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SP ENERGY NETWORKS

Distribution System Operator Strategy

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Authors:
Malcolm Bebbington, Head of Future System Strategy, SP Energy Networks
Mark Goudie, Distribution System Operation Manager, SP Energy Networks
Julian Wayne, Culan Strategy Ltd

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Foreword

The energy landscape is changing fast as the way our customers generate, distribute, and use energy evolves. This document shares our DSO strategy to respond to these changes, so that we continue to serve our customers and communities.

To tackle the climate emergency and deliver Net Zero carbon targets, a significant proportion of customer transport and building heating will be electrified. We are also going to see a further leap in renewable generation capacity as fossil fuel power stations close, more customers actively participating in the energy system, and the electricity system operator (ESO) increasingly needing to utilise distribution-connected service providers. These changes will result in higher network utilisation, more dynamic and volatile power flows, more complex distribution network planning and operation, and increasing whole system interactivity. If we do not continue to adapt to meet our customers' evolving needs, these changes will push the distribution network and wider system beyond what it is currently designed for – this would lead to higher costs and a poorer service for all customers.

The magnitude of these changes means there is a clear need for a set of roles and activities **to meet our customers' evolving needs, deliver Net Zero, and ensure the continued safe, reliable, and efficient operation of the distribution network and wider energy system for all customers**. Most of these roles and activities are evolutions of existing business-as-usual activities, whilst others are new. These roles and activities in turn require new supporting infrastructure.

This is what Distribution System Operation (DSO) is to us: the set of roles, activities, and infrastructure that we plan to deliver, so that we can continue to serve our customers and communities. They include more complex planning solutions, smarter and scalable network operation infrastructure, being a neutral facilitator of an open and accessible distribution energy resources (DER) services market, and coordinating DER services to deliver a safe, efficient, and reliable whole system. These must be delivered at a pace that meets our customers' needs.

We have already started delivering these DSO roles, activities, and infrastructure, but there remains much to do on this journey. I am therefore pleased to present our SP Energy Networks DSO Strategy, which sets out how we plan to deliver this vital development for the GB electricity system in RIIO-ED2 and what it means for our customers.

We consider that we are best placed to continue leading this delivery of DSO. We have the capability, knowledge, and experience to deliver on time and in a cost-effective way. Our strong links with our customers and communities mean we can quickly understand and respond to their needs. We will build on our industry-leading customer service position to deliver an effective and fair transition that ensures a safe and reliable supply for all customers.

This updated DSO Strategy has been published to account for the latest regulatory position on DSO and incorporate stakeholder feedback from our RIIO-ED2 engagements. We look forward to receiving further feedback as part of our Draft RIIO-ED2 submission, so that we can ensure our network continues to meet the needs of our customers.

Scott Mathieson
Network Planning & Regulation Director

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Introduction

We are SP Energy Networks. We own and operate the electricity distribution network in Central and Southern Scotland (our SP Distribution network), and in North Wales, Merseyside, Cheshire, and North Shropshire (our SP Manweb network).

It is through these two networks of underground cables, overhead lines, and substations that we provide 3.5 million homes, businesses, and public services with a safe, reliable, and efficient supply of electricity.

In October 2016, we were the first in our industry to publish a Distribution System Operation (DSO) Vision in response to evolving customer needs and system challenges. This described the whole system operating model which we think is best suited to address these changes, and the roles and responsibilities which this involves. Since then, we have worked alongside industry, government, and our customers, through the Open Networks project and other routes, to progress this evolution in the GB energy system.

This, our SP Energy Networks DSO Strategy document, first published in June 2020 and now updated alongside our RIIO-ED2 Business Plan, builds on this work. The purpose of this document is to share with our stakeholders the changing customer needs and system challenges that the distribution networks must meet (Section 3), the Ofgem defined DSO roles and activities we will undertake to respond to those changes (Section 4), and our resulting DSO Strategy for RIIO-ED2 (Section 5). We map our DSO Strategy against Ofgem requirements in Section 6. We explain what DSO means for our customers and the stakeholder feedback we have received in Section 7.

We are aware that our industry contains a wide range of terminology – we have included a comprehensive glossary (Section 8) to clearly explain the terms we use within this document.

Next steps

Our DSO Strategy focusses on the period from now through to the end of the RIIO-ED2 price control (2028), but lays the foundation for the longer term.

We believe that delivering DSO will bring real benefits to our customers and stakeholders, and is critical to the efficient and timely delivery of Net Zero. The plans set out in this document, and the feedback we receive, will directly inform our final RIIO-ED2 business plan submission to Ofgem, in which we will seek their approval to continue the investment needed to deliver these roles, activities, and infrastructure for our customers.

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A changing landscape

This section sets out the changing customer requirements that the electricity system must serve, and how these will impact the distribution network and operation of the whole system if we do not respond to them.

3.1 Drivers of change

The energy landscape is changing fast as the way our customers generate, use, and interact with energy evolves. Four key trends are driving this:

Decarbonisation – in response to the climate emergency, we need to achieve Net Zero[1] greenhouse gas emissions by 2045 in Scotland and 2050 in England and Wales. To deliver this decarbonisation, we need to electrify a significant proportion of transport and building heating. We also need to complete the transition of our generation mix from fossil fuel to zero carbon generation. These changes will significantly increase the levels of demand and generation that we need to connect to the distribution network for our customers.

Decentralisation – the proportion of the generation mix which is smaller-scale and sited close to demand is increasing. This means that we will connect an increasing proportion of GB's generation capacity to our distribution networks (known as distributed generation, DG), rather than it being connected to the transmission network. Decentralisation has two effects: we must find ways to accommodate more customer generation than the distribution network is currently designed for; and the electricity system operator (ESO) has an increasing reliance on this DG and other controllable customer assets connected to the distribution network (collectively known as distribution energy resources, DER) to maintain GB system stability.

Democratisation – means the rise of the active domestic customers (aka prosumer). Smart meters, home energy management systems, intelligent domestic and electric vehicle (EV) storage, specialist aggregators and suppliers – these are all reducing the barriers for domestic customer participation in the energy system. Democratisation has two effects: domestic customer consumption profiles are becoming less predictable and more dynamic; and we can increasingly work with many individual customers and communities, rather than just large DG or industrial customers, to source vital network and system services.

Digitalisation – means that we can better understand and coordinate the above three trends through improved transparency and coordination of data and IT systems between industry parties. Digitalisation significantly enhances our ability to measure, forecast, understand, and address the decarbonisation challenge by utilising a whole new range of data sources and solutions, driving a more efficient outcome for customers.

1 The UK's different Net Zero targets are explained in the 'Net Zero' entry in the glossary.

3.2 Forecasting the changes

To better quantify these four drivers and ensure we meet our customers' changing electricity needs, we forecast what their electricity requirements are going to be into the future. We do this by developing Distribution Future Energy Scenario (DFES) forecasts[2], and then comparing these against Net Zero compliant scenarios from the ESO[3] and the Climate Change Committee (CCC)[4] to develop our RIIO-ED2 investment scenarios.

3.2.1 DFES forecasts

These are forecasts for key customer demand and generation metrics up until 2050. We develop these considering a range of sources, including UK and devolved government targets such as: Net Zero targets of 2045 for Scotland and 2050 for England and Wales; interim legislative 2030 greenhouse gas emission reduction targets; Scottish and UK government bans on new petrol and diesel cars and vans; the UK Government Ten Point Plan and Energy White Paper; and the Scottish Government Heat in Buildings Strategy.

Given the uncertainties out to 2050, we create forecasts for four main energy scenarios. These scenarios represent differing levels of customer ambition, government and policy support, economic growth, and technology development. Our stakeholders review our forecasts and we make changes based on their well-justified feedback.

All forecast scenarios show a significant increase in the volume of customer demand and generation that we will need to serve on our distribution network. There are three areas that will change the most:

1. The electrification of transport: by 2030, the number of customer EVs on our distribution network could increase from 10,000 now to up to 1.5 million domestic EVs. An EV can double the demand of a customer property, and materially increase peak network demand.

2. The electrification of heat: how heat is decarbonised is a key variable, but one area of greater certainty is that off-gas grid customers will use heat pumps. In some of the high roll-out scenarios, heat pump impact on our network peak demand could be over five times greater than EVs.

3. More generation: by 2030, the volume of customer generation we connect to our SP Manweb network could double. For SP Distribution, it could triple. By 2050, we could have connected over five times more customer generation than we have to date. Storage is defined as a type of generation, so is included within the generation forecasts.

2 Our DFES forecasts are detailed forecasts for a range of demand and generation metrics (e.g. EVs, heat pumps, different generation technologies) out to 2050. They are available at: *https://www.spenergynetworks.co.uk/pages/distribution_future_energy_scenarios.aspx*

3 The four scenarios are Steady Progression (SP), Consumer Evolution (CE), Community Renewables (CR) and Two Degrees (TD). Please refer to our DFES for more information (see Footnote 5 for a weblink).

4 Storage is legally deemed to be generation, so is included within the generation forecasts.

3.2.2 Using DFES, ESO, and CCC forecasts to develop a robust intervention plan

Different forecast scenarios will have different impacts, requiring different levels of DSO intervention. So how do we know which one to plan for? In addition to the four DFES scenarios, we create a low scenario, a baseline scenario, and a high scenario. Our RIIO-ED2 investment plan is developed to deliver the baseline scenario, but must have the flexibility to be able to deliver anywhere within the low and high range (which mark the lower and upper credible range).

These three scenarios are developed considering the range of Net Zero compliant scenarios developed by us, the ESO, and the CCC. We only consider Net Zero compliant scenarios as Net Zero is enshrined in legislation – we must deliver it. This means that in developing this scenario range we have not included the DFES or FES Steady Progression scenarios, as they do not meet Net Zero, nor the System Transformation scenarios, as they do not deliver legislated interim targets. Our approach means even a business plan based on the low scenario would contain sufficient investment to deliver 2050 Net Zero and interim targets (although it wouldn't contain enough investment to meet customer needs within RIIO-ED2 where these are above the low scenario).

Table 1 shows our low, baseline, and high scenarios for EVs, heat pumps, and distributed generation. Figure 1 shows this same information for EVs and heat pumps out to 2035 (the red line is our baseline scenario, the grey band marks the low and high scenario).

Forecast scenario	Total uptake by 2028		
	EVs	Heat pumps	Generation
High scenario	1.02m	0.63m	+5.9GW
Baseline scenario	0.67m	0.37m	+4.7GW
Low scenario	0.65m	0.34m	+4.7GW

Table 1 | Energy system changes that DSO will enable

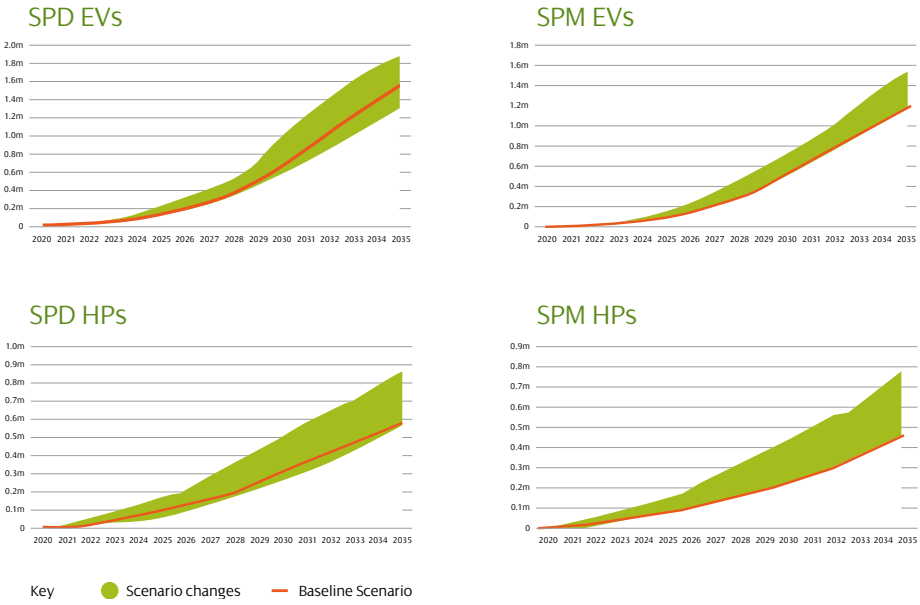

Figure 1 | Our RIIO-ED2 Baseline Scenario compared to Net Zero compliant industry forecasts

The baseline represents the best approach for our customers assuming the appropriate regulatory mechanisms are in place.

Figure 1 and Table 1 show that our baseline scenario tracks the bottom of the credible range in SP Manweb, and marginally above in SP Distribution due to Scottish Government targets. This is intentional. By basing our investment plan on EV and heat pump uptake at the lower end of Net Zero compliant forecasts, we're confident that we are only asking for the minimum investment needed to enable Net Zero, as actual EV and heat pump levels are unlikely to be lower than this baseline scenario. Where actual levels are higher than this baseline scenario, we will use uncertainty mechanisms to address the difference. This approach and the use of uncertainty mechanisms means we have a robust investment plan which can adapt to our customers' needs across the range of credible Net Zero pathways, and it protects customers by making sure we have sufficient investment to enable Net Zero, but no excess allowances.

3.3 The impact of these changes

The forecasts show that we are no longer talking about incremental changes. If we are not allowed to adapt, these will adversely impact customers in two main ways:

1. Distribution network capacity:
the volume of new demand and generation, combined with the effect of customer consumption patterns becoming more dynamic and complex, will push power flows well beyond what the distribution network is currently designed for. These changes impact every voltage level: from LV[5] networks, to which the low carbon technologies (LCTs) needed to deliver Net Zero primarily connect, to HV and EHV networks, which supply the LV networks and must accommodate increasing levels of DG. Without radical intervention, these changes will cause thermal, voltage and fault level constraints which dangerously overload the network. These will lead to customer supply interruptions, delays in delivering customer requirements, shortening of network asset life[6], higher overall costs for customers, and possible safety concerns[7].

