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The retail energy revolution

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Dealing with disruption

Disruption, it seems, is the new status quo. Rapid change, enabled by information technology and the accelerating pace of scientific research, is a constant feature of 21st century economic life.

For a sector such as power and utilities, with its long investment cycles and infrastructure whose operational life is measured in decades, disruption can sometimes appear distant, slow moving and manageable. For incumbent retail energy businesses, with healthy margins and limited customer churn, the pressure to move quickly can appear minimal.

But in today's economy, when disruption comes, it can be brutal. Recent history is littered with companies that failed to see the technological writing on the wall: Kodak, Blockbuster, BlackBerry.

> Whether through partnerships or acquisitions, incumbents and insurgents will need to come together.

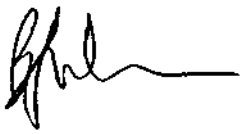
On pages 4 to 7, we explore how the digitization, decentralization and decarbonization of the energy system promises to transform the retail energy market. What is clear is that time is running out for the existing model, where utilities seek to supply a growing volume of a commodity product, competing primarily on price.

Historically, large utilities have focused on running large, long-term engineering projects; building and running power plants, and the transmission and distribution network. The relationship with the customer has, to a large extent, been an afterthought.

In a market disrupted by technology, that relationship will have to come front and center. The utility of the future will integrate retail consumers into a much more dynamic energy system, bringing together energy storage, residential renewable generation and existing grid-level supply. Through smart meters and the Internet of Things, successful utilities will be able to leverage closer relationships with their customers, allowing them to expand into higher value-added services.

With retail markets in flux, nobody has got all the answers; neither the incumbents nor the insurgents attempting to disrupt the retail power market. The former lack the agility, the latter lack the scale – and it is questionable whether the insurgents' investors will have the patience, or the deep pockets, to allow them to grow organically to become self-sustaining.

Collaboration is the answer. Whether through partnerships or acquisitions, incumbents and insurgents will need to come together if either are to succeed. Of course, collaboration is, in itself, no magic bullet. Finding the right partners, managing the relationships involved and bringing together very different cultures can be as challenging as going it alone: the difference is, at least it holds out the prospect of success.



Ben Warren
EY Global Power & Utilities Corporate Finance Leader

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A district of Heerhugowaard in the Netherlands, called the "City of the Sun"

The retail energy revolution

A digitized, distributed and decarbonizing residential energy market will see the competitive landscape redrawn. Can incumbent utilities survive?

The energy supply business is in flux. In most industrialized countries, power demand is flatlining or shrinking. Margins are under pressure, as new and agile competitors erode the market share of incumbents. Digitization and new technologies are transforming the relationship between generators and consumers and upending market dynamics, while decarbonization adds costs and complexity.

Consumers in developed countries are using less energy. In July, the U.S. Energy Information Administration released data showing that, after sustained growth for two decades, residential demand fell between 2010 and 2016 — by 3% in absolute volume and 7% on a per-person basis.

Households are also starting to abandon their traditional suppliers. From 2013 to 2016, the market share of the UK's top six energy companies fell from 99% to 85%. This competition, combined with the effect of renewable energy generation on wholesale prices, has hit utilities hard in some markets.

Underpinning these forces is the digitization of the energy system. Smart meters, digital networks and big data are enabling a distributed, democratized energy system, potentially putting control — and economic power — in the hands of the consumer.

How should utilities and their investors respond? The precise contours of the future utility business model are unclear. But Matt Rennie, EY Global Transaction Advisory Services (TAS) Power & Utilities Leader, suggests it will combine a range of technological, financing and customer-engagement innovations that save the consumer money. It will do so by bringing together increasingly low-cost distributed renewable energy and storage systems, managing away the demand peaks that account for a large part of power system capital expenditure. "These innovations will give us a peakless network, where we are no longer building for those 8 to 10 hours a year of peak demand," says Rennie.

But that also implies a complex, multidirectional and flexible power system, or costs will be much higher. And that raises questions about the role of the consumer. Should utilities prepare for the rise of engaged "prosumers," who both generate and consume power, and who take an active interest in optimizing their energy use? Or should utilities instead assume the vast majority of householders will remain passive consumers, for whom reliability and cost remain the overwhelming concerns?

"Consumers traditionally haven't had to have an opinion about energy — it's been something almost invisible," says James Mandel, a Principal in the Rocky Mountain Institute's electricity practice, based in Colorado. "Many aspects of the energy future that we're excited about involve consumers doing things — making decisions about where they source energy, pricing plans, how they fit smart devices into their lifestyles, do they participate in demand-side management programs, do they buy electric cars."

Vermont-based utility Green Mountain Power (GMP) is positioning itself in the vanguard of the energy transition, offering energy service products that range from help with energy efficiency all the way to enabling customers to go off-grid (while continuing to pay GMP for their energy).

"The majority of our customers want reliable, affordable and clean energy … that delivers increased comfort," says Josh Castonguay, GMP's Chief Innovation Executive. "But they don't want to have to think more about their energy consumption or what time of day they're consuming it. It's on us to deliver products and services that don't put any more burden on the customer, that don't complicate their lives, and hopefully improve it."

He adds: "Our view is that the energy delivery model needs to change. We're shifting to one that is distributed; home, business, community-based. To get there, we need a whole new set of tools we've never had before. We're going from thousands of power plants in New England to what could be millions of discrete points all over the distribution system, and they need to be choreographed and managed. If it's done well, it's going to reduce the cost of operating the system, and really improve the customers' energy life, comfort and reliability."

So, how do we get from here to there? Where should incumbent margin retailers be directing their investment, and where should investors make their bets?

"It's much easier to make investment decisions if you know where you're heading," says Steve Hellman, a Managing Partner at Energy Impact Partners (EIP), a US-based private equity firm backed mostly by strategic utility investors. "If you can say, 'this is where we think we're going to be in 10 years,' let's work backwards and find the components of that road map."

He spells out two broad scenarios. The energy service model sees the utility becoming "a partner in the customer's energy decisions," helping the customer to reduce their costs while, at the same time, optimizing the structure of the grid to deliver power.

The other scenario is where the utility becomes what Hellman calls "a 'smart integrator,' where the utility becomes a platform to facilitate interaction among a proliferation of customers and actors on the grid — where the utility is the manager of that interface among service providers, customers, generators and other third parties, and manages that complex interaction."

Stewart Reid, Head of Asset Management and Innovation at Scottish and Southern Electricity Networks (SSEN) in the UK, offers the analogy of distribution utilities transforming from traditional brick-and-mortar supermarkets, where consumers simply buy energy, similar to an eBay model, "where consumers might buy energy from local community projects or a neighbor's solar panels, or sell it to someone charging an electric vehicle."

"The role of the DSO [distribution system operator] then would be like the Post Office," he says, providing the platform "to tell customers, on a real-time basis, that they can transfer power from A to B, when you can do it, and how much it's going to cost. Utilities become a platform for facilitating the trade of energy across the network."

Similarly, Markus Nitschke, a spokesman for German utility E.ON, describes his company as becoming more like a bank, using both onsite and remote battery storage to allow consumers to make deposits and withdrawals. "In the future, we won't be dealing with our own energy only — we'll be handling energy produced by the consumer, servicing their account."

The speed of the changes involved poses problems for incumbents.

"Fundamentally, the biggest challenge for utilities is the agility to keep up and adapt to a market that is changing rapidly," says Brendan Lane, Senior Manager, Advisory, at EY. "How committed will they be to setting up the business of the future whilst maintaining their current margin retail businesses of today? ... The risk is that at some point they will pass the inflection point where they are too late to catch up."

Certainly, a business model that moves away from integrated generation, distribution and supply becomes one driven less by capital-intensive infrastructure and more by IT innovation — allowing more agile tech companies to erode market share.

E.ON's Nitschke says this is changing the culture of some big utilities: "Our business is becoming mainly IT-driven." This necessitates different relationships with its partners. In the past, E.ON tended to either develop products and services internally, or seek majority ownership of partners; "now, we're co-operating much more" with giants such as Google, which is working with E.ON on a service that helps homeowners evaluate the attractiveness of installing solar photovoltaic (PV) panels, as well as with much smaller firms, such as online heating supply firm Thermondo.

Lane believes that some retailers will look to acquire or partner with providers of technology platforms that will, among other things, allow peer-to-peer trading of surplus renewable energy generated by households and businesses, or that will allow the aggregation of large volumes of distributed energy generation or storage: "We expect that some of the big retailers will look to snap up, or partner with, platform providers: if they can scale those platforms across their existing customer base, they can make a big jump forward in market position and establish a base into which they can plug other technologies."

> "The biggest challenge for utilities is the agility to keep up and adapt to a market that is changing rapidly."

However, encouraging a culture of innovation is not necessarily easy for incumbents. "Innovation and utilities are complicated concepts to bring together, not because utilities have a bad culture — on the contrary — but because they have a very clear mandate to keep the lights on. ... Innovating in that environment can be risky," says Hellman at EIP.

His firm manages private equity investments, mostly on behalf of an international group of utilities, in a variety of new energy companies that have proven technologies and business models and are now seeking scale. "We're trying to derisk the innovation process," he says, observing that one of the problems for utilities seeking to invest in or partner with emerging technology providers is "asking whether the company is even going to be around in five years to support that software or product."

