UtilityWeek™

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INSIGHT REPORT

Building the flexible grid of the future

In this report

Introduction

The UK's target to hit net-zero emissions by 2050 cannot be achieved solely by scaling up renewable generation. The entire energy system will also have to become increasingly flexible, which will allow decarbonisation at a lower cost. However, this energy transition requires networks to accelerate digitalisation and mass engagement with consumers.

Despite the urgent action required to meet the net-zero target, the frameworks for encouraging flexibility remain in their infancy. There is a need to roll out new infrastructure, improve data sharing about system requirements, and ensure regulation keeps pace with the challenges of a new era.

Networks are also contending with a fundamental shift in business models with the transition to distribution system operators (DSOs). According to the Energy Networks Association (ENA), DSOs will take a more active role in operating and developing an active distribution system comprising networks, demand, generation and other flexible distributed energy resources (DER).

At the heart of this transformation, there is a need to maintain the resilience and reliability of the energy system, while also protecting the interests of consumers.

Utility Week partnered with wireless technology company Qualcomm Technologies, Inc. to explore the key barriers utilities must tackle on the journey to delivering the flexible grid of the future.

This insight report looks at the key drivers for change and the tangible steps the sector is already taking to create an energy system that is fit for current and future demand.

Image credit: UKPN

The challenges of the energy transition

Supporting grid flexibility at scale is a complex undertaking, requiring millions of decisions to be made continuously and in real-time. Without this capability, the full value of flexibility cannot truly be achieved. As such, the digitalisation of data and automating decision-making processes is critical.

Scottish and Southern Electricity Networks (SSEN) is investing heavily in the capabilities necessary to unlock grid flexibility through the digitalisation of its field processes, data capture, decision making, and the way in which information is shared with partners and stakeholders.

"The volumes of work that we expect on our network as we transition to net zero is set to grow exponentially and, as a result, we are using a range of technologies to drive down unit costs, to improve customer service and to increase the visibility of our network, says Andrew Roper, DSO director at SSEN. "There is no limit to the technologies that we are willing to consider in this quest with an innovation portfolio that covers topics as diverse as behavioural economics, vibration analysis, advanced analytics, enzymes and satellite technology."

However, there is broad recognition from networks that the digitalisation of the sector and the DSO transition introduces a variety of new and complex risks.

Roper explains that these risks extend from areas such as cyber security threats, system risks, social and political risks. "We have proactively sought to tackle these new risks head on with the aim of mitigating rather than let them slow the pace [of change]," he says.

"We have also worked with academia and through facilities like the HVDC centre [the UK's only simulation and training facility designed to support all HVDC schemes] and the PNDC [a whole energy systems research, test and demonstration environment across multiple locations, formerly known as the Power Networks Demonstration Centre] in Cumbernauld to understand new forms of system instability caused by interactions between markets, electricals systems, human behaviours and telecommunications in this 'system of systems' that DSOs will be operating."

Maximising market participation

With various types of devices now acting on the grid – from batteries and renewables to demand side response systems – there are a lot of new players entering the market. "Previously, there were less than 100 generators and everyone else was just passive demand," explains Randolph Brazier, director of innovation and electricity systems at ENA. "Now you've got potentially millions of different players, buying, selling, trading, charging and discharging on the grid. There is a lot more active movement of power all over the grid, which means that the distribution network needs to adapt to all of those new players, those new energy flows, the new demand."

To accommodate this new demand, transitioning to a smart grid that allows energy flow to be optimised is critical. "Where there is capacity, we need to optimise that and where there is congestion, we need to move power away from that area," explains Brazier. "To do that, you need a smart grid and you need to be able to see what is happening on the grid and to be able to control it in a really granular manner. You need to be able to switch power flows and move power in different directions, while also enabling new markets to participate on the grid to relieve some of those issues."

The DSO transition aims to unlock progress in this area, ultimately forging a path to using the grid in a smarter and more cost efficient way. As part of this work, networks are already engaging with key stakeholders and have established action plans.

UK Power Networks (UKPN), for example, is focused on establishing the first legally independent DSO by the start of ED2 in April 2023. Sotiris Georgiopoulos, head of smart grid at UKPN, says that this will act as the engine to deliver better value for customers – avoiding more than £400 million of network reinforcement over the next five years.

> "Real-time data collection, communication, and processing through digitalization are essential for system-level flexibility."

Faramarz Maghsoodlou, Senior Director, Business Development, Energy and Utilities Digitisation **Qualcomm Technologies, Inc**

> "Our flexibility programme over the last five years has focused on reducing barriers to entry so we can maximise participation in the market. We've grown the market from scratch to a cumulative total of more than half a gigawatt of contracts awarded at a value of more than £45 million."

