WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Business Plan 2023 - 2028

SA-05 Supplementary Annex
Delivering a smart and flexible electricity network

July 2021

westernpower.co.uk

SA-05 Delivering a smart and flexible electricity network Contents

1. Introduction

1.1. The next regulatory price control review period, known as RIIO-ED2 is a five year period and is the second for electricity distribution to be determined using Ofgem's Revenue = Incentives, Innovation and Outputs framework. This price control period runs from 1st April 2023 to 31st March 2028.

1.2. Western Power Distribution (WPD) is required to submit a 200 page main Business Plan document, supplementary annexes, detailed cost tables, financial information and a range of other documents which form our submission under RIIO-ED2 to Ofgem, which will be used to determine allowed revenues for the price control period.

1.3. Our RIIO-ED2 Business Plan has been produced and compiled in line with the following key principles:

- Co-created with our stakeholders and supported by them.
- Our Plan – 'prepared with our stakeholders for delivery by us'.
- Aligned with WPD's purpose and values.
- Affordable for all of our customers.
- Sustainable and will enable net zero before 2050.

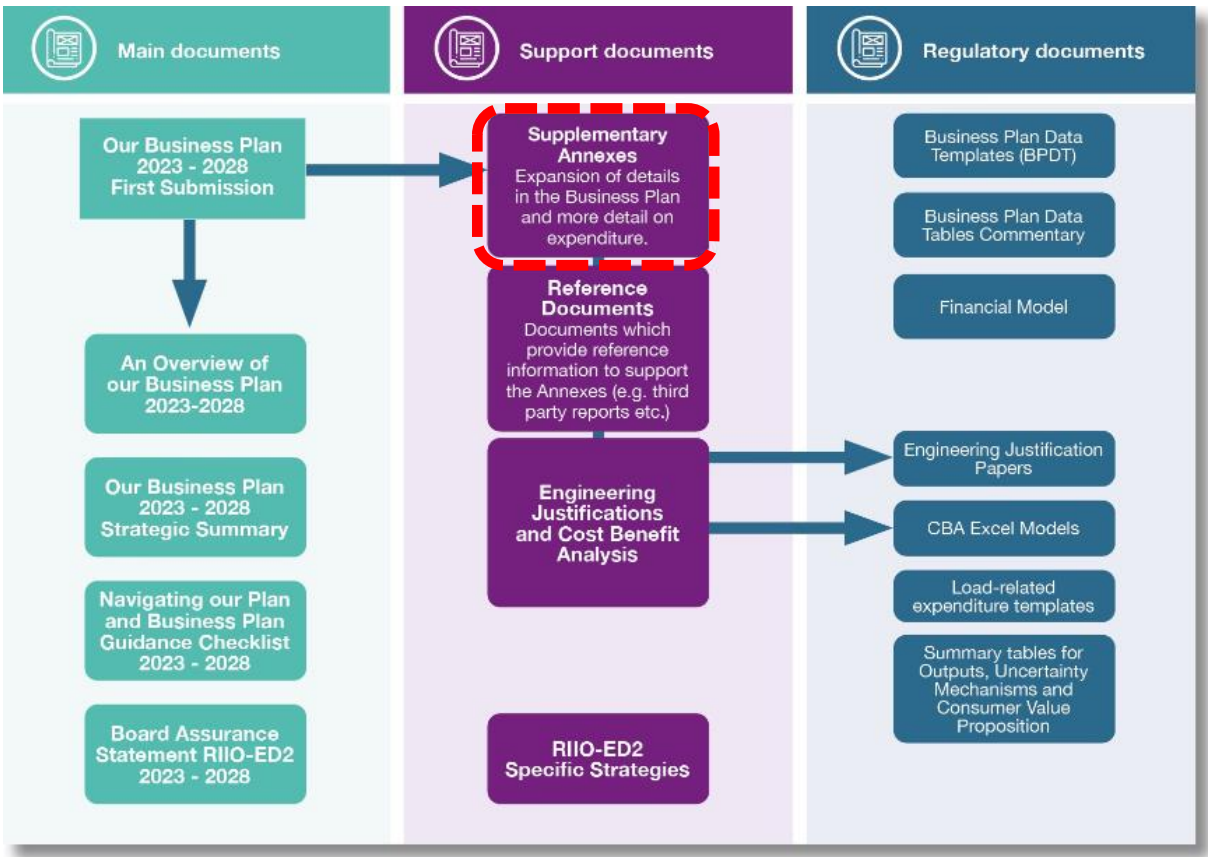


Figure SA-05.0 Business Plan submission structure

1.4. The diagram below (figure SA05.0) shows the structure of the full Business Plan submission with the red box showing where this document fits into the overall suite of documents.

1.5. Chapter 5 of Our Business Plan 2023 -2028 First Submission details our approach to managing our Business Plan development process. It sets out how we organised to develop our plan and the assurance programme that we applied to be confident that the plan is accurate and addresses stakeholder priorities

1.6. This document is a supplementary annex to Chapter 5.

1.7. We appreciate that the readers of the WPD RIIO-ED2 Business Plan suite of documents will range from regulatory experts and well informed stakeholders through to new customers who may have had little previous knowledge of WPD.

1.8. This document is aimed at readers who require a more detailed understanding of the commitments that will be delivered. A less detailed description of the outputs can be found in the Our Business Plan 2023 -2028 First Submission or An Overview of Our Business Plan 2023 – 2028 documents.

1.9. This document is subdivided into the following sections:

Section	Title	Content
2	Electricity systems to support net zero	Supporting the growth of low carbon technologies to achieve net zero
3	Net zero by 2050	A description on how we plan to meet the net zero target
4	Low carbon technologies	The increased growth of electric vehicles and heat pumps
5	Supporting Distribution System Operation	The use of smarter and flexible networks
6	Operating our network in RIIO-ED2	Providing flexible connections to our customers
7	Enabling whole systems solutions	The role of Regional Development Programmes
8	Performance metrics for a smart and flexible network	A description of our metrics for a smart and flexible network
9	Enhanced network monitoring	Our sensors and monitoring RIIO-ED2 projects
10	Smart metering	The benefits and functions of smart meters
11	Losses	Understanding and reducing losses from our network
12	Telecoms	The changing landscape for the telecoms infrastructure
13	Community energy	Engaging with our communities
14	Innovation	Themes and programmes of innovation
15	Modernising energy data	Digitalisation and data best practice
16	System Operator functions	Provision of DSO services
17	System Operation enablers	Provision of data/information/links to allow DSO providers to interact with our network
18	Operational control systems	The role of our control systems in managing and supporting a network which will become more flexible
19	Appendices	A number of appendices with additional information or containing links to supporting reports and strategies.

2. Electricity systems to support net zero

2.1. We have a critical role to play in ensuring our network can support the growth of low carbon technologies (LCTs) throughout the RIIO-ED2 period and beyond. This new period sees a shift in focus from low carbon generation connection towards the growth of LCT products such as electric vehicles, battery storage and heat pumps. Net zero is a legally binding target for the UK and our work to connect LCT demands to complement the generation already connected is central to the achievement of that target.

2.2. The government has supported net zero growth through The Carbon Plan and more recently the Ten Point Plan and the Energy White Paper. The themes remain consistent through this support: the UK will achieve its carbon targets by decarbonising heating and transport. Decarbonisation is achieved through the electrification of products supported by low carbon electricity generation.

2.3. Our role in this area is simple: we need to ensure our network can connect LCTs and generation with speed and efficiency. We will use our experiences in RIIO-ED1 and our innovation projects to achieve this role.

2.4. During the RIIO-ED1 period, we transformed our network to accept low carbon generation. A mixture of Flexible Connection Offers and a modelling approach based more on energy volumes than maximum demands helped us connect over 21GW of generation on a network conventionally designed for 14GW of demand.

2.5. In RIIO-ED2, we will see the focus shift from large scale renewable generation connections and towards high volumes of smaller LCT connections. Where we already see connection activity in generation at capacities around 5,000kW, the shift will be towards the volume connection of electric vehicles and heat pumps with capacities in multiples of 7kW. While the concept of connections and customers service is the same, the volumes will require a redesign to our business model to support the change.

2.6. Government figures forecast targets of 600,000 heat pump connections per year in the UK by the end of RIIO-ED2. At a similar time, all new cars will be electrified, leading to around 1,000,000 new EV connections per year. With WPD operating in around one third of the UK, we could see over 500,000 new connections per year, or 2,000 for each working day. These levels trigger an automated approach to provide a quality service to our customers.

2.7. An automated approach flows through to how flexibility might be realised on our domestic networks. While we will operate and schedule larger demands and generation on our higher voltage networks, the low voltage network cannot be micro-managed by us in the same way. We see flexibility being delivered through supplier tariff signals and aggregation offers. We do not expect to interact directly with our individual domestic customers.

2.8. For these new solutions to operate, we need to understand our network in more detail. Maximum demand modelling will take a back seat as energy volume modelling takes over. In all cases, data becomes a key facilitator. We will ensure that we have a smart network that uses digital technology including monitoring equipment, communications networks and automated devices to actively analyse the network status and operate the network for optimised running arrangements.

2.9. Presumed Open Data allows organisations which might not have historically operated in our area to understand how they might create solutions to benefit customers and support net zero. We are leading the industry in data provision and will continue to do so. Our Data Triage rules ensure that the maximum level of data is shared for others to develop.

2.10. We have already experienced automated eco homes in work completed in South Wales. We expect this area to grow with new players in the home energy management arena. Management of whole housing estates as pseudo power plants is also an area where we expect growth, with benefits for the connected customers and the network operator alike.

2.11. We will use the innovation tools that we developed in RIIO-ED1 to support this change. Flexibility is now embedded in our system operation plans as a result of innovation. Research in Electric Nation has showed us how we can connect more EVs to the existing network. 'Business as usual' (BAU) innovation has changed the way we provide customers with a service, now standardised on a three phase solution to provide capacity for the future.

2.12. During RIIO-ED2, we will continue to innovate and evolve to meet the changing demands of our customers. Our innovation team has an extensive back catalogue of tools and systems ready to deploy as our customers' demands evolve towards net zero. We are already researching new alternatives and expect that, during RIIO-ED2, our focus will move to support high volume connection management and community-led network management solutions.

2.13. This chapter outlines the activities we will be undertaking in response to these challenges and our commitment to do this as cost effectively as possible. We must ensure our network development encourages the connection of LCTs by responding to changes in volume, by making capacity available and also by providing access to our network data to allow stakeholders to develop their own strategies for a net zero carbon outcome.

3. Net zero by 2050

UK government net zero commitment

3.1. In June 2019, the UK parliament passed legislation requiring the government to reduce the UK's net emissions of greenhouse gases by 100% relative to 1990 levels by 2050. Doing so would make the UK a 'net zero' emitter; the first G7 national government to set such an aspiration into law.

3.2. Net zero refers to achieving a balance between the amount of greenhouse gas emissions produced and the amount removed from the atmosphere. There are two ways of achieving net zero: reducing emissions and actively removing greenhouse gases. While carbon capture will help, lowering emissions will be the main route towards achieving net zero.

3.3. The Climate Change Act 2008 requires the government to set five-yearly carbon budgets. The budgets set caps on the total greenhouse gas emissions allowed to ensure the UK meets its emissions reductions commitments. In December 2020, the UK government's Climate Change Committee set out the sixth Carbon Budget proposing to bring forward achieving an 80% reduction in carbon by 2035, which includes a further expansion of low carbon energy supplies.

3.4. On 10 September 2020, the UK Citizens' Assembly on Climate Change published a report on the UK path to net zero. The report focuses on transport, house building and energy to get to net zero carbon emissions.

3.5. In November 2020, the UK Prime Minister launched a Ten Point Plan to lay the foundation for a Green Industrial Revolution. The following aspects of the Ten Point Plan will have impacts on distribution networks:

- Zero emission vehicles - providing the power for electric vehicles
- Green public transport - providing the power for electricity based transport
- Greener building - providing the power for non-fossil fuel heating
- Offshore wind - impacting connections and capacity for coastal networks to distribute the power
- Hydrogen - providing the power to produce 5GW of hydrogen.

3.6. In December 2020, the Department for Business, Energy and Industrial Strategy issued an Energy White Paper setting out a long-term strategy for the UK's energy system. This has aspects that will have a profound impact on distribution networks. In particular, the government wants to increase the number of electric heat pumps used for heating buildings from 30,000 per year to 600,000 per year by the end of 2028 along with introducing a ban on the sale of diesel and petrol cars and vans by 2030 and hybrids by 2035.

3.7. This will lead to a growth in the ownership of electric vehicles and heat pump heating systems, which will require extra capacity to be built into electricity distribution networks to meet the higher demand.

3.8. The increased demand will add to the existing network challenges that have arisen from previous government incentives to move away from centralised fossil fuel based electricity generation to more localised renewable distributed generation. During RIIO-ED1, the

proliferation of distributed generation has impacted networks by changing how the power flows on the network are managed and how demand is balanced with distributed energy resources such as local generation and energy storage.

Welsh government net zero commitment

3.9. The devolved Welsh government has set a target of achieving a 100% reduction in greenhouse gases by 2050. It has also declared fixed targets for 2030 and 2040.

3.10. The Welsh government 'Prosperity for all, a low carbon Wales' document looks at all aspects of decarbonisation. It specifically seeks a whole energy system approach to meet its targets. Drawing on both the National Grid Future Energy Scenarios (FES) and the WPD/SPEN distribution scenarios, it plots the route to achieve decarbonisation. A multi-vector approach is key to make use of renewable generation in Wales and bio methane and hydrogen resources which are being developed. To support the key requirements of Wales, representatives from WPD, SPEN and NG work together on the Mid Wales Regional Development Programme (RDP). This draws on the strengths of all networks to consider the best solutions for Wales.

3.11. Turning to transportation, the reduction of travel requirements and the increased use of public transport are key targets. Where EVs are the proposed solution, plans to invest in an EV charging infrastructure are a key part of the document. The Welsh government has set a specific target to reduce the emissions of taxis and buses by 2028 which could also support strategic investment.

3.12. Home heating is another key area, with the Power Building Sector pathway to 2030 supporting a range of measures. Energy efficiency is the first option but, for the residual energy requirements, the decarbonisation of heating will impact electricity networks. WPD is working closely with the Welsh government on the Parc Eirrin development at Tonyrefail, where 250 net zero homes are being built. The network used to support this estate has already demonstrated the future for networks, with three phase service cables and monitoring of demands across the estate.

3.13. In July 2020, the Welsh government welcomed a 'team Wales' approach across the whole public sector to help to reduce emissions and tackle climate change. The Partnership Council for Wales is the formal statutory vehicle for Welsh public services to work together. It is made up of representatives of local authorities, the National Health Service, Fire and Rescue Authorities, town and community councils, the voluntary sector, Police and Crime Commissioners and the Welsh government. The Partnership Council for Wales will be working together through a Decarbonisation Strategy Panel to provide the strategy and leadership to help achieve a net zero carbon public sector in Wales by 2030.

Local Area Energy Plans (LAEPs)

3.14. LAEPs are aimed at implementing local action that can contribute to the overall UK net zero targets. The local plans for low energy housing stock, electric vehicle charging and industrial/commercial development will influence the demand for electricity and hence the requirements for the electricity distribution network.

3.15. A number of the local authorities have established comprehensive future energy plans, while others are still in the process of development.

3.16. WPD has utilised these plans in developing network requirements and to inform the future energy scenarios that have been developed for each licence area, which in turn influence the amount of network expansion and reinforcement that is required to meet local energy demands.

4. Low Carbon Technologies

4.1. During RIIO-ED1, there has been a significant growth of distributed generation connected to WPD's network, fuelled by government incentives such as the feed in tariff. This growth is creating new challenges for the network, such as different power flows and the need to provide sufficient export capacity.

4.2. There are a range of other technologies being developed that will add to the challenges. Energy storage is being increasingly used alongside generation to store excess power and release it to the network at a later point in time.

4.3. The most significant growth is expected to be in the use of electric vehicles (EVs) for transport and heat pumps for heating properties. This is evident from the Prime Minister's Ten Point Plan and the Energy White Paper.

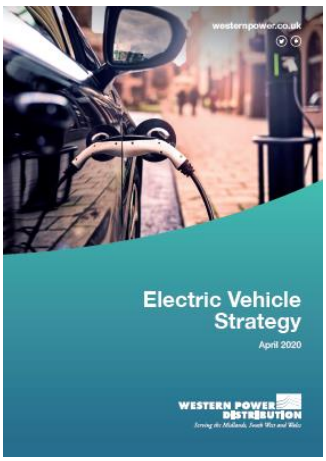
4.4. Our job is to make sure the network is ready for all kinds of low carbon technologies (LCTs). Consumers' electricity needs will vary, depending on the type of LCT they own and, for EVs, whether they have access to their own charging point or plan to use a public charging facility.

4.5. The requirement from our customers is simple. The infrastructure for net zero LCTs requires high volumes of energy – and we need to be able to deliver that energy where it's needed.

4.6. We created our Electric Vehicle Strategy as EV use grew, and our Heat Pump Strategy followed suit with the emergence of heat pumps as a commonplace solution on our networks. We will develop strategies for other technologies as they develop.

Electric Vehicles (EV)

4.7. WPD has published an EV Strategy that describes the challenges, along with the innovation and solutions that will be adopted to prepare our network for the millions of electric vehicle drivers who will want to charge their EVs at a time and place that suits them. Further details can be found in appendix A02.



4.8. It describes the rationale behind our innovation projects and business initiatives as well as describing how we are already implementing some solutions into 'Business as Usual' activities.

4.9. We have been working closely with our stakeholders to plan and prepare for the needs of different customer groups.

4.10. This engagement gives us an insight into their expectations and requirements, but also informs our understanding of the scale and pace of adoption of EVs.

4.11. The government is becoming more ambitious in the move to EVs. In 2018, it called for at least 50% of new car sales and up to 40% of new light van sales to be ultra-low emission by 2030. In early 2020, it announced its plan to end the sale of all new conventional petrol, diesel cars, vans and hybrids by 2035. In December 2020, the end of selling new petrol and diesel car and vans was advanced to 2030.

4.12. Local government bodies are also influencing the move to EVs by introducing clean air zones.

4.13. The government has also signalled the move with changes to Company Car Benefit in Kind Tax. This is set at a very low level to stimulate fleet purchases, which is significant as almost half of new car sales are to fleet users. This will also create a thriving second hand market within the timescale of RIIO-ED2.

Getting networks ready for EVs

4.14. Motorway service areas are likely to see a significant change in electricity demands. As part of Project Rapid, we are working with the government to model predicted demands at each service area. This expected demand is equivalent to the scale of demand we would typically see in a small town.

4.15. Chargers are set to become a common sight on driveways and for on-street parking, to enable overnight charging. They will also be installed at businesses and locations where any vehicle h is stationary for a longer period, such as at a 'park and ride' site or office car park, so that vehicles can be charged during the day.

4.16. Larger rapid chargers will be installed at public locations such as service stations, motorway services areas and car parks, where drivers need a faster charge. These will also be suitable for vehicle charging hubs, such as those used to charge taxis.

4.17. However consumers choose to charge their vehicles, there will be a need to provide more energy through the network for EV charging. This is likely to impact the network in various ways, but the main issues will be providing additional capacity on the low voltage (LV) network. We expect that market-led solutions such as supplier price signals and aggregator offers will incentivise charging to avoid peak network use hours and minimise the need for reinforcement.

4.18. As well as requiring energy to charge the batteries, there is the opportunity to put power back into the network. We have been exploring the impacts and benefits of vehicle-to-grid technologies and expect that these will become part of the solution.

Heat pumps

4.19. A heat pump is a device that uses a small amount of energy to move heat from one location to another. It is an energy efficient heating method. Heat pumps move thermal energy in the opposite direction to natural heat flow by absorbing heat from a cold space and releasing it into a warmer one.

4.20. Heat pumps are a key part of the UK's plans to achieve net zero by 2050 because more than one third of the UK's carbon emissions come from heating.

4.21. The government has announced in the Energy White Paper that it wants to increase the number heat pumps being installed by 20 times to 600,000 each year by the end of 2028 (the end of RIIO-ED2).

4.22. In 2020, we became the first Distribution Network Operator (DNO) to issue a bespoke Heat Pump Strategy document. Like the EV strategy, the heat pump strategy sets out how WPD will ensure that future heat pump owners are able to connect to the network in a way that suits them. It also explains the rationale behind our current innovation projects and business initiatives, as

well as how we are planning to turn early stage solutions into ‘business as usual’ practice. Further details can be found in appendix A03.

4.23. To operate efficiently, a heat pump needs to be in a well-insulated house. This means they are more suited to new builds or properties that are or can be insulated.

4.24. Their primary function is space heating through radiators, underfloor heating systems, or warm air convectors but they can also be used to heat water.

4.25. Smaller heat pumps are likely to be accommodated on existing supplies but larger installations of greater than 32A will often require a three phase service or other upgrades.

Getting networks ready for heat pumps

4.26. The biggest challenges when providing power for heat pumps will be linked to domestic properties, which may lead to service upgrades and capacity issues on the low voltage networks.

4.27. WPD is currently involved with Pobl and Sero, a new build estate of 235 homes in Tonyrefail. The homes have a complete suite of LCTs and are fully monitored by Sero which will provide valuable information to us on new build homes fitted with heat pumps. We will use this estate to understand the cumulative impact of heat pumps in volume.

4.28. In retrofit scenarios, it is likely this will result in a need for network reinforcement. We will also consider different ways of storing heat and energy and whether these can be incorporated as part of the network solution for providing capacity.

Domestic level energy storage, eco homes and flexibility

4.29. We have already experienced ground breaking automated eco homes in work completed in South Wales. We are also collaborating on a redevelopment project at Rugeley. We expect this area to grow with new players in the home energy management arena. This is an emerging area for us and we will build our solutions as the technology develops.

4.30. We see early adopter movement in this area at the moment. In many aspects, the application of storage, energy managed homes and domestic flexibility will help us manage the network. Where energy is being generated, stored and used in a way that provides efficiency to customers, it is likely that the customer’s impact on our network will be reduced by supplier price signals and aggregation markets.

District heating and heat networks

4.31. We predict that heat networks will be relatively easy for us to accommodate on our networks, with the input energy required for them being provided at one central point rather than individual homes. Where heat networks include generation elements, this may also support our network

4.32. We are monitoring plans at Cardiff Council in this area. We will monitor the demands of the heat network to understand how heat networks will impact on the wider network. This will allow us to develop connection solutions for this technology.

5. Supporting Distribution System Operation

WPD at the forefront, creating a System Operator and enabling System Operation functions

5.1. WPD has been addressing the challenges of delivering net zero for a number of years.

5.2. The vast expansion of distributed generation across the network has posed numerous challenges that have led to the development of alternative ways of connecting customers to the network. Active Network Management (ANM) became a 'business as usual' process in RIIO-ED1.

5.3. We have established markets for flexibility services and have procured the highest amount of flexibility provision across all UK DNOs. There are established processes for procurement, tendering, dispatch and payment.

5.4. Planning of network reinforcement considers 'flexibility first' for all networks except our low voltage system, where asset reinforcement will be our preference. Our flexibility requirements are signposted well in advance of need with consistent indications of where and when flexibility will be needed. The procurement of flexibility through six monthly cycles provides real insight into the scale and scope of flexibility as an alternative to conventional reinforcement.

5.5. We are using the knowledge gained from embracing flexibility to inform our forecasts for reinforcement for RIIO-ED2. The investment programme includes using flexibility solutions, but there is also a requirement for conventional reinforcement where the scale of flexibility will be limited and not meet the requirements for additional capacity.

5.6. The move to DSO highlights areas which are new to us, but also shows areas where the DNO business has a role to play in providing base information and detail to support DSO decision making. We see the Operation Enablers as an area of benefit where the DNO business will support all DSO providers. This is an essential part of the neutral facilitation of markets as they evolve with System Operator providers.

5.7. We also see a part for WPD to play in establishing a System Operator provision. Our role is to stimulate the market in flexibility and create the space in which third party providers can operate. When paired with our Operation Enablers, these System Operator services provide a holistic response to flexibility.

5.8. We have developed significant competence in a number of key areas which fall under the umbrella of Operation Enablers. They have focused on assessing network capacity in innovative ways and creating the data management and telecommunications systems to operate the network in a more real time way. The way we have integrated telecoms, data, ratings and connections is best demonstrated in our work on flexible connections.

5.9. Our suite of flexible connections products has developed options in two areas for customers seeking to connect to the grid. A timed connection offers a very simple way of acting flexibly, without the need for communications or monitoring. Load managed connections make use of ANM technology to control generation or demand behind single or more complex constraints. These are particularly useful in areas of constraint as an alternative to network reinforcement.

The load managed connections suite combines both contractual and technical approaches. These methods of connection vary in cost and complexity and enable the solution to be tailored to the individual requirements of the customer. We have been able to develop these solutions within WPD to enable our internal systems to manage transmission level constraints and provide efficient, economic and timely access for customers.

5.10. Further innovative work has given us an insight into how System Operator tasks can be completed. Our FALCON, SYNC and ENTIRE projects have demonstrated our ability to forecast, manage and dispatch both demand and generation turn up/turn down services and have been designed to do so in conjunction with National Grid, allowing customers full access to a number of markets providing revenue streams, while also minimising any risk of operating conflicting services.

5.11. Throughout all of our work to support DSO services, we must show neutrality and ensure that actual and perceived conflicts can be addressed. We have ring-fenced the DSO team away from our core regulated electricity asset management business which is responsible for providing the DSO enablers (such as data, monitoring etc) and core DNO business functions. The DSO team has a direct reporting line into the Operations Director.

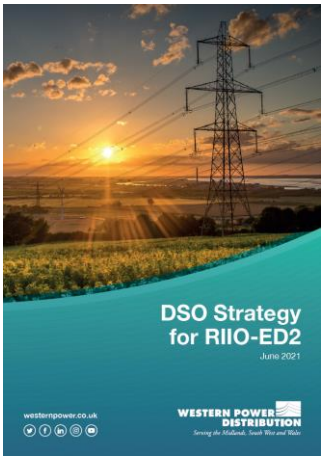
5.12. We will continue to evolve the use of flexibility, publish more data to stimulate further market developments and operate the networks in a way that continues to provide consumers with excellent reliability at an economic and efficient cost. We recognise that the change from our traditional role of DNO to incorporate a more active Distribution System Operator (DSO), is essential to driving performance and efficiency from our network and to ensure it can meet the future energy demands of all our customers.

5.13. Consequently, WPD has been very active in developing DSO functions. We have come a long way since starting to explore active network management in 2012 under the Low Carbon Networks Fund. In 2017, we were the first DNO to publish a fully costed DSO transition plan and in 2018 we established a dedicated DSO business function. We have re-engineered networks that were traditionally designed for 14GW of demand, to be able to accept a total of 21GW of embedded generation and have contracted with 457MW of flexibility services.

5.14. For network planning, WPD has evolved the processes for the identification of network constraints, seeking market based solutions and making investment decisions to embrace the opportunities provided by alternatives to conventional network reinforcement. Greater transparency of decision making is helping to develop the market by allowing participants to understand the reasons for decisions, allowing them to amend behaviour to benefit from the market and also provide greater scope of services to network operators.

5.15. These changes are viewed as being natural extensions to the functions we perform and we firmly believe that we are best placed to operate the Distribution System Operator role.

Distribution System Operator – A strategy and a plan



5.16. WPD was the first DNO to publish a costed DSO strategy in 2017 and has updated this each year to reflect changing requirements and industry developments. The latest version is available on the WPD website.

5.17. The 2021 version of our strategy was reformatted to reflect the baseline requirements from Ofgem for RIIO-ED2. Further details can be found in appendix A04.

5.18. The building blocks of our strategy are grouped into five workstreams which relate back to the Ofgem roles and baseline objectives of Planning & Network Development, Network Operation and Market Development.

- Planning and Network Development

  As customers adopt low carbon technologies or generate power more locally, the range of connection types for homes, businesses and generators is set to increase to meet customer needs. A DSO will also facilitate flexibility markets and make use of flexibility as an alternative to conventional network construction.

- Network Operation – network visibility and data

  A DSO requires accurate and granular information on asset capability (design ratings and health/condition), how they are connected (or could be) and their actual operation (both real time and historic). A new generation of sensors, control equipment and telecommunications will be used to support market integration and the new customer propositions.

- Network Operation – efficient and economic distribution system

  A DSO will look at energy in a different way to a conventional DNO. Energy flows and volumes will be more important than absolute maximums. Our systems will need to operate more autonomously and react to signals from other parts of the network. The way we dispatch DERs will become a key element of efficient system operation.

- Market Development – comprehensive market information

  A DSO acts as a platform facilitator for customers, suppliers, aggregators and other participants to offer or receive services. Sharing information on network capability in multiple timeframes will enable businesses to offer customers innovative energy services. Data sharing between transmission and distribution is critical to ensuring the whole system is optimised in the interests of customers. Our use of the Common Information Model (CIM) will help data flow smoothly.

- Market Development – fair and transparent procurement

  We must ensure our costings, requirements and active system details are published in advance to allow customers to participate. Alignment of conditions, terminology and products will allow customers to lever multiple markets.

5.19. WPD has been developing DSO functionality in all three areas and will continue to expand capability in these areas during RIIO-ED2. This will involve increasing data acquisition from the network, enhancing established processes, developing new systems and sharing more data.

Smarter and flexible networks in RIIO-ED2

5.20. Plans for network reinforcement at voltages above LV during RIIO-ED2 will begin with 'flexibility first'. Where flexibility is an option, the procurement of flexibility services through six monthly cycles provides real insight into the scale and scope of its availability as an alternative to conventional reinforcement.

5.21. We will continue to embrace the evolving use of flexibility, publish more data to stimulate further market developments and operate the network in a way that continues to provide consumers with a reliable, affordable and efficient electricity supply.

5.22. In our network planning, we have continued to develop processes to identify network constraints, seeking market-based solutions and making investment decisions which allow us to embrace alternatives to conventional network reinforcement.

5.23. We have developed DSO functionality in all three areas and will continue to expand capability in these areas during RIIO-ED2. This will involve increasing data acquisition from the network, enhancing established processes, developing new systems and sharing more data.

Working across the industry

5.24. WPD has been engaging heavily with the wider industry through the Energy Networks Association (ENA) Open Networks work programme. As part of this, we have been working on developing DSO functions. 'Work Stream three' for DSO implementation has specified eight primary DSO functions which can be mapped to the Ofgem core DSO roles as shown below in figure SA-05.1.

ENA Open Networks DSO function	Ofgem DSO role
A. System Co-Ordination	Planning and Network Development Network Operation
B. Network Operation	Network Operation
C. Investment Planning	Planning and Network Development Network Operation
D. Connections and Connections Rights	Planning and Network Development
E. System Defence and Restoration	Planning and Network Development
F. Services and Market Facilitation	Market Development
G. Service Optimisation	Network Operation
H. Charging	Market Development Planning and Network Development

Figure SA-05.1 DSO Role Mapping

5.25. This collaborative work is leading to common approaches across the companies, so that there is greater consistency across the industry making it easier for third parties to engage with new markets. The coordinated working is also enabling cross sector issues between transmission and distribution to be resolved.

WPD's DSO four point plan

5.26. At a high level, the WPD DSO strategy specifies a four point plan for how DSO functions will be applied across the network.(See figure SA-05.2)

Figure SA-05.2 DSO four point plan

5.27. The four point plan is underpinned by a step change in data visibility and digitalisation of our processes and systems.

6. Operating our network in RIIO-ED2

Changes to network operations

6.1. The changing role of the network operator requires new data and processes to help us analyse what is happening on the network. We also need more active ways of managing constraints, such as systems for dispatching flexibility, as well as greater coordination with the Electricity System Operator. We are already dealing with an increasing quantity of data and will need to enhance existing systems or develop new ones to enable the efficient operation of the network to continue.

Flexible connection solutions

6.2. Our suite of flexible connections gives customers the option to have their connection completed at a lower cost and to a shorter timescale, with the acceptance that some form of curtailment may be required at times of high demand on the network.

Flexible Power solutions

6.3. Flexible Power solutions are contractual arrangements where customers with controllable demand or generation are able to provide services to help us manage the capacity of the network. They are used as a lower cost alternative to reinforcing the network and are procured through a flexibility market.

6.4. We have been pioneering the use of flexibility solutions during RIIO-ED1 and will be using these increasingly throughout RIIO-ED2 as more demand connects to the network.

6.5. There are four types of flexibility services:

- Secure – used to proactively manage peak demand
- Dynamic – used to support the network in case of a coincident fault during network maintenance
- Restore – used to reduce the stress on the network during fault situations, with flexibility providers responding within 15 minutes
- Sustain – used to allow customer to change their energy profile to reduce costs.

6.6. The existing IT platforms used to assess the requirements for flexibility, manage the dispatch and make payments for the flexibility provided will require development to ensure that flexibility can be used to a greater extent.

6.7. In RIIO-ED2, we will continue to develop the IT systems, processes and customer information visualisations, targeting investments in areas identified by stakeholders. This will include opening live information access to other platforms, improving the cyber resilience of the IT systems and scaling up as operational volumes increase.

7. Enabling whole systems solutions

7.1. Network operators are responsible for assessing all potential options when developing their networks and then proceeding with the most cost efficient and economical solution. In the past, these have generally been focused on the solutions available from within an operator's own network.

7.2. As the energy system evolves, there may be opportunities to consider options which are delivered by others where this is a more economical solution. This may involve greater collaboration across electricity transmission and distribution, greater work across the energy vectors regulated by Ofgem (i.e. gas and electricity) or wider consideration across other utilities such as water and other energy vectors such as oil. It may also mean greater interaction with customers' systems where such interaction can provide a benefit.

