



# Whole Systems Strategy RIIO-ED2

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# Version Control

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## How this strategy impacts other areas of our plan

Our focus is to achieve the best possible positive outcomes for our customers, by utilising innovative solutions and smarter working practices to drive efficiency in all we do. This strategy forms part of a suite of wide ranging, ambitious and interconnected strategies that we will be implemented in RIIO-ED2. Each one is designed to contribute towards the delivery of the same four overarching strategic outcomes we will achieve for customers:

	<b>1. Sustainability</b> Lead the drive to net zero as early as possible.		<b>2. Connectability</b> Customers can easily connect their electric vehicles, heat pumps and renewable generation.
	<b>3. Vulnerability</b> First class vulnerable customer support programme where everyone benefits in a smart future.		<b>4. Affordability</b> Maintain excellent customer service, safety and network performance and transform the energy grid for future generations, while keeping bills broadly flat.

Each of our strategies is embedded across our operations and never delivered in silos. This will lead to joined up delivery, utilise opportunities to share knowledge and expertise across WPD teams, and achieve maximum benefits for customers. By doing so we will ensure each of our strategies has a far reaching impact and identifies opportunities to improve our service, performance and efficiency in every possible area of our business. Our strategies are therefore highly interrelated and co-dependent.

The following table provides a snapshot of some of the extensive impacts of this Whole Systems Strategy, and signposts to other areas of our plan upon which its successful delivery will be dependent.

Strategy	Reference within the strategy:		
Climate Resilience	-	-	-
Customer Vulnerability	✓	Develop collaborative outreach initiatives to support customers in vulnerable situations and tools to assess their capabilities to participate in a smart energy future	<a href="#">Page 29</a>
Destination Net Zero: Business Innovation and Efficiency	✓	Focusing on the most efficient ways to achieve net zero across wide regional areas by harnessing whole systems approaches to deliver solutions that achieve the greatest social benefit	<a href="#">Page 13</a>
Digitalisation Strategy and Action Plan	✓	Making the right type, range and format of data available to enable whole systems decisions and collaboration	<a href="#">Page 20</a>
DSO	✓	Utilising whole systems approaches specifically to develop the most effective DSO capabilities and services	<a href="#">Page 34</a>
Environment & Environmental Action Plan	-	-	-
Innovation	✓	Utilising innovation projects to develop whole system solutions	<a href="#">Page 30</a>
Major Connections	✓	Delivering collaborative regional development plans to provide connections quicker and at lower prices	<a href="#">Page 38</a>
Network Visibility	✓	Utilising whole systems innovation to increase visibility of the network	<a href="#">Page 30</a>
Net Zero Communities	✓	Introducing community energy engineers who can explore the best whole systems solutions to meet the energy needs and aspirations of local communities	<a href="#">Page 39</a>
Social Contract	-	-	-
Whole Systems			
Workforce Resilience	✓	Ensuring whole systems is integrated into the way our teams work and plan major reinforcement schemes on the network	<a href="#">Page 17</a>

# 1. Executive summary

## Delivering whole system outcomes is necessary to achieve net zero

- 1.1. To deliver against the UK government's net zero target, and to achieve effective decarbonisation for customers and society, integration across sectors will be necessary.
- 1.2. Our initial overview looked at the technology, market changes and policy and regulation updates. We can see that the energy market is changing drastically and the interaction with other stakeholders is key.
- 1.3. Our understanding of the changes in technology and markets shows that an effective whole systems approach will require identifying interrelationships in several energy systems. We focused on new technologies that will impact our network. The increasing complexity of the energy sector means an effective whole systems approach could lead to significant synergies and efficiencies being realised. We also highlighted key policy updates that have been put in place to facilitate the acceleration of these changes in technology and markets.
- 1.4. Whole systems thinking will continue to evolve over RIIO-ED2 and beyond; we can see that the energy market is changing drastically and that we have the opportunity and responsibility to deliver better outcomes for customers and wider society through an effective Whole Systems Strategy. We believe that the whole system is comprised of four layers:

1

### 'Very narrow' whole system:

Collaboration and coordination between electricity distribution and transmission networks.

2

### 'Narrow' whole system:

Collaboration and coordination between the electricity distribution and transmission, gas distribution and transmission, ESO and GSO.

3

### 'Broad' whole system:

Collaboration and coordination between other energy vectors including power generation, transport, and heat.

4

### 'Very broad' whole system:

Collaboration and coordination between other utilities and societal systems including water, health, telecommunications and the built environment.

- 1.5. Throughout RIIO-ED1 we implemented various processes that we consider 'very narrow' and 'narrow', as well as some 'broad', all of which are now regarded as 'Business as Usual' (BAU). During RIIO-ED2, our ambition is to build on our existing approach incorporating any new processes in layer one and two into BAU and to emphasise the delivery of layers three and four. As the energy transition accelerates, our intention is to be ready to fully deliver on these areas.
- 1.6. In order to achieve a good whole systems approach, there will be several vital components; these include people, culture, and ways of working, data and digitalisation, stakeholder engagement, innovation and processes. Within these components, we have outlined many commitments demonstrating a proven track record, current projects we want to take a step further and new projects and initiatives to deliver clear whole system outcomes for our customers.
- 1.7. Many of our new commitments are projects and initiatives within the 'broad' and 'very broad' layers. Throughout our plan we demonstrate our ambition to be on the forefront in coordinating and collaborating with various energy vectors and other sectors to achieve a whole system.

## 2. Our understanding of what a whole system approach is

### Introduction

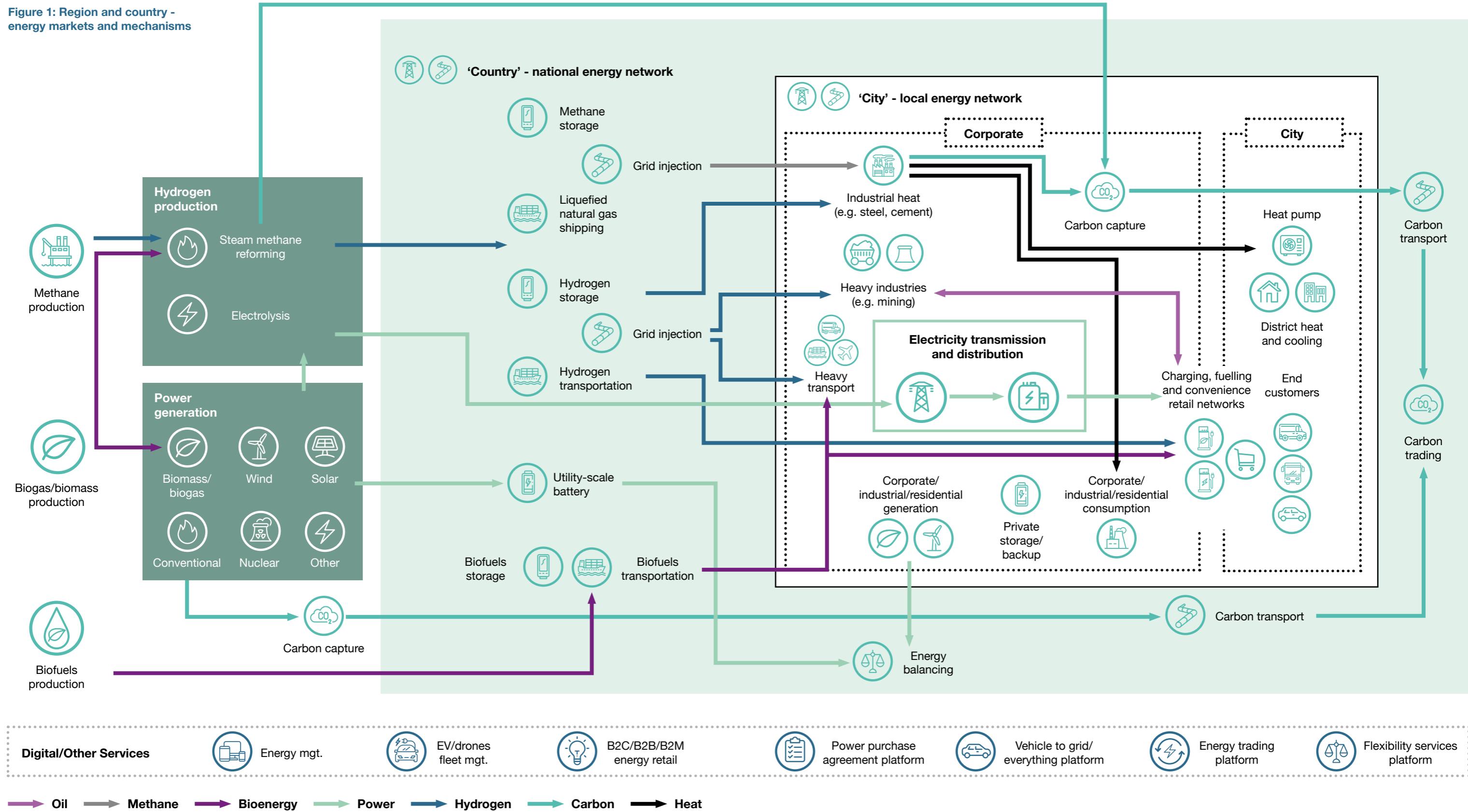
- 2.1. The UK government's target of achieving net zero by 2050 requires decarbonisation of the electricity, gas, heat, transport, and industrial sectors.
- 2.2. At the same time, improved technologies, data flows and changes in customer behaviour will mean the energy sector becomes increasingly integrated with other vectors including health, water and many others.
- 2.3. As Distribution Network Operators (DNOs) are undertaking more Distribution System Operator (DSO) activities to deliver for customers and society. The focus of DNOs will need to extend beyond their own network, or even just collaboration with other DNOs and the transmission grid. A whole system approach, which engages and collaborates with all stakeholders across a range of vectors, will be needed to deliver for customers and society.
- 2.4. In order to effectively play a full whole systems role, DNOs will need to understand, respond to and influence changes in technology, market, behaviour and policy and regulation across all the relevant vectors and sectors. This whole systems role needs to be informed by national trends, but with an increasingly localised energy system, understanding, responding to, and influencing at a regional and local level will be critical. Further, DNOs will need to recognise that the whole systems role will need to evolve over time, as the energy transition accelerates, and as other sectors and vectors also increasingly focus on whole system solutions.
- 2.5. We explore some of these key trends and issues in more detail below, explaining how we see our role in the delivery of whole system solutions for customers and society. The UK government's target of achieving net zero by 2050 requires decarbonisation of the electricity, gas, heat, transport, and industrial sectors.

### Technology and market change

- 2.6. A significant expansion and transformation of the electricity sector to deliver net zero is already underway but will accelerate in future as more technologies emerge and mature and are deployed at scale. The diagram below illustrates a possible future energy ecosystem, at the heart of which will be DNOs. This will involve:
  - Conventional power generation, while continuing to play an important role through new nuclear and Carbon Capture, Utilisation and Storage (CCUS) fitted Combined Cycle Gas Turbines (CCGTs), will be succeeded by renewable power generation, especially offshore wind.
  - Battery storage and long duration storage (such as from pumped hydro) will play an increasingly important role managing peaks in demand. Interconnectors to other countries will also be increasingly important for providing access to back up power generation and security of supply.
  - Electric Vehicles (EVs) will replace Internal Combustion Engine (ICE) vehicles, giving rise to increased demand on electricity distribution networks for charging infrastructure and changing patterns of electricity demand, but also providing additional storage and flexibility options, including vehicle-to-grid (V2G) technologies.
  - Home heating will be provided by a combination of heat pumps, district heating networks and by decarbonised gases, which may include hydrogen.
  - Balancing supply and demand is more complex, so there will be an expanded role for flexibility services and Active Network Management (ANM).
  - More local power generation, including from prosumers, as onshore wind, solar and home storage become more prevalent.
  - Customer behaviour will change in response to new smart technologies and time of use tariffs. The potential disaggregation of the energy supplier hub model and emergence of heat as a service could also influence customer behaviour.
  - The water industry will develop to reduce the levels of carbon emitted in the treatment of water through an increase in green energy usage. The industry will also look towards becoming a significant generator of renewable energy through methods such as anaerobic digestion.
  - There will be a change in the healthcare sector to reduce their energy consumption through better technologies and understanding using tools such as smart metering.
  - Telecommunications will be increasingly integrated with the energy sector as they move towards increasing their use of renewable technologies and smarter products and services are rolled out.
- 2.7. New markets and business models will also emerge in response to, and to facilitate, these changes in the wider sector, see figure 1.

## 2. Our understanding of what a whole system approach is

Figure 1: Region and country - energy markets and mechanisms



## 2. Our understanding of what a whole system approach is

- 2.8.** The increasing complexity of the energy sector means an effective whole systems approach could lead to significant synergies and efficiencies being realised, as well as improvements in resilience and service levels, not only within the electricity sector but across all the vectors mentioned. For example, influencing the location and timing of demand by different users of the grid, including generators, could:
- Reduce the need for investment in reinforcing the grid, reducing bills for all households and businesses.
  - Reduce the cost of connections to the grid and network use charges for generators and demand e.g. by co-locating demand and generation it might be possible to realise benefits of behind the meter business models.
- 2.9.** An effective whole systems approach will require identifying interrelationships in one or several energy systems including wider vectors to inform decision making and subsequently innovation and societal net benefits. By adopting systems thinking, DSOs can identify challenges as well as opportunities that would not be clear by analysing individual energy systems.

### Policy and regulatory change

- 2.10.** Responding to, and with the aim of facilitating an acceleration of, these changes in technology, markets and customer preferences and behaviours, the UK government, regional and local authorities, and regulators have all been making, or consulting on, changes to policies and regulations.
- 2.11.** Some of the key policy updates impacting the whole system are outlined below.

Local Area Energy Plans (LAEPs)	Government's Ten Point Plan	Transport Decarbonisation Plan
<p><b>Local Area Energy Planning</b> has the potential to shape key aspects of the transition as it allows a comprehensive assessment of wider non-technical factors to be understood and addressed. The process engages stakeholders and can provide a foundation for local action to cut carbon emissions by well informed local leaders.</p> <p>Our energy planning with integrated councils (EPIC) is a LAEP project that works with different local authorities to create a LAEP.</p>	<p>The plan encapsulates the energy transition.</p> <p>Key areas of focus include advancing offshore wind, driving the growth of low carbon hydrogen, delivering new and advanced nuclear power, EVs and investment into CCUS.</p> <p>Other energy distributors in the Midlands, have worked with the Midlands Energy Partnership to mobilise and deliver the Ten Point Plan in the region.</p>	<p>The phase out of new petrol and diesel cars by 2030 will require a suitable network for all charging requirements in all situations. The transformation will incorporate energy providers, local government, and others by using local information to anticipate capacity requirements.</p> <p>In March 2021 the Welsh Government published the Electric Vehicle Charging Strategy for Wales accepting the immediate need for charging infrastructure and the UK government have stated that all new homes could be fitted with an electric car charge point.</p>

### Hydrogen Strategy

The UK's ambition is for 5GW of low carbon hydrogen production capacity by 2030. A significant development and scale up of the hydrogen network is needed for the development of a UK hydrogen economy.

Decisions will need to consider interplay with existing electricity infrastructure, as well as other sectors such as oil and gas.

### Electricity System Operator (ESO) and Future Energy Scenarios (FES)

A review of the GB ESO showed changes in the physical structure of energy networks is required to involve more collaboration between DNOs, Gas Distribution Networks (GDNs) and other network developers. This would involve greater collaboration between WPD and GDN's in the region such as Cadent and WWU to enable whole system optimisation.

A proposal for an impartial FSO has been discussed by the department for Business, Energy and Industrial Strategy (BEIS) and Ofgem, the role would involve responsibility across electricity and gas systems.