Of course, IT is as much about software as it is about hardware, and the move to a digitized future is bringing with it new challenges. GMP is embarking on a large-scale program of installing and controlling Tesla Powerwall 2 batteries, partly to provide backup for consumers, and partly to provide distributed storage capacity that the utility can use to earn revenue and reduce costs. Opportunities include tapping the batteries

to reduce peak demand, energy arbitrage (such as taking advantage of negative prices in the New England power pool), frequency regulation and operating reserves. "There's also specific local benefits," such as deferring investments needed to alleviate local network constraints, says Castonguay. The company is offering residential customers the chance to install Powerwall batteries at just US$15 a month, a reduction in cost resulting from improvements in the efficiency of the technology and by the new revenue streams that it will allow customers to access.

The biggest challenge, he says, is getting all the kit to work together: "The controls are everything." For example, an earlier pilot with the first version of the Tesla Powerwall ran into problems not because of the batteries themselves, but because of the web dashboard for the SolarEdge inverter used by Tesla, which subsequently incorporated its own inverter in the Powerwall 2, which works more smoothly.

It's a familiar challenge for Matt Hastings, Programme Director for the Cornwall Local Energy Market (LEM), a pilot under way in the UK's southwest, funded by utility Centrica and the EU. It is installing technology in 150 homes and businesses that will allow consumers to test the use of flexible demand, generation and storage. "Alongside a lot of technical integration – how do you optimize your battery and your EV [electric vehicle], for instance? There's a need for software to integrate them as well."

> The biggest challenge is getting all the kit to work together.

A big part of that pilot, Hastings says, is developing a "simplification engine" that allows for distributed resources to be aggregated and traded in wholesale markets. "This will allow householders to access revenue streams" from existing and planned electricity markets, he says.

Advances in battery technology and economics have been driven in large part by the EV industry. This offers the energy sector a bright spot in terms of demand: in the UK, National Grid estimates EVs could add 8GW of peak demand by 2030. But managing that demand is also a significant challenge: meeting an early-evening EV peak, with the costs involved in ensuring adequate supply and reinforcing distribution networks, could be very expensive.

SSEN has been conducting pilots looking at the effects of the "clustering" of EV purchases – a phenomenon seen, for example, in rooftop solar. "We found when we reached 40% uptake on any one street, we had constraint issues," says Reid. SSEN tested a demand-side management system that allowed supply to be shared between the vehicles overnight, ensuring they were all charged by the morning – with an emergency button provided should a car be needed urgently. "The level of acceptance from customers was high," Reid says. It helps that the imposition is not onerous: "We'd be unlucky if there were more than two or three hours a year we need to manage," he adds.

Reid says that consumers can be persuaded of the need to share common services. He gives the example of traffic lights, which are accepted "because crossroads can't be shared, and we can't have flyovers at every junction. Road users can still do what they want to do, which is to get from A to B.

"The challenge for us is to get the message out early, and tell the story to consumers so they understand why," he adds.

There is also a pressing need for investment in the infrastructure – both physical and, increasingly, digital – needed to pull the pieces together. "Smart, digitized infrastructure will be a key enabler to the vision of the future – balancing loads, enabling large-scale distributed generation and energy storage and growing EV demand – that piece needs to happen" says EY's Lane.

For that, intervention by governments and regulators will be necessary. Nina Skorupska, Chief Executive of the Renewable Energy Association in the UK, praises regulatory changes announced in July by the UK Government that, among other things, will encourage battery storage, help enable smart homes and businesses – and help consumers use energy when it is cheapest.

A virtual insurgent

Ireland-based start-up Solo Energy, plans to break into the UK retail market with a low-cost, 100% renewable energy tariff built on a virtual power plant (VPP) comprising thousands of customer-hosted battery systems.

"There's been very little disruption to the supplier part of the energy market over the last 20 years – that's where we see the opportunity," says CEO and co-founder Mark Hamilton. "Our approach is all about taking energy storage to the mass market, as a way to disrupt the energy supply model."

The plan uses switching websites to attract customers with market-beating renewable energy tariffs, supplied by third-party generators. Solo will then offer customers even better tariffs if they agree – at no cost – to install a battery on their property.

The batteries, controlled by Solo's cloud software, will charge when wholesale prices are low, typically at times of peak renewable generation and low demand, and discharge them to customers – and the grid – when prices are high. If customers have behind-the-meter generation, such as solar, the batteries will also be used to maximize self-consumption.

"It's all about using energy storage to make demand flexible," says Hamilton. "We want to change the way we use energy by enabling demand to follow the intermittency of renewable generation."

The company is planning to begin marketing in the UK early in 2018 and is signing up customers for its launch phase. "All the elements that allow our business model to work have come together in the UK market," he says – smart metering and half-hourly settlement in wholesale power markets.

In addition, by aggregating thousands of batteries into a VPP, Solo will be able to carry out arbitrage trading in the wholesale market, as well as offering grid balancing services, which could potentially be particularly valuable at the distribution network level, according to Hamilton.

These additional revenue streams have the potential to transform the economics of energy supply, he adds. "The standard supplier model assumes you need 30,000 plus customers to get close to breakeven. If things converge as we expect in the market, we believe we can reach breakeven somewhere between 5,000 to 10,000 customers by driving the prosumer revolution where customers generate and use more of their own energy using renewables and energy storage."

Residential take-up of solar in a German village

She says that "the Government has started taking some of the key actions necessary," such as removing network charges on batteries when they are both charged and discharged: "We always want more, certainly, but we're pleased that the regulator has started to address some of the market rules needed."

However, Skorupska accepts there's a delicate balance to be struck: "Our hope is that government and regulators don't create frameworks that shut down new ideas. But we're talking about people's homes and energy supplies. Regulation needs to ensure the involvement of reliable, responsible and responsive companies."

Similarly, more work is required to ensure market standardization, says Hastings. "On the software integration side, there are a number of protocols that have been thought about … [such as] open-data style protocols that enable different layers to interact more efficiently. That work could be accelerated."

A particular problem utilities face is persuading customers to accept change. The challenge here, as Hellman puts it, is that "you can't knock on a consumer's door and say: 'In 15 years' time this is what the world will look like, and don't you want to be prepared?' Most consumers care about what they are paying today and whether it's worth even having the conversation. … A lot of change will be the result of third parties facilitating the process and bringing solutions that customers can understand in the context of their decision-making today."

Philipp Pausder, Founder and Managing Director of Thermondo, believes that utilities are not sufficiently responsive to customer needs to effectively facilitate those processes. His Germany-based firm is using the supply and maintenance of residential heating systems to develop long-term relationships that, in future, will allow the company to evolve into a full-service "non-commodity utility."

Utilities' core competencies lie with building and operating large-scale power plants, trading power and lobbying governments, Pausder says, but "the new model will be completely different," relying instead on many thousands of small-scale projects and much closer relationships with consumers.

"As a householder, you will be faced with a lot of new models of buying electricity, trading electricity, perhaps getting paid to consume electricity. In this digital, distributed and connected world, householders will need a partner to understand and take away the complexity, instead coming up with precise and simple offerings," he says. "You have to be good at lots of things: marketing, sales, coding, people management, process design and customer care. It's ultimately all about outstanding service to customers."

But there is no reason that incumbent utilities can't hold their own in a distributed, digital marketplace, believes Yunus Ozler, Partner, Advisory Services, Power & Utilities at Ernst & Young LLP. Developing capabilities in smart-home technologies can allow utilities to extend existing consumer relationships into value-added services such as security and monitoring of appliances and energy systems.

"Utilities need to adopt a new mindset, commit to a longer-term business case and plan for 'day-after-tomorrow' technologies to avoid the risk of obsolescence," Ozler says. "They should adopt an opportunistic, flexible business model, and build the right capabilities and partnerships with companies that can provide agility, market-leading digital capabilities, and offer differentiation."

For EY's Rennie, this last element may be the most important. He believes that considerations around the right technology solutions and business models are secondary to the right pairing of incumbents and insurgents. He says that it is likely to be too capital intensive for new entrants to acquire sufficient customers for the scale needed, while incumbents will struggle to adapt their internal cultures to embrace change at the speed required.

The problem is that utilities have competed for consumers almost exclusively on price, but are now attempting to sell deeper engagement and value-added services – a more complicated sales proposition. "Customer acquisition for new energy services is higher cost and, as a result, organic growth of new energy retailers is low. When you combine a higher cost-of-serve model with a cash combustion engine, you're going to implode," Rennie says. "We're not going to see new energy companies take over markets through organic growth.

"They are quietly educating the customer base, but they are doing it at high cost and burning through their shareholders' cash. The providers of that capital are going to get impatient." He calculates that around six million customers are needed to achieve the necessary scale to compete. He cites acquisition costs of around US$30–US$50 per customer, implying an investment of around US$300m – a price tag most investors are likely to consider too high.