7.3. It is anticipated that most whole system solutions within RIIO-ED2 will relate to whole electricity system solutions, meaning distribution network operators could undertake investment on behalf of the transmission system operator, or a transmission system investment could defer works required on the distribution network. However, other wider whole system benefits will be considered as demonstrated by our consumer value proposition CVP-4 which is an initiative which involves WPD being a key player in assisting the Welsh government to develop and energy plan for Wales and its proposes to engage SPEN, NGT, Wales & West Utilities and other partners in hydrogen and transport.

WPD's track record for whole systems

Regional Development Programmes (RDPs)

7.4. The Regional Development Programmes (RDPs) were set up to provide detailed analysis of areas of the network which have large amounts of Distributed Energy Resource (DER) and known transmission / distribution network issues in accommodating that DER.

7.5. The analysis is intended to innovate and push the boundaries of current thinking with a 'design by doing' approach to resolving issues. By focusing on the options for a specific case study that has a pressing need to improve outcomes for customers, it is possible to make faster progress.

7.6. The conventional methods would require agreeing changes in approach at industry forums before making changes to the way the industry works. This can take time and deals with hypothetical situations, whereas the RDP approach solves a real issue with real solutions.

7.7. While there are risks that working in this way leads to a lack of standardisation across the GB network, it has been used to feed case studies into the Energy Networks Association (ENA) Open Networks Project. This allows post solution standardisation with techniques and processes used within the RDPs being replicated across other network areas, resulting in innovative approaches being deployed much more rapidly.

7.8. The RDP process (see figure SA-05.3) involves a number of stages before recommendations for future strategy can be derived.

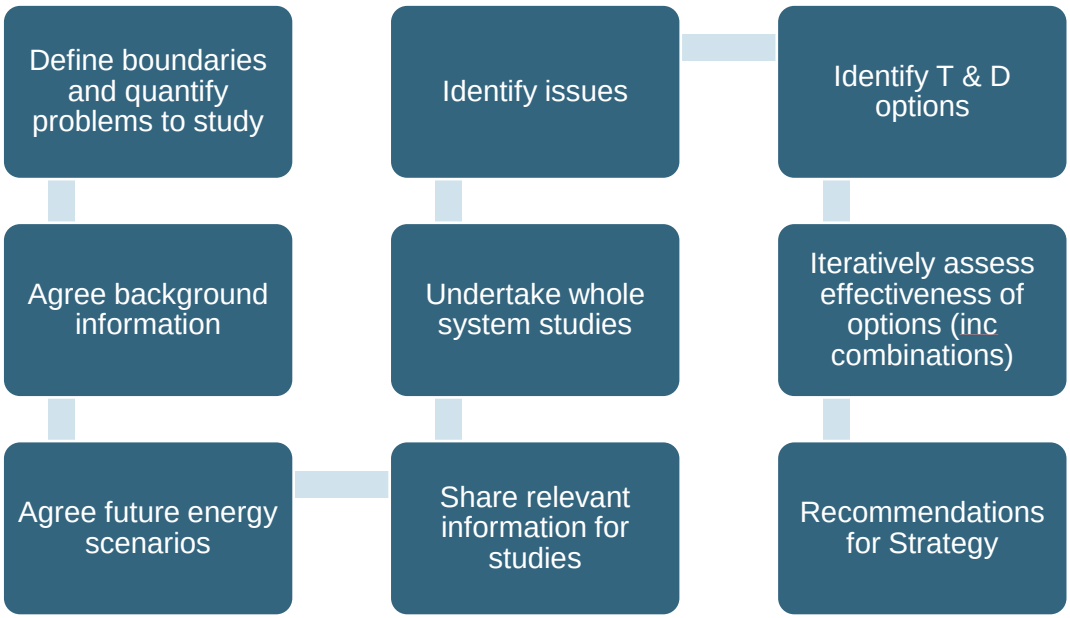


Figure SA-05.3 RDP Process Map

7.9. RDP2 focused on the South West peninsular within WPD's distribution network. A joint study between the Electricity System Operator and WPD concluded that, due to the likely higher penetrations of renewables in that geographical area, additional capacity for generation was required. It identified that, in the short-term, flexibility was the most economical solution and that generation turn down products were needed to manage transmission constraints.

7.10. RDP4 was a study looking at the issue of demand constrained networks due to the connection of energy storage. This study concluded that, although energy storage could potentially increase demand at times of high demand, it was unlikely to do so and that flexibility would be a more economical solution than conventional reinforcement.

Other whole system activities

Accelerated loss of mains change project

7.11. The accelerated loss of mains change project is a project being delivered by National Grid Electricity System Operator (ESO), Distribution Network Operators, and Independent Distribution Network Operators to accelerate compliance with new requirements in the Distribution Code on behalf of the Distribution Code Review Panel.

7.12. The purpose of the initiative is to address issues with the settings for loss of main protection installed at distributed generators. The aim is to reduce the risk of inadvertent tripping and reduce system balancing issues by giving National Grid ESO greater latitude with regards to system rate of change of frequency limits. Statement of Works Appendix G.

7.13. Generators wishing to connect to WPD's distribution system may have an impact on the transmission system. Under the Connection and Use of System Code, DNOs are required to make a request for a Statement of Works (SoW) to NGET in relation to the potential impact of generation connections on the transmission system.

7.14. Due to the lengthy SoW process and cumulative impact of connecting large volumes of new generation to the distribution system, an alternative approach has been developed with NGET and a new trial SoW process is currently in place, known as the 'Appendix G trial'.

7.15. WPD has been instrumental in trailing this new process and the first DNO to have an Appendix G in place. The introduction of the Appendix G has reduced the time customers have to wait for the outcome of the process from around four months to six weeks.

Flexible Power Collaboration

7.16. Following the successful adoption of Flexible Power as a 'business as usual' approach within WPD, other DNOs have also adopted Flexible Power within their business operations. Scottish Power Energy Networks, Electricity Network West Limited, Scottish and Southern Electricity Networks and Northern Powergrid ENWL, SSEN and NPg have all committed use the Flexible Power branding, tools suite and processes, creating much needed standardisation and consistency across network operators when assessing, procuring, dispatching and settling flexibility services.

Distribution Connection and Use of System Agreement (DCUSA) DCP350 – Embedded Capacity Register. Power Collaboration

7.17. Initially developed as the System Wide Resource Register as an Open Networks Project, this has now been enacted into DCUSA. The register provides visibility of customer connected assets and capacities, as well as the interaction between flexibility services and pending reinforcement upgrades. It provides benefits for who systems planning, visibility and operations.

FES Network Forum

7.18. Through RIIO-ED1 we have collaborated with the ESO and other network representatives within this forum. DFES data has been shared and queried during the FES process to help better inform the regionalisation of the national FES. This group also inputs to how the scenario framework is generated on an annual basis so it is reflective of distribution network needs.

Hinckley Point C

7.19. In order to develop transmission capacity to accommodate Hinckley Point C, WPD has significantly supported the optioneering processes carried out ahead of the proposed future network being selected. As the phased augmentation of the network in the vicinity continues, WPD has been exchanging data on network models to ensure the best whole network outcome is achieved. This includes transmission companies and transmission connected users, as well as embedded power stations with the distribution network.

Cross DNO Modelling Updates

7.20. We regularly exchange network data with other DNOs in a week 24 style format. This occurs where we share Grid Supply Points, supply other DNOs or are supplied by other DNOs. The purpose of these exchanges it to ensure that all parties' network models are correct such that load flow and fault level studies can be undertaken both for normal running and contingency conditions.

Spatial GB Clean Heat Model

7.21. This project has provided a first-of-a-kind integrated, high spatial granularity framework for regional energy demand and supply mapping that captures competition between all low carbon technologies and the impact that consumers, communities, distribution networks, and regional and national bodies will have on the national heat decarbonisation strategy

Whole system planning

7.22. As part of the Open Networks project, we have contributed to the development of a whole system CBA tool. This will enable the industry to adopt a common and consistent approach to the assessment of whole system solutions and should consider the long term value for consumers and society. The tool will be tested as part of our EPIC Network Innovation Allowance (NIA) project and then incorporated into BAU.

7.23. Through workstream 1B of the Open Networks project, we are also working to align the processes for the Network Development Plan with the other licensees, developing clear triggers for instances when closer collaboration through RDPs might be required.

7.24. We are also aligning processes for data gathering from common stakeholders to minimise disruption and ensure we are working from a common basis. This data feeds into our DFES work, where again work is being undertaken to maximise alignment.

WPD's approach to whole systems

7.25. There is no single vector by which net zero emissions can be delivered cost effectively, but electricity is well placed to deliver significant short-term progress. It is our priority to ensure our network and processes make electrification an easy route.

7.26. RIIO-ED2 will see a continuation of the decarbonisation of the UK's electricity supply, supplemented by large scale adoption of e-mobility and the transfer to electrification of heating where cost effective and/or mandated.

7.27. The extent of which will be driven by government policy levers, but we will be responsible for developing capacity to meet those requirements aligned to the market adoption

7.28. To ensure that any developments occurring on WPD's network have sufficient regard to interactions with the rest of the whole energy system, WPD will continue to engage with a wide range of stakeholders when developing a view of network requirements. This will include actors across the whole electricity system (ESO, TO, DNOs, iDNOs), other electricity market actors (suppliers, aggregators/ VPPs, Flex Service Providers), actors across the whole energy system (gas distribution networks, water, transportation), industry and representatives of businesses at various levels, communities/social interest bodies and also national, regional and local governments.

7.29. By understanding the requirements and capabilities of all these stakeholders, alongside WPD's own, a much wider approach to option identification pathways can be taken, delivering outcomes which maximise the total benefits realised.

7.30. Innovation will be a key delivery conduit, with whole system tools and processes still in an early stage of development. This will also be supported by technology innovation.

7.31. WPD will develop different ways of understanding and measuring customer value, so that a better picture of benefits distribution is formed, leading to creation of a portfolio of whole system projects and developments with a published implementation timeline.

7.32. Our approach to whole system development will form a waterfall-process, identifying potential projects and issues requiring mitigation, evidence based assessment of options against a quantifiable criteria and adoption of those positive elements, with WPD taking a leading role in coordinating the delivery of those outcomes. (See figure SA-05.4)

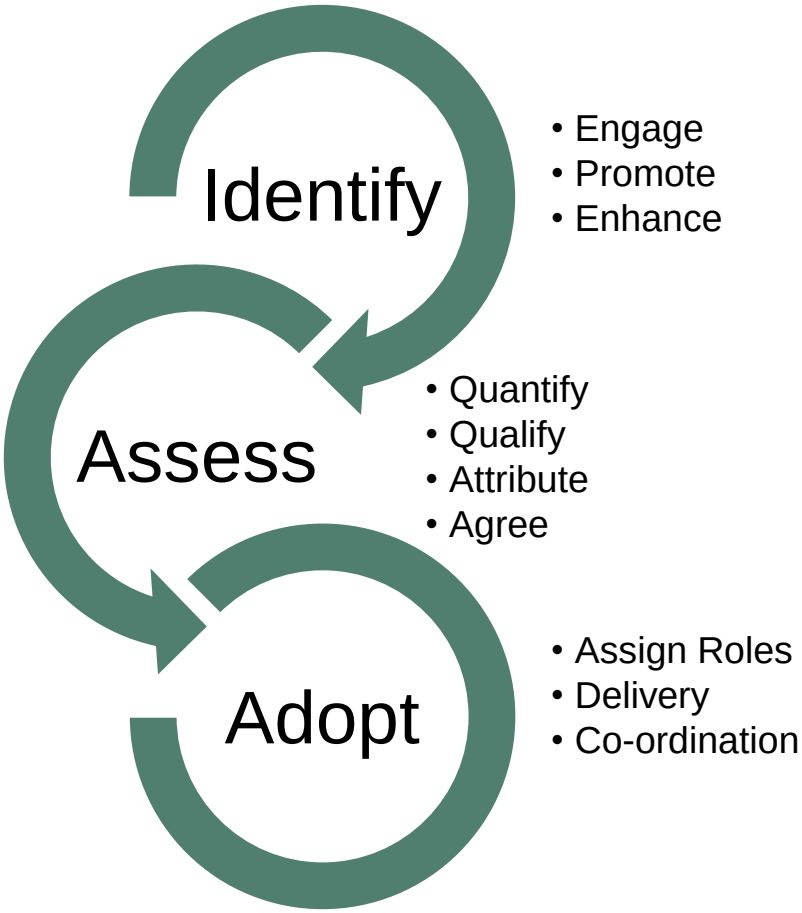


Figure SA-05.4 System Development Waterfall

7.33. There will be a number of enablers required to support successful whole system outcomes, which form the basis of innovation, data, digitalisation and DSO investment programmes:
+ Decision Transparency
+ Data Provision
+ Data Exchange
+ Engagement
+ Education
+ Assessment Methodologies
+ Service Integration
+ Service Provision
+ Consistent Approach.

RIIO-ED2 whole system actions

7.34. WPD will continue to consider whether there are activities that would benefit from whole system consideration. These may arise as a result of specific constraints on the network or as a result of proactive coordination with other organisations.

7.35. Distribution benefits of whole system actions have been included in the relevant EJPs where identified.

7.36. WPD will leverage its network to provide additional whole system benefits where identified and will continue to work with other actors to deliver those benefits, using the approach described above.

7.37. Specific benefits realised during RIIO-ED1 and expected to continue to be delivered during the RIIO-ED2 period are outlined below:

- By using the ESO's FES framework, we have reduced the cost of implementing regionally specific future energy scenarios. This has saved £2.76 million to date in RIIO-ED1 rising to £4.8 million in RIIO-ED2

- Within WPD's areas we have undertaken two RDPs within RIIO-ED1. Saving £13 milllion across the RIIO-ED1 period, with a further £13 million estimated for future RDPs in WPD areas.

- Much of the flexibility in a future energy system will be connected to the distribution network, coming from both DER and demand. Ensuring market opportunities are available to D-connected assets within WPD regions will save the whole electricity system around £45 million in RIIO-ED2.

8. Performance metrics for a smart and flexible network

Structure of metrics

8.1. As a more flexible network develops, the range of metrics required to assess performance must grow to support the new activities we undertake. In some senses, the metrics can draw upon the format of existing performance metrics. Existing measurements of customer satisfaction, time to quote, customer minutes lost and costs for specific works can all be adapted to draw out performance in flexibility.

8.2. Metrics will follow the structure of the sector specific baseline standards for DSO. A mixture of qualitative and quantitative measures will provide a holistic overview of performance. Where topics can be counted or measured, quantitative measures will be used. Where measurement is not possible, customer survey and stakeholder evidence will be used to create a qualitative view.

8.3. Metrics must be suitable for the requirement. This is assessed by considering their relevance, focus, robustness and transparency, appropriateness, verifiability, attributability and proportionality.

Ensuring metrics are consistent and robust

8.4. In the sections below, we give details of how metrics can be established for each of the roles in the baseline standard. These offer an overall view of a set of metrics which can be used to measure performance. Metrics are being developed further by all DNOs in conjunction with Ofgem. A more detailed view can be developed on the completion of this work. To ensure our set is transparent, we would aim to focus on more quantitative indicators which can be supported by base data. We expect that the set of metrics will be refined and developed to provide the best mix for performance measurement.

8.5. Where qualitative metrics are used, we will aim to combine them where appropriate. Whenever we survey our customers, we run the risk of stakeholder fatigue, so single comprehensive surveys are likely to provide the best outcome.

Role 1 forecasting and network planning

Forecasting

8.6. This set of metrics looks at how we share forecasting of our network capacity to inform customer decision making and provide the market with the visibility of forecasting accuracy and therefore confidence to base decisions upon it. We must provide the customer with extra data to inform decision making in regard to connection choices, Flexible Services Assessment and the identification of constraint areas.

8.7. Quantitative measures can be used to assess data inputs, data gathering and forecasting accuracy.

8.8. Qualitative measures will include industry engagement reports and stakeholder engagement.

Network asset data quality

8.9. This set of metrics assesses how sharing network asset data can make it easier for flexibility providers to engage in distribution flexibility markets, improving liquidity and increasing the opportunities to use flexibility as an alternative to investment (where it is lower cost). Improved information on network constraints not only improves participation in distribution flexibility markets but can also help network users understand where they can participate in other markets and develop innovative business models - delivering benefits across the system. Tools such as capacity heat maps enable a wide range of stakeholders (DG developers, IDNOs etc.) to self-serve by indicating capacity headroom and where they can connect at a lower cost.

8.10. Quantitative measures can be used to assess data quality, data volume and customer satisfaction.

8.11. Qualitative measures will include the definition of data types and scope, data triage systems and presumed open measures.

Role 2 network operations

Coordination between the ESO and DNOs

8.12. This set of metrics looks at how we coordinate and optimise network operations through the sharing of operational data to deliver whole system efficiency savings and benefits. Sharing allows the ESO to make informed decisions regarding dispatch of flexibility services and how they operate their own services, operate the transmission, and prevents reductions in quality of supply.

8.13. Quantitative measures can be used to provide counts of data exchanges and formats.

8.14. Qualitative measures will include industry engagement between the ESO and DNOs, reports on delivery and standardisation and communications processes.

Efficient dispatch of distribution flexibility services

8.15. This set of metrics assesses how we encourage the operation of a decision-making framework for dispatching DER in real time that is efficient and transparent. This will drive best whole system outcomes by promoting overall system security and resilience, coordination across services, maximising liquidity and ensuring dispatch of DER is economic and efficient.

8.16. Quantitative measures can be used to count self-derogations against standards, error corrections issued against instructions and late data events.

8.17. Qualitative measures will include the definition of a decision making framework and stakeholder feedback on the efficiency of DNO systems.

Role 3 market development

Flexibility market volume and value

8.18. This set of metrics looks at how we use flexibility services that will support our ability to more actively manage the network ensuring a resilient and secure supply that is cost effective by reducing the need for traditional network investment.

8.19. Quantitative measures can be used to provide market volume metrics, market value metrics and quality measures for commercial processes.

8.20. A qualitative measure can be used to provide annual audit evidence of DNO transparency.

Efficient, user friendly and accurate processes, contracting and procurement

8.21. This set of metrics assesses how we ensure that a wide range of participants can easily access DNO Flexible Power products and services. We aim to offer visibility of products at tender stage, allow user friendly procurement, and to ensure contracts offer customers flexibility to stack benefits from the wider market.

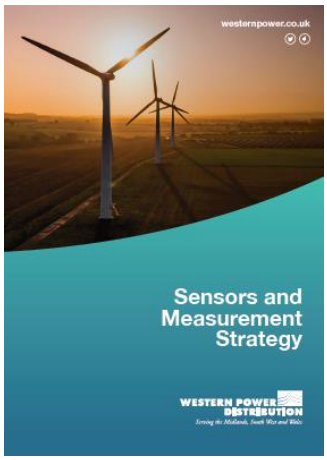
8.22. Quantitative measures will include volume of Flexible Power offered, contracted and dispatched. A customer satisfaction index will measure overall performance.

8.23. Qualitative measures will include the definition of an industry standard prequalification process and understanding of customer groups and their requirements through engagement.

9. Enhanced network monitoring

WPD Sensors and Measurement Strategy

9.1. In April 2020, WPD published a Sensors and Measurement Strategy, which identifies the monitoring requirements to be able to develop smart networks, improve network design and improve network security. Further details can be found in appendix A05.



9.2. Critical to the successful operation of these new systems is good quality, reliable, and timely data relating to the state of the network. The achievement of this depends upon a significant amount of work to upgrade WPD's data acquisition capabilities.

Development of smart network solutions

9.3. As a great deal of the new, embedded generation on the higher voltage networks is based on intermittent renewables, there is an opportunity to connect more generation than would normally be allowed under traditional design processes geared towards conventional generation. This can be achieved by exploiting the intermittency of renewable energy sources and the relatively low probability that they will all reach full output simultaneously.

9.4. These connections (referred to as 'flexible' connections) depend on the ability to control the associated load. This may involve curtailing export when the network is highly loaded and unable to accept the generator's full output or using flexibility services to manage constraints by engaging with other connected customers who are able to operate flexibly and who can be contracted with to alter their generation and/or consumption on instruction.

9.5. Regardless of whether constraints are mitigated by using alternative connections, flexibility services, or a combination of both, the need for accurate, reliable real time data allowing real time analysis of the network becomes crucial.

Improving network design

9.6. The proliferation of embedded generation and low carbon technologies has also had an impact on the information required for network design purposes. Historically, little more than the maximum demand at a substation was needed to ensure the adequacy of the network. While demand readings remain useful for network design, they need to be supplemented by more information.

9.7. In many cases, it is not possible to determine the direction of the power flow which is an increasingly important consideration because reverse power flow can occur when generation levels are high at the same time as demand levels are low. Furthermore, the half-hourly averaging that is carried out as standard runs the risk of masking true peak power flows when there is significant load variation within the half hour. Improvements are therefore needed in the way in which measurements are taken and recorded for planning and design activities.

Power quality impacting network security

9.8. The increasing addition of inverter-based technologies such as renewable forms of generation, battery storage and electric vehicles has the potential to significantly impact power quality. Excessive levels of harmonic distortion have detrimental effects on the network, including the possibility of protection systems operating when they shouldn't, putting potentially large numbers of customers at risk of disconnection.

9.9. By monitoring power quality on a continuous basis, the levels of harmonic distortion on the network can be better understood and, therefore, acted upon in order to prevent damage to network assets or to prevent protection mal-operation resulting in significant load loss events.

Existing scale of monitoring

9.10. The monitoring equipment installed at individual substations depends on a number of factors such as geographic location and network topology, but is most dependent on the nominal voltage, with the lower voltages having significantly less monitoring.

9.11. At a Grid Supply Point, Bulk Supply Point or primary substation, most of the required measurement transformers (current transformers (CTs) and voltage transformers (VTs)), telemetry, and control is already installed, but may require additional functionality such as transducers that take current and voltage measurements and convert them to directional real and reactive power flows.

9.12. At distribution substations, the amount of monitoring is considerably reduced, as the benefits have been limited in the past. There has been an increasing amount of remote control installed at high voltage (HV), but the monitoring equipment associated with this is relatively basic. For low voltages, there is even less existing monitoring, in many cases limited to a basic maximum demand indicator that needs to be read manually.

Track record and RIIO-ED1 monitoring

9.13. Monitoring at primary substations and above has been established for many years. We have taken distribution substation monitoring from Innovation through to business as usual in recent years. We have also started to add monitoring to distribution substations as detailed in figure SA-05.5 below

% of network where demand monitoring deployed	2019/2020		By end RIIO-ED1		By end RIIO-ED2	
	% substation	% customers	% substation	% customers	% substation	% customers
Primary	97.9%		100.0%		100.0%	
Secondary	0.0%	0.0%	2.1%	7.0%	10.9%	22.7%

Figure SA-05.5 Monitoring at substations

Sensors and Measurement – Our RIIO-ED2 projects

Distributed Energy Resource SCADA monitors

9.14. Traditionally, distributed energy resources (DER) were allowed to connect without a need for remote monitoring and control because the network was passive in its design. As more DER has connected to the network and the management of the network becomes more active, there is a need for improved visibility of the operating regime of DER.

9.15. During RIIO-ED1, WPD commenced a programme of retro-fitting telemetry to customer points of connection where significant distributed generation or other flexible distributed energy resources (DER) are located.

9.16. Additionally, following the low frequency event of 9 August 2019, and subsequent BEIS investigation, there is a requirement for telemetry and control to be fitted to all significant

(>200kW) DER. This programme has also commenced and during RIIO-ED1 will address 132kV, 66kV and 33kV connected DER along with locations where there are clusters of 11kV distributed generation. However, there are over 1000DER installations and the majority are associated with smaller 11kV DER where the work will be delivered during RIIO-ED2.

Directional power flow at primary substations

9.17. The growth in generation connected to the distribution network is leading to different power flows, which in some cases can flow in the opposite direction to the way the network was designed. In addition, the different types of DER connected to the network have varying power factors affecting the amount of useful power that can be delivered to customers.

9.18. In order to gain a better understanding of reverse power flow and power factors, power flow monitoring equipment is to be installed at all primary substations giving visibility of the 11kV network and higher voltages.

9.19. The amount of work required at each substation will depend on a number of factors. For visibility of the 33kV and higher voltage networks, most primary transformers already have the required instrument transformers (CTs and VTs) which would enable a multifunction transducer capable of determining direction power flow to be installed where not already present. Multi-transformer sites that do not have busbar VTs will need an additional voltage selection panel to be installed to enable busbar voltage to be determined for any running arrangement. For additional visibility to cover the 11kV network, multifunction transducers would need to be installed for each circuit at a primary substation.

Extra high voltage (EHV) monitoring for smart systems

9.20. The growth in generation connected to the distribution network is leading to different power flows, which in some cases can flow in the opposite direction to the way the network was designed. The different types of DER connected to the network also have varying power factors affecting the amount of useful power that can be delivered to customers.

9.21. WPD has been rolling out various smart solutions during RIIO-ED1, including Active Network Management (ANM) and Demand Side Flexibility (DSF). During RIIO-ED2, other smart grid solutions such as System Voltage Optimisation (SVO) will be applied more widely. For these smart systems to operate effectively, we need more detailed information about the network loading and status.

9.22. This often involves collecting additional data from existing installations or adding new telemetry systems to substations. This project will proactively fit additional sensing and monitoring to sections of the network prioritised for expansion of smart solutions.

Power quality monitoring

9.23. With more low carbon technologies relying on inverters for connection to the network, power quality is becoming an increasingly important consideration. Excessive levels of harmonic distortion have detrimental effects on the network such as increased thermal stresses on equipment and mal-operation of protection equipment.

9.24. The Primary Network Power Quality Assessment (PNPQA) innovation project is currently developing an understanding of more sophisticated, automated monitoring equipment. By monitoring power quality on a continuous basis, the levels of harmonic distortion on the network can be better understood and acted upon in order to prevent damage to network assets or to prevent protection mal-operation resulting in significant load loss events.

9.25. The PNPQA project documentation indicates that approximately 60 sites per licence area would benefit from the improved monitoring.

LV network monitoring

9.26. Domestic customers are increasingly adopting low carbon technologies (LCTs) such as rooftop solar panels, electric vehicles, and heat pumps. Electric vehicles, in particular, have the potential to add very large levels of demand coincident with existing periods of maximum demand. Our forecasts for the adoption of LCTs predict that up to 25,000 distribution substations could exceed their demand capacity by the end of the RIIO-ED2 period. This level of demand growth will lead to a requirement for reinforcement of the LV network, but opportunities should be taken to verify the requirement and prioritise the work.

9.27. Traditionally, there has been very limited monitoring of the LV network, with, at best, very basic maximum demand indictors being used that were read manually during substation inspections. During RIIO-ED1, WPD has started to install additional monitoring for LV networks to better understand load profiles and gather information

9.28. Installing monitoring to existing equipment requires a retrofit. Our solution, developed through innovation projects, uses Rogowski Coils to measure current and voltage. For new equipment, we are working with manufacturers to include the monitoring equipment as part of the equipment specification.

9.29. The locations for installation will be prioritised based upon analysis of smart meter data which will be used to provide an insight into where the network may be reaching capacity.

9.30. Monitoring at LV will provide greater visibility of the loads, allowing proactive measures to be taken in real time and providing a more accurate view of reinforcement requirements, deferring the requirement at some sites. It will also provide verification of modelled information, enabling improvements to the modelling assumptions.

Enhanced network modelling – RIIO-ED2 projects

9.31. Our list of network modelling project is shown in figure SA-05.6.

Enhanced Network Modelling – Our RIIO-ED2 Projects		
Project Title	**Background**	**Project Details**
Distributed Energy Resource SCADA Monitors	As more DER has connected to the network and the management of the network becomes more active, there is a need for improved visibility of the operating regime of DER.	This project will continue a programme of retro-fitting telemetry to customer points of connection where significant distributed generation or other flexible DER are located.
Directional Power Flow at Primary Substations	The growth in generation connected to the distribution network is leading to different power flows, which in some cases can flow in the opposite direction to the way the network was designed.	In order to gain a better understanding of reverse power flow and power factors, power flow monitoring equipment is to be installed at all primary substations giving visibility of the 11kV network and higher voltages.
EHV Monitoring for Smart Systems	WPD has been rolling out various smart solutions during RIIO-ED1, including Active Network Management and Demand Side Flexibility. During RIIO-ED2 other smart grid solutions such as System Voltage Optimisation will be applied more widely.	This project will proactively fit additional sensing and monitoring to sections of the network prioritised for expansion of smart solutions.
Power quality monitoring	With more low carbon technologies relying on inverters for connection to the network, power quality is becoming an increasingly important consideration. Excessive levels of harmonic distortion have detrimental effects on the network such as increased thermal stresses on equipment.	The project will install monitoring for power quality on a continuous basis, allowing levels of harmonic distortion on the network to be better understood and acted upon in order to prevent damage to network assets or to prevent protection mal-operation resulting in significant load loss events.
LV Network Monitoring	Domestic customers are increasingly adopting low carbon technologies such as rooftop solar panels, electric vehicles, and heat pumps. Electric vehicles, in particular, have the potential to add very large levels of demand coincident with existing periods of maximum demand. 1.367. This level of demand growth will lead to a requirement for reinforcement of the LV network, but opportunities should be taken to verify the requirement and prioritise the work.	Monitoring at LV will provide greater visibility of the loads, allowing proactive measures to be taken in real time and providing a more accurate view of reinforcement requirements, deferring the requirement at some sites. It will also provide verification of modelled information, enabling improvements to the modelling assumptions.
Internet Protocol Substation	Original protection and SCADA were electro-mechanical systems and more recently these have been replaced by electronic versions, but often manufacturers have used their own bespoke software and communications standards. Modern systems have become standardised onto Internet Protocol (IP) communications.	This project will test this IP approach to protection and SCADA to establish the working practices and policies for wider deployment.

Figure SA-05.6 Our RIIO-ED2 Enhanced Network Modelling projects

10. Smart metering

10.1. WPD does not own smart meters or have the responsibility for installing smart meters, but we will make full use of the information collected by smart meters to provide benefits for consumers.

10.2. The installation of smart meters, being undertaken by the electricity suppliers, is due for completion by the end of 2024. This means that the rollout will continue into the RIIO-ED2 period and therefore the opportunities to benefit from the data will progressively increase until the rollout is completed.

10.3. WPD will take advantage of the information provided by smart meters and has published a Smart Meter Strategy. This includes using the alerts from smart meters to improve fault response, voltage information to determine network issues and load current to inform the need for network reinforcement as well as using the data to refine planning assumptions. Further details can be found in appendix A06.

10.4. Historically, there has been very basic and limited information available about the LV network, with reporting of faults being dependent upon customers contacting DNOs and data about the load at substations being limited to basic maximum demand indicators. The installation of smart meters enables a step change in the visibility of the operational status of the LV network compared to the basic monitoring previously available.

10.5. The LV system was designed to work passively using templates and models to estimate load patterns and diversity. These models are now being challenged as LCT growth is changing the amount of load and loading patterns on the LV network. Smart meter data will allow us to see aggregated LV network demands over each half hour enabling informed decisions about the available capacity, the ability to connect new load or generation or the need for reinforcement.

10.6. The additional functionality and information available from smart metering will allow us to increase understanding of the network, improve our service to customers in existing activities and more effectively facilitate the low carbon transition.

10.7. There are, however, a number of challenges. The progressive deployment of smart meters means that certain functions will not be available everywhere. Load information for individual customers can reveal usage patterns and is deemed to be personal data and therefore we have developed a Data Privacy Plan which requires that the data is aggregated or anonymised before it is passed into WPD systems.

10.8. The majority of these systems will be developed during RIIO-ED1, but there will be costs and activity during RIIO-ED2 to cover the costs for the services provided by the Data and Communications Company (DCC) and to develop additional analytical capability and storage of data.

Smart meter benefits

10.9. Smart meter data has the potential to enhance existing business activities such as fault management, network planning and asset management.

10.10. For many of these applications, the benefits increase as the density of smart meters on the network increases. This means that the level of benefits will vary across the network until the rollout is completed.

10.11. To take advantage of the benefits, we have established compliant interfaces with the DCC, established data storage systems and have created systems to interrogate and interpret data into existing WPD processes and systems.

Fault management

10.12. Smart meters can provide alerts related to loss of supply. When there is a power cut, 'last gasp' functionality will trigger a message to notify us of the loss of supply.

10.13. Additional functionality allows the 'energisation status' of meters to be checked remotely, gaining a clearer understanding of which customers are off supply and allowing us to determine what kind of fault has occurred (blown fuse, open circuit fault, single premise). This provides a level of visibility down to the individual premise that has not been available before.

10.14. This helps us to dispatch the appropriate restoration resources and improve our restoration times. In the case of a call regarding a 'single premise', it also helps to remotely identify if the issue is on the network or on the customer's own equipment.

10.15. We have already developed an automated system which handles these messages and checks the meter status before transferring the alert into our fault management systems. Once transferred, we use our established rules to check if an off supply alert is part of a known interruption or whether a new incident needs to be created.

10.16. On completion of the fault, it is possible to check that all supplies have been restored. This is particularly useful in storm scenarios where faults on the high voltage network can mask additional issues on the LV network. The ability to check the status reduces the possibility of teams leaving the area while customers are still off supply.

Network monitoring

10.17. Smart meters measure both voltage and current and this data can be used to identify loading issues on the network.

10.18. Voltage data is related to the network rather than the individual and therefore does not need to be anonymised. This allows the measurement of voltage along a feeder which can identify potential generation or demand issues on LV networks. High voltages at the end of a network can indicate high levels of embedded generation, whereas low voltages can indicate high levels of load. The voltage data can be supplemented with aggregated load data to show whether particular feeders are highly loaded.

10.19. We can use this data as an early warning triage of our network. Substations with predominantly high or low volts over a long period of time can be identified and substation level monitoring can be installed. The monitoring can then verify the issues and appropriate reinforcement actions can be planned.