2. Whole system coordination:
ddecentralisation means that the ESO will need to utilise more services from DER. This service use affects power flows on the distribution network, and so overlaps with our responsibility to operate a safe, reliable, and efficient distribution network. At the same time, greater levels of customer demand and generation on the distribution network may create increased transmission network power flows which the ESO will need to manage. Without greater planning and operational coordination, and consideration of whole system costs, there will be increasing risk to system stability and safety, inefficient system operation, and poor use of customer money.

These changes are already having a tangible impact on the electricity system. On 9 August 2019, a lightning strike on the transmission network resulted in the loss of 1.3GW of transmission connected generation. Shortcomings in the understanding of whole system operation by various asset owners and equipment specifiers resulted in the loss of a further 500MW of DG. This resulted in over one million customers losing supply. The record low transmission demand during Covid-19 further shows the importance of whole system coordination to ensure resilience and the ability to cope with unforeseen system needs.

However these changes can also provide us with new solutions. Democratisation and decentralisation mean that there may be a far greater pool of service providers than currently, which we can work with to increase system resilience whilst keeping network operating costs efficient. Digitalisation means we can share information and better coordinate with other parties, facilitating these new solutions.

5 LV, HV, and EHV are defined in the glossary.

6 Significant increases in asset loading can reduce asset life and increase maintenance requirements. These both increase network costs for customers.

7 Potential safety issues include overloading of network equipment, which could cause failure or fire. This fire risk is particularly important for LV service cables and cut-out fuses as they often run into our customers' homes. Another potential safety issue is conductor sag, which is where overhead lines are thermally overloaded, which causes them to expand and so hang lower to the ground; this reduces the safe clearance distance.

3.4 Responding to the challenge – DSO

Our overarching purpose as a network operator is to safely, reliably, and efficiently serve our customers' needs.

So that we can continue to do this in RIIO-ED2 and beyond, the magnitude of the changes means there is a clear need for us to deliver an updated set of roles and activities. These are fundamental to meeting our customers' evolving requirements, delivering Net Zero, and ensuring the continued safe, reliable, and efficient operation of the distribution network and wider energy system for all customers. Most of these roles and activities are evolutions of existing business-as-usual activities, whilst some are new. These roles and activities in turn require new enabling infrastructure.

Industry often refers to this set of roles, activities, and infrastructure as DSO. Using this meaning, we plan to deliver DSO so that we can continue to serve the needs of our customers and communities. The remaining sections of this DSO Strategy document set out how we will do that and what it means for our customers.

In developing this DSO strategy, we have considered our customers' evolving needs, the network challenges we must address, Ofgem defined DSO roles, activities, and baseline expectations, and the wide range of industry and government work to date. This work includes the Open Networks project, Ofgem and BEIS publications, industry projects (including the three TEF projects[8]), and technological and commercial developments. We continue to monitor Ofgem's Significant Code Review in Access and Forward-looking charges, as this will likely impact how our customers choose to use the network.

What do we mean by "efficient" and "least cost"?

In this document, we stress the need to deliver Net Zero and serve customer needs in an "efficient" manner and "at least cost". What do we mean by this?

To maintain a safe and reliable electricity supply to our customers, we need to invest in our network on an ongoing basis. This investment covers everything from routine maintenance to procuring DER services and major network reinforcement projects.

This investment is approved by Ofgem and recovered from customers via their electricity bills.[9] We have a clear obligation, and a price control framework, to ensure that this investment is efficient, i.e. ensuring that investments are necessary, that they are the best value intervention for customers, and that we deliver the resulting intervention cost-effectively.

8 These are three projects led by distribution licensees that support the transition to DSO. The three projects are Transition (led by SSEN), Electricity Flexibility and Forecasting Systems (led by WPD), and Fusion (led by us).

9 Transmission and distribution network costs together account for 23.15% of a typical GB electricity bill. Source: *https://www.ofgem.gov.uk/publications-and-updates/infographic-bills-prices-and-profits?utm_medium=email&utm_source=dotMailer&utm_campaign=Daily-Alert_31-07-2019&utm_content=Infographic%3a+Bills%2c+prices+and+profits&dm_i=1QCB,6ERQC,WAOSP7,PE0FA,1*

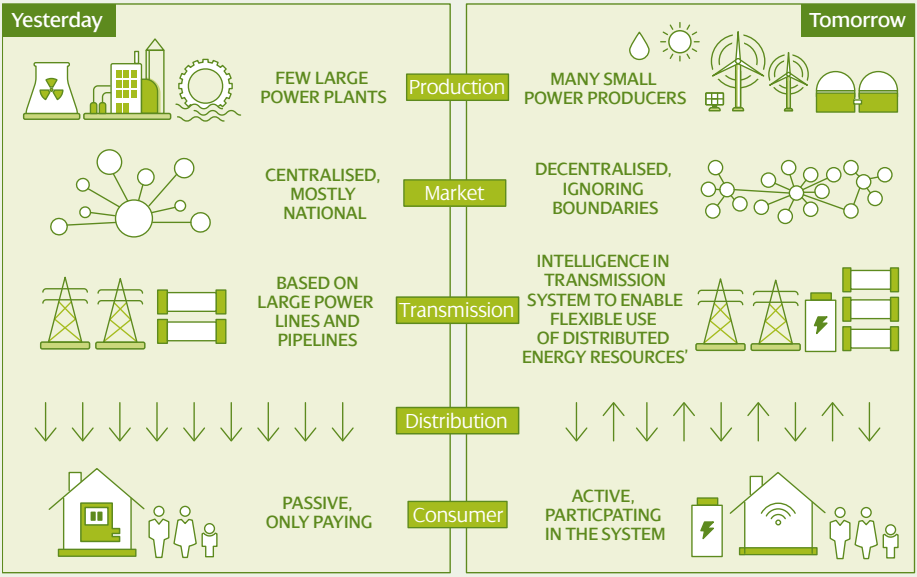

Figure 2 | Energy system changes that DSO will enable


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Distribution System Operation regulatory structure

Ofgem has defined three core DSO roles for DNOs to deliver in RIIO-ED2. These cover five main DSO activities and are described by a set of DSO baseline expectations. Together, these describe the minimum level of DSO we must deliver in RIIO-ED2.

We are already evolving the way we design, build, and operate our networks, implementing innovative solutions, and embracing new technologies to deliver these minimum DSO requirements. Looking to the future, we consider that we are best placed to continue leading the delivery of DSO roles, activities, and infrastructure.

4.1 Ofgem defined DSO roles, activities, and baseline expectations

Table 2 sets out the Ofgem defined DSO roles, activities, and baseline expectations we must deliver in RIIO-ED2. We have used Ofgem's exact wording for the roles and activities. For the baseline expectations, we have provided a short extract for each and added numbering; please see Ofgem's Sector Specific Methodology Decision document for the full details.[10]

Role	Activity	Summary of baseline expectations for DNOs to meet
Planning and Network development	1.1. Plan efficiently in the context of uncertainty, taking account of whole system outcomes, and promote planning data availability.	1.1.1 DNOs to define and develop enhanced forecasting, simulation, and network modelling capabilities…
		1.1.2 DNOs to have in place standard and effective processes for sharing network planning information with other network licensees, including the ESO, network users and other interested parties…
		1.1.3 DNOs to have in place transparent and robust processes for identifying and assessing options to resolve network needs, using competition where efficient…

10 These are set out in Ofgem's RIIO-ED2 Sector Specific Methodology Decision (SSMD), available at: *https://www.ofgem.gov.uk/system/files/docs/2020/12/ed2_ssmd_overview.pdf.*

Role	Activity	Summary of baseline expectations for DNOs to meet
Network Operation	2.1 Promote operational network visibility and data availability	2.1.1 DNOs to improve network visibility and identification and sharing of operability constraints, including publishing this data to help avoid conflicting actions being taken by other network and system operators…
		2.1.2 DNOs to provide the ESO with information across timescales about the DER it is planning to instruct to dispatch…
		2.1.3 DNOs to gather sufficient information on DER characteristics and parameters to provide information and inform decisions to secure against events that could lead to disconnection of DER…
		2.1.4 DNOs to make available operational data that supports network users and other relevant stakeholders to make better decisions about how to use the network…
	2.2 Facilitate efficient dispatch of distribution flexibility services	2.2.1 DNOs to have and regularly review a decision-making framework for when DER are instructed to dispatch in real-time…
		2.2.2 DNOs shall facilitate secondary trading of distribution flexibility services and curtailment obligations…
		2.2.3 DNOs to introduce clear processes for the design, development, and communication of the decision-making framework…
		2.2.4 DNOs to develop efficient, scalable dispatch instruction infrastructure and avoid proprietary systems…

Role	Activity	Summary of baseline expectations for DNOs to meet
Market Development	3.1. Provide accurate, user friendly, and comprehensive market information	3.1.1 DNOs to collate and publish as much relevant data and information as reasonable that will help market participants identify and value opportunities to provide network services to DNOs and take market actions that support efficient whole system outcomes…
		3.1.2 DNOs should, with stakeholder input, develop robust strategies for how they will collate and publish more helpful information…
		3.1.3 DNOs should regularly and actively engage with market participants to understand what data and information is helpful to support market development…
		3.1.4 DNOs should, where reasonable, tailor both their information provision and engagement approaches to reflect different needs…
		3.1.5 DNOs should seek to ensure the information they publish is as accurate and unbiased as reasonable…

Role	Activity	Summary of baseline expectations for DNOs to meet
Market Development	3.2. Embed simple, fair, and transparent rules and processes for procuring distribution flexibility services	3.2.1 DNOs to have clear processes in place for developing and amending distribution flexibility services products, contracts, and qualification criteria, that are, wherever possible, standardised…
		3.2.2 DNOs should identify the optimum combination of longer and shorter term lengths of markets and contract lengths reflecting the network need…
		3.2.3 DNOs should make available the necessary data to enable secondary trading, for example capacity and other peer-to-peer trading…
		3.2.4 Market support services, such as pre-qualification, credit-checking and settlement must enable simple and cost-efficient participation in markets…
		3.2.5 DNOs to introduce other proportionate measures, developed with robust stakeholder engagement, to identify and address actual a nd perceived conflicts between its market development and network ownership roles or other business interests…

Table 2 | Ofgem defined DSO roles, activities, and baseline expectations

4.2 RIIO-ED2 Output Delivery Incentive (ODI)

To promote the efficient delivery of DSO, an Output Delivery Incentive (ODI) has been proposed by Ofgem. We led the DSO Working Group across all DNOs for over six months to deliver feedback and common views to the regulator and to deliver the first framework proposal for the ODI to Ofgem. Development of the framework is still ongoing with Ofgem and has not concluded.

4.3 Our role delivering DSO in RIIO-ED2 and beyond

3.5 million homes, businesses and public services depend on our two distribution networks for a safe, reliable, and efficient supply of electricity. We recognise the critical role that our distribution networks will play for our customers long into the future, regardless of the decarbonisation pathway that our customers end up treading. To ensure we meet our customers' changing needs, we are already evolving the way we design, build, and operate our networks, implementing innovative solutions, and embracing new technologies.

Looking to the future, we consider that we are best placed to continue leading the delivery of the roles and activities set out within this DSO Strategy document.

- **Delivering safely and reliably:** we have the infrastructure, processes, and deep knowledge of how complex and highly localised distribution networks work. These mean we can continue to safely and reliably operate the networks to maintain supply to customers, whatever the future holds.

- **Delivering competitively:** our use of flexibility tenders, independent contractors, external expertise, and multiple equipment vendors mean that competition and external providers will be embedded throughout distribution network roles, activities, and enablers. For example, 84% of our regulated distribution construction activities are already delivered by the market.

- **Delivering on time:** we have the organisational capability, processes, and resources needed to manage complex projects and multiple vendors. We can deliver on time the roles, activities, and infrastructure needed to maintain a safe, efficient, reliable, and decarbonised supply for our customers.

- **Delivering on good value:** in addition to using competitively tendered external providers throughout, we are benchmarked by Ofgem against other distribution licensees. This means that poor performance and high costs will be quickly exposed and penalised.

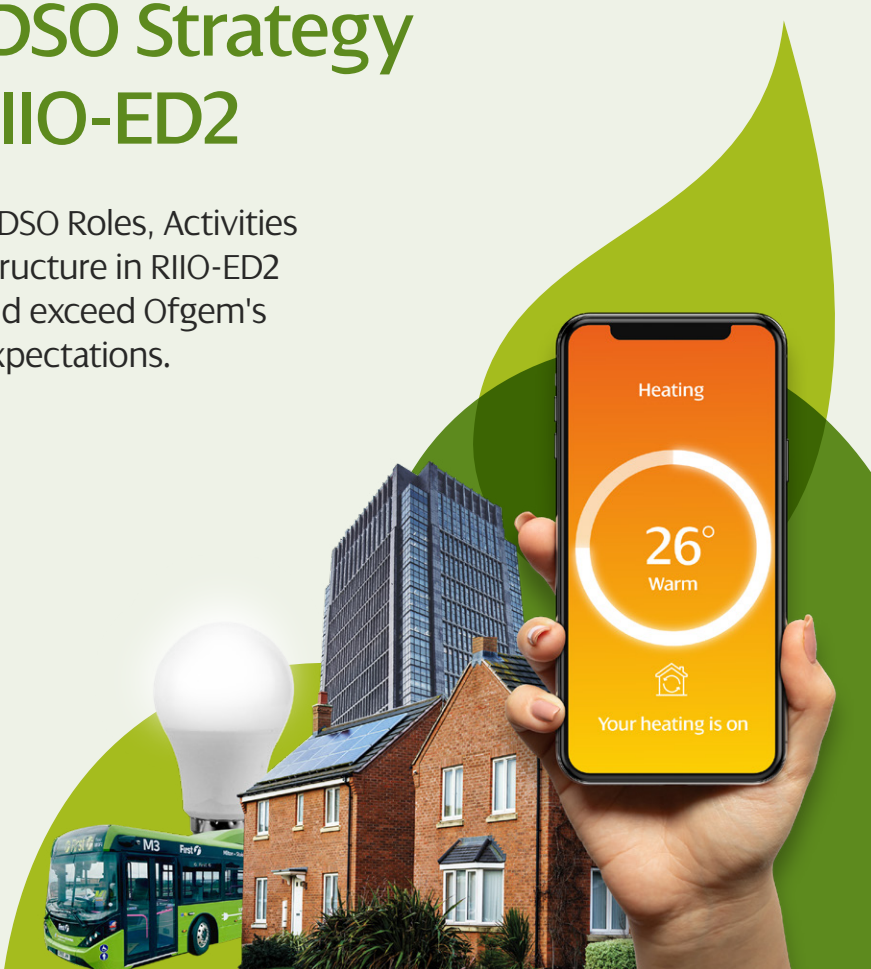
- **Delivering for all customers:** we have the existing relationships with our customers so we can quickly understand and respond to their needs. Our regulatory framework and economies of scale mean we are a low-cost provider that can deliver where the market might not, leaving no customer behind and ensuring a Just Transition. Distribution licensees are one of the few industry parties who have a clear legal responsibility to customers.