### Water UK Net Zero 2030

The Net Zero 2030 Pathway analyses the potential routes to decarbonising the water industry.

This will be addressed using a number of different tools including powering water treatment plants, using renewable energy, and sequestering carbon through nature based solutions.

However, cross sector working will be essential to ensure the appropriate pathway is taken to reduce carbon emissions.

### Net Zero Strategy

The Net Zero Strategy aims to build on the Ten Point Plan for a 'green revolution'. The plan includes decarbonisation pathways to net zero by 2050, policies and proposals to reduce emissions for high emitting carbon sectors and cross cutting action to support the transition.

The government has pledged £100 million of investment towards innovative solutions for reducing greenhouse gases, this will aim to leverage private investment. The government has also indicated they will consult on moving the recovery of policy costs from electricity bills, which will lower electricity costs and further drive demand for EVs and electrified heating.

### Customer vulnerability

Decarbonisation of the energy system has placed a greater focus on the combination of access and availability for individual customers.

Throughout RIIO-ED2 and updated whole systems thinking, the link between energy and health is increasing as stakeholder engagement is widening. We aim to improve the provision of electricity to vulnerable customers or to those who are facing fuel poverty.

We will aim to achieve this through initiatives such as sharing Priority Services Register (PSR) data with water and gas companies in the region, and identifying support we can provide to ensure they can participate in a smart energy future.

### Heat and Buildings Strategy

The government has set out plans to incentivise people to install low carbon heating systems in new homes and to replace their gas boilers.

This will support the government's new target for all heating systems installed in UK homes by 2035 to be either using low carbon technologies (LCTs) such as electric heat pumps or supporting new technologies such as hydrogen.

Homeowners will have access to new grants of £5,000, with the government investing £450 million into the Boiler Upgrade Scheme. In addition, some targeted funding for energy efficiency improvements will be available, although concerns remain that this is not yet sufficient.

## 2. Our understanding of what a whole system approach is

### Offshore Transmission Network Review (OTNR)

The OTNR seeks to increase the level of coordination in the design and delivery of OTN infrastructure to ensure balanced environmental, social, and economic costs.

As a step towards delivering the required 40GW of offshore wind by 2030, a holistic approach with the onshore wind network is being taken to enable coordination. At a regional level, the South West is working towards this target through their offshore wind resource supply chain with the aim to reach the regional target of 3GW installed by 2030.

### Smart energy systems

Smart energy systems focus on the inclusion of other sectors (including heat, industry and transportation) to identify more achievable and affordable solutions to transform into renewable and sustainable energy solutions. Features of smart grids such as bidirectional power flows are essential to facilitate better integration of fluctuating renewable energy.

We work with other DNOs to deliver a flexible system through Flexible Power. The platform allows us to enter into contract with customers to manage excess demand or supply in return for financial payment.

### Carbon Capture, Utilisation and Storage (CCUS)

Carbon capture, utilisation and storage has the flexibility to decarbonise sectors including heat, industry and power, it therefore plays a vital role in the whole systems approach to achieving net zero.

- 2.12.** The volume and breadth of policy and regulatory decisions demonstrates the acceleration towards net zero which is underway, as well as the wide range of vectors and sectors which a whole systems approach needs to engage with. An effective whole systems approach will not be reactive to these policy decisions, but proactively engage with and influence these policies so that they are informed by conditions and trends locally and regionally. This will require further regulatory policy changes on how energy sectors should undertake whole system planning to ensure they align with local area energy planning and network-led planning. This includes mandating whole system engagement and data sharing in other energy sectors where we are a stakeholder.

## Market uncertainty

- 2.13.** Whilst decarbonisation and transition towards net zero is certain, the speed and means of that transition are unclear. Since the electricity sector will be increasingly intertwined with other sectors, the outlook for electricity demand (not only annual energy consumption, but load duration curves and also locational), storage and generation (such as the amount of local generation connected to the grid) on the road to net zero is highly uncertain. To illustrate this uncertainty we note for example:
- Data from the Energy Networks Association (ENA) shows two different potential scenarios, one of which looks at a balanced combination between low carbon and renewables gases and low carbon electricity, and the other being mostly electrification.
  - We proactively feed into National Grid ESO's four potential Future Energy Scenarios (FES) each of which focus on varying levels of electrification and create our own Distribution Future Energy Scenarios (DFES) using a bottom up approach. Their Consumer Transformation FES looks at demand side innovation to achieve high levels of electrification in the energy market whereas other scenarios focus on other energy sources such as hydrogen.
  - The Climate Change Committee (CCC) has developed a 'balanced net zero pathway' with four alternative scenarios, this utilises a combination of technologies with a particular focus on maintaining optionality in heat. This allows for no over reliance on a particular source and would therefore not lead to a steep increase in the demand for electricity over the next decade.

- 
- 2.14.** There are also many more scenarios and forecasts available from other sources, such as academics. Regional and local forecasts are also increasingly emerging, such as the DFES initially produced by WPD and later adopted by other DNOs, and the National Grid's Regional Carbon Intensity API.
- 2.15.** The number and wide range of scenarios highlights the need for us to be flexible in our approach to whole systems solutions across RIIO-ED2: since the world around us will not be static, neither can our approach to whole systems. An effective whole systems approach will need to recognise and respond to this uncertainty by constantly scanning the horizon for changes in markets and sectors, proactively engage with stakeholders to understand and influence their needs and dynamically and regularly updating plans for the electricity distribution network.
- 2.16.** Our overview has looked at the technology, market changes and policy and regulation updates to achieve decarbonisation in the energy market, we can see that the energy market is changing drastically and the interaction with other stakeholders is key. The market is no longer focused solely on distribution across our regions within the grid, our role is changing to focus on the most efficient way to achieve net zero and our place within the whole system.

## Future System Operator

### DSO and ESO interaction

- 2.17.** We are already actively engaging with the ESO, through participation in forums such as the ENA Open Networks and development of initiatives like the Regional Development Programmes (RDPs). In addition to these, we interact closely on scenario planning (DFES and FES), Electricity Ten Year Statement and the Long Term Development Statement (LTDS).
- 2.18.** We have collaborated with the ESO on aligning the top down FES and bottom up DFES processes. These processes complement each other with the FES providing a national picture and the DFES providing detailed insight on the regional requirements and aspirations. This aligns with the ESO vision that the FES and DFES processes will remain separate, but with clearer standardisation of data sharing and process interaction.
- 2.19.** As we continue to develop our DSO functions, we will need to increase out coordination with the ESO. There is already strong value in the localised knowledge within DSO functions, so any new or enhanced roles must be co-developed to avoid duplication and remain complementary to functions, which will need to be retained at a local level.
- 2.20.** Significant progress is being made under current arrangements to ensure whole systems benefits are captured and leveraged. We anticipate that, in time, these arrangements will facilitate the benefits seen delivered between electricity transmission and distribution, for example, establishing equivalent datasets, exchanging system and planning information across various timescales and increased dialogue to deliver customer cost reductions through initiatives like RDPs.

### FSO consultation

- 2.21.** Ofgem and BEIS went out to consultation in July 2021 for an expert, impartial FSO with responsibilities across both the electricity and gas systems. This proposal was driven by the need to drive progress towards net zero while maintaining energy security, minimising costs to customers and ensure whole system benefits are realised.
- 2.22.** The proposal that went out to consultation is for all the current National Grid ESO roles and functions to be carried out by the FSO, and for the FSO to undertake strategic network planning, long term forecasting and market strategy functions in gas. Other considerations that are being considered as part of the consultation:
- The new roles and functions an independent FSO could potentially fulfil in gas and electricity, including in network planning and independent advice.
  - The options for organisation models including a standalone privately owned model independent of energy sector interested and a highly independent corporate body within the public sector, but with operational independence from government.
  - Phased implementation of the FSO.

This consultation closed on the 28th September 2021 and Ofgem and BEIS are currently analysing the feedback.

## 2. Our understanding of what a whole system approach is

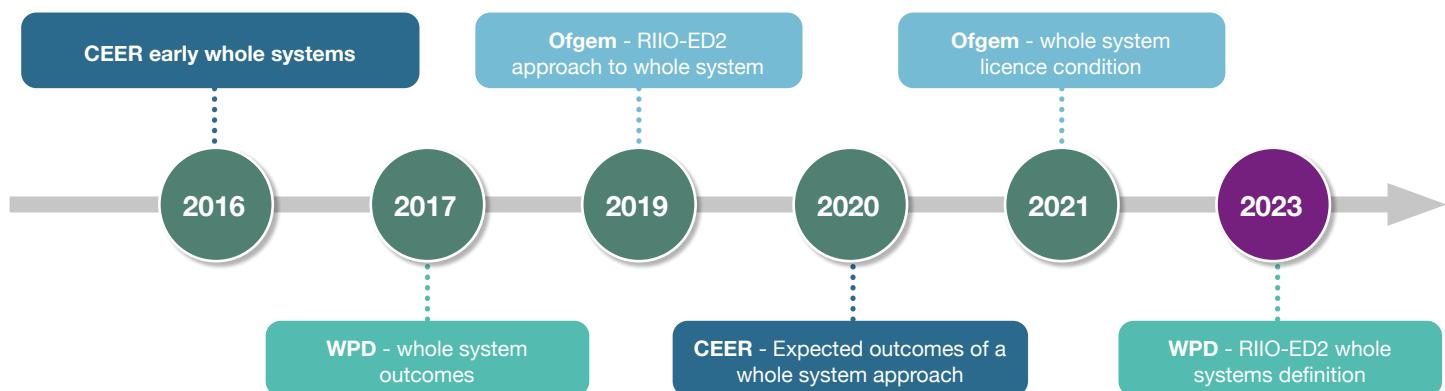
### FSO whole system requirements

- 2.23. We recognise the benefits of a FSO in delivering an economic and efficient whole system focused future energy system with a key focus on meeting the challenge of decarbonising heat and transport. The composition of the FSO should recognise the wide range of vectors impacted by decarbonisation and have sufficient technical competence and expertise across those fields. This should include both gas and electricity, but should also include other broad and very broad whole system energy vectors if they become significantly established in the future. This consideration of other vectors will ensure the wider whole system benefit is fully captured.

### What ‘whole systems’ means to WPD

- 2.24. The electricity sector’s thinking on whole system has been evolving over the past few years, as illustrated below.

Figure 2 : Timeline of whole systems



- 2.25. The Council of European Energy Regulators (CEER) explored in 2016 the relationship and regulatory arrangements between DSOs and Transmissions System Operators (TSOs) and believed that cooperation and coordination between network operators, effective unbundling and competitive retail and wholesale markets will support the delivery of optimal system outcomes<sup>1</sup>. The report findings provided key insights into our early whole systems thinking and strategy.
- 2.26. By applying these principles and insights for energy whole systems thinking; as early as 2017, we described whole system outcomes as:

**“Transmissions System Operators and Distribution Network Operators coordinating their activities in order to ensure that networks as a whole are managed efficiently and in the best interest of consumers<sup>2</sup>.”**

- 2.27. We identified that stakeholders ranked ‘efficient whole system outcomes’ as a high priority and a significant workstream for our early DSO forward planning. As a result, we published the Distribution System Operability Framework (DSOF) and outlined a number of technical issues facing DNOs as they become DSOs. By publishing insights on a variety of different topics affecting electrical networks, the framework helped the industry raise the profile and possible challenges.
- 2.28. In 2019, Ofgem outlined a definition of whole systems, explaining a narrow and broader definition of whole systems<sup>3</sup>. Ofgem described the narrow focus of whole systems on ‘coordination and operational delivery between the ESO, GSO and the four network sectors. The broader whole systems scope added to the narrow definition to ‘include other parts of the energy system (e.g. heat), as well as other sectors (e.g. transport and waste)’.

<sup>1</sup> CEER report

<sup>2</sup> WPD Your Power Future - Previous performance reports ([westernpower.co.uk](http://westernpower.co.uk))

<sup>3</sup> RIIO-ED2 sector specific methodology consultation | Ofgem

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- 2.29. CEER further developed their whole system approach concept in 2020 outlining three whole systems layers to achieve a societal net benefit. The first layer termed ‘whole network approach’ outlined a focus on network operation and planning of the regulation of distribution and transmission networks. ‘Whole chain approach’ defined as expanding beyond networks to include generation, system operation and retail and ‘cross systems approach’ is the integration between multiple sectors including gas, electricity, transport and heat sectors.
- 2.30. A decision to implement Whole Electricity System Licence Condition was made in April 2021 by Ofgem and outlined further clarification on the definition of ‘coordination’ and ‘cooperation’ in the Whole Electricity System Licence Condition. We proactively engaged with the working group in developing the template and Form of Statement scope, and will continue to engage on this important new licence condition.

## Our whole system definition in RIIO-ED2

- 2.31. Whole systems thinking will continue to evolve throughout RIIO-ED2 and beyond: as we have discussed above, the technology, market changes and policy and regulation updates to achieve decarbonisation in the energy market. We can see that the energy market is changing drastically and that WPD has a tremendous opportunity and responsibility to deliver better outcomes for our customers and wider society through an effective Whole Systems Strategy.
- 2.32. It is clear to us that our focus needs to evolve beyond considering our own grid, or the interactions with the electricity transmission grid, to focusing on the most efficient way to achieve net zero by facilitating and harnessing whole systems solutions.
- 2.33. In RIIO-ED2, we believe greater collaboration, coordination and cooperation across electricity transmission and distribution, greater work across the energy vectors regulated by Ofgem and wider consideration across other utilities such as water and other vectors such as heat and transport.
- 2.34. RIIO-ED2 will also 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.
- 2.35. This also means that there are greater interactions with customer’ systems where such interactions can provide a benefit. We believe that the whole system is comprised of four ‘layers’ to create a complete whole energy system:

1

### ‘Very narrow’ whole system:

Collaboration and coordination between electricity distribution and transmission networks.

2

### ‘Narrow’ whole system:

Collaboration and coordination between the electricity distribution and transmission, gas distribution and transmission, ESO and GSO.

3

### ‘Broad’ whole system:

Collaboration and coordination between other energy vectors including power generation, transport, and heat.

