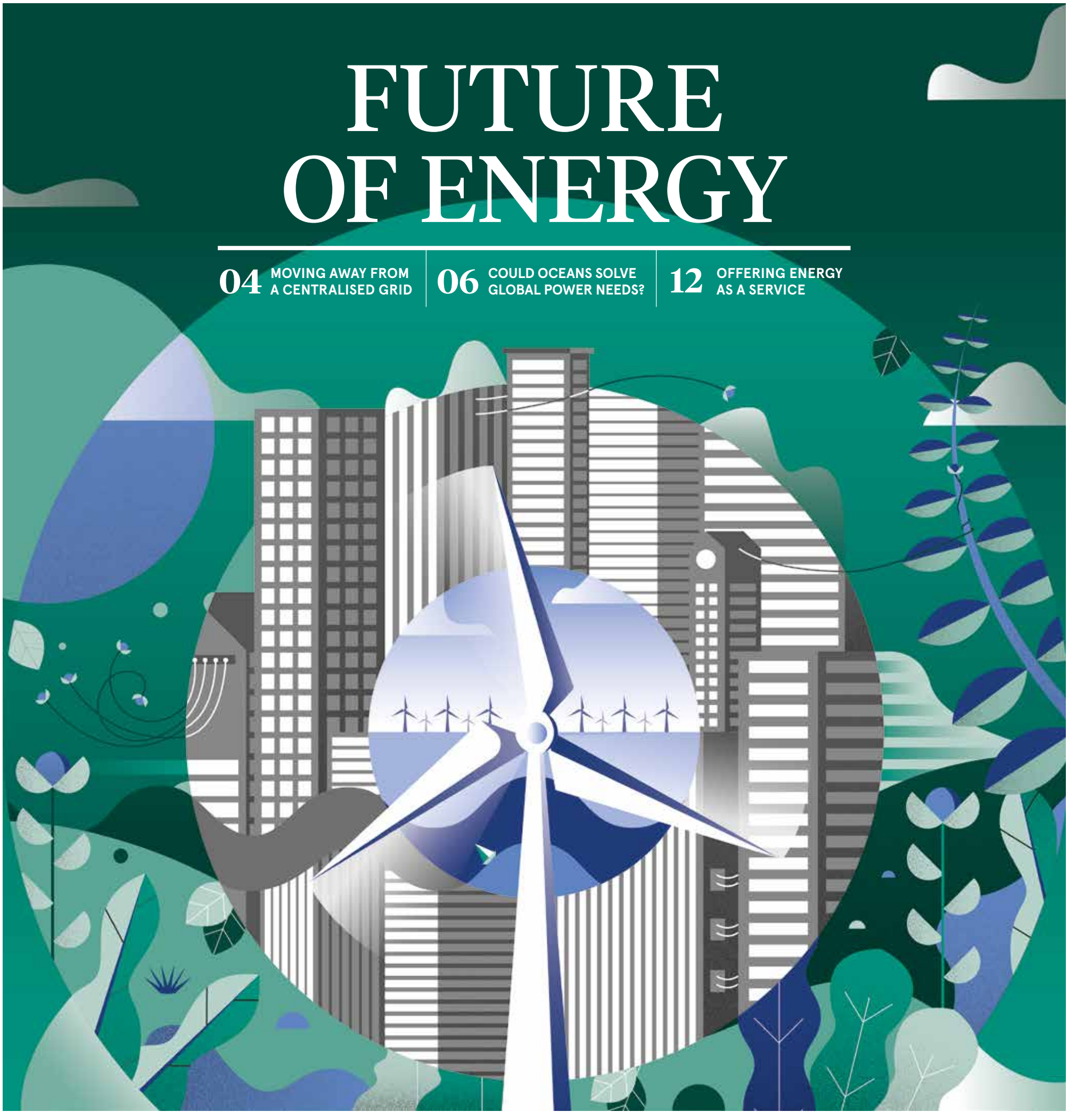
FUTURE OF ENERGY



People.
Power.

Thanks to decades of hard work by a few visionary risk-takers, renewables are becoming more cost-effective than the fossil fuels they're replacing.

Innovations in technology, storage, distribution, supply chains, and business models are driving the energy revolution forward.

But the global adoption of wind and solar creates a war for talent that's out-pacing the supply of experienced professionals.

Renewable energy employment will triple to 30 million by 2030 and we need the teams to plan, design, build, deploy, and manage the future of energy.

We build the teams that create the future of energy.

Since 2009, we've been helping the world's leading renewable energy companies to recruit and develop the talent to unlock the future of energy.

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FUTURE
OF ENERGY

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WIND POWER

What's in store for the future of offshore wind?

With the price of offshore electricity plummeting as the industry scales up, wind farms are now a major part of the UK's total energy mix

Mark Hillsdon

It may have seemed like a normal wet, blustery autumnal day to most of us, but for the UK's offshore wind industry, November 28, 2018 was a red letter day. Storm Diana was buffeting the country, sending wind turbines into overdrive, so that during one 30-minute period, wind farms contributed a third of the UK's electricity for the first time.

It was an important milestone in the sector's journey towards regularly supplying a third of the nation's energy needs by 2030, with an installed offshore wind capacity of 30 gigawatts (GW) – according to last year's sector deal with the government – compared with 8GW today.

"Offshore wind is well placed to be the backbone of Britain's electricity system," says Benj Sykes, vice president and UK country manager at Ørsted, especially with the retirement of coal and nuclear generation. "We've seen a dramatic drop in the cost of electricity from offshore wind that makes it one of the lowest-cost ways to decarbonise."

Over the last three years, as the industry has scaled up, the price of offshore electricity has halved. While the first turbines produced less than a megawatt each, today's churn out closer to ten, says Stephen Wyatt, research and innovation director at the UK's Offshore Renewable Energy Catapult, with a new wind turbine now installed in British waters at the rate of one a day.

"Deployment has been key," says Stephen Bull, senior vice president for wind and low-energy solutions at Equinor. "The more turbines you push out, the more innovation that's driven, the larger the turbines get, the more you'll see economies of scale."

It's a rate of growth that is creating jobs and by 2030 the industry expects to employ 27,000 people, more than three times the present figure.

The sector has benefited from a long-term commitment by successive governments, says Mr Sykes who, in his role as co-chair of the Offshore Wind Industry Council, is helping to broker a sector deal with Whitehall. This is likely to include a commitment to continue to grow offshore wind at the rate of 2GW a year, so it is easier for developers and wind turbine manufacturers to make the necessary investment.

"Like all parts of the energy sector, we have to think over the long term; we can't think in terms of four or five-year parliamentary cycles," he says.

The process used to award wind farm contracts has also helped make offshore energy cheaper. It begins with the release of suitable areas of seabed by the Crown Estates, passes through a long period – often taking several years – of research and consultation, before culminating in a government auction and the award of a contract for difference (CFD).

"The large utility companies that are developing these offshore wind projects have to bid in really low to be sure they are going to get a wind farm project," says Dr Wyatt. "It's this system that has helped to drive costs down."

But there is a sweetener as the CFD ensures developers receive a fixed price per megawatt hour which, says Mr Sykes, takes away a lot of the risk and has enabled companies to explore new forms of finance. For instance, Ørsted has brought in institutional money and pension funds to invest in Hornsea 1 and 2 in the North Sea, the biggest wind farms under construction in the world. Between them they will generate 2.5GW. "That's capacity comparable to a nuclear power station," he adds.

Dogger Bank, a huge sand bar in the North Sea, may be more famous for trawlers than turbines, but it's also set to become the new frontier for offshore wind in the UK. In partnership with SSE, Equinor is developing three of the four current sites (German energy company innogy is progressing the fourth) with more zones to be released over coming years.

Located nearly 200 kilometres off the coast of Yorkshire, once completed the four wind farms will have a total generating capacity of 4.8GW. "This really could be the new electricity hub for the North Sea," says Mr Bull.

But while the site is further offshore than the industry has ever ventured before, explains Dr Wyatt, because it is so far from land, wind speeds are higher, while at 30 metres the sea is relatively shallow, making installation of the turbines easier.

The wind farms are likely to be the most technical and innovative ever built, and include the use of robotics and autonomous systems, digital twins, so engineers can conduct virtual walk-rounds of the site, and predictive maintenance.

Globally the UK now controls just under 40 per cent of the world's offshore wind capacity, according to the Global Wind Energy Council, but with the likes of China, America and South Korea ramping up their own interests, it's unlikely Britain will hold its number-one status for long.

This shouldn't be seen as a problem, says Dr Wyatt. "Using our experience, our know-how and our established supply chains is absolutely key for these other countries to come down the 'cost curve' as well, and make offshore wind as economical as it is here.

"In terms of first-mover advantage, for all the learnings, all the experience and a lot of the supply chain companies, we're in a great position."

UK businesses are already exporting to wind farms all over the world, Mr Sykes adds, and by 2030 the industry hopes to have increased exports of goods and services fivefold to £2.6 billion, from £0.5 billion in 2017, according to the Offshore Wind Industry Council.

"It's the cutting-edge technology that will be most exportable, whether that's robotics, whether that's drone technology, whether that's smart systems and big data," he says.

"I'm absolutely convinced offshore wind can be the next exportable success story for UK plc."

North Hoyle offshore wind farm in the Irish Sea, North Wales

Paul Glendell/Construction Photography/Avalon/Getty Images

36%
of the world's offshore wind capacity is controlled by the UK

Global Wind Energy Council 2018

1/3
of the UK's energy needs are expected to be supplied by 2030

27k
people are expected to be employed in the UK offshore wind industry by 2030, more than three times the current amount

Offshore Wind Industry Council 2018

DECENTRALISATION

Making the move away from a centralised grid

There are many practical barriers standing in the way of decentralising the UK's energy network, but the economics of small-scale, localised power have vastly improved

Olivia Gagan

The UK's energy grid has been powered for decades by coal and nuclear plants. As these centralised power stations, designed to deliver large quantities of electricity across hundreds of miles of national power networks, are gradually shut down, they are being replaced with smaller, nimbler, decentralised sources of energy.

