powerful driver for the sector is the clean or renewable energy targets set by a growing number of states.

Thirteen states, including California, New York and New Jersey, have set 100% goals or mandates, typically to be reached between 2040 and 2050. In addition, the improved performance and falling costs of renewables, allied with growing sustainability concerns among ratepayers and corporate buyers, have encouraged utilities to favor renewables for new capacity.

Here, persistent low natural gas prices resulting from any economic slowdown have the potential to change some utilities' investment decisions in favor of natural gas generation over renewables, although the likely extent is currently unclear. The EIA is continuing to forecast that renewables will grow to 38% of power supply by 2050, from 19% today, with natural gas declining slightly – to 36% from 37% at present – and coal losing out, dropping from 24% to 13%.

Broader market realignment

A longer-term transformation is also taking place, with regulated utilities set to increase their ownership of renewables and showing a reduced appetite for signing power purchase agreements (PPAs) with independent power producers (IPPs).

Historically, many utilities have relied on IPPs as their primary source of renewable energy, entering into long-term PPAs to meet state mandates and customer demand for clean power. As these mandates and demands continue to grow, utilities are rethinking those relationships.

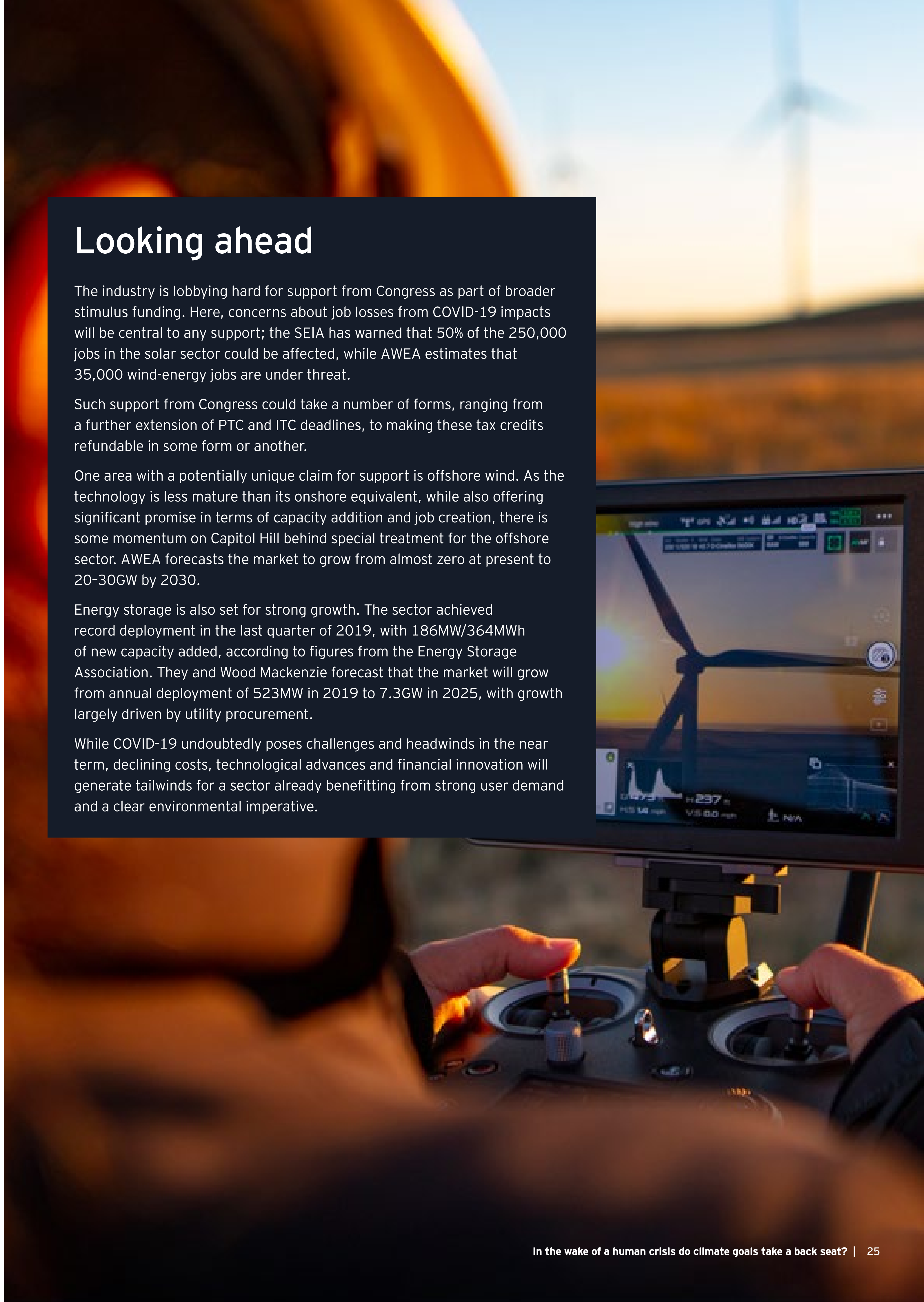
A critical enabler of the IPP renewable model has been the inability of utilities to take advantage of renewable energy tax credits in the same way as IPPs. Put simply, because of tax normalization rules and traditional utility ratemaking, utilities are required to spread the benefits of the credits across the entire useful life of the project. While IPPs can realize their benefits upfront, often through the use of tax equity partnerships. This has made renewable power from IPPs cheaper than if the utilities owned the assets themselves.