Instead, Rennie believes these investors will push new energy retailers toward acquiring incumbents: "The new energy retailers get to deploy through scale, while for the margin retailers, it provides the transformation they need to operate in the market of the future." ■

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The potential of mini-grids

In large parts of sub-Saharan Africa and other remote areas, up to two-thirds of people have no access to electricity. How attractive is the mini-grid market?

For the 1.2b people around the world that lack access to power, it's a compelling vision. Just as emerging economies leap-frogged over fixed-line to mobile telephony, so power-starved rural communities could develop their own mini-grids – small-scale power networks, using renewables, batteries and, if required, diesel generators – rather than waiting for network operators to build out expensive centralized grid infrastructure.

On the face of it, this is a big market opportunity. "The cost of energy can be dramatically cut by eliminating the need for transmission infrastructure," says Constantin Ginet, Head of Micro Grid at Siemens in Nuremberg, Germany. As an example he cites remote locations in Africa, facing electrification challenges: "Micro-grids can reduce operational costs for electricity by over 30% compared with a connected grid."

Such systems can compete favorably with diesel, often the default alternative. In some remote rural areas in Africa consumers are paying as much as US$6/kWh for power, while solar/battery mini-grids, depending on size and user numbers, can potentially deliver power at US$1.30/kWh, says a 2017 study by the Rocky Mountain Institute (RMI) and the Carbon War Room. For solar-diesel hybrids, costs may be as low as US$0.30/kWh.

This sector has attractions for investors. RMI estimates that the addressable off-grid market in just four African countries (Senegal, Kenya, Tanzania and Uganda, which have existing markets and regulatory environments that are friendly to mini-grids) would generate US$740m in annual revenue – or US$1.5b, if the costs of such systems could be reduced by 50%, which RMI believes is achievable.

Mini-grids come in all sizes. A village mini-grid with 10kW–200kW of capacity costs between US$100,000 and US$2m; mini-grids that could power a large town or small city might require up to US$30m. But there is a circular challenge, notes Pepukaye Bardouille, Senior Operations Officer at the International Finance Corporation (IFC), the private sector arm of the World Bank Group: "The 'typical' mini-grid requires average revenue per user of roughly US$15 to US$30 a month. Assuming power costs at 10% of income, that assumes monthly income of between US$150 and US$300, which in turn assumes users have 'productive use' appliances – i.e., appliances that allow their owners to make a living.

"At that level of economic activity, central grid extension is likely to make sense, so mini-grid developers would likely find themselves competing with the grid." The danger for investors is if the conventional grid is subsequently extended, and subsidized power is offered to the mini-grid users without a clear approach to compensation, their investment is at risk.

There are also other barriers, says Bardouille: "For example, no national utility mandated with serving the country wants to come across as unable to do so, which becomes apparent when other players – often smaller developers from overseas – come into the market. If viewed as competition rather than a perhaps more cost-efficient approach to complimenting the central grid's reach, the result is friction.

"Many mini-grid developers are approaching this space with limited demographic and socioeconomic information – where exactly are households located, how much do they earn, how much do they spend on electricity. And getting this data can be costly. Moreover, there is a lack of clarity on central grid extension plans on the part of utilities or rural electrification agencies. As such, business planning becomes complex."

"There is a data gap," agrees Harrison Leaf, the CEO of SteamaCo, a UK-based automation company which, among other things, provides downstream consumer management systems that enable mini-grid systems. A better understanding of how usage patterns change once consumers start paying for power can inform new investments, he says.

Meanwhile, inadequate policy and regulatory frameworks in many frontier markets can make investment difficult. "For example, in several countries only the national utility can sell power," says Fabrice Nicolas, Head of Sales Microgrid at Siemens in Nuremberg, Germany. In addition, renewable energy assets carry greater investment risk than conventional generation equipment, as the costs are all up front. "A diesel genset, by contrast, is a small capital expenditure but carries high operating costs," he adds.

All this makes the investment proposition complex and returns uncertain. "The main challenges are not around technology but financing," says Nicolas, noting that the due diligence and transaction costs are high relative to the sums needed.

"Mini-grids offer an exciting investment opportunity. But we need to be clear-eyed about how early the market is. It is really difficult to make energy access micro-grids work on a purely commercial basis," says Alexia Kelly, CEO at Microgrid Investment Accelerator (MIA), launched by Facebook and Microsoft and incubated by the

merchant banking firm Allotrope Partners.

"The participation of grant funding and low-cost, very patient debt and equity is critically important in attracting private finance," she adds. MIA is seeking to raise a US$50m facility that blends concessionary finance with private-sector funding, which should enable it to offer returns in the high-single digits, rather than the mid-teen to low-20s that private sector investors would typically expect.

"A lot of what MIA will do is looking at aggregation and investment vehicle options where we help to pool, derisk and aggregate bundles of projects," says Kelly, given that development finance institutions tend to have minimum thresholds of around US$10m for these types of investments. "There's a real need to look at innovative financing models and approaches to enable us to help scale up the market and crowd in private capital."

Bardouille at the IFC would like to see a broader array of companies in the market. "The solution is partnerships," she says. "I would like to see greater involvement of international utilities as well as domestic utilities, who know how to [have a] dialogue with regulators and who can influence policy." Larger companies, experienced in infrastructure development, can offset some of the weaknesses in the start-ups and social enterprises that currently dominate mini-grid development in emerging markets.

> "Mini-grids offer an exciting investment opportunity. But we have to be clear-eyed about how early the market is."

Such partnerships could bring down the costs. The RMI report states it is possible to halve average mini-grid costs by using best-in-class technologies and systems. Other tactics – buying components and software direct from specialists, increasing system modularity, using smart meters and demand-management techniques, clustering mini-grids – can help reduce costs by a further 50%. And this is all before factoring in continuing declines in the costs of crucial components such as solar panels.

These cost cuts make medium-term prospects for mini-grid roll-out and profitability very bright, says Kelly: "If we can make it work today at current equipment costs, and at the early stage that many developers are at, things will only get better."

But with the mini-grid sector currently dependent on funding from development finance institutions and other donors, the withdrawal of the US from the Paris Agreement\, and the expectation that it will reduce the volume of climate finance that it sends overseas, has cast a pall.

"The US withdrawal has limited the potential pool of concessionary capital we'd be looking to engage with – the US Government has done a huge amount of work across climate change mitigation," says Kelly. "Having those resources start to pull out from the Green Climate Fund and from all the bilateral programming has an impact. Although I note that a number of European governments – Germany in particular – have really stepped up." In the six years to 2020, the EU has committed more than €1.06b (US$1.25b) to West Africa for sustainable energy projects, including off-grid and mini-solutions.

Meanwhile, there are lessons that are being learned in emerging markets that can inform business models and technology deployment in industrialized countries, notes Nicolas at Siemens. "Fantastic solutions have been developed in terms of how mobile phones are used to buy electricity, and the centralized systems and databases that lie behind them," he says. "We're learning from these experiences every day." ■

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Creating an asset class

Powerhive's 50kW Bara Nne site in Kenya's southwestern Kisii County

In Nairobi, Kenya, Powerhive is building a mini-grid business that aims to deliver electricity to rural communities, on a fully commercial basis – and that could end up deploying hundreds of millions of dollars in off-balance sheet project finance. "What we're trying to do is make this an asset class that people can invest in, [via] properly structured [transactions] done in the same way you'd do large infrastructure projects," says Rik Wuts, who co-founded California-based Powerhive in 2011.

The initial plan was to develop the technology to remotely monitor and control mini-grids and their payment systems, but the lack of potential customers encouraged the company, after some pilots, to develop its own projects. It is building and operating mini-grids in Kenya and the Philippines, and is expanding into Uganda and Nigeria. "Our angle is using technology to build a scalable model for mini-grids," he adds.

Government policy is a key determinant of success. Wuts says the company is a strong proponent of "cost-reflective tariffs," on the grounds that few governments would have the resources to subsidize more than a fraction of the rural energy need. To help make its projects work, Powerhive is also developing businesses that can leverage its presence on the ground – including one providing Internet services, and another helping its customers farm chickens, and other revenue-generating activities.

Powerhive funds projects on its balance sheet, raising US$20m last year from a mix of financial and corporate venture capital funds, including Caterpillar Ventures and Total Energy Ventures. But the company is eyeing wider fund-raising.

"This model needs scale to really work. It's hard to make a good business on a few mini-grids," Wuts says. The objective has been to put the processes, methods and tools in place that will allow large-scale investment. "We're trying to show everyone that this can be done properly, that it's a viable business, and that investors can have an impact with their money rather than just investing it with oil companies."