The benefits of decentralisation – drawing power from multiple, localised energy networks – are numerous. Deploying local solar plants, small wind farms, battery storage and combined heat-and-power plants can drive competition up, and power prices down, as the number of energy providers increases.

It enables greater control in communities over the sources of the energy they consume. Consumers can sell power back to the grid, offering revenue opportunities and a way to provide backup power to the national grid. Localised power is often renewable, helping cut carbon emissions, too.

However, the UK is a long way from having a decentralised energy grid. Tim Rotheray, director of the Association for Decentralised Energy, says this is because the scale of the change needed is huge. Achieving a decentralised energy grid means turning decades of UK power policy and development on its head, and adopting exactly the opposite approach.

"This is the nub: the UK's electricity system was designed around big bits of kit," says Dr Rotheray. "In the 1970s and 1980s, the way you drove down the price of energy was by economy of scale. These plants were, and are, all trading huge amounts of electricity."

Times have changed and the economics of small-scale, localised power have vastly improved. Prices for renewable technologies have dropped dramatically over the past decade and last year business services firm Lloyd's Register said it expects decentralised renewable energy to be cheaper than power from the grid by 2025. To remain ahead of the curve, policymakers and the energy industry need to start bringing their former customers, and new competitors, into their policy conversations.

"Policy is still created in the traditional system and that's an absolutely huge barrier to growth of the decentralisation model," says Dr Rotheray. Historically, energy policy was developed "by energy experts talking to energy experts, but now power market participants include brewers or bakers or steel fabricators; their participation is vital to achieve the growth and the security of supply the country needs".

Dr Rotheray warns expansion of decentralised energy grids will be further stymied if it causes any inconvenience to the public. "The system is shifting from the traditional siloed, centralised system and it has to. But as an energy consumer, you don't want to experience these [changes]. You're interested in remaining warm and powered," he says. For the decision-makers involved in the transition, "it's about starting to see the energy system from that perspective".

The government also needs to adopt a more holistic, joined-up attitude when it comes to looking at the UK's energy future in general, he says. New and upcoming green energy auctions, for example, procure future UK power from low-carbon sources such as offshore wind. As the lowest bids win, it is typically big-hitter developers and investors with large-scale projects that are winning these contracts.

The auctions replaced subsidies, which Dr Rotheray says were key to the development of localised power. "Those policies were very successful at the local level, on a small scale. They overcame barriers for consumers to participating in the energy system. Instead of asking people to engage in the wholesale power market, they were just paid a set fee for whatever power they put into the grid," he says. As these subsidies are phased out and replaced by auctions, won by international utilities and financiers, "the challenge of the next decade is to unlock local access".

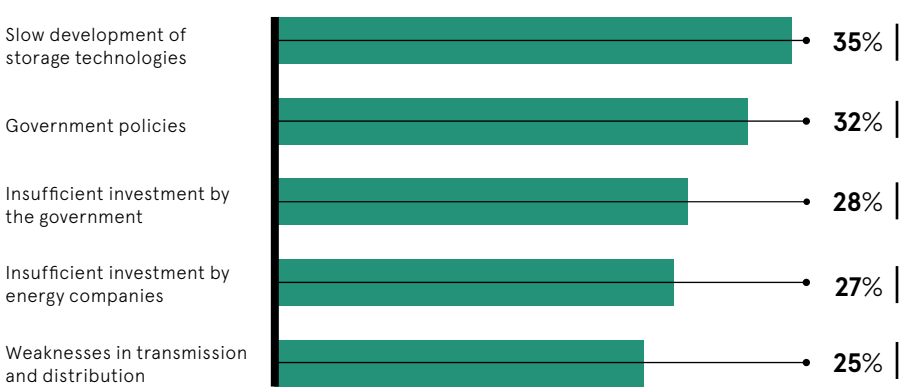
Other countries are already adapting to the challenge posed by decentralisation. Dr Rotheray points to the Nordics' Nord Pool power market, and individual states and energy firms in the United States, as examples of flexible, modern power grids. In America, consumers are increasingly being rewarded with rebates for modifying their behaviour, for example switching on air conditioning at times when the grid is less stressed, and are seeing cost-saving benefits more quickly than their UK counterparts, he says.

Could the UK eventually have a fully decentralised energy grid? Dr Rotheray says perhaps this is the wrong question to ask. It's more important that the UK's electricity ecosystem is fit for purpose. He concludes: "We need to ensure that the power system is low carbon and secure. It should be open to every possible participant. Then the market will find its own level, whether that's centralised energy, local energy or a mix."


VCG/VCG via Getty Images

FACTORS INHIBITING RENEWABLES GROWTH IN THE ENERGY MIX

Global survey of energy executives



Lloyd's Register 2018

UPS

First movers in decentralisation

Many businesses which are heavy users of energy, such as factories and retail chains, have been early adopters when it comes to decentralisation. Their heavy energy use means they have long had to consider generating their own power or developing mini-grids to guarantee supply and increasingly to hit corporate carbon-reduction targets.

Courier UPS, for example, has developed its own smart grid and is making its entire fleet of London-based delivery vehicles electric. Supermarkets, including Sainsbury's and Marks & Spencer, have installed their own off-the-grid sources of energy; M&S is the owner of one of the largest solar rooftop plants in the UK.

For other private-sector businesses, which are yet to migrate to more self-sufficient, lower-carbon sources of power, it's likely that pressure to invest in new ways of generating and buying energy will heighten. At present, the UK's 5.7 million businesses create around a quarter of the country's carbon emissions. In an effort to reduce this carbon output, the Department for Business, Energy and Industrial Strategy (BEIS) wants to cut the UK's business energy use by 20 per cent by 2030. BEIS estimates an additional £23 billion in private-sector investment could be needed to make this happen.

Future-proofing the energy system relies on decentralisation

The current electricity system is no longer fit for purpose or able to sustain the move to reliable and affordable renewable energy. The way the whole electricity system works must change, driven by a fundamental redesign of the grid itself

The UK's energy system has traditionally been based on synchronous, centralised power generation using a hub-and-spoke model: a small number of large power plants supplying relatively constant power one way to centres of demand, such as cities and industrial areas.

The need to decarbonise, however, has driven the move to asynchronous renewable sources, such as wind and solar, which are distributed widely throughout the electricity grid. These provide more variable power, and change the quantity and direction of energy flows in the system.

At the other end of the system, the way we use energy is also changing, as consumption by digital devices continues to grow and more electric vehicles divert energy previously used in the transport sector on to the grid.

Despite these major changes to the patterns of supply and demand, the grid itself, which transports power instantaneously to where it is needed, fundamentally has not changed for more than 100 years. The challenge today is how to manage these new energy flows through century-old technology.

The physics of the near-instantaneous movement of energy makes it extremely difficult to control. Disturbances, such as power cuts or blackouts, are often caused because problems observed at the edge of the grid – sudden changes to supply or demand – can't be responded to fast enough from a central control point. As electricity generation becomes increasingly decentralised, with large fossil fuel plants replaced by renewables, these complexities create increasing and costly fragility in the grid.

"The lack of change in the electricity grid is holding back the transition to more affordable and reliable energy," says Matthew Williams, founder and chief technology officer at Faraday Grid. "The approach to date has been to just add new technologies to the grid to try to manage the problem. These can no doubt help mitigate some of the issues but, by keeping the fundamental architecture the same, you are inherently limited in the scale of improvement you can make.

"What is needed is a fundamental rethink of the existing system to create a platform that enables new technologies, not the other way round."

The need to drive drastic improvements in the architecture of the electricity system is critical for the energy sector and, most importantly, for end-consumers. The cost of generating energy from solar and wind is now lower than coal or gas, yet the move to more renewable sources has in fact increased energy prices for consumers. This is because the cost of balancing services, which National Grid must procure to maintain a constant balance of supply and demand, reached £2 billion in the UK last year and continues to grow. These costs are ultimately passed on to the consumer.

With the rising cost of energy consumption more than offsetting the declining cost of generation, consumers and businesses will continue to suffer energy price hikes unless the complexities in the grid itself are comprehensively addressed. UK-based Faraday Grid is building a unique solution: a decentralised platform for energy that radically increases the capabilities of the existing grid.