- We have the capability, knowledge, and experience to deliver at least cost for our customers. This will build on our strong track record – since incentive-based price controls were introduced, network companies have delivered a 17% real terms reduction in network prices; over the last ten years, the number of customer power cuts has been reduced by 34% and the duration of these power cuts reduced by 43%. These have been achieved whilst supporting economic growth with increased jobs, facilitating the decarbonisation of the UK, and delivering industry-leading customer service.

5

Our DSO Strategy for RIIO-ED2

Delivering DSO Roles, Activities and Infrastructure in RIIO-ED2 to meet and exceed Ofgem's baseline expectations.



To meet and exceed the Ofgem defined DSO roles, activities, and baseline expectations in RIIO-ED2, we will rely on innovative tools, capabilities, and processes we've already developed in RIIO-ED1 (Section 5.1) and a new set of investments in RIIO-ED2 (Section 5.3). Together these new and existing tools, capabilities, and processes form our RIIO-ED2 DSO Strategy.

5.1 RIIO-ED1 developments that will deliver DSO in RIIO-ED2

We knew from our stakeholders, the wealth of industry and academic material, and our own experts that the energy system was changing, and that this change would require new tools, processes, and capabilities. We knew our customers would be adversely impacted if we waited until RIIO-ED2 to start delivering these, so we've already started work in RIIO-ED1. This section highlights the main tools, processes, and capabilities we've developed in RIIO-ED1 that will be essential for delivering DSO in RIIO-ED2.

5.1.1 Network monitoring and control

In RIIO-ED1 we have delivered two main monitoring and control innovations that will help deliver DSO in RIIO-ED2.

We commenced our **Enhanced LV Monitoring** project. By the end of RIIO-ED1 this will have deployed LV monitors at 2,438 secondary substations[11] across our two licence areas. As well as the direct benefits from increased visibility at these secondary substations, this project was useful in helping us develop our RIIO-ED2 LV monitoring strategy. Specifically, this RIIO-ED1 deployment has helped us understand what LV monitor specifications we should be using, and develop our data systems that analyse and share LV monitoring information.

In RIIO-ED1, we have developed the world's **first real-time fault level monitor**. For the first time for any DNO, this gives an accurate real-time understanding of network fault level. We combined this innovation with a network management scheme to create **active fault level management (AFLM)** – another first for any DNO. Together, these capabilities allow us to safely connect more generation customers without triggering fault level reinforcements. This is good for our generation customers, who can connect quicker and at lower cost. It's also beneficial for our wider customer base, who pay a portion of interventions to manage fault level.

5.1.2 Enhanced forecasting

In RIIO-ED1, we have delivered four main forecasting innovations that will help deliver DSO in RIIO-ED2.

We've developed two enhanced forecasting tools called **EV-Up** and **Heat-Up**. They use spatial, demographic, and socioeconomic data to forecast EV and heat pump uptake for every customer we serve. This is relevant as these are the two drivers of increasing demand. This knowledge benefits our customers – the more we understand about their needs, then the more efficiently we can respond to accommodate them. We are the only DNO to do this.

11 A secondary substation is a HV/LV transformer and associated equipment.

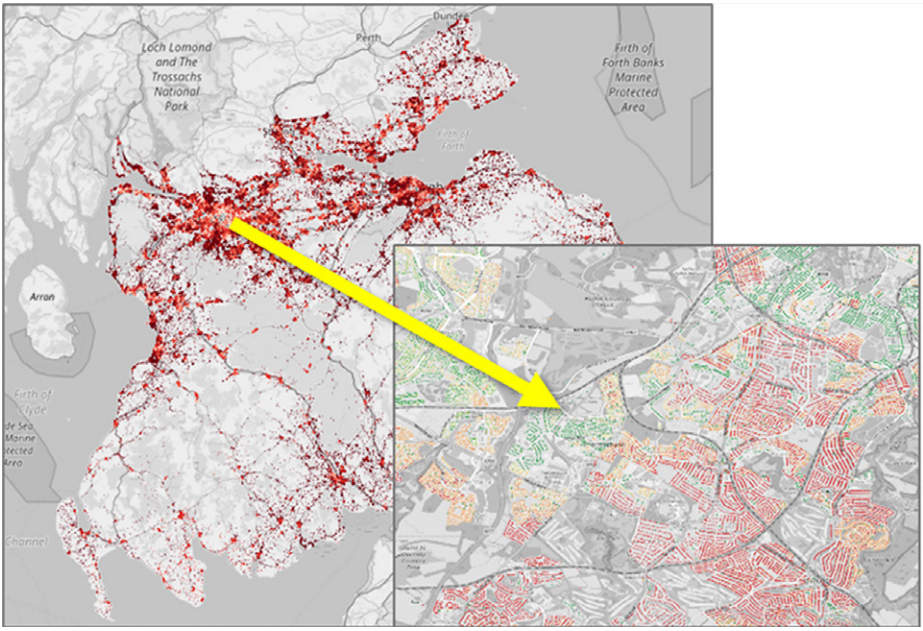


Figure 3: EV-Up forecast maps

These forecasting tools are complementary to our low, baseline, and high scenario forecasts. The scenarios consider a range of macro factors (such as legislation and technology development) to forecast total EV and heat pump volumes across our whole licence area. EV-Up and Heat-Up show, for any scenario, how these are likely to roll-out across the network – they show us which individual households will get them and in what timescales. Figure 3 shows the output from EV-Up.

We have developed a near-time PRAE forecasting platform to give demand and generation forecasts for up to four days ahead. We use this to plan our operational actions, such as flexibility service utilisation.

This has then been expanded and combined with our **Weather Normalised Demand Analytics** (WaNDA) project. This uses historical data, generation, and discretised weather data at a primary substation level, to help better understand the effects of weather on network power flows. By combining PRAE and WaNDA, we can do two things. Firstly, we can better inform operational dynamic thermal ratings, helping us get the best out of existing network assets. Secondly, our medium-term network planning (3-4 years out) is now informed by weather data. This helps us make more informed network planning decisions.

5.1.3 Enhanced modelling

We have delivered a step change in network analytical capability. Over RIIO-ED1, through our award-winning[12] **Network Constraints Early Warning System** (NCEWS) innovation project, we have built a full connectivity model of all 48,000km of our LV network. It used advanced machine learning algorithms to extract missing cable assets.

We've combined it with our existing HV and EHV network connectivity models, so we now have a complete model of our entire network, from customers' cut-outs up to the transmission network. We call this complete model our **ENZ model**, and it means we have full analytical capability for our entire network.

By combing this with our enhanced forecasting tools, we can precisely identify where, when, and how much additional capacity our customers need (Section 5.2 and Figure 4). This capability benefits customers as we're able to develop targeted interventions that are tailored to their needs. We reduce the risk of over-specifying solutions (spending more than we needed to), or underspecifying solutions (not providing enough capacity).

5.1.4 Scalable dispatch infrastructure

In RIIO-ED1, we have implemented two main scalable dispatch infrastructure developments that will help deliver DSO in RIIO-ED2.

We have implemented the **Flexible Power portal** with other DNOs. This portal stems from a number of Western Power Distribution RIIO-ED1 innovation projects. It will help us automate some of the processes needed for dispatching, billing, and settling flexibility services. These platforms can facilitate the growth of the services market by clearly setting out our service requirements. They will also provide a secure mechanism for us to coordinate and communicate with our service providers.

We are in the process of deploying **wide scale ANM** across the Dumfries and Galloway network area. This regulates the output of DG to avoid transmission constraints – this type of coordination across transmission and distribution is a UK first. The scale and nature of this project (one of the largest of its type) provides invaluable learning for further developing constraint management zones in RIIO-ED2 and extending their functionality to coordinate a wide variety of DSO functions.

Ofgem and some stakeholders have had concerns whether ANM constrains the scope of flexibility markets. This concern usually stems from a misunderstanding of the different roles they play. Appendix A explains their different uses in detail.

5.1.5 Flexibility procurement and transparency

In RIIO-ED1, we have delivered three main flexibility procurement and transparency developments that will help deliver DSO in RIIO-ED2.

12 This project won the prestigious IET and E&T 'Innovation of the Year' prize in November 2019.

Our **Project FUSION** is one of the three main TEF projects[13]. It is a live trial of a local DER flexibility market, trialling the trading of flexibility through the creation of a competitive market. This market is structured around the Universal Smart Energy Framework, of which whole system coordination is an inherent capability.

We have led industry work to create a transparent process to **value flexibility services**. Based on this, we were the first DNO to publish site-specific pricing in our flexibility tenders, showing the market exactly what the value was to the network. This promotes transparency and reduces perceptions of conflict of interest by enabling our reinforcement versus flexibility decisions to be audited.

When we run flexibility tenders, we have started to **publish clearing prices** and other information, so the market can see where we did and didn't use flexibility, the rationale for those decisions, and the number of bids received. This promotes transparency and reduces perceptions of conflict of interest by enabling our reinforcement versus flexibility decisions to be audited.

5.1.6 Data and digitalisation

In RIIO-ED1, we have delivered two main data and digitalisation innovations that will help deliver DSO in RIIO-ED2.

First, our **Smart Data Integration Fabric** (SDIF) delivers infrastructure that enables data to be collected, analysed, and shared in a consistent manner across SP Energy Networks and with external parties. A key benefit of SDIF is that it helps ensure a consistent data set, i.e. all parties are working from the same data set. Sharing data externally helps support competition and innovation, both of which bring benefits to customers.

We have digitalised our **Network Asset Management System** (NAMS) and it is now fully operational. This brings together multiple asset management stands into one integrated system. This has improved the transparency and accuracy of our asset management information, which helps support more coordinated and targeted asset management interventions. This helps keep bills lower for customers, safeguard supply reliability, and reduce disruption.

5.2 How we established what DSO infrastructure to deliver in RIIO-ED2, and where to deliver it

The tools, processes, and capabilities that we've developed in RIIO-ED1 provide a valuable foundation, but they are not sufficient by themselves to fully deliver DSO roles and activities in RIIO-ED2. We therefore had to establish what further DSO infrastructure was needed. This section explains how we did that.

Ofgem's DSO baseline expectations could be met using different types of DSO infrastructure interventions. In addition, some DSO infrastructure is locational, meaning the volume we deliver would vary depending on how large a geographic area we need to cover. LV network monitors, CMZs, and communications infrastructure are the main types of infrastructure which fall into this category. For our RIIO-ED2 DSO

13 These are three projects led by distribution licensees that support the transition to DSO. The three projects are Transition (led by SSEN), Electricity Flexibility and Forecasting Systems (led by WPD), and Fusion (led by us).

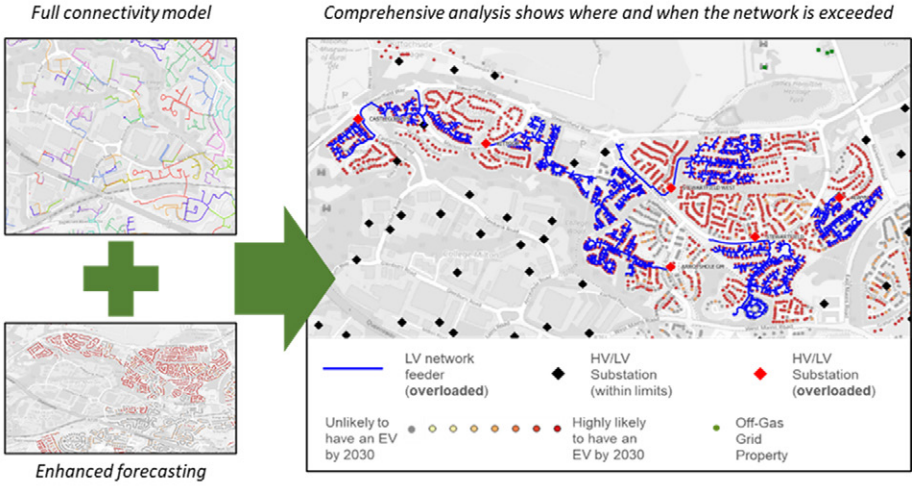


Figure 4: Enhanced forecasting combined with our ENZ Platform

intervention plan, we needed to establish what DSO infrastructure to deliver, and where and when we needed to deliver it.

Our RIIO-ED2 DSO intervention plan is built on the principle of delivering the right DSO infrastructure, and only delivering it where it will deliver benefits for our customers and stakeholders. To establish this, we needed to have a much more detailed understanding of our customers' needs and the different types of network challenges that must be overcome to deliver those needs.

We got this understanding through developing and combining two separate RIIO-ED1 innovations.