Network planning

10.20. Network planning at LV uses load profile templates to determine whether reinforcement is required. Smart meter data is being used to verify and refine the load profile assumptions. However, this only provides a representative view when there is sufficient density of smart meters on a feeder.

10.21. We have estimated that a feeder requires 80% of customers to have smart meters fitted before it can provide a reasonable representation of the whole feeder. To check that this estimation is correct, we are comparing the smart meter data to data for the whole feeder from monitoring equipment installed at the substation. We are testing a range of densities from 60% to 100% to identify the appropriate level of density that provides a reliable indication.

10.22. This will help us to refine the generic assumption used for planning and open up the opportunity for bespoke analysis for each feeder based upon its own profile.

Voltage complaints

10.23. Currently, WPD receives around 500 'voltage complaint' enquiries each year directly from customers. The existing method for investigating the enquiry is a time consuming and labour intensive process which frequently results in the voltage being within standard parameters, once investigated.

10.24. Smart meters can send alerts when over or under voltage thresholds have been exceeded. As more smart meters are installed, this has the potential to generate a number of voltage alerts that will require some form of investigation.

10.25. We are therefore developing a system, outlined in the diagram to the right, which allows us to react to voltage alerts and carry out more desktop-based investigations of reports made by customers. (See figure SA-5.7).

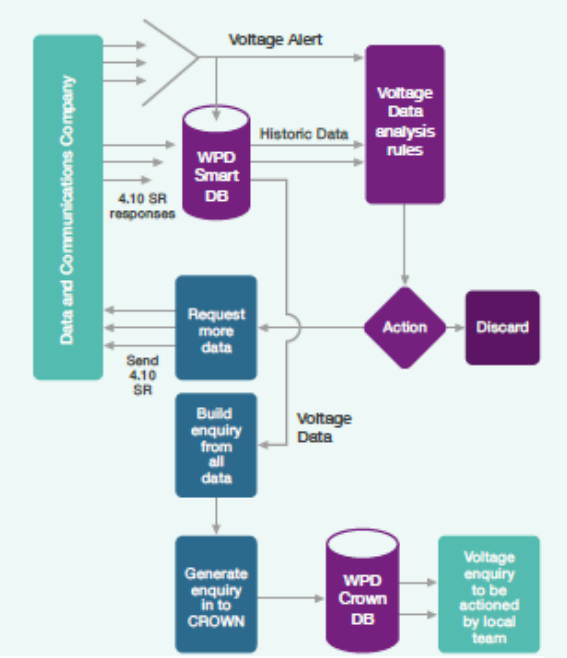


Figure SA-05.7 Voltage Alert Flowchart

10.26. The system will automatically evaluate voltage alerts from a smart meter. Thresholds will be implemented to filter alerts depending on occurrence rate, level of voltage excursion and time of excursion. Alerts which exceed the thresholds will trigger automatic analysis of the other smart meters on the same feeder. When the analysis is complete and preset rules (such as a number of smart meters exhibiting similar alerts) have been met, a 'voltage complaint' enquiry will be raised within the database. This enquiry will be automatically passed to the local team to investigate using monitoring equipment and correct any issues identified.

Future applications

10.27. It is recognised that electrification of transport and heating, along with the adoption of distributed generation, will present a number of challenges to the operation of the LV network. Smart metering functionality has the potential to support future network operations, either through directing time of use tariffs that benefit the distribution network or using the data about the status of the network to support load shifting, controlling vehicle charging or triggering vehicle-to-grid support.

Quantification of benefits

10.28. The benefits from smart metering can broadly be split into two categories;

- existing business functions such as outage management and capital investments
- future applications such as active network management and demand response.

10.29. During 2019, the Energy Network Association (ENA) employed PA Consulting to produce an updated Network Benefits Realisation paper to outline the benefits of the smart meter rollout programme for DNOs. A summary report was published in September 2019 which detailed the expected benefits available based on the current smart meter penetration levels and expected coverage increase through the remainder of the rollout and out to 2030.

DCC charging arrangements

10.30. A regulated organisation called the Data and Communications Company (DCC) manages the systems for communications between the meters and users of smart meter services.

10.31. In order to fund and support the operation of the national smart meter infrastructure, the DCC levies charges for use of its network. These charges cover the full end-to-end process and the costs of following elements:

- the communication network from the smart meters to the DCC - provided by the Communication Service Providers (CSPs);
- internal DCC processing provided by the Data Service Provider (DSP);
- the communication network from the DCC to user's processing centres;
- Enrolment of SMETS1 meters into the DCC;
- Supporting the Ofgem Faster Switching Programme including costs for the new Central Switching Service (CSS).

Smart meter-related projects and outputs

10.32. During RIIO-ED1, we started working on projects to prove the benefits of smart meter data for network management.

10.33. The development and approval of the WPD Data Privacy Plan has given us the opportunity to start designing systems to handle and anonymise customer sensitive data from smart meters.

10.34. We are undertaking the Smart Meter Profiling project which aims to compare smart meter load data with measured substation load profiles. This will provide an understanding of how these two data sets can interact and will inform the density of meters that is required for accurate representation of substation load. These will help us to refine our template models used for network planning.

10.35. Smart meter alerts enable us to respond to potential issues on the network. We have developed processes that can filter out erroneous alerts, analyse valid alerts and act upon them following rules. We currently manage over 40,000 alerts per month with over 75% being assessed and used in WPD systems.

Objectives and outputs for RIIO-ED2

10.36. Most of the work to realise the benefits of smart meters will have been completed in the RIIO-ED1 period, but some of the benefits will be limited until the rollout is completed.

10.37. In the RIIO-ED2 period, we will build on the foundations of RIIO-ED1 and use data analysis to refine our systems. We expect our alert handing systems to be improved through refined decision rules. Load profile data will be available by RIIO-ED2 and we will focus on making the data more visible in planning and operational systems. Work in this area will tie into our Data and Digitalisation Strategy projects.

11. Losses

Losses and their causes

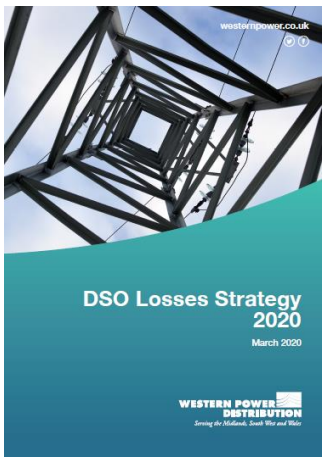
11.1. The amount of energy that enters an electricity network is greater than the amount that is delivered to customers. The principal reason for this is that an electricity network uses energy in the process of delivering power. This is known as a technical loss.

11.2. Other reasons for electricity losses occur where a connection has been made to the distribution network without authority (known as theft in conveyance), where metering equipment has been deliberately bypassed (known as illegal abstraction) or where a connection has not been properly registered and no supplier is assigned. The energy used in these circumstances is not metered and does not feature in volumes registered by suppliers. As a result, it is shown as a loss on our network.

Losses Strategy

11.3. Since 2013, WPD has produced a Losses Strategy which is updated annually and available as a standalone document. Further details can be found in appendix A07.

Our work to improve understanding of losses



11.4. The amount of losses on the network is difficult to quantify because it relies upon knowing the amount of energy entering a network (from National Grid infeeds and all distributed generation) and the amount being used by consumers at a specific point in time. Because the use of the network is not fixed, the current flowing through the network varies minute-by-minute. Any mismatch in timing of readings introduces an error into the calculation of losses.

11.5. A key to managing of losses in the future will be our ability to manage effectively the additional demands created by all low carbon technologies as we transition towards net zero in 2050. Our Losses Investigation project considered if it is possible to provide an accurate and consistent measured volume of losses. Amongst other things, it has demonstrated the low level of losses in relation to energy supplied. Working with other DNOs, the ENA Technical Losses Group has also completed research in this area to help us develop plans to measure this low level of total energy. It draws upon international best practice and suggests an incentive with a long settlement duration may provide smoothing of measurement errors. While measurement at all points remains one option, we will look at the potential to use scenarios, models and templates to extrapolate losses from a smaller number of measurement points or across a wider settlement period.

ENA Technical Losses Group

11.6. The ENA Technical Losses Task Group provides a forum for sharing best practice and working collaboratively across the industry. During RIIO-ED1, the task group commissioned WSP Group, a global engineering consultancy, to study the impact of LCTs on network losses.

11.7. The study evaluated losses through simulations of urban and rural network models. Regional variations in LCT uptakes between the urban and rural networks were reflected through consideration of the numbers of customers, types of properties and socioeconomic conditions.

11.8. The key findings of the work concluded that:

- The uptake of LCTs will significantly impact losses
- How networks accommodate LCTs will impact losses.

11.9. Future connections of LCTs such as electric vehicle and heat pumps will increase losses. Localised generation may reduce losses by supplying local demand and reducing the amount of energy flowing though the network. However, where there is greater generation output compared to local demand resulting in a significant net export, it can increase losses by increasing energy flows across networks, albeit in an opposite direction.

11.10. Methods of providing additional network capacity and how the network is used affect losses. Losses can be reduced through conventional reinforcement, which increases the size of assets to accommodate load growth. Smart solutions - which increase the utilisation of existing network assets - increase losses, due to higher loads being carried through smaller conductors.

Our achievements in RIIO-ED1

11.11. During RIIO-ED1, WPD has implemented a range of initiatives aimed at reducing losses. We have:

- met or exceeded the Ecodesign 2015 directive for all new transformers purchased;
- oversized the 11kV ground-mounted transformers which are highly loaded enough to justify replacement;
- replaced pre-1958 ground-mounted distribution transformers;
- installed a minimum size of 25kVA for single-phase pole-mounted transformers and 50kVA for three-phase pole-mounted units;
- discontinued 4 & 16mm^2 copper LV service cables;
- discontinued 95mm^2 LV Wavecon mains cables and 95mm^2 Aluminium triplex 11kV cables; and
- standardised on 185/300/400/630 and 800mm^2 copper single core cables for the 33kV network.

11.12. WPD has also been working alongside suppliers to investigate transactional theft, to perform regular random audit checks in order to monitor supplies that appear to be unmetered and to investigate theft in conveyance by comparing the metering records to Ordnance Survey records and investigating properties without meters.

Our key losses actions in RIIO-ED2

Addressing losses in transformers

11.13. There are actions that can be taken to reduce the losses in transformers. To reduce the variable losses the resistance of the conductors can be decreased by increasing the cross sectional area or using materials with a lower resistance. To reduce the fixed losses, the efficiency of the magnetism needs to be improved by using materials with better magnetic properties.

Removing pre-1958 HV transformers

11.14. During RIIO-ED1, the EU Ecodesign regulations led to a step change in distribution transformer design and reduced levels of both iron (fixed) and copper (variable) losses. This allowed us to create a positive Cost Benefit Analysis (CBA) for the replacement of older pre-1958 ground mounted transformers that were manufactured to higher loss technical standards.

11.15. In the RIIO-ED2 period, we will extend this proactive replacement programme to our pole mounted pre-1958 transformers. There will be a slight overlap of activity between the proposed losses actions, asset replacement of poor condition transformers and replacement of specific cohorts for the removal of PCB contaminated transformers.

Discontinuing smaller sized HV transformers

11.16. During RIIO-ED1, we discontinued the use of 15kVA single phase and 25kVA three phase transformers, using larger sized assets as the minimum size available. This provided both a losses and capacity benefit.

11.17. In RIIO-ED2, we will extend this approach and discontinue using 25kVA single phase and 50kVA three phase units. This will mean the smallest units used are 50kVA single phase and 100kVA three phase (which will be of a lower loss amorphous core design).

11.18. Taking the combined steps of uprating the minimum sizes and using amorphous cores for the smallest remaining sizes in our range will lead to around 160 units per annum being installed with a higher rating and lower losses.

Addressing losses in cables

11.19. The lowest cost approach to reducing the variable losses in cables is by using cables with larger cross sectional area of the conductors.

11.20. The installation of cables is a high cost activity due to the costs associated with excavation and reinstatement. It is uneconomical to re-excavate cables to increase cable sizes; therefore, the opportunity to efficiently reduce losses only exists at the time that the cable is initially installed.

Discontinuing smaller 185mm^2 cable at LV

11.21. During RIIO-ED1, we discontinued using 95mm^2 cable to reduce losses and provide additional capacity for LCT growth.

11.22. We have evaluated which networks would be best suited to having cable size increased further. The greatest benefit is obtained on LV networks which have high levels of utilisation. This means that we are able to deliver a positive cost benefit on the discontinuation of 185mm^2 cable at low voltage. However, at 11kV and above, where networks are designed to be able to pick up load from interconnected circuits and therefore carry lower normal loads, the benefits do not drive a positive CBA.

11.23. We therefore propose to discontinue the use of 185mm^2 cable to provide a losses benefit, adopting 300mm^2 as the standard.

11.24. Using 300mm^2 cable will also provide greater scope for demand increases before additional reinforcement is required.

12. Telecoms

Background

12.1. WPD operates an extensive in-house telecoms network that delivers inter-office data communications, mobile voice communications and supervisory control and data acquisition (SCADA) between electricity assets and control centres.

12.2. This approach is efficient, cyber secure and highly reliable compared to services offered by third party telecoms providers.

12.3. By using third party operators, WPD would have no control over the reliability, resilience, security and availability of these networks. Third party operators provide coverage based on population rather than geographical area. By contrast WPD has a requirement for assets to be connected in more rural areas. Our network is designed to reach these areas where this is often no coverage from third party networks.

12.4. Telecoms and control and monitoring technology within the electricity industry has undergone minimal change over the last 20 years. The focus has been on customer service to ensure customer minutes lost and customer interruptions are minimised. However, the electricity industry is now taking a technology leap in all areas through the implementation of increased monitoring for DSO functions, supporting low carbon technology with new digital strategies that will gather increasing volumes of data from our connected assets across all voltage levels.

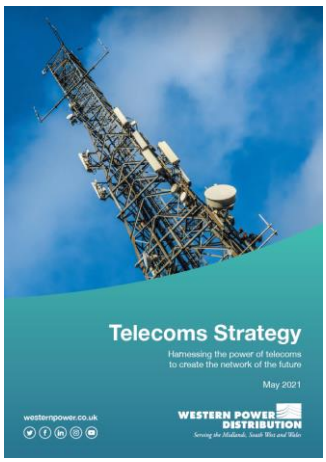
12.5. These new services require telecoms infrastructure of a new design which improves bandwidth to handle larger packets of data, communicating with a drastically increased number of connected electricity assets.

12.6. We have already started meeting these increasing demands of the future during RIIO-ED1, while maintaining our excellent standards of reliability and resilience. During RIIO-ED2, we will further improve systems and offer the additional levels of coverage and granularity required to support the electricity network to achieve the net zero transition.

12.7. The WPD telecoms infrastructure will therefore be reinforced and expanded to be able to do more remotely, including patch updates, network switching, protection setting application and network monitoring.

Telecoms Strategy

12.8. WPD has produced a Telecoms Strategy which is updated annually and available as a standalone document. This provides an insight into the challenges and solutions that will be adopted to prepare our telecoms network ready to support the changes in the Electricity network. We have been working closely with suppliers to identify solutions to overcome the future challenges. This describes the rationale behind our innovation projects and business initiatives as well as describing how we are already implementing some solutions into ‘business as usual’ activities



12.9. Further details can be found in appendix A08.

Telecoms RIIO-ED2 challenges

12.10. RIIO-ED2 will provide a number of significant challenges to our telecoms team, particularly in relation to the increase in the number of electricity assets to be monitored. Key challenges include;

- Providing geographical coverage to ensure additional electricity assets can be connected to the telecoms network.
- Providing suitable bandwidth to ensure the extra data being collected does not cause congestion on the telecoms network.
- Ensuring that the high availability of the telecoms network is maintained as the network grows, ensuring it remains resilient to all types of events, especially during a power failure.
- Providing cyber security controls on all parts of the telecoms network.

Telecoms RIIO-ED2 deliverables

12.11. The deliverables cover the modernisation, enhancement, upgrade and/or replacement of existing systems and technologies, as well as the development and/or purchase of new systems and technologies.

Power flow monitoring

12.12. Due to the increasing complexity of localised grid including reverse power flow and varying power factors, power flow monitoring equipment is to be installed at multiple and various voltage levels within the electricity network.

12.13. This expansion of data collection and communication requirements will require connection to WPD's telecoms infrastructure.

Communication for LV monitoring

12.14. Low voltage monitoring is becoming increasingly important, as customers with low voltage connections invest in low carbon technologies (LCTs) such as solar panels, electric vehicles and heat pumps, operating within a smart grid environment.

12.15. WPD is responsible for its 8 million customers and some 180,000 distribution substations as they transition to net zero. These additional demands mean that monitoring at LV will increasingly be required year on year to proactively monitor the network's behaviour in relation to these advancing technologies.

12.16. To facilitate this data collection, additional communication devices will need to be installed and connected onto the telecoms network.

Private Long Term Evolution (LTE) network

12.17. The existing radio telecoms system used for the control and monitoring of the electricity network is becoming restricted due to its limitations in terms of the number of connected assets and the small amount of throughput data it can handle.

12.18. This limited capability is widely recognised and a modernised private LTE radio system is currently under review by Ofcom, with BEIS and Ofgem oversight. All UK gas and electricity network operators collectively agree that an LTE solution is urgently required to support net zero objectives. A private LTE solution will have 100 times more capacity than the current radio system and will be quicker and more cost effective to deploy.

12.19. If regulatory consent is given, we propose to change WPD's radio-based telecoms system to an LTE solution to enable improved, resilient and secure communication capability. This will overcome bandwidth constraints and be scalable for future network growth and data demands.

Replacing Remote Terminal Units (RTUs)

12.20. RTUs are microprocessor devices that are installed at substations to collect data from transducers fitted to substation equipment to enable the data to be communicated back to control systems. As electronic devices, RTUs have a relatively short asset life.

12.21. During RIIO-ED2, we propose to modernise 1,900 substation RTUs, which have reached the end of life.

12.22. The replacement device will be an internet protocol (IP) enabled RTU providing enhanced two-way data traffic that will increase system monitoring capability and allow remote administration of system upgrades. The IP-enabled RTU will also be plug and play ready for the next generation of IP-enabled switchgear and protection relays.

Replacement of legacy PDH and SDH infrastructure

12.23. Legacy telecoms equipment including Plesiochronous Digital Hierarchy (PDH) and Synchronous Digital Hierarchy (SDH) telecoms apparatus, along with other vintage bespoke items, will not support the modern IP requirements of future electricity network systems.

12.24. WPD's proposed replacement of these devices will seamlessly enable remote operations to continue but also manage the enhanced two-way data communicating to and from field-based assets.

PSTN switch off

12.25. Public Switched Telephone Network (PSTN) is the current standard for phone line connections to all homes and businesses in the UK that are not on a fibre connection.

12.26. Openreach and OFCOM have decided to modernise the UK infrastructure to be IP-enabled by 2025; this is known as the 'PSTN switch off'. This will impact the whole of the UK.

12.27. For WPD, approximately 1,400 third party telecoms connections will be affected and will need to be replaced with a suitable alternative. In WPD, PSTN connections are used for a variety of purposes including phone lines, alarm systems and CCTV systems at distribution asset sites

12.28. WPD will migrate these affected and essential lines onto WPD's private network.

Fibre network expansion

12.29. WPD uses a combination of fibre optics and microwave for communication across our telecoms network. We will continue to use a combination of these but will increase the number of fibre optic installations, as these provide greater bandwidth.

12.30. WPD is proposing to expand the fibre optic network by taking advantage of outages and excavations for RIIO-ED2 planned overhead and underground asset replacement work.

12.31. This will enable new fibre connections to be made to strategic electricity assets. This work will be an efficient approach to extend and connect more fibre as an alternative to radio communications. This approach also affords a reduction in procured services from third party telecoms operators.

Telecom sites

12.32. The expansion of data acquisition and control will require the construction of additional telecoms sites to enable communications coverage where this does not currently exist.

12.33. Some existing sites will be refurbished to modernise the associated plant for enhanced cyber security and resilience to power failure.

Backhaul upgrades

12.34. WPD's backhaul communications network uses a mix of microwave links and fibre that include IP networks and firewalls.

12.35. Some devices on the network need to be upgraded because they are either no longer supported or require a cyber security enhancement.

12.36. In other cases, extending the reach of the telecoms network will also require additional backhaul telecoms links to be installed.

13. Community energy

13.1. Community energy is the delivery of community-led renewable energy, energy demand reduction and energy supply projects with the underlying objective of addressing climate change, whether these projects are wholly owned and/or controlled by communities or through a partnership with commercial or public partners. These projects deliver collective social, environmental and economic benefits to the local community such as fuel poverty alleviation, energy engagement and education, and community funds from renewable energy projects.

13.2. Community energy organisations have told us they face multiple barriers including the lack of viable business models, funding, finding sites with a grid connection, and being time and resource poor. Because they are largely voluntary, they struggle to engage in policy and keep up to speed with changes in our energy system.

13.3. Many community energy organisations are determined to deliver community energy projects because they are motivated by social and environmental values, rather than profit. They want a fairer energy system that doesn't leave the vulnerable behind, and a network that enables new community-owned generation to connect.

13.4. We want community and local energy to be a strong and resilient part of the energy sector. We are committed to ensuring our engagement with community and local energy stakeholders makes a positive impact, helping communities to collaborate with us and other local stakeholders.

13.5. We've been working with community energy experts Regen since 2014, who have independently facilitated events and directed our ongoing engagement programme to ensure it is appropriate and tailored to meet the needs of this unique stakeholder group. Our ongoing engagement has helped facilitate networking and collaboration, as well as build the knowledge and capacity of the sector by developing tools, resources and new ways of working.

13.6. We have implemented a Net Zero Communities Strategy, which outlines our enduring commitment to community energy and highlights our stakeholder engagement approach to delivery. Further details can be found in appendix A09.

Community energy innovation activity

13.7. To help community and local energy organisations develop new business models, and to help us understand how we might best manage a decarbonised and decentralised electricity system, we've partnered with communities on several network innovation projects. As part of developing these initiatives, we aim to:

- Be ambitious in scope, while setting realistic timeframes for rolling out the project;
- Make use of existing community organisations, structures and knowledge to understand the target audience and local impacts;
- Proactively work with partners who are known and trusted in the local community;
- Leave a lasting, positive impact on the host community and share the learning of the trial as widely as possible.

13.8. Our extensive innovation programme has consistently ensured that a wide range of community energy focused projects have been delivered. Below is a summary of a range our key community focused innovation projects as seen in figure SA-5.8.

Smart Energy Isles	The Smart Energy Islands is an EU-funded project on the Isles of Scilly, aiming to build and operate a renewable energy microgrid to increase the amount of renewable generation on the islands. Our parallel, Smart Energy Isles project helped to increase the amount of renewable energy by enhancing an Active Network Management zone, so that generation can be better managed and allow local flexibility to offset generation curtailment.
SoLa Bristol	This project explored the impact of high densities of LCTs on our network and helped customers to manage their electricity load. Solar panels, energy storage, and DC circuits were trialled in homes to test their impacts and cost-effectiveness, with participants also trialling a Time of Use tariff.
Sunshine Tariff	Local community group WREN recruited 61 participants to trial demand side response (DSR) in Cornwall, which encouraged people to shift their electricity use to sunnier times of day with a cheaper daytime tariff, using renewable energy from local solar farms. The project aimed to resolve network capacity issues in the area to enable more community energy to connect.
Open LV	The Open LV project provided local electricity substation data to communities to help them understand the network and plan low carbon projects. Seven community groups took part, getting data from their local substations through a web application, to show local electricity use, generation, substation temperature, voltage level and carbon intensity of electricity.
Cornwall Local Energy Market	This is an EU-funded project led by Centrica to create a local energy market and test flexible demand, generation and storage across homes and businesses. We contributed to this project through the Visibility Plugs and Sockets project, exploring the potential for DNOs to purchase flexibility through a third party. We wanted to reach different customers that might not engage via our own Flexible Power platform, to better understand what sort of flexibility services we could buy from new customers, including domestic energy users. This project should improve our ability to provide flexibility services to domestic customers in the future.
Future Flex	This second-generation flexibility markets project aims to improve market design for smaller-scale and domestic customers, by better understanding the barriers in the process and increasing participation. This innovation project will make network flexibility services more accessible to homes and communities, such as groups of households with smart EV chargers, domestic electricity storage or smart, hybrid heating.

Figure SA-05.8 Community Energy Projects

Community engagement

13.9. Since 2014, we have delivered an extensive programme of community energy engagement, helping the WPD regions to become the most active areas of community energy in England and Wales.

13.10. Our approach to engagement has been informed by feedback from community energy organisations, to ensure we are delivering the support communities want, and providing value for our customers. Through this, we've developed a constructive relationship with many community energy organisations, which is forward-looking and solutions-focused. Between 2014 and 2020, we delivered 40 community events with over 1,380 participants.

13.11. Our participatory engagement events have aimed to provide:

- Information on the latest developments in our changing energy system, such as connections, flexibility markets, support for vulnerable customers and innovation projects;
- Sharing of learning between community groups about new business models and leading community energy projects;
- Space for discussions so participants can ask questions, discuss innovative project ideas and give feedback to us on what support they need next;
- Informal networking at our community energy feasts;
- Immersive learning experiences through site visits.

Track record

Working with community energy groups

13.12. Our track record has been demonstrated through significant community energy engagement and support over the previous seven years, which has seen the creation of 97 community energy groups throughout our four licence areas, which accounts for 43% of all community energy groups in the UK. This has facilitated 100MW of community-owned renewable electricity to be connected to the network. Examples of these groups are:

- Burnham and Weston Energy Community Interest Company which operates a 9.3 MW Communities for Renewables solar farm providing income for the local community which funds a fuel poverty service;
- Plymouth Energy Community which owns 33 solar arrays generating clean electricity and helping to fund PEC's extensive fuel poverty work and cost savings for schools;
- Green Fox Community Energy, Leicester's community energy co-operative, which has the largest community-owned renewable heat project in the UK, a 2 MW biomass boiler providing renewable heat for a local secondary school. This saves 500 tonnes of CO2 per year and helps to pay for energy efficiency measures in other nearby schools.

Providing information and support

13.13. We have provided support to the communities and their representatives through accessible guides. Our 'Connecting Community Energy' guide is a 'how to' for any local energy group looking to develop its own renewable energy project and connect to our network. Supported by the Centre for Sustainable Energy, we developed our 'Community-Based Network Innovation' guide, which has supported our collaboration with community energy groups on several innovation projects with a total investment value of over £9m.

13.14. Some organisations prefer to discuss matters in more detail with our engineers and therefore we have implemented Community Energy Surgeries with our local teams. These allow us to engage more closely with groups at the start of their journey and provide guidance on how best to connect to the network and operative efficiently and effectively.

Context for RIIO-ED2

13.15. We have seen an increase in climate action groups and local authorities engaging with us, as a result of climate emergency declarations. These new local energy stakeholders are working towards carbon reduction plans that will include new low carbon energy infrastructure and we want to support them alongside existing community energy organisations.

13.16. During RIIO-ED2, the energy system will continue to transform into a smarter, more flexible and responsive low carbon energy system. The associated changes will potentially change the way consumers interact with the energy system.

13.17. We are committed to continuing our leading edge engagement with communities and community energy groups to support the delivery of their ambitions and in turn to maximise their support of a more dynamic and flexible network. Where community energy groups have the potential to provide significant localised energy balancing services, this enables us to further optimise the operation of the distribution network.

Key activities/actions for RIIO-ED2

13.18. Community energy organisations face multiple barriers, including the lack of viable business models, are time and resource poor and struggle to engage and stay informed about the complex and fast-moving changes in our energy system. We recognise that we need to provide additional support to communities and local energy collaborators. We are committed to working closely with communities to support their goals.

Providing support

13.19. Engagement with community energy stakeholders will form an important part of the support that we provide. We will build on our existing community energy surgeries and programme of engagement, evolving our approaches to meet the changing needs of the various groups.

13.20. Stakeholders have identified that they struggle to understand the complex nature of the energy system and therefore we will look to enhance our support for local energy groups through the provision of dedicated resource. The 'Community Energy Engineers' will provide a clear focal point for communities to engage, develop and importantly deliver their plans with the help and support of WPD.

13.21. We will use these interactions to build a knowledge base for community energy development and share the knowledge throughout our business. This will enable us to implement community energy training to ensure that advice is being provided consistently.

13.22. Community energy stakeholders have limited resources and therefore may not be able to contribute to industry consultations. Because this places them at a disadvantage, we will capture their concerns and needs to make sure that their interests and requirements are represented in the responses we provide. We will also ensure that relevant changes are communicated to community energy stakeholders in a simple and digestible manner.

13.23. Data is becoming increasingly important and providing community groups with the right level of data in the right format can empower them to maximise the value of their investments. We will ensure that our presumed open approach to data will capture the needs of this group.

13.24. We have a strong track record of working with community energy groups to trial new ideas through funded innovation and we are committed to further developing this. We will use our dedicated community energy resource to identify opportunities to support community energy group-led projects. To support this, we will ensure that 'communities and vulnerability' is an explicit theme in our Innovation Strategy.

Delivering network benefit

13.25. In addition to supporting community groups to achieve their objectives, a key driver for our community energy engagement is to deliver network benefit. As we continue and develop our support for these groups, we expect to see a number of benefits such as:

- information to enhance our future energy scenarios work;
- development of local level energy balancing;
- development of new community energy focused solutions and implementation into business as usual activities.

14. Innovation

Our track record

14.1. Innovation is the process of having new ideas, developing them into practical solutions and trialling them to investigate their effectiveness. It is through innovation that we continue to improve the way we operate and develop our network in order to provide best value for money to our customers.

14.2. Our innovation programme develops the solutions, skills and processes required to create a future decarbonised and intelligent electricity distribution network that is affordable for all of our customers.

14.3. In RIIO-ED1, our innovation programme has transformed our network and enabled us to provide our customers with a better service, faster and cheaper network connections and opportunities to provide flexibility services. This was achieved through the rollout of solutions designed, implemented and successfully trialled in our innovation projects. For example, we are now able to offer our customers Active Network Management (ANM) connections so that they can connect to our network more quickly and cheaply than with a conventional connection. We developed new policies and solutions that enable customers to connect in areas where fault level issues would have previously prevented a connection due to high network costs.

14.4. Additionally, we led the creation of new standards such as Engineering Recommendation G100, driving the use of export limitation devices in UK electricity distribution networks. We developed network optimisation technologies that enable us to maximise the existing capacity in our network and completely changed our approach to network monitoring to increase visibility in the operation of both LV and HV networks. We also responded to stakeholder feedback asking for more information on the carbon intensity of the energy mix in their local areas and developed an app for this purpose.

14.5. We also developed solutions for the way we manage voltage. This helps to reduce our customers' consumption by changing the voltages at our primary substations. This has increased network efficiency, reduced losses and network costs. We are now adding advanced functions to our Network Management System to perform real time optimisation of voltages in 33kV networks to increase network capacity for low carbon technologies and defer expensive traditional reinforcement.

14.6. Reducing the costs associated with operating and developing our network is important to us as it lowers the overall costs to customers through more efficient ways of operating. The flexibility services we now offer to customers originated from one of our innovation projects and shaped the way we interact with customers commercially. Our flexibility services provide our customers with the opportunity to help us manage our network more effectively while at the same time earning additional income and making the most out of their existing assets.

14.7. Not all of our projects have produced solutions that were suitable for rollout within the business for a number of projects. For example, some projects were ahead of their time and need to be revisited again in the short term future to re-evaluate their business case as technologies are more widely adopted. Some other projects, such as our Superconducting Cables NIA project, have proved that the solutions investigated should not be implemented as they would not provide any customer benefits. This has prevented unnecessary investment in the UK distribution network that would not provide value for money.

14.8. Both our successful and unsuccessful projects have helped us build and continuously improve our robust framework for delivering innovation, develop the skills needed to plan complex projects and manage relationships with project partners.

14.9. These skills and the experience we gained are our greatest assets, making all of our work incredibly valuable even if the outputs were not what we expected.

14.10. We recognise that not all projects will be successful or produce solutions that are suitable for rollout but we remain proud of our passion for continuous improvement and our focus on extracting maximum learning out of every single project and providing the best possible value for money.

14.11. It is widely recognised that dedicated innovation funding over the previous price controls has been highly effective in allowing companies to embark upon longer-term, energy system transition, whole system, or vulnerability-related innovation which deliver benefits beyond those accrued by the individual company.

Innovation in RIIO-ED2

Our innovation ambition and RIIO-ED2 innovation programmes

14.12. Our innovation ambition is to drive the transformation of the industry to enable the UK meet net zero affordably. This ambition underpins our strategic innovation plans for RIIO-ED2, shapes our priorities and defines our values. Building on our successes in RIIO-ED1, we will widen our innovation programme to continue developing the solutions for a sustainable and intelligent network as well as demonstrating new ways to support out vulnerable customers throughout the energy transition, ensuring that everyone can benefit from a smart, net zero future.

14.13. For RIIO-ED2, Ofgem is proposing to continue the Network Innovation Allowance (NIA) but will limit eligibility to projects linked to the energy transition and consumer vulnerability. The Network Innovation Competition (NIC) will be replaced with the Strategic Innovation Fund (SIF). We will be actively seeking to secure funds from both the NIA and SIF throughout RIIO-ED2 to continue our extensive core innovation programme.

14.14. We will dramatically increase our innovation activities in the RIIO-ED2 period by delivering two innovation programmes instead of one. Our core innovation programme will deliver projects funded through external mechanisms such as NIA and SIF, while our new business innovation programme will consist of the rollout of previously proven innovation and projects to enable our business to operate more cost efficiently. Our business innovation programme will be funded through Totex.