Sotiris Georgiopoulos, head of smart grid, **UKPN**

"This fundamental shift, creating an independent DSO, sees UKPN managing an increasingly complex, dynamic, and low carbon electricity network while the DNO [distribution network operator] maintains focus on our core responsibilities – safety, customer service and reliability," he says.

"Our flexibility programme over the last five years has focused on reducing barriers to entry so we can maximise participation in the market. We've grown the market from scratch to a cumulative total of more than half a gigawatt of contracts awarded at a value of more than £45 million."

For SSEN, the focus is on setting up a separate DSO Directorate to develop DSO functions and manage network capacity development investment decisions. The company has also built foundational systems, such as asset data mapping and active network management at grid substation level, to enable provision of data for analysis and automation of DSO functions.

Roper adds that a "learning by doing" approach has also been adopted, working with stakeholders to implement flexible connections for customers and testing flexibility service procurement and product development. This approach is demonstrated through SSEN's Project LEO in Oxfordshire, a smart grid trial that is seeking to accelerate the UK's transition to a zero-carbon energy system.

But for the flexibility market to grow and provide reliable network solutions, maximising market participation and tackling barriers to entry is critical. Roper explains that market participants need consistency and alignment between the DNOs in terms of procurement, dispatch and settlement of flexibility services.

"They also need to see coordination between the DNOs and the ESO so they are confident in stacking services to generate additional revenue," he adds.

Faramarz Maghsoodlou, Senior Director, Business Development, Energy and Utilities Digitisation at Qualcomm Technologies, Inc., agrees that improved collaboration across the sector and increased standardisation will be key going forward. "The system must be based on open, agreed-upon standards, with well-defined interfaces for interoperability," he says. "This will support ease of use, competitiveness and cybersecurity. If we don't focus on standardisation, we are all at risk of slowing down innovation."

A common framework for flexibility

Image credit: UKPN

The Open Networks programme seeks to facilitate collaboration across the sector, bringing together the nine electricity grid operators in the UK and Ireland to work together to standardise customer experiences and align processes."

This work should make connecting to the networks as easy as possible, while also bringing record amounts of renewable distributed energy resources, like wind and solar, to the local electricity grid.

Brazier explains that the Open Networks project has been established to drive consistency across the country, "consistency in terms of standards, customer service and these new local flexibility markets".

He says that getting regulatory and government support for the programme has been vital, along with buy-in from businesses. "That includes not just support for the project, symbolically, but dedicated resources as well. You really need senior buy-in from the outset to help build momentum behind the project," he insists. "If we tried to do it bottom up from some of the working groups, I don't think we would have been as successful and we wouldn't have moved as quickly."

Brazier reiterates the importance of consistency on the journey to delivering a smart, flexible energy system that is fair for all stakeholders, including consumers. "The people and the devices that are going to be providing flexibility won't just be fixed in one location. If you think about an investor or a battery investment company, they're not going to have all of their batteries in Cornwall, for example, they're likely to be spread all over the country," he says.

"If they had to have six different IT systems, six different types of marketplaces and six different protocols, it would be relatively expensive and inefficient for them. However, if we have consistent processes and protocols across the country, it will help to drive down costs. It's really beneficial to customers to have that consistency, that's what's fair."

Historically, the disjointed nature of the flexibility sector has seen flexible assets earning a "revenue stack" with different revenue streams from different sources, managed by different parties. These services have been developed separately, evolving incrementally over time, leading to increased inconsistency.

It is hoped that the creation of a common framework for flexibility services will help to tackles some of these issues.

Emma Burns, interim head of regulation at Flexitricity, explains that the current approach can be incredibly confusing for asset owners and energy consumers, creates an unnecessary administrative burden, and can lead to an "unlevel playing field". "Therefore, increasing consistency between all services that flexibility and DSR participate in is critical to bringing forward the levels of flexibility the system requires," she says.

But combining multiple DNO and DSO systems into a unified framework is not without significant challenges, including the difficulty of aligning processes, skills and legal approaches across the sector.

A range of industry working groups and initiatives, including the Flexible Power portal – a joint project from Western Power Distribution, Northern Powergrid, SSEN, SP Energy Networks, and Electricity North West to offer a single point of information in relation to their flexibility service requirements – are already in progress and aim to develop on-the-ground solutions. Open Networks will be crucial in helping to bring these learnings and industry insight together.

Burns welcomes programmes such as Open Networks, but believes more needs to be done to ensure smooth access for capacity to all the flexibility services.

Beyond a common framework, Alex Schoch, head of flexibility at Octopus Energy, would like to see more ambition in the current RIIO-ED2 framework, particularly around local flexibility. More broadly, he believes a cultural shift is needed within the energy sector to help drive the level of change required. "If you look back to 20 years ago, you didn't go into the energy space because you were a risk taker and you wanted to change the industry. It was a job for life, for the Steady Eddies of this world," he quips.