Renewable energy country attractiveness index

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Rank 1 China

Rank 2 India

Rank 3 United States

Rank 4 Germany

Rank 5 Australia

Rank 6 France

Rank 7 Japan

Rank 8 Chile

Rank 9 Mexico

Rank 10 United Kingdom

Rank 11 Argentina

Rank 12 Canada

Rank 13 Morocco

Rank 14 Denmark

Rank 15 Netherlands

Rank 16 Turkey

Rank 17 Brazil

Rank 18 Italy

Rank 19 Egypt

Rank 20 Portugal

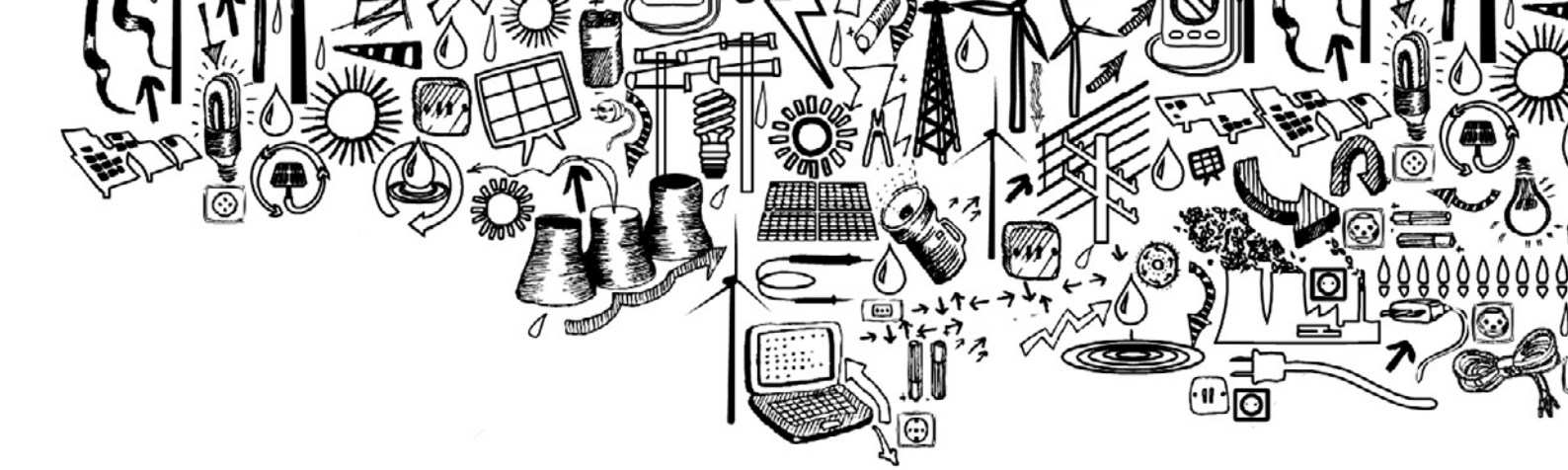
The second contract for difference (CfD) auction awarded over 3GW offshore wind at the historically low price of £57.50/MWh (US$77.9/MWh) delivered in 2022-23, undercutting 2015 prices by half and Hinkley Point C nuclear CfD by almost 40%.

A decline in new investment in renewables this year due to grid overcapacity. However, a north-south link due in late 2017 should help settle the market.

PV capacity rose 21GW over the past six months while wind curtailment fell 7% over a year. New targets have set to cancel or defer 106GW of coal power, while Beijing mulls the deadline for a future ban on internal combustion engine sales.

Latest tender awarded 1GW to onshore wind at 50% below the ceiling price, drawing international interest from major manufacturers. PV grew three-fold in a year to 1.5GW.

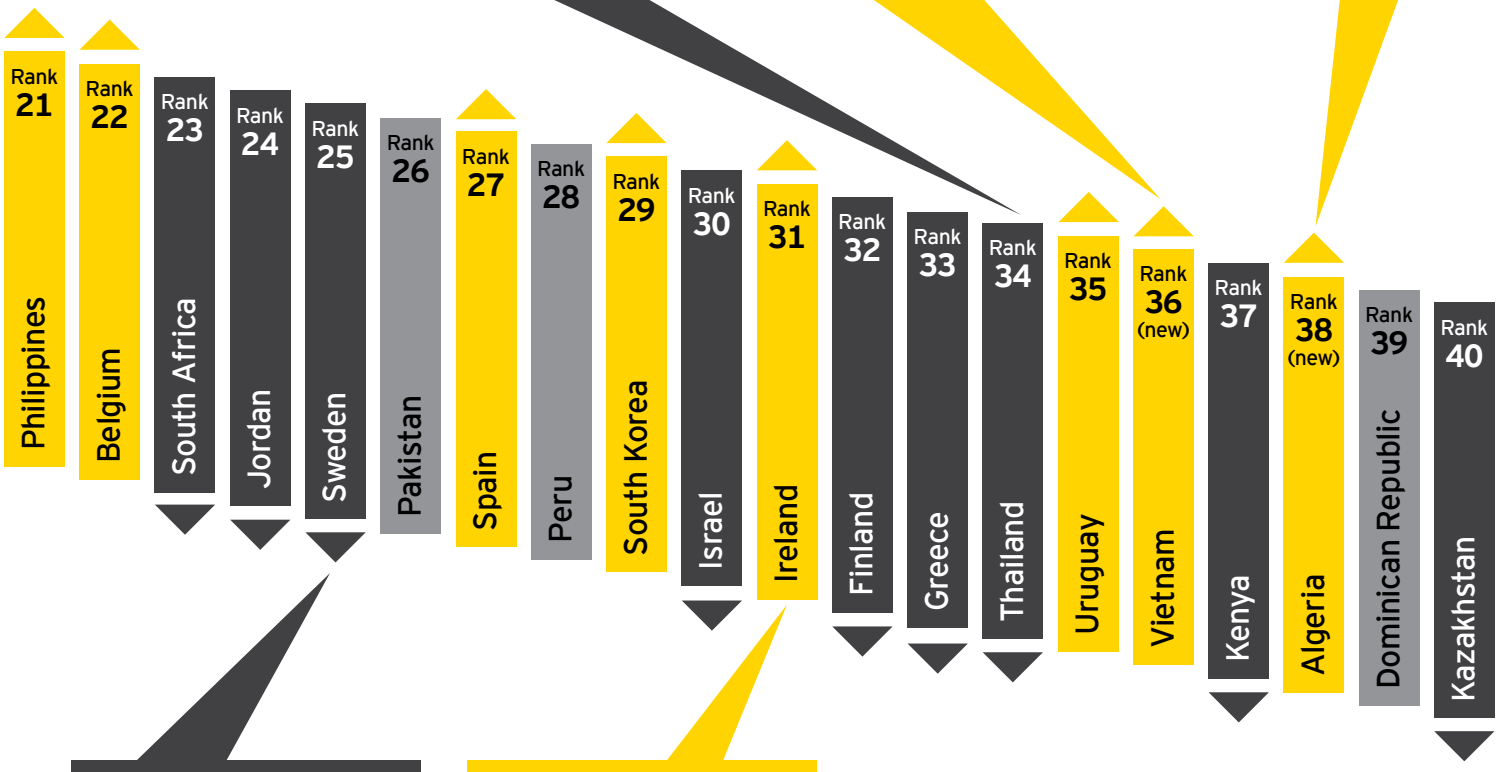
Feed-in tariff (FiT) system has resulted in 1GW PV under construction, with more projected for next year under a potential auction program.



With an increase in pricing for onshore wind alongside an ambitious new solar policy and FiT, renewables are increasingly seen as a means to reducing coal use and achieving energy independence.

Despite recent challenges and delays, Algeria continues to seek to rival other North African countries in solar PV production with a 4GW solar tender.

FiT rates are set to be lowered in the next round of projects tendered in 2018, alongside a comprehensive review of the bidding system.



Low power prices and returns have weighed on recent deal activity. The Government has put in place a US$829m investment program to achieve Sweden's zero emissions goal by 2040.

Solar power will be included in Ireland's new CfD auction to replace the Renewable Energy Feed-in Tariff (REFIT), alongside support for new technologies such as storage.

Methodology

The Index was recalibrated in early 2017, with all underlying datasets fully refreshed. 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

Concerns raised about India's solar target

Doubts are growing concerning India's ability to meet its 2022 target of 100GW of solar PV, while the cancellation by state-owned distribution companies (discoms) of wind energy power power purchase agreements (PPAs) is ratcheting up uncertainty in that part of the market.

In July, the Indian Parliament's Energy Committee published a report arguing that India's 40GW rooftop solar target is unrealistic because such systems are not sufficiently remunerative to consumers. It also warned that steep falls in tariffs bid in recent auctions – to INR/kWh (US$0.038/kWh) in the latest, in May – could be unviable. It also raised concerns about the quality of the predominantly Chinese equipment used, advising that New Delhi should pursue anti-dumping tariffs. The Indian Government had, a few days earlier, opened an anti-dumping investigation, which will also include cells from Taiwan and Malaysia.

The committee was more positive on the wind target, which it expects to be achieved, but wind developers face issues nonetheless. A number of discoms – including those in Uttar Pradesh, Andhra Pradesh and Karnataka – have cancelled PPAs struck at higher rates than those bid in more recent auctions, and are seeking to renegotiate at lower rates. However, the Government has responded by barring state authorities from unilaterally modifying or cancelling PPAs.

In the latest Government auction, which closed 15 July, developers bid for three times the 1GW of capacity on offer. Media reports suggested tariffs could drop below the INR3.46/kWh (US$0.054/kWh) of the first auction, which took place earlier this year.