4

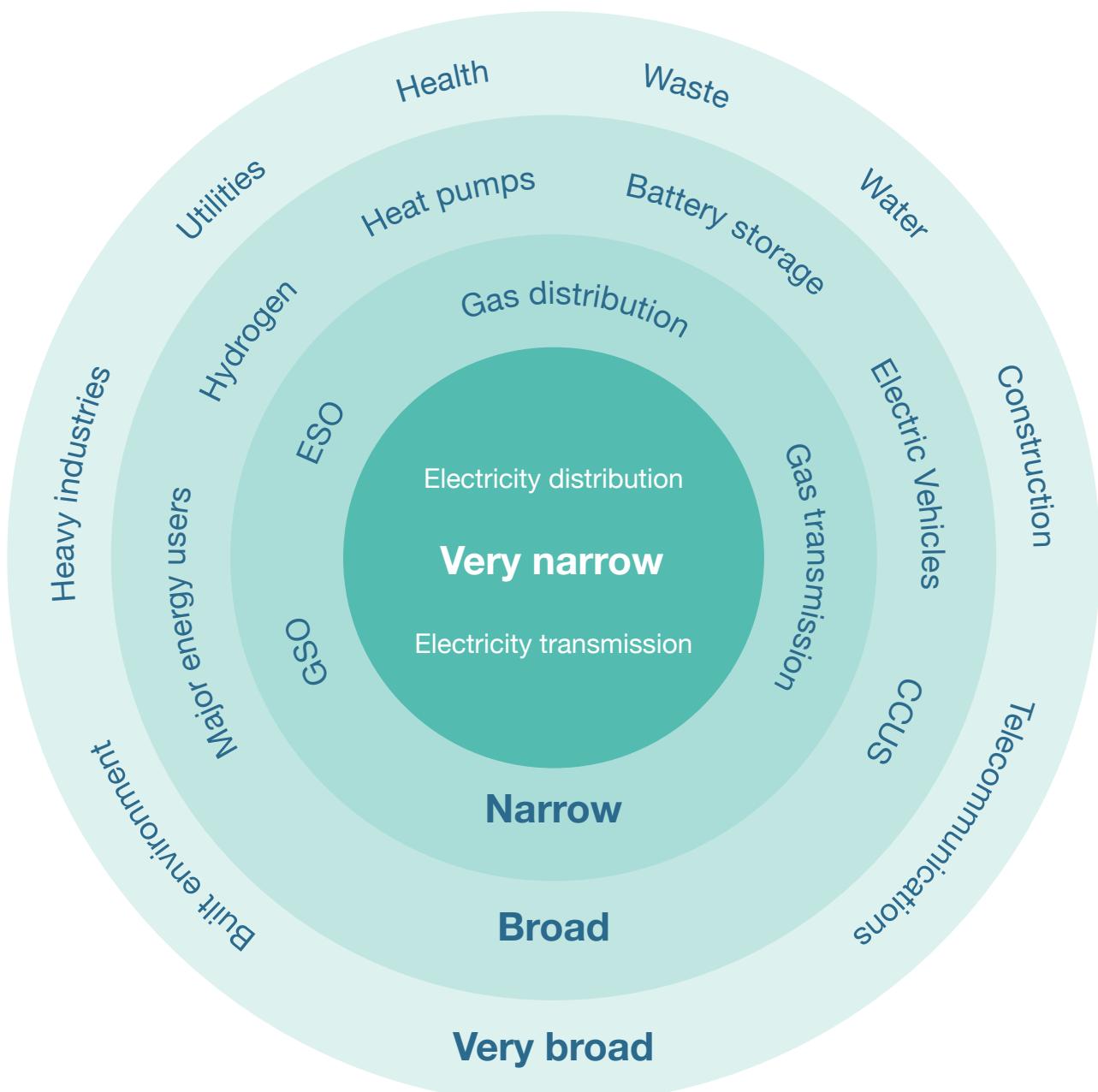
### ‘Very broad’ whole system:

Collaboration and coordination between other utilities and societal systems including water, health, telecommunications and the built environment.

- 2.36. For the RIIO-ED2 price control, our whole systems ambition is to build on our existing approach – where layer one and two of our whole systems framework are essentially ‘Business as Usual’ already – to start delivering on layers three and four during RIIO-ED2 and, importantly, ensure we are ready to fully deliver on these areas in later years as the energy transition accelerates and other stakeholders also engage in whole systems thinking more fully.

## 2. Our understanding of what a whole system approach is

Figure 3: Complete whole energy system

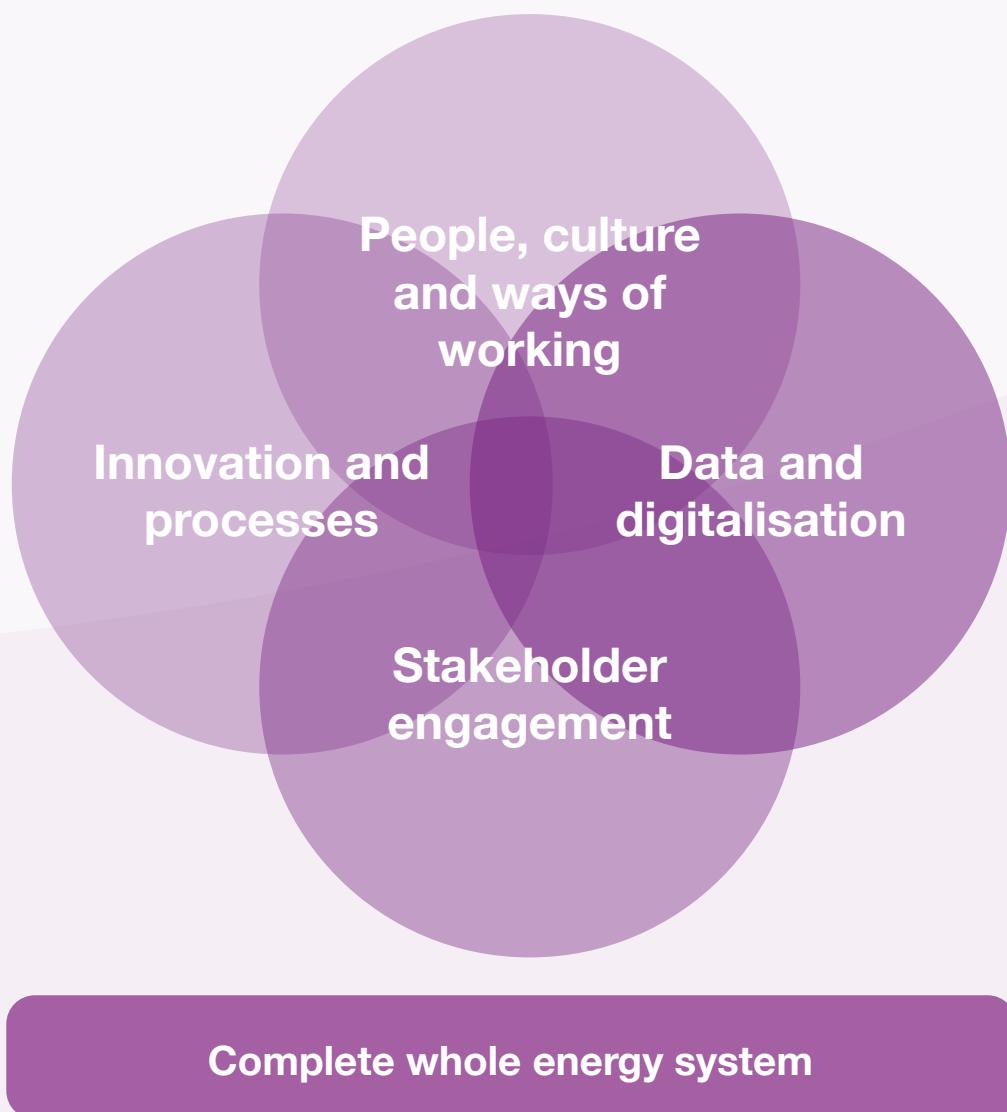


Complete whole energy system

### 3. Our RIIO-ED2 approach to whole systems and how we will deliver it

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- 3.1.** The previous section outlined our understanding of what the objectives of our whole systems approach needs to be for RIIO-ED2 and beyond. In this section we outline the practical steps we are already taking and plan to take, to deliver a whole systems approach during RIIO-ED2 and, equally importantly, to be ready to deliver a whole systems approach during RIIO-ED3 and beyond.
  - 3.2.** Delivering a whole systems approach requires the right people, systems, processes, and data to be in place to meet the needs of our stakeholders, see figure 4 below. Recognising that the needs of our stakeholders are ever evolving, a whole systems approach also requires appropriate engagement with our stakeholders on an ongoing basis. Accordingly, a good whole systems approach will have several components to it:

**Figure 4:** Components to form a complete whole energy system



### 3. Our RIIO-ED2 approach to whole systems and how we will deliver it

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1

#### People, culture and ways of working

- Refers to internal processes and different methods in implementing projects. As outlined earlier, the pace of change in changes to policies, emerging technologies and subsequently our stakeholders means that we need to adapt internally to ensure our people are up to date in industry trends and needs.
- This also means our culture needs to change further ensuring whole system ideas and solutions are implemented in an efficient manner.
- In this subsection, we outline the projects and processes we are planning to implement in RIIO-ED2 ensuring our people understand the importance of whole systems and how whole systems outcomes can provide further benefits for our customers.

2

#### Data and digitalisation

- Data and digitalisation continues to be vital to deliver a smart, fair and delivering innovative solutions where traditionally the only solution would be reinforcing the network.
- In this subsection, we outline the projects we plan to deliver and implement in RIIO-ED2 and existing projects we plan to incrementally improve providing whole system benefits and further net societal benefits.

3

#### Stakeholder engagement

- Refers to our stakeholder engagement processes and initiatives ensuring we are delivering the correct projects and outcomes for our stakeholders. As explained in the other components of the whole systems approach, our stakeholders are constantly changing and evolving with new stakeholders emerging who previously have not engaged with us or the needs of existing stakeholders changing over time.
- In this subsection, we outline the initiatives we plan to introduce and enhance our current stakeholder engagement processes.

4

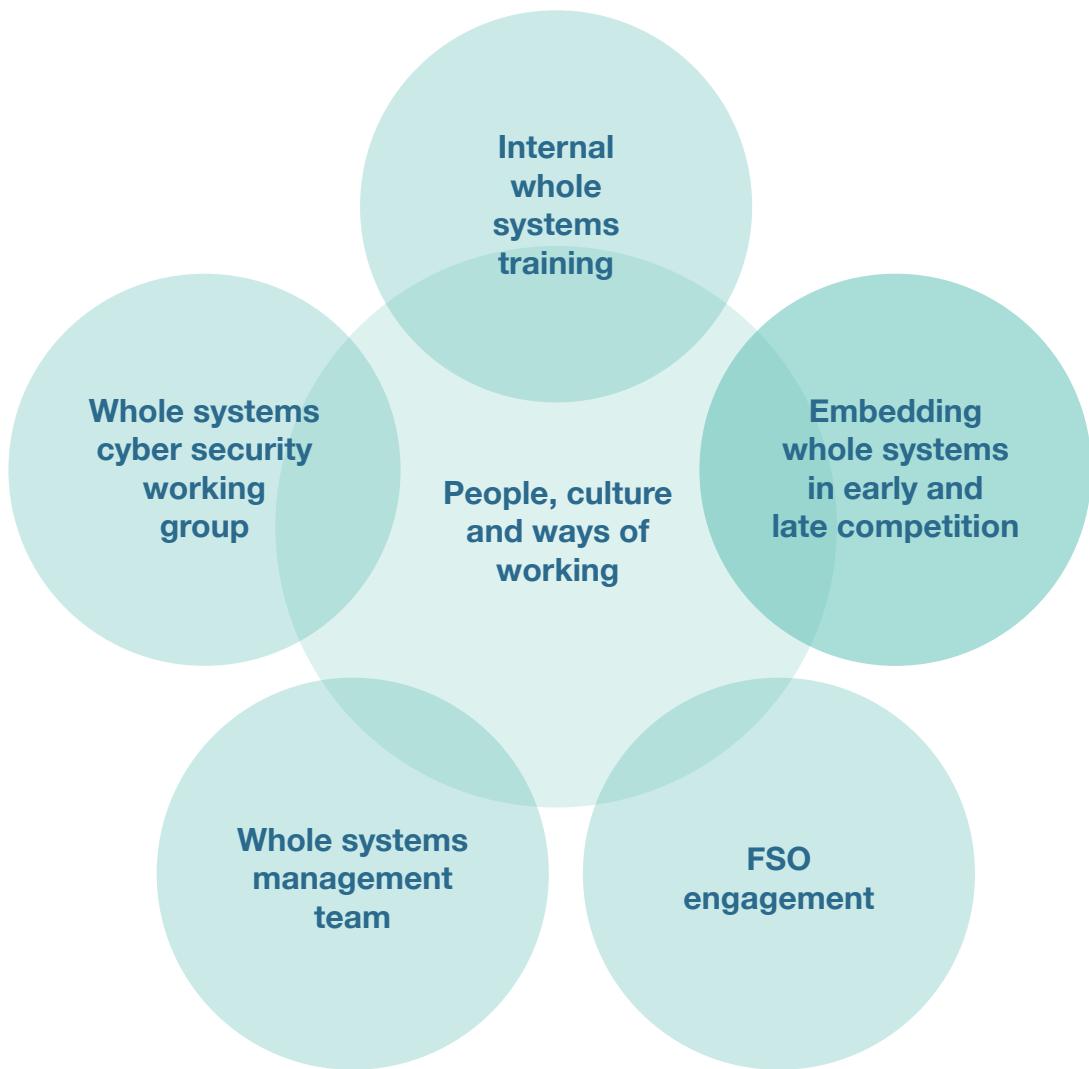
#### Whole systems innovation and processes

- Refers to the process of developing and creating new ideas to provide long term societal benefits for our customers that are more flexible, cheaper, or quicker than current processes.
- For example, we are seeing significant increases in the number of connections of distributed energy sources into our network such as solar, wind and energy storage with increases in LCTs mostly EVs and heat pumps.
- In this subsection, we outline our whole systems innovation projects and processes we continue to deliver and provide whole system benefits for our customers but also new innovative projects we commit to deliver in RIIO-ED2.

## People, culture and ways of working

- 3.3. People, culture, and ways of working refers to the evolving nature of our internal processes. We need to adapt internally to meet the needs of our stakeholders as well as changing policies in the industry.
- 3.4. By adapting our culture, we will ensure greater whole systems consideration within our thinking. Within RIIO-ED2, we will set up various new tools to embed whole systems thinking into our culture through numerous methods.

**Figure 5: People, culture and ways of working**



### 3. Our RIIO-ED2 approach to whole systems and how we will deliver it

**Figure 6:** People, culture and ways of working

Item	Whole system layer	Description
Internal whole systems training  (CW-1)	Broad (Energy)   Future	<p><b>Context</b></p> <ul style="list-style-type: none"> <li>Developing training tools for our individuals will enable them to understand and implement whole systems thinking and techniques into their work.</li> <li>Training sessions held will be driven by our stakeholder and wider system needs to ensure we target the appropriate spaces.</li> </ul> <p><b>Actions</b></p> <ul style="list-style-type: none"> <li>As an initial engagement stage, we will host training sessions to sense the current understanding of whole systems within the business. The internal training sessions will be driven by our stakeholders through our stakeholder engagement activities and wider whole system needs.</li> <li>Using our whole systems framework and definitions we will host further training sessions to enhance the knowledge of our teams to ensure they develop their understanding.</li> <li>Within our training we will include useful tools such as sessions on the effective use of the various cost benefit analyses Common Evaluation Methodology (CEM), Ofgem and ENA Whole Systems templates) as we further integrate these into BAU.</li> <li>We will host sessions with various groups, including innovators, digitalisation teams and others to learn how teams can embed whole systems thinking into their work.</li> </ul> <p><b>Outcomes</b></p> <ul style="list-style-type: none"> <li>We will measure the success of our sessions by reassessing people's understanding of whole systems following the training in comparison to our initial engagement stage.</li> <li>Ensuring the effectiveness of our training is hinged upon the implementation of processes and vice versa. Introducing training sessions on whole systems will build on the knowledge of individuals and allow our teams to embrace whole systems thinking in their decision making.</li> </ul>
Embedding whole systems in early and late competition  (CW-2)	Broad (Energy)   Future	<p><b>Context</b></p> <ul style="list-style-type: none"> <li>Early competition is competition that occurs prior to the detailed design, surveying and consenting phases of a large project.</li> <li>Late competition is when a decision is made later on in a project programme, prior to physical construction, to open the delivery of a large project up to competition.</li> </ul> <p><b>Actions</b></p> <ul style="list-style-type: none"> <li>We are committing to embed whole systems thinking and criteria into the early competition decision making that occurs throughout the business. This involves considering whole systems at the stages prior to the detailed design phases of any large projects.</li> <li>Demonstrating this, we will investigate a further option to deliver a Competitive, Low Carbon Isles of Scilly Power station. This will be run in parallel with the preferred reinforcement scheme, and assessed when more complete information is available (please see EJP 191 for more details).</li> </ul> <p><b>Outcomes</b></p> <ul style="list-style-type: none"> <li>Implementing our whole systems framework in our assessment of early and late competition will allow us to adapt and demonstrate that all investments, regardless of size, achieve the best outcome for customers through optioneering and the whole systems cost benefit analysis (CBA).</li> </ul>