This is likely to change the US renewable landscape again, by enabling more utilities to develop renewables projects on their own balance sheets. IPPs will probably evolve as well, pursuing develop, build and operate models on behalf of utility clients — in which case, they would no longer own the renewable assets.

However, utilities are exploring how they might access the same tax equity markets that IPPs use — and, so far, seem to be making progress on addressing the critical issues. While complexities exist, and each utility is in a different position, there appears to be a clear opportunity to close the renewable energy price gap with IPPs.

While utilities may encroach on the existing IPP business model, however, they face their own mounting pressures as well. One to watch is from Community Choice Aggregation (CCA) programs. These allow municipalities to procure power on behalf of their residents and businesses, and for their own needs, from alternative energy suppliers.

These CCAs — which typically involve municipalities tapping power from renewable sources (often provided by IPPs) — are permitted in California, Illinois, Ohio, Massachusetts, New Jersey, New York and Rhode Island. In California, roughly 15% of the state's load has moved from incumbent utilities to CCAs. The growth and increasing cost-competitiveness of energy storage is likely to accelerate this trend.



Looking ahead

The industry is lobbying hard for support from Congress as part of broader stimulus funding. Here, concerns about job losses from COVID-19 impacts will be central to any support; the SEIA has warned that 50% of the 250,000 jobs in the solar sector could be affected, while AWEA estimates that 35,000 wind-energy jobs are under threat.

Such support from Congress could take a number of forms, ranging from a further extension of PTC and ITC deadlines, to making these tax credits refundable in some form or another.

One area with a potentially unique claim for support is offshore wind. As the technology is less mature than its onshore equivalent, while also offering significant promise in terms of capacity addition and job creation, there is some momentum on Capitol Hill behind special treatment for the offshore sector. AWEA forecasts the market to grow from almost zero at present to 20–30GW by 2030.

Energy storage is also set for strong growth. The sector achieved record deployment in the last quarter of 2019, with 186MW/364MWh of new capacity added, according to figures from the Energy Storage Association. They and Wood Mackenzie forecast that the market will grow from annual deployment of 523MW in 2019 to 7.3GW in 2025, with growth largely driven by utility procurement.

While COVID-19 undoubtedly poses challenges and headwinds in the near term, declining costs, technological advances and financial innovation will generate tailwinds for a sector already benefitting from strong user demand and a clear environmental imperative.

How Spanish renewables are set to weather short-term storms

Investors remain positive about the country's prospects, as the new coalition Government outlines ambitious targets for increasing wind and solar.

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Spain's renewable energy industry entered 2020 with an optimistic outlook, buoyed by aggressive targets introduced by the country's new coalition Government and the anticipation of strong growth in unsubsidized merchant generation. While the COVID-19 pandemic has complicated the near-term picture, prospects for the sector look good in the medium term.