Brazil developers bid to terminate unviable contracts

The Brazilian Government has carried out an auction to allow project developers to bid to terminate contracts won under previous auctions. The companies involved paid a total of BRL105.9m (US$33.9m) to cancel 16 wind projects, totaling 308MW, and 9 solar projects, of 250MW. The reverse auction comes ahead of the restart of the Government's program of renewable energy auctions in December, after a two-year hiatus in the wake of economic slowdown and falling power demand.

The news comes as Brazil's energy agency releases its 10-year energy expansion plan, which foresees wind growing to 28.5GW in 2026 from around 11GW currently, and large-scale solar reaching 9.7GW from just 100MW at the end of 2016.

The volume of wind and solar capacity to be offered in the new auctions is not yet known, as the Government is embarking on a process of "decontracting" existing projects and is awaiting forecasts for future power demand from distribution companies.

The new auctions will be for licenses to begin operating in January 2021 and January 2023.

Germany bans negative offshore bids as prices keep falling

Germany's Bundestag has outlawed below-zero bids for offshore wind tenders, following three successful zero-subsidy bids in the country's first offshore wind tender in April. These bids will see developers build 1.38GW of offshore capacity to be operational in 2025, and will solely rely on wholesale power prices.

However, to deter what some industry observers warn could be a risky downward price spiral, with potential quality and safety concerns, the Bundestag passed amendments to its 2016 WindSeeG legislation ahead of the next auction, due in April 2018, for 1.6GW of offshore capacity.

On land, recent auctions have seen costs of both solar PV and wind energy continue to tumble. In June, the Government awarded 200MW of contracts to supply power from solar PV at an average cost of €56.6/MWh (US$67.6/MWh), compared with €65.8/MWh (US$78.6/MWh) at the previous auction, in February. Average prices have fallen almost 40% since the first auctions in April 2015.

In August, bidders were awarded tenders for slightly more than 1GW of onshore wind projects, at an average price of €42.8/MWh (US$51.1/MWh), down from €57.1/MWh (US$68.2/MWh) at the first onshore auction, in May. Around 5.6GW of onshore wind is to be auctioned this year and next.

Spain awards 8GW across two auctions

The Spanish Government has carried out two renewable energy auctions in quick succession, awarding 3GW in the first, in May, and a further 5GW in July.

The first tender drew the ire of the solar sector, after wind won almost all of the capacity available, with bids as low as €43/MWh (US$51/MWh). Just one solar PV project, with 1.5MW of capacity, was successful.

However, the tables were turned in the second auction, with 1.1GW of contracts awarded to wind projects, while solar projects totaling 3.9GW were successful. Including an earlier auction carried out in 2016, more than 8.7GW of capacity has been contracted over the last 18 months, all of which is due to be operational before 2020.

Almost no renewable energy capacity has been built in Spain since 2011, following severe cuts to subsidies and the imposition of retroactive tariff reductions on existing projects.

Interest builds in latest Russian auction

Developers successfully bid to build 2.2GW of wind and solar projects in Russia's latest auction, but a further 600MW of capacity was left on the table, illustrating challenges with meeting the country's local-content requirements.

Fortum-RUSNANO, a consortium of the Finnish power company and a subsidiary of Russia's state nuclear power producer Rosatom, won 1GW of wind contracts, at a cost corresponding to around €115 to €135/MWh (US$137 to US$161/MWh). A further 650MW of wind contracts, out of a total of 1,900MW on offer, were awarded. In solar, 520MW of capacity was contracted, out of 625.2MW on offer. Small-scale hydro saw just one successful bid, for two 25MW plants by dam operator RusHydro, out of 284MW on offer.

Planned capital expenditure on the wind projects averages RUB106,000 (US$1,834) per kW of capacity, while the solar projects have estimated average costs of RUB112,000 (US$1,938) per kW. Projects are due to come onstream between 2018 and 2022. Despite the capacity left unclaimed, the auction was more successful than last year's, in which only one bid – for 610MW of wind capacity – was successful.

Private PPAs boost Argentine renewables

Large energy consumers in Argentina will be allowed to enter into PPAs directly with renewable energy generators to meet their green energy obligations under new Government rules. Previously, renewable energy developers were able to sell power only to the market administrator, Compañía Administradora del Mercado Mayorista Eléctrico (CAMMESA).

The news – which observers say will provide a boost to the local market – also comes as Argentina launches its second RenovAr tender. The Government is inviting bids for 1.2GW of new renewables, including 550MW of wind, 450MW of solar and 100MW of biomass, as well as small hydro and biogas projects. The projects, which are required to begin supplying to the grid by mid-2019, will be awarded 20-year PPAs with CAMMESA.

The volume on offer is less than half the 3GW awarded last year under the first RenovAr tender. This is due to infrastructure and supply chain bottlenecks and the expectation of continuing falls in cost.

Netherlands allocates almost US$7b to 3.2GW capacity

The Dutch Government is to provide €5.83b (US$6.98b) to 4,530 solar and wind projects, with a total capacity of 3.2GW, under the latest round of its Stimulation of Renewable Energy Production (SDE+) program.

The majority (4,386) of winning projects are solar PV, accounting for 2.35GW, ranging from the minimum size of 15kW up to 69.9MW. Onshore wind farms with a total capacity of 644MW accounted for much of the remainder. The projects will receive the payments for up to 15 years, depending on technology type. The next SDE+ round, with an available budget of €6b (US$7b), will be open until 26 October. The Government has also announced that its residential solar net metering program, due to expire in 2020, will be extended to 2023. ■

Middle East and North Africa see a surge of renewables activity

A raft of policy developments, financing deals and tender processes have been announced across the Middle East and North Africa in recent months.

Finance is flowing to projects under development with the support of Egypt's feed-in tariff program, with the International Finance Corporation approving US$635m for 500MW of solar projects at Benban (on the Nile in southern Egypt), out of a total of US$2b that the bank expects to provide. In May, the European Bank for Reconstruction and Development committed US$500m to an additional 750MW of PV projects.

In Morocco, its sustainable energy agency, MASEN, has prequalified five consortia for the development of the first 150W to 190MW phase of the Noor Midelt Plant, a hybrid solar PV and concentrated solar power (CSP) plant with storage. The project is part of MASEN's Noor Solar Plan, which envisions 2,000MW of new renewables capacity by 2020.

Meanwhile, Saudi Arabia has invited bids for its first utility-scale wind farm, a 400MW project in the northwestern province of Al-Jouf. Looking ahead, Tunisia has announced plans to tender for 140MW of wind and 70MW of solar capacity in November this year, in the first of around 1GW of auctions by 2020. Kuwait plans to issue a 1GW tender in 2018.

In addition, long-held hopes of large-scale exports of solar

energy from North Africa to Europe have been revived, with the application to the Tunisian Government for a huge, 4.5GW CSP project, exporting energy via undersea cables to Europe. The TuNur consortium, backed by UK investor Low Carbon and others, is planning an initial 250MW phase.

But it's not all good news. Algeria's 4GW large-scale solar tender, announced in March and already delayed once, has been delayed again. The draft tender rules had raised concerns among potential bidders over domestic content rules, but the full RFP is yet to be published.

RECAI@50

A lot has changed since the first issue of RECAI in 2003. Ben Warren outlines the changes in the renewables sector that EY has seen since that launch, and Angus McCrone of Bloomberg New Energy Finance predicts the changes to come.

From 2003 to today ...

Renewable energy has come a long way: from an expensive, niche technology to, in many countries, the largest source of new electricity generating capacity. From occupying a small part of the generation mix, its influence now reaches beyond the power sector into the built environment, transport and across any number of energy-intensive industries.

When we launched the Renewable Energy Country Attractiveness Index in 2003, we were faced with a confusing mosaic of policies, subsidies and market mechanisms intended to incentivize renewables. We wanted to understand what worked – and what didn't – and help investors best direct their capital.

What we have seen since then is an evolution from policies designed to promote deployment, typically by providing attractive and stable returns, to policies designed to drive down costs, through, for example, competitive auctions for limited capacities. In broad terms – and with plenty of hiccups along the way – we have tracked a textbook case of technology development, commercialization and deployment.