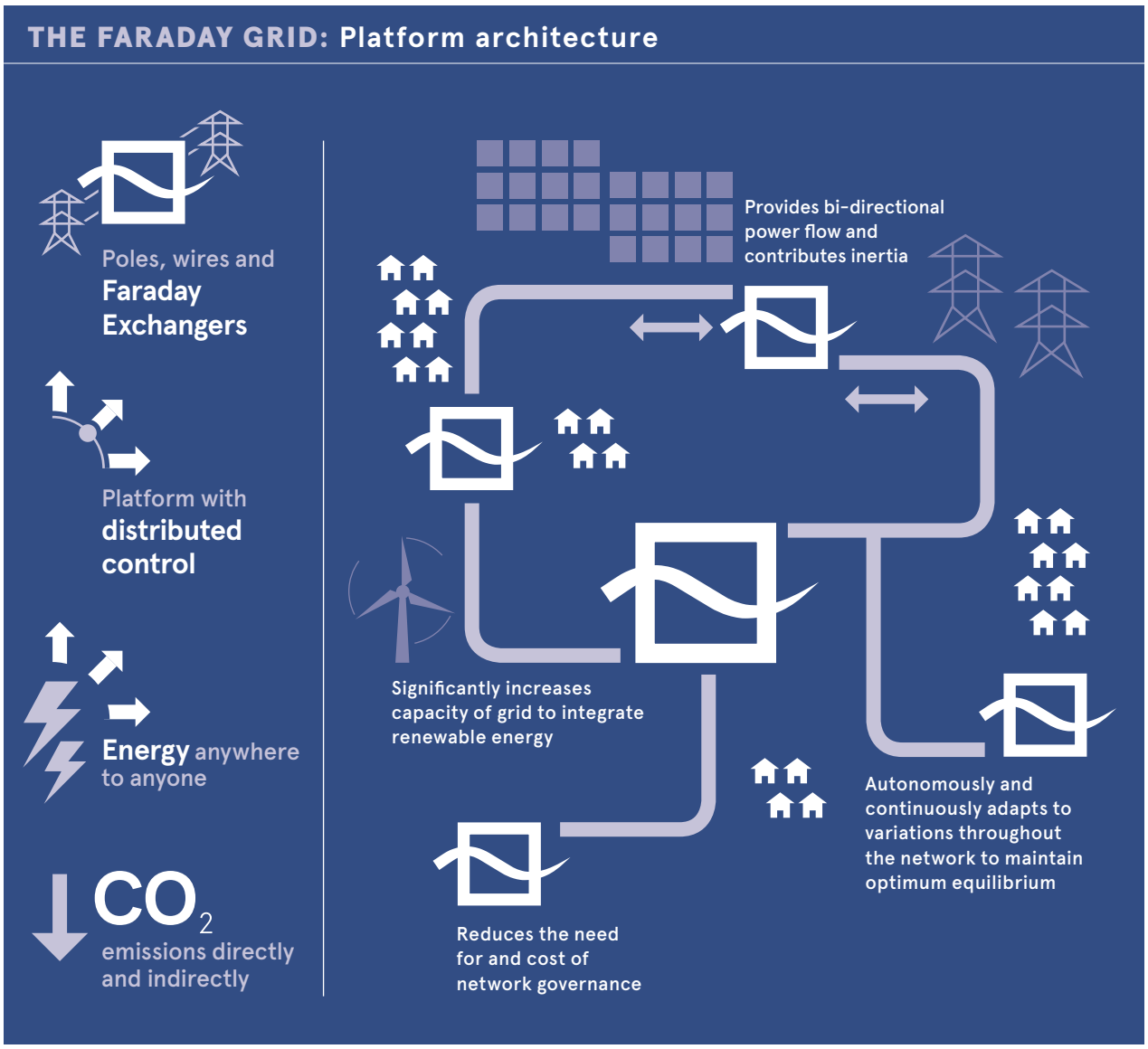
"No one idea, technology or company can provide the silver bullet to solve all of the problems in the energy system," says Mr Williams. "We are enabling a platform specifically designed to allow all of these technologies, from renewables, batteries, electric vehicles, machine-learning algorithms and others yet to be invented, to collaborate without the need for centralised control. This collaboration is what will deliver the necessary transition to the energy system of the future."

80%+
integration of non-synchronous renewable energy generation

▼34%
reactive power generation requirement

▲25%
network carrying capacity of the grid

▼7%
network losses



Faraday Grid believes that to make the grid fit for purpose, it should be underpinned by a system of decentralised control. This is similar to the principle behind the internet, where there is no master control point monitoring and controlling the whole system. All the agents in the system co-operate under a common set of rules to achieve the common goal; for the internet, this is the open sharing of information. Faraday Grid's vision is to do this to create an open and secure energy system.

In its platform of energy, the Faraday Grid acts like the internet: an autonomous, self-balancing network, agnostic to different technologies or patterns of supply and demand. The Faraday Grid is based on networks of Faraday Exchangers, the company's hardware devices. These act like the internet router, replacing existing equipment (transformers) to change radically how power flows through the network and enable new technologies to be connected without increasing the fragility of the system.

"This has never been possible before," says Mr Williams. "As a transformer reaches its end of life, you can literally just pull it out and drop in a Faraday Exchanger and it will automatically make its local area of the electricity network work better. The more exchangers in a network, the bigger the impact will be. It needn't be a huge big-bang changeover though; you can do it incrementally at no net additional cost.

"Ten years ago, the UK grid had about 80 points of generation within it; today it has almost a million. With so many rooftop solar panels and wind turbines going up, the energy system in its current iteration will no longer work. Faraday Grid is bringing control of the entire energy system to the grid itself. This will enable high levels of renewable energy at an affordable cost and, ultimately, sustainable, reliable and affordable energy for everyone."

For more information please visit faradaygrid.com

THE FARADAY GRID


Michael Olsen/Unsplash

MARINE POWER

Harnessing the power of the oceans could be within reach

Energy from tides and waves could satisfy the world's power needs, yet harnessing it on a commercial scale remains a dilemma for many tech startups in the space

Oliver Balch

King Canute may be remembered for his vainglorious attempts to stem the tide, but the Danish monarch at least knew how to get tongues wagging.

A thousand years on, the world of Canute's North Sea Empire is barely recognisable. Yet two constants remain: the tide keeps rising and mankind keeps trying to tame it.

And we do so with good reason. In an era of rapid anthropogenic climate change, the race is on to find alternatives to oil, gas and other energy-dense hydrocarbons.

With per-kilowatt prices dropping by the day, solar and wind power look like an increasingly viable bet for the future. However, they are not perfect as the sun doesn't always shine and the wind doesn't always blow.

So how could the renewable energy mix be diversified and strengthened? Is there a reliable, predictable source of clean energy that remains untapped?

Roll forward tidal and wave energy. Its plus points are numerous. Most importantly, it never stops. As long as the moon stays in the sky, the tides will keep rising and receding.

Water is also super-dense, a fact that conventional hydropower has put to good use for decades. Water only needs to be running at one metre a second to turn a turbine, in contrast with three to four metres a second for wind.

The key question, of course, is whether these natural assets can be effectively and efficiently harnessed.

As in Canute's day, it is not hard to find optimists. A recent report by the analyst firm Zion Market Research forecasts revenues from tidal and wave energy are set to rise more than tenfold over the next five years.

Enthusiasts also abound and the sector is flush with startups, all with promising technologies. Few genuinely merit this confidence more than Minesto. Founded in 2007, the Stockholm-listed firm has developed an award-winning turbine specially adapted for areas with low-flow tidal streams and ocean currents.

The firm's subsea kite-style technology, which attracted a €13-million investment from the European Regional Development Fund in 2015, is currently being piloted off the Welsh coast and the Faroe Islands.

"2018 was a terrific year for us as we verified our subsea kite technology for the first time with a commercial-scale unit," says Martin Edlund, Minesto's chief executive.

Predicting full commercialisation in the next few years, Dr Edlund believes the time is nearing when energy from marine currents will provide a "substantial part of tomorrow's renewable energy mix".

Swedish marine energy developer InnoEnergy is sufficiently persuaded to have dropped €1 million into the project in December, adding to the €5.5 million it has already invested in the firm.

Others strike a more cautious note. Take the influential International Renewable Energy Agency (IRENA). With a potential capacity of 80,000 terawatt hours a year, IRENA predicts ocean energy could feasibly satisfy the world's entire power needs.

Yet the sector's growth is hindered by a number of uncertainties, says Dolf Gielen, director of IRENA's Innovation and Technology Centre. Top of his list are the disputatious politics of sharing the ocean, lack of resource information, absence of a grid connection and insufficient investment.

"To harness ocean energy at a commercial scale in the face of these barriers, tailored combinations of different policies need to be implemented that encourage research and development, and increase stakeholder engagement," Mr Gielen says.

Recent news gives weight to such cautious appraisals. The most high-profile setback came last summer when the UK government pulled out of an ambitious tidal lagoon project in Swansea Bay. The £1.3-billion scheme was supposed to act as a pathfinder for five more tidal lagoons.

Similar large-scale projects have excited hopes in recent years, only to come to naught. All face the same tricky combination of high capital costs, limited site availability, technological uncertainty and possible environmental impacts, in the form of altered currents and the emission of electro-magnetic fields, among other potential downsides.

As a consequence, for nearly half a century, the world counted only a single large-scale tidal barrage. In 2011, the club extended to two, when the long-standing 240-megawatt (MW) Rance Tidal Power Station in Britanny, France was joined by a similar 254MW project on Sihwa Lake, South Korea.

Now the nascent sector is encountering perhaps its biggest challenge yet. The falling costs of offshore wind makes it very difficult for tidal and wave energy of all types to be price competitive.

"Tidal [energy] has to compete with fixed-bottom offshore wind, which is impossible due to a different level of technological maturity," says Viriginie Lemière, spokesperson for Naval Energies.

> **"Tidal and wave energy never stops. As long as the moon stays in the sky, the tides will keep rising and receding**

As a result, many small tidal and wave energy firms have gone to the wall or been bought up, while others have been forced to take dramatic shifts in strategic direction.

