SP Energy Networks | DSO

Whole System Strategy for RIIO-ED2

Contents

1. An Introduction

Scope

The purpose of this document is to set out our ambition to achieve a step change in Whole System solutions and outcomes. To do so, we will unlock the full value of Whole System thinking, by collaborating not only with other electricity companies, but also key stakeholders including gas and water networks, innovators, network users, Local Authorities, Non-Governmental Organisations (NGOs), corporates, local areas and communities to ensure efficient investment in the electricity network and to achieve a just transition[1] to Net Zero for customers.

Key highlights

At the heart of our plan is the introduction of a Whole System planning function within our investment decision-making framework. This function will be accountable for delivering a step change in Whole System solutions and outcomes. We are working with the Energy Systems Catapult (ESC) to help shape our approach, drive innovation, address knowledge gaps, improve deliverability of our plans and deal with uncertainty in future energy scenarios. We recognise that this plan cannot remain static as it needs to adapt to both changing societal, electrical and Whole System needs. Therefore, our relationship with ESC will be based on a continuous cycle of challenge and improvement.

Benefits

We have undertaken a Social Return on Investment (SROI) assessment of our entire package of Whole System initiatives in RIIO-ED2 and estimate that it will deliver a net benefit of £18.23 for every £1 spent. A detailed cost-benefit analysis (CBA) of our cornerstone initiative – the introduction of a Whole System planning function – shows that it delivers a net present value benefit of between £7.8m and £49.1m over the course RIIO-ED2.

Customer and stakeholder input

As explained in our business plan, we took a comprehensive four-phased approach to our engagement to ensure that every aspect of our plan is representative of the views of our customers and stakeholders. Since our draft business plan submission in July, our engagement activity on Whole System has included an online consultation of our strategy, three bilateral discussions with strategic partners and two challenge sessions with stakeholder panels covering SP Distribution (SPD) and SP Manweb (SPM) areas. Overall, our stakeholders strongly support both the strategy and specific Whole System commitments outlined in this document. This support gives us confidence that if properly delivered, our plans can achieve new and improved Whole System outcomes that are in line with stakeholder expectations.

Delivering our Plan

There are several aspects to how we will strengthen our ability to deliver. We will create accountability through the Whole System planning function, change our business to embed Whole System thinking and engage strategically with stakeholders. In addition, we will ensure there is independent challenge and intellectual input from the ESC of our Whole System planning, solutions and outcomes. Our senior leadership team (SLT) will be responsible for implementing an ISO-accredited governance framework that will drive transparency and progress in our efforts to achieve a step change in Whole System solutions and outcomes

Signpost for Ofgem's business plan requirements

Ofgem has set out the information it expects to see in companies' business plans in the RIIO-ED2 Business Plan Guidance document. For ease of reference, we provide a table below which maps these requirements to the contents in this document.

[1] The concept of a 'just transition' builds on global frameworks addressing climate change, human rights, labour standards and inclusive growth. It focuses attention on the need to anticipate the social implications of the shift to a low-carbon economy and the increasing impacts of climate change.

Ofgem BP Guidance No	Page Number
4.29 As a minimum requirement under Stage 1 of the BPI, DNOs must set out their approach to enabling whole system solutions in their Business Plan. This must include:	*(See references to each bullet point in 4.29 below).*
• Plans and processes for joint planning with other network companies and/or the system operator (and evidence of that already undertaken).	• **Page 8 – Figure 1** is an 'at-a-glance' illustration of planning and data touchpoints within and beyond the electricity sector that we are enhancing for Whole System planning. • **Pages 10/11 – Our Whole System strategy** and the three overarching programmes of work to engage in a structured manner, implement a Whole System planning function and undertake business-change to embed Whole System thinking as business as usual activity. • **Page 43 – Appendix 4** – Provides evidence of frameworks for cooperation and collaboration within and beyond the electricity sector • **Page 67 – Appendix 8** - We have developed extensive strategic engagement to facilitate joint planning within the electricity sector, regularly co-ordinating with National Grid ESO, National Grid TO, SSEN and other DNOs (such as through the Whole System Charter (Appendix 8, Case Study 13)) as well as outside our industry including our strategic partnerships for the decarbonisation of heat and transport with the Scottish Government and SSEN (Appendix 8, Case Study 14) • **Page 90 – Appendix 9** - we describe our investment decision-making framework and how it will change in RIIO-ED2 to accommodate a Whole System Operational Framework (WSOF). The WSOF sets out how we will operationalise our Whole System thinking and outcomes we are targeting by energy vector.
• 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.	• **Page 12/13 – Section 6 Our Track Record in RIIO-ED1 and Plans for RIIO-ED2** • **Page 47 – Appendix 5** – Methodology for quantification of benefits • **Page 67 – Appendix 8** – We provide 20 Case Studies of Whole System solutions and approaches we have adopted
• 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 (see section 5 'Forecasts and scenarios').	• **Pages 10/11 – Our Whole System strategy** to implement a new team with accountability for Whole System solutions and outcomes • **Page 29 – Section 7 Deliverability of Our Plans** – discusses how we will mitigate uncertainties and put controls in place to ensure progress • **Page 47 – Appendix 5** – Methodology for quantification of benefits • **Page 55 – Target Operating Model** for how we will organise our business for long-term delivery