Climate and energy policy is a high priority for the coalition Government, which was formed after the latest round of inconclusive elections in November and is led by Socialist Party Prime Minister Pedro Sánchez. In April, it submitted to the European Commission its national energy and climate plan, which sets a target of a 23% cut in emissions by 2030, compared with 1990 levels.

The plan anticipates an increase in wind power from 28GW in 2020, to 40GW by 2025, and 50GW by 2030. It is targeting growth in solar photovoltaics (PV), from 8.4GW at the start of this year, to 22GW by 2025 and 39GW in 2030.

These plans are seen by market participants as aggressive, but achievable — and a long way from the start-stop history of renewables in Spain, which resulted in generous feed-in tariffs being cut retrospectively, raising the ire of investors and developers.

This follows strong growth in both wind and solar last year. In wind, 2.3GW of new capacity came online, bringing the total to 25GW, according to transmission system operator Red Eléctrica de España (REE). In solar, Spain became Europe's top market again for capacity additions for the first time since 2008, says SolarPower Europe. Figures from REE show the country adding 4.2GW of solar PV. That growth continues: in April, Iberdrola's 500MW Núñez de Balboa solar farm in southwest Spain — Europe's largest solar PV plant — began supplying power.

While the Government had planned auctions for the end of March, these have been delayed because of COVID-19. However, a large proportion of the growth in renewable energy is expected to be delivered by merchant plants, given the increasing cost-competitiveness of wind and solar technologies.

COVID-19 impacts

Spain has been hit hard by COVID-19. As is the case elsewhere, pressure on international supply chains and difficulties moving key staff around will delay construction on some projects. However, the Government gave exemptions to developers to continue working on some renewables projects during the shutdown, and manufacturers with Spanish operations — such as Vestas, Siemens Gamesa and LM Wind Power — resumed production after a two-week halt.

Of bigger concern to developers, particularly of merchant projects, is the impact of the economic lockdown and any subsequent downturn on power prices. Wholesale power prices in Spain's pool were down 63% year on year in early April. However, futures prices are recovering, signaling that the market sees the impact as short term.

Meanwhile, flagship Spanish energy companies have signaled their determination to continue investing in renewables. Iberdrola, for example, unveiled a "global action plan" in response to COVID-19, including a commitment to accelerate its €10bn investment plan. Endesa is also continuing with its planned increases in renewables capacity.

Low power prices do, however, make it challenging to sell corporate power purchase agreements (PPAs) to local buyers. Most domestic buyers are driven by near-term cost, rather than sustainability considerations or the advantages of using PPAs to lock in long-term power prices — current low pool prices provide an attractive opportunity to do so.

At the present time, many PPAs are sold to corporate buyers outside of Spain. For example, Amazon has entered into PPAs with two Spanish projects, the latest being a 50MW solar farm in Aragón. In December, energy trader Statkraft entered into a 10-year PPA with five solar projects, totaling 252MW, while Heineken has struck a deal with Iberdrola to support a new 50MW solar plant in Andévalo, and AB InBev has signed a 10-year virtual PPA for 130MW of solar power to cover its pan-European operations.

In a move that would promote domestic demand, the Government is considering requiring local energy-intensive companies to source 10% of their power through PPAs. The proposed regulation would also allow corporates to meet this target by purchasing guarantees of origin (GO) certificates, but such a strategy would expose them to the risk of a supply squeeze in that market.

Outlook

Short-term disruptions from COVID-19 notwithstanding, most investors remain positive on Spain. The country benefits from good renewable energy sources; the direction of travel is clear, in policy terms; and the lack of subsidies now needed by the clean-energy sector makes pro-renewables policies less costly and less exposed to regulatory risk than in the past.

How the power market model for Great Britain creates cause for optimism

The EY GB power market model forecasts increased power prices to 2050 thanks to market dynamics, technology development and government policy.

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The COVID-19 pandemic has thrown energy markets around the world, including those for electricity, into turmoil. Despite the current shock, however, a new proprietary model of the GB power market suggests that a combination of technology evolution, changing patterns of supply and demand and, crucially, policy decisions could help to support and gradually increase wholesale power prices over the next three decades.

