October 2021 | 58th edition

Renewable Energy Country Attractiveness Index

RECAI

Can we avoid gridlock on the road to carbon neutrality?

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Contents

Introduction

The low-carbon transition is coming thick and fast. Renewable energy is thriving as market conditions, policy decisions, investment and technology improvements push clean energy to new heights.

Amid the COVID-19 pandemic and recession, investment in **renewable energy capacity** still grew by 2% to US$303.5b last year, while renewable capacity installs surged 45% compared with 2019, to 265GW, signaling the fastest growth rate since 1999. The prospects look even rosier this year, with the International Energy Agency projecting **renewable electricity generation** to expand by more than 8% to reach 8,300TWh, which would be the fastest year-on-year growth since the 1970s.

We are also approaching what could be a watershed moment in combatting the climate crisis. The 2021 United Nations Climate Change Conference of the Parties (COP26) is to be held in the UK in November and, in RECAI 57, we discussed the **key requirements needed at COP26** if the Paris Agreement goals are to be realized. The urgency for climate action was highlighted by the Intergovernmental Panel on Climate Change's recent report warning that global warming could reach 1.5°C by as early as 2030 if it continues to increase at the current rate. But momentum has been building in the run-up to the conference and, in April, a pledge by China and the US to **commit to working together** and with other nations to tackle climate change has sparked optimism for a breakthrough on climate policy.

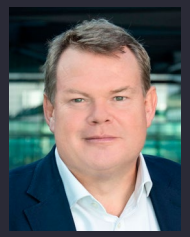
With growing investment and policy support for renewables, the conditions appear ripe for renewable energy to continue growing at high speed. However, the sector must be careful to navigate around bottlenecks that could threaten the continuing rapid growth.

Integrating increasing volumes of variable resources will put grid infrastructure under significant strain. To meet sustainability goals, a **50% increase in grid spending** could be needed over the next decade as markets adapt for a net-zero future. In this edition of RECAI, we examine how the sector could overcome a major obstacle by upgrading and expanding transmission infrastructure.

RECAI 58 also shines a spotlight on how markets in Eastern Europe are beginning to shift into high gear in their drive to net zero. Compared with Western European economies, Eastern Europe is trailing in its development of green energy infrastructure: only Poland and Hungary are among the RECAI top 40. Each nation is navigating its own economic, social and political hurdles to ensure the EU deadline of carbon neutrality by 2050 is achieved, but funding – through instruments such as the **Just Transition Fund** – is being allocated to catalyze the shift to a net-zero future and the realization of the **European Green Deal**.

New to this edition of RECAI is the Power Purchase Agreement (PPA) Index, which puts nations' corporate PPA markets and growth potential under the microscope. An extension of the established RECAI model, the PPA Index offers a new ranking focused on corporate PPAs, as opposed to the entire renewable energy industry.

With COP26 approaching, we are at a critical juncture for the energy transition. Read on to discover how the low-carbon transformation can be accelerated, as we outline some of the key developments in renewable energy from around the globe.



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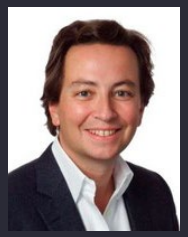

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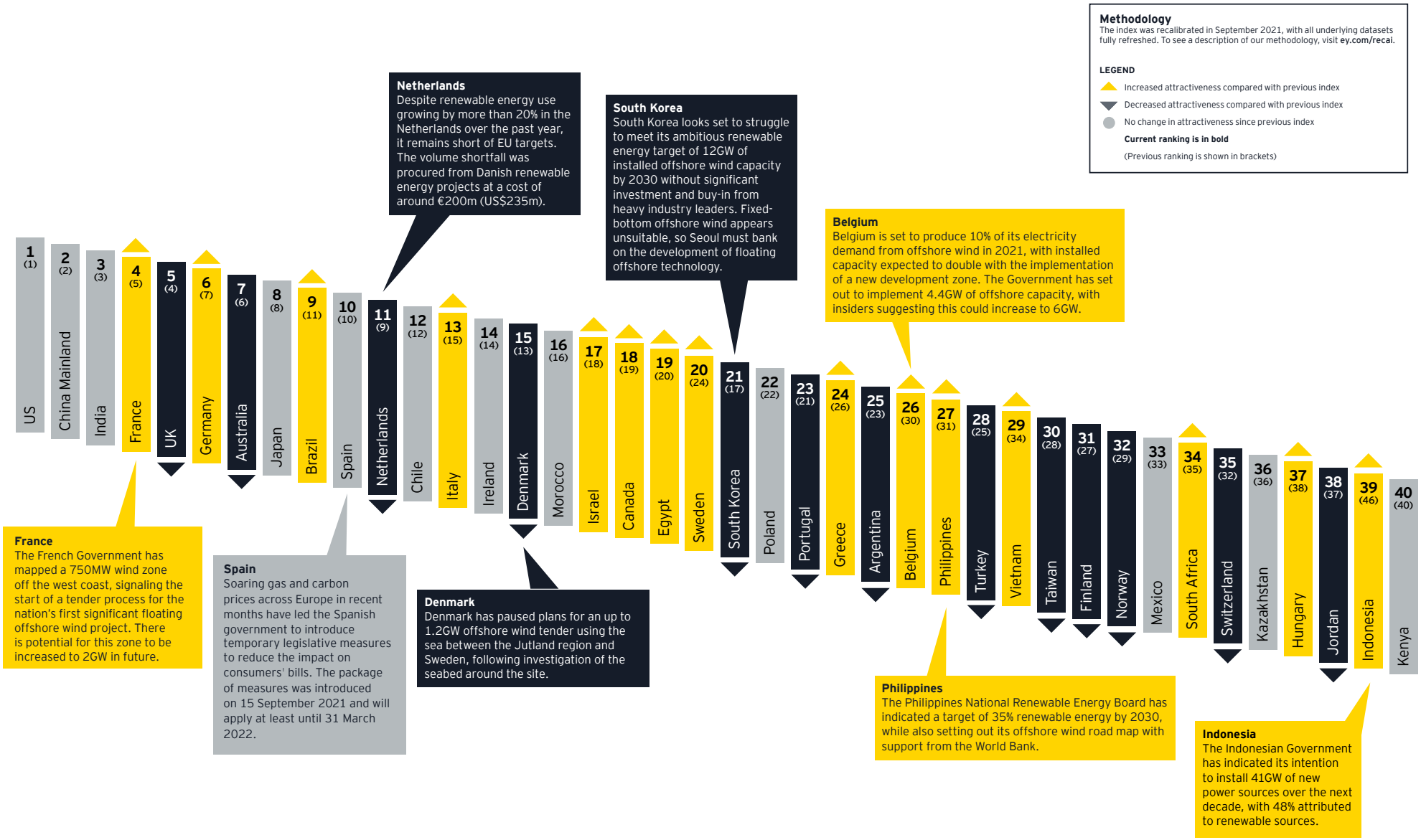
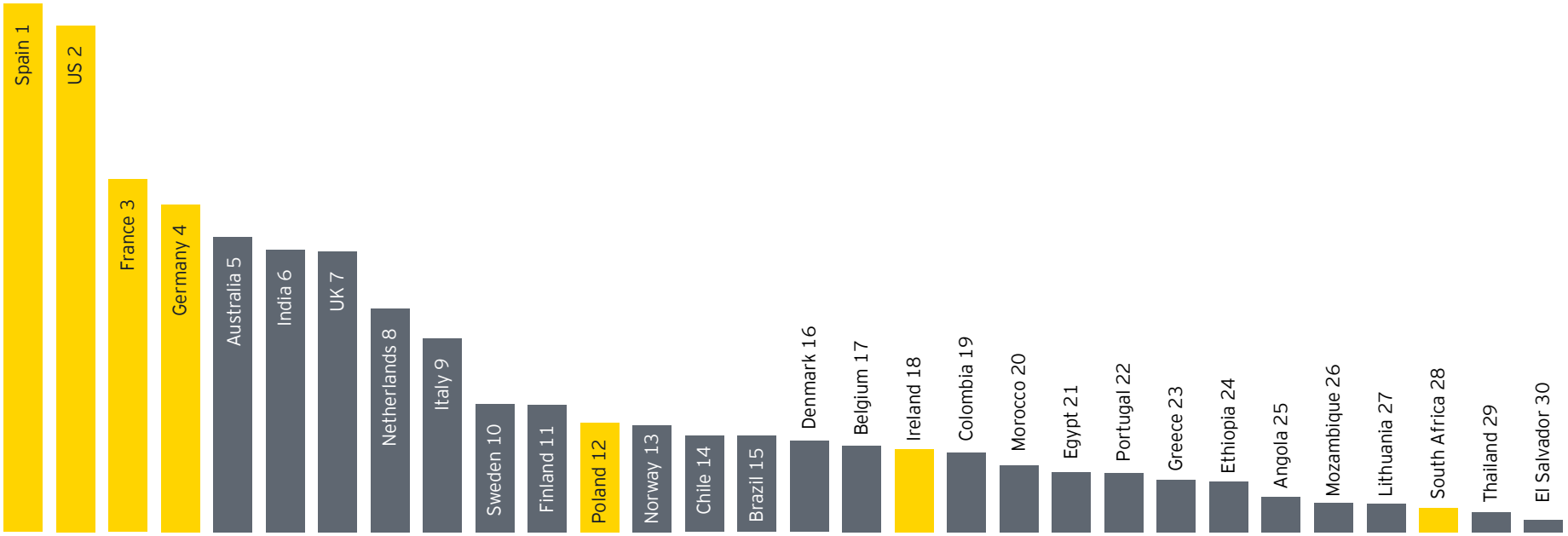
RECAI – Renewable Energy Country Attractiveness Index