• Demonstrable cross-sector engagement, optioneering, and planning with sectors other than their own.	• **Page 12/13 – Section 6 Our Track Record in RIIO-ED1 and Plans for RIIO-ED2** • **Page 43 – Appendix 4** – Provides evidence of frameworks for cooperation and collaboration within and beyond the electricity sector • **Page 67 – Appendix 8** (Multiple Case Studies)
4.30 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:	*(See references to each bullet point in 4.30 below).*
• 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.	• **Page 12/13 – Section 6 Our Track Record in RIIO-ED1 and Plans for RIIO-ED2** • **Page 33 - Engineering Justification Papers and Cost Benefit Analysis** • **Page 47 – Appendix 5 – Methodology for quantification of benefits**
• 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).	• **Pages 8/9 – Section 4.3 Why Whole System thinking matters** • **Page 67 – Appendix 8 (Multiple Case Studies)** • **Page 90 – Appendix 9 Whole System Operational Framework** with targeted outcomes by energy vector
• 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 (eg telecommunications).	• **Page 47 – Appendix 5 – Methodology for quantification of benefits**
• 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.	• **Page 43 – Appendix 4 – Provides evidence of frameworks for cooperation and collaboration within and beyond the electricity sector** • **Page 60 – Appendix 7 – Memorandum of Understanding with the Energy Systems Catapult**

• why a market solution could not, or should not, be utilised to deliver the activity, and that all options have been considered on a level playing field.	• **Pages 10/11 – Our Whole System strategy** • **Page 21 – Flexibility Assessment Methodology** • **Page 90 – Appendix 9 Whole System Operational Framework**
• that the activity is not BAU, and expenditure which sets the activity as above BAU should be clearly identified and delineated.	• **Page 47 – Appendix 5 – Methodology for quantification of benefits** • **Page 55 – Target Operating Model for how we will organise our business**
• 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.	• **Pages 12/13 – Section 6 Our Track Record in RIIO-ED1 and Plans for RIIO-ED2** • **Page 67 – Appendix 8 (Multiple Case Studies)**
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.	*(Not relevant – SPEN has identified potential opportunities)*
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.	• **Page 23 – Whole System focus in our innovation strategy** • **See Our Innovation Strategy**

2. Purpose

Throughout RIIO-ED1, we have taken a Whole System approach across a range of projects incorporating SP Distribution (SPD), SP Manweb (SPM), SP Transmission (SPT) and external stakeholders. This has given us a foundation on which to build further solutions. However, we believe it is our responsibility in the context of the climate emergency to move beyond enabling Whole System solutions to driving a step change in Whole System solutions and outcomes, including making a positive impact beyond the electricity sector – this is our ambition. We outline our approach to delivering this step change and describe our strategy, track record, forward plans, the benefits of our proposals as well as frameworks to enhance cooperation and collaboration.

3. Executive Summary

Increasing interdependence across the electricity system and growing interactions with gas, heat, transport and other sectors necessitates thinking that exceeds traditional boundaries. We believe the interconnection of the electricity network with heat, gas, transport, water and other energy vectors leads to a single 'eco-system' i.e. an interconnected mesh that requires joined up thinking. We refer to this as Whole System thinking.

Our mission is to unlock the full value of Whole System thinking, by collaborating not only with other electricity companies, but also key stakeholders including gas and water networks, innovators, network users, non-regulated companies, local areas and communities to ensure efficient investment in the electricity network and to achieve a just transition to Net Zero for customers.

We have developed six guiding principles ('pillars') to underpin the mission statement above. They promote partnerships, innovation, market solutions, thinking beyond the electricity sector, customer support, mastery of data and long-term value. Each pillar is intended to influence our actions and drive behaviours that are needed to achieve a step change in Whole System outcomes.

At the heart of our plan is the introduction of a Whole System planning function within our investment decision-making framework. This function will be a new team consisting of Whole System leaders and planners who will be accountable for structured engagement beyond the electricity sector, maintaining frameworks for cooperation and collaboration with strategic partners, data sharing, ensuring flexibility solutions are considered from the outset, providing Local Authorities and Community Energy schemes with access to individuals empowered to make investment decisions and ensuring compliance with the Whole Electricity System licence condition.

We are working with the Energy Systems Catapult (ESC) to help shape our approach, drive innovation, challenge our thinking and develop pathways for us to deal with uncertainty in future energy scenarios. Our goal in RIIO-ED2 is to embark on ground-breaking projects with the ESC that push the boundaries of Whole System solutions beyond easy-to-reach projects. We intend to openly share any findings that will help to advance Whole System thinking across our industry.