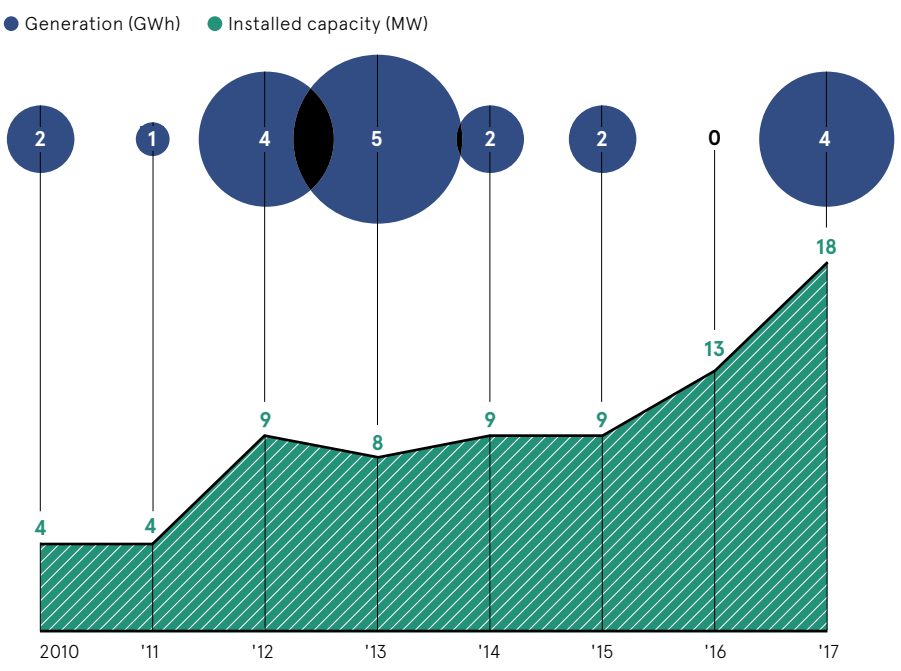
Naval Energies, one of the big names in tidal energy, fits into the second category. Despite recently installing a grid-connected 2MW tidal turbine in Canada and predicting that as many as 50 a year would follow, the Cherbourg-based firm now says it is pulling out of tidal turbines altogether.

Choppy as the waters look right now, don't go writing off the tidal and wave sector just yet. So warns Professor AbuBakr Bahaj of the Sustainable Energy Research Group at Southampton University. As a veteran of the industry, he has seen the sector's fortunes ebb and flow over the years, but retains a fierce belief in the technology's innate potential.

"Generating power from the tides and waves presents a really interesting technical problem to solve. And there's a lot of really pioneering work going into this that deserves to be recognised, coupled with perhaps appropriate support from governments to further propel the technologies forward," he says.

Given its huge potential, the tidal and wave industry has good reason to remain committed. Yet, recalling King Canute, its proponents ignore the market's hard realities at their peril. ●

MARINE ENERGY CAPACITY IN THE UK HAS SURGED



Lloyd's Register 2018

Why most energy companies have been getting digital transformation all wrong

Business leaders in the energy and resources sectors believe they have achieved or are working towards digital transformation. The trouble is they are frequently wrong

Research by OpenText and IDG Connect shows that more than 90 per cent of energy companies in the UK and Nordic countries say they have digital transformation programmes in place. One of the problems is a misconception of what digital transformation actually is.

"Companies often equate digital transformation with IT transformation," says Dr Gianvito Lanzolla, professor of strategic leadership at Cass Business School. "That is a recipe for disaster."

Chris Bingham, vice president for the oil, gas and utilities sector at Avanade Europe, a digital innovator formed in 2000 by industry giants Microsoft and Accenture, says: "When we look at what the market is saying, many people associate digital transformation with technology implementation. Yet when you look at best in class, those organisations also have a clear focus on transforming their employee experience as well as their business operations."

Avanade, which works with many large oil, gas and utilities companies, including Centrica as well as smaller organisations such as Tullow Oil and Subsea 7, believes that to truly transform to be digital on the outside, they need to be digital on the inside. This means engaging employees and helping them improve their ways of working, leveraging their technology investments. And for good reason.

Research led by Dr Kristine Dery, a research scientist at MIT's Center for Information Systems Research, says the top quartile of companies based on rating of employee experience enjoy twice the level of customer satisfaction and twice the level of innovation as other companies. As a result, these companies are 26 per cent more profitable, not just because of better customer satisfaction and innovation, but also because they are reducing their costs and identifying new streams of revenue.

While energy companies believe they are on track with digital transformation, across industry as a whole there is work to do.

A 2015 global survey from Avanade found that while 75 per cent of companies across all sectors understand the benefits of digital transformation, only 40 per cent have actually adopted such tools.

Paul Beaumont, modern workplace business lead at Avanade Europe, says things have moved on since the survey, but there is still more to do. "Many organisations still talk about digital transformation without recognising the need or opportunity to make meaningful business transformation," he says.

Centrica, however, has successfully grasped digital transformation. Centrica Energy Marketing & Trading (EM&T) engaged Avanade's Managed Services Team for support with more than 100 trading platform custom applications. Avanade works with Centrica using a combination of onshore and offshore resources for ongoing application management, application development and application portfolio management.

The partnership has led to a 50 per cent increase in trading volume, 50 per cent reduction in downtime incidents and a 60 per cent reduction in the time taken to resolve incidents.

"IT used to be the bottleneck on anything that needed to get done," says Stuart Beeston, Centrica EM&T chief operations officer. "Since working with Avanade, we have a track record of meeting business needs. IT is now an asset that gives the business confidence to explore opportunities."

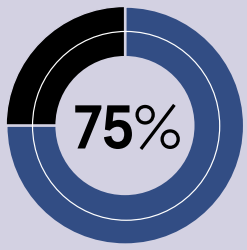
Building a successful digital workplace depends on having the right technology partners and Avanade has been awarded Microsoft's number one systems integrator for 11 years in a row.

Chief information officers (CIOs) are also recognising Microsoft's strength in digital transformation and ranked the company as its top vendor in Morgan Stanley's annual CIOs survey in 2018.

"The company's new CEO Satya Nadella has changed its focus and Microsoft's extremely successful cloud platform Azure has allowed them to rotate. Microsoft now plays nicely with companies such as SAP and Adobe which were previously 'sworn enemies'," says Avanade's UK and Ireland chief technology officer Mark Corley.

Better data analytics, in particular, is helping energy companies transform the way they operate and many are already doing so; 98 per cent of energy companies surveyed say they already draw on data analytics and predictive data to make decisions.

HOW DIGITAL WORKPLACES DRIVE TANGIBLE BENEFITS FOR ENERGY COMPANIES



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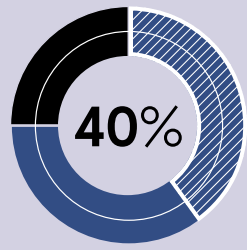

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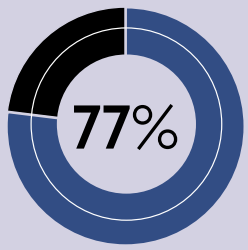
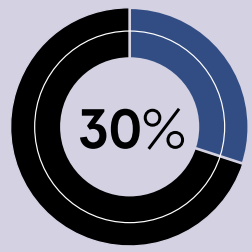
Avanade 2015

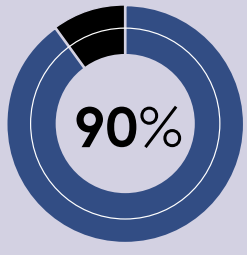


of UK utilities see digital transformation coming within 15 years and 17 per cent expect radical digital transformation within five years

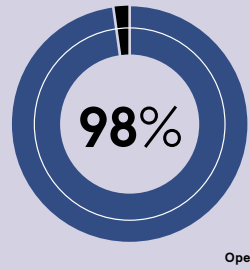


say digital technologies will drive significant changes to organisational structures

***Utility Week*/Open Text 2018**



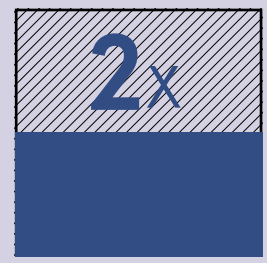
of energy companies in the UK and Nordic countries have digital transformation programmes in place



said they already drew on data analytics and predictive data to make decisions

Opentext/IDG Connect 2017

Research from the MIT Sloan Center for Information Systems Research shows that companies in the top quartile for employee experience realised...



the level of customer satisfaction, and...

higher profitability than their competitors

Dery, K., and Sebastian, I. (2017). 'Building Value with Employee Experience', MIT CISR Research Briefing. XVII:6. June 2017

Stanley Louw, Avanade's UK and Ireland head of digital innovation, shares an example of how this is working in practice. "We have been helping one company to manage when drill bits are breaking and using data to understand the best way to prevent or fix them," he says.

While energy companies feel they have digital transformation under control, the picture in the utilities sector looks less developed.

One recent study from OpenText shows 77 per cent of UK utilities see digital transformation coming within fifteen years and 17 per cent expect radical digital transformation within five years. Some 30 per cent say digital technologies will drive significant changes to organisational structures.

Mr Corley agrees that utilities are ripe for transforming into digital workplaces. "In many utilities, we still see Windows 7 and XP, and there is an absence of unified communication and collaboration. That is a massive opportunity," he says.

Avanade Europe's Mr Bingham says: "Utilities have done things the same way for a very long time and they have thrown armies of people at problems rather than automation, and have made do with out-of-date IT. We are starting to see that turn."

Mr Beaumont adds: "We have helped one of the world's largest investor-owned electrical utilities invent a new operating model which no longer focuses just on the IT organisation. The model is based on constant change and evolution. It is also being driven by the business for the business; IT no longer has the sole responsibility for driving technology change."

Making digital transformation less about technology and more about the business is going to be crucial for the survival of the energy and utilities sector in a challenge-strewn road to the future that includes climate change, the move away from fossil fuels to renewables, and a world of geopolitical tension and protectionism.