#### Project/Process Key

	In progress	
Completed	In progress	Future

Item	Whole system layer	Description
Whole Systems Cyber Security Working Group (CW-3)	Broad (Cross-sector)	<p><b>Context</b></p> <ul style="list-style-type: none"> <li>As reliance on systems and technology has increased, so, unfortunately has the volume and sophistication of cyber attacks. The importance of electricity to individuals' lives and the economy is increasing massively especially with regard to heating, transportation and reliance to internet connectivity. Hence disrupting supply continuity is an increasingly attractive target for cyber terrorists.</li> <li>Our stakeholders are demanding more modern interactions with us including online and smart phone interaction and sharing of data. This increased overall connectivity between WPD and the outside world increases the risk of a cyber threat.</li> </ul> <p><b>Actions</b></p> <ul style="list-style-type: none"> <li>We believe cyber resilience requires whole systems thinking and outcomes. In RIIO-ED2, we are committed to reducing the risk of data loss or network interruption from a cyber attack by continually assessing emerging threats in order to enhance our cyber security systems.</li> <li>We have formed an internal cyber security working group gathering experts and specialists across the organisation to ensure requirements are met, risks are understood and to analyse various case studies where cyber security resilience is important.</li> <li>Establishing a Whole Systems Cyber Security Working Group enhances our cyber security systems and ensures we collaborate and coordinate with relevant parties.</li> <li>We will also collaborate with third parties including the National Cyber Security Centre (NCSC) to ensure our systems remain security compliant.</li> </ul> <p><b>Outcomes</b></p> <ul style="list-style-type: none"> <li>Applying a whole systems approach to our Cyber Security Strategy in RIIO-ED2 will ensure our cyber security risk model continues to develop as the threat landscape changes.</li> <li>Establishing this internal working group ensures we deliver on our Business Plan (BP) commitment to reduce the risk of data loss or network interruption from a cyber attack by continually assessing emerging threats in order to enhance our cyber security system (Please refer to BP commitment 39).</li> <li>Establishing this working group will also continue to raise awareness and profile of cyber security within the business and further support the business from a security perspective in the trial and development of new technologies, system integration and digitalisation.</li> </ul>
FSO Engagement (CW-4)	Broad (Energy)	<p><b>Context</b></p> <ul style="list-style-type: none"> <li>A recent consultation by BEIS in August 2021 outlined the possible formation of an expert, impartial FSO with responsibilities across both the electricity and gas systems.</li> <li>The FSO would coordinate with DNOs and GDNs to enable whole system optimisation as part of network planning. As a DNO our role would be to assist and provide information to the FSO with regards to system planning.</li> <li>We would also be involved in research and coordination between the FSO and other network operators in order to enable whole systems thinking.</li> </ul> <p><b>Actions</b></p> <ul style="list-style-type: none"> <li>We will set up effective engagement channels to enable us to liaise bilaterally with other relevant parties including other GDNs.</li> <li>Internally we will assess responsibilities and determine who is best placed to make the decisions from a whole systems perspective.</li> <li>We will feedback any discussions and learnings from this collaboration via the ENA and any other relevant forums.</li> </ul> <p><b>Outcomes</b></p> <ul style="list-style-type: none"> <li>As a result of these actions our decisions and thinking will be more appropriate to feed back to the FSO creating an established framework that provides clear coordination and benefits for customers. We will feedback new knowledge learnings through relevant forums including the ENA.</li> </ul>

### 3. Our RIIO-ED2 approach to whole systems and how we will deliver it

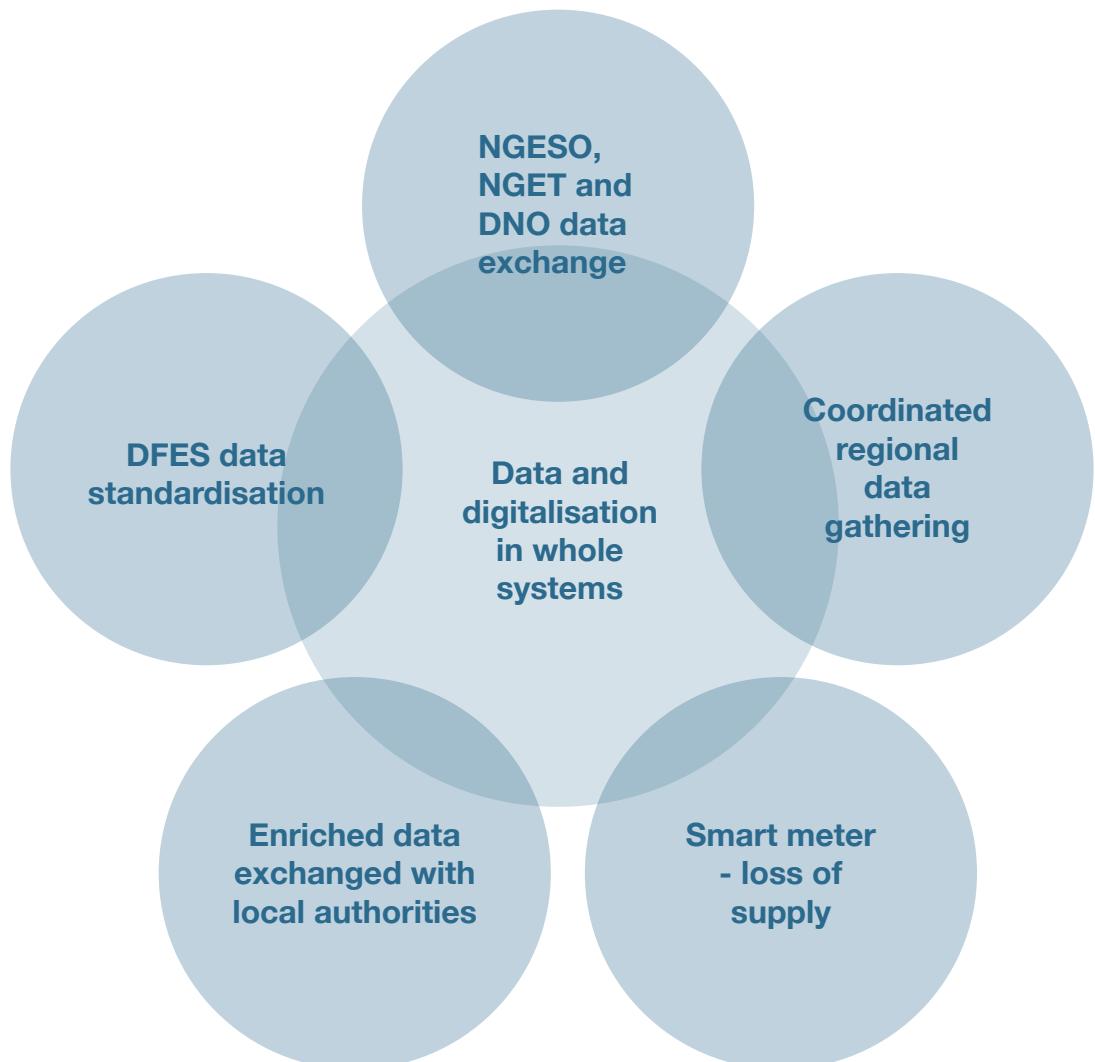
Item	Whole system layer	Description
Whole systems management team (CW-5)	Broad (Energy)   Future	<p><b>Context</b></p> <ul style="list-style-type: none"> <li>Establishing a whole system management team will enable us to deliver on our Business Plan commitments and ensure whole system outcomes. This team will also allow us to apply a whole system thinking to decision making across the business, as well as ensuring accountability of the team to deliver our commitments.</li> </ul> <p><b>Actions</b></p> <ul style="list-style-type: none"> <li>We will create a management team made up of experienced individuals within our company who will drive whole systems thinking throughout the business.</li> <li>The management team will be involved with encouraging whole systems thinking, hosting the internal whole systems training sessions increasing awareness of the importance of whole systems thinking across the organisation.</li> <li>The management team will also be responsible in our whole system stakeholder engagement. The team will be involved in listening to stakeholders' views and understanding of whole systems, as well as ensuring stakeholders understand our whole systems framework and how we plan to deliver outcomes for our customers.</li> <li>As part of their role in embedding whole systems processes into our investment decisions throughout the organisation, the management team will be responsible for delivering training. We are committed to training our team members on whole systems CBA processes and integrating them into BAU.</li> <li>We are leading the way regarding the creation of our whole systems management team through our allocation of resources to collaborate with the Welsh Assembly on reaching their net zero targets. The learnings from this collaboration will be used to inform other areas of our whole systems processes both within WPD and externally. This is highlighted through core commitment 1 where we are driving to achieve net zero across our regions sooner than 2050 in line with stakeholder plans (some areas as early as 2028), by ensuring network capacity is available.</li> </ul> <p><b>Outcomes</b></p> <ul style="list-style-type: none"> <li>Having a whole system team will allow us to embed whole systems thinking into our daily decision making enabling effective results for our stakeholders.</li> </ul>

#### Data and digitalisation in whole systems

- 3.5. Both data and digitalisation within whole systems is vital in our transition to build a smarter, efficient and complete energy system. The requirements of our network are changing, driven by customers' needs, decentralisation of generation now connected throughout our network and decarbonisation focused on the increasing transition of the transport and heat sectors to electricity.
- 3.6. Digitalisation applies to the whole energy industry, not just the network operators like us. We recognise our central position in the energy delivery chain, independent from energy service providers, suppliers and generating companies meaning our role is critical. We are committed to 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.
- 3.7. Good data is essential to maximising the impact of digitalisation for our customers and wider stakeholders. Making the right data available allows our stakeholders to make better whole system decisions when collaborating and coordinating with other stakeholders. We have demonstrated already in the improvements and innovation delivered in our smart and flexible solutions which require accurate, reliable data to deliver for our customers.

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- 3.8. With better quality data, we can better coordinate our services to deliver the whole system outcomes our customers require providing different stakeholders the same mutual benefits.
  - 3.9. The activities that we have carried out to date have been informed by extensive engagement with both internal and external data users, this will continue and strengthen in RIIO-ED2 and beyond. We are working with the other energy network companies via our trade association the ENA, the government's Energy Systems Catapult (ESC) and our stakeholder community to identify the data that should be shared across the industry, how it should be pooled and how it can be accessed.
  - 3.10. Our core principles are, and will remain, improving data management, increasing network insight and operation and most importantly ensuring data is presumed open. These principles ensure value is driven to the whole energy system and wider sectors all supporting the net zero transition. In figure 8, we have outlined our data and digitalisation in whole systems outlining where we are collaborating and coordinating with other energy vectors and other sectors.

**Figure 7: Data and digitalisation in whole systems**



### 3. Our RIIO-ED2 approach to whole systems and how we will deliver it

**Figure 8:** Data and digitalisation in whole systems

Item	Whole system layer	Description
ENA coordinated regional data gatherings  (D&D-1)	Narrow (Energy)   In progress	<ul style="list-style-type: none"> <li>We helped lead a collaboration with the ENA as part of the Open Networks project (WS4 P5 in 2020 and P3 in 2021) which identified the opportunity to take a consistent and coordinated approach to gathering regional data in particular local authorities. We identified that all networks gather this type of data independently, with coordinating with other networks, the project provides whole system outcomes as with consistency and standardisation within the industry.</li> <li>We continue to trial more coordinated approaches to how gas and electricity networks collect information from regional stakeholders to inform network planning.</li> <li>We continue to engage with the ENA and local authorities in how data is collected and used by networks as part of forecasting processes and analysis.</li> </ul>
Smart meter data – loss of supply  (D&D-2)	Narrow (Electricity)   Completed	<ul style="list-style-type: none"> <li>The loss of supply functionality of the SMETS2+ metering system now allows us to receive loss of supply alerts directly from an affected premise into our HVCT.</li> <li>The project demonstrated that we can rely less on the consumer informing us that they have lost their electricity supply and enabling us to react and respond faster to customer's needs, providing an improved service and reducing their disconnection time.</li> <li>We still expect customers to contact us and report a loss of supply, using the SMETS2+ metering functionality allows us to have an additional source of information enabling us to respond more rapidly.</li> </ul>
Data standardisation  (D&D-3)	Narrow (Electricity)   In progress	<ul style="list-style-type: none"> <li>We are collaborating on an ongoing basis within our industry to increase data standardisation, with Embedded Capacity Register (ECR) for example, we are aware that customers need greater standardisation of data across electricity DNOs and wider energy system operators.</li> <li>We are committed to facilitate this standardisation and the provision of usable data supported by information to access, interpret and drive value from the data.</li> <li>We have committed to enhancing access to data that is tailored to the individual needs of our customers by making 60% of our networks data available via an interactive Application Programming Interface (API), further detail of this can be found in core commitment 17.</li> <li>We want to drive data standardisation of the terms used to describe data, whether that is datasets or the detail within the industry. As a result, when a stakeholder is searching for our data they are provided the same detail as any other DNO.</li> <li>For example, an online version of our GIS is already available and we will continue to develop this to provide customers the information they need to support their planning activity and beyond. We will be collaborating with our stakeholder users to understand their needs further and use this information to support the implementation of a network wide Digital System Map.</li> </ul>
'Data first'  (D&D-4)	Narrow (Electricity)   In progress	<ul style="list-style-type: none"> <li>By the end of RIIO-ED2, our ambition is to become a fully data centric business and using data consistently throughout the business to drive improved and automated decisions. With our continuous data and systems integration approach in digitalisation, our ambition by the end of RIIO-ED2 is to be sector leading and is used by other sectors as a successful approach.</li> <li>As discussed in D&amp;D-4 above, one of our core commitments is to make 60% of WPD's network data available via an interactive API – please refer to core commitment 17.</li> <li>Our hybrid cloud infrastructure means that our customers have direct access to more data than ever as well digitalised solutions to coordinate and collaborate new connection and flexibility solutions.</li> <li>With our data first approach, our customers will have confidence of single source of truth data throughout the business driving improved outputs.</li> <li>Our RIIO-ED2 Data and Digitalisation Strategy found on our website and provides further information in how our customers will benefit with further trust in our data and improved data governance.</li> </ul>

Item	Whole system layer	Description
More enriched data exchanges with local authorities  (D&D-5)	Broad (Energy)   In progress	<ul style="list-style-type: none"> <li>As part of our commitment to improving stakeholder engagement (see further detail in the section below); we are committed to improving our data exchanges with local authorities to directly understand the needs of our regions and the stakeholders within them.</li> <li>The flexible and integrated market requires improved data flows between parties to ensure innovative technologies are used to their full potential. Our EPIC project and other DFES allow coherent data exchanges between ourselves and our regions. In the future we plan to increase the data we share as part of our DFES projects.</li> <li>Our increased data sharing with stakeholders including local authorities will lead to better conversations within our regions allowing us to improve our decision making therefore reducing costs to customers.</li> </ul>

## Stakeholder engagement in whole systems

- 3.11.** WPD has engaged consistently with stakeholders annually for more than 15 years. Throughout this time, our engagement has adapted and grown significantly both in scope and depth, requiring a pragmatic and adaptive approach ensuring all stakeholders are listened. Throughout RIIO-ED1, stakeholder themes and priorities continuously evolve and change with new areas of interest such as cyber security, electric vehicles and the transition to the DSO becoming important areas. More recently, stakeholders are becoming more interested in our whole system approach and how we operate guaranteeing whole system outcomes through cooperation and collaboration.
- 3.12.** Since 2015 in collaboration with Regen, we have developed DFES to forecast the growth of LCTs such as solar and wind. Producing the DFES annually allowed us to engage with stakeholders more proactively and involving stakeholders in network planning and requirement processes. The DFES encompasses stakeholder engagement covering a two way dialogue, both gathering information from stakeholders as an input to the process and presenting the output analysis results in a format that stakeholders can use.
- 3.13.** We engage with a large variety of stakeholders including:
- |                        |                     |                            |                      |
|------------------------|---------------------|----------------------------|----------------------|
| • Energy industry.     | • Water companies.  | • Community energy groups. | • Regulators.        |
| • Local government.    | • Energy consumers. | • UK networks.             | • Major energy user. |
| • National government. | • Trade Unions.     | • Academics.               |                      |
- 3.14.** Engaging with a range of stakeholders allowed us to develop and iterate whole systems approaches and thinking therefore providing greater net societal benefits for our consumers. Within the relevant annex - SA-05 Giving customers a stronger voice: Enhanced engagement we provide specific details on our stakeholder engagement; we have also identified some of the key commitments within this annex. In the below case studies we highlight some of the stakeholder interactions with stakeholders to achieve whole system outcomes and solutions.
- 3.15.** Our stakeholder engagement has significantly increased throughout RIIO-ED1 surrounding whole systems thinking and solutions. With technological advances and novel innovative solutions, our stakeholder engagement is required to be targeted and precise in achieving stakeholders' outcomes and delivering positive customer societal net benefits.
- 3.16.** In our preliminary stakeholder engagement research, we found that community energy groups, enabling EV uptake and the environment were the top two priorities. Delivering a more quick charging EV points was the most popular recommended initiative in this space. Customers noted that access to charge points was the best way to encourage the update of EVs.
- 3.17.** In RIIO-ED2, we want to take our stakeholder engagement in whole systems further and provide outcomes for our customers within 'broad' and 'very broad' whole systems.