Harnessing and optimising the opportunities presented by Whole System thinking will deliver benefits to consumers by lowering bills, reducing environmental damage, improving network reliability and services, strengthening regulatory and policy oversight as well as providing a just transition. Realising these benefits is a key enabler in achieving ambitious Net Zero targets and we outline how we propose to do so.

We have assessed the benefits of introducing a Whole System planning function using Ofgem's standard cost-benefit analysis (CBA) template. Our calculations show that the function delivers a net present value benefit of between £7.8m to £49.1m over the course of RIIO-ED2.

In terms of our entire package of Whole System initiatives, we have adopted a comprehensive social value measurement framework, which incorporates social return on investment (SROI) modelling and builds upon traditional CBA by also measuring and accounting for typically qualitative, social impacts of a project. We estimate that our package of Whole System initiatives will deliver a net benefit of £18.23 for every £1 spent.

To implement our plans effectively, we have set out the structure and role specifications for the Whole System planning function. We have also developed and consulted on a target operating model that joins up our Distribution System Operator (DSO), investment planning, data and analytics, engagement, and delivery functions in a cohesive manner. Our groundwork also includes development of a Whole System Operational Framework that sets out by energy vector the activity and target outcomes that are intended to guide our Whole

System planning function. In addition, our executive team will be responsible and accountable for implementing an ISO-accredited governance framework that will deliver four key objectives:

1. ensuring transparency in our delivery of Whole System solutions,
2. making real progress towards embedding Whole System thinking in our organisation,
3. ensuring customers and communities in vulnerable circumstances are supported, and
4. consideration of science-based targets (such as equivalent carbon emissions) to ensure our Whole System thinking includes understanding the impact of our actions on the environment.

4. Introduction

4.1 The Whole System concept

In the past, network companies have focussed primarily on their own network requirements and the extent of active coordination and information exchange beyond each company's network boundary has been limited.

However, as we decarbonise the energy sector to meet climate change targets, we and other network companies must develop our networks to create additional capacity to facilitate the connection of low carbon technologies (LCTs) and the electrification of other sectors such as heat, transport and gas sectors.

The concept of Whole System is where joined up consideration of the needs of energy vectors[2] results in effective coordination and data sharing between network companies and relevant stakeholders to facilitate the energy transition[3] at a reasonable cost to consumers. For example, we worked in collaboration with Transport Scotland and Local Authorities to deliver 167 new public chargers in 44 locations across Lanarkshire, targeting areas and communities where the commercial market has not yet delivered these facilities and is unlikely to in the short to medium term.

Therefore, the concept of Whole System challenges us to plan and develop our network with knowledge of the full range of solutions and awareness of the impact of our actions beyond our own networks. It requires frameworks for joint planning and data sharing between network companies, system operators, network users and other stakeholders.

Our view is closely aligned with the definition provided by the Future Power System Architecture (FPSA) programme[4] which states that Whole System includes:

- The physical energy system equipment.
- Consumers and the equipment they control.
- The touch points with other energy vectors e.g. gas, heat and transport.
- Associated communications, data and digital platforms.
- Energy system regulations and market rules.
- Commercial transactions, business models and contracts.

4.2 Engagement across other sectors

Network operators have a duty to develop and maintain efficient, coordinated and economical distribution and transmission systems under the Electricity Act. The RIIO framework incentivises licensees to pursue efficiencies in delivering on their outputs and obligations on their own networks.

Therefore, network operators already take a Whole System approach in certain elements of network planning and operation. For example, the Dunbar ANM scheme, involving collaborative work between SPT and SPD, allowed the connection of renewable generators before transmission reinforcement works could be carried out,

[2] Systems that enable energy to be transferred and converted to other forms of energy. Examples or energy vectors are electricity, transport, heat and gas systems.
[3] The energy sector's shift from fossil-based systems of energy production and consumption
[4] https://es.catapult.org.uk/projects/future-power-system-architecture-fpsa/?EKXSHOW=SHOW

enabling outputs that would not otherwise have been realised including 653GWh of generation over the past 6 years, a saving of around 98,000 tonnes of CO2, and an annual community benefit of around £75,000 per year.

Nevertheless, changes to the nature, volume and location of energy sources and consumption devices connected to electricity networks mean that new areas of Whole System coordination are needed to achieve an efficient, co-ordinated and economical system across the transmission and distribution grid.

Figure 1 is a topology illustrating our view of a Whole System that extends beyond the electricity sector. It highlights touchpoints between the electricity grid and other sectors. In addition, it summarises areas where frameworks of cooperation, collaboration and data sharing with strategic partners are necessary to realise the benefits of Whole System thinking. We describe these frameworks as well as the associated consumer benefits flowing from this structured engagement later.

