Renewable energy country attractiveness index

# recai

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Issue 49

## Offshore winds blow strongly
Amid falling costs and larger turbines, a global boom is forecast

## India's power play
The target is 175GW of renewable energy capacity by 2022 – can it be done?

## High-level solar opportunity
Southeast Asia's commercial rooftops avoid the region's barriers to solar

## Back in the game?
Spain seeks to win back disappointed renewable energy developers

# Batteries: leading the charge

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Building a better working world

# Renewables unshackled

> It is difficult to overstate just how profound the impacts of wide-scale, low-cost energy storage will be on the utility sector.

For years, those advocating a clean energy revolution have faced two undeniable barriers: the relatively high cost of renewables and, for most renewable technologies, their intermittency. As long as these barriers remained in place, the penetration of renewable energy generation would remain constrained.

As we explore in this issue of RECAI, the renewable energy sector is, finally, breaking free. On pages 14–16, we find falling costs in the offshore wind sector beginning to deliver subsidy-free clean power, at scale, across northern Europe. With the right conditions – including a little help with transmission costs – developers are confident that the next generation of offshore turbines will be able to pay their way without government support.

This has been a remarkable story, where the industry has rapidly refined its technology and slashed costs. It shows what is possible with supportive policy and a long-term vision.

A parallel process is taking place in energy storage, albeit with somewhat different drivers. Here, the possibilities presented by electric vehicles have driven enormous investment in battery technology, leading to dramatic price declines. This is enabling battery storage to insert itself into a growing number of niches within power generation, distribution and supply (see pages 4–7).

It is difficult to overstate just how profound the impacts of wide-scale, low-cost energy storage will be on the utility sector. Ever since the first power plants were built in the 1880s, electrical engineers have grappled with the challenges of balancing, in real-time, the supply and demand of a commodity that was almost impossible to store.

These challenges have become only greater with the rising proportion of intermittent renewable energy on electrical grids around the world. Battery storage promises to address these challenges, as well as ultimately enabling the entire decarbonization of the world's electricity supply.

The impacts on the power and utility sector will be disruptive. While the sector has generally been able to adapt to new types of generation capacity such as renewables, the rapid spread of battery technology will be much harder to integrate into legacy business models. It promises to shift power toward consumers, undermine grid operators' investment plans and allow new entrants to challenge utilities.

It also presents an enormous investment opportunity. Utilities start with some advantages – existing customer bases, network knowledge and relationships with regulators – but they will have to move quickly. The combination of distributed renewable energy and affordable storage presents perhaps the biggest challenge to the utility sector since the switch was flicked "on" at the first Edison power plant.

**Ben Warren**
EY Global Power & Utilities Corporate Finance Leader

# Contents




## Batteries: leading the charge

Battery storage is set to jump-start the clean energy transition while at the same time disrupting the traditional utility business model. 4

**Market spotlight: India** 8

## India's power play

The Government's ambitions for renewable energy are huge – but can it overcome the country's challenges?

**Insight: Offshore wind** 14

## Offshore winds blow strongly

Dramatic falls in the cost of offshore wind are now helping to spread the technology around the world. But low costs are raising concerns about risk.

## RECAI



**Insight: Southeast Asia** 17

## High-level solar opportunity

The region has some of the world's fastest-growing countries, with accompanying energy demand. But local issues are hindering solar take-up – and the answer may be to take to the rooftops.

## Country focus



2016's solar tender brought overwhelming response and keen prices. The Government is tweaking the process to quicken the pace in its next tender.



Renewables developers were hit hard by Spain's subsidy U-turn – and new tenders may cause further problems for investors and developers.

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# Leading the charge

## Battery storage is set to jump-start the clean energy transition while at the same time disrupting the traditional utility business model.

In a series of tweets in early March, Tesla founder, CEO and Chairman Elon Musk made a dramatic offer to help address the issues bedeviling South Australia's electricity grid: he offered to install 100MW of battery storage within 100 days – or the system would be free. This led to talks between Musk and South Australia's Premier, and with Australia's Prime Minister Malcolm Turnbull.

At the time of writing, it was unclear whether the offer would be taken up, and there are serious questions as to whether such a system would be an appropriate solution to the blackouts plaguing the Australian state. But the attention that Musk's offer generated is testament to the increasingly important role that battery storage, at scale, is playing in modern electricity systems.

Storage technology is the vital missing element in the struggle to enable the transition to clean energy, allowing grids to accommodate ever-growing volumes of intermittent generation and transforming the economics of renewable energy systems. But, along the way, the growth of battery storage promises to transform power markets, accelerate disruption of the utility business model and challenge regulators to rethink how they oversee generation, transmission and distribution.

The growing penetration of batteries is, essentially, a solution to a problem that dates back to the construction of the first electricity grids. "The electricity supply chain is the longest supply chain in the world with almost no ability to store the product," says Matt Roberts, Executive Director of the Washington, DC-based Energy Storage Association (ESA). "That means we have scaled everything to meet the absolute peak of demand – it's an incredibly costly and inefficient way to build a network."

The inability to store surplus power (beyond the limited capacity of older storage technologies such as pumped hydro systems) is becoming a more pressing problem with the greater penetration of wind and solar technologies. Solar output, while relatively predictable, dips in cloudy conditions, while local wind speeds are hard to predict with confidence more than a few days into the future.

In addition, thermal power plants currently play an important role in balancing generation and load to maintain the frequency of power grids within a constant range, which protects electric equipment. Renewable energy generation is unable to provide the on-demand balancing power needed for grid stability.

This means that battery systems – predominantly, to date, using the lithium-ion technology seen in electric vehicles – have multiple uses, and multiple market needs they can address.

"The opportunity for battery storage exists in all areas of the utilities value chain – in generation, transmission and distribution, as well as on the consumer side, behind the meter," says Manish Kumar, Managing Director of Arlington, Virginia-based AES Energy Storage, an arm of power company AES Corporation.

Thomas Christiansen, Associate Director at EY in Stuttgart, Germany, describes a hierarchy of applications that will become progressively more commercially attractive as battery costs fall:

- **Islanding** uses batteries alongside renewables in isolated grids, displacing expensive small-scale fossil fuel generation using diesel or fuel oil.
- **Grid balancing** provides short-term supply (or demand) to keep electricity grids in equilibrium, and helps to reduce the need for investment in transmission and distribution networks.
- **Peak shaving** reduces demand for expensive power from the grid at peak times. As batteries get cheaper, it becomes economical to use them for energy load shifting, charging the batteries when grid power is cheap and discharging them when it is expensive. These techniques become economic first for commercial users with high peak charges but moderate overall use, followed by large industrial users with high energy demand.
- The **behind-the-meter** market pairs on-site batteries and renewable systems, allowing both commercial and industrial (C&I) and domestic users to consume more of the power they generate by, for example, using stored solar power into the evening.

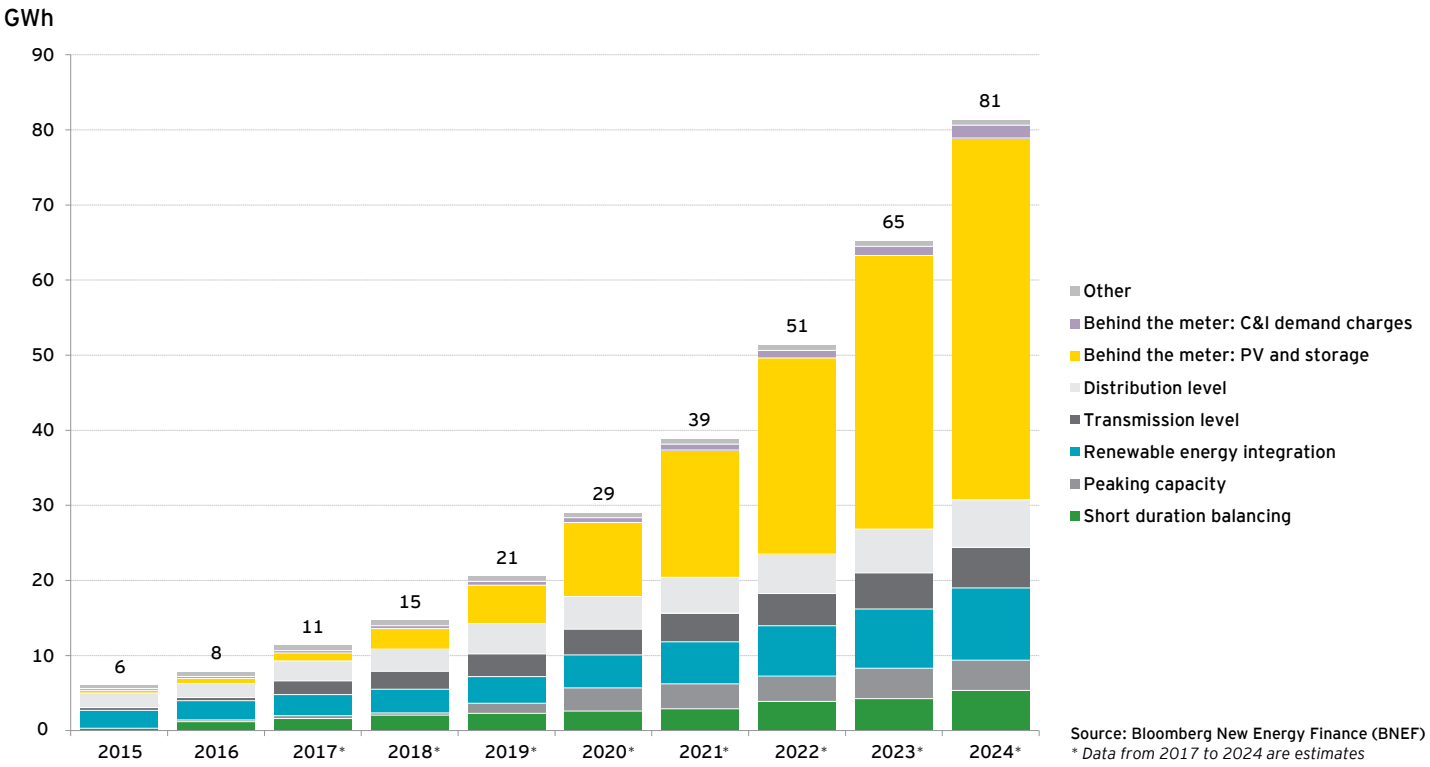
Around the world, battery storage capacity is rising fast: according to figures from Bloomberg New Energy Finance (BNEF) installed capacity will grow at a cumulative average rate of 44%, leaping from just 6GWh in 2015 to more than 81GWh by 2024 (see the chart on page 5). At present, its main applications are to provide balancing services for transmission and distribution systems, and for integrating renewable energy. However, according to BNEF the use of batteries behind the meter, paired with photovoltaic (PV) systems, is set to overtake after 2020.