RECAI – Corporate PPA Index



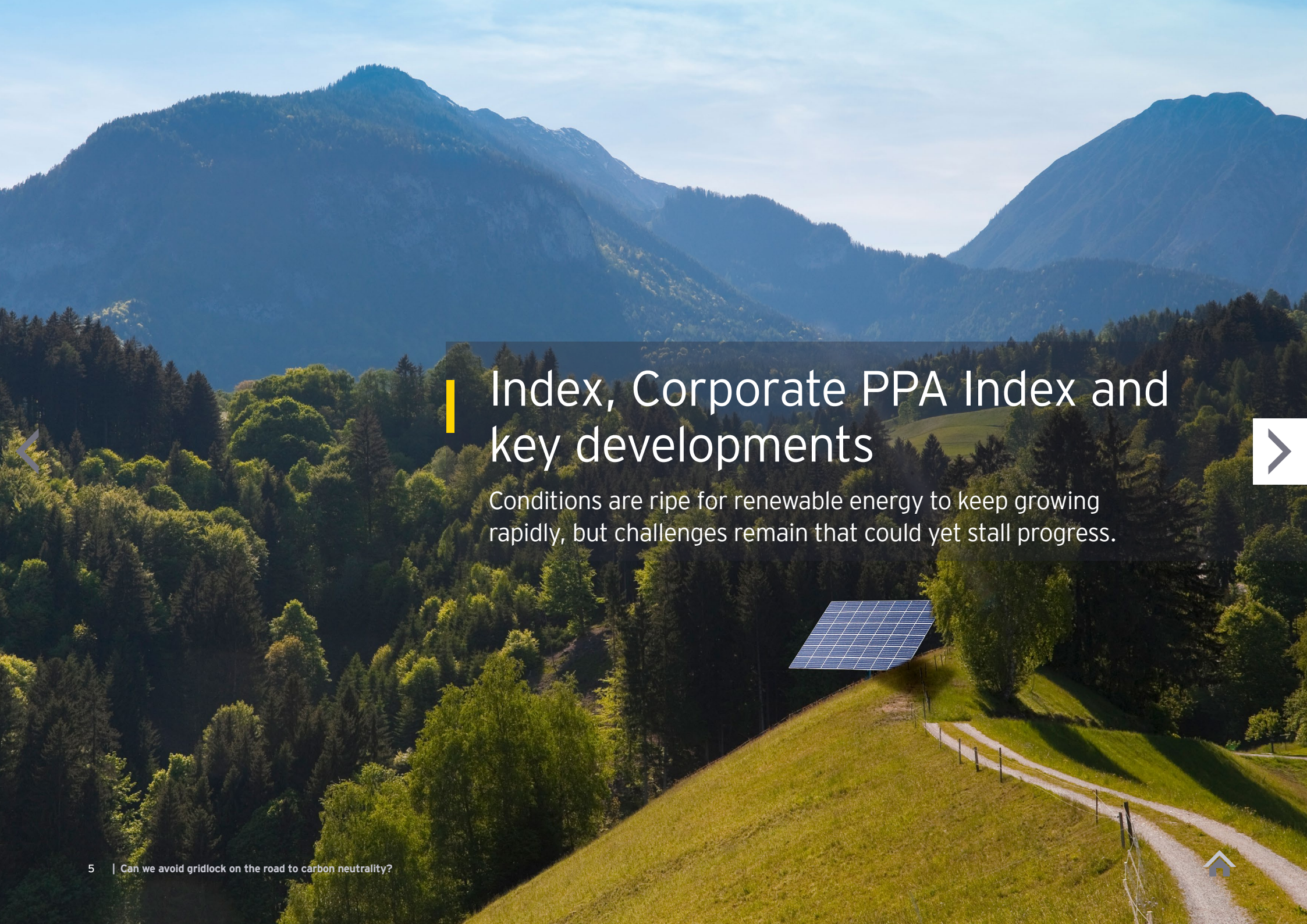
Spain and the US – jostling for top rank. The US started the PPA race several years earlier and was still the largest market in 2020, but with signs of growth slowing a little. Meanwhile Spain is currently booming and – as long as regulatory uncertainties remain in check for new-build projects – is expected to be the hottest market for growth as pan-European Virtual PPAs often site there.

France and Germany – slower starters in the corporate PPA market, primarily due to competition from the continuing government auctions at subsidized levels with the relatively low wholesale market prices. However, the PPA Index predicts that these two markets will grow significantly within the next five years as local corporates strive for renewable targets.

Poland – although only mid-table at the moment, our view is that Poland will climb rapidly in future indexes. As the largest renewables market in Eastern Europe and also one of the most expensive and "carbon-dirtiest" grids, many corporates are targeting Poland for PPAs. Regulatory hurdles have slowed growth in the past, but we are seeing these now being overcome.

Ireland – corporate PPAs are relatively new to the Irish market, with only a handful to date. But large multinational companies are now starting to do deals here too, helped by the delayed Renewable Electricity Support Scheme (RESS) auction process and relatively high wholesale prices – allowing PPAs to compete. Also, the Irish Government has set a 15% goal of renewable electricity to be sourced through corporate PPAs by 2030.