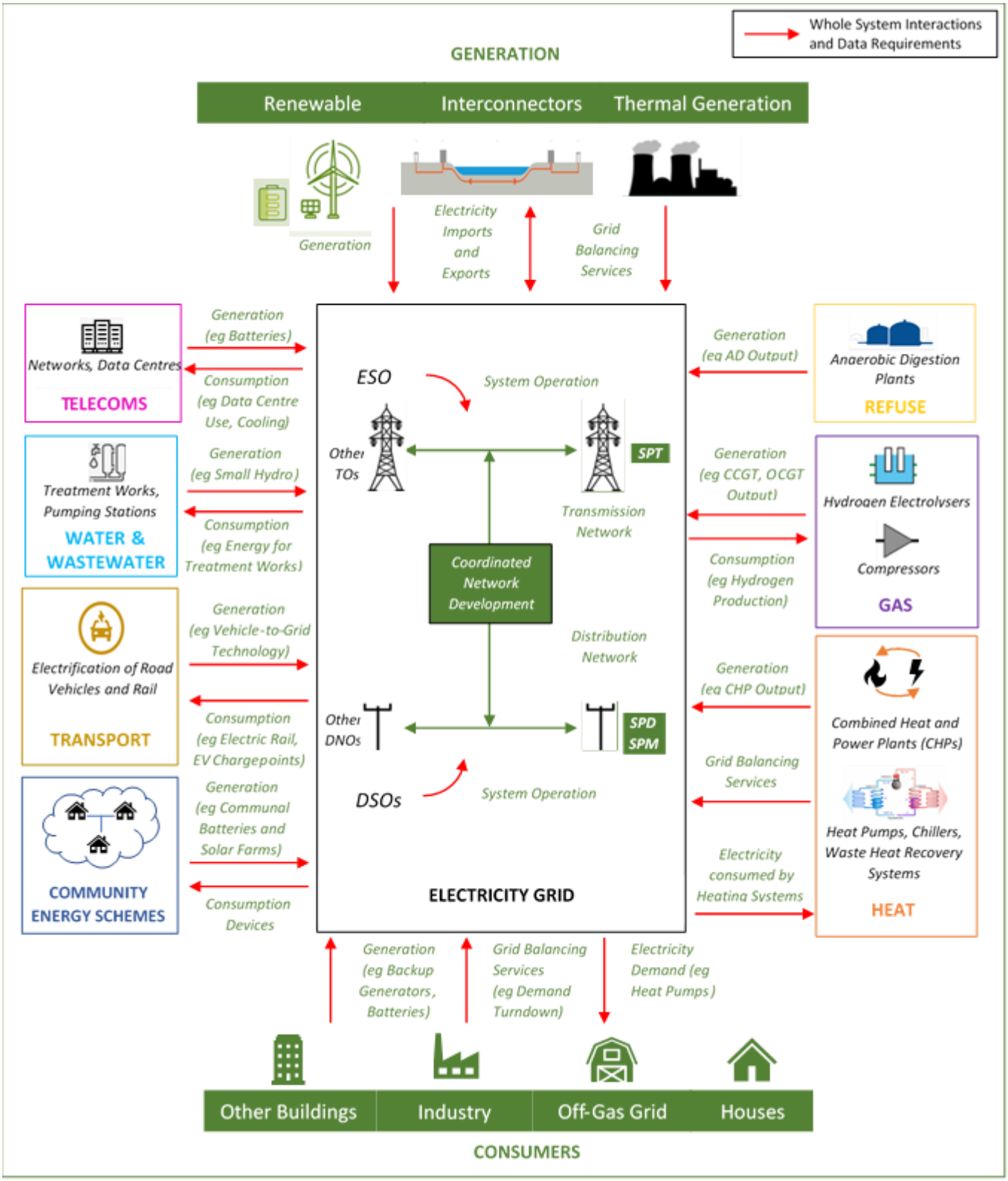


Figure 1: Whole System Topography

4.3 Why Whole System thinking matters

The complex and inter-related nature of energy systems means that operational and investment decisions can have a wide range of benefits and impacts for customers of more than one licensee. Harnessing and optimising these wider benefits is an integral part of an efficient Whole System and is necessary to meet the challenge of achieving ambitious Net-Zero targets.

In this section, we present our view of key benefits arising from embedding Whole System thinking across all energy vectors and why there is an unquestionable case for adopting it. At a high level, we believe Whole System thinking delivers benefits to consumers under five overarching categories:

1. Lower bills
2. Reduced environmental impact
3. Improved reliability and service.
4. Policy and regulatory oversight
5. A 'just transition'

There are a number of specific consumer benefits in each of these overarching categories which are described in the table below.