First, through our award-winning NCEWS innovation project, we have built a complete connectivity model of our entire distribution network. We hosted this connectivity model within an analytical platform – our ENZ Model (Section 5.1.3).

Second, we've developed two enhanced forecasting tools. They're called EV-Up and Heat-Up, and they use spatial, demographic, and socioeconomic data to forecast EV and heat pump uptake for every customer we serve (Section 5.1.2).

To develop our RIIO-ED2 intervention plan, we entered the granular EV and heat pump forecasts into our ENZ model (Figure 4). This assessed the entire network from customers' cut-outs all the way up to the transmission interface, for system normal and fault conditions, for multiple forecast scenarios. For many areas where the analysis showed constraints, we did this analysis for every half hour period to beyond 2030. This approach systematically identified where, when, and by how much existing network capacity would be exceeded.

This modelling was intensive. Each model run analysed over 175,000 iterations per

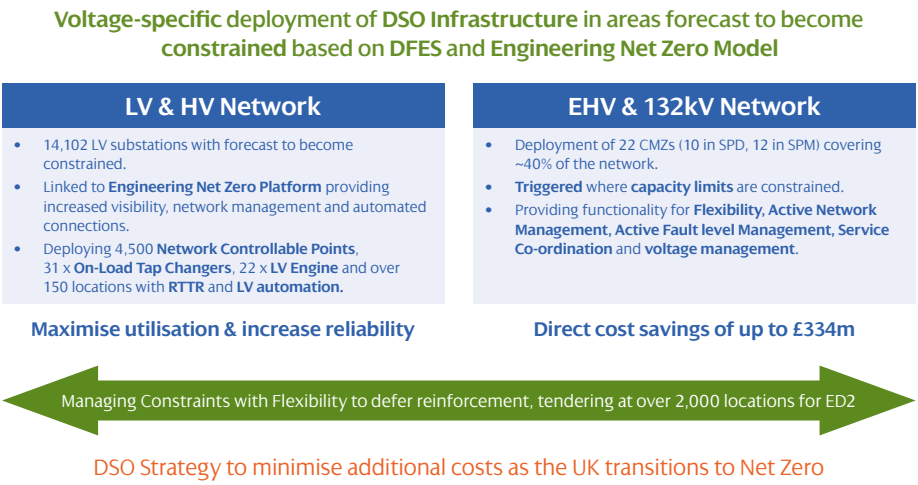


Figure 5: Our voltage specific DSO approach

network asset. We didn't have any computers powerful enough, so we had to use cloud-based servers – each model run still took 20 hours to complete. But this approach has provided us with a more detailed view than ever before.

The outcome is that, for the first time, we precisely know the challenges we need to overcome to deliver our customers needs and priorities. This means we can establish what DSO interventions to use, and where we need to deploy them in RIIO-ED2.

5.3 What new DSO investments we will deliver in RIIO-ED2

By considering Ofgem's baseline expectations, and our comprehensive network analysis to understand where DSO would deliver customer value, we have developed our RIIO-ED2 DSO strategy. It is tailored to each voltage level of our network, reflecting different customer requirements, types of constraints, and levels of network risk. This section summarises the main new investments we will make, and Figure 5 summarises this DSO Strategy.

The following sections 5.3.1 to 5.3.6 expand on the main types of DSO investment we will make in RIIO-ED2:

5.3.1 14,102 LV monitors

Network monitors provide visibility of the network. The data they deliver helps us efficiently and safely plan, develop, and operate the network to meet our customers' needs. For this reason, our network has extensive monitoring at HV and EHV voltage levels. However there is very little monitoring on the LV network, as there hasn't historically been a need.

Looking forward, the LV network is on the front line of the changing energy system. Decarbonisation means that LV customer power flows will increase, and the rise of LV customers actively engaging with markets means that power flows will become more dynamic. We also expect a surge in notifications, connection applications, and customer enquiries to connect low carbon technologies. These changes are going to require significant investment in the network, our operational capabilities, and our internal processes.

Without the data that LV network monitors deliver, this investment would be less efficient and less timely, leading to higher costs and a poorer service for our customers. LV monitoring provides the data we need to deliver DSO roles, activities, and baseline expectations by:

1. Getting more out of existing network assets by safely operating closer to limits – delivering more value from assets customers have already paid for.

2. Making smarter and more coordinated network investments, by better knowing where, when, and how we need to intervene – pre-empting constraints, enabling decarbonisation, and reducing customer costs and disruption by making the right interventions.

3. Facilitating flexibility solutions and increasing the pool of providers and competition – helping defer more costly and disruptive interventions.

4. Responding to network faults more quickly – delivering a more reliable supply for our customers.

5. Automating LV connection offers – reducing overheads which are paid for by customers.

6. Managing network losses – reducing the cost and carbon impact of our networks.

7. Encouraging innovation, by sharing data with third parties.

8. Increasing competition in connections, by enabling ICPs and IDNOs to better serve customers.

Given these benefits, we need to increase LV monitoring over RIIO-ED2. In RIIO-ED2 we will deliver LV monitoring at 14,102 secondary substations[14]. When added to the 2,438 LV monitors we are delivering in RIIO-ED1, by the end of RIIO-ED2 52% of secondary substations rated at ≥200kVA will have LV monitoring.

14 We have the capability to adapt this roll-out across the range of Net Zero compliant scenarios (Section 3.2.2). This equates to delivering LV monitoring at 13,784 secondary substations for the low scenario, and at 29,370 secondary substations for the high scenario.

Please see our RIIO-ED2 Business Plan for more information on why we need more LV network data in RIIO-ED2 and beyond, why LV monitoring is necessary to get this LV network data, how it will be combined with smart meter data, and how we will increase LV monitoring during RIIO-ED2.

5.3.2 22 Constraint management zones (CMZs)

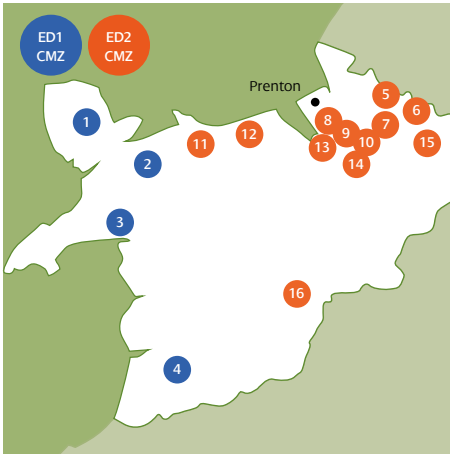
Through DPCR5 and RIIO-ED1 we have developed several Constraint Management Zones (CMZs) in our deployment of ANM (see Section 5.1.4). The driver for CMZs ultimately comes from the requirement to facilitate the connection of new customers in areas where conventional connections would either be slow or prohibitively expensive, or to defer reinforcement through network automation.

Our ambitious RIIO-ED2 plans seek to roll out CMZs more widely, forming the backbone of our DSO infrastructure, and to extend their functionality to coordinate a wide variety of DSO functions. We have identified the areas of network we expect to become constrained during the RIIO-ED2 period (Section 5.1). Our RIIO-ED2 plans involve rolling-out an additional 22 CMZs (10 in SP Distribution, 12 in SP Manweb; shown in Figure 6). These will be rolled out in a priority

Kirkintilloch DSO Control Centre

SP Distribution Network Consraints Managment Zones

1. Dunbar
2. Dumfies & Galloway
3. Berwick
4. Coylton
5. Bonnybridge
6 Saultcoats B
7. Redhouse
8. Earlstoun Hydro
9. Livingston East
10. Galasheilds
11. Dunfermline
12. Dalmarnock
13. Linnmill
14. Kaimes



Prenton DSO Control Centre

SP Manweb Network Consraints Managment Zones

1. Amlwch
2. Bangor
3. Four Crosses
4.Aberystwyth
5. Bold
6. Warrington
7. Percival Lane
8. Rock Ferry
9. Capenhurst
10. Ince
11. Colwyn Bay
12. St. Asaph
13. Deeside
14. Chester
15. Lostock
16. Legacy

Figure 6: CMZ rollout in RIIO-ED2

order based on the DFES forecasts. We will keep the priority order of the roll-out of CMZs under review, and if additional constrained areas arise within RIIO-ED2, we will seek to ensure the CMZ infrastructure includes the additional areas. The centralised CMZ infrastructure is scalable and could be extended as required subject to provision of suitable communications infrastructure to the CMZ equipment. The core components of the CMZ infrastructure are listed below:

- **Centralised ANM Operating Platform (CANMOP) for SP Distribution and SP Manweb:** the CANMOP will provide the backbone of our extended CMZ infrastructure, enabling a phased and proportionate enablement of DSO services across our licence areas in the fullness of time, agnostic to voltage, DER and constraint. The CANMOP will provide full license coverage for SP Distribution and SP Manweb, and will have an anticipated hardware refresh during RIIO-ED2.

- **Constraint Management Zones (CMZ):** local controllers will be established across the network in areas we expect to become constrained during the RIIO-ED2 period. Initially the focus will be on legacy ANM schemes in East Lothian and across south west Scotland as part of the D&G Integrated Network Management Project. The CMZ will manage all ANM connected customers in an electrically connected area and will be extended to provided additional functionality during RIIO-ED2.

- **Customer Outstations:** a local outstation will connect directly into the customers and issue commands. The customer outstation and any communication infrastructure are sole use assets and so will be chargeable to the connecting customer.

We are designing an architecture which is a key enabler for DSO, we believe provides a level of choice for customers whilst maximising the scalability of the solution and ensuring that our Licence and network security obligations are maintained.
We believe that the minimum level of intervention should deliver the capabilities listed below, with additional functionality added over the course of RIIO-ED2:

- **Active Network Management:** delivering the required infrastructure to support our existing ANM projects and deliver the Constraint Management Zone (CMZ) infrastructure to support a further 22 locations during RIIO-ED2.

- **Active Fault Level Management (AFLM):** delivering AFLM across our CMZ areas during RIIO-ED2.

- **Flexible Connection Management:** enhancements and extensions for the CMZs to support flexible connections.

- **Flexibility Services:** enhancements and extensions for the CMZs to support the dispatch of flexibility services.

- **Voltage Management:** enhancements and extensions for CMZs to support the delivery of voltage management services.

- **Service Coordination with ESO and DSOs:** enhancements and extensions for SP Energy Networks systems to support service co-ordination with other networks.

5.3.3 The ENZ Platform

A key theme that emerged in preparing for RIIO-ED2 is that the LV network will be on the front-line. EV chargers, heat pumps, condition-driven cut-out replacement, domestic customers actively participating in energy markets, increasing smart meter data, increasing connection applications – this is all happening at LV.

This level of activity is a step change from decades of steady, predictable, incremental change. We need to do more than just increase LV network capacity – we need to radically shift our LV network planning tools, our operational capabilities, and our internal processes. These all depend on LV network analysis capability.

Therefore over RIIO-ED1, through our award-winning NCEWS innovation project, we have built a complete connectivity model of our entire network, from customers' cut-outs up to the transmission network. We call this our **ENZ Model** (Section 5.1.3).

For RIIO-ED2 we will develop our ENZ Model into a real-time analytical platform – our **ENZ Platform**. This will integrate four previously independent data sources (network monitoring, smart meters, enhanced forecasting, asset condition), and use them to run automated power flow analysis for the entire network in real-time. This produces network analytics to tell us what is happening on the network right now, and what will happen in operational and planning timescales. This information means we can make real-time data-driven planning and operational decisions. We will increase its capability by deploying 14,102 LV network monitors in RIIO-ED2, in addition to the 2,438 LV monitors we are delivering in RIIO-ED1.

This industry-leading approach means that we have an integrated data and analytical system covering the entire network. This is a UK first. We now have data-driven visibility of the LV network. We can now make more informed real-time operational decisions which improve the safety, reliability, and efficiency of the network for our customers. And we can now better coordinate the range of load related, asset management, and DSO interventions, to reduce cost and disruption for our customers while delivering what they want. Please see Figure 7 for more information.

The platform marks a significant move forward for us as a network, and a step change for our customers.

5.3.4 Operational IT and telecoms

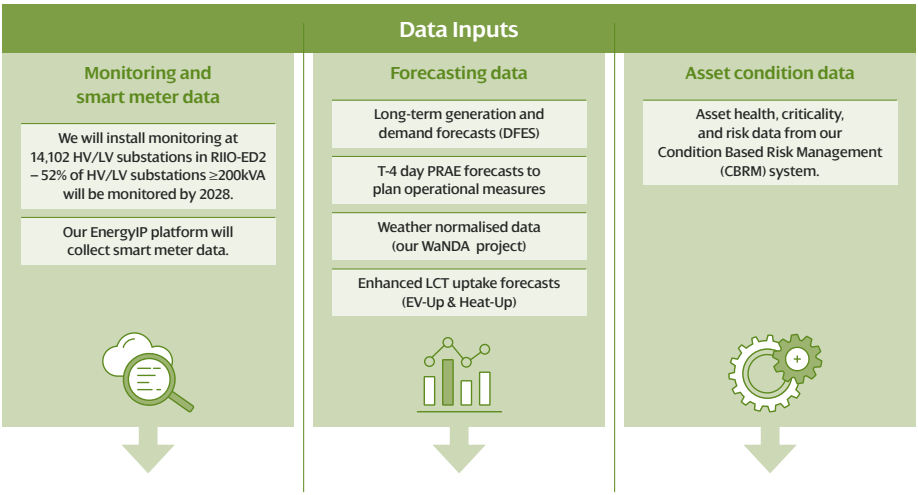
Operational IT and telecoms consists of four key components:

1. The telecommunications network, which communicates all data and control signals.

2. Supervisory Control and Data Acquisition (SCADA) systems, which are the network monitoring and control system architectures.

3. Smart systems and central data management, such as the full network connectivity and loading model developed through our NCEWS and Network Analysis and View (NAVI) innovation project.