South Africa – near the bottom of the table, but as the country transitions from a coal-heavy grid to renewables, South Africa could become a new corporate PPA hot spot. However, currently most attention by large companies is on energy security, looking at on-site or adjacent installations to save on high grid-wheeling costs, limiting appetite for off-site PPAs.



Index, Corporate PPA Index and key developments

Conditions are ripe for renewable energy to keep growing rapidly, but challenges remain that could yet stall progress.

New EY analysis reveals top 30 PPA markets

As environmental, social and governance (ESG) has soared to the top of the agenda for companies and investors, corporate PPAs are emerging as a key driver of clean energy growth – last year, a record 23.7GW of renewable energy was purchased via corporate PPAs. This is due to their ability to show an organization's green credentials while providing developers with a secure revenue stream to repay the debt of financing a new project. EY's new PPA Index – published for the first time in this edition of RECAI – uses key parameters from four pillars to analyze and rank the growth potential of a nation's corporate PPA market.

The Netherlands: tech clusters help green hydrogen drive

The Netherlands has been touted as a market leader for green hydrogen production by Fitch Solutions, drawing praise for its advanced regulatory, policy and strategy support. With nearly 300 hydrogen tech firms already operating in the country, and clusters in the ports of Amsterdam and Rotterdam, the nation is a step ahead of many of its European neighbors in this nascent industry.

Headlining developments is NortH2, a 10GW offshore wind-to-hydrogen project in the North Sea being developed by a consortium of Equinor, Dutch gas grid operator Gasunie, RWE and Shell. The project, which will be one of the world's biggest renewable hydrogen projects, is currently in the study phase.

In September2021, news also broke of a new hydrogen production facility at the Port of Rotterdam that will see Uniper develop a 100MW electrolyzer plant at its Maasvlakte location. An investment decision will be made in 2022, and the facility could potentially be scaled up to a 500MW unit.

The Port of Rotterdam is also expected to boast a 200MW green hydrogen plant that is being developed as a joint venture between Gasunie and Shell. Scheduled to go into operation by 2023, the facility will produce about 50,000kg–60,000kg of hydrogen per day. Additionally, the H2-Fifty project by BP and Nouryon at the same location will see the construction of a 250MW electrolyzer facility that is expected to become operational in 2025. The Netherlands has also set ambitious offshore wind targets of 11.5GW by 2030 and 38GW by 2040. The first project to be added to the 2030 development pipeline is expected to be a 2GW area north of the existing 4GW IJmuiden Ver Wind Farm Zone, which will bring power ashore at Rotterdam.

The UK: largest round of CfDs in bid to boost renewables capacity

The UK has announced £265m (US$366m) for its biggest ever round of the contracts for difference (CfD) scheme, as it seeks to reach record extra renewable energy capacity. The scheme has been instrumental in driving investment in green energy, incentivizing investment by providing protection from volatile energy prices for developers of projects with high upfront costs.

Offshore wind will be the biggest beneficiary, with £200m (US$276m) allocated to support projects. Emerging renewable technologies will be given £55m (US$76m), of which £24m (US$33m) will be ring-fenced for floating offshore wind projects. An additional £10m will be available for established technologies, including onshore wind, solar and hydropower.

As many as eight million homes could be powered by the addition of an estimated 7GW of offshore wind capacity resulting from the funding, while the Government hopes to add up to 5GW of capacity for onshore wind and solar. This comes after a hugely successful fourth leasing round in the recent Scottish offshore wind auction that

drew 74 bids for the rights to secure seabed leases across 15 areas. The bidders will begin receiving initial offers to progress with their applications in January 2022.

In August, the UK launched its hydrogen strategy, which will also use a CfD mechanism. The strategy will adopt a twin-track approach to support both zero-carbon green hydrogen and low-carbon blue hydrogen. The UK is seeking to build 5GW of hydrogen capacity by 2030, to be used in industry, transport and heating. Consultation is also under way for the design of the £240m (US$332m) Net Zero Hydrogen Fund, which will support the commercial deployment of new low-carbon hydrogen production plants.

The US: solar installation to overtake wind in 2022

Large-scale solar installation will exceed wind power installation in the US for the first time in 2022, predicts the Energy Information Administration (EIA). With government support diminishing for onshore wind power, utility solar capacity installation is expected to dwarf wind with 16GW vs. 6GW. In 2021, the EIA expects new wind installation to narrowly edge solar by 18GW to 16GW. With solar installation accelerating, the US passed 100GW of total installed capacity in the first quarter of this year.

Utility-scale renewables are expected to increase their share of the electricity mix this year to a record 21%, with further growth to 23% projected in 2022, boosted by the country's infrastructure bill allocating US$73bn for clean energy. Meanwhile, because of project delays caused by the COVID-19 pandemic, the Internal Revenue Service will allow wind and solar companies one to two years longer to finish construction of existing projects and to qualify for federal tax credits on projects where construction started between 2016 and 2020.

As part of the path to net zero, US$52.5m of support for 31 next-generation clean hydrogen R&D projects has been announced under the Energy Earthshots scheme. The projects have been selected for their potential to bridge technical gaps in production, storage, distribution and utilization, and the technologies range from electrolysis innovation and new fuel cell designs to domestic supply systems.

Indonesia: renewables ambition increased as energy demand soars

Indonesia is aiming to increase the proportion of renewable energy in its power mix to at least 48% by 2030 – a rise in ambition from its previous target of 30% by 2028. The announcement symbolizes a significant U-turn, as investment in fossil fuels was three times more than renewable energy from 2016 to 2019.

Energy demand is soaring in Indonesia and is expected to increase five-fold to 1,800TWh by 2060, by which time the nation intends to be carbon neutral.

Over the next 10 years, however, Indonesia – a major producer and exporter of thermal coal – will continue to prioritize fossil fuel power plants over renewable energy plants at a rate of 52% to 48%, as it plans to add power plants with a total capacity of up to 41GW.

In an effort to achieve the 48% renewables target by 2030, Indonesia plans to convert diesel power plants into renewables plants, with older facilities gradually retired. Problems around regulatory and contractual considerations could be encountered, however, given that many of the power plants have been developed under an independent power producer model.

Greece: licensing regime reforms spark record auction

Greece's latest **renewable energy tender** in May resulted in 350MW of contracts being awarded to solar photovoltaic projects up to 20MW, with an average tariff of €37.6/MWh (US$44.5/MWh).

Tariffs ranged from €32.97/MWh (US$38.99/MWh) to €51.2/MWh (US$60.55/MWh), with domestic firm Egnatia Group's bid for a 19.3MW solar farm marking a new record low for the Greek market. In total, the company was awarded 130MW, while EcoSolar won 90MW. Wind power projects failed to win any capacity.

The successful tender had 126 projects, totaling close to 1.1GW, competing against each other. The stiff competition for contracts was a welcome sight after previous tenders were undersubscribed.

Under the previous regime, Greece's Regulatory Authority for Energy (RAE) was required to process all projects' generation licenses, resulting in a **backlog of applications that surpassed 6GW**. This led to only a few projects acquiring a generation license, causing tenders to be undersubscribed and failing to reach the full amount of power capacity allocated. Last year's reform of Greece's licensing regime to an expedited digitized process was the key driver in improving the market outlook.

Amid a boom in production license requests following the simplification of the system in September 2019, Greece has passed legislation requiring developers to submit a bond alongside permit applications. All new bids, as well as those filed in the past 18 months, must include letters of guarantee of €35,000 (US$41,000) per MW.

Since the licensing restructuring, the RAE has received applications of more than 85GW, increasing Greece's in-planning renewables pipeline to more than 100GW. A significant portion of the applications are believed to be speculative moves by inexperienced developers.