Table 1: Key Consumer Benefits

Overarching Benefit	Specific Consumer Benefit
Lower bills	Joint planning processes and data sharing between network companies have the potential to promote efficient use of flexible resources to meet demand, the identification of a greater range of network reinforcement options, more efficient constraint management and improved network connectivity. We envisage that this enhanced 'toolkit', derived from network companies working collaboratively rather than independently, will ultimately lead to **lower cost options and efficient alternatives to traditional network reinforcement** to address network requirements.
	A more joined-up (Whole System) approach to congestion management, enhanced data-sharing between networks and stakeholder-driven data provision to market participants will **promote greater investment in Distributed Energy Resources (DER).** DER can be a faster, less expensive option to the construction of large, central power plants and distribution or transmission lines. **DER offers consumers the potential to lower their net demand, increase energy efficiency and gain energy independence**.
	Greater visibility and understanding of interactions with multiple energy vectors at each level of the electricity grid and between all network operators will result in a better understanding of the issues faced across the electricity grid, and of the options available to resolve them. **A better understanding of these issues will drive innovation and reveal system efficiency and productivity gains.**
	Improved visibility of Whole System requirements and an openness by network companies to receive suggestions from third parties will lead to **greater liquidity in service provision and stronger price discovery**. **Competitive pressure will be brought to bear** on the provision of balancing services, flexibility, storage and energy provision. This in turn will **enable new entrants to make more robust decisions ahead of entering energy markets.**
Reduced environmental impact	The use of low-carbon technologies (LCTs) and renewable distributed generation such as wind, photovoltaic, geothermal, biomass, or hydroelectric power provide significant environmental benefit. Through Whole System thinking, **licensees will consider the impacts of our decisions on LCTs and renewable generation.** Greater engagement, consultation and coordination between network companies and stakeholders as well as information provision and data sharing will avoid material costs being passed to LCTs and renewable generation thereby **lowering barriers to entry.**
	The creation of our Distribution System Operator (DSO) model will allow us to further develop a coordinated approach and at the same time take on new responsibilities and activities which will **promote the uptake of low-carbon technologies (LCT).** The transition to Net Zero will place a greater emphasis on this requirement and we foresee our DSO as a catalyst to the proliferation of LCT.
	Greater clarity of Whole System requirements will drive a better understanding of the need, location and functionality of energy assets. This will lead to **more efficient procurement and utilisation of energy assets** leading to a reduction in the carbon footprint associated with supply chain and operational activities.
Improved reliability and service	Whole System thinking drives the provision of energy data. It will enable innovators to develop **new products and services**, that have the potential **to improve network**

	resilience and efficiency as well as giving rise to new products and services for customers. Therefore, **market development** for grid balancing services and energy provision would be stimulated by Whole System thinking.
	Through SPEN's integrated distribution and transmission control room, we provide coordinated planning and management across the electricity network in our area. This functionality will enable us to achieve **a step change how we connect and coordinate with generators and harness the increasing role of flexible demand in minimising future reinforcement requirements.**
Policy and regulatory oversight	The Whole Electricity System licence condition establishes a mandate for network companies to collaborate. It **encourages companies to overcome competitive tensions and places an obligation on network companies to deliver common Whole Electricity System obligations** in a consistent and non-discriminatory manner.
	The principle of **transparency** embedded in Whole System thinking will lead to less asymmetry of knowledge between industry, policy-makers, regulators, users of the network and consumers. There will be a **levelling-up across all parties in terms of understanding the needs and risks** facing the energy sector and more informed scrutiny of actions taken by network companies.
A just transition	We will have dedicated teams in place to **support Local Authorities and Community Energy schemes** in our efforts to cater for all customer cohorts. The outputs from these dedicated support functions will feed into a new team (the Whole System planning function) in our **investment decision-making framework that will be accountable for achieving a step change in Whole System outcomes.**
	Data and information sharing will unlock partnerships that leverage incumbent network companies' understanding of the complexities of the sector with new entrants' potentially stronger understanding of future consumer requirements, cross-sector opportunities and innovative technology**. Partnerships will address knowledge gaps and raise awareness in network companies of the impact of our actions on the Whole System.**

5. Our Whole System Strategy

Our Whole System strategy is centred on bringing a more collaborative approach into how we operate and to achieve a step change in both solutions and outcomes. To do this, we will implement a package of initiatives under three interdependent and overarching programmes of work:

1. Structured strategic engagement
2. Implementing a Whole System planning function
3. Business transformation

Structured strategic engagement is both inward and outward looking. It aims to put in place targeted and effective external sectoral, cross-sectoral and regional ties as well as internal coordination between our transmission and distribution businesses. Where these links already exist, we will establish a focus on Whole System thinking. Through this programme of work and the collaboration that emerges from it we will aim to identify opportunities to deliver Whole System outcomes.

Implementing a Whole System planning function is a programme of work aimed at building on our track record in RIIO-ED1 of Whole System outcomes, creating a focal point within our investment decision-making framework for Whole System planning and collaboration, assimilating feedback from Strategic Optimisers (dedicated support for Local Authorities), establishing accountability for delivering the plans outlined, tracking benefits, creating ownership of Whole System data sharing, recruitment of specialists and innovation of tools to enhance Whole System performance.