There are two factors behind this rapid growth.

First, the cost of batteries has been falling dramatically, driven by enormous increases in manufacturing capacity and expertise. Lithium-ion batteries have fallen in price by some 80% over the last five years, according to BNEF figures. The construction of "gigafactories" is forecast to triple production capacity between 2015 and 2020 to almost 125GWh according to RBC Capital Markets. Lazard estimates that this will help to reduce battery costs by nearly 50% by 2021.

Second, the services provided by batteries – especially around fast frequency response – are being recognized by regulators. "The

## Global cumulative energy storage deployment by application (GWh)




Source: Bloomberg New Energy Finance (BNEF)
** Data from 2017 to 2024 are estimates*

> "The electricity supply chain is the longest supply chain in the world with almost no ability to store the product."

cost of energy storage systems could fall to zero and they still wouldn't be viable in many markets," argues Roberts at the ESA. "You need to recognize their value, and that's what has been accelerating. Frequency response and system reliability have been the gateway, illustrating the value that energy offers."

Changes to rules governing payments for fast-response assets in the Pennsylvania–New Jersey–Maryland (PJM) electricity market earlier this decade allowed batteries to compete in providing frequency regulation services. This was followed, in 2013, by a mandate from the California Public Utilities Commission (CPUC) requiring that the utilities it regulates build 1.3GW of energy storage capacity by 2020. Similarly, the National Grid in the UK has conducted enhanced frequency response auctions in which batteries provided the bulk of the capacity.

"We were able to convince PJM of the benefits – in terms of the flexibility, precision and speed – that energy storage can provide in improving grid reliability and resilience," says Kumar at AES. Because fast-responding resources like batteries provide regulation more efficiently, they offer a higher utilization rate and better availability than traditional power plant resources, he says.

Kumar also notes that battery projects were rapidly rolled out in response to the Aliso Canyon methane leak in California, which was discovered in 2015. There, the disaster at the natural gas storage facility left southern California at risk of forced power outages, and the CPUC ordered "expedited procurement" of large-scale, grid-connected energy storage resources. A number of developers and battery makers, including AES, Tesla and Canada's AltaGas, stepped forward to put in place around 100MW of battery capacity within months of contracts being signed.

According to Kumar, "It shows that battery-based energy storage can compete both technologically and economically against traditional fossil fuel-based resources such as gas-peaking plants," which, until now, have been favored to provide back-up capacity.

However, increasingly cost-competitive battery storage is set to bring disruption in its wake. By helping to smooth the intermittent supply from renewable resources, wider battery use will continue to reduce the peak power prices on which many natural gas-fired power plants depend.

In addition, by reducing network utilization, batteries reduce the need for additional grid investment on which regulated network operators depend for their revenues. And by increasing the utilization of customers' renewable energy systems, batteries will accelerate grid defection, and reduce the peak and system charges that utilities can earn.

"The fastest way into the market for batteries is in frequency response, but the higher-revenue opportunity is in avoiding the network peak," notes Matt Rennie, EY Global Transaction Advisory Services (TAS) Power & Utilities Leader. He points out that around 50% of network capital expenditure is directed toward meeting around 1% of peak demand.

"If you can deploy a solution that alleviates that peak in some other way than building new transformers and new lines, that's very valuable," adds Rennie. However, he also notes that the amount of revenue regulated network operators are allowed to collect from network users is partly a function of capital expenditure: "For networks to value that [foregone expenditure], and choose to transfer that value to a new technology company, it's a big step."

The growth of behind-the-meter battery storage presents even tougher challenges. The technology becomes most valuable for utilities when they are able to aggregate and control, through smart grid technology, large numbers of their customers' batteries, creating virtual power plants (VPPs). However, the question remains as to whether they have the appropriate relationships with their customers to control the batteries, argues Rennie.

"Over the last 15 years, energy retailers have taken so much cost out of their businesses and reduced the relationships

with their customers to a transactional level. I'm not sure there's enough trust there to shift the business model to the sort of partnership you'd need for a virtual power plant model to work," says Rennie.

"It's likely to be easier for telecoms companies and consumer electronics firms to learn to be energy retailers than the other way around," he adds.

While it is early in the process, some technology companies are already challenging energy retailers. Logan Goldie-Scot, who heads up BNEF's Energy Storage insight team, says that Germany is currently the largest market for residential solar plus storage systems, with about 50,000 installed: sales are now picking up in other markets, such as Italy and Australia, driven by high retail power prices and limited ability to sell surplus power back to the grid.

Combining these systems to provide centralized utility- or grid-scale storage is at the pilot stage, says Goldie-Scot, but notes that companies such as Sonnen in Germany are competing with utilities. "You also have companies such as Sunverge that are targeting the utility as the primary customer, but with a similar model," where the retail customer receives a discounted system, in exchange for allowing the utility to tap into the battery as required.

On the other hand, utilities do benefit from some incumbency advantages, as well as from typically low costs of capital. A great deal of the value of energy storage is location dependent, says Roberts at the ESA — and utilities have the data that reveals the best places on the grid to install these systems.

Also, utilities often benefit from brownfield sites with existing electrical interconnections, notes Scott Valentino, Vice President Finance at AltaGas Services (U.S.), part of the Canada-based energy infrastructure firm AltaGas. It was one of the successful bidders to meet the CPUC Aliso Canyon resource adequacy call, contracting with Southern California Edison (SCE) to build a 20MW energy storage facility at AltaGas's existing Pomona natural gas power-generation facility.

Around the world, utilities are responding to the challenges posed by battery technologies with a range of strategies. Some are partnering with or acquiring technology companies. Last year, Innogy in Germany bought Belectric Solar & Battery, and France's ENGIE took a majority stake in

A Younicos battery storage installation at the Alamo Solar Power Project, San Antonio, Texas

California battery storage company Green Charge Networks. Meanwhile, the Finnish utility Fortum has teamed up with French battery maker Saft to conduct battery storage pilots.

Others are undertaking their own VPP pilots. In Australia, AGL Energy is building what it says will be world's largest VPP, connecting 1,000 batteries. In New York, local utility Con Edison is working with the California-based PV manufacturer SunPower to connect some 300 residential PV and storage systems.

Some are exploring even more novel approaches. For example, German utility MVV Energie piloted a service that combined district-level storage with customers' PV systems, allowing them to store excess solar-generated electricity without the need for batteries on site.

In addition, E.ON has introduced what it calls a solar cloud service, which allows customers with PV systems to "bank" their generation for use at a later time. "It does this virtually, without physically storing the generation on site," says Goldie-Scot at BNEF. "It's essentially a local net-metering tariff. It could completely kill the economic driver for storage within the home."

He says that a year ago he would have been "quite negative on the utility response" to insurgent battery storage business models, adding: "Now, they are raising the bar for these third-party companies."

But while utilities and insurgents experiment with new battery storage business models, the actions of regulators are likely to dictate their success or failure. "In many cases, regulatory barriers are quite high to utilizing batteries," says Christiansen at EY.

For example, in Germany, grid operators are forbidden from owning batteries. And, until recently, German users had to pay system fees both when charging and discharging their batteries. This is still the case in the UK, despite industry lobbying. "The lack of a regulatory definition for storage has led to problems in its treatment under current market rules," says Andrew Horstead, London-based Strategic Market Analyst, EY Global Power & Utilities.

Christiansen says: "There is a role for utilities in lobbying to let the regulators know that, if you lighten up a little bit, there are lots of things we could do that are beneficial for customers, for the

> "The lack of a regulatory definition for storage has led to problems in its treatment under current market rules."

economy and for the grid." On the other hand, Horstead notes that there is a need for strong standards to support consumer confidence at the domestic level.