4. Network automation and monitoring.



This will perform automated power flow analysis for the entire network in near real-time using the four data inputs. Combining these data sources with this real-time modelling capability means in RIIO-ED2 we will be able to:

Identify network constraints in real-time	*Enables us to intervene before constraints escalate, and only dispatch flexibility when it's needed, reducing costs for customers.*
Forecast network constraints in the near future	*We can give the flexibility service markets time to respond and increase whole system coordination.*
Automate the design of LV connections and LV reinforcements	*We will be faster to respond to and connect customers. We will be able to process the forecast surge in connection applications and save at least £20m in staffing costs.*
Automate LV flexibility tendering and management	We will reduce the overheads of flexibility, making it a more cost competitive solution.
Manage LV faults	*We will reconnect our customers more quickly after a fault.*
Coordinate condition driven replacement with capacity driven reinforcement	*Delivery programmes will be less disruptive and more cost-effective. We will make more efficient intervention decisions, considering a greater range of data than before.*
Track LCT uptake	*We will make more cost-effective and timely interventions for our customers.*

Figure 7: Our ENZ platform

These integrated systems and infrastructure are vital for DSO roles and activities, and accommodating Net Zero decarbonisation: increased network monitoring; collating and sharing information with third parties; smart network technologies to manage a more dynamic and interactive energy system – these all depend on safe, resilient, and cyber secure operational IT and telecoms.

Our existing systems were designed for historical passive networks. While they have evolved in RIIO-ED1 to accommodate increasing levels of generation, the magnitude of the changes needed to achieve Net Zero goals in RIIO-ED2 and beyond means these systems need to undergo a more dramatic revolution.

Given this, we will materially increase our investment compared to RIIO-ED1, to significantly expand these capabilities. This will enable:

- The deployment of LV monitoring at 14,102 substations. These help us more efficiently operate our network for our customers, by better knowing where and when to intervene, and enhance competition, by supporting our more targeted and effective use of flexibility services.
- The analysis and sharing of data across the organisation and with third parties.
- The expansion of our world leading active fault level management, which will enable renewable generation to connect quicker and at lower cost.
- The ENZ Platform.

See our RIIO-ED2 Business Plan for more information on our planned interventions and how we make sure that our operational IT and telecoms is cyber secure and meets industry recommendations for critical network infrastructure resilience.

5.3.5 Non-operational IT (Data and Digitalisation)

Data is the key to fully unlocking the value of the network for our customers. This includes data from our network assets through increased network monitoring, asset condition data, improved operational and planning data from forecasting, data from the markets we facilitate and data from third parties (including smart meters).

We will also be gathering and communicating data with far more sources, from simple network monitors to sharing whole network models with customers. So that we can effectively record, store, analyse and share data, and deliver the benefits it offers, we are undergoing a digitalisation transformation[15]. This digitalisation transformation includes hardware, software, processes and IT/cyber security, and interoperability between our platforms and systems. Our data and digitalisation work is focussed on making data visible, accessible, and interoperable.

15 Please see our Digital Strategy for more information about our data and digitalisation plan. Available at: *https://www.spenergynetworks.co.uk/pages/our_digitalisation_strategy.aspx*

Together, data and digitalisation underpin all network activities and wider system coordination, from allowing us to make more informed operational decisions to helping markets better understand network opportunities. These deliver benefits from the micro (predicting a cable fault and repairing it before the customer loses supply) to the macro (a new whole system operating model which enables the continued safe, reliable, and efficient operation of the whole electricity system).

5.3.6 Resource

The extent of roles and activities that need to be delivered to ensure the continued provision of a safe, reliable, and efficient service is significant. We are working to have the right organisational structure and the right people to successfully deliver for RIIO-ED2:

- **Organisational change.** It is important to retain institutional optionality where ownership for DSO activities has yet to be decided – we understand this and will structure our organisation accordingly. This organisational change will help deliver transparent information and decision making whilst delivering against the Ofgem defined roles.

- **Investing in our people.** We are investing in our existing staff and recruiting new talent to ensure that we deliver the DSO roles whilst continuing to provide industry leading customer service. This includes building a digital-ready workforce and embracing more effective ways of working.

5.4 Supporting our customers and stakeholders

We have an important responsibility and opportunity to inform and educate customers and stakeholders through our well-placed stakeholder engagement. This ensures that customers, community groups, businesses, academia, and government are aware of the changes in the energy sector and the resulting opportunities. This will empower these parties to maximise their engagement, realise local and national benefits, and keep energy costs as cost-effective as possible. As a company, we are already committed to supporting current and future stakeholders to meaningfully engage with the opportunities presented by a Net Zero future; for example, through our Zero Carbon Communities Hub[16], helping customers understand EV charging points[17], and by supporting local educational projects such as Community Energy Scotland's Community Energy Futures[18] training via our dedicated £20m Green Economy Fund.

16 More information is available at: *https://www.spenergynetworks.co.uk/pages/zero_carbon_communities.aspx*

17 We have a dedicated webpage and handbook to help different customer types (e.g. domestic, car park owner) understand the process to install EV chargers: *https://www.spenergynetworks.co.uk/pages/electric_vehicles.aspx*

18 More information is available at: *https://cef.scot/*

6

Our DSO Strategy mapped against Ofgem requirements

To ensure that we deliver the Ofgem defined roles and activities and surpass all Ofgem defined DSO baseline expectations, we have mapped what we will deliver in RIIO-ED2 against Ofgem's DSO activities.

Figure 8 shows a high level mapping of our DSO Strategy against the Ofgem defined DSO activities. It shows that we envisage exceeding, and in some cases substantially exceeding, Ofgem's baseline expectations.

This mapping exercise is shown in detail in Sections 6.1 to 6.3. It shows how the DSO interventions in Section 5 will deliver Ofgem defined DSO activities. So readers can easily find more information, each intervention is referenced back to where it is discussed in Section 5. Where an intervention directly delivers an ODI metric or Regulatory Reporting Evidence (RRE), we have shown this in red. We haven't shown resource (Section 5.3.6) as this applies to all activities.

Role 1
Activity 1.1

1. *Enhanced forecasting, simulation, modelling & increased network monitoring*
2. *Effective processes for sharing planning information*
3. *Robust optioneering process*

Role 2
Activity 2.1

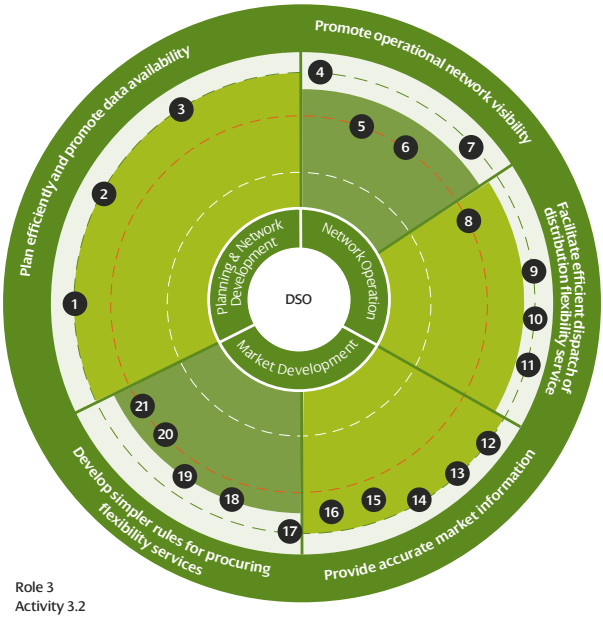
4. *Improve network visibility*
5. *Provide ESO with info on DER plans*
6. *Understand & gather DER characteristics*
7. *Share data with network users*

Role 2
Activity 2.2

8. *Clear decision making framework*
9. *Facilitate secondary trading*
10. *Communicate Decision Making Framework*
11. *Scalable dispatch instruction infrastructure*

Role 3
Activity 3.1

12. *Publish relevant data to assist market participation*
13. *Develop info communication strategy*
14. *Engage with market to understand needs*
15. *Tailor information provision and engagement approaches for different participants.*
16. *Ensure data that is published is accurate and unbiased*



Role 3
Activity 3.2

17. *Develop clear process for securing flexibility*
18. *Identify the optimum combination of longer and short term contracts*
19. *Provide necessary data to facilitate secondary trading*
20. *Provide Market Support Services*
21. *Manage potential conflict of interest*

Figure 8: Our DSO Strategy mapped to the five Ofgem DSO activities

6.1 DSO Role 1: Planning and network development

DSO Role 1 covers one DSO activity. Table 3 shows how our DSO Strategy will deliver this.

Activity 1.1. Plan efficiently in the context of uncertainty, taking account of whole system outcomes, and promote planning data availability.

Purpose: DNO planning processes are clear, that high-quality, data driven decisions are made, and that DNOs provide stakeholders with relevant info to inform their own decision making.

How we will deliver this activity in RIIO-ED2	Relevant DSO baseline expectations & timescales
We will continue to use and further develop the enhanced EV-Up and Heat-Up forecasting tools we've developed in RIIO-ED1 (5.1.2). These assess spatial, demographic, and socioeconomic data to forecast EV and heat pump uptake for every customer we serve. These insights help us identify precisely where and when we need to invest. By better understanding our customers' requirements we can make more targeted, efficient, and timely network planning interventions.	**Ofgem Baseline Expectations: 1.1.1, 1.1.3** **Timescale:** Further development during RIIO-ED1 and RIIO-ED2
ODI Ref: Efficient Operation - Published forecasts Regular reported evidence to demonstrate DSO is evolving and developing forecasting ability. Initially to focus on LTDS and DFES and ensuring reports evolve over time to include high level demand forecasting.	**Ofgem Baseline Expectations: 1.1.1, 2.1.4** **Timescale:** Annual reporting during RIIO-ED2

How we will deliver this activity in RIIO-ED2	Relevant DSO baseline expectations & timescales
The installation of **14,102 LV network monitors** (5.3.1) will help us plan efficiently by enabling us to accurately establish existing spare capacity and produce enhanced forecasts of future customer capacity needs. These mean we better know: when existing capacity levels will be exceeded, helping us establish when and where we need to intervene; and the nature of the constraint (current or voltage) and how much additional capacity is needed, helping us to identify the best solution. Increased LV monitoring means we can publish more information about our LV network. This means ICPs and IDNOs aren't as reliant on us (reducing our resourcing overhead), can better serve their own quotation offers (levelling the playing field), and can better audit our decisions (increasing transparency). We have a **LV Monitoring Strategy** which covers "rigorous presentation and analysis of needs and use of data for networks and non-network parties, well-established functional and technical specifications, and cost-effectiveness analysis" [19]. This ensures we are delivering LV monitors where they provide value, and that they are complementary to smart meter data. ODI Ref: Efficient Operation – Network Monitoring	**Ofgem Baseline Expectations: 1.1.1, 1.1.3** **Timescale:** Installation during RIIO-ED2. Annual reporting during RIIO-ED2
Metric to assess the progress of network monitoring rollout. Performance of DNO in rolling out network monitoring vs. agreed upon plan with Ofgem ahead of RIIO-ED2.	

19 Ofgem's 'RIIO-ED2 Methodology Decision', published 17 December 2021. Available at: *https://www.ofgem.gov.uk/publications-and-updates/riio-ed2-sector-specific-methodology-decision*

How we will deliver this activity in RIIO-ED2	Relevant DSO baseline expectations & timescales
Our ENZ Platform (5.3.3) delivers enhanced network modelling. This combines enhanced forecasting data, LV monitoring data, smart meter data, asset condition data, and a full model of our entire network (from customer cut-outs up to the transmission network) to produce detailed network analytics. This helps us make data-driven network planning decisions considering the range of Net Zero pathways. ODI Ref: Data - Data and Modelling capabilities We will use annual reports to demonstrate our progress in using data driven insights and transparent decision making, through advancements in our modelling capabilities. Evidence will be provided through the development of strategies and processes, whilst demonstrating how modelling advancements has quantifiable benefits for our customers.	**Ofgem Baseline Expectations: 1.1.1, 1.1.3** **Timescale:** The ENZ model will be ready by the start of RIIO-ED2, with development and improvement during RIIO-ED2 to develop it into a full platform for near real time management of LCTs.

How we will deliver this activity in RIIO-ED2	Relevant DSO baseline expectations & timescales
We will go beyond creating a data sharing standard – our comprehensive Digital Strategy will identify a whole new range of relevant data sources and share these securely, as part of our commitment to open data. We will report the percentage of approved datasets that are shared and aim to make 100% of the Ofgem agreed datasets available, within fixed timescales. The continued use and development of our SDIF (5.1.6) tool means we have the share planning information (including whole network models) with other network companies and interested parties. ODI Ref: Data - Data Sharing Method Metric As part of the comprehensive Digital Strategy, we aim to make access to our open datasets more intuitive for stakeholders, by publishing in a dynamic, close to real-time manner, and making the majority of datasets available through self-service portal or an Application Programming Interface (API). ODI Ref: Data - Open Data & Data Sharing Metric Metric to determine the level and ambition in relation to committing to sharing data and ensuring open source and available to industry and embedding a data and insights driven approach to business decisions. Metric assesses the percentage of approved and agreed upon datasets that are shared and available to industry.	**Ofgem Baseline Expectations: 1.1.2, 2.1.1, 2.1.4, 3.1.1, 3.1.5, 3.2.3** **Timescale:** Annual reporting during RIIO-ED2
We will continue to transparently value flexibility services and publish clearing prices (5.1.5). This will enable third parties to audit our use of flexibility services and our intervention decisions.	**Ofgem Baseline Expectations: 1.1.3** **Timescale:** Further details within our RIIO-ED2 business plan.