### 3. Our RIIO-ED2 approach to whole systems and how we will deliver it

**Figure 9:** Current stakeholder engagement in whole systems

Item	Whole system layer	Description
Distribution System Operability Framework (DSOF) (SE-1)	Narrow (Electricity)	<ul style="list-style-type: none"> <li>In RIIO-ED1, we identified our stakeholder groups were changing and identified customers with requirements to access resources (e.g. storage) and services (e.g. demand side response) that have at their disposal that may benefit the distribution network. We started our dialogue early in RIIO-ED1 which enabled us to work with customers to provide whole system solutions.</li> <li>Publishing the DSOF identified technical and commercial issues facing DNOs as we become DSOs raising nine technical problems identified as arising at the boundary between DNOs and the transmission network.</li> </ul> <p>After holding a number of round table engagement sessions to seek feedback on our DSOF from a range of stakeholders, we created a distributed generated operator/owner forum initially with 28 stakeholders to provide them with early publication of likely constraints to their operations due to WPD maintenance works.</p>
Stakeholder engagement in RDP process (SE-2)	Narrow (Electricity and gas)	<ul style="list-style-type: none"> <li>Various stakeholders emphasised the need for closer coordination in our planning. As a result, we were the first DNO to publish a joint RDP with National Grid Energy Transmission (NGET) for the South West region. With the whole system approach adopted by WPD and NGET, this has enabled us to provide customers with connections quicker and lower prices.</li> <li>We recognised the narrow scope of this commitment in RIIO-ED1 and we have committed to further improve network efficiency in RIIO-ED2 by utilising a whole system approach. This will allow major reinforcement to ensure delivery of solutions with the greatest social return on investment. We will undertake three regional collaboration trial schemes by 2025 involving gas, electricity, water, waste, transport and heating sectors. See core commitment 7 for further detail.</li> <li>Engaging with our stakeholders and coordinating our activities has ensured that activities on one network does not impose constraints on the other. Engaging with generators, we are creating a joint flexibility service in transmission constrained areas called 'MW Dispatch'. The service allows generators to connect immediately by granting ESO access to flexibility on the distribution network (managed by WPD on NGET's behalf), with value payments to customers.</li> </ul>
Local authorities/ LAEP engagement (SE-3)	Broad (Cross-sector)	<ul style="list-style-type: none"> <li>In RIIO-ED1 we started and continue to engage with local authorities through our distribution managers acting as a point of contact for current and future local plan preparation. Furthermore, we have committed to investigate how to accommodate other utilities to provide a whole system approach to Local Area Energy Planning.</li> <li>As part of our core commitments, we are committed to driving the delivery of ambitious Local Area Energy Plans to achieve net zero by proactively engaging with all 130 local authorities each year via 90 local energy surgeries. See core commitment 3 for further detail.</li> <li>See CVP2 for information on how we are going to proactively partner with every local authority in our region to help them develop ambitious Local Area Energy Plans. This will be enabled by setting up a team of 4 Local Authority Engagement Engineers to deliver core commitment 3.</li> </ul> <p>We have also identified that stakeholders were interested on how our scenario planning and projects can effectively feed into Local Plan Infrastructure Delivery Plans. As a result, whole system scenario projections and assumptions are distributed to local authorities to review our assumptions and understand how we can feed into our Infrastructure Delivery Plans.</p>
Network Capacity Map (SE-4)	Broad (Cross-sector)	<ul style="list-style-type: none"> <li>After consulting 46 Connections Steering Group members and ran a bespoke workshop with 12 key industry stakeholders, we produced a Network Capacity Map including energy storage. The map provides data on capacity headroom for demand and generation with simple red, amber and green indicators and likely reinforcement costs.</li> <li>Following further stakeholder engagement and feedback, we also committed to refresh data monthly from quarterly and enabled data downloads in excel format.</li> <li>We are also planning to improve this process by running detailed automated power system analysis to further improve the accuracy of our Network Capacity Map.</li> </ul>

Item	Whole system layer	Description
Electric Vehicles (EVs) (SE-5)	Broad (Energy)   In progress	<ul style="list-style-type: none"> <li>To help local authorities (LAs) prepare better for the uptake of EVs and required installation of charging infrastructure we regularly host DNO led EV conferences for LAs. In 2018, we developed an EV guide to help LAs with their own plans.</li> <li>These conferences have had, and continue to have, a real impact. For example, across two events in Bristol and Birmingham, we were able to share our EV charging plans with 186 local authority representatives. From collaborating and hosting these sessions, we updated our EV guidance better informing LAs.</li> <li>We are also cooperating and collaborating with Moto Services and Grid Service/Electric Highway on Take Charge (NIA project) which will provide a module approach to supply large amounts of power motorway service areas and when they need the capacity to meet the forecasts set by OZEV with project Rapid.</li> <li>As the number of Electric Vehicles is expected to grow exponentially and the announcement in December 2020 that the sale of new petrol and diesel cars and vans would end by 2030, we continue to actively engage with local authorities, our customers and other stakeholders to ensure their requirements are met.</li> <li>We also continue to engage with Ofgem's Electric Vehicle Strategy and remain aware of the opportunities and implications of vehicle-to-grid (V2G) strategies.</li> </ul>

## Our whole system definition in RIIO-ED2

- 3.18.** 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.
- 3.19.** This will include actors across the whole electricity system (ESO, TO, DNOs, independent DNO's (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. As a result, we are determined to ensure our 'very narrow' and 'whole' system processes and solutions are 'Business as Usual' by the end of RIIO-ED2.
- 3.20.** To achieve our whole system solutions and outcomes in RIIO-ED2, have four lenses when approaching our projects and processes:

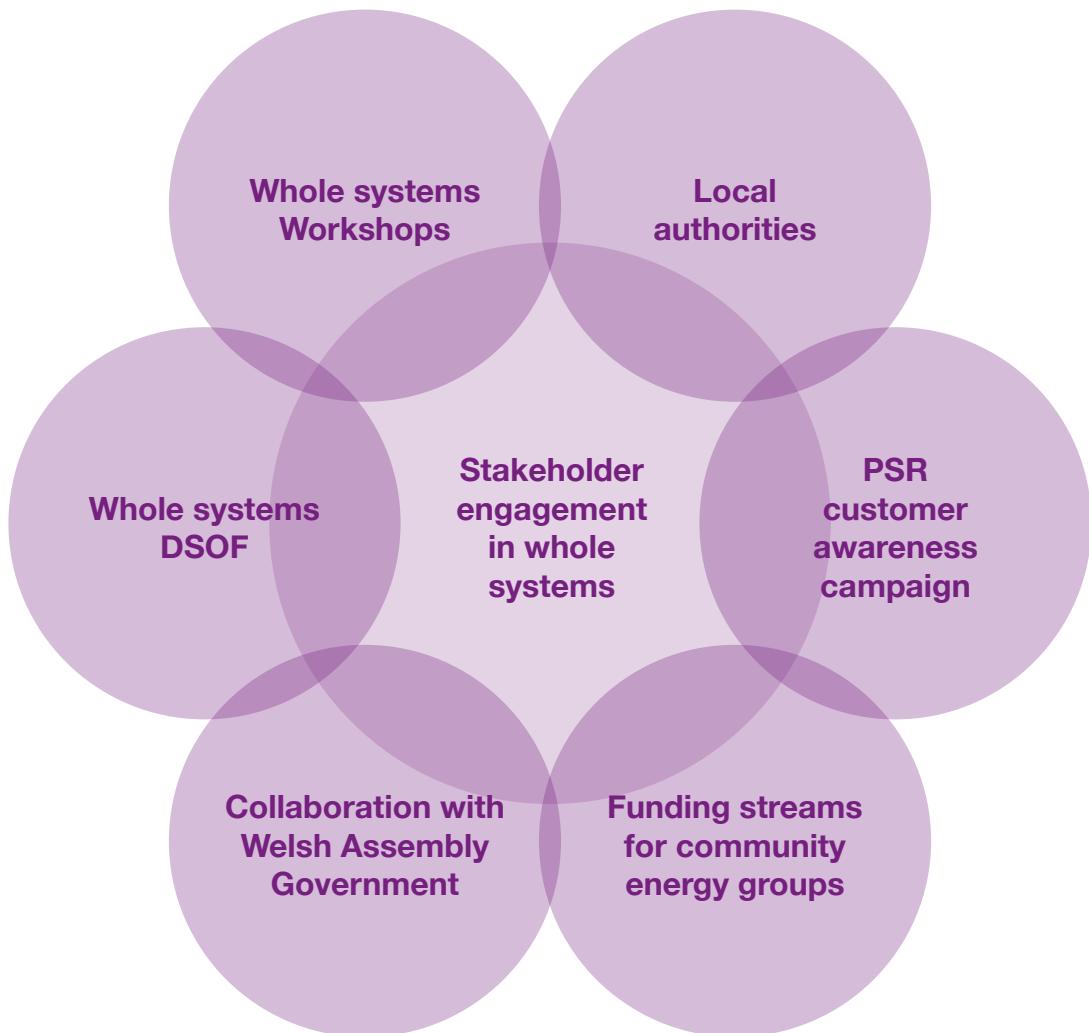
**Figure 10:** Whole systems lenses in RIIO-ED2

<b>Clarity</b> <p>When delivering whole system outcomes, we actively seek to ensure our whole system projects and projects are accurate and precise. Spending more time understanding the cause of the problem and issue has led to our projects delivering more lasting solutions with clear outlines and aims for our project teams to execute and deliver.</p>	<b>Collaboration</b> <p>When appropriate, we collaborate with stakeholders to achieve whole systems solutions and consumer benefits. Building on the work in RIIO-ED1, we continue to identify the correct stakeholders and industry bodies to collaborate with ensuring the right and correct partnerships are established.</p>
<b>Cooperation</b> <p>Within all of our whole systems projects and processes, we cooperate both internally and externally numerous stakeholders including industry bodies, regional and local stakeholders, and organisations who have a substantial interest in delivering energy whole system outcomes.</p> <p>Cooperation is vitally important to achieve whole system solutions and provide consumer net benefits.</p>	<b>Coordination</b> <p>A robust and efficient coordinated energy system can reduce system and network constraints. From the ENA Open Networks project, several work programmes including WS4 whole energy systems seeks to achieve a more coordinated approach across areas including planning, data sharing and flexible solutions. Achieving a standardised and coordination whole system nationally, regionally and locally enable us to provide large beneficial outcomes for our customers.</p>

### 3. Our RIIO-ED2 approach to whole systems and how we will deliver it

- 3.21.** In RIIO-ED2 our vision is to create and further implement processes in the ‘broad’ whole systems layer collaborating and coordinating between other energy vectors including power, transport, and heat. We are seeing a large seismic shift in our industry and our ability to adapt swiftly and continue to achieve positive outcomes for our consumers. To provide high quality stakeholder engagement throughout the price control, we believe applying whole systems thinking will ensure we continue to deliver on our promises.
- 3.22.** We will also outline our ambition and intention to consider the ‘very broad’ whole systems layer collaborating and coordinating between other utilities and societal systems including health, telecommunications, and the built environment. Whole system will not only be at a regional scale, we will see local communities seeking our support in the decarbonisation targets, taking a whole systems approach to heat and transport.

**Figure 11:** Stakeholder engagement in whole systems



**Figure 12:** New stakeholder engagement initiatives in whole systems

<b>Item</b>	<b>Whole system layer</b>	<b>Description</b>
Collaboration with local authorities to inform process and drive investment  (SE-6)   In progress	Narrow (Electricity)	<ul style="list-style-type: none"> <li>Since 2015 we have been creating Distribution Future Energy Scenario (DFES) reports. In order to enhance the quality of the reports, our distribution managers work proactively with the local authorities in the areas to understand their strategic ambitions and delivery plans. This allows these ambitions to be factored into WPD's best view of the future energy requirements.</li> <li>We have committed to driving the delivery of ambitious Local Area Energy Plans to achieve net zero by proactively engaging with all 130 local authorities each year via 90 local energy surgeries – please see core commitment 3.</li> <li>In RIIO-ED2 we will continue to improve our collaboration with local authorities through our appointment of four local authority engagement officers. This will allow the creation of future DFES to ensure we provide the most appropriate consumer benefits for our regions.</li> </ul>
RIIO-ED2 whole systems DSOF  (SE-7)   Future	Broad (Cross-sector)	<p><b>Context</b></p> <ul style="list-style-type: none"> <li>We published a number of Distribution System Operability Framework (DSOF) throughout RIIO-ED1. The DSOF is an assessment of technical issues facing DNOs as they become DSOs. We are actively looking for future technical and commercial issues which could impair our ability to operate and maintain our networks efficiently whilst developing capacity for new connections. Raising awareness of these issues will enable us to seek new solutions and manage them efficiently and cost effectively.</li> <li>We started our dialogue early in RIIO-ED1 which enabled us to work with customers to provide whole system solutions.</li> <li>In RIIO-ED2, we want to take this further and provide insights to our stakeholders in key energy vectors allowing them to make more informed decisions.</li> </ul> <p><b>Actions</b></p> <ul style="list-style-type: none"> <li>In RIIO-ED2 our ambition is publish two further DSOFs assessing the technical issues surrounding the integration of EVs, heat network and wider vectors as we move further towards a low carbon future.</li> <li>We will share our learnings and discussions with other DNOs with a particular focus on collaboration through the ENA Open Networks programme.</li> </ul> <p><b>Outcomes</b></p> <ul style="list-style-type: none"> <li>Publishing insights on EV and heat network integration will help the industry raise the profile on the technical issues surrounding these areas.</li> </ul>
Whole systems workshops (enhanced stakeholder engagement)  (SE-8)   Future	Broad (Cross-sector)	<p><b>Context</b></p> <ul style="list-style-type: none"> <li>In 2018/19, stakeholders put whole system approach as a high priority citing that increased collaboration, whole system planning and scenarios development as top issues. Stakeholders also emphasised the importance of engaging with local authorities to support them to deliver on their net zero targets, sharing knowledge and information.</li> </ul> <p><b>Actions</b></p> <ul style="list-style-type: none"> <li>Throughout RIIO-ED2, we will host a series of targeted workshops to identify potential partnerships with authorities we previously would not have cooperated.</li> <li>We will also host a number of general workshops with a wide mix of stakeholders and local authorities collaborating together to solve WPD and stakeholder challenges.</li> <li>As part of our core Business Plan commitments we are dedicated to supporting communities. We plan to significantly increase the volume of community energy schemes, connecting at least 30 community energy groups to the network each year by holding 60 Community Energy Surgeries per year and providing a dedicated WPD community energy representative to assist with connection and flexibility offers (please refer to core commitment 8).</li> </ul> <p><b>Outcomes</b></p> <ul style="list-style-type: none"> <li>Organising and delivering whole system workshops will allow us to further collaborate with other agencies such as water companies which are delivering in positive programmes in areas like biodiversity and the Environment Agency around flood defences.</li> <li>With a large variety of stakeholder collaborating, we hope that the workshops will identify new methods and interlinkages through collaboration and coordinating where previously we would implement conventional methods.</li> </ul>