Regulators should facilitate widespread storage use, says Kumar at AES: "Regulators should encourage utilities to consider storage as an alternative to flexible peaking capacity on the generation side, or as an alternative to transmission or distribution investments."

But regulators should also aim to provide clarity and consistency in their treatment of battery technology, argues Henrietta Stock, a manager in EY's Energy Optimisation service in London: "Things are changing very rapidly, and stability in policy would be very helpful."

Undaunted by the complexities involved, investors and independent power producers are increasingly dipping their toes into battery storage markets, aided by the longer-term contracts they are able to strike with utilities. "Developers typically have financed systems from their own balance sheets, cobbling together revenue from short-term utility contracts or wholesale electricity markets," says EY's Horstead. "Storage contracts to date in the US and Canada rarely exceeded 3 years. Now utilities are signing agreements for 3 to 7 years, and sometimes as long as 10 years."

This, alongside increasing confidence in the technology, is encouraging investors into the sector. Financial institutions including InfraRed, Investec and Prudential Financial have either backed projects or are seeking investments.

However, despite the investment certainty that longer-term contracts with utilities or network operators offer, developers note that it is usually necessary to "stack" revenues from a number of services to make each battery project viable. Valentino at AltaGas notes that the Pomona project supplements revenues from its capacity contract with SCE by supplying energy and ancillary services into day-ahead and real-time markets.

Investors face a range of technology and market risks. Valentino notes recent bankruptcies among start-up battery makers, most recently that of Aquion Energy in March. AltaGas uses Samsung batteries, preferring to go with a well-established Tier 1 provider. Ian Wood, Director in EY's Corporate Finance service, also notes that, in some markets, demand-side response programs may prove to be more cost-effective than batteries, challenging the latter's business case.

There is also the danger that, in fast-evolving markets, battery system developers may find that how their systems are configured and contracted for becomes out of date. "There is a lot of regulatory change going on," says Felicity Jones, Partner – Energy storage, at the UK-based technical and commercial consultancy Everoze Partners. "Developers need to make sure their contracts are designed for agility, to allow them to move between revenue streams."

For example, warranties may be restrictively worded to allow only for certain types of battery use, she notes. Alternatively, in seeking to stack revenues and sell services to different offtakers, battery owners may find that they are subsequently unable to take advantage of emerging revenue streams. "It's very complex to anticipate, but the goal is to bake in optionality in contract design," Jones says.

But, for all the complexity involved, EY's Wood argues that the market for battery storage is taking off without the need for a high degree of revenue certainty, paid for with large government subsidies, which was required to develop the nascent renewables sector: "Having certainty around a portion of revenues is sufficient to allow investment to happen."

Nonetheless, the market and technology risks involved suggest that investors and insurgent developers should pursue a different business model to one that worked for renewable energy, Wood suggests: "In renewables, investors would invest in single assets. In battery storage, they are looking to invest in a platform – with a portfolio of assets, and also a management team that will operate, run and trade it, and that is able to adapt to changes in the marketplace." ■

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## Behind the meter: the C&I business case

**For the pioneering German battery storage firm Younicos, the biggest market opportunity is to be found behind the meter, with C&I users.**

**"We started with grid-level storage, and that's still important, but we see even more growth potential in providing medium-sized storage systems for commercial and industrial clients – it's an overlooked part of the market," says Philip Hiersemenzel, a company spokesman.**

**Younicos has carried out 38 projects around the world, with 200MW of energy storage commissioned or under construction. "As storage and renewable energy becomes more cost-competitive, it's becoming more interesting for large energy users to invest in battery storage," he says.**

**As at grid level, batteries for commercial customers offer a variety of services: security of supply, load shaving, improving the economics of on-site renewables, peak-shifting, supporting demand response and avoiding system charges.**

**Depending on the jurisdiction, energy storage systems could typically create savings for commercial customers between 30% and 50%, based on studies EY has conducted in various global markets.**

**As with any battery investment, the economics can be dramatically improved by stacking the services the batteries provide, and ensuring that the owner is getting paid for as many of these as possible, says EY's Stock.**

**She also cautions that buyers need to understand how the technology type that is chosen, and how the batteries will be used, will influence the economics of the investment. "There are challenges around communicating and understanding the technologies involved," she says, noting that how frequently the batteries are used, and how completely they are cycled, "can have a significant impact on how long batteries will last."**

# India's power play

**India's Government has committed to an audacious program of building new renewable energy generation. But, as bid prices tumble, can it deliver sustainable results?**

A combination of strong government support and increasingly attractive economics has helped to push India into second place in the latest issue of our Renewable energy country attractiveness index. This follows recent dramatic growth in renewables, with more than 10GW of solar capacity added in three years – from a low base of just 2.6GW in 2014 – and record new wind capacity installed in 2016-17 of 5.4GW, according to official figures.

This growth is in the context of the Government's ambitious targets – 175GW of renewables by 2022, with 40% installed capacity from renewables by 2030 – and the dramatic price falls in solar PV technology in particular. In recent tenders, solar developers have offered to supply power at lower prices than new-build coal plants, effectively blocking new coal capacity.

India's 2022 target, set by Prime Minister Narendra Modi in 2014, includes 100GW of solar; 60GW ground mounted and 40GW rooftop. Wind is expected to deliver 60GW, with biomass and small hydro accounting for the remaining 15GW. In the 2016-17 financial year, India added 12.5GW of renewable energy capacity, compared with 10.2GW from conventional sources.

In March, ENGIE's subsidiary Solairedirecte won a tender for 250MW of solar capacity in Andhra Pradesh with a bid of INR3.15/kWh (US$0.049), beating the previous Indian record bid of INR3.30 (US$0.05) by ACME Solar in the Rewa Ultra Mega Solar auction in Madhya Pradesh in February. But the May tender for 250MW of solar capacity in Rajasthan saw a new low of INR2.62/kWh (US$0.041), bid by Phelan Energy Group and Avaada Power for 50MW and 100MW respectively at Bhadla Solar Park.

However, such low bids raise questions over whether developers are taking on excessive risk. On the one hand, falling bids track lower technology costs and cheaper capital, allowing developers to maintain margins. On the other hand, those margins are already squeezed by the competition that auctions tend to generate. Some projects may not be delivered or quality may be compromised.

Many developers and their investors are assuming costs will continue to fall. Bids also appear to be predicated on developers achieving scale so as to generate operational efficiencies; it is doubtful that all developers will be able to reach the scale required. In addition, major adverse currency moves or rising interest rates will make equipment and finance more expensive, putting projects at risk.

Major failures could have knock-on effects. Increased risk perception among investors could raise the cost of capital; if future bids began to climb back up, the utilities and distribution companies with whom developers are entering into power purchase agreements (PPAs) would become less willing to buy. Although these utilities and large power consumers have targets to buy clean power (or green certificates) under the Government's Renewable Purchase Obligation (RPO) program, more needs to be done to enforce these obligations, with a number of utilities falling far short.

The Government needs to increase compliance with the RPO, as well as ensure that India's distribution companies, many of which are financially distressed, have the capacity to continue to purchase renewable electricity, especially if bid prices level off or rise. And the availability of capital remains a concern; the Government could ease rules around tapping foreign debt.

The Government faces several other challenges in meeting its 175GW target. Issues around land rights – for renewable energy systems or transmission lines – are slowing development. In February, the Government increased the proportion of

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Wind turbine blade production by Suzlon Energy at its factory in Bhuj, Gujarat, India

> The Government will have to turn its attention to the ability of India's grid to manage intermittent renewables.

solar capacity it expects to build in large-scale solar parks to 40GW from 20GW. These parks, where the Government secures land rights and transmission capacity, have proved attractive to developers and investors.

The Government's 40GW rooftop target is also looking challenging, with only around 1GW of rooftop capacity added in the country so far. Developers have proved cautious about the credit risk involved in contracting with residential customers, while incumbent utilities have stalled, reluctant to lose valuable clients to insurgent solar companies.

In the wind sector, a lack of transmission capacity between areas of high wind resource and load centers has created bottlenecks in the past – although bid prices for wind have also been falling. In February, the country's first 1GW reverse auction cleared at INR3.46/kWh (US$0.053), substantially below recent bids around the INR5 mark, due to intense competition from 2.6GW of bids. More wind auctions are now expected to drive prices down further.

In the last financial year, wind beat its target, installing 5.4GW compared with the target of 4GW. However, despite impressive growth of 6.8GW in 2016, solar is lagging its target of 12GW (7GW of utility-scale and 5GW of rooftop solar), showing just how ambitious the Government's goals are. The Government's additional emphasis on PV parks will help to plug the gap, but it needs to do more to encourage rooftop solar installations.

In the medium term, as renewable energy penetration rates increase, the Government will have to turn its attention to the ability of India's grid to manage intermittent renewables, especially around the evening peak, when solar availability falls away. The cost and availability of energy storage technology could dictate how close India gets to meeting its renewable targets.