The business transformation programme involves projects to ensure compliance with obligations in the Whole Electricity System licence condition, shape our approach with input from the ESC, implement a Whole System Operational Framework (WSOF) that ensures tangible action is taken for each energy vector, implement a target operating model (TOM) that brings together our DSO, investment planning, data and digitalisation

functions, carry out a review of our suite of processes and procedures to embed Whole System considerations and implement an ISO-accredited Whole System governance framework.

We illustrate these three programmes of work in Figure 2 below.

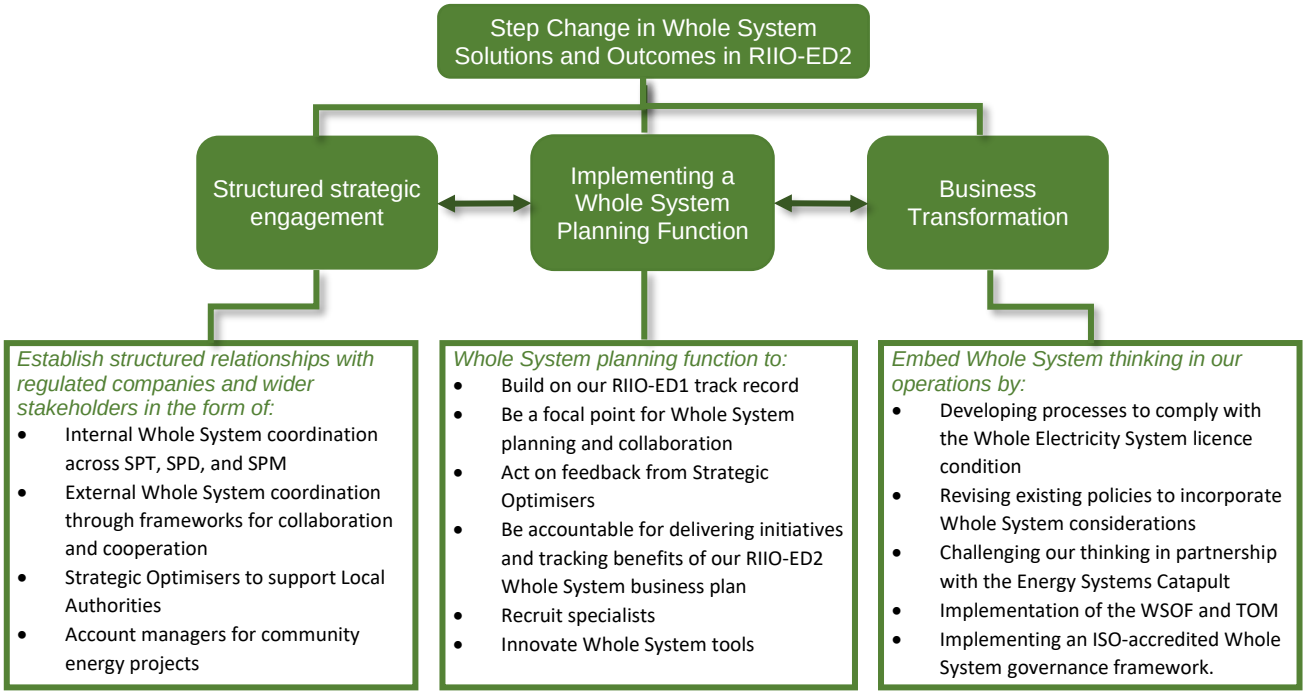


Figure 2: Work Programmes to achieve a step change in Whole System solutions and outcomes

5.1 Mission statement and strategic pillars

To help us communicate the meaning and purpose of our Whole System strategy and to generate a common understanding of how our initiatives will benefit the larger goals of decarbonisation and improving outcomes for consumers, we have produced the mission statement below.

"Our mission is to unlock the full value of Whole System thinking, by collaborating not only with other electricity companies, but also key stakeholders including gas and water networks, innovators, network users, non-regulated companies, local areas and communities to ensure efficient investment in the electricity network and to achieve a just transition to Net Zero for customers"

This mission statement reflects feedback from stakeholders that our approach to Whole System thinking needs to consider not only solframutions that result in efficient investment in our electricity network but also ones that will support our customers and communities in the journey to Net Zero. We also believe it is important to drive behaviours, actions and priorities that are in line with our mission statement. To achieve this, we have developed six guiding principles we refer to as our 'six pillars' – stated in Figure 3 below.

Our mission statement is underpinned by these six guiding pillars					
Pillar 1 Establish strategic partnerships to achieve common Whole System goals.	**Pillar 2** Use innovation, markets and flexibility to push the boundaries of Whole System thinking.	**Pillar 3** Think beyond the electricity sector to support other energy vectors including heat, transport and hydrogen.	**Pillar 4** Use Whole System thinking to support our communities and vulnerable customers in the transition to Net Zero.	**Pillar 5** Improve our mastery of data, share data easily to unlock Whole System and consumer benefits.	**Pillar 6** Embed Whole System thinking in our organisation, culture, and ways of working to deliver long-term value.