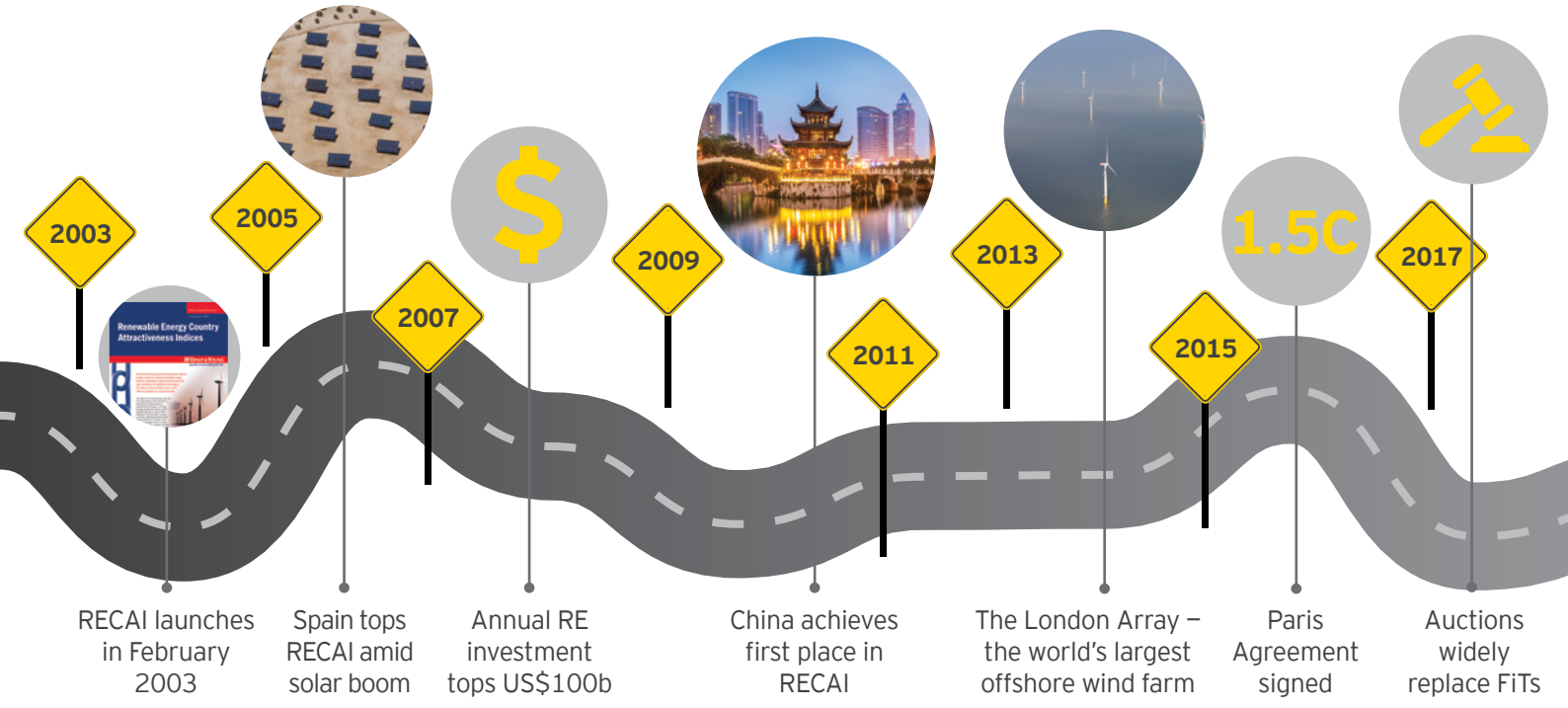
Closely following policy development in multiple countries and regularly updating the Index have, we believe, given us valuable insights on how best to promote renewable energy. We have helped hundreds of private sector clients direct billions of dollars in investments. We've helped governments design policies to attract those investment dollars: for example, we worked closely with the South African Government on its successful initial rounds of renewable energy tenders.

The Index has rewarded governments that have shown leadership in renewable energy policy. By giving a platform to governments to explain their policies and plans, we have brought sometimes overlooked jurisdictions to the attention of a global audience of investors and developers.

And RECAI has sometimes prompted action from policymakers: the most notable example being in 2010, when China first overtook the United States to claim the top spot, leading to a hearing in the US Senate.

Just as the industry has grown and evolved, so too has our approach to constructing the Index. Initially, it was essentially a "tariff barometer," helping investors chase attractive subsidies. As renewables policy focus has shifted to affordability, and as renewables became cost-competitive, the RECAI has become more focused on macroeconomic factors and the fundamental drivers for renewable power, such as the cost and security of supply advantages it is able to provide.

One measure of the sector's success is the degree to which its boundaries are blurring. As energy storage becomes cost-competitive, and digitization opens



opportunities for disruption, the industry's interaction with other sectors is creating an ecosystem that is more complex, interrelated and intriguing than we imagined possible 15 years ago. This presents challenges for us to understand its emerging contours – but no shortage of opportunities as we build an economically efficient and environmentally sustainable energy system.

Ben Warren
EY Global Power & Utilities Corporate Finance Leader

... and from tomorrow to beyond

An investor considering how to deploy capital in the emerging renewable energy sector in 2003 might have been advised to bet on biofuels, to favor solar thermal over PV, or to back one of the fast-growing German solar module manufacturers. All three of those decisions would, most likely, have left the investor nursing heavy losses and an antipathy to the clean energy business.

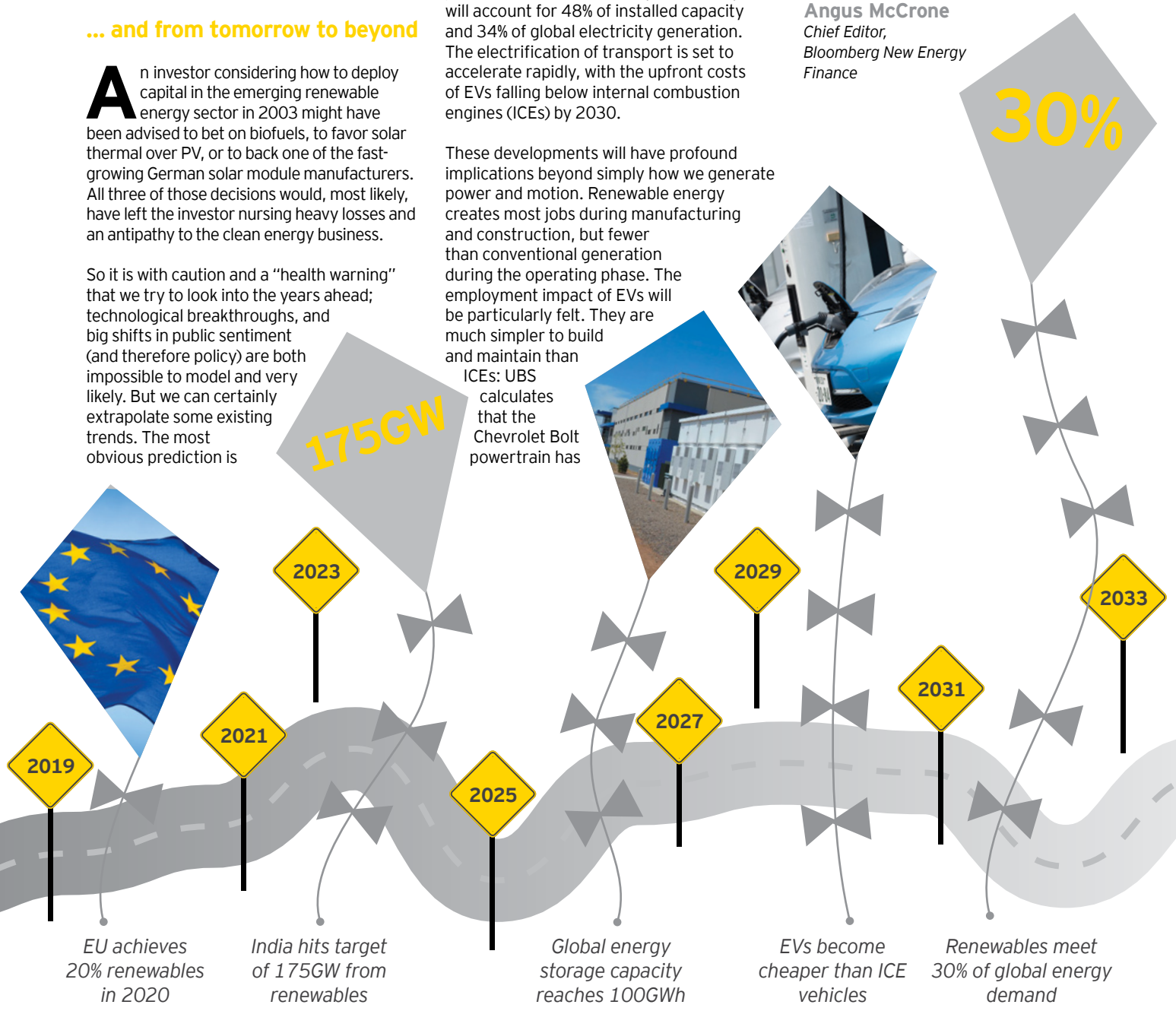
So it is with caution and a "health warning" that we try to look into the years ahead; technological breakthroughs, and big shifts in public sentiment (and therefore policy) are both impossible to model and very likely. But we can certainly extrapolate some existing trends. The most obvious prediction is that technology costs will continue to fall. According to our New Energy Outlook model, the levelized cost of new electricity from solar PV will drop by 66% by 2040. Onshore wind costs will drop 47%, while offshore costs will fall even more rapidly, by 71%.

These cost reductions will help drive enormous investment and faster penetration of renewables. Wind and solar are already cost-competitive options for countries wanting to build new capacity: but by 2030, new wind and solar will also start to undercut the cost of generation from existing coal plants in some countries. By 2040, they will account for 48% of installed capacity and 34% of global electricity generation. The electrification of transport is set to accelerate rapidly, with the upfront costs of EVs falling below internal combustion engines (ICEs) by 2030.

These developments will have profound implications beyond simply how we generate power and motion. Renewable energy creates most jobs during manufacturing and construction, but fewer than conventional generation during the operating phase. The employment impact of EVs will be particularly felt. They are much simpler to build and maintain than ICEs: UBS calculates that the Chevrolet Bolt powertrain has 24 moving parts, compared with 149 in a conventional car. Oil-producing countries, meanwhile, are set for a dramatic reduction in their tax base.