Meanwhile, India's regulators must be mindful of the erosion of electricity market peaks caused by growing volumes of renewables and storage – this can undermine the economics of thermal power plants, risking the stability of the system as a whole. ■

## Going all in on EVs?

**In April, India's energy minister Piyush Goyal suggested that, by 2030, the Government aims to have such a robust electric vehicle (EV) sector that no new petrol or diesel cars would be sold in India; he added that the Government is working on promoting EVs significantly.**

**State-owned energy companies such as NTPC and POWERGRID are reportedly exploring the potential of EV charging stations: lower than expected energy demand growth is prompting generators and utilities to develop new markets.**

**Last year, EY calculated that, assuming six million EVs on Indian roads by 2020, with an average battery size of 100kWh, the EV fleet would increase annual power demand by 93TWh and could boost distribution company revenues by INR990b (US$15.4b). The fleet would also help absorb growing volumes of renewable energy, and improve grid stability by providing extra storage and distributed generation. Overall, such a fleet would deliver a net positive economic impact of around INR200b (US$3.1b) on the power and utilities sector in India by 2022.**

Renewable energy country attractiveness index

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Strong levels of recent investment will be aided by the country's feed-in tariff (FiT) regime for wind being extended to 2019. Solar volumes may fall slightly following the country's move from FiTs to auctions and a focus on smaller rooftop projects.

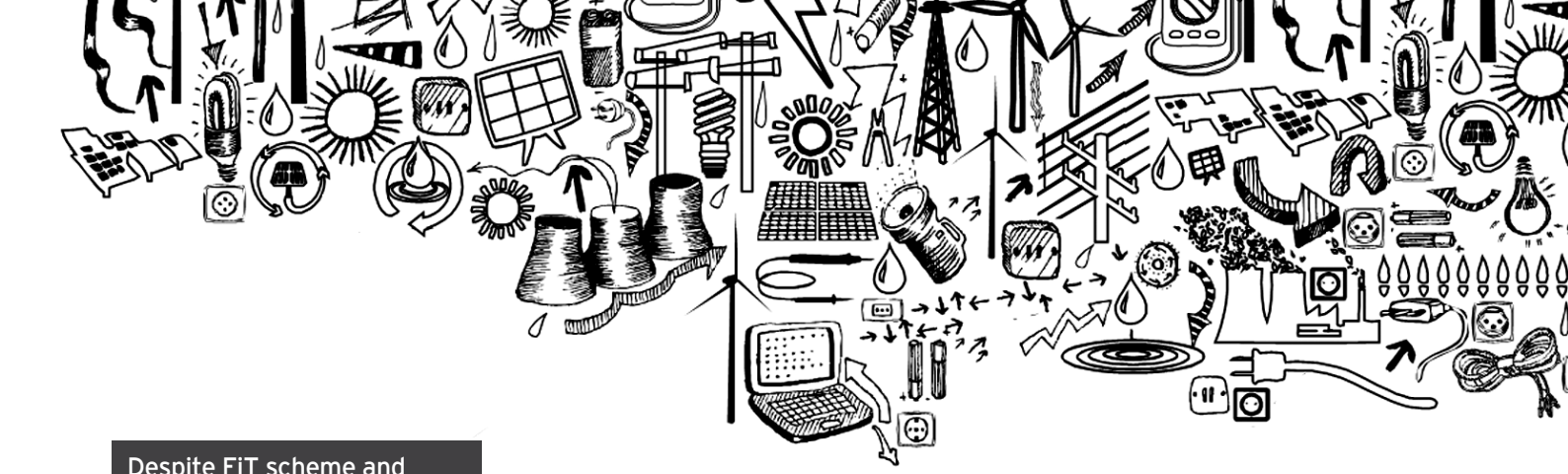
Rank 1 China
Rank 2 India
Rank 3 United States
Rank 4 Germany
Rank 5 Australia
Rank 6 Chile
Rank 7 Japan
Rank 8 France
Rank 9 Mexico
Rank 10 United Kingdom
Rank 11 Canada
Rank 12 Argentina
Rank 13 Denmark
Rank 14 Morocco
Rank 15 Brazil
Rank 16 Netherlands
Rank 17 Turkey
Rank 18 Italy
Rank 19 South Africa
Rank 20 Sweden

A marked shift in US policy has resulted in the demise of the Clean Power Plan, which has made renewable investors more nervous about possible reductions to the Investment Tax Credit and Production Tax Credit. Concerns also include if gas prices continue to remain low and transmission capacity remains stagnant.

After a year of record investment in renewables, with coal on the decline, the country is gearing up to maintain its renewables target but also ensure grid stability through increased storage.

The cancellation of Brazil's A-3 wind and solar auction in December demonstrates the effect the sharp decline in energy demand has had on the country, due to the severe recession and political instability.

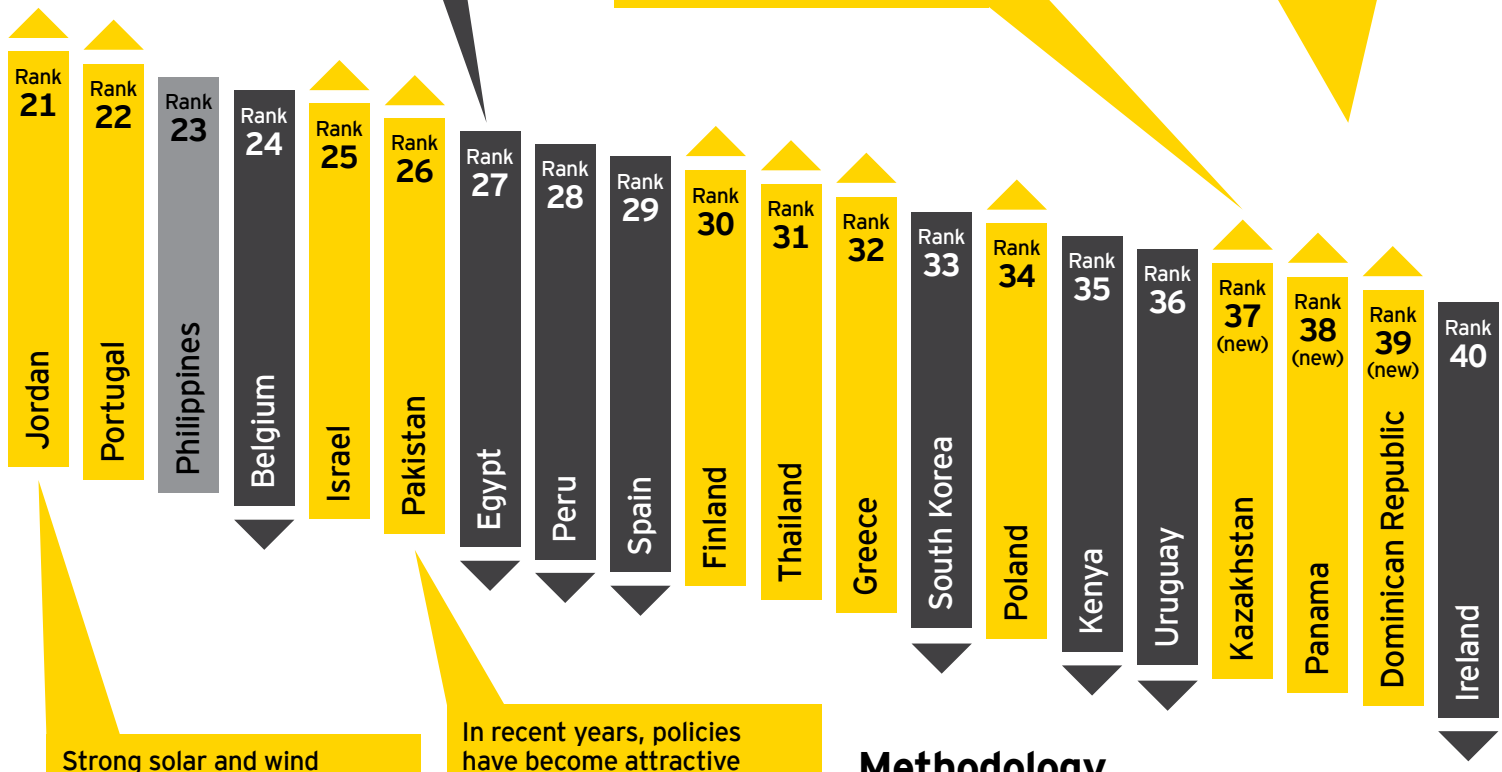
Following the credit rating downgrade and ministerial reshuffle, uncertainty continues over whether Eskom will finally sign the 37 outstanding PPAs it has with renewable energy independent power producers (IPPs), leaving investors nervous.



Despite FiT scheme and targets in place, investment in Egypt has slowed this year, caused by slower economic growth, political and security risks, and local content requirements.

Kazakhstan's macro fundamentals and high energy imperative have driven it into the RECAI. The European Bank for Reconstruction and Development agreed in December 2016 to a €200m (US$218m) loan to boost the country's renewable generation and transmission systems through private investments.

Following in the footsteps of Mexico's booming renewables market, other Central American and Caribbean nations are now lining up for green energy – driven primarily by energy security risks and an increasing demand for more power.




Strong solar and wind resources in the country are encouraging investment. There are plans to award 300MW by the end of this year: four solar and two wind plants, each at 50MW, helping to edge toward a 2020 target of 1,800MW.

In recent years, policies have become attractive for renewables through a successful FiT regime. There is a 3.5GW wind target in place by 2018 and large solar plants are also being constructed, though solar is now due to move to competitive auctions.

## Methodology

The Index has been recalibrated, with all underlying datasets fully refreshed, leading to a fair degree of movement since the October 2016 issue. To see a description of our methodology, please go to ey.com/recai.