WPD's RIIO-ED2 Innovation Strategy

14.15. Our RIIO-ED2 Innovation Strategy provides detail on our innovation ambition, our values and priorities, our strategic plans for RIIO-ED2 and our approach to changing our culture to embrace and reward innovation within the business.

14.16. Our RIIO-ED2 Innovation Strategy will be updated on an annual basis or more frequently if required, to reflect rapidly changing external factors including government policy, stakeholder priorities and incorporate learning. Further details can be found in appendix A10.

Innovation programme delivery

14.17. Our innovation team is dedicated to working with our business experts, external partners and customers to identify their most pressing problems, find solutions and trial them through our innovation projects. To date, we have delivered more than 120 projects investing over £80m in innovation.

14.18. Team members are drawn from internal resources including employees of all levels, as well as external support from outside the organisation to bring in fresh ideas. They come from a range of

backgrounds including active transmission networks, craft skills, data science, research science, project management and customer service.

14.19. To achieve our innovation ambition, we believe it is important to have clear values that align with our ambition. These values determine how we deliver our strategy and projects, how we interact with others, how we work as a team and how we manage our work. Our three core values are:

Figure SA-05.9 Our innovation core values

14.20. We have developed a strong framework, documented within our Project Governance Guidelines, for creating and delivering our projects which is based on internationally recognised project management methodologies (PRINCE 2) and applied in the projects we delivered so far.

14.21. All projects include representatives from outside the innovation team to ensure that new solutions can safely be implemented on the WPD network and integrated into our current processes and systems. The representatives work alongside the project manager to develop policy, operating standards and practices to provide the framework for replication.

14.22. The approach to rollout is developed as part of the project and detailed in project closedown reports. Where a new solution requires staff training, this is identified, developed and trialled within the project.

14.23. During RIIO-ED2, we will develop a new interactive 'ideas portal' for staff, third parties, communities and other stakeholders to make their own suggestions for new projects that align with our core or business innovation programmes. Where appropriate, we will make grants to individuals or groups to progress an idea through feasibility assessment and to create a high level project scope.

Our innovation commitments

14.24. Innovation has a crucial role to play in the decarbonisation of the energy system. We need to ensure that our electricity distribution network can meet the increasing demand from the electrification of heat and transport while also allowing the connection of more low carbon generation. We will continue to innovate to find novel ways of transforming our network efficiently and effectively and operating it to meet these demands.

14.25. We are committed to maintaining our industry leading standards of customer service, safety and reliability while keeping costs low for our customers and protect our most vulnerable. We will harness innovation to achieve this and develop new technologies, commercial solutions and standards that will enable us to make the most of our existing network and assets.

Core innovation programme

14.26. Our core innovation programme will deliver projects funded through external mechanisms such as Ofgem innovation funding, BEIS competitions, InnovateUK, calls and initiatives connected to the Energy Systems Catapult and other national and international schemes.

14.27. We welcome the continuation of NIA funding and the introduction of the new Strategic Innovation Fund for RIIO-ED2, which will support future-facing strategic challenges. These innovation funds will be targeted at projects linked to the energy system transition, focusing on key strategic challenges. Projects will also be carried out to address consumer vulnerability.

14.28. We will be requesting £30m of NIA funding for the RIIO-ED2 period, which is at similar levels as our RIIO-ED1 allowance and continue to contribute at least 10% of the costs of all projects.

14.29. The exact pathway to UK decarbonisation remains unclear. It is therefore important that our projects are is sufficiently broad to support whatever route is taken. We use a principle of a 'balanced portfolio' of projects. Our portfolio of projects will therefore have a mixture of:

- projects that develop incremental improvements;
- projects that are more radical or disruptive;
- projects from 132kV sub-transmission networks to low voltage servicing individual customers;
- socially focused projects to ensure we continue to improve the way we support all of our customers;
- demonstrations for solutions involving heat, e-mobility and generation;
- projects considering engineering technology, data analytics, competition and markets;
- locations spanning urban, suburban and rural locations; covering a range of customer demographics;
- trials across all four WPD regions to gain feedback from across a wide geographic area; and
- delivery approaches from WPD teams through to those delivered primarily by third parties.

14.30. For those solutions which involve more disruptive process change, a business impact assessment will be carried out. Organisational or budget changes will be progressed by the relevant senior management teams.

14.31. There will be specific emphasis on the following themes over RIIO-ED2:

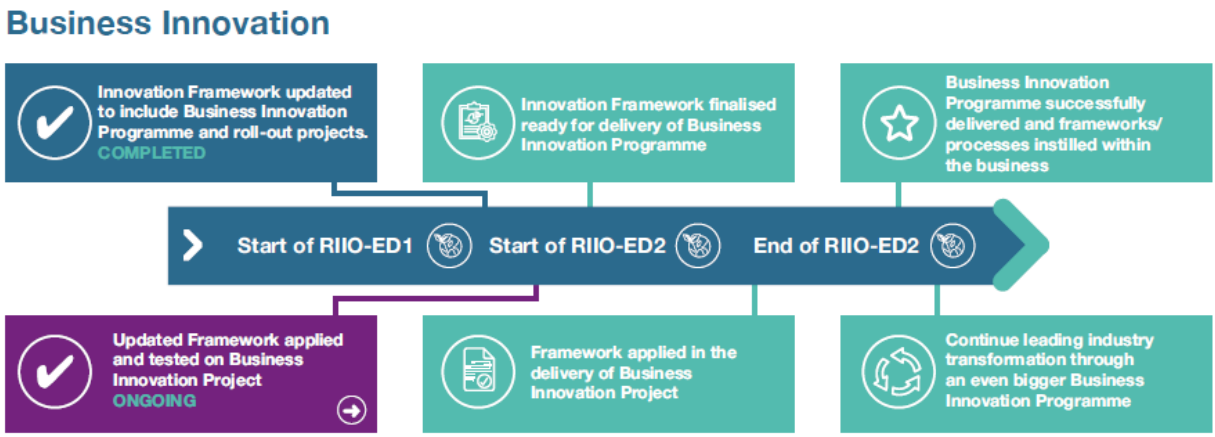
Decarbonisation	• Investigation and trial of new ways of reducing our carbon footprint in the various areas of our business.
Communities and vulnerability	• Specific projects to support energy communities; • Initiatives focused on consumer vulnerability, solutions to ensure communities and vulnerable groups can access new energy services and markets.
Behavioural analysis and probabilistic planning	• Application of statistical research and analysis of consumer behaviours to inform planning and operations; • Transfer of techniques from other sectors such as defence and retail.
Digitalisation	• Use of analytics tools and application of data science; • opening of data to authorised third parties and the general public; automation and artificial intelligence; • application of ICT to all part of the grid; • secure, simple integration with customer end use / equipment; data collection and aggregation technologies including cyber security aspects. • This work area will build on the work of the Energy Data Task Force and concept of presumed open data.
E-mobility	• support the mass market adoption of electric cars and vans, using innovation to solve any issues which arise; • further development of smart charging and V2G solutions (vehicle-to-grid technologies); • develop further solutions for connection of charging infrastructure as new technologies become available; • exploration of solutions for heavy freight; • inland and coastal shipping; technology tracking on on-vehicle technology for batteries and charging
Low carbon heat	• projects developing and demonstrating innovative electric heat solutions; district heat; • industrial waste heat; • hybrid customer solutions; • mass market scale up of heat pump adoption; • integration of heat flexibility and storage; • inter-seasonal storage and market integration
Distributed generation	• technology tracking and integration of renewable generation in to the network; • thin film PV and falling prices; • rooftop and ground deploy technologies; • integration with community and municipality local energy schemes.
High Voltage power electronics and battery storage	• falling prices of power electronic equipment will make application at DNO level more cost effective; • enhancement of EHV solutions and expansion to HV/LV networks; • technology tracking for battery storage especially grid scale solutions used internationally

Flexibility services and energy efficiency	• development of DSO flexibility products; • expansion to lower voltage networks; optimisation techniques across multiple markets; • introduction of distributed ledger and peer to peer trading; • relationship of markets with Energy Efficiency solutions

Figure SA-05.10 RIIO-ED2 innovation themes

Business innovation programme

14.32. We will strategically focus on delivering BAU innovation and innovation rollout to accelerate cost efficiencies and the adoption of innovation.



14.33. We define business innovation, otherwise referred to as BAU innovation, as lower risk innovation that cannot be funded though the Ofgem driven mechanisms but can provide benefits to our network and customers by reducing our costs and introducing efficiencies.

14.34. We will deliver business innovation projects through our new business innovation programme which will be funded through TOTEX.

14.35. Our innovation team will be supplemented by additional resources to support the delivery of these objectives.

14.36. We have already started preparing for the delivery of our new business innovation programme in RIIO-ED2, by updating our existing framework to capture how it applies to business innovation projects (see figure SA-05.11). We have even started applying that framework in the delivery of our first business innovation project, called PrimeEV, which is now in the delivery stage. This enables us to test our updated framework and identify further changes required before applying it on our business innovation programme in RIIO-ED2.

Figure SA-05.11 Business innovation framework

14.37. We will not limit our business innovation programme to specific areas of our business but instead ensure we have a broad portfolio of business innovation projects. Through our business innovation work, we want to drive continuous improvement and make our systems, processes and technologies as efficient as possible in any business area where there is space for improvement.

14.38. Throughout RIIO-ED2, all our business owners will be able to submit their business innovation ideas through our new ideas portal for assessment to be approved and scheduled for delivery.

14.39. Although we will not limit out business innovation work to specific areas, we have already engaged with all of our senior managers and captured their initial ideas in preparation for the start of RIIO-ED2. These include network performance, asset management, customer service and new connections support, fleet maintenance and management, regional energy modelling and carbon reporting, network planning and finance.

14.40. Our business innovation programme will include the rollout of successfully proven innovation delivered by us or other DNOs in previous price controls and during RIIO-ED2. As part of that, among other solutions, we will be delivering the rollout of System Voltage Optimisation (SVO), our centralised voltage control system that we successfully trialled in a previous LCNF project and our PrimeEV connection solution currently being developed as a business innovation project in RIIO-ED1.

14.41. To ensure that we maximise the value for money from the innovation work we have delivered so far, we have already started re-assessing innovation projects which were completed in previous price control periods but concluded that it was too early for their outputs to be used in BAU.

14.42. During RIIO-ED2, we will deliver any of these projects that now have a strong business case and continue re-assessing previous work so that no opportunity is missed to roll out proven innovation that can provide benefits to our customers.

Involving third parties in business innovation

14.43. We welcome third party collaboration in our business innovation work. In fact, we believe it is necessary in order to be able to create the technologies, processes and solutions needed to drive change within our business.

14.44. Third parties will therefore be able to submit ideas for business innovation projects through our new ideas portal, which will then be assessed and allocated for delivery, if successful. These ideas could be related to solutions already developed with other DNOs, ideas proven independently of any Ofgem funded projects or low risk innovation that has the potential to create a new solution, all of which would introduce cost efficiencies.

14.45. Where Business innovation projects involve the rollout of previously proven innovation (by ourselves or other DNOs), it is likely we would require the involvement of the third parties that created the innovation in order to ensure it is successfully applied and used.

14.46. We will therefore be open to collaborating with such organisations when delivering our business innovation programme.

Overcoming the barriers to the adoption of innovation

14.47. To ensure that we develop robust plans that will enable us to successfully deliver business innovation, we start by understanding potential barriers and then shaping our plans to overcome these.

14.48. From our previous experience in delivering innovation projects, we have found that sometimes staff are not comfortable with change and do not see innovation as beneficial or exciting. We are therefore focusing on changing our culture and will be running campaigns to alter perceptions and to make all our business areas aware of the positive changes brought by. We believe that embracing change and being excited about the prospect of improving the business is absolutely essential to successfully deliver innovation in the business.

14.49. Even if the overall perception of innovation is a positive one for staff, there is still a risk that their interest will be low in delivering the innovation within their area. Research from the Harvard

Business review has shown that engaging people from the very first stages of creating the innovation idea and ensuring that ownership of the idea is shared with all stakeholders motivates them to deliver it as they feel responsible for it when it originates from them. We will follow this approach and involve stakeholders in the initial detailed discussions but also ensure we are flexible and take on board any suggestions they have during the delivery of the project.

14.50. Budgetary priorities can also be a barrier to the adoption of innovation and could delay business implementation. For this reason, we will be allocating £3m of annual budget specifically to fund our business innovation programme.

14.51. Existing business processes such as procurement or IT development can decelerate the application of new innovation within the business. For this reason, in every business innovation project, from the idea creations stage, we will be identifying all internal teams that will need to be involved in all stages project and discussing the idea with them to determine how it can be delivered overcoming existing issues. This process will also be followed for any projects delivered within our core innovation programme so that the solutions developed will be suitable for business use.

14.52. Other industries have been successful in adopting innovation and we have identified how we can use their learning to shape our approach. This is demonstrated in more detail in our RIIO-ED2 Innovation Strategy.

Embedding a culture that celebrates innovation

14.53. We recognise that driving business innovation and change throughout our organisation is not just about delivering projects. It is about changing perceptions so that innovation is not seen as scary, complicated or difficult. It is about rewarding innovation, encouraging continuous improvement and embracing change. We will do that by embedding a culture that celebrates innovation.

14.54. We plan to drive business innovation and change our culture by rewarding innovation through internal performance metrics, creating a competitive spirit between our internal teams that encourages efficient delivery and adoption of innovation, sharing ownership of business innovation projects within the business area where the project is delivered and having innovation ambassadors in each of our main business teams. Our detailed approach for this and how we plan to overcome the expected challenges that could prevent innovation adoption are captured in our RIIO-ED2 Innovation Strategy.

14.55. Our culture will also be shaped by the new people who join our business to become our future leaders. Attracting the best talent and giving opportunities to ambitious individuals who are passionate about making a change in the industry will be key to achieving and maintaining the culture we want to create.

14.56. We have already started acting on this through our most recent graduate recruitment where we changed our process to focus on getting the right people into the business able to drive innovation and change.

14.57. All of our business graduates will also be spending time with our innovation team as part of their graduate scheme where they will be given opportunities to make a change and appreciate the benefits innovation can bring.

14.58. We also recognise that culture change cannot happen quickly. We expect to see business engagement grow within the RIIO-ED2 period and our aim is to have new business innovation ideas submitted to the innovation team every month by the end of RIIO-ED2.

14.59. We will keep monitoring our business engagement and we will be continuously assessing our innovation culture during RIIO-ED2 by taking into account the number of projects in delivery, the benefits provided through implemented business innovation and our staff's perception of innovation captured in surveys.

Understanding the barriers to changing our culture

14.60. The nature of our business means that the focus of the majority of our main business has been constant over the years with no or very little change.

14.61. Although we did have some great engagement with our main business teams when delivering innovation projects, not all of our teams in all areas have had the chance to be involved in our previous innovation projects. This is because innovation trials usually take place in a specific geographical area depending on the project.

14.62. This means that change and innovation are not familiar concepts for most of our staff. To explore this further, we have engaged with our business owners to discuss with them what innovation means to them and any innovation activities already completed with their teams or planned for RIIO-ED2. This exercise verified that perceptions of innovation vary within the business and that there is insufficient awareness of how innovation has already improved many of our activities when it comes to operating the network, connecting customers and increasing network capacity.

14.63. Therefore, to embed a culture that embraces innovation, we need to start with the basics and first of all help our staff understand what innovation is and how it has already improved our activities.

14.64. We will do that by running internal campaigns to spread the positive message and also visit our local teams to speak to them in person about innovation and how their ideas can be implemented through our business innovation programme. We will focus on ensuring that our staff know their suggestions will always be listened to and that we can help them to implement these.

14.65. When engaging with our business owners, we also discovered some great, novel initiatives being carried out by local teams, such as trials of new technologies that can accelerate the restoration of supplies in fault conditions. We do believe that by enhancing the communication we have with all of our business teams we can discover even more exciting and disruptive ideas.

Creating new projects

14.66. The identification of projects arises from within WPD and from external suggestions.

14.67. We capture ideas by running calls for innovation projects. These calls are run at different times of the year, when we ask individuals or organisations to submit proposals for NIA projects focusing on a specific topic. Example topics include data, communities and consumer vulnerability. Once an idea is selected, we work with the successful companies to develop NIA projects around their proposal.

14.68. In RIIO-ED2, we will continue our socially focused calls for ideas, targeting community groups and organisations that support the vulnerable and fuel poor.

14.69. During RIIO-ED2, we will develop a new interactive 'ideas portal' aimed at staff, third parties, communities and other stakeholders where suggestions for new projects can be made. Where appropriate, we will make small grants to individuals or groups to further progress an idea through feasibility assessment and the creation of a high level project scope. This ideas portal will be used for both innovation programmes.

14.70. We will also actively explore external involvement in the generation of ideas for new projects through a variety of mechanisms such as identifying best practice development from other DNOs' projects that can be incorporated in our business or developed further through innovation trials, interacting with wider stakeholder groups and EV chargepoint operators' forums to understand their challenges, investigating innovations developed outside of our direct industry to understand what can be learnt and adopted to improve our wider business operation.

14.71. We also want to discover new ways of generating ideas. We will, therefore, remain open minded in our approaches and will continuously review them. We have already started conversations with leading technology companies which have a track record of leading innovation in their sectors as we are keen to learn from their approaches.

14.72. Each project idea will be assessed to determine:

- If it is suitable for our core innovation programme or our business innovation programme based on its risk level and compliance with NIA/SIF governance.
- Its business case to show what benefits it can provide to our customers or what cost efficiencies it can introduce in our BAU operations and over what timescales the investment in the project will be recovered.
- Its alignment with our RIIO-ED2 Innovation Strategy.

14.73. Projects will only be progressed where:

- a potential cost benefit can be identified and provided within acceptable timescales
- the project meets regulatory criteria
- the project aligns with our innovation priories and strategy.

Consolidating and sharing the learning

14.74. Process and policy change is usually informed by a wide range of developments and trials. It is unusual for a single innovation project to develop a standalone new policy or process. More often, several projects across the innovation programme and learning from other organisations will inform such developments.

14.75. During RIIO-ED2, we will continue to track lessons learned from projects, including capturing those things which have been tried but proven to be ineffective. We will use learning from our own projects and gather information from other network companies. We will also do more to track international developments.

14.76. We will continue to run effective dissemination events and openly publish reports. All significant reports will be peer reviewed prior to publication. We will maintain a dedicated website for innovation projects. Project specific and programme level papers will be published for a variety of audiences. The international Conference and Exhibition on Electricity Distribution (CIRED) will be our main forum for sharing technical papers while trade and mainstream press will be used for more general audiences.

14.77. We will participate in national events such as Utility Week Live, ENA's Network Innovation Conference and our own annual dissemination event. We will also participate in at least one European conference or exhibition each year. At a more regional level, we will support local events, especially in those localities which host specific project trials.

Stakeholder engagement

14.78. Stakeholder engagement is an integral part of WPD's core activity.

14.79. Engagement on innovation takes many forms. It includes generic engagement with a wide range of stakeholders, specific engagement with the innovation community and targeted engagement on specific technical topics.

14.80. For specific projects, the innovation team project manager will carry out dedicated engagement with focus groups to share learning and discuss project outcomes.

14.81. The innovation team also acts as a point of contact and informal advice for local groups and universities. This may involve attending community meetings or delivering lectures or tutorials for undergraduates and post-graduate students.

14.82. The team also responds to suppliers who ask for advice on developing their products, which may lead to collaborative work with WPD or suggesting collaboration partners.

14.83. We will continue to engage with our stakeholders regularly to share the learning generated in our innovation projects, whether successful or unsuccessful, obtain stakeholder feedback on our innovation strategy and plans, involve them in the process of identifying the areas we should be focusing on and have informal conversations on how we can support their needs.

14.84. We are proud of our passion for continuous improvement and therefore always look for ways to improve our stakeholder engagement.

14.85. At every event, we collect feedback on how we performed and what we could do better to make our events more enjoyable and beneficial for our stakeholders.

14.86. We also consider the views and interests of our stakeholders when planning our events. Our most recent innovation showcase event, for example, was shaped entirely by the interests of the stakeholders who registered for the event through information we collected at the registration stage.

14.87. We want to make it as easy as possible for our stakeholders to get in touch with us if they have an idea but also to be able to collaborate with us effectively to turn that idea into a project and deliver it successfully. For this reason, we will be creating a form on our website asking our stakeholders to tell us about how they found their journey with us, starting from their initial contact, through to the stages of creating the project and delivering it. We will be continuously reviewing our existing processes and using the information collected to improve them whenever possible.

Collaboration with other industries within the UK and internationally

14.88. We know that in order to achieve net zero, we cannot be looking at our infrastructure in isolation. We need to be working with other key infrastructure providers and industries to find solutions that work for the whole system and provide the best overall benefit to the UK consumer.

14.89. This collaboration is necessary to facilitate the energy transition in the most economical way.

14.90. We are passionate about driving this collaboration to bring together all the right people and jointly, strategically tackle the biggest challenges to decarbonisation.

14.91. To achieve this, during RIIO-ED2 we will be running our net zero working group with key decision makers form other industries such as transport, utilities, manufacturing. We will use this working group to keep everyone up to date with each sector's strategic innovation plans, capture any impact on other sectors and overcome barriers in regulation and governance that make collaboration difficult.

14.92. We have started strengthening our links with the water and rail industries and aim to collaborate on our first innovation projects before the end of RIIO-ED1. This process has already provided us with useful knowledge on how innovation is funded in different sectors what the existing challenges and the solutions are to overcome them. For example, we have been working with water utilities and railway network operators to understand how they innovate and create our first joint innovation projects ahead of RIIO-ED2.

14.93. We believe that establishing contacts and relationships early is key to be able to create larger scale whole system solutions in RIIO-ED2.

14.94. Additionally, through our EPIC NIA project, we are exploring in detail how whole system solutions and integrated planning with different sectors can produce solutions that are overall cheaper to the UK consumer. This has shown the significant potential cost savings that can be achieved by looking at the system as a whole.

14.95. Additionally in RIIO-ED2, we want to increase our collaboration with international DNOs which are leading the industry changes in their countries. We aim to do that by increasing our attendance at international events and conferences in order to expand our contacts base, make connections and work with them to understand in detail how they are innovating their energy system. From our current contacts with European DNOs, we have seen that we all share the same challenges and follow different approaches in addressing them.

14.96. We believe that close collaboration between industry leaders internationally is the only way to effectively address global issues such as decarbonisation.

14.97. Therefore, we are committing to partnering with at least two large scale international projects within RIIO-ED2 (one in Europe and one further afield). We will also support at least one smart grid project with a developing nation.

15. Modernising energy data

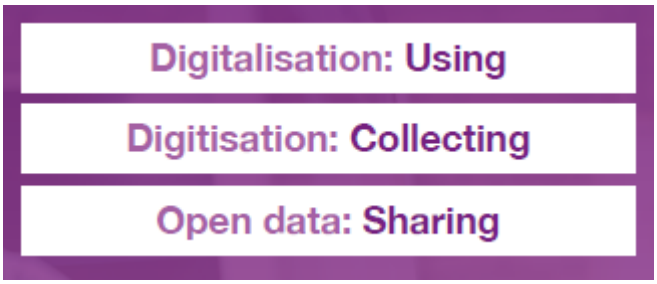
Digitalisation

15.1. WPD has developed a Digitalisation Strategy and associated Action Plan to which is core to building a smarter energy system and enabling greater sharing of data. Further details can be found in appendix A11

15.2. To understand the scope of digitalisation we draw a distinction between digitalisation (using data), digitisation (collecting data) and open data (sharing data).

15.3. For us, the term digitalisation means using digital technologies to fundamentally change how we develop and operate the network to deliver an economic and efficient service for customers.

15.4. Digitisation is the process of collecting information about the electricity network using sensors and control equipment. We are collecting some information for the first time and converting previous analogue information into digital formats. This allows it to be computer processed in support of digitalisation.



15.5. By open data we assume that all data should be presumed open unless proven otherwise for privacy, security, commercial or confidentiality reasons.

15.6. Digitalisation applies to the whole energy industry; therefore we are working with the other energy network companies (via our trade association the Energy Networks Association (ENA), the government's Energy Systems Catapult and our stakeholder community to identify the data that should be shared across the industry and how it should be pooled.

15.7. Our digitalisation activity will deliver change in how we plan, manage, and operate our network and interact with and provide data to customers and third party system participants.

15.8. We are committed to continuing to build on our significant work to digitalise our business to ensure that we remain an efficient and effective operator of our network and deliver data and solutions in the right format, at the right time to customers and stakeholders to meet their needs and ambitions.

15.9. Our core principles are, and will remain, improving data management, increasing network insight and operation and ensuring data is presumed open. These principles ensure value is driven to all parts of the energy industry and wider, supporting the net zero transition.

Our approach

15.10. Building a smarter energy system is a core driver of our digitalisation activity embodied in our process to drive change effectively focused on our three core approaches, Data Management, Insight & Operation and Delivering for Stakeholders.

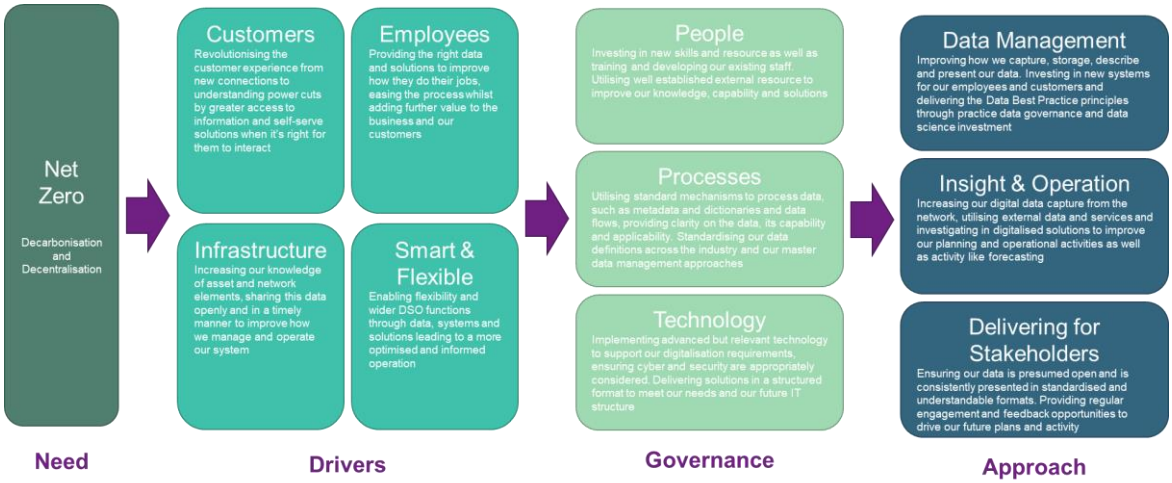


Figure SA-05.12 Our approach to digitalisation

15.11. We have ensured these elements have been the focus of activity to deliver digitalisation and data developments and improvements and to enable us to work towards delivering the key recommendations of the Energy Data Taskforce report and beyond. This has served us and our customers well and will continue to be utilised to ensure systems, solutions and data are developed in a way that maximises the value, benefit and longevity.

15.12. Improving and increasing data management acts as the backbone to drive insight both internally and externally to meet current and future system needs. Standard processes for creating, managing and handling data though a robust data governance process has been implemented and will continue to be developed. This invests in solutions to improve our data quality and ensures we have a single source of the truth.

15.13. Having better quality data will help us to improve our understanding of network performance and operation. We are investing in solutions that are improving the visibility and availability of data, automating network design and operational activities and enabling predictive and preventative maintenance.

15.14. We recognise it's important that our data is presented in the same format, described in the same way and provides the same level of detail as that of other network operators. This allows customers and stakeholders to have a consistent view of the data across the industry to support existing, new and developing markets. This will help developers to easily identify optimal locations for the installation of new generation or for aggregators and energy market participants to identify suitable assets to provide local and national flexibility services.

Improving data management

15.15. Improving our data management provides benefits for both WPD and for our customers and stakeholders. It will increase our ability to deliver value from data and enable digitalised solutions to be developed.

15.16. There are a range of changes that are required to improve our data management. We view this as a journey where we need to track and measure our progress to ensure we continue to focus in the right areas.

15.17. We have already demonstrated improvements in our data management processes through targeted project activity to understand our data sets, lineage, and business and third party use. We have recently invested in a new Geographic Information System, enabling us to further digitise our records and improve data capture activities.

Governance

15.18. Our data governance focusses on having appropriate data owners and processes, ensuring responsibility and transparency, to enable data quality to be managed and improved. It establishes rules and processes to maintain a consistent approach to data improvement and management as well as providing a route for feedback to improve and adapt.

Improving data quality

15.19. Continuous data quality improvement is required to maximise the value of digitisation. The scope and quality of our data quality has been fit for purpose in the 20th century but, as digitalisation grows, there is a need for more data and better quality data. We have seen this through our developing flexibility activity, where good data has provided improved solutions.

15.20. Our data governance will play an important role in improving our data quality through clear ownership and responsibility but we recognise that we still have gaps and inaccuracies in our data, especially where this data has historically not been required or utilised. A data centric approach is being used to drive data quality improvements. This includes projects to change how we capture data at source, store the data and manage it.

15.21. We have already made significant changes to data collection by developing a range of iPad applications that are used by field staff. We are increasingly removing manual processes through automation supported by machine learning to provide improvements on an enduring basis.

15.22. We will invest in automated processes to improve and monitor data quality, setting clear levels of acceptance to tangibly monitor and measure performance and improvement.

Single source of the truth

15.23. We need to improve confidence in our data. We have a number of different legacy systems that store our data, with data about the same thing being stored multiple times (e.g. asset records are held in the asset register and in the control systems). Storing data in multiple systems can lead to inconsistencies and our focus is to have a single source of the truth.

15.24. Changing our processes to ensure that data is only entered in a single place, rather than a number of times within different systems, and developing appropriate complementary master data management processes will provide data that is trusted, accessible and usable.

15.25. We have begun activity in this area, through the development and implementation of our Integrated Network Model (INM), which connects directly to our three main systems: our enterprise asset management, network management and geospatial information system. This identifies discrepancies in data between these systems and through an automated process creates a single version of our network, the assets and connectivity.

15.26. Our implementation and continuing management of a data catalogue will provide regular and reliable single point access to trusted data in a timely and effective manner. This will also facilitate a single self-service environment to its users that help them to find, understand, trust and manage data. Further, it will be clear to all data users within the organisation what each piece of data means, how it's collected, and how to use it effectively.

Increasing network insight and operation

15.27. Continually increasing access to more data enables decisions to be better informed and made more dynamically. It is becoming more important to have access to more data at increased granularity.

15.28. Leveraging value from data is fundamental to a successful digitalised business. Increased amounts of better quality data will improve how we operate the network in real time, allow more informed actions to maximise the capability of our assets and enhance how we maintain, plan and reinforce our network.

15.29. We have used innovation projects to develop new solutions capable of providing enhanced visibility of our network. These solutions, together with advanced control systems, are being rolled out to improve the effectiveness and efficiency of how we operate the network.

Additional data and monitoring

15.30. We are proposing to improve network load monitoring to have better visibility of the network's operational state. This will be targeted at areas of high (actual or projected) low carbon technology integration to inform optimised network operation and assess the need for additional network capacity.

15.31. We will use increased asset data to understand the condition of specific assets to identify and optimise planned interventions such as maintenance and replacement using digitalised solutions.

15.32. As well as network data and monitoring, additional data will improve customer facing activities such as processes for new connections, providing information about planned outages and operability constraints and information provided to customers affected by power cuts.

Use of external data and services

15.33. While we will increase the volume of monitoring and data capture on our network, there are external data sets and services that can be used or combined with our data.

15.34. We already utilise data sets such as weather forecasts to inform our operational readiness decisions and we will be making greater use of smart meter data to inform our processes.

15.35. We recognise that external organisations have skills and capabilities to drive value from our data, either through advanced analytic techniques or integrating it with other data sets. By sharing more data, third parties have the opportunity to identify improvements and we will consider using these third party services where they drive value to our network and customers.

Increasing internal access to data

15.36. The availability of reliable centralised data throughout our business enables operations to be coordinated, efficient and effective. Coordination will become increasingly important as WPD systems and network management become more reliant upon third party services.

15.37. As well as providing better information for external parties, internal processes can be improved as the scope of data grows. We will build on our data catalogue and governance activity to ensure that staff have an awareness of what data is available and that data used internally is accessible to drive benefits.

15.38. We will continuously and actively look for developments and improvements, both to the data and the access processes to ensure they're fit for purpose and support our business objectives.

Delivering for stakeholders

15.39. We understand that access to our data is vital to support a variety of current and future elements of the electricity and wider energy system. We also recognise that the needs of different customers and stakeholders are varied and that data may need to be presented in different formats.

15.40. Our data triage process ensures all relevant data is assessed and provided a data classification: this may be open, public, shared or closed.

15.41. Our Connected Data Portal is already home to many sets of network data and information. Because we recognise that the needs of different data user types vary, we committed to sharing

data in three principle formats to deliver usable and valuable data to as wide an audience as possible. These are:

- Easy-to-use and visual data representations, such as interactive heat maps of network capacity data, providing the direct route to answers for non-technical data users;
- Downloadable, standardised and interpretable data for data users to interrogate and drive their own insight and value, different to that presented in visualised representations;
- Data automatically presented to technical data users through application programming interfaces (API), focused on regular and repeatable data to, for instance, to inform real time dispatch detail for aggregators and flexibility providers.

15.42. Our process of presuming data as open will ensure it is available to optimise existing and support new processes, particularly focused on new connections and flexibility provision.

15.43. We also need to learn about how the data is being used, so that we can deliver data and access to it in a way that is most useful for stakeholders.

15.44. We are committed to making sure that our data is both discoverable and searchable; and ensuring that we continue to collaborate with wider industry to ensure that data, irrespective of organisation, has the same meaning, format and description (metadata and data dictionaries).