The 100GW+ in the permitting system far exceeds the 19GW of renewable energy the nation needs to meet its 2030 target of at least 61% renewable energy in the electricity mix.

Spain: plans could secure lead role in floating offshore wind

Spain has announced plans to develop up to 3GW of floating offshore wind by 2030, with a public monetary injection between 2021 and 2023 of more than €200m (US$237m) invested in its offshore sector technologies, including development of infrastructure at ports.

Funding would come from the Recovery, Transformation and Resilience Plan. If the plans come to fruition, Spain would provide an important portion of the 7GW of floating offshore wind that the European Commission has vowed to achieve by 2030.

Spanish firms are already on the front foot. BlueFloat Energy has announced it wants to develop a **1GW floating wind farm** off the coast of Catalonia, in the Gulf of Roses. The Parc Tramuntana project will be constructed in two phases of 500MW, with up to 40 floating wind turbines installed each time. The permitting phase is expected to be completed by 2023, with the first phase operational by 2026.

The development comes as Spain's wind power sector faces issues related to proposed legislation to reduce the impact of the sharp rise in electricity prices on consumers' bills. Measures to be applied include a transitory reduction in the remuneration of electricity production facilities that do not emit greenhouse gases in the Spanish mainland, regardless of their technology, provided that they are not less than 10MW, are not covered by any regulated remuneration scheme and have not signed bilateral fixed price contracts with third parties prior to the publication of the regulation.

Taiwan: price ceiling set for Round 3 offshore wind auction

Taiwan has revealed plans for its **Round 3 auctions for offshore wind projects**, allocating an aggregate of 15GW capacity by 2035. This will be broken down into two phases, with 9GW added between 2026 and 2031, with the aim of allocating 1.5GW each year through three auctions, each covering two years. A further 6GW will be allocated between 2032 and 2035. Each offshore wind farm will be limited to 500MW, subject to an adjustment of up to an additional 100MW. And bidders will also face a performance ability review.

Officials have scrapped a **plan to use Taipower's "avoidance cost"** – the average cost of electricity generation, including fossil fuels. Instead, they have chosen a new price ceiling limit of NT$2.49/kWh (US$0.09/kWh). The previous plan had drawn criticism from developers, as the price cap would have put a heavy premium on corporate PPAs. As a result, developers would have been best served looking for agreements with tech companies and other large electricity users in need of green energy at a premium, and using Taipower as a last resort offtaker.

Meanwhile, a Taiwanese consortium consisting of developer Swancor Renewable Energy and three supply chain companies has revealed it will target "mega-scale" fixed and floating wind power development domestically and throughout Asia. The partners' first collaboration will be the development of Swancor Renewable Energy's **Formosa 4 Offshore Wind Farm** as a fixed-bottom project, before turning its attention to floating foundations at Formosa 5. The project is located about 20km off the coast of Miaoli County in north-western Taiwan and will have total potential capacity of up to 4.4GW, capable of powering more than 4.5 million homes.

Kazakhstan: plans for world's largest green hydrogen facility

German investor and project developer Svevind has signed a memorandum of understanding with Kazakhstan's investment promotion agency to develop what would be the world's largest single-nation green hydrogen facility planned to date.

Under the proposed project, Svevind would install wind and solar arrays with a combined capacity of 45GW in flat steppe areas in western and central Kazakhstan. These would supply 30GW of electrolyzers to produce around three million tonnes of green hydrogen annually. Taking advantage of Kazakhstan's vast natural resources, the plant could produce green hydrogen to be exported to Eurasian markets, or used domestically to produce fossil-free ammonia, steel or aluminium.

The project's development engineering, procurement and financing phases are predicted to take three to five years, while the construction and commissioning phase is expected to take around five years. A final investment decision on the project is expected to be made between 2025 and 2027.

Germany: onshore wind installation surges beginning of 2021

Germany's onshore wind market had a **fruitful first half of 2021**, with 971MW added, marking a 62% rise from the first half of 2020. Overall, net additions reached 831MW as turbines with a capacity of 140MW were decommissioned. Germany's onshore wind power generation capacity now exceeds 55GW, and a rosy outlook persists, with wind power installation expected to range from 2.2GW–2.4GW for the whole year.

Slow permitting and an insufficient allocation of land areas for onshore wind power had caused the sector to slump in recent years, with heavily undersubscribed tenders and new installations dwindling. It is hoped that regulatory reforms through the establishment of a new federal-state cooperation committee will lead to more land area allocated for development and a streamlined permit process.

Germany's renewables sector also received a boost with the approval of its National Hydrogen Strategy. Complementing existing funding for research and pilot projects, the strategy allocates €9b (US$10.2b) in fresh support. Germany is targeting 5GW of electrolyzer capacity by 2030, with the aim of adding an additional 5GW by 2040 at the latest.

Japan: first offshore wind foundation plant to be constructed

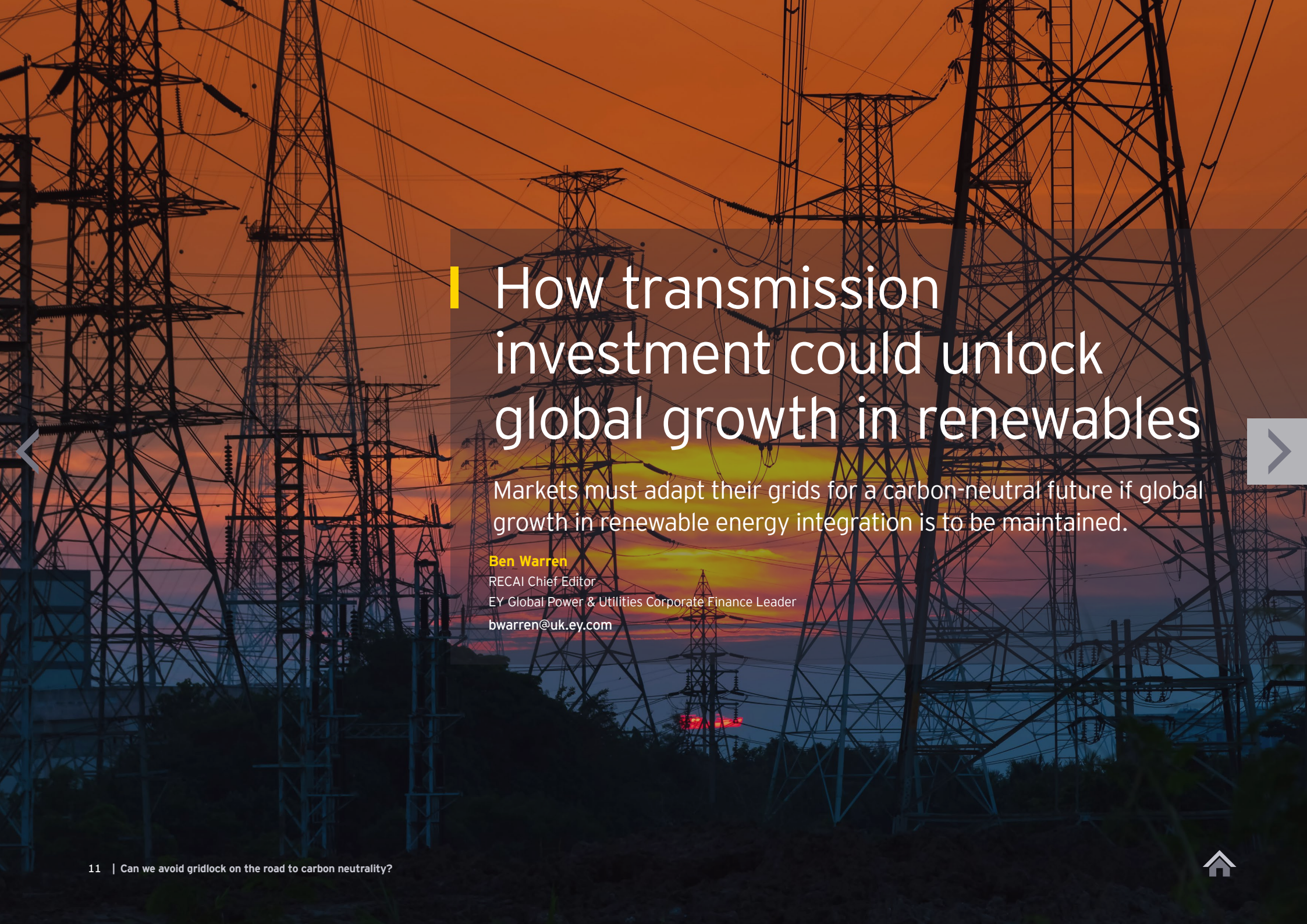
Domestic engineering conglomerate JFE Engineering Corporation has announced it will construct Japan's first offshore wind foundation plant, as the nation looks to develop a local supply base in targeting expansion of offshore wind capacity.