### Legend

▲ Increased attractiveness compared with previous index
▼ Decreased attractiveness compared with previous index

## German offshore tender sees zero-subsidy bids

Three of the four winning bidders in Germany's latest offshore wind tender have offered to supply subsidy-free power. German utility EnBW and Danish firm DONG Energy secured PPAs in April's auction for a total of 1,490MW of capacity, to be operational by 2025.

One of DONG's projects, the 110MW Gode Wind 3, submitted a bid for a subsidy of €60/MWh (US$65), which it will receive in addition to the wholesale power price. The other three winning bids had no subsidy requirements, so the weighted average subsidy for the tender was just €4.40/MWh (US$4.80), less than a 10th of the previous tender.

DONG and EnBW said that the projects will rely upon lower-cost "next-generation" turbine technology, and noted that developers will not bear the cost of grid connection.

The next German offshore wind auction, for 1.55GW, is planned for April 2018. In total, the program targets a total of 6GW to 7GW of offshore capacity.

*See the "Insight" article on offshore wind growth on page 14.*

## Australia mulls batteries as grid gets greener

The role of renewables and battery storage technologies has shot up the political agenda in Australia amid closing coal power plants, a shortage of natural gas and recent state-wide outages that were blamed on an over-reliance on renewable energy.

On 3 April, ENGIE shut its 1.6GW Hazelwood coal-fired power plant, the country's largest; an additional 3.6GW of Australia's 24.6GW of coal capacity is scheduled for closure over the coming years. Meanwhile, export demand for Australian natural gas means that domestic gas-fired generation is struggling to compete. Wind and solar, by contrast, account for 70% of proposed new capacity.

However, Australia's grids are struggling to cope with large volumes of intermittent renewables. In September, the grid operator blamed a seven-hour blackout in South Australia – where 43% of capacity was wind and solar, as of May 2016 – on control settings in wind turbines leading to a failure of grid frequency controls. Large-scale battery storage has been put forward as part of the solution. Tesla founder, CEO and Chairman Elon Musk won headlines by offering to install a 100MW battery system within 100 days. The South Australian Government subsequently announced a tender for 100MW of battery storage, as well as a 250MW gas-fired plant, to shore up its grid.

Energy policy remains highly contentious, with the opposition Labor Party pushing for continuing investment in renewables, while Prime Minister Malcolm Turnbull has been more supportive of fossil power. Nonetheless, the Minister for the Environment and Energy Josh Frydenberg recently told ABC Radio that the Government has no plans to change its 2020 renewable energy target of 33,000GWh, or about 23.5% of demand.

## China to invest US$363b in renewables by 2020

China is to spend CNY2.5t (US$363b) developing renewable power capacity by the end of 2020, according to the country's National Energy Administration (NEA). Its plan, unveiled in January, will see renewables account for half of all new generating capacity by 2020, creating 13 million jobs.

The NEA did not provide details of where the money would be directed, but it follows the publication last December of the 2016–20 plan from the National Development and Reform Commission (NDRC), China's economic planning agency, which said CNY1t (US$145b) would be directed to solar power and CNY700b (US$101b) to wind over the period.

China is also to launch a pilot green certificate program in July, in which project operators would be issued tradable certificates proving they have generated clean power. These could then be sold to consumers, such as utilities or large corporates, ultimately with a view to replacing subsidy payments.

The proposal follows reductions, also announced by the NDRC in December, in the subsidy payments that new wind and solar projects will be entitled to receive. The Government also has continued restrictions on new wind farms in remote areas where power demand and grid infrastructure are weak, and where turbines have been left idle.

China plans to cut its greenhouse gas emissions by 18% per unit of economic growth by 2020 compared with the 2015 level; it has now made the target binding, as part of its commitments under the Paris Agreement.

## UK continues CfD round, despite looming election

The UK will continue with its forthcoming auctions of renewable energy Contracts for Difference (CfDs), despite the snap general election called for 8 June. The Government plans to allocate CfDs providing £730m (US$943m) of annual support over three rounds, including £290m (US$375) in the current round, which opened on 3 April.

This round is open to "less established" technologies – offshore wind, advanced conversion technologies, biomass with combined heat and power, wave, tidal stream and geothermal – but not onshore wind and solar. The Government has published maximum CfD strike prices, set at £105/MWh (US$136) for offshore wind projects operating in 2021–22, and £100/MWh (US$129) in 2022–23. It has also capped offshore wind at 1.5GW from the existing tender.

While the UK environment for renewables is more settled than in recent years, which saw subsidy cuts, there is little clarity around the landscape after Brexit. Issues around

renewable energy targets, subsidies and connections with mainland power markets are unlikely to be resolved before Brexit. Despite the UK being behind on progress to its 2020 EU renewables target, coal-fired power has declined significantly, reaching zero usage during an entire day (24 April) for the first time.

## Chile starts taxing carbon

Chile introduced South America's first carbon tax on 1 January, levying power generators and other large producers US$5 for each tonne of carbon dioxide equivalent they emit.

The tax is expected to make it almost impossible for new fossil fuel-fired generation to compete, especially in the context of recent technology-neutral power tenders where wind and solar plants have won the bulk of available capacity.

Around 90% of Chile's power is from fossil generation, and 85 companies that generate more than 50MW of fossil fuel-fired power are set to pay the carbon tax. According to a recent study by the Pontifical Catholic University of Chile, it will raise power prices by about US$2/MWh, raising around US$100m a year, and could reduce GDP by 0.4% by 2030.

## Trump reverses US climate policy but holds fire on Paris

US President Donald Trump has signed an executive order rolling back many of the Obama Administration's climate change policies, but has yet to decide whether the US will pull out of the Paris climate change agreement.

At the end of March, Trump signed the Energy Independence Policy Executive Order, which aims to promote domestic energy production, explicitly mentioning fossil, nuclear and renewable sources.

It requires the U.S. Environmental Protection Agency (EPA) to review the Clean Power Plan, which seeks to reduce dramatically carbon emissions from the power sector. However, the new EPA Administrator Scott Pruitt has said he is not planning to challenge the 2007 Supreme Court endangerment finding, which ruled carbon dioxide to be a pollutant that must be regulated.

Despite claiming before his election that climate change was a Chinese "hoax" aimed at damaging US manufacturing, Trump has not yet acted on his campaign pledge to withdraw the US from the 2015 Paris Agreement. Administration officials are split on the issue, with some – supported by some oil majors and even US coal companies – arguing US interests are best served by staying at the table. A decision was promised ahead of the G7 meeting in Italy this month, but was postponed until after the event.

Similarly, despite Trump's promise to put coal miners back to work, energy market economics suggest that natural gas and renewables will continue to deliver the bulk of new power market capacity. The the ITC and PTC, which support solar and wind respectively, were extended in 2015 and enjoy bipartisan support, not least given related job creation. Developers are pressing ahead with PTC-supported projects, with NextEra Energy alone announcing plans to build out 10GW of wind by the end of 2022.

## Saudi Arabia launches 9.5GW renewables drive

Saudi Arabia has started its planned program to develop 9.5GW of renewables by 2023 with the launch of a tender for 400MW of wind and 300MW of solar projects. A tender for 620MW of solar and 400MW of wind is to follow. Saudi Arabia is developing 30 wind and solar projects as part of a US$50b program to increase power generation and reduce oil consumption. It currently has just 200MW of solar capacity.

Meanwhile, the state-owned oil giant Saudi Aramco has won the country's first license to generate renewable energy. It relates to a wind power joint venture with General Electric to provide energy for Aramco's own need. ■

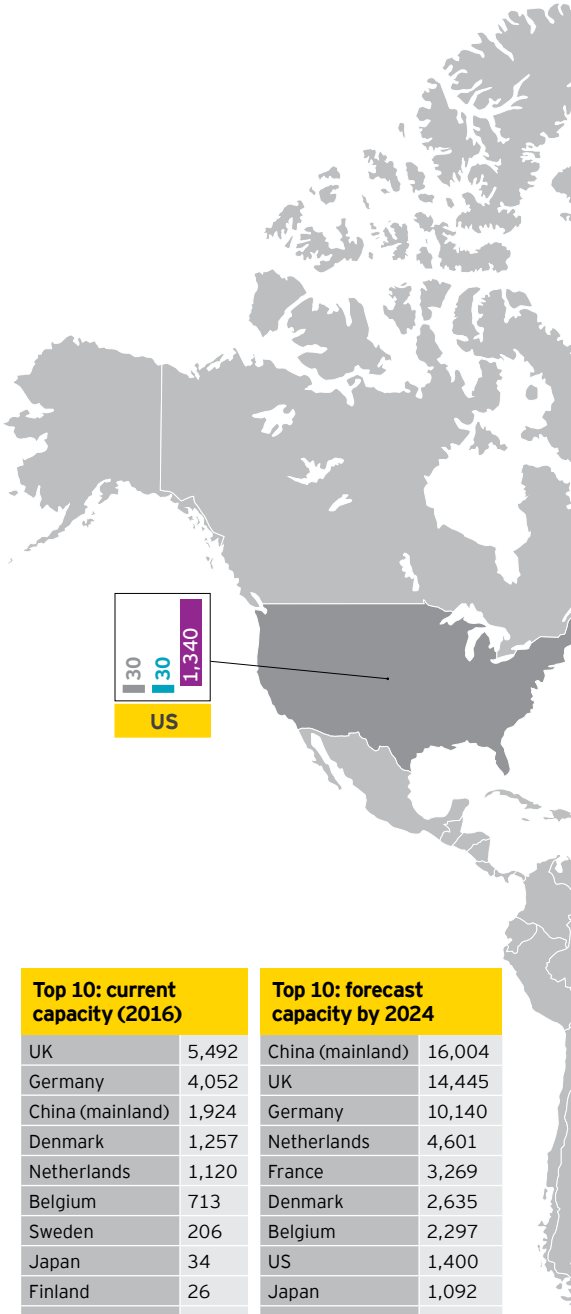
## EU renewable energy revisions threaten consumer choice

In an effort to strengthen consumer choice and clarify post-2020 regulations, the European Commission released in November its vision for a new Renewable Energy Directive, REDII. However, proposals in article 19:2 of the draft text for the mandatory auction of Guarantees of Origin (GOs) have united end users, market players, environmental groups and many national governments in opposition. They are concerned that, in its current form, the mandatory auction of GOs – the "currency" that drives the renewable electricity market – would take away consumer choice and restrict the ability to support specific renewables projects.