15.45. We recognise that our data has often been difficult to find and we have already undertaken a number of improvements. We will continue to develop our Connected Data Portal to further improve the availability and access to our data and complementary data sets.

15.46. Presuming our data to be open goes beyond making it available through our systems and services. Our role is to enable data to be harvested, housed and utilised irrespective of specific access point. Our implementation of APIs and Client URLs will ensure that this is available and appropriate. Our ENA wide work on the creation of an energy digital system map for GB has demonstrated our commitment to, and the availability of, our data to serve this purpose.

15.47. We will use our improved data management activity to understand our data, its format, its key descriptors and other relevant information to drive value. An online data catalogue, complementary to our internal version, will enable customers and stakeholders to find the right data, in the right format at the right time.

Track record

15.48. We are committed to maximising the value of data from within our business and utilising external data to inform and improve our decisions to increase and further improve our service to customers.

15.49. We have already started the process of digitalisation through the delivery of several projects in our DSO Strategy and work plan. Many of these projects are acting as enablers of DSO solutions through the creation of accessible data sets which will be used both within WPD and shared with third parties.

15.50. The following tables summarises some of the enhancements we have already made:

Connected Data Portal	The Connected Data Portal is an online facility that provides our customers and interested stakeholders access to a wide variety of our existing data sets.
Map based data	We have developed a number of open access maps to provide customers, stakeholders and other interested third parties access to a visual representation of our data, with the capability to download the background datasets.

	We currently have maps for power cuts, network capacity, network flexibility, EV capacity and our DFES.
Integrated Network Model (INM)	The INM enables us to align our previously disparate data sets to enable data improvements and a consistent format of network data.
Common Information Model (CIM)	Developing data into a more consistent format has meant that we can now share openly our data via the internationally recognised CIM standard for the transfer and provision of electricity network data, to allow direct access to a complete asset and connectivity model to support investment and operational planning for customers and stakeholders.
Open LV	OpenLV is a common, low cost monitoring system connected at a substation that can facilitate the deployment of different apps to provide data to suit the needs of the network, customers, and the broader supply chain. We have already seen communities utilising this real time data to further understand their electricity utilisation, plan for the integration of increased LCTs and explore potential revenue streams from emerging flexibility solutions.
Smart meter data	WPD was the first company to achieve an approved Data Privacy Plan for the use of smart meter data.
Embedded Capacity Register	This Embedded Capacity Register is an industry wide initiative to capture and share data about all generation assets of 1MW. This data is now publicly available in a consistent format.
System Voltage Optimisation (SVO),	We have implemented the System Voltage Optimisation (SVO), utilising data provided by the INM to improve our network management system to facilitate automated voltage control, optimising the network for the current power flow conditions meaning that the network can be tailored to maximise the connection of load or generation on the network.
Online GIS	We have provided an online version of our GIS system, available through DataPortal2.0 (https://dataportal2.westernpower.co.uk/Auth/Register) We will continue to develop this to provide customers with the information that they need to support their planning activity. It will also act as a basic to support a system wide Digital System Map (https://youtu.be/MyZs0wxc0OI).

Figure SA-05.13 Enhancements made during RIIO-ED1

Understanding the needs of data users

15.51. The data and digitalisation activities that we have carried out to date have been informed by extensive engagement with both internal and external data users, and this will continue and strengthen moving forwards. We use regular and relevant stakeholder engagement to understand what data is required, the format most suitable and how it is to be used most effectively as part of digitalised solutions.

15.52. We have worked to provide greater insight into our data stakeholders through the creation of user personas. We have developed profiles for specific roles within our user types to ensure our investments and developments are aligned to meet and exceed their needs.

Figure SA-05.14 User persona profiles

15.53. We continue to use a number of diverse engagement strategies, from our traditional face to face round table events to providing regular updates in digestible formats, such as short podcasts and videos of our latest developments and activities. Consultation is also important and we will provide opportunities to feed in to formal consultations, as we do today, but also short polls on LinkedIn and Twitter, to provide quick and easy ways for all user types to readily engage.

External engagement

15.54. Our external engagement recognises that different users have different needs and expectations of the same data. That means that ensuring the right data is available in the right format at the right time will lead to different formats at different times to serve different users.

15.55. An example of where we have made different formats of data available relates to our network capacity and FES interactive maps, where the maps provide users with an easy to navigate geographic view, but we also make available the more detailed source data for more technical users to build their own analysis.

Enabling digitalisation

15.56. Enabling digitalisation and data solutions requires WPD to have staff with data skills and enhanced IT and data communication infrastructure.

Workforce and skills

15.57. In order to build on our existing activities to ensure our current and future workforce can deliver our long-term strategy of using digital technologies, we will need to transform aspects of our business including staff capability, people and culture.

15.58. Recognising that new skills and capabilities are required within our business, we have already started introducing new development roles within our business, including Telecoms and DSO Control Systems apprentices. These will complement the graduate intake, which is being broadened beyond traditional electrical engineers to include the disciplines of data science, mathematics and IT. We are also creating and implementing a multidisciplinary digitalisation and data team, with a range of diverse skills, to speed up the time from design through to build and deployment.

15.59. Cultural change is also required so that data is recognised as being an important commodity. We have already seen that the use and expansion of field apps to collect data and provide information to field staff is helping to enhance the importance of data. We will continue to raise the profile of data, make improvements to the data and demonstrate the benefits of the data to ensure that good quality data is available for use by both internal staff and external stakeholders.

Information Technology

15.60. To support the transition to a fully digitalised organisation, our IT systems will need to be rationalised and modernised and this will include: replacing and upgrading legacy applications, as well as investing in new technologies, integration tools and common data platforms.

15.61. Our IT systems have traditionally been developed under the core principles of security, reliability and resilience. This has served us well but, as we move to a culture of open data and digitalisation, we need to make our systems more accessible, agile and adaptable to change, while also continuing to enhance our cyber security controls.

15.62. We will continue to ensure that our IT solutions are appropriate with use cases driving investment in new and augmented solutions. It is anticipated that some of our on premise solutions will become cloud-based solutions to ensure that they continue to be scalable, supported and flexible. We are likely to encompass a hybrid cloud architecture, utilising infrastructure, platform and software as a service solutions (IaaS, PaaS and SaaS).

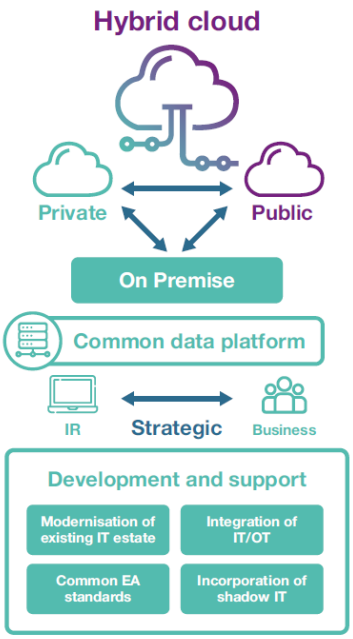


Figure SA-05.15 Hybrid Cloud Architecture

Delivering data best practice

15.63. As more data is made available to third parties, there is a need to provide it in a clear way and we are committed to ensuring our activities are in line with the Data Best Practice Guidance, adopted by Ofgem, which outlines 12 principles.

Data Best Practice Principles
Identify the roles of stakeholders of the data
Use common terms within data, metadata and supporting information
Describe data accurately using industry standard metadata
Enable potential users to understand the data by providing supporting information
Make data sets discoverable for potential users
Learn and understand the needs of their current and prospective data users
Ensure data quality maintenance and improvement is prioritised by user needs
Ensure that data is interoperable with other data and digital services
Protect data and systems in accordance with security, privacy and resilience best practice
Store, archive and provide access to data in ways that maximise sustaining value
Ensure that data relating to common assets is presumed open
Conduct open data triage for presumed open data

15.64. We have already undertaken a number of digitalisation and data enhancements aligned to these principles including:

- Adoption of the Dublin Core metadata standard;
- Providing data in a discoverable and accessible form (e.g. information maps, guiding users to key network and supporting information);
- Implementation of a centralised online data catalogue – Connected Data Portal;
- Establishing data governance roles; and
- Implementing a data triage process.

16. System Operator functions

Scope

16.1. More intermittent and less predictable use of the electricity distribution system is inevitable as customers substitute carbon based fuel sources with cleaner electricity. Traditional DNO operations would require very substantial investments in passive grid infrastructure, which would be under utilised much of the time. Continued construction, maintenance and operation of passive distribution networks is no longer going to deliver the best outcomes for UK electricity bill payers.

16.2. DNOs therefore need to change and provide DSO systems and solutions in order to operate and maintain efficient, economic and coordinated networks. WPD plans to be at the forefront of this transformation.

16.3. We will roll out DSO competences using a top-down approach, ensuring the 132kV, 66kV and 33kV networks are targeted first, prioritising those areas which will benefit most. This enables the rest of the network to be incrementally upgraded as the customer need dictates. We aim to develop wider flexibility for the use of import/export capping as an alternative to conventional solutions, only reinforcing the networks when these solutions cannot deliver what is required.

Meeting baseline requirements

16.4. We have mapped our System Operator functions against the DSO roles and activities for RIIO-ED2 as listed in the Ofgem sector specific baseline standards for DSO. In our list, we have sub-divided some items to provide additional granularity. The list is at the end of this annex.

Planning and network development		Promote operational network visibility and data availability		Facilitate efficient dispatch of distribution flexibility services		Provide accurate user friendly and comprehensive market information		Embed simple, fair, and transparent rules and processes for procuring distribution flexibility services	
1.1	✓ED2	2.1.1	✓ED1	2.2.4	✓ED2	3.1.2	✓ED1	3.2.1	✓ED1
1.6	✓ED1	2.1.3	✓ED1	2.2.6	✓ED1	3.1.3	✓ED1	3.2.3	✓ED1
1.7	✓ED2					3.1.4	✓ED1	3.2.4	✓ED1
1.8	✓ED1					3.1.6	✓ED1	3.2.5	✓ED1
						3.1.7	✓ED2	3.2.6	✓ED1
								3.2.7	✓ED1
								3.2.8	✓ED2
								3.2.12	✓ED1
								3.2.13	✓ED1

Planning and network data

16.5. WPD uses numerous sources of data to establish a forecast of future network loads and constraints. Established processes take national forecasts and combine them with local information to generate local forecasts. A common cross sector scenario (used in the gas distribution and transmission price controls) has been referenced to determine an early WPD Best View forecast. This Best View has been used to identify future network constraints and inform the future work programme that forms the RIIO-ED2 network reinforcement requirements.

16.6. Through forecasting using internal data sets, WPD will be able to provide instantaneous and predicted constraint levels for Distributed Energy Resources (DER) within operational timescales. This will allow the levels of constraint to be used when dispatching flexibility services and ensure the network is managed to maximise capacity and minimise constraints. We will develop enhanced forecasting, simulation and network modelling capabilities, with processes in place to drive continual improvement to meet network and user needs.

16.7. During RIIO-ED1, we will have completed the conversion of WPD network models to enable switch level analysis and develop the systems to record and simulate network asset behaviour. Through RIIO-ED2, we will improve our understanding of customer behaviour, enabling the impact of consumer-led smart technologies to be modelled alongside smart grid mitigations, to better understand true network capacity needs.

16.8. A core forecasting and capacity management team developed within the DSO business will drive improvement in understanding electricity system impacts on customer assets and behaviour. A system modelling team within the DSO business will develop the systems, techniques and data required to understand the electricity system impacts on network assets and behaviour.

WPD's track record and processes

16.9. Since 2015, WPD has been undertaking scenario planning work through Distribution Future Energy Scenario (DFES) reports, updating them on a two-yearly cycle to provide a forward looking 10 year window of potential low carbon technology uptakes. The DFES projections have been aligned with the latest National ESO scenario forecasts that are available when the DFES process is carried out. Further details can be found in appendix A12.

16.10. A separate process called Shaping Subtransmission determines the impact of the scenarios on the network. This process uses data from the DFES analysis to determine whether the change in use of the network leads to constraints. The information about constraints is used to inform future requirements for investment. Further details can be found in appendix A13.

16.11. The forecast network requirements are used to provide information for potential flexibility providers. Signposting gives a multiple scenario five year forward view of requirements and Forecasting provides a single two year Best View of requirements. This information informs the flexibility procurement process which operates on multiple cycles up to the point when investment is required.

16.12. The options for investment are considered in the Distribution Network Options Assessment process (formerly the Strategic Investment Options process) which determines whether flexibility, conventional reinforcement or alternative innovative approaches provide the most economical solution.

16.13. This leads to either implementing the operation of flexibility or proceeding with conventional reinforcement, where flexibility is unavailable.

16.14. The use of future energy scenarios and the associated processes are embedded as business as usual within WPD and therefore activities in RIIO-ED2 will be focused on expanding, enhancing and evolving these processes.

16.15. Enhanced visibility will give us the data, not only for us to manage our network to the highest levels, but also to enable us to give the best information to customers, providing leading indicators on where distribution network capacity is plentiful and where further support from flexibility services is required. By making this information available, WPD will contribute to the neutral facilitation of regional markets for the deployment of third party owned flexibility services.

16.16. The space between the Long Term Development Statement timescales and the Distribution Future Energy Scenarios forecasts will be filled with a Network Development Plan. We will use this to provide information across current and future Business Plan periods. We will ensure that our models and outputs are consistently available in all our forecasts.

16.17. Distribution network options assessment will be a six monthly publication providing transparency in decision making on the use of flexibility and other competitively tendered innovative network mitigations. An industry standard tool, the Common Evaluation Methodology (CEM), will be used to compare the investment options around a number of industry standard scenarios and the DSO's own Best View. Stakeholder engagement and whole system optioneering will be a crucial part of the DNOA process. The Distribution Network Options Analysis (DNOA) framework set out by WPD will solidify robust and transparent processes to ensure independence of decision.

16.18. WPD will develop a front-loaded payment mechanism to catalyse investment in energy efficiency measures, building on the revenue potential of flexibility. Network areas which would benefit from flexibility may also benefit from energy efficiency measures which reduce network loadings at cardinal points assessed by the DSO. A specific energy efficiency proposition should deliver low risk, long-term network utilisation reductions at an economic level.

Strategic network planning process

16.19. There are three main stages involved in our strategic network planning process:

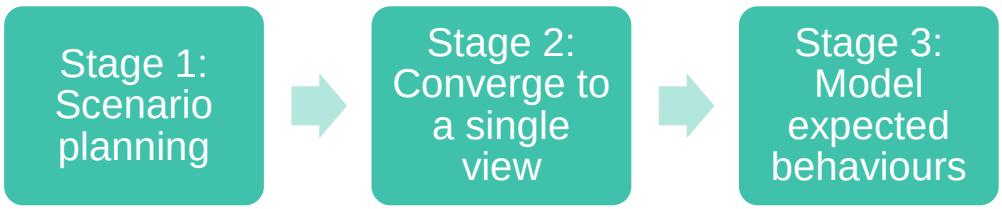


Figure SA-05.16 The strategic planning process

Stage 1: Scenario planning – Production of Distribution Future Energy Scenarios (DFES)

16.20. The first stage of the strategic network planning process is creating the Distribution Future Energy Scenarios (DFES).

16.21. The DFES use national Future Energy Scenarios (FES) forecasts produced by the ESO and local information to provide a distribution view of the technology volume changes across DNO licence areas.

16.22. WPD starting developing DFES studies in 2015 and was the first DNO group to develop DFES analysis and documentation. Since the publication of the first DFES report for the South West, WPD has continued to work with Regen to carry out the analysis which has been captured and published in licence specific DFES documents for all WPD licence areas.

16.23. WPD has committed that, from 2020, a full suite of DFES documents will be produced annually. This means that by January each year there will be an updated suite of DFES documents for all WPD licence areas following release of an updated ESO FES in the preceding July.

Considerations in DFES analysis

16.24. The DFES investigates 50 different technology types and assesses the potential for growth under each of the four ESO FES scenarios. It follows a four stage process as shown in the diagram.

Stage 1: Baseline	Stage 2: Pipeline	Stage 3: Resource	Stage 4: Scenarios
• **A baseline assessment**. Technology baselines are calculated from WPD's network connection database. This information is then reconciled with other market intelligence and external databases. In addition, further desktop research is undertaken to address inconsistencies	• **A pipeline assessment.** For technologies with significant lead times WPD's network connection agreement database is reconciled with the BEIS planning database and market research is undertaken. This allows an assessment of which commercial projects in the pipeline may go ahead and in what timescale.	• **Resource assessment.** Locational data from a wide range of data sources and GIS analysis is used to understand the geographical distribution, local attributes, constraints and potential for technologies to develop within the licence area and each Electricity Supply Area.	• **Scenario projection.** The National Grid FES scenarios are interpreted for specific local resources, constraints and market conditions. This includes the findings from a local consultation event and interviews from developers, investors and other stakeholders.

Figure SA-05.17 DFES stages

16.25. The analysis for the DFES considers the impact of each ESO FES scenario on a range of demand and generation technologies resulting in a projection of the volumes of these technologies.

16.26. This is illustrated by the West Midlands battery electric vehicle volume projections shown in figure SA-05.18 below. Similar projects are available for the full range of demand and generation technologies across all four WPD areas.

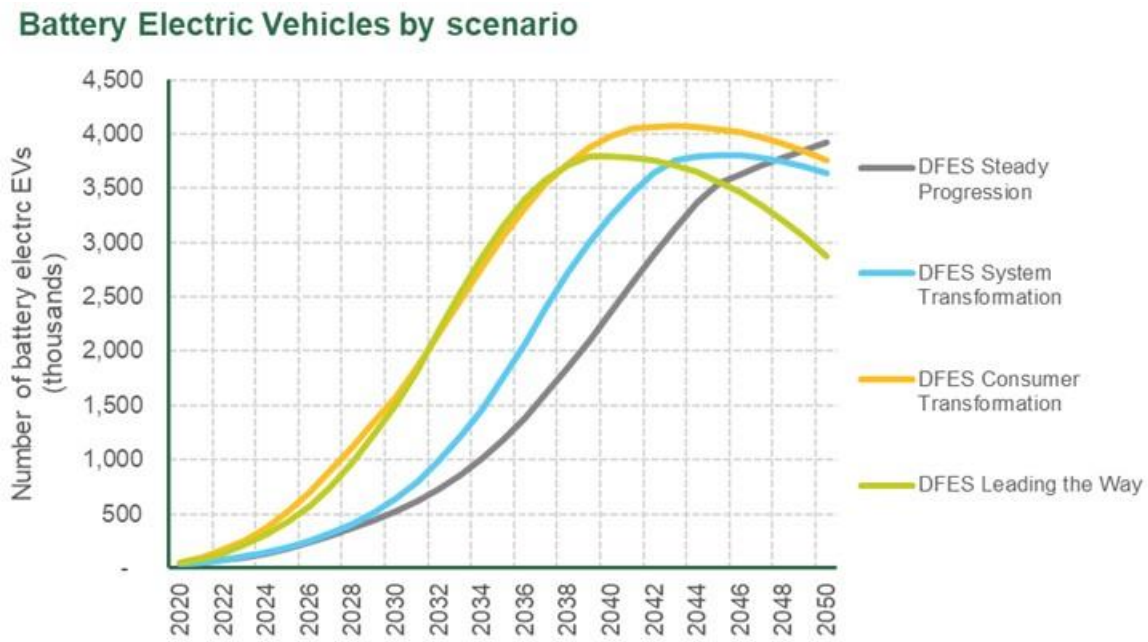


Figure SA-05.18 Electric Vehicle projections

16.27. The DFES uses the concept of Electricity Supply Areas (ESA) to define the level of granularity of the analysis. These are aligned to primary substations, resulting in around 1150 ESAs across WPD.

16.28. The growth of each technology is considered for each individual ESA using information gathered from DNO network data, connection agreement information from local sites and other external data.

16.29. The heat map in figure SA05.13 below shows the expected growth of non-hybrid heat pumps under the Leading the Way scenario in the West Midlands. This illustrates how much LCT uptake is expected to vary on a locational basis and how this will have a different effect on each electricity supply area.

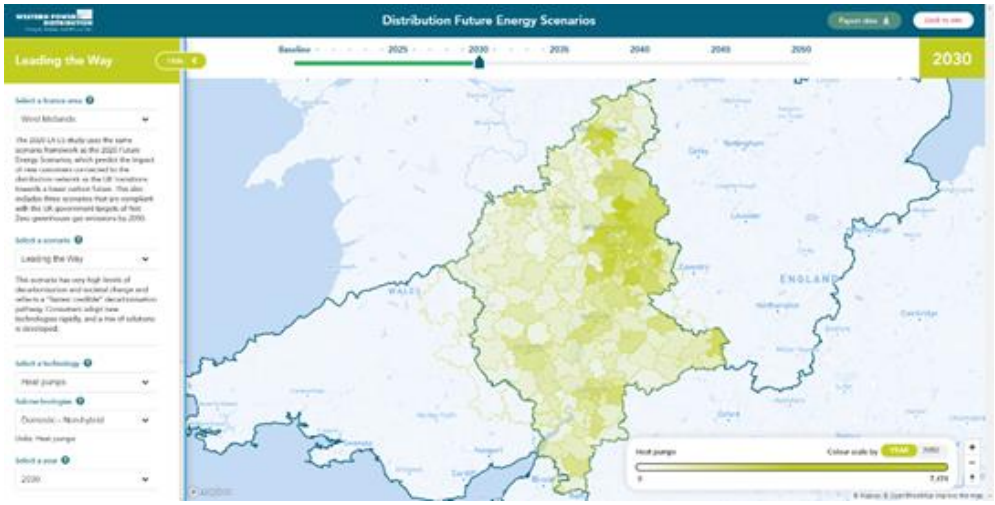


Figure SA-05.19 Heat Pump Growth – West Midlands

16.30. The analysis results in a report and an associated data set of scenario projections for each unique combination of technology, scenario, year and Electricity Supply Area. This data is available on the WPD website at: www.westernpower.co.uk/distribution-future-energy-scenarios-map

16.31. The scenario projections for each technology are given in quantifiable units – i.e. a value that can be counted. Examples of this are MW of installed capacity (for generation and storage) and number of heat pumps and electric vehicles. Electrical behaviour assumptions are not included at this stage.

16.32. The DFES is a key input to our continual assessment of the distribution network. The outputs from the DFES inform multiple business operations, including informing the electrical analysis underpinning our Shaping Subtransmission series of reports. We make this data available publically on our website through the DFES map (www.westernpower.co.uk/distribution-future-energy-scenarios-application) and also via our Connected Data Portal: https://connecteddata.westernpower.co.uk).

Development of Local Area (LA) DFES

16.33. As part of our extensive stakeholder engagement programme, we invited all 130 local authority stakeholders in our area to work with us to build a joined-up energy plan.

16.34. We sought the following data from the local authorities:

- General data based around a local energy strategy, declaration of a climate emergency and setting a target date to reach net zero;
- Availability and comparison of data sets;
- Technology projections for electric vehicles, heat pumps, new industrial, commercial and domestic developments, generation including solar, wind and battery storage.

16.35. As part of the interactions, WPD shared DFES projections which had the electricity supply area data in the WPD DFES analysis recut into each local authority area. WPD Distribution Managers from depots in the local areas held meetings with local authority energy representatives to review the assumptions and projections.

16.36. This resulted in a range of responses, with some local authorities being more ambitious than the LA DFES and other local authorities finding the interaction helpful to assist them in formulating their LAEPs. The chart below shows the progress that local authorities are making in developing their LAEPs, with one third having established a LAEP, around half still developing their plans and a fifth with no plans under development. This is an evolving area and therefore it will be important to revisit this interaction to gain further knowledge about local energy plans.

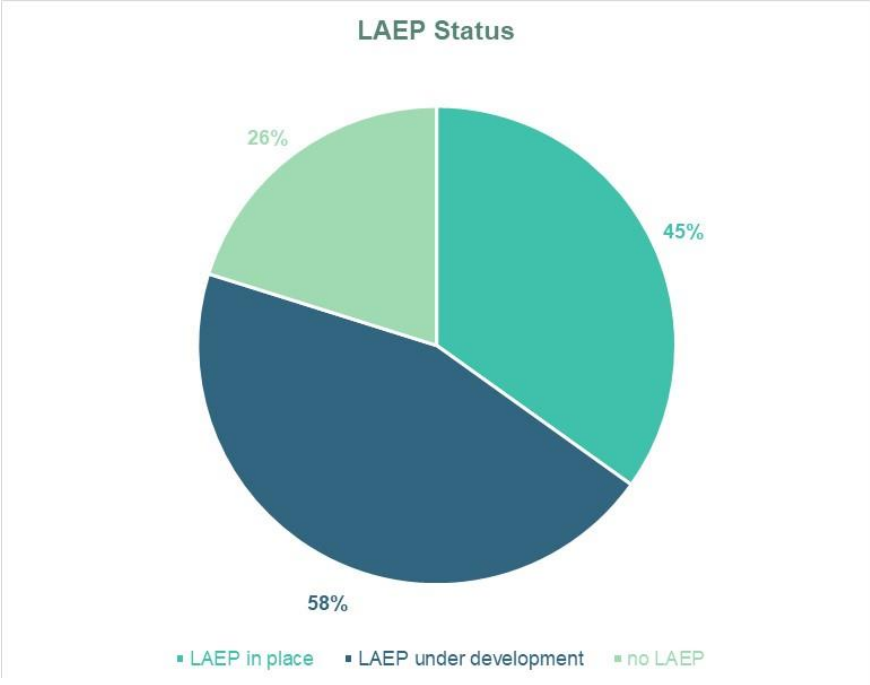


Figure SA-05.20 Business Plan submission structure

16.37. The feedback from local authorities has been used to refine the allocation of growth projections across the WPD licence areas, which makes them more representative of local requirements and more certain that they will be required.

16.38. It is proposed to continue the interaction with the local authorities on an annual basis to feed into the annual review of WPD DFES scenarios and also use this data to feed back regional information into the ESO FES process.

Stage 2: Defining a single WPD Best View

16.39. Having created a series of scenario projections, the next stage is to converge these into a single WPD Best View.

Determining a WPD Best View scenario

16.40. To determine the WPD Best View, WPD uses an iterative process. DFES data and previous Best View is used to support stakeholder and local area engagement, which then allows the quality of Local Area Energy Plans to be assessed using criteria derived from Ofgem guidance to gauge the ambition, engagement and deliverability.

16.41. The assessment is carried out by WPD's senior regional managers, scoring against the criteria matrix and a local area specific DFES scenario is selected.

16.42. The DFES scenario is chosen by closely comparing the ambition of the planned volumes across all technology types within the area, and then further ranked on how close this ambition is likely to be to the needs of stakeholders (engagement completed), how accurate the modelling is and the capability of the area to deliver.

16.43. A single DFES scenario is currently chosen to approximately represent all technologies, but there is scope in the future for differentiation between expected uptakes of technologies to be simultaneously assessed.

16.44. This process enables these scenario volumes to be summated up to a licence area level, and checked against WPD strategic views of development to generate a new WPD Best View.

16.45. Before the WPD Best View is finalised, the licence area totals are checked against national ambition to ensure WPD targets are aligned to deliver governmental policy. Scenario boundaries across the rankings may be moved to be more closely aligned, assuming incentives and policy are directed at achieving national net zero ambitions.

16.46. Each primary substation also receives a disaggregation of this WPD Best View which is used to inform the growth rates required for investment across the network.

16.47. The Best View growth rates are used in our modelling process.

Stage 3: Modelling expected behaviours

Shaping Subtransmission reports

16.48. This process considers the MW impact, the timing of the impact and diversity of the impact to identify where the growth will result in specific network constraints.

16.49. As part of this process, we consider the impacts of various customer behaviours and responses to price signals (such a flexibility services). These are captured in our customer behaviour profiles and assumptions report. Through RIIO-ED2, we will look to strengthen our analytics process to better consider more complex behaviours.

16.50. The output is published in Shaping Subtransmission reports for each of the four WPD licence areas.

16.51. The constraints identified feed into WPD's longer–term Signposting process for identifying long term flexibility requirements.

16.52. Different strategic investment options are considered to alleviate potential network constraints, which incorporates both flexibility service provision and conventional reinforcement.

Using WPD's Best View for the RIIO-ED2 Business Plan

16.53. WPD's Best View scenario is processed in a similar way to the Shaping Subtransmission process.

16.54. The WPD Best View growth projections are tempered with extra characteristics that have been included to account for future changes in consumer behaviour.

16.55. It is assumed that some of the projected growth will be offset by increases in efficiency. These will arise form a combination of a gradual decrease in the underlying demand and the assumption that new demand connecting to the network will be more efficient than the existing stock.

16.56. There is also an allowance made for pricing-led Demand Side Response. This assumes that market-led price signals (not initiated by WPD) will be utilised to avoid electricity usage at times of demand peak.

16.57. The forecast is determined using three components: WPD Best View projected growth driving demand up and efficiency and pricing-led DSR reducing the impact of the demand growth. The projections show that future demand will be higher than current demand.

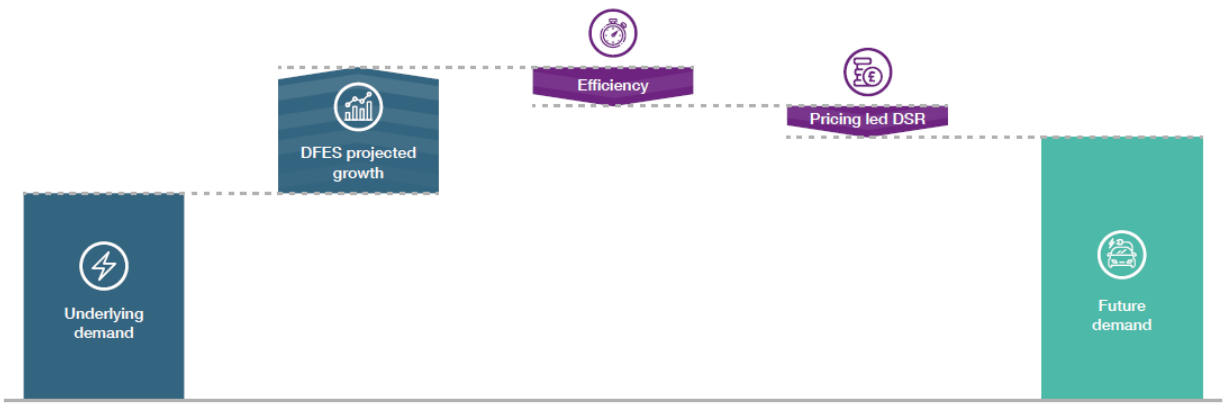


Figure SA05.21 Components considered when calculating future demand

16.58. The results of this analysis are used to inform shorter term flexibility requirements in the Forecasting process, used for flexibility procurement cycles and inform the projections of network reinforcement requirements for the RIIO-ED2 period in this Business Plan.

16.59. Figure SA05.15 summarises some of the high level figures for WPD from the calculation of the WPD Best View for each licence area at the start (2023) and the end (2028) of RIIO-ED2.

WPD Best View 2023						
Technology	**Units**	**WMID**	**EMID**	**SWALES**	**SWEST**	**WPD**
Solar generation	GW (installed capacity)	0.971	1.922	0.772	1.676	5.342
Onshore wind generation		0.050	0.409	0.548	0.354	1.362
Other distribution connected generation		1.445	2.208	0.893	0.954	5.500
Battery storage	GW (installed capacity)	0.251	0.357	0.027	0.155	0.789
Electric vehicles	Number of vehicles	255,510	184,320	34,863	73,734	548,427
Heat pumps	Number of heat pumps	72,205	95,738	30,839	66,068	264,850

WPD Best View 2028						
Technology	**Units**	**WMID**	**EMID**	**SWALES**	**SWEST**	**WPD**
Solar generation	GW (installed capacity)	1.290	2.784	1.090	2.036	7.200
Onshore wind generation		0.050	0.414	0.587	0.407	1.458
Other distribution connected generation		1.505	2.353	0.944	1.074	5.876
Battery storage	GW (installed capacity)	0.347	0.430	0.065	0.223	1.065
Electric vehicles	Number of vehicles	859,665	739,693	168,661	318,053	2,078,872
Heat pumps	Number of heat pumps	248,492	352,980	109,712	181,870	893,054

Figure SA05.22 Expected LCT volumes in RIIO-ED2

16.60. For RIIO-ED2, the data shows that there will be a significant growth in EVs, increasing from 550,000 to 2.1 million while the number of heat pumps is set to grow from 265,000 to 893,000.

Network planning

16.61. During RIIO-ED1, WPD has established flexibility markets that provide an alternative means of addressing network constraints. These make use of new technology and the ability for some network users to provide flexibility in their own consumption either by increasing, reducing or shifting their net import or export.

16.62. This flexibility can be commercially controlled by WPD to:

- offset the need for reinforcement;
- provide more capacity to other connections;
- improve network security or
- increase system operability.

16.63. When considering how to address a network constraint, WPD will consider whether flexibility provides a more economical solution. Adopting a 'flexibility first' approach will enable the network to develop efficiently and economically.

Timing of investment and use of flexibility

16.64. Ideally, the capacity of the network is increased once the network approaches its capacity limits, with work being started just ahead of need so that it is completed as the new capacity is required.

16.65. Conventional reinforcement, using larger capacity assets, releases large blocks of capacity due to the discreet sizing of network upgrades. These large steps in additional capacity generally do not require further investment for a number of years resulting in longer term capacity availability. However, these large steps in capacity increases may be excessive for the anticipated future network requirements.

16.66. Since conventional reinforcement can take a long time to deliver, this can cause problems and delays for customers who want to connect to heavily loaded parts of the network. They may have to wait until the network is reinforced until they can connect or accept a lower capacity connection.