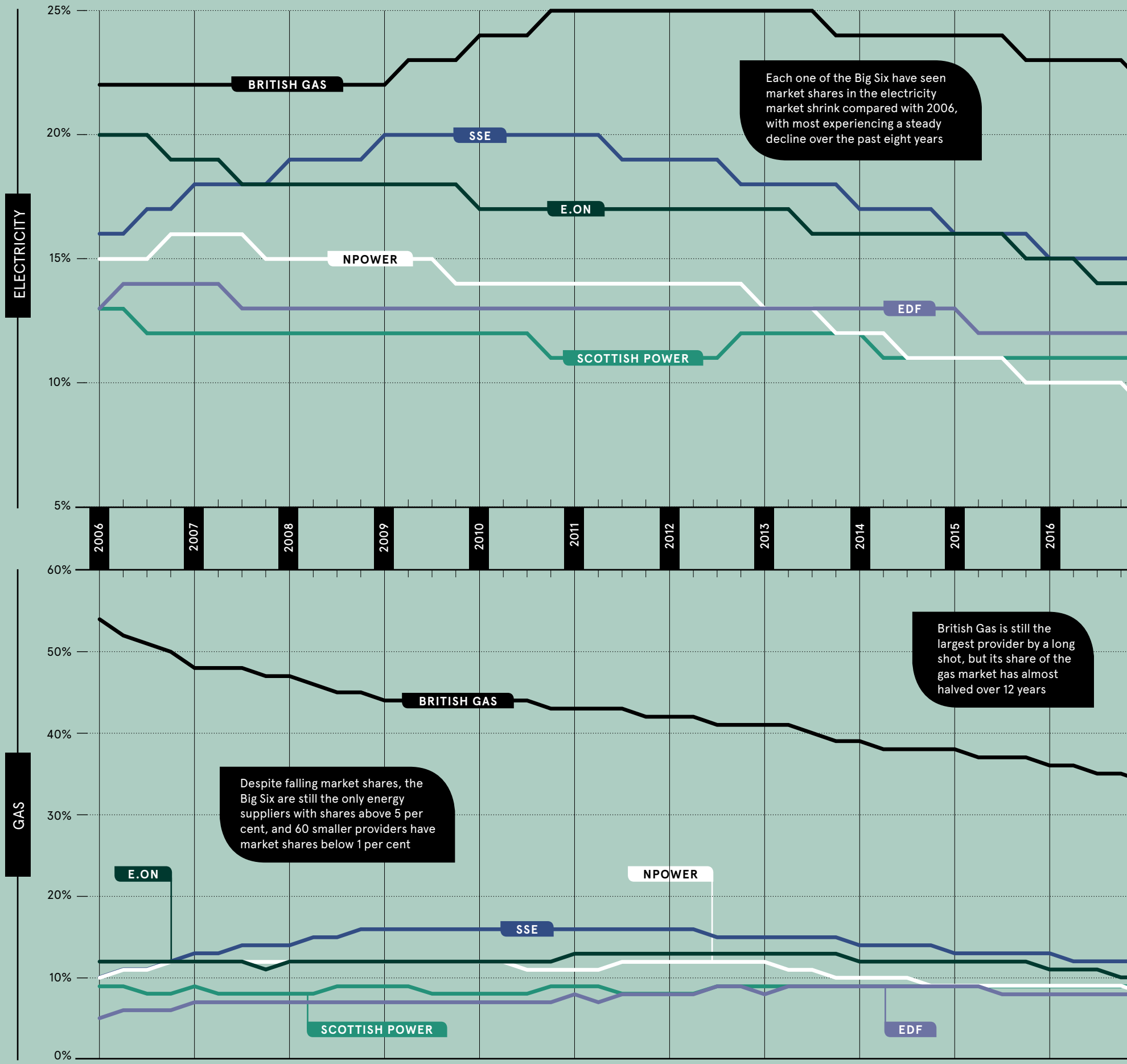
Avanade believe that to transform your organisation to meet this future, the real work needs to start at home.

For more information please visit avanade.com

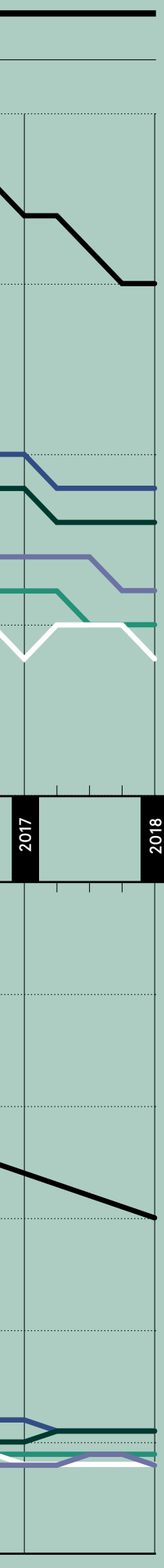
avanade

BIG SIX BATTLES

MARKET SHARES OF THE BIG SIX PROVIDERS, DOMESTIC RETAIL ELECTRICITY AND GAS (%)

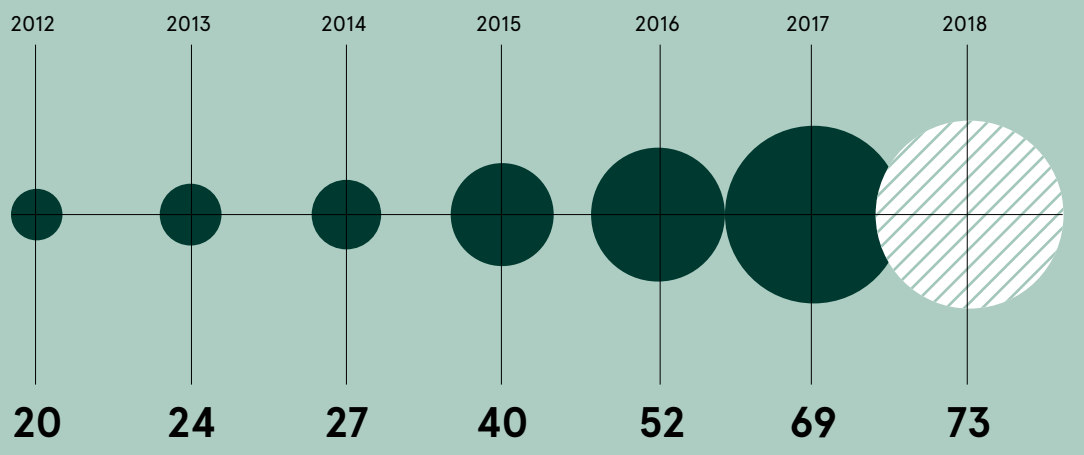


The six largest energy providers in the UK – British Gas, EDF Energy, E.ON, npower, Scottish Power and SSE – used to supply 100 per cent of the nation's electricity and gas back in 2004. However, recent years have seen market shares decline as new entrants have ramped up competition. With profits slipping and customers now able to switch easily between one of the now-73 domestic suppliers, dynamics in the energy market are beginning to change



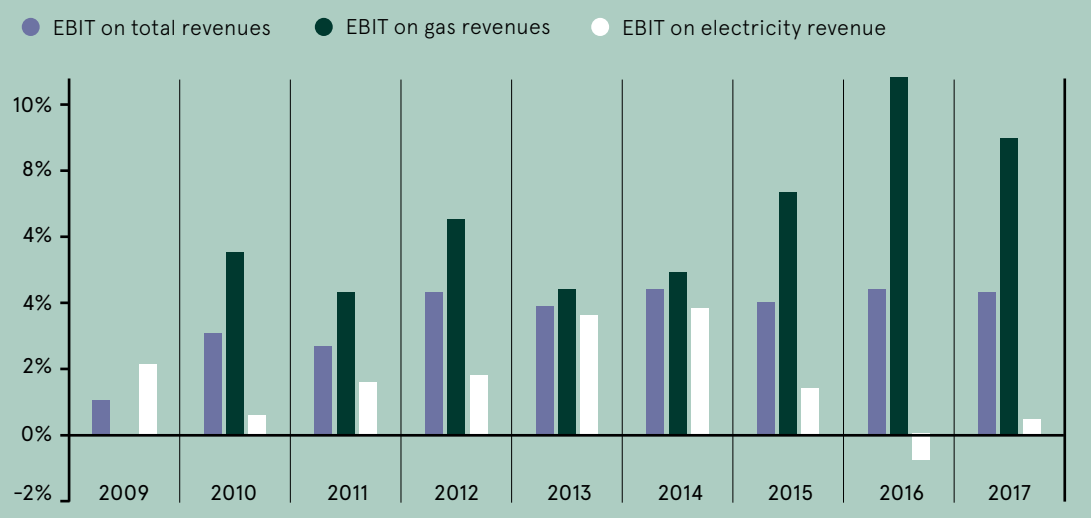
NUMBER OF ACTIVE SUPPLIERS

Supplier numbers at the end of each year, retail electricity and gas combined



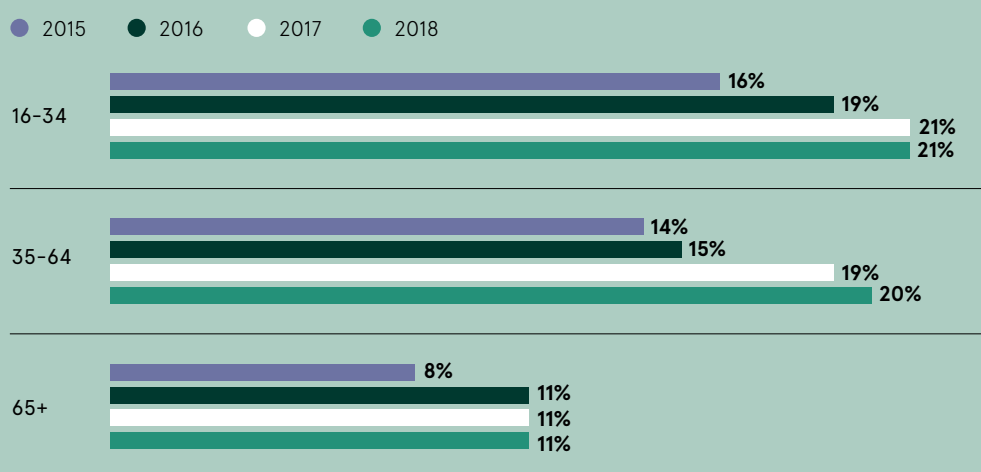
PROFIT MARGINS DIVERGE FOR ELECTRICITY AND GAS