Initially, the firm will build monopiles and transition pieces, with plans to then add construction of jacket structures to give Japan a full line-up system for manufacturing offshore wind power foundations. The plant, as well as a secondary site for finishing transition pieces, comes at a cost of JPY40b (US$362m).

The announcement marks a key step forward in the ambition for a 60% share of local content in offshore wind projects. Japan is seeking to add 10GW of offshore wind by 2030 and up to 45GW by 2040.

Its renewables sector looks set to take off, with growing domestic manufacturing capabilities and falling costs for renewable energy. The Government estimates that lower costs for solar panels will result in the cost of solar power dropping to be the cheapest of all energy sources by 2030, at a price of between JPY8/kWh (US$0.07/kWh) and JPY11/kWh (US$0.10/kWh) – less than the JPY12/kWh (US$0.11/kWh) in 2020.

The cost of offshore wind power is also expected to drop from JPY30/kWh (US$0.27/kWh) to JPY26/kWh (US$0.24/kWh).



How transmission investment could unlock global growth in renewables

Markets must adapt their grids for a carbon-neutral future if global growth in renewable energy integration is to be maintained.

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Renewable energy generation is **flourishing** around the world as it becomes one of the most cost-effective ways to power homes, industries and **future transportation networks**. The best locations for renewable generation assets tend to differ from legacy thermal generation assets, with the largest potential often concentrated in sites far from the power grid, such as offshore or rural areas. The dependency of renewables production and future grid development must also take into account local weather conditions and emerging power sources and technologies, such as green hydrogen.

It could take a 50% rise in global grid spending over the next decade to meet long-term sustainability goals, **according to the International Energy Agency**. In particular, significant investment in the **nearly 7 million kilometers (km)** of transmission lines around the world will be crucial in supporting the continued transportation of increasing amounts of renewable energy, and helping manage volatility in supply and demand.

A wave of realization about this need is sweeping through markets around the world, but challenges remain. Attempts to upgrade legacy systems have traditionally been stymied by complex permitting processes, integration difficulties, and uncompetitive or challenging financing environments. The need to accommodate variable capacity only adds challenges as markets try to create more connections in different or varied locations, as well as addressing the need to both store and trade power between markets.

As governments start to recognize and address these issues, how are different markets adapting grids built for fossil fuel generation to suit a carbon-neutral future?

South Africa

Connecting the renewables boom to the grid

The South African renewables sector has benefited from nearly 10 years of what has become a very successful renewable energy development program. The Renewable Energy Independent Power Producer Programme has awarded more than 6,000MW of generating capacity to developers across a range of technologies.

"Developers like the clarity of the process – there is no interference, it's very reputable and stable," says Johan Greyling, Energy & Natural Resources Leader – Ernst & Young Incorporated. "As a result, several developers have been in the market for quite some time and have established themselves, with many more trying to enter. So, it is a relatively mature market." According to Greyling, a number of these participants are global players, and banks have become accustomed to financing these deals, creating an efficient market for renewable energy development in South Africa.

The market has started to become somewhat of a victim of its own success, however, because of a growing connection bottleneck caused by a lack of grid availability. "We now have a glut of renewable resources and a group of very proficient bidders eager to do more at very competitive rates," Greyling continues. "The challenge will be getting all of them on to the grid while maintaining stability."

He points out that ongoing efforts to **unbundle South Africa's regulated utility, Eskom**, into three businesses covering generation, transmission and distribution could help place more of a focus on adapting transmission to meet current and future renewable generation needs. In November 2020, Eskom published a 2021–30 **Transmission Development Plan (TDP)** to account for an anticipated

reduction in thermal generation (with 11.4GW of coal and 0.3GW of gas set to be decommissioned by 2030) and 26.8GW of proposed new generation capacity – much of which will be "from renewable energy resources that are in areas with limited network capacity," according to Eskom. In fact, a total of 20.4GW of renewable capacity is expected to be added during the TDP period, and capital expenditure on the integration of renewables is expected to cost ZAR22.7b (US$1.6b).

This indicates the Government's desire to support further renewables development. As with most markets transitioning from thermal to renewable energy, however, there is a great deal of work to be done.

The US

Transitioning to carbon-free energy amid extreme weather events

In the US, 40 states, including territories, currently have a renewable portfolio standards (RPS) or a carbon emissions reduction target.

At the US federal level, one of the milestones set to achieve a global decarbonization economy is to transition to a carbon-free electric grid by 2035. Today's US energy mix representing 40% is carbon-free from nuclear and renewables generation. Pathways for the remaining 60% of carbon-emissions based power energy mix will require scaling existing commercially viable carbon-free power generation sources and a full array of emerging decarbonization technologies.

US renewables development has surged in recent years to meet this potential demand, but it is proving difficult to connect to the grid system. Of at least 755GW of generation currently stuck in interconnection queues, about 680GW is zero carbon, according to a recent U.S. Department of Energy-funded study by Lawrence Berkeley National Laboratory. The study also estimates that only 13% of this capacity has an executed interconnection agreement. As a result, the US grid cannot move the new power that is coming online to the areas of growing demand. Significant investment in transmission infrastructure, therefore, will be a factor in meeting US emission reduction goals.

The complex nature of the US grid system is a large part of the reason for such bottlenecks. In the contiguous US, the grid is divided into three parts: the eastern and western interconnections, and the Electric Reliability Council of Texas (ERCOT). The complexity goes further than that, however. "Transmission and distribution (T&D) grid development is typically a multidimensional issue because the regulations of how we run the grid vary at a state level," explains Kimberly A. Johnston, EY Americas Power & Utilities Regulatory Leader.

Contemplating this complex system has also caused stakeholders to begin to consider how to "take their energy into their own hands," she says. Large power users – such as municipalities, industrial companies and universities – that are concerned about the social and financial devastation of climate change are looking to become "energy islands" by turning hyper-local electricity or electric vehicle networks into distributed energy resources.

"In less than 10 years, the EY organization projects that more than half of electricity customers will become energy distributed resources, operating as an emergency reserve or producing excess capacity that goes back onto the grid," Johnston says.