16.67. Flexibility can provide more granular network capacity increases, better matching the in-year requirements of network users. Flexibility has the potential to manage capacity shortfalls economically and responsively until the need for conventional reinforcement is more certain. In some circumstances, particularly where uncertainty is high, a greater period of operation of flexibility may allow for more optimal longer term investment plans to be implemented. Flexibility can also be used to allow new customers to connect to heavily loaded parts of the network without the need for reinforcement.

16.68. While we will be making greater use of flexibility, we anticipate that there will be situations where it is necessary to carry out conventional network reinforcement. This will be where there is insufficient flexibility provision for the scale of network constraint.

16.69. The following diagram illustrates the different approaches that may arise.

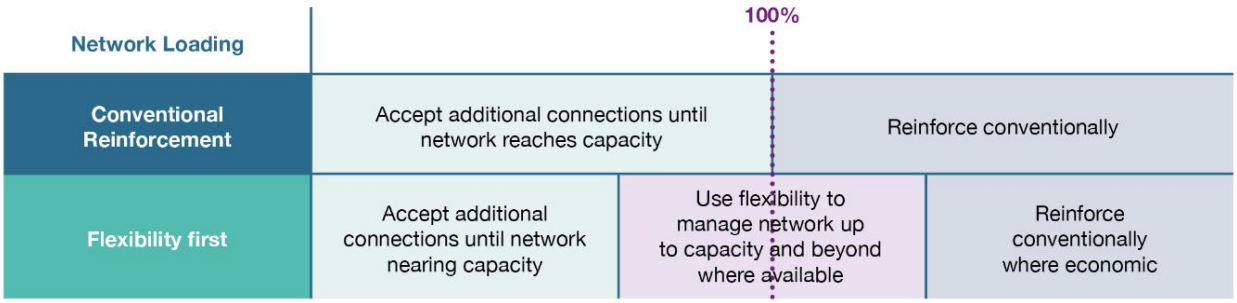


Figure SA05.23 Approaches to using flexibility to improve network

16.70. Until distribution flexibility is sufficiently developed and ubiquitous enough to be relied on, the identification of flexibility provision needs to be carried out at an earlier stage compared to when conventional reinforcement work would start. This is to allow enough time to assess whether there is sufficient flexibility available and (in circumstances where it is not available) to give sufficient time to carry out the conventional reinforcement.

16.71. WPD has an investment trigger for flexibility ahead of when conventional reinforcement would be undertaken. This ensures that the flexibility market is fully explored in advance of when conventional reinforcement needs to start. Generally, this will involve publishing flexibility requirements and investing in flexibility 12 months ahead of when a conventional investment decision would be made.

16.72. At the time of reaching the decision for conventional reinforcement, further flexibility can be sought to determine whether the conventional reinforcement can be deferred or replaced completely by flexibility solutions.

16.73. If, however, there is insufficient flexibility available in the market, the conventional reinforcement will need to take place.

Using flexibility to provide capacity for new connections

16.74. As well as using flexibility to provide additional capacity to manage load related constraints, WPD has developed and trialled processes to use flexibility to provide additional capacity for new connections coming onto the network.

16.75. In Constraint Management Zones, any flexibility that is provided from the market in excess of requirements to meet existing network constraints can be used to offer capacity for new connections. New connections that trigger the need for reinforcement will be offered the option of having a flexibility solution as an alternative to conventional reinforcement. Depending on the scale of requirement, this may allow more time for the construction of the conventional reinforcement, defer the conventional reinforcement or remove the need for conventional reinforcement. This will allow the connection to proceed more quickly and may reduce the costs for the connecting customer.

16.76. WPD will take on the liability and costs associated with providing the network capacity by contracting with the flexibility provider, just as it does in the case of conventional reinforcement. This will provide confidence for the connecting customers that the network will be managed in a way that provides them with the power they require.

16.77. Connecting customers will be offered two methods of paying for these costs: one option will be to pay the costs for flexibility and assets retrospectively on an annual basis; the other option will be to settle the costs upfront, based on WPD's Best View of the blend of flexibility and asset costs that will be required. The first option will be settled against actual costs incurred and will

be subject to variations due to external factors such as the market cost of flexibility and deviations from assumed network loadings. The second option will be a fixed cost and benefit from a reduction due to NPV applied for future costs.

16.78. Both of these options will allow the connection to be made without using Active Network Management and without any risk of curtailment and both will still have costs apportioned based on the network capacity. WPD will manage the constraints using flexibility and take on the risk and responsibility for doing so.

16.79. These arrangements were piloted as part of WPD ICE plan in 2019 and the pilots have allowed the development of the commercial details.

Distribution Network Options Analysis (DNOA)

16.80. WPD's DNOA process (formerly the System Investment Assessment process) provides a systematic methodology to recommend a single investment option. We are the first DNO to have published a DNOA, demonstrating our commitment to providing transparency.

16.81. Conventional network reinforcement typically requires a large upfront capital expenditure. For larger investments, which take a longer time to construct, the costs might be incurred across a number of years.

16.82. Deferment of reinforcement by flexibility requires ongoing payments to flexibility providers to turn down/up import or export of power to allow other customers in the Constraint Management Zone (CMZ) to have the power for their needs. Initially, flexibility costs may be small; however, as network requirements grow, more flexibility will need to be procured, resulting in flexibility costs rising year-on-year. Should changes in demand or generation reduce the network requirements, these flexibility costs may reduce.

16.83. WPD compares the viability of the various options (Traditional Reinforcement, Innovative DNO solutions, and Service based solutions) against specific constraints by using the Common Evaluation Methodology (CEM) process, which has been developed under Open Networks. This process considers multiple factors including financial, social, losses, safety and carbon benefits to determine the right investment pathway.

16.84. The decision tree below demonstrates the different choices our analysis can lead to. Firstly, the schemes that do not require any intervention are removed from future DNOAs. Where schemes require intervention but constraint cannot be managed using flexibility, reinforcement is pursued. If the constraint can be managed using flexibility but no intervention is required within the next year, signposting is published. The schemes which require flexibility services within the next year are put through cost benefit analysis to determine if flexibility can be used to defer reinforcement. This is further detailed in the latest DNOA document in appendix A14.

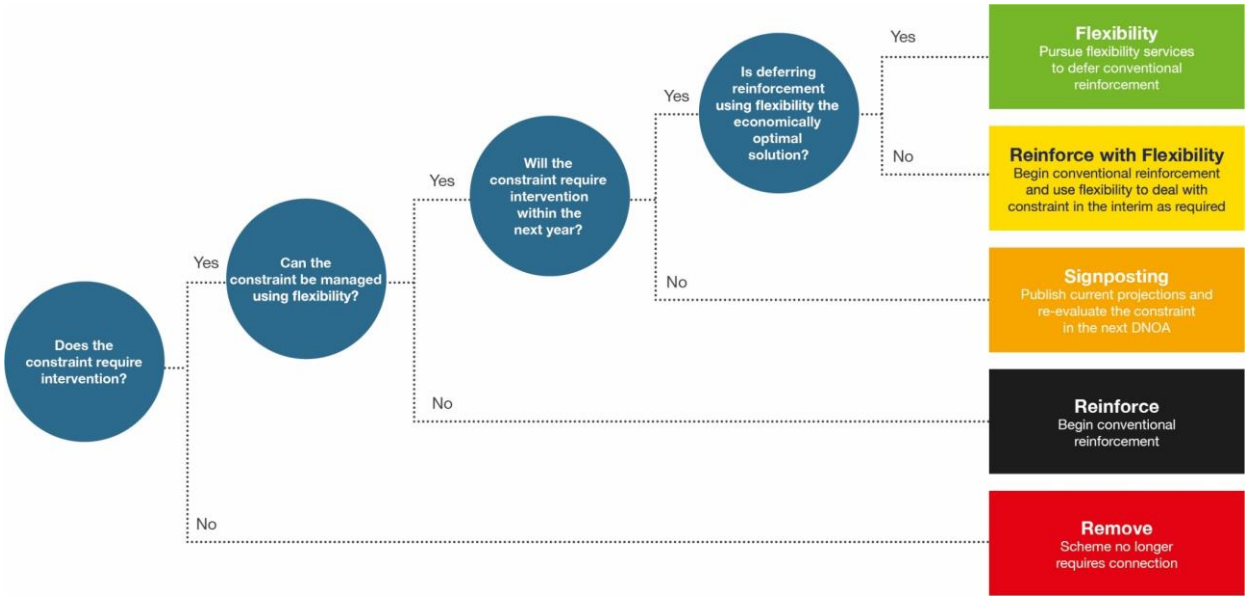


Figure SA-05.24 DNOA Decision Tree

16.85. The outcomes of the DNOA are published every six months to maximise transparency around our decision making. As part of this process, we collect feedback to allow us to refine the process going forward.

Network operations

Changes to network operations

16.86. Traditionally, the operation of the distribution networks has been relatively passive. Power flows have been one directional from the transmission system to consumers. Network operation has mainly focused on responding to network faults and alarms, outage planning and coordinating access to the network for work activities. These functions will continue into the future.

16.87. However, the growth in intermittent distributed generation and decarbonisation of transport and heat has led to reverse power flows, increased loads and greater need to redirect power flows away from heavily loaded parts of the network. This has resulted in implementation of Active Network Management for constraining new connections and evolution of flexibility markets, where capacity is provided by flexibility providers adjusting their demand or generation output.

16.88. In addition, there are other drivers that call for optimisation of the network's operation. These include the need to manage voltages, losses and power factor that need increasingly sophisticated and smart ways of network operation.

16.89. This requires new data and processes to analyse what is happening on the network and more active ways of managing constraints, such as processes for dispatching flexibility and greater coordination with the Electricity System Operator. The volumes of data will significantly increase which means that systems will need to be enhanced or developed to enable efficient and effective operation of the networks. The primary objectives of operating the network safely and maintaining network reliability will remain unchanged.

Flexible connections and Flexible Power

16.90. Traditional approaches to providing connections require customers to fund a proportion of the network reinforcement costs where additional network capacity is required. At higher voltages, this work may also take a number of years to deliver. For new connections, this poses delays and costs.

16.91. WPD has developed a suite of flexible connections that offer the opportunity for the connection to be made at lower costs and with quicker timescales, recognising some form of curtailment may be required at times of high network loads.

16.92. Our flexible connections suite has developed options in two areas for customers seeking to connect to the grid. A Timed connection offers a very simple way of acting flexibly, without the need for communications or monitoring. Timed connection customers schedule their load to avoid specific times. Load managed connections make use of ANM technology to control generation or demand behind single or more complex constraints. These are particularly useful in areas of constraint as an alternative to network reinforcement.

16.93. Flexible Power solutions are contractual arrangements where customers with controllable demand or generation are able to provide services to help WPD manage the capacity of the network. They are used as a lower cost alternative to reinforcing the networks and the services are procured through a flexibility market.

16.94. WPD has been pioneering the use of flexibility solutions during RIIO-ED1, learning from key innovation projects and deploying capability as part of our BAU process. We currently have over 400MW of flexibility services in contract and expect that these will be used increasingly as more demand connects to the network.

16.95. The table below highlights how capacities in contract have grown at each procurement round. The procurement has now impacted over £140m of reinforcement.

Procurement Cycle	Primaries Covered	MW Sought	Flexibility Contracted (MW Total)
2018	18	63	35.3
2019 H1	80	93	56.8
2019 H2	120	184	123.1
2020 H1	175	334	217.7
2020 H2	256	304 (+73)	439.8

Figure SA-05.25 Growth of flexibility

We have also worked extensively with the other DNOs to share the learning from our experience of operating flexibility services. As part of this process, and to increase industry standardisation, we have opened up our Flexible Power brand and processes. We are now actively collaborating with four other DNOs to deploy a more common approach to the procurement and operation of flexibility services.

16.96. There are three types of flexibility services that we currently use:

- Secure – used to proactively manage peak demand

- Dynamic – used to support the network in case of a coincident fault during network maintenance

- Restore – used to reduce the stress on the network during fault situations, with flexibility providers responding within 15 minute

- We do not currently procure the fourth Open Networks Service: Sustain

16.97. The existing IT platform used to assess the requirements for flexibility, manage the dispatch and make payments for the flexibility provided has limited capacity and a more enduring solution is required to ensure that flexibility can be used to a greater extent.

16.98. We apply clear distinctions between the application of flexible connections and flexibility services. The first involves participants accepting restricted access to the network to accelerate or reduce the costs of connection. Technical systems are implemented to manage that access, with various levels of sophistication. In contrast, flexibility services involve participants reducing their output to below that specified in their access rights to benefit the wider network. These are services that are paid for by the beneficiary (generally the network, but can be used for new customer connection). These distinctions will be reviewed in line with the outcomes of the Access and Forward Looking Charges Significant Code Review.

Market development

Providing market information for flexibility services

16.99. WPD recognises that, across the distribution network, there are many electricity consumers who have the potential to shift their demand, by amending when they use power, or adjusting their export from onsite generation.

16.100. The flexibility market allows these customers to earn a financial payment for the provision of specified flexibility services.

16.101. The type and amount of service required is dependent upon the nature and scale of a constraint on the network, which could be as a result of increased loads at certain points in time. Across the portfolio of zones, we have requirements in every month in the year, every day of the week and all half hours for some days. We acknowledge the requirement for comprehensive market information on our detailed procurement needs for each zone and therefore have created a suite of information to communicate our latest needs to the market. These include:

- Network Flexibility Map (https://www.westernpower.co.uk/network-flexibility-map-application): We publish comprehensive data on signposting and forecasting through our Network Flexibility Map. This includes the availability windows and expected market volumes required for all our Distribution Future Energy Scenarios (DFES) for a five year period under the Signposting process. Visualisations of the data are available online through the mapping tool and data sets are downloadable without registration. The Network Flexibility Map also presents our firm flexibility requirements which feed into our procurement process. This shorter term view gives clarity on our needs and is refreshed every six months in line with our procurement timeline.

- Flexible Power Map (https://www.flexiblepower.co.uk/map-application): The Flexible Power Map replicates much of the functionality of the Network Flexibility Map but focusses on the requirements against which we will procure. It highlights the required volumes and forecast availability windows. This map is held on the Flexible Power website and hosts data from the other DNOs which are also involved in the Flexible Power Collaboration.

- Procurement documents (see latest here: https://www.flexiblepower.co.uk/downloads/426): For every six monthly cycle of procurement, we publish market information detailing the requirements for procurement at each of the CMZs. This includes information such as the MW required, expected MWh availability windows and MWh estimated utilisation volumes.

- Distribution Networks Options Assessment (DNOA) (https://www.westernpower.co.uk/DNOA): Our DNOA process provides a systematic methodology to recommend a single investment option for potential constraints. (See section 5.1). As part of the DNOA process, we publish the outcomes of our assessment on a six monthly basis. This highlights why we have gone out to procurement for each zone.

16.102. These publications link together as shown in figure SA-05.26 below:

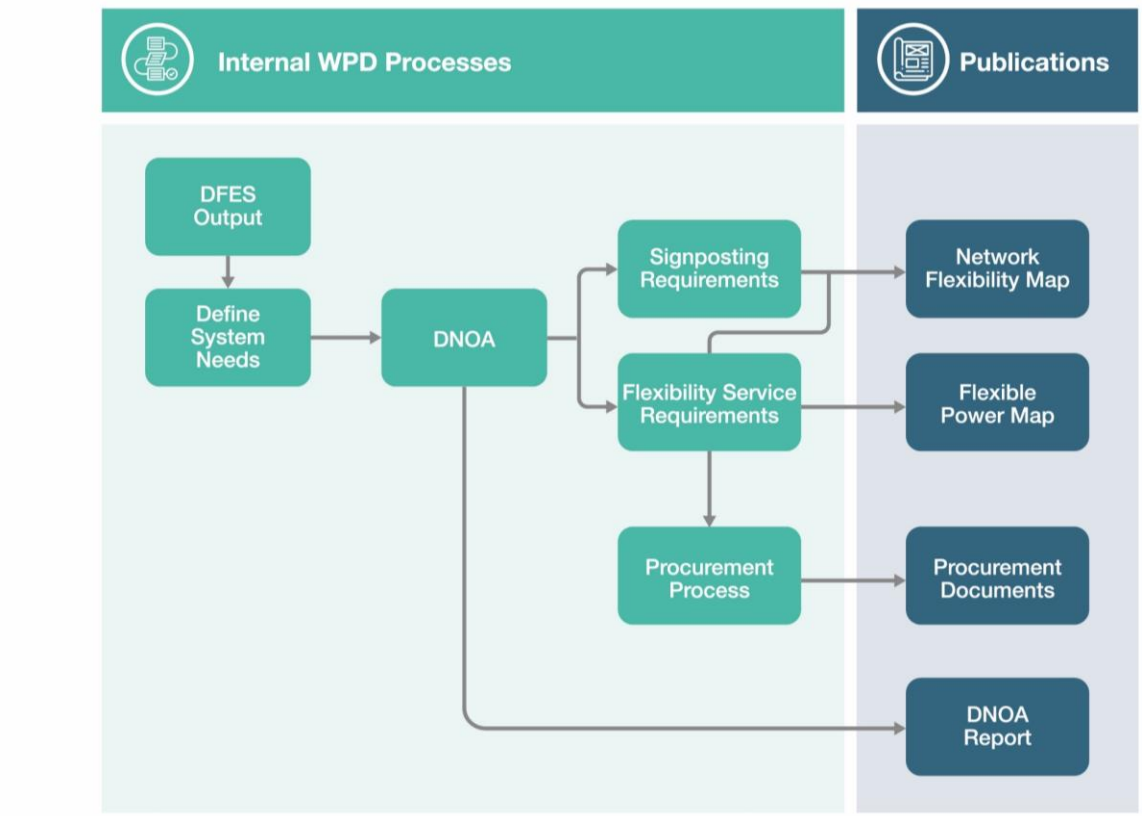


Figure SA-05.26 Processes and publications

16.103. Since 2018, we have published a procurement cycle results document within one month of contract award (see example here: https://www.flexiblepower.co.uk/downloads/582), summarising the various stages and results of the tendering process. As the tendering process has developed, more information has been published. Going forward, we expect to publish:

- Volumes of flexibility coming through all stages of the procurement process

- The counterparty, technology type, MW capacity, length of contract, payment structure and price agreed for each contracted party

- A summary of the outcomes per CMZ. This includes the volumes required, the number of bids received, the MW awarded and the zone price.

16.104. We are committed to engaging regularly with our stakeholders to ensure that the information provided can be as useful as possible.

Forecasting

16.105. Forecasting is a more accurate single-scenario view of the constraint on the network across a two-year window. It explicitly states WPD's flexibility requirements and is used to advise what flexibility is being sought during procurement cycles.

16.106. Like Signposting, Forecasting also describes the amount of flexibility required and specifies the availability window (i.e. when the flexibility is required), but over a shorter, more defined timescale.

16.107. By defining requirements in a neutral way, forecasting data enables flexibility providers to respond to flexibility tenders and, as it is openly available, allows different providers to have the same opportunity to participate in the market.

Accessibility to markets

16.108. WPD expects that flexibility services will be provided by many different market participants including demand response aggregators, electricity suppliers, generation operators, battery operators, industrial and commercial customers, local authorities, community groups and electric vehicle charging operators.

16.109. Because we recognise that each of these participants may wish to provide services to WPD through a variety of routes, we have established access through a number of channels and continue to investigate options for third parties to support the development of processes and functions.

Flexible Power
By Western Power Distribution

The Flexible Power brand has been created by WPD to deliver the procurement of demand response services. It acts as our customer facing brand when seeking flexibility services and is implemented consistently across all four of our licence areas.

As well as providing visibility and enabling routes to participation, Flexible Power also encompasses our flexibility participant portal and electronic dispatch, monitoring and settlement services.

piclo®

Piclo has developed and trialled the UK's first GB-wide flexibility marketplace, supported by funding from BEIS Energy Entrepreneurs Fund.

WPD has displayed its flexibility requirements on the Piclo platform since November 2018.

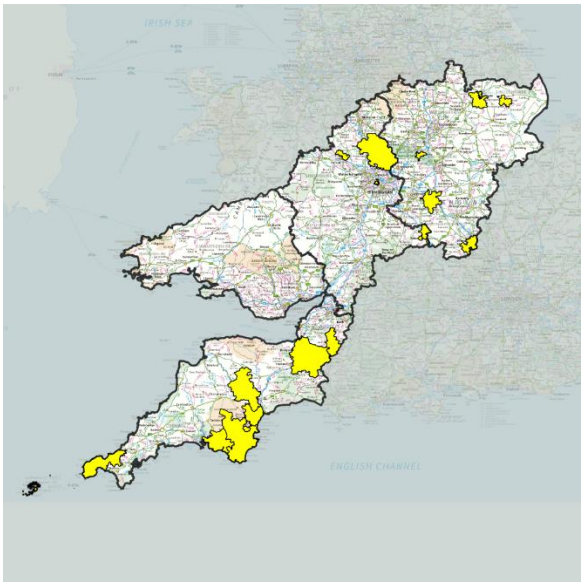
Flexibility providers with matching assets in WPD Constraint Management Zones are directed to WPD's Flexible Power site to enter procurement.

At a more local level, since July 2017, WPD has partnered on Centrica's Cornwall Local Energy Market (LEM) project, which is developing a virtual marketplace for flexibility services across the Cornwall region.

The Cornwall LEM project is targeting both business and residential customers and is providing new technology solutions to enable flexibility and help unlock new revenue streams for customers.

Figure SA-05.27 Channels to access flexibility

16.110. WPD's Flexible Power website provides a map of the CMZ's location, a postcode finder to allow potential suppliers to confirm their site is within the CMZ and the operational window the demand response will be required in.



16.111. The operational window details the time of day, day of week and month of year, MW change required and a forecast of the total MWhs. Operational windows will generally be seasonal to support the constraints within the summer and winter demand peaks.

16.112. To ensure that WPD is able to stimulate market participation through multiple routes, we are enhancing Flexible Power to provide better market integration. These actions are going to be completed during RIIO-ED1 and include:

- Availability of geographic and postcode information for platforms to pre-qualify and validate flexibility assets (Q1 2021)
- Standardisation of visibility and forecasting data for hosting on flexibility platforms (implemented)
- Improved sources of data for asset qualification – e.g. linking MPAN to constraint managed zones (Q1 2021)

16.113. As third party platforms emerge and mature, we will aim to promote competition and coordination across these.

Procurement process for flexibility services

Procurement cycles

16.114. Since 2019, WPD has been operating a multiple cycle approach to procuring flexibility. After specific requirements have been identified through the Forecasting process, there are typically three six-monthly procurement cycles. This approach allows WPD to test the market every six months, enabling more participants to be involved in the provision of flexibility and refinement of flexibility requirements. This means that WPD contracts with flexibility services in three tranches between six and 18 months ahead of need.

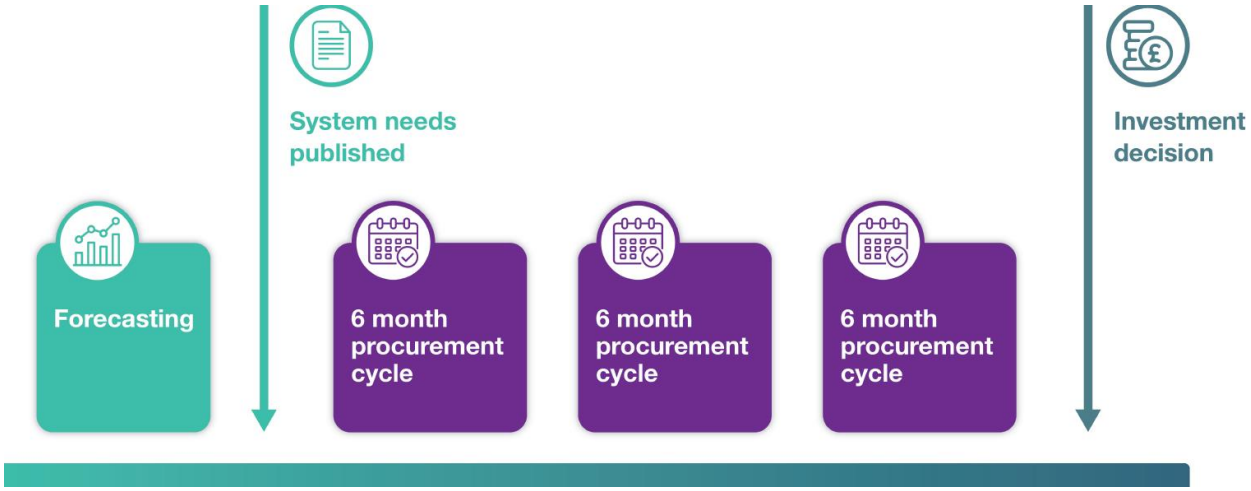


Figure SA05.28 Timetable for providing visibility of flexibility services

Procurement qualification

16.115. Potential suppliers of flexibility need to undergo a registration process but, once registered, the suppliers are invited to consider providing services at each procurement cycle, without further requirement to register.

Technical requirements for participation

16.116. In order to be able to provide flexibility services, there are some technical requirements that need to be met. These include the ability to provide minute by minute metering, integration of systems through an Application Protocol Interface (API) and ability to dispatch when instructed. The API is software based and can be set up in-house by the majority of participants without the requirement for any proprietary or specialist hardware.

16.117. WPD seeks flexibility from a wide range of providers and has not set a contractual minimum limit for participation. Removing the potential barrier of a commercial minimum allows direct participation for a larger range of participants, including those connected at lower voltages. However, as there are a number of technical requirements, the route for the coordination of portfolios of smaller market participants is expected to be through aggregators.

16.118. While some larger market participants will contract directly with WPD, aggregators can offer an important alternative route to market. Aggregators act as coordinators of services and enable participants to stack revenues for providing different types of service. They can use their expertise to allow more flexibility providers to participate in the market.

Pricing structures

16.119. Since 2019, WPD has been operating a pricing structure that is dependent on the level of competition revealed through the procurement process. Each Constraint Management Zone (CMZ) is assessed independently because the number of flexibility providers and scale of flexibility provision varies. WPD has established a three phase strategy, with each phase reflecting the maturity of the market. The prices paid are based upon the availability of flexibility in each CMZ. This starts with fixed pricing for non-competitive markets, pay-as-clear arrangements for markets with some competition and excess of suppliers, with shorter term contract pricing for fully mature and liquid markets.

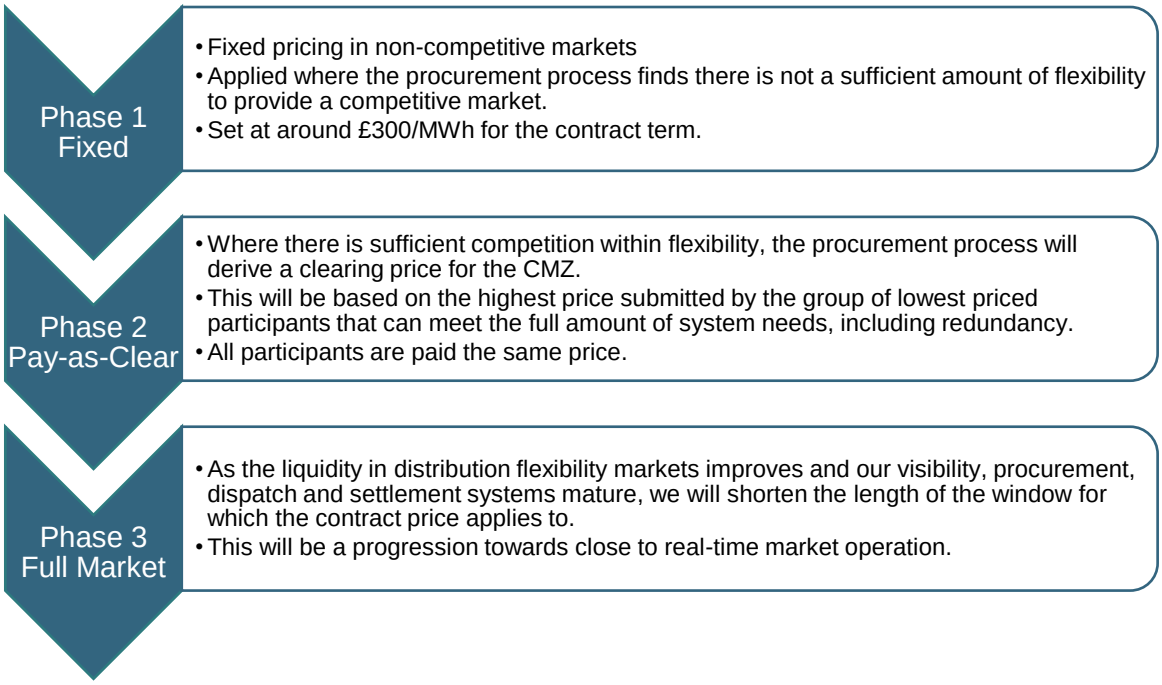


Figure SA-05.29 – WPD Pricing Strategy

16.120. Since the markets are at an early stage of development during RIIO-ED1, we expect most CMZs to be based upon a fixed price basis in the short term. However, as flexibility provision and competition grows in a CMZ, we will move towards the Phase 2 stage.

Specified flexibility services

16.121. WPD has developed three DSR services that each address different requirements on the distribution network. These services are: Secure, Dynamic and Restore. These have been adopted as industry standard services under Open Networks, as well as an additional Sustain service.

16.122. WPD will continue to assess the requirements for new services and market timeframes, both through our innovation work and standard market development. If a new service is needed, we will follow the new product process developed by the Open Networks project, as well as our own process for engaging with stakeholders as defined in our Distribution Flexibility Services Procurement Statement.

Sustain

16.123. The Sustain service is under trial within the WPD region, specifically targeting domestic users who are able to adjust their consumption behaviour to set windows across the year. Successful delivery of this adjusted energy profile is financially rewarded.

16.124. Sustain services are forecasted many months ahead of operation and provide a simple, contractual method of self-dispatch to allow domestic participation.

16.125. Further trials are currently underway through WPD's FutureFlex innovation project to bring this product to a wider audience, as we have done with our main flexibility services.

Secure

16.126. The Secure service is used to manage peak demand loading on the network and pre-emptively reduce network loading. As these requirements are predictable, payments consist of an Arming fee which is credited when the service is scheduled (irrespective of whether it is used) and a further Utilisation payment awarded on delivery (related to the amount of flexibility provided).

16.127. Secure service requirements are declared in advance for the following week. The week-ahead declarations are scheduled to allow providers to participate in alternative services when not required for the Secure service.

Dynamic

16.128. The Dynamic service has been developed to support the network in the event of specific fault conditions, often coincident with other outages for maintenance work.

16.129. As the service is required following a network fault, it consists of an availability fee and utilisation fee. By accepting an availability fee, participants are expected to be ready to respond to utilisation calls within 15 minutes. Utilisation under the Dynamic service is usually expected to be of a longer duration compared to the pre-emptive Secure service.

16.130. Dynamic availability windows are also declared in advance for the following week.

Restore

16.131. The Restore service is intended to help with restoration following rare network fault conditions. Under such circumstances, the Restore service can be used to reduce the stress on the network.

16.132. As the requirement is inherently unpredictable, Restore is based on a premium 'utilisation only' fee. This will reward response that aids network restoration, but will pay no arming or availability fees. Participants who are declared available for the Restore service will be expected to respond to any utilisation calls within 15 minutes and will receive an associated utilisation fee.

Tendering and payments for services

16.133. During the procurement process, the flexibility provider must submit a preferred price for providing flexibility, as well as confirming that the fixed price basis (phase 1) is acceptable.

16.134. The preferred price is a single total price for a MWh of both arming/availability (i.e. being able to provide flexibility) and utilisation (i.e. providing the flexibility). The preferred price can be higher or lower than the fixed price.

16.135. Comprehensive details about pricing and payments are available in the WPD publication CMZ Payment Mechanism and Contract Assistance Notes.

Contractual terms

16.136. All of the contract terms are available to view on WPD's Flexible Power website.

16.137. WPD has worked collaboratively with the industry to develop a common set of terms and conditions and was the first DNO to adopt them. These have been written to provide low barriers of entry, maximise participation and reduce complexity. These have been informed by stakeholder feedback, are subject to continued review and include:

- Mutual and capped liabilities
- Performance-based payment mechanisms to incentivise participation
- No penalties for non-delivery, only loss of potential revenue
- No exclusivity clauses
- No obligation to provide availability

16.138. WPD's contracts do not have any exclusivity, maximising the ability for a flexibility provider to increase revenue stacking opportunities by providing services to other parties.

16.139. The products WPD is offering are designed to be stackable with other revenue streams and are particularly complementary with the ESO's Reserve products.

16.140. The products being offered are also aligned with other distribution system operators' flexibility services and use the common terminology developed under ENA's Open Networks project.

16.141. Following feedback from flexibility providers, we have altered our contractual length to give better certainty for market participants. Since 2019, we have been allowing flexibility providers to choose their optimum contract length, from between one and four years. We will continue to review the contract lengths to optimise benefits for participants and the DNO.

Operating process

16.142. Once flexibility providers accept contracts and establish the API interface, they are available for providing flexibility services. They get paid when they participate and declare availability and when they respond with sufficient change in their demand or generation when utilisation is required.

Dispatching flexibility

16.143. WPD recognises that being transparent about how flexibility is dispatched is important to market participants to enable them to understand how to maximise returns and maximise liquidity across markets.

16.144. Where competitive markets have developed, resulting in multiple flexibility providers being able to provide flexibility (as per Phase 2 or Phase 3 pricing), WPD needs to select the priority order on which flexibility assets are accepted and dispatched first.

16.145. The approach to dispatching is published on the WPD Flexible Power website. It is based on the Open Networks standard dispatch principles of Security, Cost and Operability and will evolve as our operational experience grows.

16.146. Being transparent about the rules by which WPD will dispatch flexibility allows flexibility providers to consider what service they provide and how they make these available.

16.147. In the future, as the market grows and matures towards full market-led pricing, then pricing submitted for each flexibility asset will become the dominant factor for consideration.