Figure 3: Our Strategic Pillars

5.2 How stakeholders have shaped our approach

In line with our stakeholder engagement strategy, and the broader RIIO-ED2 engagement programme, we interacted with a broad cross-section of relevant parties (e.g. energy networks, local and national government, the housing sector) using different engagement methods, such as surveys and bilateral discussions. This approach to engagement was designed to capture comprehensive and informed feedback from relevant stakeholders while maximising participation.

Since our draft business plan submission in July, our engagement activity on Whole System has included an online consultation of our strategy, three bilateral discussions with strategic partners and two challenge sessions with stakeholder panels covering SP Distribution (SPD) and SP Manweb (SPM) areas. We consulted stakeholders on our Whole System strategy, mission statement, pillars and target operating model. Overall, our stakeholders strongly support these aspects of our approach and this feedback gives us confidence that if properly delivered, our plans can achieve new and improved Whole System outcomes that are in line with stakeholder expectations.

Figure 4 encapsulates some of the feedback we have received as part of our stakeholder engagement and how we have integrated these views into our six guiding pillars. Detailed results and analysis of stakeholder feedback on our Whole System approach can be found in Appendix 3.

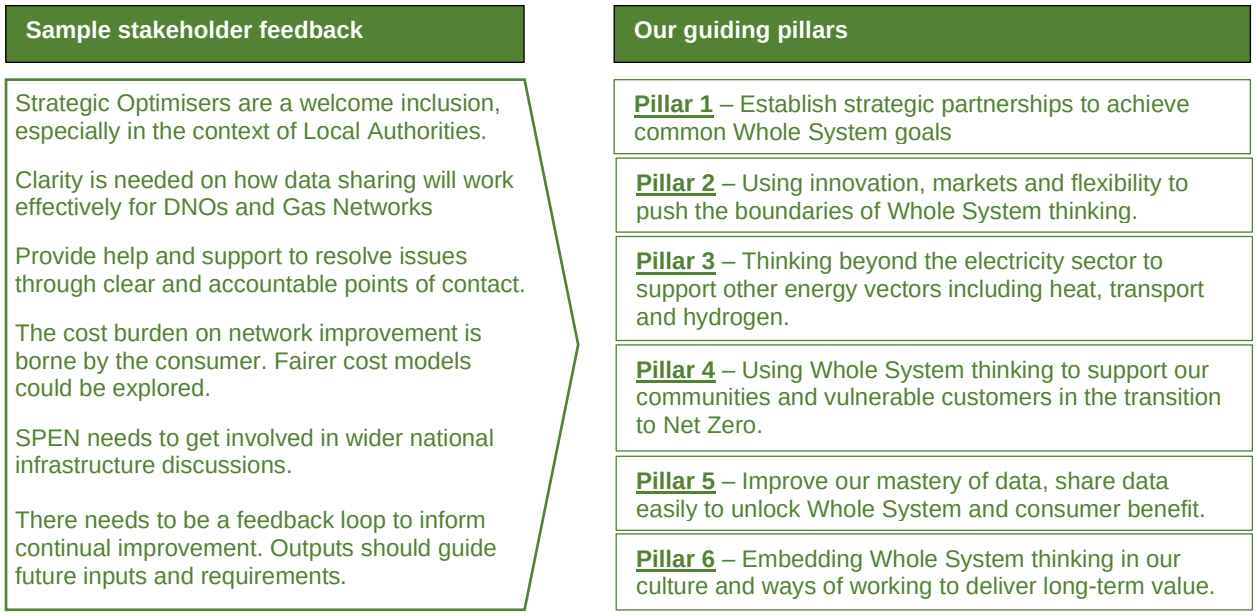


Figure 4: Stakeholder shaping of our guiding pillars

Our engagement strategy and deployment was strong in terms of number and diversity of parties that we held meetings and listened to their views. As well as the bilateral engagement with our colleagues in the Transmission Owners and Distribution Network Operators, we have spoken to our customers (wind, solar, nuclear and batter storage) and gas networks. However, recognising the need to go beyond our own system we held two stakeholder panels at the start of October 2021. Representatives from the Welsh Government, Transport for Wales, Cadent Gas, Edinburgh City Council, Cala Homes and Energy Action Scotland took part and reviewed our strategy, sense of direction, ambition, credibility and ultimately deliverability of our plans.

6. Track Record in RIIO-ED1 and Plans for RIIO-ED2

The preceding sections have provided context on what we believe Whole System thinking entails, why it is important, overarching consumer benefits and our strategy to deliver a step change in solutions and outcomes.