These energy islands will still require a connection to an overarching macro grid for regulation and protection against cyber attacks or other risks. As a result, Johnston describes US grid development as progressing along two parallel paths. "One is amending the historical, highly complex, multidimensional regulatory framework," she explains. "The new, parallel path relates to the need for a whole new ratemaking framework for a customer-centric macro grid, to provide safe, reliable and affordable energy delivery services."

Like many other parts of the world, the US is also reckoning with the physical impact of climate change on its power sector infrastructure, as well as the need to strengthen and expand the grid to withstand increasingly extreme weather events, such as the disruption caused by Storm Uri and Hurricane Ida in 2021. In Texas, Uri's impact was most extreme because its grid operates almost entirely separately from the eastern and western interconnections. This means that, while other states can trade power, Texas has very little ability to do so. So, as the storm impacted almost every generation source, the Texas system ran out of power supply options.

Johnston believes the havoc caused by the Texas freeze of 2021 has created a ripple effect among US policymakers and regulators, particularly in light of the rise of renewables. "There is a heightened awareness of the need to ensure grid reliability, public safety and customer affordability, particularly when we have rising extreme weather. And, of course, this is also happening at a time when we need to transition at an accelerated pace to a net-zero carbon grid by 2035," she says.

While the US grid remains highly fragmented on a state basis, recent federal efforts to address resilience and the need to connect renewables are likely to have a significant impact. A bipartisan infrastructure bill passed by the Senate in August 2021 earmarks US$113b for power and grid-related projects, including those that address reliability and resiliency, as well as the creation of a national Grid Deployment Authority. The package includes other major sectors impacting the grid which includes US$15b for electrification of the transportation sector which will prompt T&D infrastructure investment to prepare for increased electricity demand from EVs as well as the US$25b for the modernization of transit, airports, rail, roads, and safety along with US$65b for 5G fiber deployment to solve the digital divide in communities. The US$21b to brownfield and super fund sites will prompt potential repurpose uses for emerging decarbonization energy sources.

The US Federal Energy Regulatory Commission (FERC), which regulates wholesale power and gas trading and transmission, also launched a consultation on transmission reform in July 2021. It will focus on issues such as improving planning and cost allocation – major roadblocks to transmission development at present – as well as generator interconnection processes. FERC and State Public Utility Commissions have opened hearings and commenced studies on distributed energy resources to assess and determine the forward-thinking regulatory frameworks needed to ensure reliability while progressing towards a customer-centric carbon-free electric grid.

Australia

Interconnector to boost renewables after coal plant retirements

Australia's National Electricity Market (NEM) is navigating a shift to integrate more renewables. The transformation has largely been driven by the National Renewable Energy Target for 20% renewables by 2020, although the driver going forward is upcoming coal plant retirements throughout the market.

"Australia's situation is quite interesting; although we currently do not have a strong federal policy to decarbonize, our states have renewable energy targets, and the bulk of our coal-fired generation

fleet is reaching end of life in the next couple of decades," says Clare Giacomantonio, Strategy and Transactions Partner, Power & Utilities – Ernst & Young Australia Operations Pty Limited. With the transition to renewables very much underway, Australia's transmission network needs to be "significantly reconfigured," she adds. This will be "an expensive challenge" because of the physical size of the grid relative to the load size, as well as the comparatively small number of customers who will pay for any upgrades.

With this in mind, TasNetworks, Tasmania's state-owned electricity transmission and distribution company, has proposed the AU$3.5b (US$2.6b) Marinus Link. This high-voltage direct current (HVDC) undersea cable would connect the renewables-rich island of Tasmania with mainland Australia. Tasmania, which met its 100% renewable energy target in November 2020 and currently has access to an expected 10,741GWh of renewable energy, has recently raised its ambitions to double that renewable energy by 2040 to become a clean energy exporter. Current resources include wind and significant hydroelectric power, with plans to develop more wind, as well as hydrogen, resources.

"The Tasmanian system is currently almost entirely fueled by hydroelectric generation," Giacomantonio explains. "The island gets a lot of rain and has some very large dams, and quite a sophisticated hydroelectric scheme with many cascades." Wind production is also high yield and less correlated to that of the mainland, which adds value in terms of turning Tasmania into a net exporter of energy.

By strengthening the connection between these two parts of the same market, the proposed interconnector would essentially turn Tasmania into a giant battery providing capacity firming services to the NEM. The island would be able to store excess renewable energy generated on-island or transported from the mainland, using this energy itself or returning it to the mainland as needed. Development of long-duration pumped storage hydro on existing dams would further strengthen this role.

A stronger federal imperative to transition to renewables – for example, a carbon price – would reinforce the case to build Marinus Link, according to Giacomantonio. Grid development in Australia's NEM faces similar challenges to those in other parts of the world, particularly as transmission is usually a regulated asset. This challenges include high standards and lengthy processes for gaining approvals, a regulatory test that was not designed for assessing multiple transmission projects simultaneously to achieve rapid transformation of the grid, issues around cost allocation, and the need to maintain grid stability throughout the transition.

In response to issues related to planning the NEM's energy transition, a 2017 review of the whole of the NEM resulted in the Australian Energy Market Operator (AEMO) taking a larger planning role. "The regulatory investment test for large transmission projects has been more integrated with AEMO's modeling in an attempt to streamline the process," Giacomantonio says. "Whether that has improved efficiency is currently being tested by projects using the new rules for the first time." Another, more targeted review started in August 2021, and will explore options to further reform or improve regulatory frameworks around transmission planning.

Marinus Link has passed the regulatory investment test for transmission and is progressing toward a 2023–24 investment decision. According to Bess Clark, TasNetwork's General Manager for Project Marinus, cost allocation remains a key issue, however. "The main challenge to date is the resolution of the current NEM pricing framework for transmission infrastructure, whereby costs are allocated based upon the region (largely Australian state-based) where assets are located, rather than to the customers benefiting from the services."

When it comes to attracting private investment, Clark believes this issue could cast doubt on the project's ability to recover all required revenue. Unless there are seen to be fair pricing outcomes, private investors may also have concerns about the reputational and project risks around funding a project without strong community support.

"The investment test has demonstrated that the project provides net benefits to the NEM, but the current pricing/cost allocation frameworks need to be resolved before the project can proceed as a regulated service," Clark says. "The methodology used to allocate transmission costs between NEM regions and between generators and load customers is, therefore, coming under greater scrutiny, with ongoing energy minister discussions on a way forward."

If Marinus Link does go ahead, it will also provide an avenue for Australia's hydrogen ambitions. Tasmania, in particular, provides a solid use case, given its 100% renewables status. "A number of green hydrogen proponents are active in Australia," Clark says. "Marinus Link complements hydrogen opportunities by supporting continued development of variable and dispatchable clean energy resources and supporting transmission at lowest cost, as well as providing additional resilience in the national power system. This enables hydrogen investors to have greater confidence in the adequacy of their clean energy supply."

The UK and Europe

Connecting markets and supporting future hydrogen development

Hydrogen is likely to play a key role in the UK's efforts to decarbonize its power system by 2050. As renewables output increases, green hydrogen production could support grid flexibility by providing storage solutions for excess generation. In its August 2021 Hydrogen Strategy, the UK Government said such solutions would provide a wide range of system benefits, as well as an additional route to market for new renewables capacity. "Coupling this electrolytic hydrogen production with storage, including long-duration storage where hydrogen is a lead option, can help integrate hydrogen further into our power system by helping to balance the grid when generation from renewables is higher or lower than demand," the report states.