How we will deliver this activity in RIIO-ED2	Relevant DSO baseline expectations & timescales
We will continue to use the transparent and coordinated network planning processes we've established in RIIO-ED1. These value flexibility, energy efficiency, smart, and traditional interventions on an equal and impartial basis. We will continue to use the Common Evaluation Methodology[20]. Our intervention decisions will consider the option value provided by shorter-term interventions during periods of uncertainty – our enhanced forecasting (5.1.2) and ENZ Platform (5.3.3) mean we can go beyond baseline. ODI Ref: Efficient Operation - Network Optionality & Decision making Regularly Reported Evidence to assess DSOs decision making approach. Review of Policies to ensure transparent and submission of evidence to demonstrate how data and analytics is being used to drive data-driven insights to support decisions.	**Ofgem Baseline Expectations: 1.1.1, 2.2.1, 2.2.3, 3.2.1** **Timescale:** Annual reporting during RIIO-ED2

Table 3 | Our DSO Strategy delivering DSO Activity 1.1

20 It introduces a standard and transparent methodology for distribution network operators when choosing solutions to solve congestion. *https://www.energynetworks.org/newsroom/ena-standardises-approach-to-flexibility-for-gb-distribution-network-operators*

6.2 DSO Role 2: Network operation

DSO Role 2 covers two DSO activities. Table 4 and Table 5 show how our DSO Strategy will deliver these.

Activity 2.1 Promote operational network visibility and data availability.
Purpose: DNOs to share relevant network operations data with stakeholders, and to ensure that DNOs have sufficient network knowledge to safely and reliably operate their network.

How we will deliver this activity in RIIO-ED2	Relevant DSO baseline expectations & timescales
We will deliver **LV monitoring** (5.3.1) at 14,102 secondary substations. This will significantly increase our visibility of the LV network, and we will be able to share this data with third parties.	**Ofgem Baseline Expectations: 2.1.1** **Timescale:** Further details within our RIIO-ED2 business plan.
We will continue to use and further develop the **near-time forecasting platform (**5.1.2) we've developed in RIIO-ED1. This gives demand and generation forecasts for up to four days ahead down to LV feeder level. We use this visibility to plan our utilisation of operational measures such as flexibility service providers.	**Ofgem Baseline Expectations: 2.1.1** **Timescale:** Further details within our RIIO-ED2 business plan.
Our **ENZ Platform** (5.3.3) will combine LV monitoring data with smart meter data, forecasting data, and asset condition data, to produce real-time network analytics which provide data-driven visibility of the network. This will improve the **identification of network constraints** in operational and planning timescales.	**Ofgem Baseline Expectations: 2.1.1** **Timescale:** Further details within our RIIO-ED2 business plan.
We will deliver a significant increase in **operational IT and telecoms** (5.3.4). This is needed to support the LV monitoring role out, expanded network operation approaches, and data sharing with third parties.	**Ofgem Baseline Expectations: 2.1.4** **Timescale:** Further details within our RIIO-ED2 business plan.

How we will deliver this activity in RIIO-ED2	Relevant DSO baseline expectations & timescales
We will use a combination of asset registers, contract data and system data, to record DER characteristics to avoid possible events that could lead to the disconnection of DER.	**Ofgem Baseline Expectations: 2.1.3** **Timescale:** Industry work currently ongoing, with expanded process in place for the start of RIIO-ED2.
We are working closely with the ESO, through the Energy Network Association (ENA), to support the co-ordination of DER providing flexibility. This work will continue into RIIO-ED2 as our systems support the increased exchange of data with the ESO (and the receipt of data from the ESO) to support the timely notification of dispatch intentions.	**Ofgem Baseline Expectations: 2.1.2** **Timescale:** Industry work currently ongoing, with initial process in place for the start of RIIO-ED2.
We will share operational data with our customers, stakeholders, and market participants through an online data portal and through our digital systems (5.1.6). We will make better use of existing data as well as new data that will become available over RIIO-ED2.	**Ofgem Baseline Expectations: 1.1.2, 2.1.4, 2.2.3, 3.1.1** **Timescale:** Established for start of RIIO-ED2
ODI Ref: Stakeholder and Customer Service - Data Request Service Level Agreement (SLA) To ensure we are providing the highest level of service possible, we record and monitor the average time taken to respond to **requests for data**. We will be aiming to provide an initial response to any request within 14 days or less with next steps for the data request. We will co-ordinate with other network licence holders where appropriate and aim to demonstrate continual improvement.	**Ofgem Baseline Expectations: 1.1.2, 2.1.4, 2.2.2, 3.1.1** **Timescale:** Further details within our RIIO-ED2 business plan.

Table 4 | Our DSO Strategy delivering DSO Activity 2.1

Activity 2.2 Facilitate efficient dispatch of distribution flexibility services.

Purpose: developing operability capabilities and actions, to ensure DNOs facilitate DER dispatch that is economical and safe.

How we will deliver this activity in RIIO-ED2	Relevant DSO baseline expectations & timescales
We will create an engineering standard for DSO actions in conjunction with a published summary policy document outlining the **Decision-Making Framework** for when DER are instructed. The decision making process will be transparent and will identify the alternatives considered. The Framework will include rules for coordinating dispatch between us and the ESO.	**Ofgem Baseline Expectations: 2.2.1, 2.2.2** **Timescale:** Established for start of RIIO-ED2
The Framework will be developed with stakeholder input. Annual reports will document **policy reviews** for ensuring transparent and data-driven approaches to determining options, with quantifiable customer benefits.	
We will roll-out **22 CMZs** (5.3.2) and a **scalable flexibility platform** (5.1.5). These are complementary s**calable dispatch infrastructure** which will give us dual capability, going beyond baseline expectations. The CMZs will provide a safety net in the event of market failure, rather than being used instead of markets. Please see Appendix A for more information on why we are deploying both, rather than just one.	**Ofgem Baseline Expectations: 2.2.4** **Timescale:** Further details within our RIIO-ED2 business plan.
We will continue to use the near-time forecasting platform (5.1.2) we've developed in RIIO-ED1. This gives demand and generation forecasts for up to four days ahead down to LV feeder level. We use this to efficiently plan our utilisation of operational measures such as flexibility service providers.	**Ofgem Baseline Expectations: 2.1.1, 2.1.4, 2.2.3, 3.1.1** **Timescale:** Further details within our RIIO-ED2 business plan.

How we will deliver this activity in RIIO-ED2	Relevant DSO baseline expectations & timescales
Our **ENZ Platform** (5.3.3) combined with our LV monitoring (5.3.1) programme means we can: • more accurately define service windows. Where this results in less onerous windows, it can increase participation and free up providers to operate in other markets. • forecast near-term flexibility need, giving contracted providers some warning we will dispatch them. This can increase the quality of the service we receive and market functioning.	**Ofgem Baseline Expectations: 2.1.1, 2.1.4, 2.2.3, 3.1.1** **Timescale:** Further details within our RIIO-ED2 business plan.
We are working closely with the ESO, through the ENA, to support the co-ordination of DER providing flexibility. This work will continue into RIIO-ED2 as our systems support the increased exchange of data with the ESO (and the receipt of data from the ESO) to support the timely notification of dispatch intentions. This supports increased network coordination across distribution, transmission, and other energy vectors as customers change their energy patterns in the move to Net Zero. Operational coordination, especially over the use of DER services by us and the ESO, is needed given both our growing dependency on DER services and the resulting distribution to transmission operational interactivity.	**Ofgem Baseline Expectations: 2.1.2** **Timescale:** Industry work currently ongoing, with initial process in place for the start of RIIO-ED2.
We are leading the industry with several significant trials focused on facilitating flexibility trading, including data provision. This will continue throughout RIIO-ED2, with the intention to continue to test **secondary trading arrangements**. Our leadership has also included the development of Products within the ENA Open Networks Projects – supporting the development of standardised approaches for flexibility.	**Ofgem Baseline Expectations: 2.2.3, 3.2.3** **Timescale:** Further details within our RIIO-ED2 business plan.

How we will deliver this activity in RIIO-ED2	Relevant DSO baseline expectations & timescales
We will deliver a significant increase in operational IT and telecoms (5.3.4). This is needed to support the efficient dispatch of flexibility services.	**Ofgem Baseline Expectations: 2.1.2** **Timescale:** Industry work currently ongoing, with initial process in place for the start of RIIO-ED2.
We will continue to use industry standard definitions for different types of flexibility services and the associated specifications and use cases. We will work with the ENA and our stakeholders to continue this co-development work through RIIO-ED2.	**Ofgem Baseline Expectations: 2.2.4** **Timescale:** Industry work currently ongoing, with co-development work throughout RIIO-ED2.
The investments in DSO infrastructure, and the resultant data it will generate, will focus on common and interoperable data formats. This means we are not tied to a single manufacturer/equipment provider, and makes it easier for roles to be reassigned in the future.	**Ofgem Baseline Expectations: 2.2.4** **Timescale:** Further details within our RIIO-ED2 business plan.

Table 5 | Our DSO Strategy delivering DSO Activity 2.2

6.3 DSO Role 3: Market development

DSO Role 3 covers two DSO activities. Table 6 and Table 7 show how our DSO Strategy will deliver these.

Activity 3.1. Provide accurate, user friendly and comprehensive market information.
Purpose: ensure DNOs sufficiently inform stakeholders of information that will help them engage and participate in markets.

How we will deliver this activity in RIIO-ED2	Relevant DSO baseline expectations & timescales
Through our **Flexibility Platform / Portal** (5.3.5), we will offer a single point of information in respect of flexibility service requirements, going beyond baseline by giving greater clarity and ease of access to market participants. This will also support third party platforms to 'plug-in' to the flexibility procurement process. This Platform / Portal will support our activities to neutrally facilitate an open and accessible DER services market. Throughout RIIO-ED2, we will be transparent in our operation of an open and accessible DER services market from which we will contract flexibility services. We will send clear price signals to incentivise DER participation and service stacking across markets.	**Ofgem Baseline Expectations: 3.1.1, 3.1.2, 3.2.1, 3.2.2** **Timescale:** Currently in place, with further development throughout RIIO-ED2
The installation of **14,102 LV network monitors** (5.3.1) will increase our visibility of the LV network. They will provide us with more data than we currently have, which can be shared with third parties.	**Ofgem Baseline Expectations: 3.1.1, 3.1.5** **Timescale:** Further details within our RIIO-ED2 business plan.

How we will deliver this activity in RIIO-ED2	Relevant DSO baseline expectations & timescales
Our **Digital Strategy** will take us beyond baseline for publishing data to assist market participation, with greater provision for identifying and relevant data and making this more easily accessed through self-service portals or APIs. Our approach to shared data is to ensure it is as accurate and user-friendly as reasonably possible. We will share market data with our customers, stakeholders, and market participants through an online data portal and through our digital systems (5.1.6).	**Ofgem Baseline Expectations: 3.1.1, 3.1.2, 3.1.3, 3.1.5** **Timescale:** Further details within our RIIO-ED2 business plan.
We will make better use of existing data as well as new data that will become available over RIIO-ED2.	
We will continue to transparently value flexibility services and publish clearing prices (5.1.5). This information will help market participants identify and value opportunities.	**Ofgem Baseline Expectations: 3.1.1, 3.1.5** **Timescale:** Further details within our RIIO-ED2 business plan.
We will not only engage with stakeholders and respond to their feedback as per the baseline expectation, but we will also set an **ambitious Service Level Agreement (SLA) for responding to specific data requests.** Throughout RIIO-ED2, we will also help our customers and communities identify opportunities from participating in the energy system.	**Ofgem Baseline Expectations: 3.1.2, 3.1.3, 3.1.4** **Timescale:** Annual reporting during RIIO-ED2

How we will deliver this activity in RIIO-ED2	Relevant DSO baseline expectations & timescales
ODI Ref: Stakeholder and Customer Service - Evidence from DSO on how stakeholders have helped shape and tailor offerings We will log or record of all customer and stakeholder feedback in relation to the services that we offer. We will evidence where feedback was taken on board, not taken on board or in progress with justification of why decision was made. Records of engagement will provide evidence of attempts to embed views and shape DSO Offerings.	**Ofgem Baseline Expectations: 3.1.3, 3.1.4** **Timescale:** Annual reporting during RIIO-ED2
We will deliver a significant increase in **operational IT and telecoms** (5.3.4). This is needed to support data collection and sharing with third parties.	**Ofgem Baseline Expectations: 3.1.1, 3.1.5** **Timescale:** Further details within our RIIO-ED2 business plan.

Table 6 | Our DSO Strategy delivering DSO Activity 3.1

Activity 3.2. Embed simple, fair, and transparent rules and processes for procuring distribution flexibility services.

Purpose: ensure distribution flexibility services design leads to good competitive outcomes, including lower prices and innovative services

How we will deliver this activity in RIIO-ED2	Relevant DSO baseline expectations & timescales
ODI Ref: Developing & Progressing Flexibility - DSO Dispatch We will complete an annual report to provide evidence of our processes, procedures, and systems around transparent, efficient, whole system dispatch. This will include strong evidence of appropriate network infrastructure, for dispatching when issues arise, and implementation of common contractual arrangements.	**Ofgem Baseline Expectations: 2.2.4** **Timescale:** Annual reporting during RIIO-ED2
ODI Ref: Stakeholder and Customer Service Product & Services Assessment To ensure that we are continually evolving products and services offered to market, and that sufficient processes are in place to develop and amend products and services, we will provide quantifiable evidence within annual reports.	**Ofgem Baseline Expectations: 3.2.1** **Timescale:** Annual reporting during RIIO-ED2
ODI Ref: Developing & Progressing Flexibility Flexibility Solution Evaluation We will utilise a Distribution Network Options Assessment (DNOA), or similar, to report the improvements in our ability to ensure that the right traditional, smart, or flexible option is chosen. This continual assessment will include identification of lessons learnt and how our approach has evolved over RIIO-ED2.	**Ofgem Baseline Expectations: 3.2.1, 3.2.2** **Timescale:** Annual reporting during RIIO-ED2

How we will deliver this activity in RIIO-ED2	Relevant DSO baseline expectations & timescales
We are working closely with the **ESO through the ENA** to standardise process and contracts across the industry to support the co-ordination of DER providing flexibility. This will include trying to minimise the use of exclusivity clauses where possible.	**Ofgem Baseline Expectations: 2.2.1, 3.2.2** **Timescale:** Industry work currently ongoing, with co-development work throughout RIIO-ED2.
ODI Ref: Developing & Progressing Flexibility - Flexibility Market Volume To assess the flexibility market volume, we will report annually on the **volume of flexibility tendered for versus the forecast flexibility**, with a proposed target of 75% - 100%. This will be assessed at the mid-point and end of period.	**Ofgem Baseline Expectations: 3.2.3** **Timescale:** Annual reporting during RIIO-ED2
We are leading the industry with several significant trials focused on facilitating flexibility trading, including data provision. This will continue throughout RIIO-ED2, with the intention to continue to test secondary trading arrangements. Our leadership has also included the development of Products within the ENA Open Networks project – supporting the development of standardised approaches for flexibility.	**Ofgem Baseline Expectations: 2.2.3, 3.2.3** **Timescale:** Further details within our RIIO-ED2 business plan.
ODI Ref: Developing & Progressing Flexibility - Flexibility Commercial Process The **Flexibility Commercial Process Metric** will be used to assess the time taken for new customers to be accepted to deliver services in the flexibility market, measured from the receipt of all relevant information provided by the client. This approach will also support simple and cost-effective participation in distribution flexibility markets.	**Ofgem Baseline Expectations: 3.2.4** **Timescale:** Produced in Year 1 and Year 5 to show improvement.