The EY GB power market model forecasts that the combination will deliver a power price increase from between around £40/MWh and £55/MWh by 2025 to between around £35/MWh and £70/MWh by 2050, in real 2020 terms. This price should support the UK's decarbonization, while incentivizing and compensating sufficient low-carbon generation, and, at the same time, provide a clear incentive for corporate energy buyers to lock in forward power prices through PPAs.

Forecasting is a challenging, but vital, task

The effects of the pandemic on supply and demand will be temporary; developers of long-lived infrastructure — such as renewable energy generation — or corporates entering into multi-year power purchase agreements (PPAs) need to take the long view on power prices.

Long-term forecasting of power markets is challenging. It requires modeling of complex market dynamics on an hourly basis over a long horizon. It is particularly challenging in the context of the energy sector undergoing an unprecedented transition, impacted by continuous policy intervention, in the midst of a very uncertain global macroeconomic outlook.

However, it is also vital. Power price forecasts can dictate whether a developer goes ahead with an investment in a wind farm or solar park, or whether a corporate energy manager locks in the cost of buying power or takes a bet on a volatile wholesale market.

These decisions are particularly difficult in an era when some analysts believe the rapid increase in renewable energy capacity will push down wholesale power prices through a process known as "cannibalization." This is where supply from power sources with an extremely low marginal cost of operation — such as wind turbines or solar panels — swamps demand for power, periodically pushing prices to zero or, in some cases, into negative territory.

As we note above , however, markets for power are some of the most regulated in the world. Policy decisions and changing policy priorities can have profound impacts on the price of electricity paid by consumers.

EY teams have developed a new model

Over the past six months, EY teams have developed a new, proprietary power market model for Great Britain (covering the wholesale power market for England, Scotland and Wales), while another model is in development for Ireland. It draws on factors including:

- Macroeconomic drivers, such as oil, gas and coal prices, and GDP growth
- Emissions, carbon prices and net-zero targets
- Demand forecasts, including the growth of electric vehicles (EVs) and behind-the-meter generation, energy efficiency improvements and the electrification of heating
- Commercial drivers, such as technology costs
- Dispatch decisions, including load factors and dispatch optimization
- Changes to the energy mix from plant retirements and new capacity
- Assessments of policy changes

The model then applies linear optimization techniques to forecast dispatch decisions and market prices over the short and long term. It assesses several scenarios, incorporating different assumptions around commodity prices, decarbonization trajectories and the regulatory framework, to generate central, low and high views of market power prices.

The starting point for any model of contemporary power markets is that the process of price forecasting is different, and more complex, than in the past. Before, power prices were mainly a function of commodity prices – especially energy commodities such as coal and natural gas – and economic growth. Now, pricing models need to also account for technological innovation, policy change, the responsiveness of consumers to price signals, and the role of power generation in decarbonizing the rest of the economy.

The model includes some reasonable assumptions

While much is uncertain, there are some clear signposts created by policymakers – such as the UK's 2050 net-zero target. Some assumptions can therefore be made with reasonable confidence, such as continued renewable technological innovation and a growing demand for power as the heat and transport sectors are decarbonized.

For example, we assume that power demand will grow by around 70% over the next 30 years, driven primarily by EV penetration and the decarbonization of residential heat. In response – and given the intermittent nature of wind and solar – we expect installed capacity to almost double by the same date.

It would be reasonable to assume that such growth in capacity would severely depress average wholesale power prices, and lead to significant periods when prices were at or near zero. However, because such a scenario would deter investment in needed capacity, we expect government and regulators to step in to support the energy transition.