While such hydrogen-based solutions remain in the early stages of development at present, the UK's electricity regulator, Ofgem, is already laying the groundwork for the much-needed redevelopment of its grid. According to Iain Cameron, Chief Operating Officer of Frontier Power, Ofgem is seeking to attract more investors and encouraging innovation through increased competition. "In our view, as participants in this process, this has been successful in bringing in new sources of finance and driving project development at a faster pace than the incumbent grid companies would have done so on their own accord."

In addition, the UK needs to connect its burgeoning offshore wind market to the grid. As a world leader in this market, the UK is well on its way to meeting its target of 40GW of installed offshore wind capacity by 2030 – the project pipeline reportedly surpassed 50GW last year. This sector is also likely to support the future development of hydrogen production, with several North Sea projects already planned.

"The grid needs a lot of new investment to enable these connections along the coastlines, so there is a challenge as to how to achieve a competitive market for this development," Cameron adds. "Ofgem is trying to encourage more coordination between offshore and onshore network development to facilitate more efficient network build-out to enable energy transition and offshore renewable energy. That's going to require more central facilitation than there has been in recent times."

In addition to the offshore wind build-out, interconnectors will be needed to manage the variability of increased renewable generation in the UK and throughout Europe. As the UK moves away from a thermal power system in which supply and demand can be balanced in a controlled way, these connections will enable power to be traded between markets.

"Interconnectors not only support the convergence of average energy prices between markets, but they are also particularly effective in smoothing the increasing volatility in supply and energy pricing, as renewable penetration increases," says Humza Malik, Founder and Chief Executive of Frontier Power. "Interconnectors are only one part of an overall solution that will include storage, interconnectors and different types of renewable generation."

In the UK Government's December 2020 **Energy White Paper**, it pledged to work with Ofgem, developers and European partners to increase 18GW of interconnector capacity by 2030. The paper states: "This represents a three-fold increase from current levels and will position us as a potential net exporter of excess green energy, helping to keep wind turbines generating even when GB electricity demand has been met."

Both the European Commission and the European Council **support** a 15% electricity interconnection target for EU members, with a Commission study estimating that an integrated European energy market could save citizens €12b–€40b (US$14–US$48) annually by 2030.

Frontier Power is engaged in several interconnection projects, including NeuConnect, a proposed 1.4GW "invisible highway" that would connect the GB and German power markets. In this new competitive environment, Malik says organizations such as Frontier Power and its partners are working to accelerate the pace at which such solutions are implemented, including introducing new sources of finance and project innovation. Independent developers will be critical in bringing about the sort of infrastructure development needed to help meet **ambitious** decarbonization **goals at pace**.

The role of grid investment in the global energy transition

Given the extent of grid development needed across the globe, it will be crucial for all regulators to reconsider the permitting, regulatory and financing environment to help ensure outdated grid systems do not become a major hurdle in the race to net zero.

Many markets are already aware of this need, and some are even working on solutions in a bid to streamline these processes. As demand for renewables capacity continues to increase, such efforts will be necessary to attract much-needed investment and follow the net-zero pathways laid out by governments around the world.

Why Eastern Europe is stepping up a gear in the drive for net zero

Innovative and ambitious routes to becoming low-carbon economies are needed if the EU is to achieve its 2050 emissions target.

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The EU's increasing ambition in respect of renewable energy is putting economies across the continent under pressure to step up their transition. While Western Europe still has a long way to go, it nonetheless has an advantage over many of the EU's more recently added Member States from Eastern Europe, where particular challenges and geopolitical influences are at play.

Many countries and regions — from the Baltics to Romania and the Balkans — face a broad range of challenges, including updating legacy infrastructure and reducing energy dependency on Russia.

Common themes include the need to move swiftly on building renewable capital, and the potential financial backing from the EU and its institutions, designed to help with the transition. Further, the markets are highly diverse, and politics and geography are key. The further north in the region, the stronger the argument for wind power, while, in the south, it is solar power farms that are more evident — for example, across acres of Romania and Hungary.

The countries and regions that joined the EU in the first wave of post-Soviet accessions in 2004 (the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia) have relatively developed capital markets, but several have a long way to go in building renewable energy infrastructure.

Those experiencing the most advanced stages of transition — Poland, for example — are often where new ideas, both in terms of renewables technology and the capital market instruments that support them, can be tried out, according to Grzegorz Zielinski, Head of Energy Europe at the European Bank for Reconstruction and Development (EBRD).

As an example, he cites the green bond issued last year by Poland's TAURON Polska Energia. It raised €324m (US$383m) to support decommissioning of the company's coal-fired facilities and the build-out of its solar and wind power capacity, with the EBRD taking almost a quarter of the issuance.

With a Lithuanian bond issue being the first green bond raised by a power utility, and a floating offshore wind platform being financed in Albania, Eastern Europe is clearly a site of innovation and change.

This appetite for change will be very necessary in years to come, as the EU targets for carbon emissions abatement become more ambitious — and the need for them more pressing. While many of Western Europe's economies have well-developed green energy infrastructure, Eastern Europe has much further to go along this path. Poland and Hungary are the only two to make it into the RECAI top 40, compared with 13 regions from Western Europe.

In 2020, the EU target for cutting greenhouse gas emissions by 2030 was raised from 40% to 55% of 1990 levels. Although this ambition may be essential for keeping climate change within manageable limits, it will pose significant difficulties for economies such as Poland, currently largely dependent on coal-fired power.

In particular, the question of whether natural gas is acceptable as a transition fuel may make or break the transition for nations with bitter winters that rely on urban district heating systems. Without the ability to move swiftly to the much less carbon-intensive natural gas, these systems will struggle to make significant cuts to emissions with any speed.

The EU's ambition, however, is supported by the Green New Deal, to help countries and regions build the necessary infrastructure. The European Commission has created a Just Transition Fund of nearly €17.5b (US$20.7b) to support economic diversification in the coal- and carbon-intensive regions most affected by decarbonization, and to help retrain the workforce whose main industry is falling rapidly into obsolescence.

Poland is set to be the largest recipient of the Just Transition Fund, with a proposed allocation of €3.5b (US$4.1b).

Signals from governments in this new market are positive and, with greater support from EU institutions, the region is experiencing greater interest from established investors that are exploring opportunities for the first time or in more depth.

Poland

Wind power rises as it becomes Poland's alternative to coal

Poland, the region's economic leader, is also a leading emitter of carbon. In 2020, coal-fired power accounted for 70% of electricity produced, down from 74% the previous year. As coal mining employs around 80,000 people directly, with probably the same again indirectly dependent on the industry, closing the mines by 2049, as the Government has pledged to do, is a huge undertaking.

Support from the Just Transition Fund is clearly a help, but internal political pressure is changing the Government's view of the need for transition. Domestic protests about local air quality have added to the climate change voices both at home and abroad, while a number of older coal-fired plants are nearing their end of life, so the Government is looking for alternatives.

Nuclear fuel is one option being examined, but the lead-in is long and costly, and it comes with its own environmental issues. Wind power, on the other hand, is relatively easier to install and increasingly popular with investors.

"A decade ago, people thought of renewables as inefficient, costing too much," says Zielinski. "But renewable energy is now cost-competitive, particularly for EU countries and regions that are part of the EU Emissions Trading Scheme."

Poland's Baltic coastline offers great potential for offshore wind power, as it has strong steady winds over shallow waters with weak tides, making for ideal conditions. Since putting a contract for difference (CfD) system in place to guarantee stable income for investors, the Polish Government has seen huge interest from investors in its offshore wind industry. Northland Power, Equinor and Ørsted have, for example, all announced partnerships with Polish companies to build capacity in the Baltic Sea.