The onward march of renewable energy will also create enormous opportunity. Energy storage, micro-grids, the transformation of residential energy supply and the smart integration of a distributed energy system – these represent new areas of economic activity that will generate employment, tax revenue and attractive returns for the prescient investor. ■

Angus McCrone
Chief Editor, Bloomberg New Energy Finance



Looking beyond the Beltway

Outside Washington, DC, renewable energy's improving economics — and bipartisan appeal — promise strong support for the sector in the face of headwinds.

For the renewable energy industry's advocates in Washington, DC, the next few years look pretty tough. President Donald Trump's administration is vigorously pro-fossil fuel, promising support for coal mining, unshackled hydrocarbon extraction and a repudiation of much of Obama-era climate regulation — most notably by withdrawing the United States from the Paris Agreement.

However, beyond the Beltway the picture is more positive. According to the American Wind Energy Association there were 25.8GW of wind energy projects under construction in the second quarter of 2017, 40% more than at the same point in 2016. The picture for solar is more mixed, with the Solar Energy Industries Association (SEIA) forecasting that 12.6GW of PV will be installed in 2017, down 16% on a record-breaking 2016. Even so, the 2GW of solar installed in the first quarter still represented 30% of all new electric capacity installed in the US.

Brian Murphy, National Tax Partner, Power & Utilities at Ernst & Young LLP, says the prospects for US renewables increasingly no longer depend on federal support. "The train has left the station," he says. "Changes in federal incentives could cause it to accelerate or decelerate, but it is well on its way."

Historically, federal tax incentives set by Congress — the Renewable Energy Production Tax Credit (PTC) for wind, and a Business Energy Investment Tax Credit (ITC) for solar PV — have represented the most important support for renewable energy development in the US. At the end of 2015, a bipartisan tax act set out a timetable for complete phase-out of the PTC by 2020, and the phase-down of the ITC (to 10% of project costs) by 2022.

These schedules were broadly supported by the industry, which recognizes that falling costs make wind and solar increasingly cost-competitive without subsidy. There was some concern that the phase-outs could be accelerated as part of comprehensive tax reform legislation, which the Trump administration is prioritizing. However, bipartisan support for the 2015 PATH Act has led most analysts to conclude that the timetable would survive tax reform.

Even in the worst-case scenario of the sudden cancellation of federal incentives, other drivers would continue to underpin renewable energy development.

One such driver is the continuing state-level mandates requiring utilities to generate or buy a growing percentage of their power from renewable energy sources. Currently, 29 states have mandatory Renewable Portfolio Standards (RPSs); eight have voluntary targets. California and New York have some of the highest targets — with both aiming for 50% by 2030 (compared with 27% and 24% respectively in 2016).

It's also noteworthy that Republican-leaning states such as Texas, Montana and Iowa have RPS programs in place. Republican governors such as Idaho's Sam Brownback are strong supporters of renewables, welcoming the skilled employment — and cheap power — that they bring.

Critically, however, decisions to invest in renewables are being made purely on financial terms, says Mike O'Sullivan, Florida-based Senior Vice President, Development, at NextEra Energy Resources, which claims to be the world's biggest generator of electricity from wind and the sun. "The economics of wind and solar in the US are so compelling that the majority of the projects we're developing have nothing to do with RPSs," he says.

According to figures from the United States Department of Energy (DoE), onshore wind in the US — without factoring in the PTC — costs less than US$50/MWh, compared with costs of around US$54/MWh from a best-in-class combined cycle natural gas plant. In solar, Tucson Electric Power announced a 20-year PPA with NextEra Energy Resources struck at less than US$30/MWh, including the ITC.

Non-energy companies and retail consumers are also increasingly choosing clean energy over supply from fossil fuel generation. According to figures from the Rocky Mountain Institute, 1.24GW of capacity was contracted through corporate PPAs in the first half of 2017, compared with 1.61GW for the whole of 2016 (3.25GW were contracted in 2015, ahead of the expected expiry of the PTC and ITC at the end of that year).

The residential solar market has seen growth rates in excess of 50% for several years, although maturity of key markets and changes to net metering rules — which allow PV owners to sell excess power back to the grid — have crimped that market segment in recent months.

> "The train has left the station. Changes in federal incentives could cause it to accelerate or decelerate, but it is well on its way."

Turbines in Montana

Falling costs are driving strong growth in energy storage deployment — often in conjunction with renewable energy installations. The volume of storage doubled in 2016, measured in MWh, and the number of PPAs that bundle renewables and batteries is growing rapidly, helping to reduce intermittency issues and improve overall project economics.

But the US renewables sector is not without its headwinds. The utility-scale solar market faces challenges from changes to the PURPA regulations that require utilities to buy power from qualified facilities if it can be supplied at or below the utilities' own development costs (their "avoided costs"). These regulations, named after the 1978 Public Utilities Regulatory Policies Act, have been a major driver of large-scale solar projects as their costs have tumbled. However, some utilities and local regulators have been pushing back against PURPA, shortening the duration of contracts offered and/or lowering the avoided cost threshold.

However, this issue could become moot following efforts by Suniva and SolarWorld Americas to slow imports of cheap overseas solar equipment. The bankrupt solar manufacturers are seeking the imposition of import tariffs on solar cells of US$0.40/W and US$0.78/W on solar modules, on the grounds that cheap imports have caused "serious injury" to domestic US manufacturers.

Such tariffs, the SEIA argues, would return solar PV costs back to 2015 levels, leading to the loss of 88,000 jobs in solar PV installation, sales and construction, out of a total of 250,000 currently working in the US solar industry. As well as chilling the residential market, import tariffs would likely make most utility-scale projects too expensive to qualify under PURPA.

The US International Trade Commission found on 22 September that foreign imports have caused damage to domestic manufacturers; it will now recommend, by 14 November, a trade remedy to President Trump, who can accept, reject or amend it.

However, the immediate impact of tariffs may be muted: "Some companies have been able to secure panels for the next couple of years," says John Eber, Managing Director, Energy Investments at J.P. Morgan in Chicago.

EY's Murphy adds that the commission will consider short- and long-term impacts across the entire sector, which may include impacts to both consumers and US jobs. "Although a significant increase in tariffs could be initially costly and disruptive to development, the industry would likely adapt fairly quickly, which may include the potential for on-shoring panel assembly," he says.

The renewables industry has also been anxiously awaiting a DoE study on the reliability of the grid, commissioned by Secretary Rick Perry to investigate the impact of growing volumes of intermittent renewables alongside the retirement of large volumes of baseload capacity, particularly coal-fired power plants, in the last decade. Renewable energy advocates were concerned that it would be skewed in favor of the fossil fuel and nuclear lobbies, and would call for constraints on additional renewable capacity, or for subsidies for baseload generation.

Its release in August gave comfort to both sides. The report rejected the claim that environmental policy or renewables had led to coal and nuclear shutdowns, pointing instead to cheap natural gas. However, it did call for reducing environmental controls triggered by upgrades to coal plants, and for changes to power market rules that allow renewable generators to supply at negative prices (which they can do to claim federal tax credits).

Of longer-term concern to the industry are proposed cuts to R&D in energy innovation. The White House budget proposal for 2018 would cut around US$3b, or almost a fifth, from research programs within the DoE, as well as a 69% cut in the budget of the Office of Energy Efficiency and Renewable Energy and a 93% cut for the Advanced Research Projects Agency-Energy.

Budget approval is required from Congress, and its 2017 budget resolution kept funding largely at 2016 levels. However, the White House proposals illustrate the administration's priorities. If implemented, some fear that the cuts could cost the US its historic global leadership in new energy technologies.

Here, too, O'Sullivan at NextEra is dismissive. "The true research and development in wind and solar is done by the [equipment manufacturers]. The amount of money that the US Government spends is a drop in the bucket compared to what the global manufacturers have invested."

But for the time being, at least, the industry is in good shape, says Eber of J.P. Morgan. "We're as busy as we've ever been, as are all the developers and everyone else involved in the US renewable energy market."

O'Sullivan adds that concerns over attitude of the current administration are overblown. "We're not looking for handouts. We believe renewables are economic on their own, and we fully support the tax credit phase-out," he says. "We just want consistency and certainty on public policy and we believe we're getting that." ■

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Change of plan

The Seoul skyline

The election, in May, of President Moon Jae-in of the center-left Democratic Party, has brought with it plans for a profound change of direction for Korea's energy policy. The President has announced sweeping plans to end the country's reliance on nuclear and coal-fired power, increasing the share of renewables from around 6.6% today to 20% by 2030.

The move comes amid growing public concern about air pollution caused by coal-burning power plants – which currently account for 40% of Korea's electricity supply – and worries about nuclear safety in the wake of the 2011 Fukushima disaster. The new Government has responded by temporarily closing eight old coal-fired plants, putting plans for 20 new ones under review and abandoning plans for new nuclear facilities.