Auctions would commoditize renewable electricity and make it impossible for GO buyers to choose certificates from specific projects or project types. The proposal would severely impact existing long-term agreements as well as new renewable power projects in Europe. For example, generators entering into corporate PPAs would be obliged to release the GOs their projects generated to government-run auctions, rather than transferring them to the PPA offtaker – undermining the sustainability goals of the corporate organization. It would strip from end consumers the opportunity to have direct contact with electricity producers and would significantly complicate community investment in renewables.

Industry stakeholders, generators and consumer groups alike view this as reversal from the direction previously endorsed by the European Commission, and fear that it will constrain consumers in the electricity market precisely at a time when governments and end-users are looking for ways to empower citizens and businesses. RECS International is leading a coalition of interested stakeholders to address these issues with the European Commission and the European Parliament.

# Offshore winds blow strongly




**Dramatic falls in the cost of offshore wind are now helping to spread the technology around the world. But are low costs sustainable, and does the industry have sufficient long-term visibility to guarantee its continued success?**

Five years ago, the Government of the UK – then, as now, the largest market for offshore wind – set the industry a challenge: to bring down the levelized cost of electricity (LCOE) from offshore wind by a third by 2020. In January, the Offshore Wind Programme Board (OWPB), which brings together industry and the Government, reported that this target was achieved last year, four years early: offshore projects had an average LCOE of £97/MWh (US$125), down from £142/MWh (US$183) in 2010–11.

"We have seen cost reductions thanks to the early adoption of larger turbines, increased competition and the lower cost of capital," the report noted. "[The] industry is now embracing new opportunities, and the cost of offshore wind will continue to fall over the next decade."

The UK is not alone. In 2016, project developers won tenders run by the Dutch and Danish governments at less than half of the UK LCOE. In November, the Swedish state-owned utility Vattenfall won a Danish Government tender to build the 600MW Kriegers Flak wind farm in the Baltic, at just €49.9/MWh (US$54.4), thought to be the lowest yet for offshore wind.

A month later, a consortium led by Shell won the tender for the Dutch 700MW Borssele III and IV Wind Farm, in the North Sea. The €54.5/MWh (US$59.4) bid means that, over the 15-year contract, the Dutch Government will pay operators a total subsidy of just €300m (US$327m), a fraction of the €5b (US$5.4b) subsidy it expected to pay.

For these two bids, there are local factors at play. The cost of connecting these farms to grids – perhaps €10/MWh to €15/MWh (US$11 to US$16) – is not included in the bid price. Both are close to shore and in shallow waters, reducing installation and maintenance costs. But the tenders still demonstrate the potential of what was once a comparatively expensive clean energy technology to deliver, at scale, without prohibitive subsidy costs.

"That offshore wind is becoming increasingly cost-competitive with other technologies is almost self-feeding," says Nick Gardiner, Managing Director, Head of Offshore Wind at the UK's Green Investment Bank (GIB), which has committed more than £2b (US$2.6b) to the sector. "The activity you see in the space in Europe is leading to an explosion of interest in other markets."

Globally, around 16GW of offshore wind is expected to be commissioned from 2017 to the end of 2020, according to figures from MAKE Consulting. This compares with 14.9GW installed by the end of 2016. By 2024, MAKE estimates global capacity will reach almost 60GW.

The most significant factor in cost declines is the dramatic growth in turbine size, says Gunnar Groebler, Senior Vice President – Head of Business Area Wind at Vattenfall: "We're finalizing implementation of project Sandbank [where construction started in 2015] with 4MW turbines. By the end of this year, we'll be installing 8.3MW turbines."

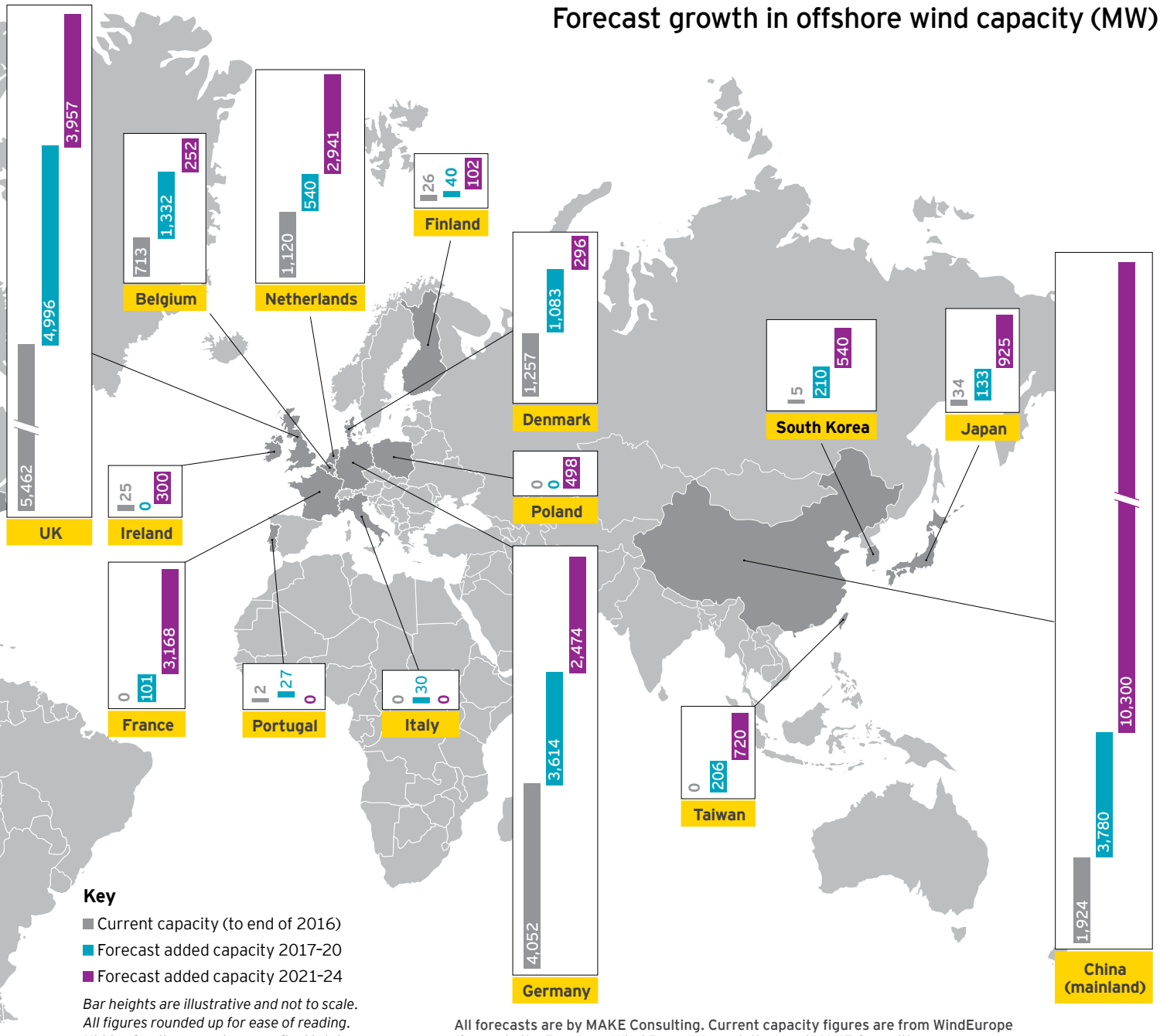
Doubling each turbine's capacity halves the number of foundations that need to be built for the same total output, and dramatically reduces operation and maintenance (O&M) costs, both of which reduce the exposure of the project to weather-related delays. "All of this adds up to quite substantial cost decreases," Groebler says.