### 3. Our RIIO-ED2 approach to whole systems and how we will deliver it

**Figure 13:** New stakeholder engagement initiatives in whole systems

Item	Whole system layer	Description
Collaboration with Welsh Assembly Government, NG, WWU and SPEN  (SE-9)	Broad (Cross-sector)	<p><b>Context</b></p> <ul style="list-style-type: none"> <li>The Welsh Assembly Government has recently published 'Net Zero Wales'. The publication contains 123 government policies and proposals to reach their target of delivering 70% of Wales' electricity demand from Welsh renewable electricity sources by 2030, as well as delivering net zero across the Welsh public sector by the same date.</li> <li>The plan looks to support innovation in new renewable energy technology, as well as working with network operators to plan for a national energy grid fit for a renewable future.</li> <li>There is also the potential for significant offshore wind connections connecting to Wales.</li> <li>There needs to significant coordination between network companies, the Welsh Assembly Government and other key stakeholders to ensure that efficient whole system solutions can be developed to allow the connection of the required generation in a timely manner and at lowest cost for consumers.</li> <li>One of our core commitments is to drive the achievement of net zero across our regions sooner than 2050 in line with stakeholder plans (some areas as early as 2028) by ensuring network capacity is available, see core commitment 1.</li> </ul> <p><b>Actions</b></p> <ul style="list-style-type: none"> <li>We have committed £2 million of specific resources across RIIO-ED2 to collaborate and assist the Welsh Assembly to identify challenges faced by the Welsh energy system and assess potential solutions.</li> <li>We will engage with stakeholders to ensure a joined-up approach enabled with relevant data and information sharing. Our stakeholder engagement will also capture where decisions and actions are being taken at a more local government level utilising our stakeholder engagements in DFES with local authorities.</li> </ul> <p><b>Outcomes</b></p> <ul style="list-style-type: none"> <li>With increased coordination and planning through our specific resource and other partners, we will ensure that the transmission network use is maximised where possible and therefore ensuring lower network reinforcement costs for the consumer.</li> <li>While there will be a significant number of different parties involved in delivering these targets, our work in delivering a National Energy Plan for Wales will enable these benefits, by providing the grid infrastructure required to connect the various LCTs.</li> </ul>



Item	Whole system layer	Description
<p>PSR customer awareness campaign – WPD PSR awareness (SE-10)</p>  <p>In progress</p>	<p>Very broad (Health)</p>	<p><b>Context</b></p> <ul style="list-style-type: none"> <li>Supporting vulnerable customers is a key priority in our Business Plan, this Consumer Value Proposition (CVP) (6) highlights our work in going beyond our core commitments to ensure no one is left behind. Our proposal aims to ensure those who are vulnerable or living in fuel poverty have better opportunities to access smart and flexible networks. The initiative aims to offer 1.2 million PSR customers a bespoke smart energy action plan every two years.</li> </ul> <p><b>Actions</b></p> <ul style="list-style-type: none"> <li>Our current activities are focused on providing relevant support and information to vulnerable and PSR customers through the appropriate channels, but within this proposal we go beyond this by proactively engaging and developing bespoke energy plans.</li> <li>We are committed to achieving a one stop shop service so that customers only have to join the PSR once to be registered automatically with their energy supplier, water company, gas distributor and telecommunications companies. See core commitment 21 for further detail.</li> <li>We aim to go beyond the RIIO-ED2 baseline expectations for vulnerable customers through our commitments. Through this CVP we propose the following:</li> <li>We will take a leading role in a coordinated approach with a range of industry participants (including funding for collaborations with community energy stakeholders) to share best practice and co-deliver schemes to ensure vulnerable customers are not left behind by the smart energy transition.</li> <li>We will proactively contact over 2 million PSR customers once every two years to remind them of the services we provide.</li> <li>We will have data share arrangements in place with suppliers, gas distributors and water companies, compliant with GDPR and Ofgem data best practice guidance. Exceeding baseline: We will extend our data share arrangements to partner with telecommunications companies. We will establish two way data sharing, partnering with all eight water companies in WPD's region.</li> </ul> <p><b>Outcomes</b></p> <ul style="list-style-type: none"> <li>Through our initiative to support vulnerable customers in the provision of a smart energy action plan, the expectation is financial savings through saved money in electricity bills. The fall in electricity consumption through changes in behaviour will also have an added societal benefit given the reduction in carbon emissions.</li> <li>Other utilities' customers gain the benefit of WPD's extensive PSR reach, as data shared with other utilities enables those customers to access a wider range of support.</li> <li>Over RIIO-ED2, we will support 113,000 fuel poor customers and saving £60 million on their energy bills.</li> </ul>
<p>Funding streams for community energy groups and advisory groups (SE-11)</p>  <p>Future</p>	<p>Very broad (Cross-sector)</p>	<p><b>Context</b></p> <ul style="list-style-type: none"> <li>Our community energy groups have requested that we support them to access any available funding streams which could help them to establish a new project. We will therefore partner with them and support their ideas.</li> <li>One of our core commitments is to support a growth in community energy schemes by facilitating their access to available funding streams (see core commitment 9).</li> </ul> <p><b>Actions</b></p> <ul style="list-style-type: none"> <li>As explained in page 8, our CVP3 will engage a team of four community energy engineers to proactively support community energy stakeholders. This will help them to access funding streams by providing support to community energy groups when making submissions to our calls for ideas.</li> </ul> <p><b>Outcomes</b></p> <ul style="list-style-type: none"> <li>Supporting local energy stakeholders to secure funding will allow the reality of viable and ambitious low carbon schemes to go ahead, benefiting the community in the long run and provide whole system benefits.</li> <li>The expected benefit of this service will provide advice and consistent support to various community groups. We expect the net present benefit over the next five years to be around £11.3 million (see page 8, or CVP3 for further detail).</li> </ul>

### 3. Our RIIO-ED2 approach to whole systems and how we will deliver it

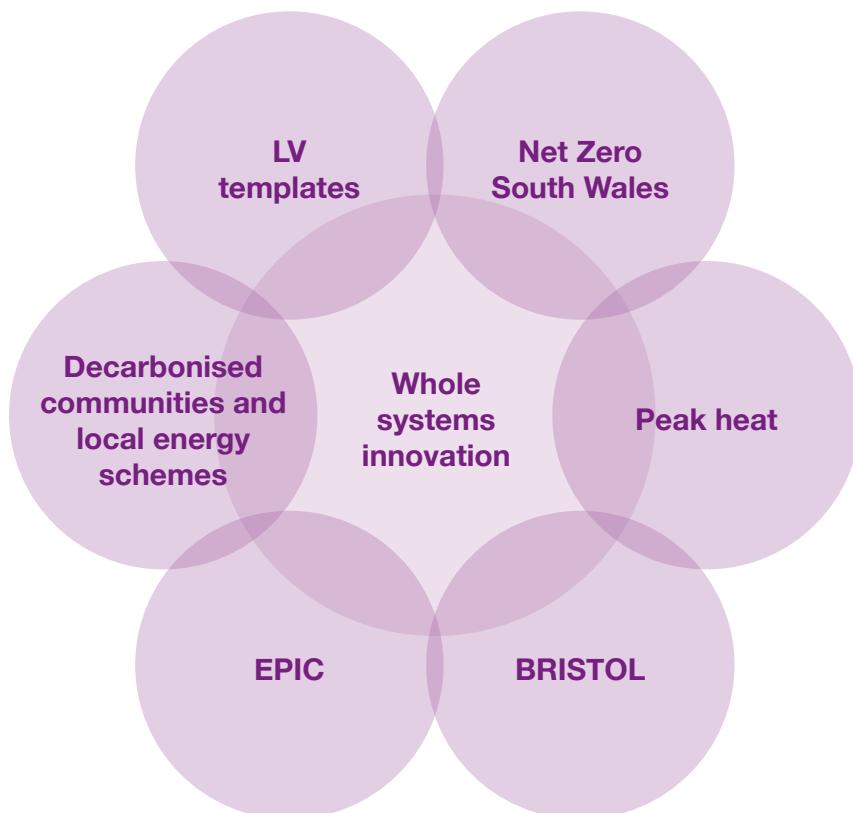
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#### Whole systems innovation and processes

##### Innovation

- 3.23. We have delivered more than 120 innovation projects over previous and the current price control periods, which have significantly evolved how we operate our business and overall consumer benefits.
- 3.24. With the new Strategic Innovation Fund and UK's net zero targets, innovation will continue to bring large and significant changes opportunities. With more focus on whole system solutions and outcomes, innovation does not have to be on a large scale. With increased collaboration and coordination with energy vectors and other sectors, innovative ideas using a whole systems framework can provide significant improvements through evolutionary and incremental changes to existing methods.
- 3.25. In RIIO-ED2, we will further implement and build on existing innovations we have pioneered in the current price control; relying on innovation and applying a whole systems mindset will enable us to maintain our position as a top performer in network performance and customer services in all key output areas including safety, customer service, reliability and environment.
- 3.26. Using whole systems innovation in RIIO-ED2 and beyond, this will allow us to improve further on these areas and help us to address the current and future challenges towards net zero. We cannot stop here and our ambition is to further push the whole systems boundary incorporating 'broad' whole solutions and in the longer horizon plan and interact to produce 'very broad' outcomes.
- 3.27. We need to build on the whole system projects and processes that we previously collaborated and cooperated through innovative solutions and now use in BAU, to extract as much value as possible from our network. Therefore, in RIIO-ED2, we plan to continue transforming our network to achieve whole system solutions and outcomes while keeping our service efficient and affordable for all our customers.

Figure 14: Whole systems innovation



**Figure 15:** Whole systems innovation

Item	Whole system layer	Description
Low voltage templates (IN-1)	Very narrow (Energy – electricity)	<p><b>Context</b></p> <ul style="list-style-type: none"> <li>With the UK government ambitious net zero target, this will impose new and additional stresses on DNO electricity networks. We identified this emerging issue as early as 2011 and understood the importance of increasing visibility on our LV distribution networks for a net zero future.</li> </ul> <p><b>Actions</b></p> <ul style="list-style-type: none"> <li>We initially installed over 800 substation monitors and 3,600 voltage monitors together with communication and data handling infrastructure. We also collaborated with NPower involving customers who have microgeneration equipment installed in their property.</li> <li>Building upon this innovation trail, we collaborated with Bath University where they analysed the data leading to a wide range of valuable findings that have been shared with industrial, academic, and regulatory stakeholders.</li> </ul> <p><b>Outcomes</b></p> <ul style="list-style-type: none"> <li>Our consumers continuously benefit from our initial trail and are proactively checking that consumer voltages are to standard and with our collaboration with the Welsh Assembly Government, identified key stakeholders to further deliver whole system solutions and outcomes.</li> </ul>
Net zero South Wales (IN-2)	Narrow (Energy – gas)	<p><b>Context</b></p> <ul style="list-style-type: none"> <li>With Wales and West Utilities (WWU), we were the first DNO to produce an integrated Distribution Future Energy Scenario (DFES) study which covered both the electricity and gas distribution networks in South Wales. The project went above and beyond the current industry standard in producing a DFES every two years.</li> </ul> <p><b>Actions</b></p> <ul style="list-style-type: none"> <li>This innovation project was about bringing two networks together, developing insights and value from an integrated approach to gas and electricity network planning.</li> <li>The project involved combining and extending studies previously completed separately for both WPD and WWU into a single integrated view of future net zero scenarios for their network areas.</li> </ul> <p><b>Outcomes</b></p> <ul style="list-style-type: none"> <li>The analysis produced a set of joint electricity and gas net zero 2050 scenarios covering WPD and WWU shared distribution network region in South Wales and explores a range of possible futures for our electricity and gas distribution networks. The main output of the project is a dataset of scenario projections provided to inform network planning and investment for WPD and WWU.</li> <li>Building on this project and collaborating with WWU, we continue to develop shared in DFES ensuring standardisation and ultimately more accurate forecasts for our local authorities, wider stakeholders and consumers.</li> </ul>

### 3. Our RIIO-ED2 approach to whole systems and how we will deliver it

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Item	Whole system layer	Description
Peak heat (IN-3)   In progress	Broad (Energy - heat)	<p><b>Context</b></p> <ul style="list-style-type: none"> <li>With our ongoing work in publishing DFES and forecasting emerging technologies, we identified that heat pumps will play a prominent role in the future energy system. As a result, domestic heat electrification could have a major impact on Low Voltage (LV) and medium voltage distribution network peak loads.</li> <li>As a result, understanding further the resultant load profiles of these new electricity loads and technology shifts (e.g., from economy seven storage to heat pumps), the impact they may have on networks, and the opportunities they present for flexibility will provide whole system benefits for our consumers as we become more informed with additional information and data.</li> </ul> <p><b>Actions</b></p> <p>This project is comprised of the following work packages:</p> <ul style="list-style-type: none"> <li><b>WP1: Archetype creation</b> <ul style="list-style-type: none"> <li>Defining the relevant archetypes of interest to establish the physical demand characteristics.</li> </ul> </li> <li><b>WP2: Heat market landscaping</b> <ul style="list-style-type: none"> <li>Characterising the range of technologies (e.g. maturity, cost, size etc.) potentially available and mechanisms which could be deployed to help deliver low carbon electric heating, including domestic thermal storage.</li> </ul> </li> <li><b>WP3: Customer modelling</b> <ul style="list-style-type: none"> <li>Exploring the range of impacts on load profiles from heating technologies, storage, and flexibility at a single customer level.</li> </ul> </li> <li><b>WP4: Area typology modelling</b> <ul style="list-style-type: none"> <li>Representative mixes of house archetypes will be modelled for a sample of four representative distribution (LV) network community typologies at the primary substation level.</li> </ul> </li> <li><b>WP5: CBA, analysis and recommendations</b> <ul style="list-style-type: none"> <li>Drawing together all the findings from the research. This will include conducting a high level cost benefit analysis (CBA) to identify the potential lowest cost options.</li> </ul> </li> </ul> <p><b>Outcomes</b></p> <ul style="list-style-type: none"> <li>The project will create demand profiles that can be incorporated into main business planning tools for future network development planning and load growth modelling.</li> <li>The project also assesses and investigates how heat pumps operate in different types of buildings (e.g. construction, size) and regions of our network.</li> <li>We will also analyse how thermal storage as an enabler to flexibility compares to other flexibility sources. This includes assessing the overall economic case for these sources versus upgrading the network.</li> </ul>