"Of course, those people who went into the industry 20 years ago are now generally the executives running different parts of the energy industry. Unless there's a real mind shift, we're not going to move fast enough."

Qualcomm Technologies' Faramarz Maghsoodlou agrees that utilities are at different stages of their transformation journey. "More technologically advanced utilities are collaboratively working with forward-looking regulators to drive change in the industry by setting examples for others to model their transformation after."

CASE STUDY

How technology can accelerate grid edge digitalisation

Santiago Cascante, chief commercial officer, **Gridspertise**

Gridspertise, launched in September 2021, leverages energy distributor and manufacturer Enel's expertise in testing, assessing and scaling up technologies to operate smart grids.

The business' focus is on partnering with medium and small DSOs, which chief commercial officer Santiago Cascante describes as a "gap in the market".

"The larger DSOs have their own technology departments and they can afford to invest in and pilot different technologies. Meanwhile, the smaller DSOs are looking for new partners with field tested technologies to cope with the quick changes that are happening in the distribution system," he says.

Gridspertise has a strong commercial and technology collaboration with Qualcomm Technologies, which is founded on real-time data and edge processing.

"In order to deal with these bi-directional flows and all of the complexity on the network, we have to look at different options to tackle these challenges," Cascante says. "One option is to keep everything as it is and centralise all of the decision-making processes. Or the second option, for a more decentralised approach which is closer to where these new distributed energy resources are connected to the grid, you need edge processing capabilities to facilitate quick, real-time decisions."

Gridspertise offers an automation process that promises to be self-healing within a few seconds. The QEd – Quantum Edge® device is powered by Qualcomm Technologies' Industrial IoT technology. Its artificial intelligence capabilities, allow key grid functionalities to be captured and represented in a virtual format. The solution, Cascante explains, is a culmination of Gridspertise's and Qualcomm Technologies' collaboration and a response to the complex challenges facing the grid.

The device enables DSOs to optimise distributed flexibility management, reducing the amount of equipment in the secondary substation as well as the number of field interventions.

Gridspertise has also launched a co-creation programme to support collaboration with DSOs. The programme will allow the QEd solution to be rigorously tested, while also facilitating the development of new applications that can boost its functionality.

Conclusion

A key area where the sector must move quickly and work closely with government and the regulator is reducing carbon emissions. While grid flexibility can help to accelerate the transition to net zero, there are concerns that the sector is not being ambitious enough as we edge closer to the UK's 2050 deadline.

Schoch believes there is some solid policy and great aims to achieve a net zero system, but admits there is often a lot of bureaucracy in the way. "The solutions to a lot of these challenges exist today, but they're not being brought in quickly enough," he says. "Sometimes there is a trend of trying to solve for a future that is unknown, instead of making incremental, real-world progress today."

Schoch reiterates his disappointment in what he describes as a lack of ambition in the RIIO2-ED2 plans, particularly when it comes to tackling carbon and the associated penalties for failing to do the right thing. He believes that the carbon requirements for participants should be clearer, regardless of whether this relates to DNO services or the capacity market.

"I could get a DNO flexibility contract, plonk a diesel genset there and there would be no penalty for that," he says. "In the same way, I could finance a whole new CCGT through a 12-year capacity market contract," he says. "I still think there is a huge lack of understanding across the country that the capacity market levy that every bill payer is paying every winter is directly going to financing these new polluting power stations. I think this needs a lot more attention and ambition."

> Sometimes there is a trend of trying to solve for a future that is unknown, instead of making incremental, real-world progress today."
>
> Alex Schoch, head of flexibility, **Octopus Energy**

Defending networks' progress towards achieving net zero, ENA's Randolph Brazier points to the fact that the sector has already enabled over 30GW of DER to connect to the grid. "We're doing the most that we possibly can within the constraints of the regulatory system," he says.

"When it comes to carbon reporting, we're looking at consistent practices within ENA. We currently have a working group set up to explore that. There is an element of us driving that ourselves, but if you consider investment in the grid, we are constrained by what the regulator allows us to invest."

Brazier notes that a lot of potential investment to support low carbon technologies has been put into so-called "uncertainty mechanisms". In theory, when the demand for renewables increases, the investment is released and the solution is rolled out quickly. "But that mechanism has to be very agile and automatic," he says. "We are unclear on how the regulator is going to do that because it hasn't worked like that historically.

"I appreciate the regulator has other pressures, including the immediate cost of living crisis, but I do think there is more scope to be more ambitious on net zero."

> For DSOs [getting the right balance in the regulatory regime between encouraging competition and collaboration between DNOs] is required if we are to maintain the progress the UK has made and deliver efficient and effective DSO and digital capabilities."