Andrew Ho, Senior Offshore Wind Analyst at WindEurope, stresses the importance of multi-year policy support for offshore wind.

| Top 10: current capacity (2016) | |
|---|---|
| UK | 5,492 |
| Germany | 4,052 |
| China (mainland) | 1,924 |
| Denmark | 1,257 |
| Netherlands | 1,120 |
| Belgium | 713 |
| Sweden | 206 |
| Japan | 34 |
| Finland | 26 |
| Ireland | 25 |

| Top 10: forecast capacity by 2024 | |
|---|---|
| China (mainland) | 16,004 |
| UK | 14,445 |
| Germany | 10,140 |
| Netherlands | 4,601 |
| France | 3,269 |
| Denmark | 2,635 |
| Belgium | 2,297 |
| US | 1,400 |
| Japan | 1,092 |
| Taiwan | 926 |

## Forecast growth in offshore wind capacity (MW)




All forecasts are by MAKE Consulting. Current capacity figures are from WindEurope (formerly the European Wind Energy Association) and MAKE Consulting.

"We wouldn't have got that technological innovation had we not had a supportive framework and market visibility. ... The support we've received has allowed the industry to invest in made-for-offshore turbines."

Charles Thompson, Director at the UK's Offshore Renewable Energy Catapult (ORE Catapult), notes that specific policy and regulatory support can help drive down costs: "Local factors play a significant role. Regulatory and consenting regimes differ considerably, with the burden of risk – a significant cost driver – varying enormously."

As an example, he points out the recent low tender prices were supported by regimes that undertake the burden of consenting, site surveys, grid connection and transmission, greatly reducing the cost to developers.

Andrew Ho notes the "one-stop" permitting authorities provided by Denmark and the Netherlands greatly reduce the complexity of bidding and negotiating contracts, unlike the "multiple authorities" that developers in UK waters have to deal with.

Overall, says Gordon Edge, former Director of Policy at industry lobby group RenewableUK and now Director at Inflection Point Energy Consulting, the accretion of experience across the gamut of offshore wind activities has led to reduced perceptions of risk, which help to shrink the returns that investors demand.

"This is helping to bring in bigger pools of capital with lower return expectations," he says, which – given low interest rates and investors' constant search for assets with predictable revenues – means there is low-cost debt and equity available.

Market participants agree that offshore prices in the €50/MWh to €60/MWh (US$54 to US$65) range are likely to remain the exception rather than the rule, given the local factors at play. But the industry is confident average prices can be driven lower. Last

> "The activity you see ... in Europe is leading to an explosion of interest in other markets."

Converter substations in Germany's Nordsee OST wind farm

June, 11 leading participants, including utilities (Vattenfall, E.ON, Iberdrola and RWE), equipment makers (Siemens, MHI Vestas Offshore Wind and GE) and oil company Statoil, stated that the industry could achieve cost levels of €80/MWh (US$87), including costs of grid connection, by 2025.

Lower offshore wind costs are encouraging countries beyond Europe, which accounted for 87% of installed capacity in 2016, according to MAKE Consulting. Mainland China had already installed almost 2GW by then; it is expected to have 16GW by 2024. Japan, Taiwan and South Korea also have offshore wind development plans. In the US, the industry has faced stiff opposition, but the first offshore wind farm – 30MW off Rhode Island – began operating in 2016. By 2024, it is forecast to have installed 1.4GW of offshore capacity.

The GIB's Gardiner credits the cost reductions the industry has delivered, its performance record and its ability to deliver large volumes of capacity. Analysts note that, while countries outside Europe will benefit from some of the forces bringing down costs – such as technological innovation, cheap capital and accumulated experience – other factors are location-specific. Edge notes that local supply chains will take time to develop, and some regulatory barriers will add costs. In the US, for example, the 1920 Jones Act requires that ships carrying goods between US ports be US-built, which will slow installation of offshore turbines.

Similarly, costs tend to increase where governments require that their offshore subsidies benefit the domestic economy, through local content requirements and the development of domestic supply chains. In the UK, Edge notes that, "the Government's putting in lots of money, and they're asking, 'Where's the beef for the UK economy?'. To keep pushing down costs, you're going to want to be importing components from Riga [in Latvia], rather than making them in Rotherham [in the north of England]."

Meanwhile, some industry voices have raised concerns about unsustainable tender levels due to bidders seeking to buy market share by proposing loss-making projects. DONG Energy CEO Henrik Poulsen has warned of "irresponsible players" submitting bids that are "value destroying."

The danger, some fear, is of auctions leading to a race to the bottom with undesirable results: contingency funding cut to the bone, cost-cutting that adds to health and safety exposures, skimped operational practices or overly optimistic assumptions made on project availability. The risk is that projects could end up being shelved, leaving holes in government renewables targets, or could fail, leaving investors nursing heavy losses.

Groebler argues that Vattenfall, at least, has proceeded prudently: "I've heard the concerns. But we're talking about billions of euros of investment. No one can afford to buy market share at that level." He adds that Vattenfall's owner – the Swedish state – "has clear return expectations at the industry standard level." However, he agrees that offshore wind "remains a young sector with associated risks."

Investors should be mindful of them, says Ross McWhirter, Senior Executive – Power & Utilities, Corporate Finance, EY. Key pre-construction considerations are the number of contracts the investor is party to as well as counterparties' track records, he says. Once the project is operational, investors should consider the contractual protection provided: availability guarantees, manufacturers' warranties, the scope of service agreements as well as any protections embedded in the PPA.

Tenders and procurement methodologies should take into account the quality of bids, including deliverability as well as price, says Andrew Perkins, Partner, Corporate Finance, at Ernst & Young LLP: "Tender processes should be adapted to reflect this. Feedback from recent market tenders shows an increasing appetite to take long term O&M risk – and, of course, the current cost of capital is low. A major threat to the market, however, would be higher interest rates, as this would increase the LCOE at a time when government support will be even more limited."

But a bigger concern for the sector – and for prospects of further price declines – is medium-term visibility on policy support, says Ho at WindEurope, which, in Europe, is lacking after 2020. Such visibility "would allow investment to continue in offshore."

The corporate group that predicted an average €80/MWh by 2025 also warned that the commitment depended on "the right build-out and regulatory framework," and that it is "only possible with a stable, long-term market for renewables in Europe."

It continued: "If the offshore industry is to realize its cost-reduction goals, a strong pipeline of projects is needed to scale up offshore deployment and identify efficiencies in the supply chain. Following a record year for installations in 2015, a serious question mark remains over the post-2020 environment for offshore wind."

Thompson at ORE Catapult agrees, and says that policymakers should "take a long-term view: building a large and complex industry does not happen overnight and requires certainty to deliver investment." ■

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# High-level solar opportunity

A 2.6MW solar installation on the roof of Cambodia Beverage Company's bottling factory in the Phnom Penh Special Economic Zone

Southeast Asia has some of the world's fastest-growing economies, accompanied by rapidly growing energy demand. High levels of solar radiation, coupled with a rising awareness of the overall benefits of clean energy, suggest significant potential for solar power. However, the region's uptake of utility-scale solar systems, as seen in other emerging markets, lags significantly behind as a result of a number of local challenges for project developers, including access to large areas of land and to deregulated power markets.

Solar developers are therefore shifting their focus upward: specifically, to the rooftops of C&I energy users. With the right support from regulators and policymakers, C&I rooftop solar represents a multi-gigawatt opportunity across the region.

"It's a way of monetizing an idle asset, and it presents a win-win for the clients and developers," explains Raju Shukla, executive chairman of Cleantech Solar, a Singapore-based solar rooftop developer that has already commissioned a portfolio of 50 projects across the region. Falling solar system costs – down 25% to 30% over the last year alone – mean that his company can install, own and operate rooftop solar systems while providing customers with power at least 10% cheaper than from the local utility, and up to 40% less, he says.

Tapping commercial rooftops could help overcome two of the biggest barriers to large-scale deployment of solar in Southeast Asia. The first is access to suitable land for solar systems. In some countries, securing the necessary approvals and permits can be an onerous process, while compensation payments to existing landlords can be costly. Moreover, there are often alternative uses for land – such as palm oil cultivation or, for that matter, fossil fuel-based energy generation – that are likely to offer higher yields per hectare than a solar farm can achieve.

The second challenge is the structure of local electricity markets whereby power prices – especially for residential customers – are cross-subsidized by retail customers, making it difficult for solar farms to sell energy to the grid at competitive prices.

Installing rooftop solar systems can get around these problems. C&I customers often have readily available "real estate" in the form of substantial roof space on factories, offices and warehouses. In addition to potentially offering power at a lower cost than that available from the grid, rooftop solar systems can deliver higher energy security where power supplies are unreliable.

In addition, C&I customers can be offered long-term, fixed-price contracts, often over 20 to 25 years, reducing their exposure to price rises imposed by the local utility. And, whether the customers involved are multinationals with local operations or local suppliers to global supply chains, they can reduce their environmental footprint.

The proposition is not without its challenges. Shukla notes that customers tend to require extensive health and safety as well as technical due diligence before allowing a third party to install large systems on their rooftops. Some are reluctant to enter into contracts that extend beyond 10 years. And, in markets where surplus power – such as that generated at the weekends – can't be sold into the grid through net metering regulations, the power price discounts that can be achieved tend to be at the lower end of the range.

Rooftop developers face additional regulatory barriers in the region. For example, in Vietnam, the state utility EVN is currently the sole off-taker of electricity generated by independent power producers. Nonetheless, Shukla says that client interest is building fast, presenting opportunities for investors. The business model is capital intensive, meaning that those developers who can tap cheap institutional funding offer a competitive advantage. Similarly, advantages will accrue to those developers with the scale to manage their assets actively on an ongoing basis, not least in trading surplus power.