Item	Whole system layer	Description
Buildings, renewables and integrated storage, with tariffs to overcome network limitations (BRISTOL)  (IN-4)	Broad (Energy - battery)	<p><b>Context</b></p> <ul style="list-style-type: none"> <li>In this project, we developed an innovative approach to operating networks utilising battery storage at a customer premises.</li> </ul> <p><b>Actions</b></p> <ul style="list-style-type: none"> <li>Coordinating and collaborating with local authorities, we installed 30 homes 2kW of battery storage in their lofts along with PV Solar panels. The PV Panels were directly connected to the battery to store solar energy for use when the sun was not shining. Each home was also connected to the local electricity network, so that excess stored energy could be exported to the grid at peak times.</li> <li>Data was captured to enable analysis on the benefits to customers and the electric network, along with the effect if the systems on power quality.</li> </ul> <p><b>Outcomes</b></p> <ul style="list-style-type: none"> <li>The project benefitted customers by lowering their energy bills as customers had better control of their energy with introducing Smart Tariffs and passing on cost savings. We collaborated with Bristol City Council where the technology was deployed at their sites. The average saving of the 11 houses on the piloted substation was £52.10 and the average saving per month equated to £7.43.</li> <li>The outcomes from this project continue to benefit our customers and into RIIO-ED2 with low energy bills as more customers have better control of their energy and passing on cost savings.</li> </ul>
Energy Planning Integrated with Councils (EPIC)  (IN-5)	Broad (Energy)	<p><b>Context</b></p> <ul style="list-style-type: none"> <li>This project will develop a process to support the creation of an integrated local energy plan in a format that can be incorporated back into a DFES analysis.</li> <li>The project will incorporate LAs long term strategic plans to create a standardised process that can be used with different local authorities to create a Local Area Energy Plan.</li> <li>The project aligns plans across energy networks and take a more holistic and strategic view of future investment options. This will in turn lead to better investment outcomes for the networks and for regional stakeholders.</li> </ul> <p><b>Actions</b></p> <ul style="list-style-type: none"> <li>The project will build on the existing process to build a DFES and analyse its impact which is currently used to create WPD's shaping sub-transmission reports which consider the 132kV and EHV networks.</li> <li>The analysis of the networks and the generation of solutions and investment options will consider at least one primary substation in each of the selected trial areas.</li> </ul> <p><b>Outcomes</b></p> <ul style="list-style-type: none"> <li>Coordinating and cooperating with local authorities, the project will develop a new process for creating Local Area Energy Plans as well as new tools for HV analysis and supporting the development of an integrated investment plan.</li> </ul>
Build decarbonised communities and local energy schemes by funding solar PV on schools and community buildings in areas of high economic deprivation  (IN-6)	Broad (Energy)	<p><b>Context</b></p> <ul style="list-style-type: none"> <li>This initiative aims to engage with schools in areas of high economic deprivation to support them to establish solar PV at their locations, allowing them to be energy efficient and reduce their bills.</li> </ul> <p><b>Actions</b></p> <ul style="list-style-type: none"> <li>We're proposing the delivery of a solar PV starter pack worth £10,000, alongside a related educational programme supporting the net zero agenda.</li> <li>The pack would allow for the installation of 30 panels which could generate approximately 10MWh.</li> </ul> <p><b>Outcomes</b></p> <ul style="list-style-type: none"> <li>Collaborating with schools would result in immediate benefits for schools arising from energy savings. The savings would be generated from the implicit savings of the schools producing their own energy.</li> <li>Cooperating with schools will also have behavioural changes including the importance of sustainability and the use of smart meters in the current and future energy system.</li> </ul>

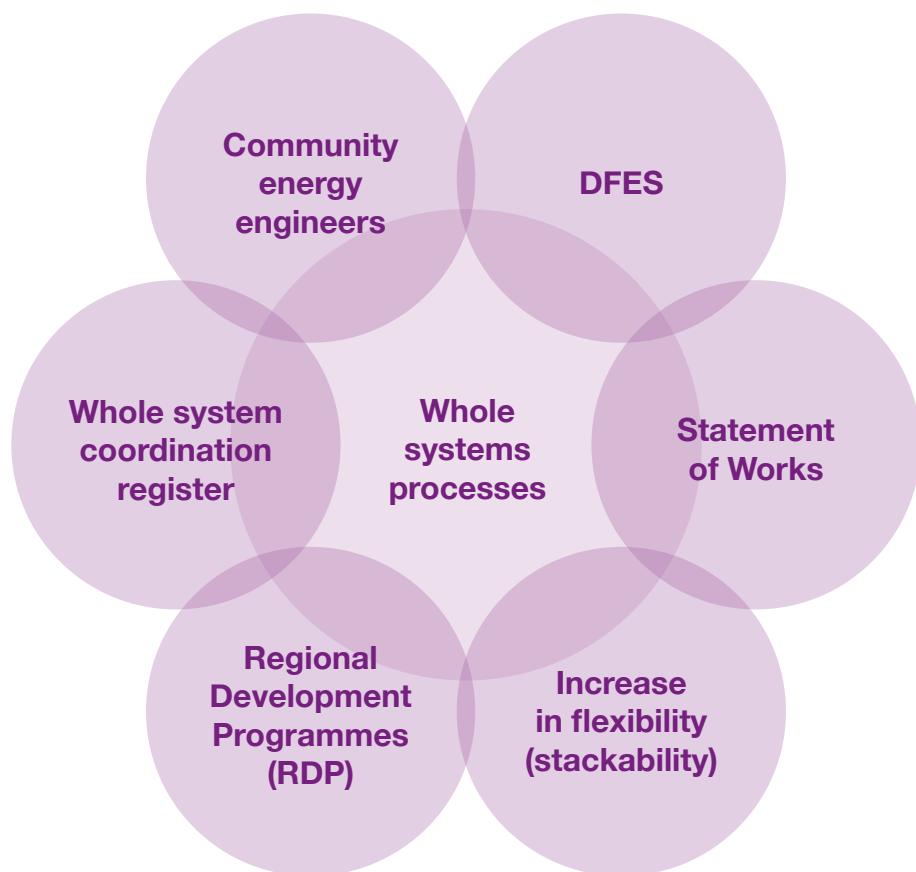
### 3. Our RIIO-ED2 approach to whole systems and how we will deliver it

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#### Processes

- 3.28. We operate the network for our customers, so it is essential we respond to their changing use of the network and adapt our operations to continue to deliver excellent customer service, reliability, and value for money.
- 3.29. Our role as a Distribution Network Operator (DNO) is shifting to take on more Distribution System Operator (DSO) activities to manage real time energy flows, and use technology, innovation and commercial arrangements to make optimal use of the existing network capacity. A more flexible network operation which embraces DSO requirements is needed. The enhanced capabilities we are developing will evolve markets to give our customers the freedom to access other opportunities within the developing energy system.
- 3.30. To enable a greater level of coordination, collaboration, and cooperation in delivering whole system outcomes, our networks are becoming smarter and more active. Creating a more efficient and flexible system will benefit all customers and empower them to be at the centre of the energy revolution.
- 3.31. We recognise that change is essential to driving performance and efficiency from our network and to ensure it can meet the future energy demands of all our customers.

**Figure 16:** Whole systems processes



**Figure 17:** Whole systems processes

Item	Whole system layer	Description
ESO and DNO data exchanges (P-1)	Very narrow (Electricity)   In progress	<ul style="list-style-type: none"> <li>Data visibility and availability is crucial in building a smarter energy system that supports net zero targets whilst also creating opportunities. From the Energy Data Taskforce (EDTF), the report set out a number of recommendations to transform data in the energy system. To accelerate this transformation, collaborating with the ENA we exchange data between the ESO and IDNOs.</li> <li>The process is to ensure data exchange between network companies that will better facilitate a coordinated and efficient approach to whole electricity system planning.</li> <li>DNOs are required to submit standard planning data to NGESO as part of the week 24 process. In week 42, the grid code requires NGESO to submit detailed planning data to DNOs to allow DNOs to model the transmission system.</li> </ul>
Distribution Future Energy Scenarios (DFES) (P-2)	Broad (Gas and transport)   In progress	<p><b>Context</b></p> <ul style="list-style-type: none"> <li>Since 2015, the output of the DFES studies inform us in long term strategic planning and flexibility analysis. 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.</li> </ul> <p><b>Actions</b></p> <ul style="list-style-type: none"> <li>One of our core commitments is to ensure customers can connect LCTs quickly and easily, with the network being ready to connect at least an additional 1.5 million EVs and 600,000 heat pumps by 2028. The DFES investigates 50 different technology types and assesses the potential for growth under each of the four ESO FES scenarios. To produce this, we have a four stage process:</li> </ul> <p><b>A baseline assessment</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul> <p><b>A pipeline assessment</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul> <p><b>Resource assessment</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul> <p><b>Scenario projection</b></p> <ul style="list-style-type: none"> <li>The National Grid FES 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.</li> </ul> <p><b>Outcomes</b></p> <ul style="list-style-type: none"> <li>We continue to produce a full suite of DFES documents annually. Building on the work we have done; we will further explore and develop an integrated DFES in partnership with other GDNs as we have demonstrated in the Net Zero South Wales.</li> <li>By updating our Distribution Future Energy Scenarios every 12 months, it allows us to deliver our core commitment of delivering a network to meet the evolving needs of our customers by aligning our future energy forecasts with the plans of local regions and the Electricity System Operator (ESO). (Refer to core commitment 4).</li> <li>To accelerate the transition to net zero, integration and standardisation of data including more precise forecasts continues to be important.</li> <li>We believe this will enhance our whole systems outcomes as our forecasts will be more integrated and accurate therefore providing further net societal benefits.</li> </ul>

### 3. Our RIIO-ED2 approach to whole systems and how we will deliver it

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Item	Whole system layer	Description
Statement of Works (SoW) (P-3)	Very narrow (Electricity)   In progress	<p><b>Context</b></p> <ul style="list-style-type: none"> <li>In collaboration with National Grid Electricity Transmission (NGET), as one of the first DNO's we pioneered and developed a new SoW process known as the 'Appendix G trial'. We introduced this due to the large volumes of new generation connecting to the distribution system and to provide better visibility of transmission reinforcement.</li> </ul> <p><b>Actions</b></p> <ul style="list-style-type: none"> <li>We continue to provide these benefits for our consumers and wider stakeholder minimising disruption and increasing efficiencies in our processes through coordination and collaboration with NGET.</li> </ul> <p><b>Outcomes</b></p> <ul style="list-style-type: none"> <li>Introducing this trial has reduced the time customers have to wait for the outcome of the process from around four months to six weeks.</li> <li>The process provides an overview of the generation connection levels at each Grid Supply Point (GSP) and transmission connection requirements. Customers can use the information to make more informed decisions when applying for a connection.</li> <li>With this success, Appendix G is in the process of being codified within the Connection and Use of System (CUSC). This will formalise our trial into a process we will execute 'Business as Usual'.</li> </ul>
Increase in flexibility – including stackability – WPD report with the ENA (P-4)	Narrow (Electricity)   In progress	<p><b>Context</b></p> <ul style="list-style-type: none"> <li>We have been pioneering the use of flexibility solutions during RIIO-ED1 continuing leading the way in this sector.</li> <li>Flexibility Service Providers (FSPs) are increasingly seeking to dynamically 'stack' revenues which means both stacking of multiple streams in the same time period, as well as moving between revenue streams in different time periods to take advantage of opportunities at different times of the day.</li> </ul> <p><b>Actions</b></p> <ul style="list-style-type: none"> <li>In RIIO-ED2, we are reviewing the potential opportunities to deal with network constraints through active network management and tools such as stackability.</li> <li>As outlined in the ENA report, we will further analyse the three important factors for a flexible asset when considering whether to stack revenues from different streams which include: <ul style="list-style-type: none"> <li>- Baseline (i.e. the level against which delivery of the service in question will be assessed).</li> <li>- Procurement timescales for different services.</li> <li>- Penalties for non-delivery.</li> </ul> </li> </ul> <p><b>Outcomes</b></p> <ul style="list-style-type: none"> <li>With the ENA, we investigated the ability of flexibility service providers (FSP's) to dynamically stack revenues. These providers would reduce constraints on the network whilst avoiding expensive network reinforcement and minimising consumer costs by widening revenue streams.</li> <li>Flexible asset providers are capable of moving between revenue streams much more readily than they are able to stack revenue streams. Better coordination of procurement by DNO's will allow flexibility and optimisation of capacity across the energy system.</li> </ul>

Item	Whole system layer	Description
Cost benefit analysis tools (P-5)	Narrow (Energy)  In progress	<p><b>Context</b></p> <ul style="list-style-type: none"> <li>Our use of cost benefit analysis tools is continually evolving to consider the options available. Below we have included some of the tools we have used to perform CBA's across different areas of the network.</li> <li>Throughout our Business Plan we have incorporated the Ofgem RIIO-ED2 cost benefit analysis template to assess various reinforcement options. The tool has been used as part of the business planning process to determine the optimal conventional reinforcement.</li> <li>We have used the CEM cost benefit analysis tool to evaluate the extent to which flexibility is used on our network. The tool is used to assess flexibility deferral within our Business Plan as well as the twice yearly Distribution Network Option Assessment (DNOA) process.</li> <li>As part of the Open Networks project, we will continue to work with the ENA to contribute to the development of whole system CBA tools which will be used to appraise projects in the future.</li> </ul> <p><b>Actions</b></p> <ul style="list-style-type: none"> <li>The Ofgem CBA template is used to calculate the NPV of an asset by assessing the spend profile of all options, as well as the capacity added to the network.</li> <li>The CEM tool allows us to assess the net benefit of flexibility against a baseline of conventional reinforcement. If flexibility procurement is determined the optimal solution, it could create savings that can be passed onto consumers and stakeholders.</li> <li>The whole system CBA tool will be tested as part of our EPIC Network Innovation Allowance (NIA) project and then incorporated into BAU.</li> </ul> <p><b>Outcomes</b></p> <ul style="list-style-type: none"> <li>The range of tools used allows us to perform a greater assessment of whole system solutions and allows us to consider the long term value for consumers and society.</li> <li>Once BAU, we will use the ENA whole systems tool for all our whole system projects enabling us to compare costs and benefits across different sectors and across a number of stakeholders and allow us to evaluate a number of scenarios.</li> </ul>



### 3. Our RIIO-ED2 approach to whole systems and how we will deliver it

Item	Whole system layer	Description
Regional Development Programmes (RDP) (P-6)	Broad (Electricity)	<p><b>Context</b></p> <ul style="list-style-type: none"> <li>The Regional Development Programmes (RDPs) 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.</li> <li>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.</li> </ul> <p><b>Actions</b></p> <ul style="list-style-type: none"> <li>The analysis innovates and pushes 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.</li> <li>The RDP process involves a number of stages before recommendations for a future strategy can be derived.</li> </ul> <pre> graph TD     A[Define boundaries and quantify problems to study] --&gt; B[Identify issues]     B --&gt; C[Identify options]     C --&gt; D[Undertake whole system studies]     D --&gt; E[Iteratively assess effectiveness of options (including combinations)]     E --&gt; F[Share relevant information for studies]     F --&gt; G[Agree background information]     G --&gt; H[Agree Future Energy Scenarios]     H --&gt; I[Recommendations for strategy]     </pre> <p><b>Outcomes</b></p> <p><b>RDP2 - South West</b></p> <ul style="list-style-type: none"> <li>RDP2 focused on the South West peninsula 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.</li> <li>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.</li> </ul> <p><b>RDP4 - Midlands</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul> <p>In RIIO-ED2, we have committed to delivering three RDPs to further understand the interaction between the transmission and distribution network gained via whole system planning.</p> <p>As we discussed in SE-5, our Business Plan commitment 7 highlights our ambition to broaden our RDP’s in order to further improve network efficiency. In RIIO-ED2 we will utilise a whole system approach for major reinforcement. We intend to ensure delivery of solutions with the greatest social return on investment.</p> <p>We will undertake three regional collaboration trial schemes by 2025 involving a combination of gas, hydrogen electricity, water, waste, transport, and heating sectors.</p> <p>For example, we will investigate possible hydrogen network and storage requirements in our regions including blending hydrogen into the gas grid and for heating, analysing the possible impacts on our electricity distribution network.</p>