How we will deliver this activity in RIIO-ED2	Relevant DSO baseline expectations & timescales
Several our new and evolving activities involve interacting more closely with our customers, other network parties and other markets. This could give rise to real or perceived conflicts of interest which must be addressed by creating a fair and transparent holistic conflict management regime. ODI Ref: Efficient Operation - Conflict of Interest Management We will complete an annual report to provide evidence and justification that sufficient processes and measures to manage **conflicts of interest** are in place, whilst ensuring relevant statistics are published.	**Ofgem Baseline Expectations: 3.2.5** **Timescale:** Annual reporting during RIIO-ED2

Table 7 | Our DSO Strategy delivering DSO Activity 3.2

7

What DSO means for our customers and stakeholders

We have refined how we will deliver our DSO Strategy that we published in June 2020 so that it meets the expectations of our customers, stakeholders, and Ofgem's requirements.

Over the course of preparing our RIIO-ED2 plan, we have carried out extensive engagement across our customer base and with stakeholders to refine our decision making and to inform our approach and ambition.

We have extensively engaged with our customers to understand their priorities for RIIO-ED2. From this, we know that our customers prioritise four main things in their electricity supply: reliability, safety, cost-efficiency, and the capacity they need to decarbonise (domestic customer especially do not want to be constrained). Section 7.1 explains how our DSO Strategy has been developed to deliver these. Section 7.2 goes into more detail explaining the benefits that DSO will deliver for different customer types.

Since we published our DSO Strategy in June 2020 we have engaged with our stakeholders to draw on their expertise. Section 7.3 summarises the feedback we received, and how that has been used to guide our prioritisation and decision making when refining our plans for RIIO-ED2.

7.1 Delivering the top four customer priorities

We have listened to our customers' priorities when developing this DSO Strategy, and so developed our DSO Strategy according to four key guiding principles.

1. Safety

Our responsibility: Safety of our staff, customers, and the general public is our first priority and built into everything we do. We have a clear responsibility to ensure that everyone who interacts with and relies on our network is not harmed by that interaction.

How we are responding: In the future, we will operate our assets in new ways, increasing the utilisation of our network to get greatest value for customers. These smarter networks will improve our customer and staff safety. We will increase asset monitoring, gather more asset data, and operate new asset management standards that not only maintain the safe operation of our assets, but the safety of anyone who interacts with our network.

2. Security, resilience, and reliability

Our responsibility: Our primary operational responsibility is to keep the electricity on for our customers – we all depend on it to enable our modern lifestyles. Looking to the future, the importance of electricity in our customers' lives will increase even further as we use it to heat our homes and power our transport. In addition, as essential system balancing services increasingly connect to the distribution network, the security and stability of the wider GB energy system is also at stake. We have a responsibility to maintain the security, resilience and reliability of the distribution network and wider energy system.

How we are responding: This responsibility informs our approach, from cyber security and asset management, to how we manage external factors, such as the impact of shallow[21] flexibility service markets and whole system resilience during low-probability high-impact events. As we begin to operate the network in new ways, we must maintain the security, resilience and reliability of the system in response to changing system characteristics, new customer operating profiles and technologies, an ever-evolving range of external factors and threats, and the risks of higher asset utilisation and greater operational complexity.

3. Customer value

Our responsibility: All electricity system and network costs are ultimately recovered from customers. We know that for some fuel poor customers, these costs can be a significant proportion of household income. We have a responsibility to serve our customers' needs, whilst keeping network costs as low as possible. The Net Zero transition must not penalise or leave behind vulnerable and fuel poor customers – it must be a Just Transition.

How we are responding: Increasing efficiency, using competition, and deploying innovation are essential tools for delivering customer value, but we plan to go further – this responsibility has informed the way we will deliver the three DSO roles.

21 Shallow markets are typically characterised by fewer service providers. This can have an adverse impact on market competition and, where networks rely on flexibility to defer reinforcement, can result in an increased loss of supply risk for customers if the flexibility providers have a lower reliability than the network assets they defer.

This responsibility has also informed the DSO infrastructure we will deliver, which help us make the best use of what we've already got, make more targeted and lower-cost interventions, and allow our customers to directly participate and benefit by providing services.

4. Delivering Net Zero for our customers and communities

Our responsibility: Distribution networks are key to delivering Net Zero – the decarbonisation of heat and transport, and the increasing levels of renewable generation capacity, depend on distribution network capacity. We therefore have a clear responsibility to deliver the capacity this decarbonisation needs on time and at least cost to customers.

How we are responding: This responsibility has shaped our approach to DSO roles, from providing flexible connection arrangements like ANM so new renewable generation can connect more quickly, to enabling the use and sharing of DER services to provide additional revenue streams for LCTs. In addition, our underpinning infrastructure, like enhanced forecasting and modelling, mean we can intervene ahead of time to ensure there are no delays in connecting LCTs.

We have just 30 years to achieve Net Zero. In network terms, this is not a remote horizon: the majority of the assets we install today will still be operational in 2050. This means that our journey to deliver decarbonisation has already started.

7.2 What DSO means for our customers

We have engaged over 10,000 customers in the preparation of our RIIO-ED2 draft plan across a range of customer segmentation groups including domestic & commercial customers, further disaggregated into 39 customer groups covering a range of demographics and lifestyles. This feedback has highlighted the importance of Net Zero, the resilience and the reliability of our network to our customers.

It is essential that the roles, activities, and infrastructure that we plan to deliver meet our customers' needs. Table 8 sets out, for different customer types, how we foresee our customer requirements evolving through to the end of RIIO-ED2, and how DSO will deliver on these requirements. We've used the four customer types developed by the Open Networks project.

Customer type	Customer requirements	How DSO delivers
All customers These requirements and benefits can apply to all four customer types described below.	A safe network.	Greater use of network monitoring and data will allow potential safety issues to be identified earlier and mitigated.
	A reliable supply.	DSO will enable a reliable and resilient supply through improved whole system planning and operational coordination (including coordinating the optimal use of DER services for transmission and distribution needs), greater distribution asset monitoring, and smarter network infrastructure.
	Cost-efficient network capacity.	DSO will enable a cost-efficient supply by using a wide range of activities and infrastructure to get the best out of existing network capacity, defer the need for new network capacity, and minimise losses.
	Delivery of Net Zero	Some customers will value playing their part in delivering Net Zero and the environmental benefit which that delivers. DSO enables Net Zero to be delivered safely, on time, and in the most cost-efficient way.

Customer type	Customer requirements	How DSO delivers
Passive customer Normal demand customers with little or no interest in time of use tariffs, proactively managing consumption, or providing services. These are typically domestic or business customers on a single standard tariff. They may have LCTs, but for reasons other than energy management (e.g. they were issued an EV as a company car). Vulnerable and fuel poor customers typically sit in this category.	In the event of a loss of supply, supply is quickly restored.	Enhanced network monitoring, data and network analytics mean faults can be quickly identified. Automation means the network can automatically reconfigure itself to minimise the number of customers impacted by a fault.
	Any works (e.g. road closures to bury cables) are done with minimal inconvenience to the customer.	DSO will enable us to get the best out of existing capacity, and defer the need for new network capacity. This reduces the need for network reinforcements and new network infrastructure.
	General desire for minimal visual, noise, and environmental impact from network assets.	

Customer type	Customer requirements	How DSO delivers
Passive participant Energy conscious customer generally offsetting demand using 'off the shelf' passive 'fit and forget' systems in order to reduce their energy bills. Would likely be interested in reducing costs via time of use tariffs from their energy supplier. These are typically domestic or business customers who have invested in solar photovoltaic (PV), heat pumps, EVs, or smart appliances to reduce energy bills. Also includes customers who have a customised time of use tariff with their energy supplier. (In **addition** to the passive customer's requirements:)	Easy and quick process to connect LCTs such as heat pumps and EV chargers. Customers will seek to charge EVs at home, places of work, destination parking locations or on long journeys. Commercial sites with a large work force or high customer numbers (e.g. retail parks) may require bulk EV charging capacity.	DSO will enable us to get more out of existing capacity, meaning more connections and capacity can be offered to customers immediately. Enhanced forecasting (such as our EV-Up project) and modelling will give more insight into where capacity will be needed in the future; combined with the right regulatory framework, this gives more confidence to efficiently invest ahead of need, meaning that customer ambitions aren't delayed by insufficient network capacity. Coordinating transport planning and distribution network planning, such as via our Charge project, accelerates the connection of EV charging points.

Customer type	Customer requirements	How DSO delivers
Active participant Customers who have invested in generation, storage, demand side response (DSR), or other low carbon products to actively participate and earn revenue from the energy system, reduce operating costs, and reduce their carbon footprint. These customers do not have service contracts directly with network companies or the ESO, but instead participate via aggregators, power purchase agreements, or time of use tariffs. These are typically standalone DG, behind the meter generation/ storage/DSR for peak lopping and triad avoidance, or actively participating domestic customers. (In **addition** to the passive customer's and passive participant's requirements:)	A quicker connection application process. Flexible connection arrangements where this results in a quicker or lower cost connection.	Innovations, such as our NCEWS project which has reduced design time by two thirds, means we can more quickly assess connection options for customers. ANM and wide-scale communications will enable customers to access flexible connection options, resulting in quicker and lower cost connections. More network monitoring and more detailed network modelling will enable the network to be safely operated nearer limits, reducing the periods that flexible connections are constrained.
	Access to non-service market revenue opportunities (either directly or via an aggregator).	The DSO's role as a neutral market facilitator will enable connected customers to access a range of markets, whilst ensuring a safe, efficient, and reliable whole system.
	To earn additional revenue, these customers might enter into service arrangements with us and the ESO where this is simple and can be done via an aggregator or using an automated system to deliver the service.	DSO will deliver platforms which enable most aspects of DER service provision to be automated. This reduces the cost and administrative barrier for us and customers, helping customers access these revenue opportunities.

Customer type	Customer requirements	How DSO delivers
System service provider Customers for whom actively managing their DSR, generation, or storage to sell services to network companies and the ESO is a core activity and a key part of their business model. These customers participate via bilateral contracts, ancillary service tenders, and the balancing mechanism. Customers include asset owners, and parties which manage assets on behalf of others (e.g. aggregators). In **addition** to the requirements of the other customer types:	A range of connection options to choose from to best meet their operating model. For example, some customers might value unrestricted network access, whilst others will value a lower cost flexible connection.	Greater data provision and sharing of network models (via initiatives such as SDIF) will enable customers to better assess what a flexible connection means for them.
	Minimal barriers to providing services to us and the ESO. This includes being able to easily understand service requirements and participate in tenders.	Enhanced forecasting and modelling mean we can more accurately define our service needs. The ability to share network models means we can more clearly articulate our service requirements to the service market. The common service products and contract developed under the Open Networks project will provide a common service experience across different network companies.
	A near-time (e.g. day-ahead and week-ahead) understanding of likely network capacity availability and likelihood of service use.	Forecasting, modelling, and analytical developments, such as our Enhanced Network Forecasting project, mean we have more accurate near-time forecasts. Platforms mean we can share this information with our customers in a secure manner.

Customer type	Customer requirements	How DSO delivers
System service provider (continued)	The ability to participate in multiple markets. Alignment of different service markets where possible to facilitate service stacking.	The DSO's role as a neutral market facilitator will enable connected customers to access a range of markets. The DSO's role coordinating the optimal use of DER services for distribution and transmission needs means that customers can participate in a range of markets without risking system stability.

Table 8 | Customer requirements and the benefits of DSO

In addition to the requirements listed in Table 8, for some customers there is likely to be a requirement for network use of system charge signals that are clear and visible, and can be understood by energy management systems. The most influential industry development in this respect is Ofgem's ongoing Significant Code Review in Access and Forward-looking charges, which is reviewing connection and use of system charging. We continue to monitor this as it will likely impact how our customers choose to use the network.

Our RIIO-ED2 Business Plan, specifically our Vulnerability Strategy, aims to look at the barriers that customers, in particular those who are vulnerable, face in accessing LCTs, and support them in this transition so they can gain the greatest benefits into the future. In all cases, we will support our customers in becoming more active and engaged in the energy system, so that they realise benefits.

7.3 What DSO means for our stakeholders

As part of our RIIO-ED2 engagement process, we gathered the views of 91 stakeholders, from 25 groups, to further understand priorities for guiding our actions, strategies, and investment decisions over the RIIO-ED2 period and beyond. We received considerable input from charitable organisations, manufacturers, industry associations, local governments, and academia, demonstrating the breadth of our stakeholder community.