In advising developers across the region, we have found significant investor interest in providing debt and equity to support development. International investors have experience of the business model in other jurisdictions, and they recognize the potential to generate predictable, long-term returns from such investments. Those developers offering homogenized, high-quality rooftop systems also stand to benefit from the possibility of raising finance across their portfolio.

Cleantech Solar has found significant addressable potential: it calculates that just the 10 largest companies in the region have available roof space and power demand for 2.7GW of systems. Thailand, the Philippines and Singapore already offer regulatory and market environments that are conducive to rooftop solar development, and Vietnam has recently agreed a policy framework to encourage development of solar power, including rooftop, with bidirectional net metering allowing consumers to sell excess power into the grid.

Minor regulatory reforms elsewhere could dramatically increase the opportunities, offering attractive returns for investors, compelling power-purchase terms for large energy consumers and an improved environment for local people. With nearby India targeting 40GW of rooftop solar by 2022 (although facing some challenges encouraging development – see page 8), Southeast Asia could look to follow its lead in encouraging a thriving solar rooftop sector. ■

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# Working to increase renewables' pace

The Petronas Towers in Kuala Lumpur

In 2016, Malaysia launched a series of solar tenders that, if successful, will help it on its way to achieving a renewable energy capacity target of 4GW by 2030, representing 11% of the country's total power generation by that date.

Last year's tender called for proposals to build 300MW of large-scale solar PV projects. After whittling down 66 bids, Suruhanjaya Tenaga, Malaysia's Energy Commission, awarded 21-year PPAs to 19 winning bidders, upscaling the tender to a total of 460MW of capacity. Those bids were awarded at around MYR0.4/kWh (US$0.09).

In comments to EY, the Energy Commission described the first tender as generating "both [an] overwhelming response and competitive prices."

In February, it published a second tender notice, this time calling for requests for proposals (RFPs) for PV projects ranging from 1MW to 30MW in size, for a total of 360MW in Peninsular Malaysia and 100MW in Sabah, East Malaysia. As with the first tender, foreign ownership will be limited at 49%.

In an evolution from the first tender, the Energy Commission has embedded the technical and financial qualification process within one RFP process, rather than having an earlier request for qualification (RFQ) stage, to give bidders more time to prepare ahead of the 1 August deadline for submissions. The Commission says that more than 400 copies of the RFP documents have been purchased by potential bidders.

Malaysia currently boasts around 462MW of renewable energy capacity, according to its Sustainable Energy Development Agency (SEDA), of which the majority (296MW) is solar PV. Under the country's 2011 Renewable Energy Act, a FiT program was introduced, which is available for small-scale solar PV (less than 1MW), biogas, biomass, small hydro and geothermal, with annual generation capacity caps. That legislation also created SEDA, which is responsible for administering the FiT program and advising the Government on sustainable energy policy.

Malaysia's Intended Nationally Determined Contribution (INDC) sets a goal of reducing the greenhouse gas (GHG) emissions intensity per unit of GDP by 45% by 2030 relative to 2005 levels. Of this, 35 percentage points are pledged on an unconditional basis, with the remainder conditional upon receipt of climate finance, technology transfer and capacity building from developed countries.

The large-scale solar program is intended to deliver 1,000MW of solar PV plants by 2020, according to the Energy Commission. In addition, the Government has introduced fiscal incentives and a net energy metering program for rooftop solar PV, which is intended to support a further 500MW of capacity by the same year.

The current large-scale tender is open to companies or consortia with previous experience in power or related projects, according to the bid notice. The tender is – in line with existing Malaysian Government policy – open only to consortia that are at least 51% domestically owned. There are, however, no local content requirements on developers of projects either under the FiT scheme or the large-scale tenders.

Matt Tingle, Associate Director, Infrastructure Advisory – ASEAN TAS at EY in Singapore, assessed the PPA terms for the first tender, finding that they measured up well against international standards. "We were pleased with the bankability of the PPAs," he says.

Malaysia also has a sufficiently deep local capital market to fund new renewable energy capacity, according to Tingle. "The financing market is fairly strong and there's good appetite for the tenders," he says, with interest from domestic banks, international lenders and issuers of sukuk (Sharia-compliant) bonds. Although the PPAs are ringgit-denominated, US dollar lending was competitive even after swapping into the local currency, Tingle adds. Further initiatives such as the Green Technology Financing Scheme are helping to reduce lending costs to renewable energy projects.

When it comes to the integration of intermittent renewable energy generation, the Energy Commission is taking "a controlled approach," stating that: "This is to gauge the impact on the grid system and identify any mitigation required. Economically, we also want to keep the end-user tariff affordable." A pilot project will also explore how large battery storage can help with ensuring continued grid stability.

There is a long road ahead to meet Malaysia's targets: its interim aim to achieve 2GW of renewable energy by 2020 is fast approaching. The measures being taken by the Energy Commission to focus on solar PV will help to accelerate its deployment. In addition to the Energy Commission's efforts, the Government, through the Ministry of Energy, Green Technology and Water (KeTTHA) is reportedly developing a blueprint for a long-term road map to secure a clean energy future for Malaysia. ■

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# Back in the game?

For many investors, Spain is a case study in how *not* to promote renewables. A generous feed-in tariff (FiT) program before the global financial crisis saw wind and solar development rocket – putting Spain in second place, globally, behind Germany in terms of installed solar capacity by the end of the last decade.

However, the uncapped subsidy regime failed to take into account falling technology costs, making its FiTs increasingly attractive and causing developers to pile in. The structure of Spain's electricity sector meant utilities were unable to pass the costs on to consumers, leaving the Government to shoulder a growing deficit. The post-crisis response was draconian: not only were subsidies for new wind and solar plants slashed, but retroactive tariff cuts were imposed on existing plants, leaving many owners and investors nursing heavy losses.

The upshot – apart from ongoing litigation as investors pursue the Government through the courts – was a freeze in new renewable energy capacity after 2011. Despite this hiatus, Spain still boasts substantial renewable energy capacity; some 23GW of wind, 4.7GW of solar PV and 2.3GW of solar thermal, out of a total generating capacity of 100GW. According to the system operator, renewables (including hydro) supplied about 39% of the country's electricity during the first three months of 2017.

Nonetheless, it seems Spain is on course to miss its EU renewable energy target of 20% of final energy generated by renewable sources by 2020 due to lack of progress on renewable heat and transport. To meet it, between 3GW and 6GW of further electrical capacity would need to be brought on-line, depending on energy usage in the next few years.

The actions taken so far by the Government, although highly controversial, mean the electricity sector is now in a sustainable position, allowing the Government to bring forward additional renewable energy capacity through a new series of tenders. Rather than guaranteeing income through FiTs, it is requiring developers to bid to receive relatively small subsidy payments.

The first auctions, for 500MW of wind and 200MW of biomass, took place last year. A new auction, expected to take place on 17 May 2017, seeks bids for up to 3GW of renewables capacity.

The process has raised eyebrows within the industry. The 2016 auction saw bids submitted by wind developers who sought no subsidy in addition to merchant power prices. While this partly reflected falling technology costs, market observers also interpreted the bids as a consequence of developers seeking to recover sunk costs.

For the new tender, the Government is to make available subsidies totaling €600m (US$654m) annually, which, according to Bloomberg, the Ministry of Industry, Energy and Tourism says guarantees a "reasonable yield" of 7.4%. Giles Dickson, CEO of WindEurope, welcomes the auction, but says linking subsidies to capital investments "ties investors' hands in how to do their project economics." He describes the auction as "unique across the EU for its complexity."

But what has concerned renewable energy specialists is a provision the Government has introduced that allows it to review, after six years, the level of payments to winning projects to ensure that they are not excessively profitable.

"The possibility to modify the reasonable profitability of projects every six years could be interpreted as a retroactive measure in disguise," says Dickson.

"This sends the wrong signal to investors who have been through this experience once already and who are now looking for stable revenues on their projects," he adds. He also notes that the logic of an auction is to introduce competitive tension in procurement, so "there is no excuse for any revision of support levels throughout the lifetime of the installation."

Jorge Casillas, Executive Director of Global Risk and Regulation and Markets at Madrid-based developer EDP Renewables, says his company is considering participating in the tender if it decides it can manage exposures created by the regulation. However, he notes that "the scheme introduces risks which cannot be controlled by the investor," such as the ability of the Government to adjust project returns. It does not "provide the stability and long-term visibility on remuneration which is needed for a low-cost investment in renewables," he adds.

Spain's renewable energy association APPA has also raised concerns about the lack of technology-specific tenders, noting the auction therefore favors wind as the lowest-cost technology. This is shortsighted, as it means the tender will fail to support less mature technologies, says José María González Moya, APPA's Managing Director.

Nonetheless, high levels of interest in the auction are expected, and it is likely that developers will, once more, bid to receive low- or no subsidy payments, receiving only the pool price. This will make financing these projects difficult, requiring developers either to secure PPAs direct with energy consumers or to turn to financial products that allow projects to hedge the power price risk.

Ultimately, however, renewables in Spain are following the path seen elsewhere around the world – moving toward cost competitiveness with conventional generation. As financiers get increasingly comfortable with the technologies involved and the power market risk, government auctions and subsidies will become increasingly irrelevant. ■

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