Item	Whole system layer	Description															
Whole system coordination register  (P-7)	Broad (Electricity)  In progress	<p><b>Context</b></p> <ul style="list-style-type: none"> <li>As part of the new whole system licence conditions, we are required to publish a whole system coordination register.</li> <li>The register includes details of any actions or processes that have been implemented (or are being implemented) because of coordination and cooperation activities completed with other electricity network licensees.</li> </ul> <p><b>Our ambition</b></p> <ul style="list-style-type: none"> <li>The scope of the coordination register found within ENA Open Networks Product (WS1B-P9) is very narrow and only considers the electricity network. For RIIO-ED2, we will drive more ambitious and detail relevant coordination and cooperation that are 'broad' and 'very broad' via the ENA as outlined in our whole system framework.</li> <li>This will allow our stakeholders and sectors other than electricity network licensees to understand opportunities that have been identified. This will further advance the industry in delivering whole system outcomes.</li> </ul> <p><b>Outcomes</b></p> <ul style="list-style-type: none"> <li>The coordination register will inform our stakeholders all the relevant coordination and cooperation activities completed with other electricity network licensees during a relevant period to develop whole electricity system outcomes, including data sharing.</li> </ul>															
Establish community energy engineers (CVP-3)  (P-8)	Very broad (Electricity)  Future	<p><b>Context</b></p> <ul style="list-style-type: none"> <li>The energy sector is moving towards decentralised models of energy generation, enabled by community led projects championing renewables, energy demand reduction and flexible supply. Many of these projects are wholly owned and/or controlled through energy community groups or through a partnership with commercial or public partners. With this, local communities can benefit from a range of social, environmental and economic benefits, including:             <ul style="list-style-type: none"> <li>- Fuel poverty alleviation.</li> <li>- Energy engagement and education.</li> <li>- Community funds from renewable energy projects.</li> </ul> </li> <li>To help unlock such benefits, we have provided support to the communities and their representatives through accessible guides which has proved successful. For example, our 'Connecting Community Energy' guide contains useful information for local energy groups looking to develop their own renewable energy projects and connect to our network. Additionally, WPD developed 'Community Energy Surgeries' for our customers.</li> </ul> <p><b>Actions</b></p> <ul style="list-style-type: none"> <li>Extending our support beyond the successful accessible guides, and following stakeholder engagement, WPD will:</li> <li>Employ four full time community energy engineers, each dedicated to a licence area, and</li> <li>Introduce Community Energy Surgeries.</li> </ul> <p><b>Outcomes</b></p> <ul style="list-style-type: none"> <li>Two Community Energy Surgeries have taken place to date. However, with CVP-3 and the introduction of dedicated community energy engineers, WPD will undertake 60 Community Energy Surgeries annually, providing advice and consistent support to various community groups. The community energy engineers and the targeted increase of surgeries are new activities, beyond BAU activities.</li> </ul> <p><b>Costs and benefits</b></p> <ul style="list-style-type: none"> <li>In line with the joint social value framework, agreed with the five other DNOs and shared with Ofgem in 2020, we have modelled the benefits of this CVP over both a five and ten year appraisal period.</li> </ul> <table border="1"> <thead> <tr> <th></th><th>5 years</th><th>10 years</th></tr> </thead> <tbody> <tr> <td>Total cost</td><td>£1,060,537.91</td><td>£1,060,537.91</td></tr> <tr> <td>Total gross present value</td><td>£12,426,371.85</td><td>£12,426,371.85</td></tr> <tr> <td><b>NPV</b></td><td><b>£11,365,833.94</b></td><td><b>£11,365,833.94</b></td></tr> <tr> <td>SROI</td><td>£10.72</td><td>£10.72</td></tr> </tbody> </table>		5 years	10 years	Total cost	£1,060,537.91	£1,060,537.91	Total gross present value	£12,426,371.85	£12,426,371.85	<b>NPV</b>	<b>£11,365,833.94</b>	<b>£11,365,833.94</b>	SROI	£10.72	£10.72
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## 4. Summary and whole systems beyond RIIO-ED2

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- 4.1.** As highlighted, the whole energy system requires a broad multidisciplinary approach involving multiple techniques with scenario building and modelling to understand how the system will evolve to a low carbon system. The pace of change in the energy system is increasing, making whole systems more pivotal than ever.
- 4.2.** We cannot consider various energy vectors and other sectors in isolation as we believe they are all interlinked and interrelated by the common goal to achieve net zero.
- 4.3.** Therefore, we believe there are four key components to deliver whole system outcomes for our customers in RIIO-ED2. Within each of our whole system components, we have outlined many commitments demonstrating track record, current projects we want to take a step further and new whole system projects and initiatives delivering clear whole system outcomes for our customers.
- 4.4.** In the below table, we have outlined our completed projects, ongoing and new commitments we are delivering in RIIO-ED2:

**Figure 18:** RIIO-ED2 Whole systems commitments

Very narrow and narrow	Broad	Very broad
D&D-1 ENA coordinated regional data gathering	CW-1 Internal whole systems training	SE-10 PSR customer awareness campaign – WPD PSR awareness
D&D-2 smart meter data – loss of supply	CW-2 Embedding whole systems into early and late competition	SE-11 Funding streams for community groups and advisory groups
D&D-3 data standardisation	CW-3 Whole Systems Cyber Security Working Group	P-8 Establish community energy engineers
D&D-4 ‘Data first’	CW-4 FSO engagement	
SE-1 Distribution System Operability Framework (DSOF)	CW-5 whole systems management team	
SE-2 stakeholder engagement in RDP process	D&D-5 More enriched data exchanges with local authorities	
SE-6 collaboration with local authorities to inform process and drive investment	SE-3 local authorities/ LAEP engagement	
IN-1 low voltage templates	SE-4 Network Capacity Map	
IN-2 Net Zero South Wales	SE-5 Electric Vehicles (EVs)	
P-1 ESO and DNO data exchanges	SE-7 RIIO-ED2 whole systems DSOF	
P-3 Statement of Works (SoW)	SE-8 whole systems workshop (enhanced stakeholder engagement)	
P-4 Increase in flexibility – including stackability – WPD report with the ENA	SE-9 Collaboration with the Welsh Assembly Government, NG, WWU and SPEN	
P-5 Cost benefit analysis tools	IN-3 Peak heat	
	IN-5 Energy Planning Integrated with Councils (EPIC)	
	IN-6 Funding solar PV in areas of high economic deprivation	
	P-2 Distribution Future Energy Scenarios (DFES)	
	P-6 Regional Development Programmes (RDP)	
	P-7 Whole system coordination register	

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- 4.5.** Many of our new commitments are projects and initiatives within the ‘broad’ and ‘very broad’ layers demonstrating our ambition to be on the forefront in coordinating and collaborating with various energy vectors and other sectors.
  - 4.6.** As outlined throughout this strategy, our whole system approach and ambition is clear. The majority of processes we implemented during RIIO-ED1 are regarded as ‘very narrow’ and ‘narrow’ and these are now considered ‘Business as Usual’. Our plan sets out a number of new ‘very narrow’ and ‘narrow’ initiatives which we aim to make ‘Business as Usual’ by the end of RIIO-ED2. There are also several new commitments within the ‘broad’ and ‘very broad’ whole systems layers which we believe this will ensure an important foundation beyond RIIO-ED2 as the energy transition accelerates and future stakeholders who will engage from a whole systems perspective.
  - 4.7.** Uncertainty will be an ongoing challenge in decarbonising the energy sector as there will be many competing viewpoints.
  - 4.8.** Throughout and beyond RIIO-ED2, we will continue to investigate and analyse the plausible future scenarios collaborating, coordinating and cooperating accordingly, providing whole system societal benefits and outcomes for our customers.



# Appendix: How WPD has met minimum requirements

Ofgem Business Plan requirement	How WPD's approach meets Ofgem's expectations
As a minimum requirement Stage 1 of the BPI, DNOs must set out their approach to enabling whole system solutions in their Business Plans. This must include:	
4.29. Plans and processes for joint planning with other companies and/or the system operator (and evidence of that already undertaken).	Evidence of our previous joint planning with other companies can be found in IN-2 and SE-9 and evidence of this planning with the system operator can be found in P-1. Further evidence of future planning with other companies and the system operator can be found in CW-4.
4.29. Evidence of effective identification and adoption of potential whole system solutions and approaches, reflecting how they have taken account of the impacts and opportunities of their actions for the wider system, and vice versa, and accounted for those in their cost benefit analyses.	<p>Throughout the strategy we have identified potential whole systems solutions separating them into four categories (people, culture, and ways of working, data and digitalisation, stakeholder engagement and innovation and processes). We have structured each of our solutions to highlight the context, actions and outcomes allowing the reader to understand the impacts and opportunities on the wider system. Where possible, we have included the results of the cost benefit analyses which highlights the overall quantifiable outcomes of a given project/process.</p> <p>Further information on these can be found within the appropriate strategy sections of the Business Plan – including our Digitalisation Strategy and Action Plan and our Innovation Strategy.</p>
4.29. Demonstration of long term whole system thinking and value for consumers and the wider society, including identification of uncertainties and mitigation, and how these relate to a range of different forecast pathways.	We have demonstrated long term whole systems thinking throughout the strategy by incorporating an understanding of timelines, this can be found in section 4. One of our key sections within our Whole Systems Strategy relates to stakeholder engagements and focuses on the commitments we are putting in place to ensure value for consumers and the wider society.
4.29. Demonstrable cross-sector engagement, optioneering, and planning with sectors other than their own.	Throughout our Business Plan we have highlighted our cross-sector engagement where possible, our whole systems definition is derived from our understanding of the layers of the energy system and the cross-sector interactions. We note that greater collaboration, coordination, and cooperation across energy vectors, as well as wider collaboration is required. Throughout the strategy we have included references to the 'layer' each of our commitment sits in, allowing the reader to understand the collaboration and planning with sectors other than our own.

Ofgem Business Plan requirement	How WPD's approach meets Ofgem's expectations
<p>Under this requirement, where a company proposes an activity which coordinates with, or generates benefits for, any broader area of the economy or society, the DNO's Business Plan must evidence and quantify these impacts as part of their justified and costed proposals for whole system outcomes and solutions. Such activities must demonstrate:</p>	
<p>4.30. That they meet all the same requirements for 'non-whole system' activities (costs, engineering justifications, etc), and how uncertainty mechanisms, including reopeners, could support them. We expect companies to apply proportionality when submitting a whole system CBA. For example, smaller or simple projects following the standard CBA template, whereas larger or more complex projects requiring bespoke analytical approaches.</p>	<p>As described in P-5 Cost benefit analysis tools, we have used a combination of cost benefit analysis tools in the past to determine the net impacts of a project and our CBA assessment is constantly evolving to ensure we are aligned with the latest options.</p>
<p>4.30. That there are net benefits for their sector's consumers and which type(s) of benefit the activity will generate for consumers, e.g. lower bills, reduced environmental damage, improved reliability, and service. The distribution of costs and benefits over time should also be demonstrated (i.e. for existing and future consumers).</p>	<p>We have contributed to the development of a whole system CBA tool as part of the Open Networks project. The tool follows Ofgem's requirements and uses the standard CBA methodology. 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.</p>
<p>4.30. The value – and methodologies for calculation – of the activity for other sectors, towards achieving broader goals (e.g. decarbonisation), and for other aspects of the economy (e.g. telecommunications).</p>	<p>Within IN-5 we detailed our Energy Planning Integrated with Councils (EPIC) project. Within this project we used automated analysis tools, as well as the ENA's whole system CBA to conduct options appraisals to create a network investment plan. As part of this we were able to demonstrate the net benefits to consumers, as well as for other sectors.</p>
<p>4.30. The level of coordination and potential provisional agreements that have already been secured to support these proposals, including a justification that the split of costs and benefits between the company and the whole system partner(s) are appropriate.</p>	<p>We are committed to incorporating the standard whole systems CBA template into our future projects as part of the development of our whole systems management team (commitment CW-5). This will enable us to consider the broader costs and benefits in any future innovation projects we undertake.</p>
<p>4.30. Why a market solution could not, or should not, be utilised to deliver the activity, and that all options have been considered.</p>	<p>We have used the Ofgem standard CBA template for all Primary reinforcement EJPs (113-192) and all other EJPs where the CBA can be applied. Any reinforcement where flexibility was considered, the Common Evaluation Methodology (CEM) CBA was applied to assess flexibility deferral within our Business Plan. We also use the CEM twice yearly within our Distribution Network Option Assessment (DNOA) process.</p>
<p>4.30. That the activity is not BAU, and expenditure which sets the activity as above BAU should be clearly identified and delineated.</p>	<p>As mentioned in P-5, we have used a combination of cost benefit analysis tools in the past to determine the net impacts of a project and our CBA assessment is constantly evolving to ensure we are aligned with the latest options.</p>
	<p>When completing the cost benefit analyses of our innovation projects, we assess other potential options to ensure we provide the best consumer value in investments made on the distribution network.</p> <p>Within our Business Plan we have evidenced and quantified (where possible) the impacts of any activities we deem above and beyond BAU. As part of the ENA guidance on whole systems CBA's we consider the sections on delineating BAU expenditure. An example of this is CVP-3, which assesses the societal benefit of community energy engineers. In line with the joint social value framework, agreed with the five other DNOs and shared with Ofgem in 2020. We have modelled the benefits of this CVP over both a five and ten year appraisal period to ensure it provides wider societal benefits.</p>

## Appendix: How WPD has met minimum requirements

Ofgem Business Plan requirement	How WPD's approach meets Ofgem's expectations
<p>Under this requirement, where a company proposes an activity which coordinates with, or generates benefits for, any broader area of the economy or society, the DNO's Business Plan must evidence and quantify these impacts as part of their justified and costed proposals for whole system outcomes and solutions. Such activities must demonstrate:</p>	
<p>4.30. How changes have already been made in the RIIO-ED1 operating period – in response to changing market conditions, stakeholder expectations, or potential licence changes – and outlines how these practices will be embedded and improved in RIIO-ED2.</p>	<p>Within Section 1 of the strategy we outlined the evolution of energy whole systems thinking, emphasising how key factors such as market conditions have changed throughout RIIO-ED1. We also included discussion on how we will approach these changes in RIIO-ED2 in order to further embed whole systems thinking into our network.</p> <p>Throughout our plan we have taken into consideration projects and processes from RIIO-ED1 and committed to improving these within RIIO-ED2. This includes (but is not limited to) commitment D&amp;D-3 where we have committed to improving data exchanges with local authorities, commitment P-6 where we plan to deliver three further RDP's increase our understanding and commitment SE-4 where we plan to improve the Network Capacity Map with increased accuracy.</p>
<p>4.31. Where a company has not identified any potential opportunities for proposed whole system outcomes and solutions, DNOs must provide evidence of their engagement and attempts to discover such opportunities.</p>	<p>N/A – throughout the strategy we have identified various opportunities giving rise to whole systems outcomes and solutions. We have also proposed commitments that will result in specific whole systems outcomes including our innovation projects which can be found in figure 15 'Whole systems innovation'. Within this section we reference the specific outcomes for stakeholders for both projects that have been completed and those that are in progress/in the future.</p>
<p>4.32. Additionally, as a minimum requirement under stage 1 of the BPI Business Plan, sections on innovation must contain consideration of whole system approaches as potential solutions to the barriers being addressed by the innovation proposals.</p>	<p>Further detail on our innovation projects can be found in the Innovation Strategy annex of our Business Plan, as well as within this strategy in figure 15 'Whole systems innovation'. Within these detailed sections we further discuss the projects including the context, actions, and outcomes of each individual project from a whole systems perspective.</p>



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