Earnings before interest and tax (EBIT) as a percentage of sales for the Big Six combined



SWITCHING RATES RISE AMONG YOUNGER CUSTOMERS

Percentage of the following age groups who have switched energy suppliers in the past 12 months



19%

of consumers switched suppliers between July 2017 and June 2018, up from 17 per cent the year before

17%

drop in household energy consumption over the past 15 years, after adjusting for changes in temperature

73

number of active licensed suppliers in 2018, up from just 13 in 2004

£320

approximate amount consumers on a standard variable tariff could save by switching to the cheapest tariff in the market in 2018, up from £300 in 2017

£1,117

average dual-fuel bill for customers of the Big Six in 2017, down £52 on the previous year

Sourced from Ofgem's latest available data

Commercial feature

Who will win in the energy industry's chain reaction?

Faced with rising wholesale prices and diminishing margins, most service providers are too small to be profitable or too big to be agile. Oaklin partner **Barry Hahn** looks at how the wobbling energy industry will fare in 2019

I'm in the middle of a chain reaction" – a famous line from a Diana Ross hit song – is an apt chorus for the energy industry. In just twelve months, company debts have grown, ten energy suppliers have ceased trading and the inability of smaller firms to pay liabilities has left Ofgem's environmental policy funds short by £59 million.

This is bad news for customers. Although Ofgem will protect consumers if their supplier goes bust, sharing personal details with yet another company isn't high on the public's agenda. It's also expensive, with the Supplier of Last Resort (SOLR) mechanism meaning billpayers ultimately bear the cost of this protection. This bill currently totals £171 million and is rising.

To make matters worse, the promised 'nirvana of disruption' – better service levels and lower prices – hasn't materialised. Before their demise, Spark Energy and Extra Energy were rated among the worst energy companies in the country by Which? The situation will exacerbate further if, as expected, wholesale prices continue to rise and customer service purse strings are tightened.

Elsewhere, domestic customers continue to walk away from the Big Six in droves. SSE and npower have recently reported annual customer losses of 430,000 and 500,000 respectively, while British Gas lost 370,000 customers in just four months between June and September 2018. Even if the government's price cap inadvertently discourages switching by equalising perceived differences between small and large players, its short-term impact on switching volumes is likely to be minimal.

In its fight for customer volumes, the energy industry has undermined its own profitability, with consumer choice proving destabilising. Historical regulatory focus on customers at the fringes has created a culture that ignores customer value. 2019 is, consequently, a critical time to reset the dial – to look beyond short-term disruptive behaviours and rebalance collective culture to support the majority of customers, not simply the few. While fundamental obligations cannot and should not be avoided, the industry needs to focus on building better customer experiences for all.

The cost of doing business is rising inexorably, partly driven by assertion-based policies such as smart metering. Suppliers need to become leaner and promote self-service to drive efficiencies. Parallels with the retail banking industry should not go unnoticed. Like in banking, bigger companies must re-platform on to more agile infrastructure. Value should also be seen as the key differentiator, not price, with customer loyalty earned by offering distinctive propositions such as connected home products and energy as a service.

What is likely to happen over the next 12 months? Firstly, increasing numbers of smaller companies defaulting or seeking refuge in larger rivals will trigger several acquisitions. This requires all suppliers to actively consider their merger and acquisition strategies so they are able to respond swiftly to unpredictable competitor behaviour.

Secondly, there will be a notable divergence of the Big Six's strategies. Some will 'go big', hoovering up smaller suppliers to become a monolith, while others will 'go home' and divest into higher-margin pursuits such as digital grid technologies. All suppliers are advised to develop coherent diversification and monetisation strategies so that they can effectively pivot in either direction.

Thirdly, there will be widespread product simplification, especially in the retail sector where disruptors are charging up to £150 less than the Big Six for basic tariffs. This tactic must be adopted to build customer trust. This will likely coincide with increased political pressure to limit price increases, and will require regulation teams to work more closely with product developers to enable acceptable consolidation.

Finally, smaller organisations may seek to survive by combining their purchasing power to hedge wholesale costs. This would require complex commercial agreements and process changes, as well as legal negotiation. If possible, it would be groundbreaking for the industry and a pragmatic way for smaller suppliers to achieve economies of scale.

At the end of a decade characterised by growth in service providers and customer choice, the energy industry is facing a perfect storm. Amid this uncertainty, some will flounder and some will excel. And for those who have prepared for the storm, 2019 could be their most exciting and commercially significant year yet.

For more information and further insights, visit oaklinenergy.com

OAKLIN

8.4m
switches between January 1 and October 31, 2018

32%
gains made by small and mid-tier suppliers from the Big Six

£171m
added to customer bills in SOLR costs

OPINION

'Data will open a gateway to more engaged customers and a responsive energy industry'

Energy is an essential service and fundamental to our economy. We all use it and need it to stay warm, light our homes and power our businesses. But there is a quiet revolution happening in the energy sector led by the increasing use of data and coupled with the essential need to decarbonise our economy. And smart meters are critical to delivering both.

We often focus on the initial benefits of smart meters for consumers: the immediate ability to save both energy and money. However, there are much bigger opportunities to be realised as we deliver this important upgrade to our national infrastructure.

Smart meters are the enabler of our future energy system and, when combined with electric vehicles (EV) and battery storage, they will completely transform the relationship between customers and their energy.

Imagine a world where the data produced by the everyday appliances in your home can help you easily identify where you can save money, whether this is through changes in behaviour or by identifying where more energy-efficient white goods or insulation are needed.

That data could also keep you in touch with an elderly relative living alone, by seeing they are up and have turned on the lights or boiled the kettle.

Data will open a gateway to more engaged customers and a responsive energy industry.

And we are already seeing the beginning of this new world with an increasing range of smart appliances and innovative products giving customers greater control of their energy use. Also, time-of-use tariffs mean people can choose to use energy, for example to charge their EV, at times when power is cheaper.

How we generate electricity has changed remarkably in the last ten years. Now we go days without burning coal and it provides less than 10 per cent of our power needs. Last year, the majority of our power came from low-carbon sources, such as wind, solar and nuclear. This is an increasing trend, with around 400,000 low-carbon jobs, and the sector is growing.

Future changes are going to be even more dramatic. Further decarbonisation is necessary and will be more challenging as we look to balance a system with increasing levels of renewables. Greater challenges are on the horizon when we look at how we use transport, and how we heat our homes and businesses.

Difficult choices will need to be taken when it comes to heating and this will require strong leadership from government. In addition, it is forecast that there are going to be at least ten million EVs on the road by 2030 and many people think this is a conservative estimate.

So we must make energy efficiency a national infrastructure programme. We must also harness innovation and smart technology to help consumers further reduce their energy bills and usage, while providing warmth and comfort in their homes, including for customers in vulnerable circumstances, who must be protected and not be left behind.

The energy sector is clear that we have a responsibility and an opportunity to get things right for all our customers, the UK and the environment. But to deliver this future energy system, we need a sustainable energy sector that is able to invest and innovate, which current developments threaten to undermine. ●

Lawrence Slade
Chief executive
Energy UK

STORAGE

Keeping lights on around the clock

For businesses operating complex supply chains and delivering vital services, maintaining a stable and dependable level of power is paramount when it comes to energy storage

David J Turner/Getty Images

Rich McEachran

Keeping meat and juice fresh can be an expensive business for supermarkets. The energy used by chilled aisles can account for 40 to 60 per cent of a store's total energy bill, according to the United States Environmental Protection Agency.

With the retail industry looking to reduce its carbon footprint, some supermarkets, including Aldi and Lidl, are turning to renewable energy technologies, such as solar panels, anaerobic digestion and wind turbines, to provide power to stores and distribution centres.

The problem is, while these energy sources are clean, they're subject to interruptions. Solar panels require the sun to shine, but supermarkets need to keep refrigeration units running throughout the night.

"Replacing conventional power generation with renewable generation is essentially moving from a reliable, centralised infrastructure to a decentralised and intermittent energy supply," says Stefan Schauss, president of CellCube Energy Storage Systems, which is headquartered in Toronto. The company is aiming to become North America's leading producer of vanadium electrolytes for the energy storage industry.

"Energy storage promises to solve all the quality and stability of supply issues for uninterrupted production in the wholesale and retail chain," Mr Schauss adds.

Leading the charge when it comes to energy storage are lithium-ion batteries: literally the same as the battery packs found in electric cars and smartphones, just on a bigger scale. According to GTM Research, lithium-ion battery storage could increase 55 per cent every year until 2022. The United States is expected to see the most deployments, followed by China and Japan.

In December 2017, Tesla switched on the world's largest lithium-ion battery in southern Australia, which stores excess energy generated from a nearby wind farm to meet demand during peak periods. Within its first month, the battery reportedly kicked in 0.14 seconds after one of the country's main power stations experienced an unexpected outage.

Despite lithium-ion battery storage being able to respond more quickly than traditional backups and solve the immediate problems regarding stability, it has downsides.