16.148. In order to maximise the value to the whole system and ensure we coordinate with the ESO, we will adopt the Open Networks Primacy rules once developed.

16.149. Our RDP is feeding into this work, aiming to develop the deployment of robust information sharing, as well as to provide a use case for initial testing.

Reporting of flexibility procurement/ utilisation data

16.150. Through WPD's Network Flexibility Map, raw data on signposting and forecasting data is published. This includes the availability windows and expected market volumes required for all the DFES scenarios for a five year window. Visualisations of the data are available online through the mapping tool, and the geographic shape file data set is also downloadable without registration.

16.151. Every six months, our procurement market data is refreshed, replacing the raw data on the mapping visualisation. Summary PDFs are also available for download.

16.152. For every six monthly cycle of procurement, market information is published which details the requirements for procurement at each of the Constraint Managed Zones, such as MW required, MWh availability windows expected and MWh utilisation volumes estimated.

16.153. A value calculation tool is available on the Flexible Power website to aid participants to understand potential revenue values.

16.154. Since 2018, within one month of contract award, WPD has published a procurement cycle results document, summarising the various stages and results of the tendering process. As the maturity in the tendering process has developed, more information has been published, including:

- Volumes of flexibility coming through the ITT stage
- MW capacity and technology of assets being awarded contracts per CMZ
- Pricing data bid in to the procurement process
- Prices of flexibility awarded in each CMZ

16.155. Annually, WPD also provides a summary of flexibility statistics across its operations, which aggregates the volumes of flexibility dispatched and costs associated with operating flexibility through the year.

16.156. A value calculation tool is available on the Flexible Power website to help participants understand potential revenue values.

Secondary trading of flexibility contracts

16.157. The current arrangements for flexibility are bi-lateral contracts between WPD and third party flexibility providers.

16.158. All WPD flexibility contracts are aligned to the latest version (at the time of contract award) of the Open Networks common contract ensuring consistency of terms. The Open Networks common contract does not prohibit the transfer of contracts, but does require permission from WPD to permit the transfer.

16.159. The standardisation of DSO products and flexibility contract terms now in place act as enablers for flexibility contracts to be traded on a peer to peer basis.

16.160. Standardisation of pre-qualification processes, as well as other enabling data sets, will support multiple routes to assisting the trading of flexibility contracts. WPD will work within Open Networks to ensure any learning is adopted across the industry.

16.161. During RIIO-ED2, WPD will work with flexibility providers, market operators and platforms to develop practices and systems that allow the secondary trading of flexibility contracts. This will include standard contractual agreements between parties, analysis methods for assessing tradability, monitoring systems for compliance and data systems for providing commercial visibility.

Governance arrangements

WPD's track record for acting as a neutral market facilitator in competition in connection

16.162. WPD has a track record of working with alternative providers of services, as demonstrated by the way in which we have provided information and support for Independent Connection Providers (ICPs) and Independent Distribution Network Operators (IDNOs) to increase competition in connection.

16.163. Throughout the DPCR5 and RIIO-ED1 periods, there were significant changes in the way that connections activity was delivered to customers. The growth in the number of ICPs/IDNOs and the scope of works they could undertake meant that ICPs/IDNOs became established alternatives for the provision of new connections.

16.164. One of main areas of change that increased the capability of ICPs/IDNOs was access to network data to allow them to complete their own design work. This was data that WPD owned and, in order to facilitate greater competition in connections, was made available to ICPs/IDNOs in the same way as it is made available for our own staff. All network planners, regardless of their company, have equal access to our data ensuring that we facilitate a neutral connections market.

16.165. We also worked with ICPs/IDNOs to extend the operational activities which they could carry out. In this area, WPD's network access and safety permitting systems were extended to allow ICP/IDNO operations staff access to the network on equal terms to WPD operations staff.

16.166. We also worked with the other DNOs to establish common industry standards so that ICPs and IDNOs working across DNO boundaries operate in a coordinated way with the same base procedures.

16.167. Our cooperation with ICPs/IDNOs in developing a competitive connections market demonstrates that we can act as a neutral facilitator and support the development of alternative ways of delivering work.

How we are addressing conflicts of interest and segregation safeguards

16.168. As a regulated business with no interests in UK generation or supply, WPD views the facilitation of our customers into these neutral markets as a natural extension of our current role in managing the power across our distribution networks. We are uniquely placed to ensure simple and consistent access to new markets for our active customers by maximising the utilisation of our existing electrical and communication networks. We are also able to use the flexibility inherent in our network to ensure all customers benefit, both by receiving a resilient and secure supply and through cost effective delivery.

16.169. We do not offer a direct route to our systems; all our control instructions are via API links to third party platform providers and aggregators. We actively encourage the emergence of this sector and will continue to offer 'plug-in' solutions to remain neutral in the market. All WPD's procurement data and system need information is downloadable and can be processed by third parties. We have previously used CLEM, NODES and Piclo for procurement routes.

16.170. Throughout all of our work to support DSO services, we must show neutrality and ensure that actual and perceived conflicts can be addressed. We have ring-fenced the DSO team away from a wider electricity business systems team, responsible for providing the DSO enablers (such as data, monitoring etc) and the wider DNO business. Each team has separate and equal direct reporting lines into the Operations Director.

Governance arrangements for the development of flexibility services

16.171. WPD's governance arrangements for the development of flexibility services include extensive stakeholder engagement, publication of information and standardisation across the industry. These are detailed in our Distribution Flexibility Service Procurement Statement.

16.172. WPD has a strong track record of responding to customer requirements and developing new processes and arrangements. Innovation projects have been influential in the evolution of flexible services, resulting in development in active network management and procurement/deployment of flexibility.

16.173. Flexible Power, our flexibility product, was developed through the ENTIRE innovation project where we engaged stakeholders throughout the process and have since sought to make Flexible Power a standard for flexibility across all DNOs. We continue to engage with stakeholders, taking on their feedback and evolving flexibility contracts and operational arrangements.

16.174. We have been procuring flexibility services since 2018 and have the largest contracted amount of flexibility provision which is offsetting the need for conventional reinforcement.

16.175. We are transparent about the needs of the network in the data that we publish about Constraint Management Zones, transparent about pricing structures, transparent about contractual arrangements and transparent about how we will dispatch flexibility.

16.176. As flexibility markets develop in RIIO-ED2 for capacity constraints, network access, network design or commercial arrangements, we will continue to develop processes to ensure that we will provide neutral facilitation of those markets.

16.177. This insight from WPD work has also enabled WPD to be influential in common arrangements across the industry that have been developed through ENA Open Networks. WPD supports greater commonality across the industry, so that customers and flexibility providers have clarity and consistency irrespective of which network operator they are dealing with.

Governance arrangements for independence of decision making

16.178. To determine the most economic network investment to deliver the required outcomes, WPD uses the DNOA process which recommends an investment option based on the profiled capital and operational expenditures of a range of technically viable possibilities.

16.179. DNO activities are undertaken by the network design function which defines how assets are installed, maintained and repaired, including defining the applicable capacity ratings which can be delivered by those assets.

16.180. The DSO function is responsible for understanding how the system operates and identifying the potential capacity shortfalls or network limitations that require additional investment. It develops the flexibility products suited to meeting those system constraints and ensures sufficient information is published so that distribution flexibility markets can be established.

16.181. The DSO function will assess the different investment options identified and make recommendations based on published criteria. The resulting recommendations will also be published to ensure transparency and enable scrutiny.

16.182. If the investment recommendation is to use flexibility, then the DSO will procure flexibility services through the market to meet those system needs. If the investment recommendation is to use conventional reinforcement, the DSO function will instruct the DNO function to commence conventional network build.

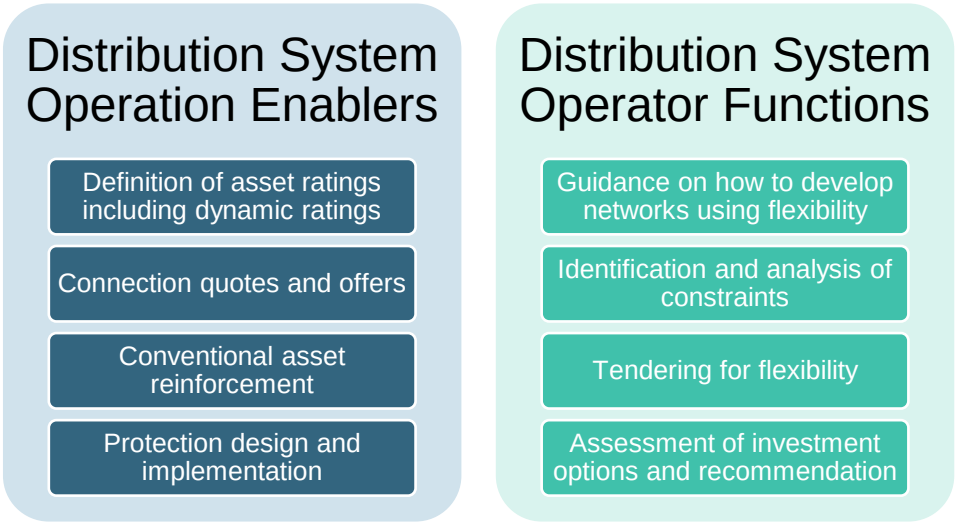


Figure SA-05.29 Split of enablers and functions

16.183. The decisions made leading to the recommendations will be subject to audit to ensure compliance with the agreed processes.

Planning and network development systems – Our RIIO-ED2 projects

16.184. The following projects support new capabilities within the ED2 period. Where these provide broader whole system benefits, they are detailed in the relevant EJPs. This includes the broader benefits and their value, justifications and costs, the potential use of uncertainty mechanisms, associated engagement and coordination, details of why market based and innovative solutions could or couldn't be used, work beyond BAU and any work already carried out.

Network analysis for DSO

16.185. This project implements a set of new applications that support the increasingly complex analysis of network requirements and optioneering of solutions.

16.186. Traditionally, DNOs have analysed and planned the network against a set of relatively certain external parameters such as future load growth. However, the range of scenarios for future growth of electric vehicles, heat pumps and distributed energy resources means that there is a requirement to carry out multiple sets of network analysis against the range of future energy scenarios. In addition, there are more network solutions available; WPD has a suite of smarter or flexibility based solutions which could be used instead of, or in conjunction with, conventional network infrastructure upgrades.

16.187. We will need to increasingly carry out more technically complex studies. Such analysis, optioneering and optimisation will be supported in RIIO-ED2 by a new set of applications. The applications will bring together time series data for measured points on the network, DER and DSR metering data and Active Network Management/Intertrip/Protection schemes data and provide the capability to assess all the requirements together to understand where there are network constraints that require additional capacity.

Data historian

16.188. Currently, data used for network planning purposes is held within a data-logger, which has historically stored half-hourly load reading for HV feeders and some half hourly metering data. The growth in availability of different types of data requires more storage capability, along with an enhanced capability to interrogate the different sources of information.

16.189. The data historian will be an implementation of a specific database and tools for time series network data obtained from our Control Systems and other data such as smart metering data obtained via the Data Communications Company (DCC) Adaptor. The historian will need to be integrated with network analysis applications. The benefits of having a more powerful historian will be improved access to a wider range of data, enabling more robust longer term network planning.

Stability analysis

16.190. Traditionally, there was a large amount of inertia within the power systems, with large turbines at large power stations spinning at high speeds. This stored energy is particularly valuable when a generator fails as the spinning reserve can make up the power lost, thus maintaining the stability of the network. However, the closure of numerous large power stations and a move to more intermittent distributed energy resources means that the amount and characteristics of the inertia is changing with more of it being connected to the distribution networks.

16.191. Distribution network operators have not traditionally needed to model for stability conditions on the system but, as the energy system changes, a lower inertia power system may place additional constraints on distribution network operation. When generation meets demands and all necessary conditions such as voltage and frequency are maintained, the system is stable and balanced. However, any mismatch or excursions outside required parameters can cause generators or circuits to trip, which can then cause other issues and further trips.

16.192. The project will understand and model sub-second voltage collapse conditions and how these may drive requirements on the way distribution network operation can support the voltage stability of the system.

Planning state estimation

16.193. State estimation is used to provide a view of the network configuration and operational status, informed by a set of measurements and data. Within a planning context, it is used to determine representative characteristics of the network to allow network planning and development decisions to be made.

16.194. Increased network monitoring and new sources of data mean that there is greater scope to improve state estimation for planning purposes. The various data sources can also be used to cross-check each other and identify data anomalies.

16.195. This project will seek to merge the data streams from more accurate real time monitoring, current/historical network configuration topologies and alternative sources of network data to improve state estimation being used in network planning.

16.196. Inconsistencies, errors and inaccuracies can be identified through the state estimation modelling and these issues can be fed back for resolution in the core systems to improve data quality and reliability.

DFES data architecture and systems

16.197. Distribution Future Energy Scenario (DFES) work completed within WPD uses data from local authority and other key local stakeholders, supplements it with market information on technology rollout and allows national energy system predictions to be regionalised, informing WPD investment plans and requirements for additional network capacity.

16.198. As the importance of this data increases in identifying network needs, driving flexibility markets and sharing more of the data with third parties, a productionised data architecture needs to be adopted to ensure the DFES process is more efficient, consistent and repeatable, providing information that is accurate and accessible.

16.199. DFES data architectures will need to be designed around third party access to the data sets. To enable this, there may be a requirement for performance aggregation, anonymisation or other reporting functions on this data before making it available publicly. This project will also develop the systems to facilitate this.

Planning data from smart meters

16.200. As more smart meters are installed and the coverage of smart meters increases, there is scope to use the information to improve assumptions about load profiles and usage patterns. The smart meter data will help to refine the usage profile templates that are currently used for network planning considerations.

16.201. While the data will be provided at LV, it can also be used to inform assumptions about HV and EHV behaviour. In particular, it can be used to confirm/refine HV level data at substations by aggregating the LV information. For example, it can be used to show the impact of embedded distributed generation on network demands along a HV feeder.

16.202. Various different analytical approaches will be adopted including data aggregation, statistical analysis, machine learning and Artificial Intelligence (AI) technology to inform better assumptions about demand profiles. These actions will be carried out in accordance with WPD's Smart Meter Data Privacy plan.

Customer facing Network Assessment Tool

16.203. During RIIO-ED1, WPD developed a new low voltage network assessment tool (NAT) used for designing network changes. It was developed as part of our Electric Nation project and has been subsequently implemented as a business as usual product for our planners to use. The legacy systems required a level of technical knowledge and the ability to interpret data from multiple WPD systems to develop a design. The NAT tool is far more interactive than previous systems and the majority of interpretations are now automated within the new tool.

16.204. Towards the middle of RIIO-ED2, we plan to offer this design functionality to our customers. This will allow the facility for optioneering to be completed by our customers before they finalise any connection applications.

16.205. By using the NAT design model, we will be able to offer customers a simple go/no-go decision for the connection of new demands and LCTs on our network. This will help customers with feasibility work at an early stage of projects and will progress enquires through to quotation more quickly when connection plans are firmed up.

Demand disaggregation, consumer behaviour & flexibility

16.206. Currently, HV and EHV demand and generation customer behaviour is normally assessed at an aggregated level. There is a limited breakdown of the constituent customer assets and their associated behaviour. This work would build a disaggregated view of existing customer behaviour to enable more accurate forecasting of future changes in behaviour; this includes flexibility and DSR.

16.207. We will collate and analyse available data to determine existing customer behaviour. This will be broken down into the necessary technology and sub-technology categories to improve forecasting accuracy. Models and assumptions for each category will need creating and periodically updating with the latest available data. These models will include the impact of electric vehicles, heat pumps and flexibility.

16.208. Developing processes to understand and quantify expected behaviour of customers will improve shorter and longer term forecasting accuracy.

17. System Operation enablers

Scope

17.1. The DSO enablers provided by a DNO are the activities and functions which support the neutral facilitation of markets and flexibility. They relate to areas where the DNO provides data for a market, and where the DNO is involved in the connection of low carbon technologies such as electric vehicles and heat pumps.

17.2. A DNO will also need to be able to reflect the flexibility responses of a DSO within its own systems for real time operational decision making. The network management tools must be open to input from proprietary systems used in flexibility markets.

17.3. Understanding how the network is performing is key to the efficient use of the network, so data from sensors and measurement devices is required at more places on our network. Existing maximum demand sensors need to be augmented to offer power flow direction and other metrics. We will protect the integrity and safety of lower voltage networks through a combination of advanced modelling, additional visibility and conventional reinforcement. Smart meter data will be used to enhance models which are applied to our low voltage networks.

Meeting baseline requirements

17.4. We have mapped our System Operator functions against the DSO roles and activities for RIIO-ED2 as listed in the Ofgem Sector Specific Baseline Standards for DSO. In our list, we have sub-divided some items to provide additional granularity. The list is included at the end of this Annex. Throughout the document, we have explained our plans for baseline requirements. These have paragraph number references in the Annex.

Planning and network development		Promote operational network visibility and data availability		Facilitate efficient dispatch of distribution flexibility services		Provide accurate user friendly and comprehensive market information		Embed simple, fair, and transparent rules and processes for procuring distribution flexibility services	
1.2	✓ED2	2.1.2	✓ED1	2.2.1	✓ED2	3.1.1	✓ED2	3.2.2	✓ED1
1.3	✓ED1	2.1.4	✓ED2	2.2.2	✓ED1	3.1.5	✓ED2	3.2.9	✓ED2
1.4	✓ED1	2.1.5	✓ED2	2.2.3	✓ED2			3.2.10	✓ED2
1.5	✓ED2			2.2.5	✓ED1			3.2.11	✓ED2
				2.2.7	✓ED1				
				2.2.8	✓ED1				

Planning and network development

17.5. The effective application of both flexible connections and DSR services is contingent on the availability of network data such as real and reactive directional power flows and voltages. On the high voltage (11kV and higher) networks, full network visibility down to primary substation level will allow WPD's Active Network Management systems to minimise the amount of curtailment customers are subject to, while maximising asset utilisation and maintaining network security. On low voltage networks, monitoring of distribution substations will ensure that network reinforcements are carried out when and where they are needed and provide the necessary data to enable smart solutions to be deployed where required to further optimise asset utilisation.

17.6. In addition to providing WPD with the necessary real time data to actively manage its network, the installed monitoring will also provide shareable data to support emerging flexibility markets. This data can be further augmented with smart meter data to provide network information where monitoring is not available.

17.7. In addition to monitoring load flows and voltages, WPD will increase its monitoring of power quality. This additional information will further facilitate the connection of Low Carbon Technologies (LCTs) while ensuring the network outages resulting from excessive harmonic distortion, for example, are avoided.

17.8. Full details, including costs and benefits, of WPD's approach, have been published in our Sensors and Monitoring Strategy.

17.9. Data sharing in a fast and efficient way becomes key as more data sets interact. We will ensure that our planning data is made available in a standard format to increase the efficiency of data sharing. We will use the Open Networks project to ensure that our approach is coordinated with other network and system operators.

17.10. A range of changes are required to improve our data management. We view this as a journey where we need to track and measure our progress to ensure we continue to focus in the right areas. We have already demonstrated improvements in our data management processes through targeted project activity to understand our data sets, lineage, and business and third party use. We recognise the need for a consistent approach to data management, delivering standardised and effective processes to share data with other network licensees and wider customers and stakeholders.

17.11. We continue to collaborate with all other network licensees through ENA to establish common data descriptions, metadata standards and approaches to sharing data to ensure that a standardised and interoperable process is taken forwards. We have demonstrated leadership in this area as the first GB DNO to share its complete asset and connectivity data, above LV, in Common Information Model (CIM) format.

17.12. Historical information can help customers and participants forecast future demands, and our historical data will be made available in a proprietary form, such as PI Historian or other time based data store.

17.13. Visualisation of data is key to ensure that it is used and gains maximum leverage in the transition to net zero. We hold heat maps and information on our website, with forecast DFES data being made available both in WPD specific geographical areas and in specific local authority boundaries. Presuming our data to be open goes beyond making it available through our systems and services. Our role is to enable data to be harvested, housed and utilised irrespective of specific access points. Our implementation of APIs and Client URLs will ensure that this is available and appropriate. Our ENA-wide work on the creation of an energy digital system map for GB has demonstrated our commitment to, and the availability of our, data to serve this purpose.

17.14. We have already undertaken a number of digitalisation and data enhancements aligned to these principles including adoption of the Dublin Core metadata standard; providing data in a discoverable and accessible form (e.g. information maps, guiding users to key network and

supporting information); establishing data governance roles and implementing a data triage process.

17.15. Our external engagement recognises that different users have different needs and expectations of the same data. That means that ensuring the right data is available in the right format at the right time will lead to different formats at different times to serve different users. Potential users include developers looking for capacity, local government bodies developing energy plans or innovative organisations looking to test new approaches.

17.16. An example of where we have made different formats of data available is associated with our network capacity and future energy scenarios interactive maps, where the maps provide users with an easy to navigate geographic view, but we also make available the more detailed source data for more technical users to build their own analysis.

17.17. Customers can self-serve this data using our interactive maps and download features. The base data is also available to download for use in third party models and systems. Improving and increasing data management acts as the backbone to drive insight both internally and externally to meet current and future system needs. Standard processes for creating, managing and handling data though a robust data governance process has been implemented and will continue to be developed, investing in solutions to improve our data quality and ensuring we have a single source of the truth. Our online Data Hub is already home to many sets of network data and information. We recognise the needs of different data user types vary and therefore commit to sharing data in three principle formats for each relevant data set to deliver usable and valuable data to as wide an audience as possible.

17.18. Easy-to-use and visual data representations, such as interactive heat maps of network capacity data, provide the direct route to answers for non-technical data users. Downloadable, standardised and interpretable data provides opportunities for data users to interrogate and drive their own insight and value, in a different way to the use of visualised representations.

17.19. Developing data into a more consistent format has meant that we can now share our data openly via the internationally recognised CIM standard for the transfer and provision of electricity network data, to allow direct access to a complete asset and connectivity model, supporting investment and operational planning for customers and stakeholders.

Promote operational network visibility and data availability

17.20. We have already established the ability to share our network information through the standard CIM format. This allows other operators and stakeholders to run their own modelling and simulations against our base network. This requires more development to encompass all of the examples of data sharing included in the Ofgem Baseline Requirement and, as an example, we do not share working network configuration in real time. We do share an as-planned network configuration. We plan to address the areas required during the RIIO-ED2 period, developing them as data becomes available and system changes are made for us to offer useful outputs. Some outputs, such as losses recorded at substation level, will rely on third party projects such as the rollout of smart meters, so we will develop solutions to make use of these projects as they are completed.

17.21. This visibility will cover real and reactive power, for both import (demand) and export (generation) connections. As well as ensuring the power flows on the network are monitored with high granularity, our systems will allow the energy distribution patterns to be recorded and traced.

17.22. By viewing energy flows on a temporal basis, we can forecast requirements and ensure the network is proactively managed in an optimum way. Complex data analytical tools will be deployed to allow us to visualise and interrogate the data. We will share the results of this enhanced visibility with customers, their energy suppliers and the NETSO.

17.23. WPD publishes the network flexibility data for a five year window across four FES and also publishes the procurement data for a two year window under WPD's Best View. These data sets provide information to the market, as well as supporting the planning process. A month-ahead

forecast is published on the Flexible Power website to outline the expected windows of availability and utilisation needed for DSO operations. The timescales of this forecast will be updated as forecasting methods improve, with multiple iterations expected all the way up to real time.

17.24. Our implementation and continuing management of a data catalogue will provide regular and reliable single point access to trusted data in a timely and effective manner. This will also facilitate a single self-service environment to its users that help them to find, understand, trust and manage data. Furthermore, it will be clear to all data users within the organisation what each piece of data means, how it's collected, and how to use it effectively.

17.25. We use a common data triage process to assess the openness of data. This is applied to assess data classification and determine whether anonymisation or redaction is required to enable the data to be shared. This results in either Open, Public, Shared or Closed classification. A summary assessment is published along with the data set to provide stakeholders with an explanation of the data classification.

17.26. During the RIIO-ED1 period, we established the DER owner/operator forum. This gave operators a route to discuss all matters related to DER ownership, such as Grid Constraint, Outage Management and Forecasting. Details of DERs connected to the WPD network and the respective owners is well established. At future owner/operator forums, we will work to collaboratively develop the specification of detail that is required to help secure DERs. We plan to develop this specification into a solution for all DERs.

Facilitate efficient dispatch of distribution flexibility services

17.27. The real time requirement for decision making drives the activity to be completed in our 24/7 network Control Centres. This is already being completed as a look ahead task with the ESO but the network is managed in real time at arm's length from the NG network, with interactions based on forecasts, predictions or unplanned events. This interaction will become more real-time and detailed through the use of ICCP links, with more DER instructions offering solutions to both. Automated systems and interfaces will help manage the efficient dispatch.

17.28. Working across the industry through the ENA, we will establish base rules for the industry in conjunction with other DNOs. This level of standardisation will be important for the ESO. Innovation projects such as the UKPN KASM project will provide a useful basis for solutions. We already have our own acceptance and dispatch principles published on the Flexible Power website; these were developed in 2019 and will be reviewed as industry level work continues.

17.29. As systems become more detailed and interactive, rules will be set to ensure DERs can operate efficiently. It is important that rules are equitable to all network participants. These will be created transparently with stakeholder engagement through the WPD DER Owner Operator forum. Through the Midlands RDP, WPD is already working with the ESO to develop these primacy rules. Once developed, they will feed into Open Networks and wider WPD operations. These primacy rules are expected to grow in complexity as we gain operational experience.

17.30. WPD's flexibility contracts are aligned to the Open Networks common contract and allow for the substitution or exchange of flexibility services, subject to WPD approval. As well as allowing for bi-lateral trades of these contracts, WPD will publish the data which will enable peer to peer markets to further facilitate this trading activity.

17.31. Our use of clear rules for the dispatch of common DSO services, in alignment and coordination with the ESO, will allow for participants to truly understand the opportunities available and the requirements needed from them, creating a cohesive market designed to maximise liquidity, encourage revenue stacking and deliver the most efficient solution for the system.

17.32. We will support the secondary trading of distribution flexibility services and curtailment obligations by providing relevant data. We recognise it's important that our data is presented in the same format, described in the same way and provides the same level of detail as that of other network operators. This allows customers and stakeholders to have a consistent view of the data across the industry to support existing, new and developing markets.

17.33. While interoperability of systems is important, it is also worth noting that the WPD network management tool is established, so proprietary systems are inevitable in network management. It is important, however, that these systems can manage interfaces with generic systems. We will ensure that our instruction infrastructure can communicate with third party systems. As our use of flexibility services increases, we will expand and grow our dispatch infrastructure to meet the requirements. Scalability is a key feature of our solutions. During the RIIO-ED2 period, we will replace and scale our platforms as required, with work starting in 2026.

17.34. WPD has operated and scaled up Flexible Power since its early inception in 2016 as an innovation project, through to the current day, where it regularly instructs 100s of MWhs of flexibility services and has been adopted by other DNOs. Flexible Power dispatch instructions are electronic, initiated through open APIs, which require no proprietary hardware onsite.

17.35. Our Flexible Power systems are able to work with other systems, such as the interface to Kiwi Power. We remain open to other providers taking signals and data from systems and inputting back into them. Although our ANM systems do not provide a DSR response, we have followed the same ethos and openness. Our control system already interfaces with ANM systems from two providers and is able to interact with other platforms.

17.36. WPD generally does not implement hard dispatch controls for flexibility services. Flexibility instructions are through electronic APIs and not direct hardware control. Hard dispatch controls are used for disconnection under fault, outage system emergency conditions, or the implementation of flexible connections. As part of our RDP work, we are considering the use of SCADA enabled flexibility services to support the application of a Deep Connect and Manage process. This aims to provide simple, low cost access to markets using existing control systems and will be supplemented by more sophisticated commercial and technical mechanisms.

17.37. In conjunction with participant feedback, we will continue to investigate alternative methods of dispatching assets to widen access to markets and improve commercial participation. For example, this may include the use of SCADA enabled dispatch as part of the RDP work, or the option for dispatch free services such as our Sustain-H product being trailed in our Future Flex NIA project. Clear rules will be established to provide clarity on which signals can be used in which situations.

17.38. WPD does not have a hard coded system for flexibility. The flexibility service platform does not run off any DNO infrastructure. Data exchange to and from DNO control systems is limited to monitoring and real time control and is implemented through industry standard communications protocols. As such, the systems could be assigned to another party.

Provide accurate user friendly and comprehensive market information

17.39. Our digitalisation activity is already delivering, and will continue to deliver, change in how we plan, manage, and operate our network and interact with and provide data to customers and third party system participants. We are committed to continuing to build on our significant work digitalising our business to ensure that we remain an efficient and effective operator of our network and deliver data and solutions in the right format, at the right time to customers and stakeholders to meet their needs and ambitions. Our core principles are, and will remain, improving data management, increasing network insight and operation and ensuring data is presumed open. These principles ensure value is driven to all parts of the energy industry and wider, supporting the net zero transition.

17.40. Data provision in a useful format is essential and we will develop systems that can integrate through API links and machine readable formats. The information must be easily accessible and navigable. We will tailor both their information provision and engagement approaches to reflect different needs of potential market participants, including groups in vulnerable situations. Our core principles are, and will remain, improving data management, increasing network insight and operation and ensuring data is presumed open. These principles ensure value is driven to all parts of the energy industry and wider, supporting the net zero transition.

17.41. Improving and increasing data management acts as the backbone to drive insight both internally and externally to meet current and future system needs. Standard processes for creating,

managing and handling data through a robust data governance process have been implemented and will continue to be developed, investing in solutions to improve our data quality and ensuring we have a single source of the truth.

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

17.42. We do not offer a direct route to our systems. All our control instructions are via API links to third party platform providers and aggregators. We actively encourage the emergence of this sector and will continue to offer 'plug-in' solutions to remain neutral in the market. All WPD's procurement data and system need information is downloadable and can be processed by third parties. We have previously used CLEM, NODES and Piclo for procurement routes.

17.43. Through the Midlands RDP, WPD is working with the ESO to develop how the existing DSO products can serve transmission constraint needs. This will feed into Open Networks.

17.44. The ESO is the key organisation for managing the wider UK network. We already interact with them when planning ahead for DNO and ESO needs. In real time, there is no detailed visibility of ESO needs within the DNO environments as a standard; this is managed by exception and when events occur. Within our ANM systems, we cross link WPD constraints with NG constraint signals to ensure that our own actions do not undermine the responses being called for by the ESO.

17.45. WPD helped support the development of work around the stackability assessment of DSO flexibility products and their interaction with ESO flexibility services. The industry standard products implemented by WPD enable both transmission and distribution needs to be met. Contracts put in place by WPD also provide no barriers to serving whole electricity system needs.

17.46. We will investigate the additional arrangements that are required to support DERs and the ESO in a more real time automated basis.

17.47. We are committed to making sure that our data is both discoverable and searchable ensuring that we continue to collaborate with wider industry to ensure that data, irrespective of organisation, has the same meaning, format and description (metadata and data dictionaries). We continue to collaborate with all other network licensees through ENA to establish common data descriptions, metadata standards and approaches to sharing data to ensure that a standardised and interoperable process is taken forwards. We have demonstrated leadership in this area as the first GB DNO to share its complete asset and connectivity data, above LV, in Common Information Model (CIM) format.

17.48. Presuming our data to be open goes beyond making it available through our systems and services. Our role is to enable data to be harvested, housed and utilised irrespective of specific access points. Our implementation of APIs and Client URLs will ensure that this is available and appropriate. Our ENA wide work on the creation of an energy digital system map for GB has demonstrated our commitment to making our data available to serve this purpose.

Our Distribution System Operation enabler projects

Project – Automated data mastering solution

17.49. As we approach RIIO-ED2 and beyond, there is a need to further increase this level of data mastering and implement increased automation, supporting our transition to a single source of data. This will deliver operational and performance improvement, as well as flexibility, through the provision of improved quality, completeness and volume of relevant data internally and externally to enable optimised and new connection and flexibility services.

17.50. Given the evolving needs of customers and stakeholders, robust and validated data sets are required to deliver operational, planning and maintenance efficiency for customers and internal stakeholders alike. It also enables our human processes and technological systems to operate effectively by delivering our business objectives.

17.51. Master data management (MDM) is a technology-enabled discipline in which business and IT work together to ensure the uniformity, accuracy, stewardship, semantic consistency and accountability of the enterprise's official shared master data assets. Master data is the consistent and uniform set of identifiers and extended attributes that describes the core entities of the enterprise including customers, prospects, citizens, suppliers, sites, hierarchies and chart of accounts.

17.52. Utilising modern approaches to ensure this consistency between systems is crucial in achieving our business goals and ensuring that data can be easily accessed, shared and utilised throughout the organisation and externally, enabling the effective operation of DSO services.

17.53. This project will facilitate multiple outcomes including:

- Common Information Models (CIM) available internally and externally to drive consistent understanding over assets and connectivity to improve operations
- Enabling single source of truth data to enable LV to EHV self-serve design functionality improving connections and flexibility service provision
- Automated data sharing such as in ICCP format to National Grid and other DNOs

Project – Time series historian analysis system

17.54. A lot of work has been done during RIIO-ED1 to increase the reliability, quality and dependability of our time series data within our systems. As a result, we have shared a significant element of this in real time. During RIIO-ED2, we will ensure the same is true of time series data between systems, such as our Advanced Distribution Management System (ADMS), smart metering and low voltage (LV) monitoring data; this will ensure that we can both maximise the value of our time series data internally to further optimise short and long term planning and operational decision making as well as providing increased granularity of real time data to customers and stakeholders to support improvements in their planning, operational and flexibility decisions.