Andrew Roper, DSO director, **SSEN**

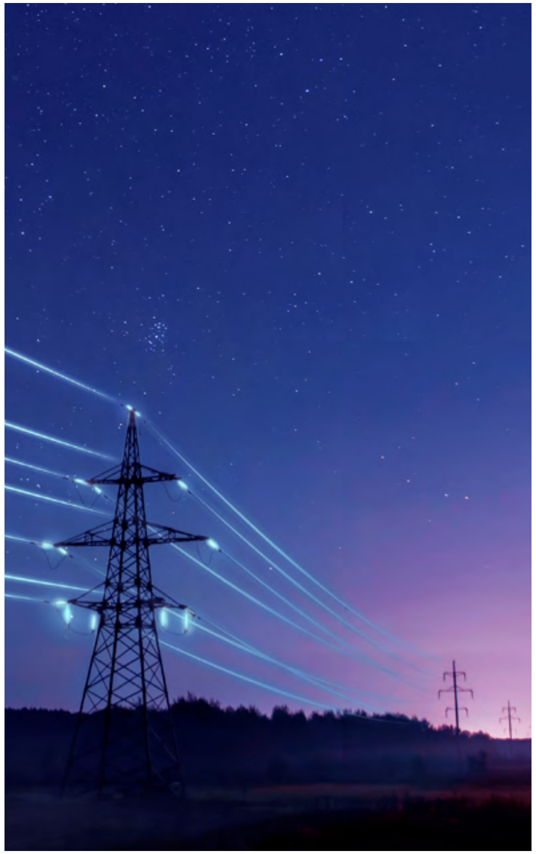
> Flexibility from DSR is ready to go – technically and commercially – but is being held back by rules and regulations, which are usually slow to develop and change."

Emma Burns, interim head of regulation, **Flexitricity**

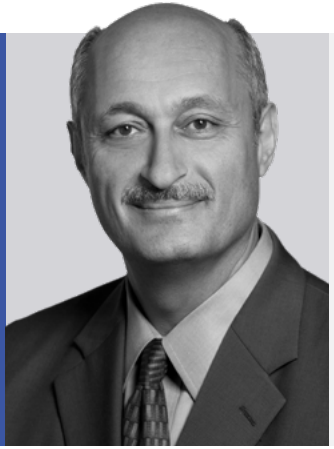
Despite the raft of challenges, regulations must keep pace with the rate of change required to deliver the smart, flexible grid of the future. Flexitricity's Emma Burns remains concerned that current rules and regulations are too slow to develop.

"Flexibility from DSR is ready to go – technically and commercially – but is being held back by rules and regulations, which are usually slow to develop and change," she says. "For example, although we can participate in most flexibility markets, as an independent aggregator we are not allowed to participate in the wholesale market. We're hoping a change to the market rules, currently being considered, will be approved to allow our participation, so we can participate on a level playing field with more traditional energy market players."

SSE's Andrew Roper admits that while the regulator and government are engaging with the industry through participation in initiatives such as Open Networks and the Smart System Forum, the biggest challenge will be getting the right balance in the regulatory regime between encouraging divergence and competition between DNOs and encouraging collaboration and alignment. "For DSOs, much more of the latter is required if we are to maintain the progress the UK has made and deliver efficient and effective DSO and digital capabilities."



Complex challenges require smarter solutions



Faramarz Maghsoodlou
Senior Director, Business Development, Energy and Utilities Digitisation
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We are at an inflection point for two radical, related transformations across the global energy sector: decarbonisation and electrification. Climate change and severe weather events are increasingly impacting the resilience of global electricity infrastructure. Meanwhile, providers are digitising their grids to increase agility, improve quality of service, and reinforce network resilience and reliability.

Power distributors will encounter complex demand- and supply-side challenges through the next decade and beyond. Two such immediate challenges are rising demand for energy, combined with energy price increases and the rising cost of living. There is a growing need for flexible energy loads to ensure a better balance between supply and demand. Will utilities need to engage in more proactive management of customers' energy consumption in future as a result? Markets have grown accustomed to highly reliable networks, but certain trade-offs may be needed as utilities invest more heavily in resiliency. Will customers accept more resilient networks in the long term if it means more network outages in the interim? And, as more customers make a bid for cleaner, greener power and greater self-sufficiency through the likes of solar panels and heat pumps, how will utilities respond to increasing complexity and the introduction of more active sources of power to the grid?

The energy sector needs faster digitisation and smarter grids to tackle these challenges. Forward-thinking utility companies are already engaging with customers to incentivise good behaviours around energy consumption, but wholesale change will mean increasing smart technology in the grid itself.

Ultimately, regulators have a huge role to play in creating the conditions that will allow energy companies to pursue progressive, future-proofed strategies. We are entering a new world where it no longer makes sense for utilities to be locked into a regulatory system that favours CapEx investment to the detriment of other areas such as OpEx, analytics, customer service and smart technology. Utilities themselves need the flexibility and incentives to drive the radical transformation we all want to see.