The state has the means and incentive to address distortions

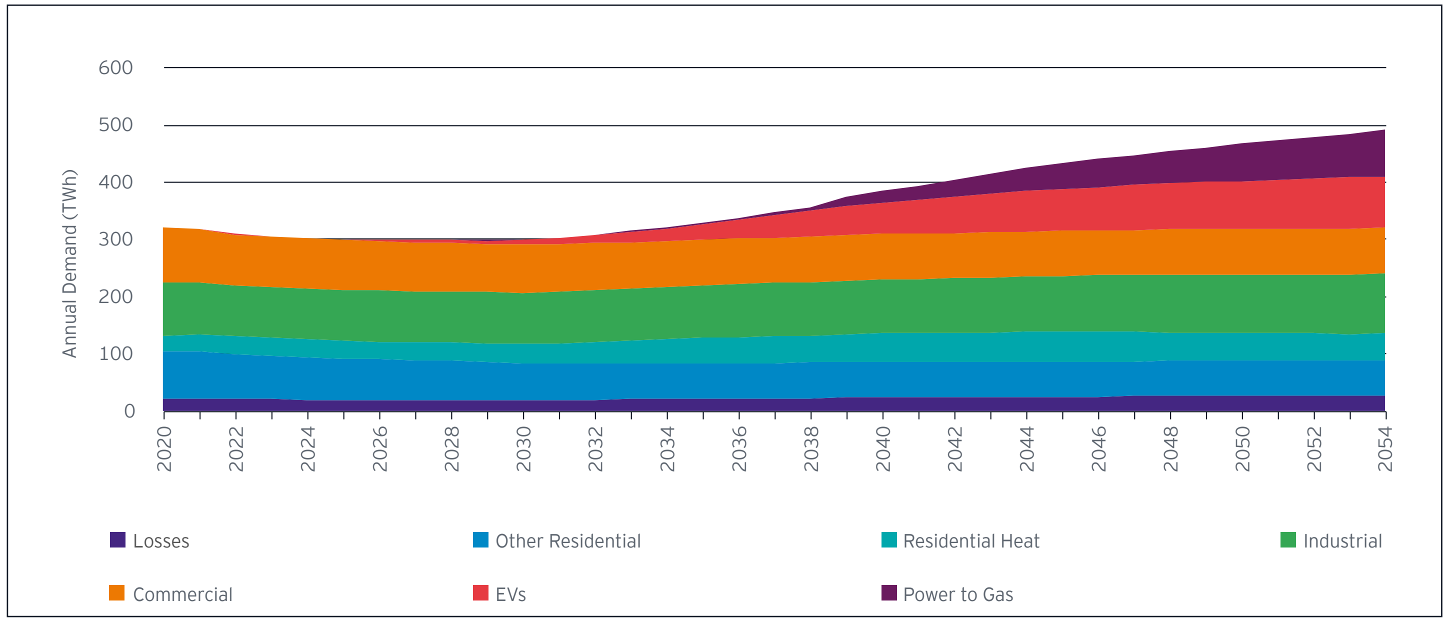
Negative power prices are a market distortion and, typically, the unintended consequences of government policy. Government has the tools at its disposal to address these distortions, as well as the incentive to do so when they threaten other government priorities such as addressing climate change.

For example, support to low-carbon generators – through the contracts-for-difference program or an equivalent mechanism – could be amended in future to pay out only at times of positive prices. Or to pay on the basis of whether plants were available to run, rather than whether they actually dispatched.

The potential for low or negative prices in some periods of the year could also stimulate a growth in "responsive demand" – such as from power-to-gas (producing hydrogen through electrolysis), battery storage, smart charging of EVs, industrial and commercial demand-side response and increased use of smart tariffs. This can help stabilize prices and shift demand from periods of high power prices to times when prices are low. Here, we expect technological development to be complemented by supportive policy to grow markets, such as through investment in EV charging infrastructure or a network for transporting hydrogen.

The deployment of carbon capture and storage (CCS), assisted by government, could also constitute a low-carbon source of power that helps stabilize power price as it seeks to recover its fuel costs when generating. The UK Government's 2020 budget included an £800mn CCS infrastructure fund. This, combined with increasing opportunities for re-use of UK carbon storage infrastructure and depleted aquifers, plus a rising carbon price, could help boost investment in CCS technology in future.

EY projection of annual GB power demand to 2050



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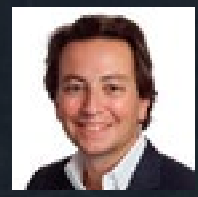

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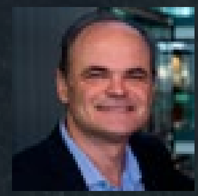

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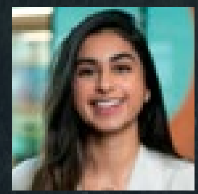

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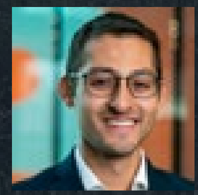

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