17.55. We recognise that customer and stakeholder needs are dynamic. We also recognise that, to deliver excellent customer service, societal, environmental and system reliability, we must create value for money throughout our decision-making processes. Using high quality, high resolution and confident data sets helps us to do this. As we increase the amount of data regarding customers, assets and operations, this future capability - namely to make timely decisions with high levels of confidence - becomes ever more important to us, our customers and aggregators. Our ability to contextualise and govern high volume data sets, ensuring that high quality data is informing our decisions processes, is also increasingly important. In order to facilitate the next step change in our journey to make more informed, more confident and more assured operational decisions, we are looking to develop the capture, collation and utilisation of time series data from across our various systems.

17.56. This project will facilitate multiple outcomes including:

- Real time and historic time series data available openly to at least primary substation level and LV where appropriate
- Enabling real time flexibility data for scheduling and settlement purposes
- Facilitating a fully enabled flexibility management system
- Optimisation of integrated DNO and DSO operational systems

Project – Open Cloud Data Platform

17.57. We are the first DNO to make an online data catalogue available, providing access to our data sets in a common location, with standardised definitions and descriptions to ensure the data is usable and interoperable. Our current network operations and future operation plans are reliant on robust, reliable and transparent data to continue delivering exceptional services. Sharing this data through a secure, interactive Open Cloud Data Platform will provide benefit to customers and stakeholders, enabling them to make more informed decisions.

17.58. To deliver net zero, changes are required to both energy usage and delivery, as well as, more imperatively, to ensure that the data that drives these changes is effectively utilised. Building on our initial data portal, the implementation of an Open Cloud Data Platform will enable us to share data sets more quickly, reduce the risk of data errors by reducing human interaction and developing and implementing a framework embedded in a cloud architecture.

17.59. This improved method of providing data to customers will unlock opportunities for new processes to be developed, resulting in an expansion in the services and network activities that are facilitated.

17.60. This project will facilitate multiple outcomes with a number included below:

- All data centrally accessible and described consistently ensuring it is standardised and interoperable from asset information to operational data to ensure open and fair flexibility services
- Historic and database level data accessible to meet the needs of a wide range of user types

Project – Internal Data Platform

17.61. Our Internal Data Platform will provide a centralised process for data systems to transfer data, which staff can trust and utilise across different systems and environments. This will help us to continue to move away from a decentralised, historic knowledge-based culture and ensure that we deliver a data centric approach as an organisation.

17.62. Linked to automated data mastering, the central storage and utilisation of data will be a critical step in meeting future DSO requirements and accessing benefits. At the same time, it will enable a move to probabilistic-based asset and network operation. It will ensue that the business is prepared for the future, enabling more effective decision making, and overall trust within the business regarding the accuracy and validity of data used in these decisions.

17.63. This solution is fundamental to delivering multiple outputs as described above as well as outcomes, such as:

- DFES Data Architecture and Systems;
- Planning State Estimation solution implemented;
- Network analysis for DNO and DSO functionality;

- Enabling real time flexibility data for scheduling and settlement purposes;
- Facilitating a fully enabled flexibility management system;
- Optimisation of integrated DNO and DSO operational systems.

Project – Improved network monitoring and power flow sensing

17.64. Conventional network design focused on maximum demand solutions and did not distinguish between imported and exported demand. As the network evolves and more distributed generation assets are connected, the maximum demand becomes less important than the actual power flows.

17.65. Measurements of flows in demand and generation, and awareness of the cumulative effects of both working together, become key for efficient network operation. Half hour changes and forecasting will allow us to operate the network in a more fluid way and develop capacity.

17.66. This project looks at the current ranges of monitors and sensors available for use on the network and assesses their future applications to support flexibility.

17.67. This project will facilitate multiple outcomes including:

- Power flow visibility
- Power quality visibility
- Real time management
- External influence monitors, such as temperature and weather effects.

18. Operational control systems

18.1. We are proposing a number of significant enhancements to existing control systems. Some of these will be enhancements to the existing applications and others will require development of new systems that will interact with the existing control systems. This will require changes to hardware as well changes to the applications.

18.2. In line with WPD's four point plan, the focus will be on higher network voltages, but there will be increased amounts of data and visibility of network operation implemented for lower voltages.

18.3. WPD's control systems are based upon a proprietary suite of products. They also interface with SVO and KIWI products. The core modules used include:

- Network Management System (NMS) for control of the network
- Time Series Data Store (TSDS) that records data about the state of the network
- Historic Network Viewer (HNV) which allows playback of network status and configuration
- Outage Management System (OMS) which enables fault management
- Call Taker which captures the details of incoming and outgoing calls
- Mobile module which allows field staff to access certain functionality

18.4. It is possible to interface data with our control systems at a high level or with the specific modules. Currently, all operational interfaces link directly with the NMS.

18.5. The RIIO-ED2 operational system projects are described below.

Cyber security and networking

18.6. It is expected that cyber security risks will continue to grow during the RIIO-ED2 period. Network and Information Systems (NIS) regulations will continue to evolve, leading to improvement actions on access control, intrusion detection and attack recovery. While many of these actions will be implemented on the control systems hardware or within the data communications network, there will also be a need to implement application level changes.

Physical control system hardware and communications segregation

18.7. We have identified a need for further physical segregation and improved network security architecture on controls systems hardware and the operational telecoms network.

18.8. Physical segregation is used to mitigate risk of cyber-attack by isolating critical control systems from wider corporate networks. It requires separate servers, network points, cabling, switches, routers, telco links, etc. Connections to the wider corporate network will be made through a carefully managed firewall (and possibly a demilitarised zone where further integration to other DSO and ESO systems can take place).

18.9. Improved network security architecture considers four key control measures

- Policy/standards – these define who can do what, how it is controlled, who has oversight.
- Defence – including actions such as physical network separation, data encryption and secure communications.

- Detection – such as network sniffing and intrusion detection which seeks to detect abnormal network traffic or irregular messages as part of our Security Operations Centre services

- Recovery – enhance emergency plans for cyber events. Our emergency plans will be business wide and have dedicated communication channels and command structures.

Application cyber enhancements

18.10. It is envisaged that, as a result of expanding NIS requirements, cyber enhancements will be needed for our control systems applications, the growing number of distributed control systems supporting DSO solutions (such as Active Network Management, Demand Side Response and System Voltage Optimisation) and network analysis systems using machine learning and artificial intelligence.

18.11. We also expect NIS to be extended to encompass all network connected devices to ensure end to end security covering the whole chain of communication from our control system application through to the connected devices (plant) in WPD substations. There is also the possibility that the scope of NIS will be expanded to include customer side DER and equipment.

Remote updates and patching

18.12. The data networks supporting the network control systems are evolving, and will continue to evolve, to support more real time intelligent electronic devices within the electrical network. This will include providing the ability for engineers to access relay settings, control system configuration and connected plant (e.g. transformer or tap changers for health information). It will also provide a facility for cyber vulnerability patching to be done remotely to the OT network and electrical plant.

18.13. As a result, the communications networks and associated protocols will need to evolve to obtain the benefits from modern protocols and software, ensure that the protocols used remain within the support of manufacturers, have high levels of resilience and make efficient use of communications resources.

Control systems core IT server hardware

18.14. The hardware used by our control systems typically has a five year life. We refresh the hardware estate every five years; the last hardware refresh for our control systems was in 2018. The next is due in 2023, with another due in 2028 during RIIO-ED2.

Distributed Energy Resource management – Hardware/hosting

18.15. There are a number of systems that interface directly to the core Control Systems Management System (NMS). Currently, they tend to have standalone applications and servers.

18.16. During RIIO-ED2, we are expecting increased requirements for existing applications as communication expands to more devices on the network. We also expect an expansion of the range of different applications that will require to interface to the NMS to support further real time analytics, optimisation and control.

18.17. At present, these applications perform certain functions (such as demand side response) or collect specific data (such as cable low pressure alarms and earth fault indicator alarms) and link to the NMS via a system called ihost. The current installation of ihost has limited capability and therefore new hardware is required for the NMS related applications.

18.18. We propose to use more powerful hardware to consolidate a range of existing separate servers onto a single platform. The new hardware will use a process of virtualisation to allocate memory and processing capability from the main server to individual applications. This will enable greater flexibility for the applications, because more memory and processing can be easily provided as it is required. It will also support both Linux and Windows applications, enabling a larger range of applications to be interfaced to the NMS.

Connecting our systems to other operators

18.19. In VED2, we will need to integrate with more trusted third parties in the energy system such as the transmission ESO, all five neighbouring DSOs, aggregators and energy suppliers or service providers.

18.20. We expect that some of these links will use ICCP, an international standard for control systems, enabling data transfer capability between control centres for different organisations.

18.21. Organisations which require less inter-operability will make use of our third party integration data digitalisation platform.

Cloud architecture for digitalisation strategy

18.22. As part of our commitment to make more date open to third parties, we will be storing large quantities of data for use and access by third parties. This work will include establishing and supporting the hosting of open data, including

- access control,
- data security and
- self-serve access.

Control systems application enhancements

18.23. WPD's Network Management System is continually enhanced to ensure it remains capable of delivering outstanding network performance. Requests for new features, functionality and reports arise regularly with small enhancements being developed in-house and deployed when ready. Larger changes may require development by the manufacturers GE with updates deployed as patches.

Pseudo analogues

18.24. We are making greater use of state estimation within our control systems. A Distribution Power Flow (DPF) module has been deployed during RIIO-ED1 and can run at HV and LV. In RIIO-ED2, we propose to deploy the Power System Analysis (PSA) module which runs at voltages above HV. Both modules provide the capability to have pseudo network analogues at any point on the network. DPF and PSA can be used to drive other processes such as Active Network Management, to optimise network access and manage network capacity in exactly the same way as using real measured analogues.

18.25. Historically, there has been very limited data available for the operation of the LV network. But going forwards, it is anticipated that there will be a need to have much greater visibility of the status of the low voltage network. WPD has started deploying monitoring at distribution substations and data is already being pulled back for each phase of every LV network feeder. (where monitoring is available and data privacy allows). It is proposed to have an LV layer within our control systems that will display the LV data. This will be based upon the direct readings from site or state estimated data based on pseudo analogues or aggregated smart meter data where the real time demand is derived from a combination of smart meter data and state estimation.

18.26. This project will enable the following:

- Display of actual LV analogue data
- Derivation of pseudo analogues

- Alerting of alarms for LV assets
- Aggregation of the LV analogue data to show the load at HV substations

System Voltage Optimisation

18.27. The technique of System Voltage Optimisation (SVO) was initially developed as part of WPD's Low Carbon Network Fund Equilibrium project. It showed that capacity for generation and demand can be created by changing the voltage on the primary 33kV network. During the first three years of RIIO-ED2, the SVO system implemented as part of the LCNF project will be replaced with an enterprise scale platform which will be fully integrated with our Network Management System. This will allow the expansion of SVO to any area within WPD as required.

Control systems enhancements

18.28. There are a range of control systems enhancement projects that will be implemented during the RIIO-ED2 price control. Some of these enhancements are already known, whereas others will emerge as additional functionality requirements are identified.

18.29. WPD anticipates growth in the amount of machine learning and AI during RIIO-ED2. We already use basic machine learning to assess the state of the network, determine where it is possible to restore supplies from (by considering loads and network ratings) and initiate the operations in a logical sequence that restores supplies to non-faulty parts of the network.

18.30. In the future, we expect the system to self-learn optimum fault restoration, minimise/eliminate alternative connection constraint triggers, minimise losses and maximise capacity. The dynamic way in which loads may fluctuate on the network in the future, especially where there are intermittent DER connected, will mean that optimisation of network running will need to be more automated.

RTU replacement

18.31. Remote Terminal Units (RTUs) are installed at substations and act as an interface between equipment being monitored locally and the communication with control systems.

18.32. These are electronic microprocessor based devices which have a relatively short life compared to the electricity network assets. During RIIO-ED2, WPD proposes to modernise 2,400 RTUs, which are now end of life.

18.33. The replacement device will be an Internet Protocol (IP) enabled RTU, providing enhanced two way data traffic that will drastically increase system monitoring, allow the remote administration of system upgrades and be plug and play ready for the next generation of IP-enabled switchgear and support cyber security.

Distributed energy resource management – Applications

18.34. To support new DSO functions, the following requirements have been identified:

Demand Side Response

18.35. Demand Side Response (DSR) is a new/enhanced customer facing system which will be used for WPD's Flexible Power arrangements including contracting, monitoring, dispatch and settlement.

18.36. It will be used for the dispatch of curtailment (for ANM) or other flexibility actions when authorised by the DSO control team. It will also take information, such as alerts or alarms, from the DER which declare the DER unavailable; these will be passed through an interface to our

NMS to make control engineers aware immediately and to enable the proposed Future Network Viewer tool in our control systems to inform outage planning and near-future flexibility requirements.

18.37. This project is for the enhancement or replacement of the existing Kiwi Flexible Power Application Programming Interface platform with a system capable of managing more DER and having more functionality and features.

LV geo-schematic representation in our control systems

18.38. Our NMS currently does not incorporate visibility of the LV network.

18.39. This project will develop the schematics of each distribution substation and link the data to the HV layer in our control system. It will also provide the geo-schematic background to show how the LV network is interconnected.

18.40. Once in place, this will enable data about the LV network to be displayed to control engineers. This will include the information being directly monitored at distribution substations as well as pseudo analogues where monitoring has not yet been installed.

TSDS enhancements

18.41. WPD's Time Series Data Store (TSDS) module has the ability to store operational data taken from other modules such as the Network Management System. The way that data is stored within TSDS enables rapid access to operational data at a granular level of detail. This gives control engineers quick access to the data and enables automated processes to operate quickly.

18.42. As new functionality is required for operating the network (e.g. growth in LV monitoring), there will be a need to make incremental enhancements to the TSDS system.

18.43. The architecture of the TSDS is not suited to extracting or analysing large amounts of data over many years for investment purposes. These functions are being implemented in a separate data historian.

Technology refresh of early ANM systems

18.44. Active Network Management (ANM) provides a low cost alternative for new connections to be made quickly and for a lower cost, avoiding the cost of reinforcement. These systems have been evolving since being trialled during DPCR5 and early implementations are installed on bespoke hardware, some of which is standalone.

18.45. WPD is rolling out ANM to all areas which therefore calls for an enterprise-wide.

18.46. While some of the ANM systems are linked into our control systems via an ICCP link, only simple ANM functionality is available. There is a need to improve the integration with our control systems and ensure that all ANM schemes can communicate with the NMS.

18.47. It is proposed that there will be an Advanced Distribution Management System that will act as an orchestration layer sitting above and directing a number of systems. This will integrate with the Demand Side Response system, SVO and the ANM systems to ensure that network actions are coordinated and conflicting sub-system requirements result in appropriately balanced actions.

Homogenisation of our control systems

18.48. WPD operates a NMS across all four licence areas. However, the nomenclature and symbols used differ, due to the retention of legacy approaches from previous company acquisitions.

18.49. These differences prevent staff familiar with a specific system in a licence area from working on the systems in other areas.

18.50. This project proposes to homogenise the diagrammatical representations, operating processes and data structures between the systems by redesigning the application and database architecture. This will provide three main benefits:

- Greater staff flexibility, giving better coverage between control rooms (especially during storm situations or for business continuity) and opportunities for efficiencies through changing working arrangements.
- Simplification of technical support, with standardisation meaning that upgrades or patches need only be tested once, rather than numerous times, for each instance.
- Common data architecture for interoperability, allowing easier import and expert capability which is currently made difficult by having four different data structures.

Development of 'Future Network Viewer (FNV)' forecasting system

18.51. A prototype tool for looking at the state of the network in the future was developed under the Electricity Forecasting and Flexibility System (EFFS) innovation project.

18.52. The Future Network Viewer project will implement an enterprise-wide system that will give visibility of the network configuration and operation for up to a year in the future. This will provide short term information about upcoming outages, as well as a slightly longer term view of network requirements to accommodate known future work activity or availability of DER.

19. Appendices

Appendix A01 - Ofgem Sector Specific Baseline Standards for DSO

Role 1: Planning and network development

WPD Ref	Paragraph number	SSMD Ref	BPG Ref	Activity Description
1. 1	16.8	A1.16 bullet 1	Appendix 4 1.2 bullet 1	DNOs to define and develop enhanced forecasting, simulation and network modelling capabilities, with processes in place to drive continual improvement to meet network and user needs
1 .2	9.1, 17.8	A1.16 bullet 1	Appendix 4 1.2 bullet 1	We expect increased monitoring equipment to be rolled out across their network where it has demonstrable value. We expect demonstrable value to include a rigorous presentation and analysis of needs and use of data for networks and non-networks parties, well-established functional and technical specifications, and cost-effectiveness analysis. DNOs should also explore all reasonable options to use data from third parties, including harnessing smart meter data subject to data sharing agreements, to improve their simulated forecasting
1 .3	16.33-16.38, 17.11	A1.16 bullet 2	Appendix 4 1.2 bullet 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, for example to enable innovation and support the development of local government plans for decarbonisation
1 .4	16.48-16.52, 17.16	A1.16 bullet 2	Appendix 4 1.2 bullet 2	As part of this, we expect DNOs to liaise with their network users to collate and share data, to publish comprehensive and comparable heat maps that provide network users high value information about where to connect, and to inform their operations
1 .5	17.19	A1.16 bullet 2	Appendix 4 1.2 bullet 2	These geographic information system datasets should be available for download or for access independently of DNO websites (for example, via Web Map Service server connections). Ofgem-led reforms to the LTDS will seek to licence minimum standards against these improvements
1 .6	16.64-16.73	A1.16 bullet 3	Appendix 4 1.2 bullet 3	DNOs to have in place transparent and robust processes for identifying and assessing options to resolve network needs, using competition where efficient. This should include demonstrable cross-sector45 engagement, optioneering, and planning with sectors or vectors other than their own
1 .7	16.18	A1.16 bullet 3	Appendix 4 1.2 bullet 3	DNOs should consider flexibility and promoting energy efficiency in addition to innovative use of existing network assets and traditional reinforcement. The process of identifying options should include engaging with other network licence holders and current and prospective network users. Options must be fairly compared against one another, with flexibility used where it is economic and efficient compared to investing in traditional reinforcement or technological solutions
1 .8	16.119-16.120	A1.16 bullet 3	Appendix 4 1.2 bullet 3	We expect a consistent approach for valuing flexibility, taking into account the option value it provides in the context of uncertainty. DNOs must ensure transparency in their approach to allow scrutiny of decision-making

Role 2: Network operation

Activity 2.1: Promote operational network visibility and data availability

WPD Ref	Paragraph number	SSMD Ref	BPG Ref	Activity Description
2.1.1	15.32, 17.23	A1.21 bullet 1	Appendix 4 1.5 bullet 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	15.48-15.50, 17.25	A1.21 bullet 1	Appendix 4 1.5 bullet 1	DNOs must take reasonable steps to access and subsequently share, including by publishing, data and operability constraint information in a timely manner
2.1.3	18.19	A1.21 bullet 2	Appendix 4 1.5 bullet 2	DNOs to provide the ESO with information across timescales about the DER it is planning to instruct to dispatch. Data should include contracted parties, availability and information on scheduled and unscheduled utilisation. Sharing this information in a timely manner should enable the ESO to identify which DER are available for its own needs and improve the ability of DER to stack value across markets.
2.1.4	17.26	A1.21 bullet 3	Appendix 4 1.5 bullet 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
2.1.5	17.20	A1.21 bullet 4	Appendix 4 1.5 bullet 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. Data should be readily available in agreed and common data formats. This could include, but is not limited to: - Working network configuration data - Losses recorded at substation level - Outages both planned and unplanned - As recorded historic Feeder MW/MVA Utilisation and calculated headroom/footroom - Utilisation and curtailment of areas under the control of capacity management systems such as Active Network Management systems

Activity 2.2: Facilitate efficient dispatch of distribution flexibility services

WPD Ref	Paragraph number	SSMD Ref	BPG Ref	Activity Description
2.2.1	16.121-16.132, 17.28	A1.26 bullet 1	Appendix 4 1.7 bullet 1	DNOs to have and regularly review a decision-making framework for when DER are instructed to dispatch in real-time. The decision-making process, including alternatives considered, should be transparent. This should promote coordination across services (including curtailment as part of non-firm connection agreements and ESO flexibility services), maximise liquidity, avoid market fragmentation and ensure dispatch results in the best outcome for the whole system; this includes service provision to the ESO and other distribution networks
2.2.2	16.143-16.149, 17.29	A1.26 bullet 2	Appendix 4 1.7 bullet 1	As part of this decision-making framework, there must be rules in place for coordinating dispatch instructions for DSO and ESO flexibility services. This could be through primacy rules or more comprehensive optimisation processes that better enable stacking of revenues for DER. The rules should be transparent, objective, and promote whole system efficiencies
2.2.3	16.157-16.161, 17.32	A1.26 bullet 3	Appendix 4 1.7 bullet 2	The DNOs shall facilitate secondary trading of distribution flexibility services and curtailment obligations. In this context, facilitating means providing the relevant operational data, ensuring the DNO has processes in place to collect the relevant data about the trade, and making the operational parameters clear (and justified in the context of network reliability and efficiency)
2.2.4	16.150-16.156	A1.26 bullet 4	Appendix 4 1.7 bullet 3	DNOs to introduce clear processes for the design, development, and communication of the decision-making framework. These should include transparent and participatory processes for stakeholder input
2.2.5	17.35	A1.26 bullet 5	Appendix 4 1.7 bullet 4	DNOs to develop efficient, scalable dispatch instruction infrastructure and avoid proprietary systems
2.2.6	16.121-16.122	A1.26 bullet 6	Appendix 4 1.7 bullet 4	We expect clear definitions of different types of dispatch instruction for distribution flexibility services and transparent rules about when and in which markets they should be used. Circumstances for different dispatch instructions should be well-justified. Definitions of these circumstances should be developed with input and cooperation from network users
2.2.7	17.36	A1.26 bullet 7	Appendix 4 1.7 bullet 4	The application of hard dispatch controls shall be for the improved reliance on market-based mechanisms, not to the detriment of their development
2.2.8	17.83	A1.26 bullet 8	Appendix 4 1.7 bullet 4	Capabilities in network operations, for example in dispatch instructions and associated system architectures shall not be hard coded to the DNO. These must be developed so that they can be cost effectively assigned to another party in future, if this is needed

Role 3: Market development

Activity 3.1: Provide accurate, user friendly and comprehensive market information

WPD Ref	Paragraph number	SSMD Ref	BPG Ref	Activity Description
3.1.1	16.105-16.107, 16.114, 17.39	A1.32 bullet 1	Appendix 4 1.9 bullet 1	DNOs 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. Relevant data and information include planning and operational data (such as that set out in Activity 1.1 and 2.1).
3.1.2	16.143-16.149	A1.32 bullet 1	Appendix 4 1.9 bullet 1	This should be provided with sufficient lead times to enable wider participation in distribution flexibility services markets. It also includes information on historic and future distribution flexibility services market actions. This should include tender results, prices bid and paid, the carbon content of aggregated units, how often DER is dispatched (and volumes) and other actions taken by the DNO (with anonymisation as required), including curtailment as part of non-firm connection agreements. The information should include all requirements set out in licence conditions to support DER to identify revenue opportunities. This increases the accessibility of tendering for distribution flexibility services for flexibility providers (while also taking account of DNOs flexibility needs).
3.1.3	15.454-15.555	A1.32 bullet 1	Appendix 4 1.9 bullet 2	DNOs should, with stakeholder input, develop robust strategies for how they will collate and publish more helpful information, wherever possible consistently and in coordination with other network licence holders, and communicate this clearly
3.1.4	15.454-15.555	A1.32 bullet 2	Appendix 4 1.9 bullet 3	DNOs should regularly and actively engage with market participants to understand what data and information is helpful to support market development. While there will be minimum legal requirements set out in licences, we expect DNOs to use their stakeholder engagement to consider the most effective format and frequency of publishing that data to ensure it is user-friendly.
3.1.5	15.363-15.464, 17.39-17.41	A1.32 bullet 2	Appendix 4 1.9 bullet 3 and 4	The information must be easily accessible and navigable. We expect this includes publishing data in machine readable formats. DNOs should, where reasonable, tailor both their information provision and engagement approaches to reflect different needs of potential market participants, including groups in vulnerable situations.
3.1.6	15.363-15.464	A1.32 bullet 2	Appendix 4 1.9 bullet 4	In many instances, collaboration across DNOs in engagement is expected to reduce duplication, make it easier for stakeholders to engage and avoid stakeholder fatigue
3.1.7	16.105-16.107	A1.32 bullet 3	Appendix 4 1.9 bullet 5	DNOs should seek to ensure the information they publish is as accurate and unbiased as reasonable (ie correct at time of publication, as close as possible to the actual value and not skewed in any direction).

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

WPD Ref	Paragraph number	SSMD Ref	BPG Ref	Activity Description
3.2.1	16.116	A1.36 bullet 1	Appendix 4 1.11 bullet 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. The processes should be transparent and participatory, involving other DNOs, the ESO, and current and potential distribution flexibility service providers
3.2.2	16.108-16.113, 17.42	A1.36 bullet 1	Appendix 4 1.11 bullet 1	DNOs should also coordinate and engage with third party platform providers, who can offer system value by providing new routes to market and driving whole system outcomes. DNOs should not prevent the emergence of this sector and should enable third party platforms to 'plug-in' to DNOs' flexibility procurement processes
3.2.3	16.121-16.132	A1.36 bullet 1	Appendix 4 1.11 bullet 1	Products and contracts should be adaptive to reflect prevailing system needs, type, and availability of flexible resources. The objective of these processes is to enable as wide participation in distribution flexibility services markets as possible
3.2.4	16.136-16.141	A1.36 bullet 2	Appendix 4 1.11 bullet 2	DNOs should identify the optimum combination of longer and shorter term lengths of markets and contract lengths reflecting the network need. Needs should be neutrally defined, to allow for a range of flexibility providers to participate. This will help improve market liquidity and the opportunities for innovation and dynamic competition
3.2.5	16.141	A1.36 bullet 2	Appendix 4 1.11 bullet 2	Individual decisions and frameworks for deciding market timeframes and contract lengths should be transparent, informed by stakeholders and justified as being the most economic and efficient solution. Notwithstanding, deviations from the standard should be justified with clear governance processes for managing change that should be clearly communicated
3.2.6	16.143-16.148	A1.36 bullet 3	Appendix 4 1.11 bullet 2	DNOs should have clear, comprehensive and transparent mechanisms and associated commercial structures for coordinating distribution flexibility services and ESO flexibility services procurement
3.2.7	16.108-16.113	A1.36 bullet 3	Appendix 4 1.11 bullet 2	DNOs shall not act as the commercial route for DER accessing ESO flexibility services
3.2.8	16.146	A1.36 bullet 3	Appendix 4 1.11 bullet 2	Transparent (and possibly tripartite) commercial agreements may be required to reflect the potential effects of DER dispatch on distribution system operability and the role of DNOs in setting dispatch parameters (as set out in Activity 2.1 and 2.2). These agreements should remove exclusivity clauses as far as possible, including with regard to non-firm connections
3.2.9	17.43	A1.36 bullet 3	Appendix 4 1.11 bullet 2	Coordination on dispatch parameters should enable a closer to real-time understanding of what DER needs to be armed and available for a particular service, and what can be available to provide other services
3.2.10	16.140, 17.46,	A1.36 bullet 3	Appendix 4 1.11 bullet 2	DNOs should consider arrangements to support DERs to provide services that meet both DNO and ESO needs
3.2.11	17.42-17.48	A1.36 bullet 4	Appendix 4 1.11 bullet 3	DNOs should make available the necessary data to enable secondary trading, for example capacity and other peer- to-peer trading. Enabling includes defining, communicating and justifying the parameters in which these trades can take place for operability purposes
3.2.12	16.114-16.118	A1.36 bullet 5	Appendix 4 1.11 bullet 4	Market support services, such as pre-qualification, credit-checking and settlement must enable simple and cost-efficient participation in markets. DNOs should enable, and never prevent, the opportunity for third parties to provide these services where they could do so more efficiently
3.2.13	16.162-16.183	A1.36 bullet 6	Appendix 4 1.11 bullet 5	DNOs to introduce other proportionate measures, developed with robust stakeholder engagement, to identify and address actual and perceived conflicts between its market development and network ownership roles or other business interests. Measures to address might include ring-fencing of particular teams and external auditing of

WPD Ref	Paragraph number	SSMD Ref	BPG Ref	Activity Description
				objectivity in addition to measures that promote transparency and enable scrutiny

Appendix A02 - Electric Vehicle Strategy

19.1. The EV Strategy describes the challenges, along with the innovation and solutions, which will be adopted to prepare our network for the millions of electric vehicle drivers who will want to charge their EVs at a time and place that suits them.

19.2. The strategy can be found on our website at:
https://yourpowerfuture.westernpower.co.uk/downloads-view/40830

Appendix A03 - Heat Pump Strategy

19.3. In 2020, we became the first DNO to publish a bespoke, annually updated Heat Pump Strategy document. The strategy sets out how WPD will enable heat pump owners to connect to the network in a way that suits them, using innovation and other initiatives to make this happen.

19.4. The strategy can be found on our website at:
https://yourpowerfuture.westernpower.co.uk/downloads-view/40848

Appendix A04 - DSO Strategy

19.5. We were the first DNO to publish a costed DSO Strategy in 2017 which has been updated to reflect changing requirements and industry developments

19.6. The strategy can be found on our website at:
https://yourpowerfuture.westernpower.co.uk/downloads-view/40833

Appendix A05 - Sensors and Measurement Strategy

19.7. In April 2020, we published a Sensors and Measurement Strategy, which identifies the monitoring requirements needed to develop smart networks, improve network design and enhance network security.

19.8. The strategy can be found on our website at:
https://yourpowerfuture.westernpower.co.uk/downloads-view/40875

Appendix A06 - Smart Meter Strategy

19.9. Our Smart Meter Strategy outlines how we will harness the data provided by the use of smart meters in order to further improve service delivery and prevent power cuts.

19.10. The strategy can be found on our website at:
https://yourpowerfuture.westernpower.co.uk/downloads-view/40845

Appendix A07 - Losses Strategy

19.11. Since 2013, we have produced a Losses Strategy, which is updated annually. This strategy supports our commitment to reducing losses associated with our network.

19.12. The strategy can be found on our website at:
https://yourpowerfuture.westernpower.co.uk/downloads-view/40827

Appendix A08 - Telecoms Strategy

19.13. We have produced a Telecoms Strategy which is updated annually and available as a standalone document.

19.14. The strategy can be found on our website at:
https://yourpowerfuture.westernpower.co.uk/downloads-view/40854

Appendix A09 - Net Zero Communities Strategy

19.15. We have implemented a Net Zero Communities Strategy, which outlines our enduring commitment to community energy and highlights our stakeholder engagement approach to delivery.

19.16. The strategy can be found on our website at:
https://yourpowerfuture.westernpower.co.uk/downloads-view/40860

Appendix A10 - Innovation Strategy

19.17. Each year, we publish an ambitious Innovation Strategy to reflect rapidly changing external factors including government policy, stakeholder priorities and to incorporate learning from the previous 12 months. The strategy looks ahead to 2035, but provides more detail on shorter-term priorities, requirements and proposed initiatives.

19.18. The strategy can be found on our website at:
https://yourpowerfuture.westernpower.co.uk/downloads-view/40857

Appendix A11 - Digitalisation Strategy and Action Plan (DSAP)

19.19. We have developed a comprehensive Digitalisation Strategy and associated Digitalisation Action Plan which are central to our plans for a smarter energy system and increased sharing of data.

19.20. The strategy and action plan can be found on our website at:
https://yourpowerfuture.westernpower.co.uk/downloads-view/40851

Appendix A12 - Distribution Future Energy Scenario (DFES) Reports

19.21. Since 2015, we have been creating Distribution Future Energy Scenario (DFES) reports. From 2020, our System Operator team is producing reports annually to forecast rapidly changing low carbon technology uptakes up to 2050. The DFES projections have been aligned to the latest National Electricity System Operator (ESO) scenario forecasts which are available when the DFES process is carried out.

19.22. The reports can be found on our website at:

East Midlands Report: https://yourpowerfuture.westernpower.co.uk/downloads-view/40872
South Wales Report: https://yourpowerfuture.westernpower.co.uk/downloads-view/40869
South West Report: https://yourpowerfuture.westernpower.co.uk/downloads-view/40866
West Midlands Report: https://yourpowerfuture.westernpower.co.uk/downloads-view/40863

Appendix A13 - Shaping Subtransmission Reports

19.23. The scenario information data from the DFES analysis is used to create demand, generation and storage load sets which are then modelled to identify the impacts on the network which could lead to constraints. These are published in our Shaping Subtransmission document series.

19.24. They can be found on our website at:

East Midlands Report: https://yourpowerfuture.westernpower.co.uk/downloads-view/40818
South Wales Report: https://yourpowerfuture.westernpower.co.uk/downloads-view/40821
South West Report: https://yourpowerfuture.westernpower.co.uk/downloads-view/40824
West Midlands Report: https://yourpowerfuture.westernpower.co.uk/downloads-view/40815

Appendix A14 – Distribution Network Options Assessment

19.25. The Distribution Network Options Assessment (DNOA) outlines investment decisions made by WPD in order to deal with constraints that arise across our licence areas. This includes demand side response procured through WPD's Flexible Power, conventional reinforcement schemes and innovative solutions such as active network management. To determine the economically optimal solution, cost benefit analysis is carried out which is described in the DNOA. By outlining

our analysis process stakeholders and customers can be assured that WPD is giving them the best possible value for money while maintaining a secure and sustainable network.

19.26. The DNOA also works in tandem with Flexible Power in helping inform flexibility providers of the potential for future opportunities to provide flexibility services with signposting data for the next 5 years.

19.27. The DNOA is published on our website at: https://yourpowerfuture.westernpower.co.uk/downloads-view/40812

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