The pricing system is an essential element of implementing Poland's, or any nation's, shift to renewable energy, adds Zielinski. "A well-designed and well-introduced CfD system makes a great difference," he says.

With more than a dozen wind farm projects under consideration in Poland's Baltic Sea territory, it has the potential to generate a quarter of Poland's energy needs by 2040. For that to happen, however, investors need to be confident that the Government's commitment to renewable energy is reliable. One way for it to demonstrate that would be to smooth out regulatory obstacles to other green energy sectors, such as onshore wind. In 2016, for example, a regulation barring wind turbines from being placed within a certain distance of buildings put a significant damper on that sector. This restriction is now expected to be rolled back so that wind farms will be permitted as long as they have local community support, giving reassurance to investors that renewable energy is welcomed by the Polish Government.

Recent auctions for wind farms allow for 6GW of capacity, which should at least be doubled in the next round, bringing the total offshore wind capacity to 10GW–12GW by 2030. However, with pressure on the Polish Government to aim for carbon neutrality, future plans are likely to be subject to change.

"The transition pathway is still to be developed," says Maciej Markiewicz, Senior Manager at Ernst & Young spółka z ograniczoną odpowiedzialnością Consulting, "but the direction is good."

Despite this, it is not necessarily straightforward to gain exposure to this huge industry growth, especially for investors in public equities.

"The whole transition from 70% coal is a massive project," says Eglé Fredriksson, Portfolio Advisor at East Capital, a Swedish asset manager specialising in emerging and frontier markets. "But our interest is connected to how liquid the sector is."

Although the giant state-owned PGE is listed and a relatively liquid stock, Fredriksson is cautious. "It is responsible for the whole transition, so we have some concerns about protections for minority investors — who will pay for the costs of transition?"

Smaller energy companies exist, but are not traded frequently enough to be attractive to an asset manager intent on maintaining a flexible portfolio. So, for now, Poland is a "watch and wait" market for East Capital.

Baltic states

Lithuania, Latvia and Estonia still seeking energy independence

The Baltic states — Lithuania, Latvia and Estonia — also stand to benefit from the Baltic offshore wind boom, but they have their individual challenges.

Although they are now connected to other EU markets by the Baltic Ring, a system of interconnectors between markets, they are still synchronized with the Russian and Belarusian markets rather than the EU. The disconnection from the Russian and Belarusian electricity system is an ongoing process expected to conclude in 2025, when all three Baltic countries will be synchronized with the grid of the continental Europe.

Improvement in energy efficiency and economies tilting away from carbon-intensive industries have made it easier for these states to lower their emissions, but energy independence is yet to be achieved.

Problems encountered earlier on have pushed Lithuania ahead of its neighbors — Lithuania agreed to decommission its Ignalina nuclear power plant, the sister of Chernobyl, as a condition of joining the EU. This has left it heavily dependent on imported power, with two-thirds of energy consumption based on imports, largely from Russia. The combined drive to energy independence and carbon neutrality has led to an ambitious national energy plan, targeting 70% domestic electricity generation by 2030, and complete energy independence by 2050.

Of that domestic production, the Lithuanian Government aims for 45% of electricity consumption and as much as 90% of heat energy to be produced from renewable sources by 2030, and 100% of both by 2050.

With targets this ambitious, Lithuania is likely to be a very active market in renewables for the coming decades.

Latvia and Estonia may not have previously felt the same pressure as Lithuania to become sustainable, but that is changing. Estonia is still heavily dependent on carbon-intensive shale oil, so cutting its emissions by 2030 will require a swift transition. Biomass is likely to be a major focus, with Europe's largest biomass pellets producer, Graanul Invest, based in Tallinn.

Although biomass has come under fire from climate activists questioning its sustainability, recent advances in technology and creating pellets that burn more cleanly, have allowed it to be designated a green fuel by the EU.

With significant hydropower capacity in place, 40% of Latvia's total energy consumption is already from renewable sources, and it aims to reach 50% by 2030. This will entail expanding wind power and biomass usage into the total fuel mix, leveraging its geographical strengths of a Baltic coastline and more than 50% forest cover.

Other markets

Romania and Hungary attract strong solar interest

The size and diversity of the region leads to a divided picture, with natural resources pointing to wind power in the north, solar in the south and hydropower resources concentrated in the Alpine region. With the cost of solar power equipment shrinking quickly, new solar capacity is growing rapidly, with inward investment to countries such as Romania and Hungary.

Although Hungary's recent auctions for solar power generation have been oversubscribed, showing strong interest in the market from international investors, there are still some obstacles. The regulatory framework, including a tax intended to support smaller domestic heat producers, needs to be ironed out if international interest is to increase further. The recent imposition of further non-tariff barriers as part of COVID-19 crisis changes — including closer scrutiny of foreign investments under the guise of "national security" — will be regarded with caution.

Of the Eastern European states, Romania is leading the way in terms of renewable energy, with significant hydropower generation helping it reach its 2020 renewables target (24% of production) several years ahead of schedule.

To reach its 2030 target of 30.7%, Romania plans to add around 7GW of new renewables capacity, more than half of which is likely to be from solar projects.

While there has been pressure for the Eastern Europe region to increase the mix of renewables in the past decade, that pressure will be stepped up significantly in the next few years. Although the EU target of cutting emissions by 55% by 2030 is a whole-EU project — meaning there will be leeway for some countries to move a bit more slowly — the deadline of carbon neutrality by 2050 will not allow for any complacency.

With support from the EU and national governments, these Eastern Europe markets are already showing they are able to find innovative and ambitious routes to their destination. Distribution networks are being upgraded, technology is being developed and financial instruments are being designed as each country navigates its particular economic, social and political obstacles to a green future.

Ukraine's renewable meltdown

Ukraine has huge potential for renewable energy, both solar and wind power, thanks to its huge, sparsely populated territory, with reliable sunshine and steady winds. The EU saw it as a potentially huge supplier of green energy but, instead, its largest energy company, DTEK, is looking to build 1GW of renewable power plants outside of Ukraine, largely in the EU.

The collapse of its guarantee system for investors is to blame. The feed-in tariffs (FIT) scheme, set up in 2008, created a government agency called Guaranteed Buyer to reassure investors they would be paid for their product. Unfortunately, it ran out of money in 2019, so developers went unpaid.

An EU-mediated settlement has not yet been implemented, and investors have become very wary of the market.

Even if a settlement is reached, and an attractive and reliable pricing system for renewable energy is put in place, Ukraine will still face problems in reaching its potential as a producer of green hydrogen.

In ideal circumstances, hydrogen is transported from the point of production to the point of use via pipeline, but, failing that, it can be carried by road in cryogenic liquid tanker trucks or gaseous tube trailers.

"The lack of interconnection for distribution is a problem," says Maciej Markiewicz. "It would have to be imported in vehicles."

In addition, he adds, the unstable political environment will put off many investors.

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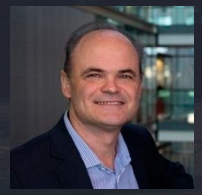

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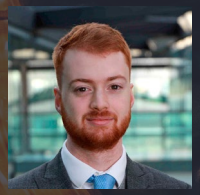

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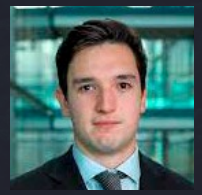

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