To fill the gap, Korea plans to increase gas-fired capacity and rapidly ramp up renewable energy penetration. The draft version of its 8th Basic Plan for Long-term Electricity Supply and Demand, released in August, specified a goal to increase wind and solar to 48.6GW by 2030 – up from just 1GW of wind energy, and around 5GW of solar PV by mid-2017, according to the Korea Energy Agency. This compares with the former target of 32.9GW by 2029 under the previous plan, published in 2015.

However, the new target faces numerous headwinds: the structure of Korea's power markets; limited land availability; and resistance from the country's powerful industrial conglomerates.

The country has a renewable portfolio standard (RPS) in place, which sets obligations on power companies to source a rising percentage of their power from renewables, or buy Renewable Energy Certificates (RECs) from qualifying generation. The 2017 target is 4%, rising to 10% by 2024. However, heavily subsidized power prices and tax incentives for coal and nuclear generation make it difficult for renewable energy developers to operate outside this system. Furthermore, the limited availability of suitable land in what is a mountainous country also inhibits growth in renewables.

Thus far, the Government has not set out how it plans to kick-start the country's renewable energy sector. One possible proposal is for licenses to develop projects on publicly owned land, and the new Government is also working on plans to remove electricity subsidies enjoyed by industrial buyers.

A report from the new State Affairs Planning Advisory Committee, released in July, found that Korea has the potential to generate up to 28% of its electricity from renewables by 2030, and recommended an acceleration in RPS targets to do so. It also proposed that businesses should be incentivized to install on-site PV, and that the Government should introduce a feed-in tariff for small-scale renewable generation.

In the meantime, developers are exploring the potential of floating PV systems, installed on reservoirs or lakes. Hanwha Q CELLS, a leading Korean integrated PV producer and developer, and solar developer Solkiss have signed a memorandum of understanding with Korea Hydro & Nuclear Power to build an 80MW floating and rotating solar PV system. This would be double the size of the largest existing floating solar farm, a 40MW system in Anhui province, China, which began generating power in June.

Korea currently has just 35MW of offshore wind capacity in place, but the offshore sector has the potential to make a substantial contribution to the country's renewable energy goals – indeed, the Government anticipates offshore wind growing to 13GW by 2030. Siemens Gamesa, for example, is in talks to develop a 120MW project off the Korean coast. However, MAKE Consulting forecasts just 750MW of offshore wind installed by 2024, and Government plans for wind farms off the western coast have run into opposition from the local fishing industry.

While large-scale development is challenging, the potential for smaller-scale projects is considerable – especially those that combine storage and demand-side management features. The Government offers subsidies worth up to 75% of the costs of rooftop PV (on a first-come, first-served basis); it also plans to offer a 50% discount on battery-charging costs out of peak hours, and awards systems with both PV and energy storage five times the RECs that standalone PV systems can earn.

Korea is also making strides in digitizing the electricity system, with the state-owned power monopoly Korea Electric Power Corporation investing heavily in its digital strategy. It is conducting pilots for virtual power plants, peer-to-peer trading and blockchain-enabled EV charging, among other things.

While President Moon's vision for a cleaner, renewables-focused electricity system is clear, the mechanisms that will remove existing economic barriers to renewable energy penetration are not. More clarity is expected in the coming months but the biggest risk to Korea's renewable energy market would be another change of government. If the opposition were to return to power at the presidential elections in five years' time, it is possible that the direction of travel could be reversed. ■

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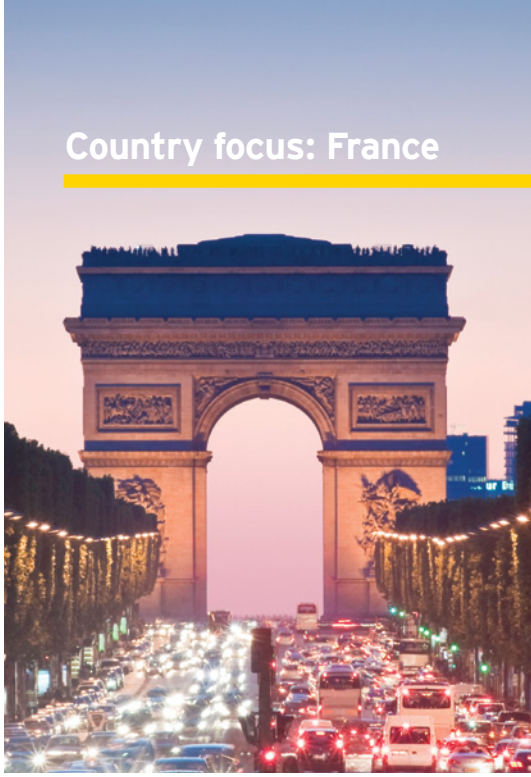

Arc de Triomphe in Paris

Waiting on Macron

Five months on from the election of Emmanuel Macron as President of France, renewable energy developers and investors are keenly anticipating the detailed policies, plans and administrative decisions that will flesh out the headline pledges made during his campaign.

Without doubt, those pledges are positive for the industry. Prior to the election, Macron promised to implement the previous administration's 2015 Energy Transition Law, which includes reducing the share of nuclear energy in France's energy mix to 50% by 2025, down from around three-quarters at present – but questions persist over the feasibility of that timetable.

Macron also backed the target to double renewable energy capacity by 2022, from 21.4GW in 2016, set out in the programmation pluriannuelle de l'énergie (PPE), the multi-year energy investment program approved in October 2016 that set targets for the periods of 2016 to 2018 and 2019 to 2023.

In addition, Macron promised a tender for 26GW of renewables at the beginning of his term, requiring €30b (US$36b) in private sector investment, and pledged an additional €15b (US$18b) in state spending on energy and the ecological transition. The latter is likely to be directed at funding innovative clean energy technologies. Macron also pledged to close all coal-fired power plants by 2022 – they currently supply just 1% of the nation's electricity.

Since the election, the Government has released its Plan Climat, a five-year program to accelerate the climate and energy transition, in line with the Paris Agreement. That plan bans onshore and offshore oil and gas exploration in both France (where shale gas fracking is already banned) and its overseas territories, reaffirms the target of increasing the share of renewable energy to 32% (including a 40% target for electricity) by 2030, and proposes ending the sale of cars with internal combustion engines by 2040.

The Government is also reviewing the PPE, which will set new targets for the period from 2019 to 2023 covered by the existing plan, as well as targets for 2024 to 2029. Specifically, the new PPE – which should be released by the end of 2017 – will provide a timetable for renewable energy tenders.

For the renewables sector, the election result was the best of the likely outcomes: compared with the right-wing candidate François Fillon, knocked out in the first round, and the climate-skeptic Front National contender Marine Le Pen, Macron is considerably more committed to clean energy and addressing climate change. His ecology minister, the environmental activist and TV personality Nicolas Hulot, is an enthusiastic advocate of the energy transition. Importantly, he is backed by a strong and experienced team of civil servants, led by Michèle Pappalardo.

However, the industry wants clarity on the Government's plans. In the first half of this year, the volume of new onshore wind capacity installed was 13% lower than the same period in 2016, at 492MW. The dip was attributed to developers and financiers wrestling with a new support scheme, the "complément de rémunération," which is similar to the Contracts for Difference model used in the UK, which replaces the previous feed-in-tariff program.

The process, which applies to any project involving more than six wind turbines, involves the Government paying renewable energy generators a variable premium that is added to the wholesale price to match the "strike price" determined by a competitive auction and tender process. The first wind tender – for 500MW – is due in November, followed by five others in 2018 and 2019.

In the offshore sector, 10 companies have been preselected for a third tender, for between 250MW and 750MW off Dunkirk in Northern France. The winner is due to be announced in early 2018. The tender follows auctions for 2GW of capacity in 2012, and 1GW in 2014.

France Énergie Éolienne (FEE), the French wind energy association, is calling for the Government to more vigorously support the floating wind sector. Four pilot projects are under way, initiated by the previous administration, which also instructed local authorities to identify potential zones for commercial projects. FEE would like to see tenders for 2GW of floating wind next year, with a view to a total of 6GW installed by 2030.

Solar installations, meanwhile, are proceeding apace. In July, Hulot announced that 77 bidders had been awarded tenders to supply 500MW of solar power, at an average cost of €55.5/MWh (US$66.3/MWh) for larger installations, and an overall average of €63.9/MWh (US$76.3/MWh).

Strong political support for renewables in France is encouraging consolidation in the sector. In June, electricity and gas retailer Direct Énergie announced the acquisition, for €300m (US$358m), of French renewable energy producer Quadran. The same month, EDF Énergie Nouvelles completed its purchase of a two-thirds stake in wind developer FUTUREN in a deal that valued the company at around €320m (US$382m).

Such acquisitions are demonstrating commitment to the energy transition of big utilities, whose large balance sheets will help underpin continuing development. At the same time, they allow mid-sized developers to access end consumers, as well as delivering successful exits for their investors.

These transactions coincide with growing interest from infrastructure funds and other European utilities in French renewable energy assets, illustrating the growing attractiveness of a market underpinned by strong policy support. However, more detail on the Macron Government's plans to further promote renewables in France are expected in the months to come – with industry watchers expecting announcements around the President's high-profile international climate conference, to be held in Paris in December. ■

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