Lithium-ion batteries are ideal for filling in the gaps, but not for long periods of intermittency. Their life cycle, on average, is between two to seven years. In comparison, vanadium redox flow batteries, which CellCube specialises in, can store more energy and last up to 25 years. This makes them suitable for businesses that want to store up enough energy to support them for weeks or months when the sun isn't out or the wind isn't blowing.

"Vanadium redox flow batteries connected to the grid are increasingly being recognised as the future of energy storage," claims Mr Schauss.

The leading developer of vanadium flow technology in the UK is redT. The company has a number of operational installations, including in Cornwall on a 600-acre farm and 28-cottage holiday retreat, and in Melbourne, where a vanadium flow-lithium battery hybrid system has been installed at Monash University.

2%

of total vanadium demand was used for vanadium redox flow batteries in 2017 – this is expected to rise to...

20%

of total demand by 2030

Bushveld Minerals/TTP Squared 2018

29%

of the world's energy was consumed by buildings in 2016

DNV GL 2018

According to Scott McGregor, chief executive of the London Stock Exchange-listed company, its redox flow devices – he prefers to call them machines rather than batteries – can cut large businesses' energy bills by half.

"These machines can cycle heavily every day for many years without degrading. They aren't small and sexy, but that's not their purpose; they are true storage infrastructure, designed for heavy industrial use unlike disposable lithium batteries," says Mr McGregor.

Another financial benefit of redT's machines is users are able to make money by supporting the grid at peak times, giving them "a long-term hedge against rising energy prices", adds Mr McGregor. This is "energy storage 2.0", he says.

The price businesses will pay for not investing in energy storage or battery storage could be high. At the same time, businesses that are mission critical, such as datacentres, are risk averse and will already have uninterruptible power supply (UPS) systems in place, says Stephanie Jamison, a managing director at Accenture, who leads its transmission and distribution division.

> **"Vanadium redox flow batteries connected to the grid are increasingly being recognised as the future of energy storage**

For this reason, such businesses are likely to play it safe and the way they operate, relying on diesel or gas-powered backups, for example, is unlikely to change in the short term.

"Businesses without mission-critical processes, but still suffering significant impacts from outages or from poor quality, have generally been unable to justify the cost of deployment," says Ms Jamison. "Now they have the opportunity to use innovative storage technologies to improve power reliability and provide new revenue streams."

ENERGY AS A SERVICE

Bright future for as-a-service energy offering

Providers, under pressure from new industry entrants, could look to offer energy as a service to diversify their offering

Heidi Vella

As the utility industry continues to undergo major transformation driven by decarbonisation, decentralisation and digitisation, an emerging business model, known as 'energy as a service', is set to disrupt it further.

This broad umbrella term describes the growing sub-market of selling not only energy, but also technology, analytics, personalised services and even access to the grid.

"We are seeing more effort now to develop a new retail model than at any time over the last 100 years," says James Sprinz, head of decentralised energy at Bloomberg NEF.

The trend is driven, in part, by advances in technology, and the desire of residential and business consumers to reduce costs and/or their carbon emissions. But also, says Mr Sprinz, by major European energy suppliers trying to claw back market share lost to renewables and new markets entrants, such as smaller players including Good Energy and Ovo Energy.

"Energy providers are looking at other things they can sell besides electricity, which has seen a large increase in capital in the market, as well as more mergers and acquisitions," he adds.

In the UK, most of the Big Six energy suppliers have developed or acquired companies offering new services. Centrica, for example, in 2015 bought AlertMe, a smart tech company that provides energy and home-monitoring hardware and services, and Panoramic Power, which helps companies improve their operational efficiency.

> **Certainly the business models of the large utilities will have to change dramatically to keep up**

In fact, according to a Bloomberg NEF report that tracked 30 selected companies' activity in decentralised energy products and services, in 2017 there was an uptick in investments and partnerships in new areas such as battery storage and virtual power plants, but also in existing capabilities including energy management and micro-grids.

These companies are facing competition from outsiders, including Google, with its Nest offering, as well as startups, such as WATTY and ONZO.

"There are many companies looking to move into this sub-sector because digitalisation allows them to aggregate and control assets, resources and demand in a way that previously wasn't possible," says Professor David Healey, director of smart energy at WSP.

Though still relatively nascent, this market is poised to grow and diversify, especially with the continued emergence of electric vehicles and smart cities. According to Navigant Research, the energy-as-a-service annual market for commercial and industrial customers is expected to reach $221 billion by 2026.

But what impact will it have on the current structure and hierarchy of the overall utility sector?

"No one can be sure where it will go, but certainly the business models of the large utilities will have to change dramatically over the next five to ten years to keep up with the changes," says Professor Healey.

Unsplash/Kendall Ruth

DGLimages/Shutterstock

What it means for energy prices

More services and competition in the utility market are generally considered a positive development, but it's unclear what effect it will have on overall cost for the end-user.

Francesco Venturini at Enel X insists this will allow customers access to better pricing models. For example, through demand-side-response services, customers willing to adjust their energy consumption to off-peak, cheaper supply times will benefit from the lowest prices.

He adds: "Through these new business models, more and more companies will join the game, blurring the line between sectors and increasing competition, with potential pricing benefits."

Furthermore, Professor David Healey at WSP believes cost reductions and increased energy security can be achieved by more aggregation and management of demand in localised areas.

And Charmaine Coutinho, principal analyst at Delta-ee, points out that though it is too early to really say either way, consumers may make savings "through more effective energy use and more precise meter readings".

But there's always a risk, cautions James Sprinz at Bloomberg New Energy Finance, that with more choice in new services, some more valuable than others, or if services are oversold by companies keen to maintain relationships with customers, costs won't be reduced and "consumers will just end up spending money on different things".

As the market continues to move from fossil fuel-based, centralised generation to distributed, greener power, he adds, the sector will see more new suppliers entering the market to offer services locally at a lower cost, utilising local generation supply.

And though it is still quite challenging for new players and startups to enter the complex energy market, says Charmaine Coutinho, a principal analyst for Delta-ee's New Energy Business Model Service, the sector could see big tech players capitalise on their brand affiliation with more energy-as-a-service offerings.

"In their favour, they have a great understanding of data and data analytics, which is a key part of energy as a service," she says.

And technologies such as Google's Nest are, in many ways, a 'trojan horse' for the industry, according to Duncan Barnes, partner at Deloitte, and Energy and Resources sector lead for Deloitte Digital in the UK.

"Once a consumer has this technology in their house their agency is with Google not the Big Six," he says. "Currently, these devices are controlled by customers, but in the future, they could be run by algorithms, so those businesses that can manage data and provide insights will be the ones that succeed."

Furthermore, smart metering will create even more emphasis around data and the opportunity for same-day switching, "which will make switching more rapid and dynamic", says Mr Barnes.

Francesco Venturini, head of Enel X, agrees that the boundaries between energy and other sectors will continue to blur through new business models.

"If I think about electric mobility, utilities are competing with car manufactures; in energy managements systems, utilities compete with digital platform providers; in the field of the smart home, utilities are competing with the tech giants; and so on," he says.

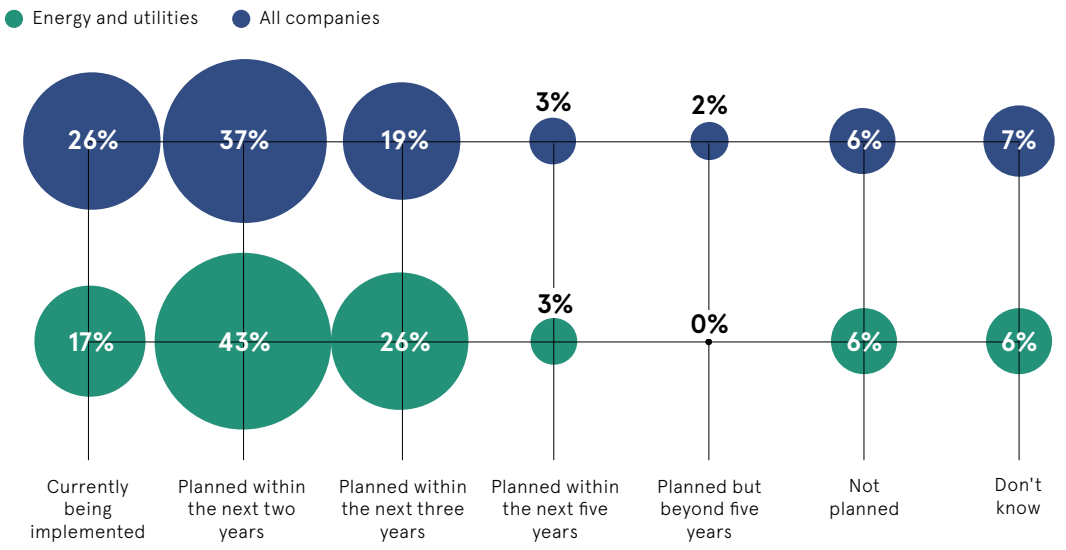
"Therefore, traditional utilities, which are not ready to tackle this new ecosystem, are definitely disadvantaged in comparison with those players that decide to deal with these new business models proactively."

The future of the energy-as-a-service model promises new revenue opportunities, especially as demand for electric vehicles, smart cities and energy storage grows. But with it also comes uncertainty and disruption.

"We are at a stage where several companies are the market leaders and are making the necessary investments, while others are unconvinced by the demand. Over the next few years, we will see which companies are successful," Mr Sprinz at Bloomberg NEF concludes.