Overall, our stakeholder community endorsed the overarching aims of our June 2020 DSO Strategy, with some of the key insights including:

- Stakeholders agree with our principles, but some believe that we could include others, such as 'Dynamism' and 'Efficient System Utilisation', whilst issues such as customer education and consideration of customers in vulnerable circumstances were also raised.

- Most stakeholders agree that the DSO functions that we presented are important to deliver a safe, efficient, reliable, and decarbonised network, whilst it was also suggested that investment planning, forecasting of future energy scenarios, network visibility and last resort aggregator should be considered. We have retained the approach outlined in each function within our response to Section 5, as part of our update to align with Ofgem's DSO Roles and Activities.

- The vast majority of stakeholders agree we should be responsible for performing DSO responsibilities.

Stakeholders unanimously agreed that the enablers presented by SP Energy Networks in our June 2020 DSO Strategy were comprehensive. When discussing enablers, stakeholders mentioned the importance of cybersecurity, forward-looking planning, the potential of striking deals with aggregators to deliver DSO functions and the opportunity of performing a technology mapping exercise. We have retained the approach outlined in each enabler within our DSO Engineering Justification Paper (EJP), as part of our update to align with Ofgem's DSO Roles and Activities.

Most stakeholders appreciate the significant challenge we face in enabling the energy systems transition, and meeting net zero targets. Most stakeholders agree with our DSO Strategy, and our priorities, whilst some state that there are factors requiring further consideration, such as system efficiency, particularly when considering more localised delivery of DSO functions. It was clear that there should be notable focus on decarbonisation, ensuring a reliable and secure electricity supply, and safeguarding the resilience of vulnerable customers and communities.

Stakeholder endorsement has had a significant impact on the proposed actions within our DSO Strategy. We have committed to sharing planning, operational, and market data with stakeholders and customers, including visibility of our user-friendly short-term & long-term forecasts. We have raised the prominence in customer and stakeholder education of our DSO activities, services, and plans. We have also amended areas of the strategy and the overall plan to account for feedback received.

8 Glossary

Active network management (ANM) – ANM schemes are monitoring and control platforms which sit above the physical network, and reduce constraints by regulating the output of ANM-connected customers during times of system constraints.

Customer – means anyone connected to our network and who depends on us for an electricity supply. This includes demand, generation, and storage sites, and iDNO networks.

Decarbonisation – the process to reduce the amount of carbon dioxide (CO_2) and other greenhouse gas emissions by introducing new low carbon alternatives and technologies. Much of the decarbonisation strategy is based on switching carbon energy vectors (e.g. petrol and diesel for transport, and natural gas and oil for heating) to electricity, and then using renewable generation to provide zero carbon electricity.

Decentralisation – this reflects the extent to which generation is sited closer to demand consumption (or is even undertaken by demand customers themselves) via the use of smaller-scale technologies such as solar PV and local energy storage. A less decentralised system would be characterised by fewer, larger-scale generators sited further from where the electricity is ultimately consumed (demand); a more decentralised system would be characterised by more smaller-scale generators sited closer to demand.

Distributed generation (DG) – generation connected to the distribution network, as opposed to the transmission network.

Distribution energy resources (DER) – means any asset that is connected to the distribution network which can change its import/export position in a controlled manner in response to a signal. DER will likely include DG, demand side response, and storage. See also 'Services'.

Distribution Future Energy Scenarios (DFES) – DFES forecasts are detailed forecasts we publish annually for our two distribution networks. We work with an external party to determine and produce them. They cover a range of demand and generation metrics (e.g. EVs, heat pumps, different generation technologies) out to 2050. They are available at: https://www.spenergynetworks.co.uk/pages/distribution_future_energy_scenarios.aspx

Distribution network – in England and Wales this is the overhead lines, underground cables and other network infrastructure that operate at 132kV and below; in Scotland it is the infrastructure that operates at 33kV and below. The distribution network delivers electricity from the transmission network and DG to end users (demand customers). Nearly all demand in GB is connected to the distribution network; only very large demand users (e.g. the rail network) are connected to the transmission network. Nearly all medium-scale and smaller-scale generation in GB is connected to the distribution network; typically only large fossil fuel power stations, offshore generation, and large onshore generation are connected to the transmission network.

DSO – depending on context, means the act of distribution system operation, or the distribution system operator (the party carrying out the act of distribution system

operation). From the Open Networks project, the definition of distribution system operator is:

"a DSO securely operates and develops an active distribution system comprising networks, demand, generation and other flexible DER. As a neutral facilitator of an open an accessible market, it will enable competitive access to markets and the optimal use of DER on distribution networks to deliver security, sustainability and affordability in the support of while system optimisation. A DSO enables customers to be both producers and consumers; enabling customer access to networks and accessible markets, customer choice and great customer service."

Electricity System Operator (ESO) – the company responsible for operating the GB transmission network. They have two main operational roles: balancing the total demand and generation on the system to maintain system frequency at 50Hz, and ensuring transmission power flows remain within transmission network capability and statutory limits.

Extra high voltage (EHV) – all distribution voltages greater than 22kV.

Flexibility – the ability of a customer to change their import/export position in a controlled manner in response to an external signal. With the push towards the electrification of heat and transport, being able to flexibly utilise demand and generation will help minimise the amount of additional network capacity required, balance the system and provide system stability – these can all help reduce customer electricity bills. See also 'Services'.

High voltage (HV) – all voltages above 1kV up to and including 22kV.

Grid supply point (GSP) – the interface points (usually substations) between the transmission network and distribution network.

GW – equal to 1,000 MW.

Long term development statement – a set of documents which detail all distribution network assets from EHV up to the connection point with the transmission network. They also set out network fault levels, connected and forecast DG (excluding domestic-scale DG), and historical and forecast demand. They are published annually in November, with an interim update published annually in May.

Low carbon technologies (LCT) – means the range of customer technologies that are needed to deliver decarbonisation. For example, EVs, heat pumps, storage, and renewable generation.

Low voltage (LV) – all voltages up to and including 1kV.

MVAr – mega volt amps (reactive) is a unit of reactive power. It can be useful to help manage network voltage levels. It can describe both the amount of reactive power that a user is importing (e.g. this generator is importing 1MVAr of reactive power"), and the amount of reactive power that a user is exporting (e.g. "this generator is exporting 1MVAr of reactive power").

MW – megawatt is a unit of power (not energy). It can describe both the amount of power that a demand user is consuming (e.g. "this town's peak demand has increased by 3MW due to an increase in EVs and heat pumps"), and the amount of power that a generator is producing (e.g. "3MW of solar PV generation has been installed in this area").

Net Zero – means the legislated target of reducing greenhouse gas emissions to net zero. For the UK, there are three Net Zero targets:

i. The UK Government has introduced the Climate Change Act 2008 (2050 Target Amendment) Order 2019. This legislation introduces a legally binding target for the UK to have net zero greenhouse gas emissions by 2050. The legislation is available at: http://www.legislation.gov.uk/ukpga/2008/27/contents

ii. The Scottish Government has introduced the Scottish Climate Change (Emissions Reduction Targets) Act 2019. This legislation introduces a legally binding target for Scotland to have net zero greenhouse gas emissions by 2045. The legislation is available at: http://www.legislation.gov.uk/asp/2019/15/contents/enacted

iii. The Committee for Climate Change recommends a target of at least a 95% reduction of greenhouse gas emissions by 2050 for Wales. The Welsh Government has accepted this advice but declared the ambition to go further and achieve Net Zero greenhouse gas emissions by 2050. This ambition is available at: https://gov.wales/written-statement-response-committee-climate-changes-net-zero-report

Open Networks – this is a pan-industry project involving transmission and distribution network companies, the ESO, the Department for Business, Energy, and Industrial Strategy (BEIS), Ofgem, and other stakeholders. It has done much work developing DSO models, the customer experience, whole electricity system planning and distribution to transmission data exchange, and flexibility services.

Peak demand – the point in the year, typically during the winter months, when our distribution network as a whole sees the highest demand. It is an important study condition (along with minimum demand) as it places the greatest need on network capacity – our network must be sized to accommodate peak demand.

Primary substation – see 'Substation'.

RIIO-ED2 – means the distribution network price control period which runs from 1 April 2023 to 31 March 2028. Before this period starts, we will agree with Ofgem the outputs we will deliver during this period, and the funding, incentives, and penalties for delivering those outputs.

Secondary substation – see 'Substation'.

Services (aka DER services or flexibility services) – DER can change its import/export position in a controlled manner in response to a signal. This capability can be utilised for the benefit of the network or wider system (e.g. a DER reducing their import to reduce the overall level of demand the network must supply). Where we utilise this capability, the DER is providing us with a 'service'. See also 'Flexibility' and 'Distributed energy resources'.

SP Distribution – the distribution network operator for Central and Southern Scotland, we own and operate the distribution network at 33kV, 11kV and LV into the home.

SP Manweb – the distribution network operator for Merseyside, Cheshire, north Shropshire, and north Wales, we own the distribution network at 132kV, 33kV, 11kV and LV into the home.

Substation – a building or outdoor compound which contains one or more transformers and switchgear protection. The primary purpose of a substation is to change the network power flow from one voltage level to another. In a primary substation the highest voltage is EHV (primary substations are typically 33kV/11kV); in a secondary substation the highest voltage is HV (primary substations are typically 11kV/LV).

Transmission Network – the high voltage electricity network used for the bulk transfer of electrical energy across large distances. The transmission network takes electricity from large generators (e.g. coal, gas, nuclear and offshore wind) to supply large industrial customers and the distribution network.

9

Appendix A

ANM complementing flexibility services

Ofgem and some stakeholders have had concerns whether ANM constrains the scope of flexibility markets. This concern usually stems from a misunderstanding of the different roles they play. This Appendix explains their different uses in detail. We submitted this information to Ofgem's 'Key enablers for DSO programme of work and the Long Term Development Statement' consultation, dated 6 December 2019.

ANM schemes are monitoring and control platforms – they monitor the network to identify constraints, and then ramp down ANM users to avoid those constraints. ANM schemes were developed to provide an alternative connection route for connecting generation customers (the other route being an unconstrained connection). ANM is popular with connecting generation customers as it provides a quicker and cheaper route to connection if the unconstrained connection requires reinforcements. Participation in ANM schemes is voluntary and is the customer's choice – the role of the DNO is to provide sufficient information so that the customers can make an informed decision, and then deliver the connection type that the customer chooses.

Once operational, the ANM decides which ANM user(s) to constrain based on location, how much constraint is required, and a merit order. The most common merit order used is LIFO (last in first out), i.e. the most recent customer to join the ANM scheme gets constrained off first. When considering what merit order method to use, customers value predictability (when they are assessing whether to connect to ANM, they want high certainty as to how much they will be constrained – this is to reduce the uncertainty in their investment model).

One perception of conflict of interest could arise because the DNO is seen to be deciding what ANM users to constrain. This is not the case: the ANM scheme decides based on criteria pre-agreed with ANM users. Once the ANM scheme is live, the DNO does not normally have any operational involvement; DNOs don't use ANM to "dispatch" sites or use discretion – it is an automated system .

Another perception of conflict of interest could arise because ANM is seen as an alternative to flexibility markets – the DNO could be choosing ANM over flexibility markets. This is not the case as they are used in fundamentally different scenarios:

- ANM schemes are used to manage specific identifiable ANM users where they would cause network constraints (e.g. a wind farm seeking to connect). Like flexible or time-bound connections, ANM is another option offered to connecting customers as an alternative to reinforcements which the user would pay for. It is the customer's choice, and only the customers who have chosen to participate in the ANM scheme ('ANM users') are constrained by it. Whatever the option chosen, the costs are born by the user. As a result of the current charging methodology, ANM is used almost exclusively to manage EHV generation constraints.

- Flexibility markets on the other hand are used to manage constraints that have no single attributable user (e.g. to accommodate general load growth). The alternative here is reinforcement (or another intervention) that would be socialised through DUoS (and so paid for by all customers) and enter the DNOs' RAV. As a result of the current charging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methodology, flexibility markets are primarily used to manage demand constraints.

- It is worth noting that this split is as a result of connection charging boundaries and methodologies approved by Ofgem, rather than a DNO policy.

Another perception of conflict of interest could be that ANM is seen as being mutually exclusive to markets and pricing signals. This is not the case – ANM users are active members of the energy system (e.g. they are still subject to use of system charging signals, their supply contracts can still contain time-variable energy pricing, they can choose who to trade their energy with etc.). Looking forward, there are two potential developments that could enhance this:

- Whilst the LIFO method is currently mainly used, most ANM schemes also have the capability to use a commercial merit order. If ANM users consent, then ANM schemes could move to a commercial merit order, where users would be constrained off based on price.

- There is nothing to say that ANM and markets can't be overlaid. In this arrangement, markets could be used in the first instance to manage the network constraints. Only in the event of market failure, the ANM is the network safety net that would then constrain ANM users off to safeguard the network. Having this safety net could support the development of new markets.

To protect ANM users, one approach SP Energy Networks is using is information transparency. The new ANM scheme being installed in Dumfries and Galloway includes a customer portal. This provides information to ANM users about every curtailment event they experience. This information protects customers as it enables them to audit each constraint. This portal will also provide constraint information to any prospective customer, to help them form a view as to how likely their site is to be constrained (an essential piece of information for their financial model).

In summary, ANM schemes are cost-effective tools that have enabled the quicker cheaper connection of significant volumes of DG. They have given potential connecting customers more choice and are not inhibiting the development or use of flexibility markets. Given the significant volumes of renewable DG that will need to be connected to deliver Net Zero, it simply does not seem sensible to limit the use of such an effective tool. Looking forward, they could complement and support for the development of flexibility markets by providing a safety net.

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SP Energy Networks
320 St Vincent Street
Glasgow, G2 5AD

Contact us
facebook.com/SPEnergyNetworks
twitter.com/SPEnergyNetwork
RIIO_ED2@spenergynetworks.co.uk
spenergynetworks.co.uk