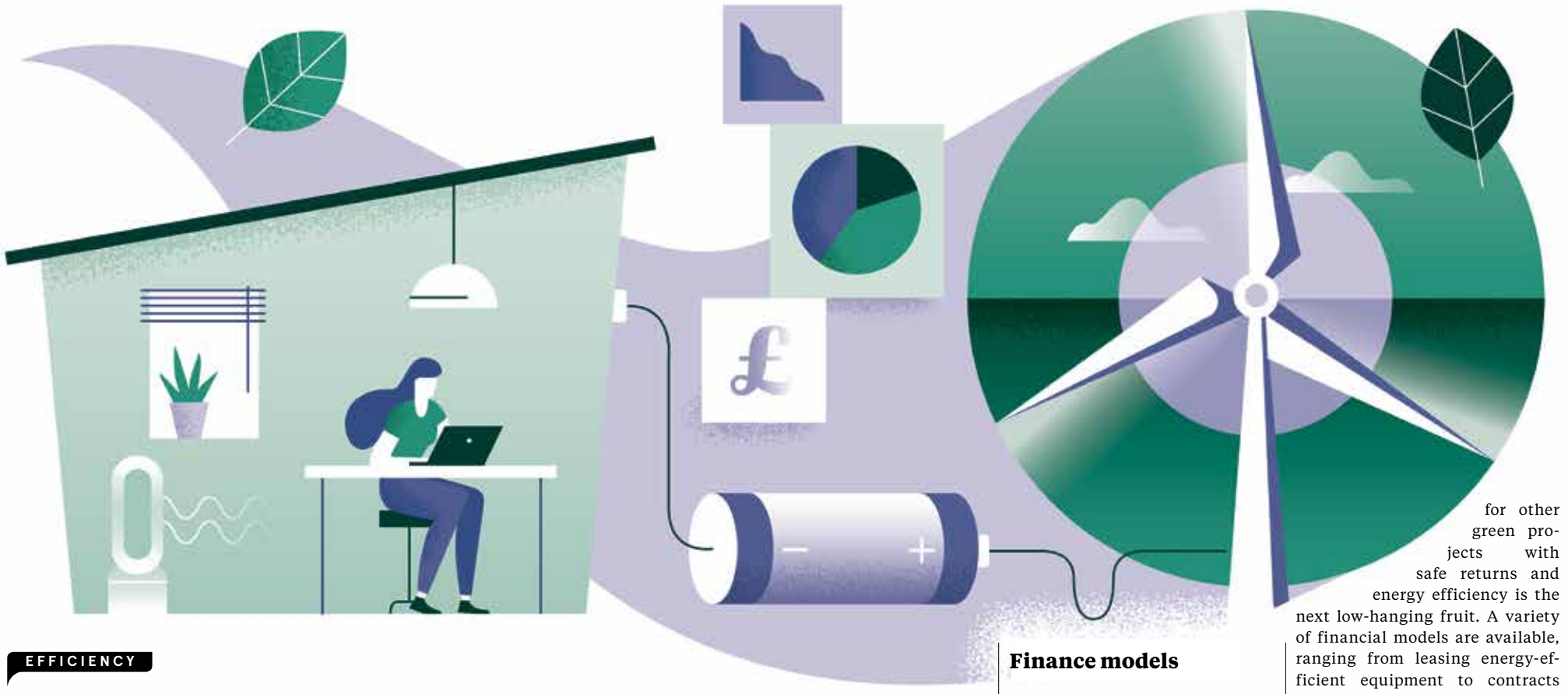
HOW COMPANIES HAVE EMBEDDED DATA ANALYTICS INTO THEIR BUSINESS MODEL

Data analytics will be key to offering energy as a service, yet the sector remains slightly behind the average in terms of data maturity



Percentages may not add up to 100 due to rounding

Exasol 2018



EFFICIENCY

Five ways to drive the ‘negawatt’ revolution

Nick Easen

Twenty years ago, American energy policy guru Amory Lovins noticed a wrong spelling of the word megawatt – subsequently the “negawatt” was born. Fast forward and today this unit of energy saved through efficiency is going great guns. Take the UK alone: electricity generated last year fell to its lowest level since 1994, according to Carbon Brief. Both consumer and business energy efficiency contributed to this drop.

"Every year, companies spend more than £345 billion on energy efficiency and sustainability initiatives,” says Mike Hughes, zone president for UK and Ireland at Schneider Electric. “Businesses are beginning to recognise the positive financial, operational and societal benefits that energy efficiency brings.”

Many thousands of negawatts come from deploying LED lighting upgrades or erecting energy-efficient offices. The impetus on energy efficiency has come from rising energy costs, compliance and cheaper technology, which mean paybacks get shorter each year.

Looking to the future, here are five emerging innovations that will drive further efficiencies:

1 Disruptive tech

Artificial intelligence (AI) could be the new energy watchdog in our workplaces. “This will allow real-time analysis of energy use alongside data on production or other metrics. AI will instantly alert people when energy is being wasted or it will take direct action to reduce consumption,” explains David Oliver, solutions consultant at Inenco.

Meanwhile blockchain could help create an accurate record of energy transactions. With the rise of micro-grids and distributed renewable energy sources, such as solar panels on office roofs and warehouses, companies will be able to sell their excess energy with a high degree of autonomy. Utilities could then become more efficient by balancing supply and demand in real time, engaging producers and their blockchain data. Lo3 Energy have trialled this system in New York.

“Energy buyers will also be able to act with increased autonomy at a lower cost and time commitment. Combining multiple technologies is fundamental to the future of energy efficiency,” says Mr Hughes.

2 New-wave heating

Heat recovery is a nascent initiative championed by the UK’s Department for Business, Energy and Industrial Strategy. There are now many schemes to recover heat and distribute it through networks. “However, they are expensive and require participants to sign up to long-term contracts, so many companies are cautious about such agreements,” says Mr Oliver.

For instance, the Industrial Heat Recovery Support Programme opened in autumn 2018, funding projects that use waste heat from business processes. “It has already generated high interest among manufacturers to capture and reuse heat for process or space heating elsewhere in the factory or local community,” says Georgina Penfold, director of ICON. “We know of a steel mill in South Yorkshire and a food processor in Northampton that are currently working on designs to take advantage of this support.”

Over the next decade expect more efficient electric heating from an increasingly green grid, instead of polluting fuels such as heating oil, and LPG. “Recent consultations suggest the government will look to crack down on such fuels in new buildings. Building regulations could also be changed encouraging greater use of air and ground-source heat pumps,” says Mr Oliver.

3 Finance models

One of the biggest barriers to business energy efficiency is funding and this is especially true for small and medium-sized enterprises. Cutting fuel bills isn’t as sexy as investing in shiny solar panels, yet the effects can be surprising. “For a supermarket with a profitability of only 2 per cent on turnover, saving £100,000 on energy has the same impact as selling an additional £5 million of goods,” says Mr Oliver. Yet unrealistic payback criteria sour investment.

However, now government subsidies are ending for renewable schemes, investors are looking for other green projects with safe returns and energy efficiency is the next low-hanging fruit. A variety of financial models are available, ranging from leasing energy-efficient equipment to contracts where savings on energy bills are used to recover the investment cost over several years. “The challenge for energy users is to find the best finance model aligned with their business needs,” says Mr Oliver.

All eyes are also on the Industrial Energy Transformation Fund. Announced in the 2018 Budget and backed by £315 million, the aim is to support businesses with high energy use slash bills through energy efficiency, yet there’s scant detail on its future terms.

4 Energy storage

Storing energy is becoming more realistic for industry as battery costs come down. Combine this with on-site energy generation and businesses can become increasingly self-sufficient and manage their own supply. Energy flexibility is key. “Storage is speeding up the adoption of renewables like solar and wind, but at the same time helping companies to level out the variance in energy prices that can happen due to a surge in demand,” says Mr Hughes.

This year could be an interesting one as businesses start to become autonomous in how they supervise their energy needs. “2019 is the year that management, generation and balancing of business energy truly starts to converge with efficiency finally moving into the limelight on a political level, as well as a practical one,” says Ms Penfold.

5 Digital and data

Digitalisation of businesses and better energy data collection will drive future efficiencies. “The main issue with implementing new innovations is building a clear business case upfront,” says Mr Hughes. “There is a lot of data needed to justify and measure efficiency efforts, from utility bills to energy management systems. Some organisations also lack the internal expertise or tools required to drive insights, or are dealing with incomplete data; this will change.”

Data-driven insights have the potential to initiate better human behaviour in the future. However, the widespread use of smart meters has driven little change. The fact is many are basic and aren’t that smart; this is evolving.

“If employees understand how they can help save energy and are motivated to do so, then businesses will see the benefits of even basic energy awareness programmes. Only by adopting behavioural management systems can tangible savings be realised,” Mr Oliver concludes.

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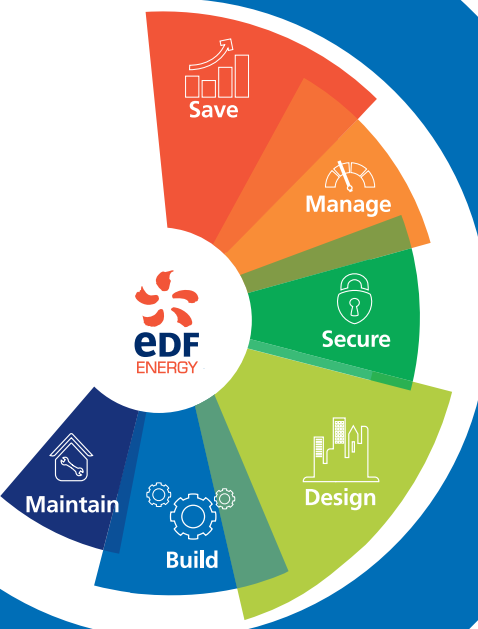

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