In this section we provide insights and evidence of a wide range of Whole System activity we have undertaken in RIIO-ED1, how we intend to transition to RIIO-ED2 and our plans for RIIO-ED2.

In reality, there is a mix of discrete Whole System initiatives with deliverables that can be neatly bound within the RIIO-ED1 period and others that generate a continuum of activity that will extend into the next price control and beyond. Appendix 10 provides a checklist against our six guiding pillars of Whole System activity that is currently ongoing in SPEN and illustrates that we will be maintaining a baseline of Whole System activity from RIIO-ED1 that is additional to initiatives we are proposing for RIIO-ED2.

6.1 Existing Whole System Planning – Our RIIO-ED1 Experience

In RIIO-ED1, we can point to a strong track record on Whole System thinking and planning as a credible foundation to build from. We have developed extensive strategic engagement to facilitate joint planning within the electricity sector, regularly co-ordinating with National Grid ESO, National Grid TO, SSEN and other DNOs (such as through the Whole System Charter[5]). Our existing engagement also extends beyond our industry and includes strategic partnerships for the decarbonisation of heat and transport with the Scottish Government[6] and SSEN and regular strategic engagement with Network Rail and EDF among others.

We describe some of these examples in the sections that follow and have grouped them into the following categories:

- Within SPEN
- Within the electricity sector
- With other regulated companies
- With heat, transport and other energy vectors
- With customers, communities and local areas

In Appendix 8, we expand on these and other RIIO-ED1 examples in the form of twenty Case Studies.

6.1.1 Within SPEN

Internal SPEN Whole System Planning

Our business arrangements are organised to promote Whole System discussions between our design, commercial, engineering teams across distribution and transmission boundaries. This has been effective in promoting Whole System thinking for projects that involve distribution and transmission connections.

An example of coordinated working that has delivered Whole System solutions for our customers is the Dunbar Active Network Management (ANM) scheme (Appendix 8, Case Study 15). ANM is a system which allows us to connect new generators to the power network more quickly and cheaply where previously the network was believed to be at fully capacity. The ANM solution involves enhanced monitoring and communications infrastructure, enhanced network planning tools and implementation of automation and control systems. We provide full details and reports (including benefits) of the ANM project on our website[7].

In addition to the ANM solution, internal SPEN Whole System planning is also delivered through our integrated distribution and transmission control centre that provides coordinated planning and management across the electricity network in our area. In RIIO-ED1 this has been evident through the control centre's increasing use of flexible demand in minimising future reinforcement requirements. We have accepted bids totalling 140MW of flexibility services following the latest round of tendering[8].

A further example of internal Whole System planning lies in the joint system design work undertaken by our transmission and distributions teams problem-solving together to manage the ability of grid supply points to withstand faults without compromising the pace and volume of Distributed Generation connections (Appendix 8, Case Study 1). We have a dedicated landing page on our website which provides details, benefits and a video of our Fault Level Management innovation[9].

[5] Appendix 8, Case Study 13
[6] Appendix 8, Case Study 14
[7] Accelerating Renewable Connection (ARC)
https://www.spenergynetworks.co.uk/pages/arc_accelerating_renewable_connections.asp
[8] Press release (16 March 2021)
https://www.spenergynetworks.co.uk/news/pages/140mw_flexibility_tenders.aspx
[9] Fault Level Management
https://www.spenergynetworks.co.uk/pages/fault_level_management.aspx#tablist1-tab1

6.1.2 Within the electricity sector

Other Distribution Network Operators

We collaborate with other electricity network companies through our participation and leadership on the ENA Open Networks project, working together to lay the foundations for a smart, flexible energy system and the transition to Distribution System Operation (DSO). We have provided leadership on key policy areas including data, digitalisation, DSO development and flexibility. In RIIO-ED1 we collaborated with (and continue to do so) other DNOs on a number of our innovation projects, as outlined in Table 2 below:

Table 2: Collaboration with other DNOs

Innovation Project*	DNO collaboration	Benefits of collaborating with DNO partners**
Re-Heat[10]	SSEN	Working with SSEN allows us to test heat pumps with smart controls and thermal storage on different house types in different geographical areas across Scotland. This gives a wider sample from which to extrapolate results and will allow us to present joint feedback and recommendations to the Scottish Government, which will, in turn, inform their heat policies going forward.
CHARGE[11]	UK Power Networks Optimise Prime project	UK Power Networks are carrying out another innovation project, Optimise Prime, which is complementary to CHARGE. Collaborating with UKPN and sharing learnings between these 2 electric vehicle innovation projects, can result in joint learnings in this critical innovation area that can be built on in future projects.
FUSION[12]	SSEN & ENWL TRANSITION project, WPD Electricity Flexibility and Forecasting System (EFFS) project	FUSION is working directly with the TRANSITION and EFFS projects as all three projects are running at the same time and focussing on the Distribution System Operator transition. This is a rapidly developing area of focus and gathering learning from the 3 complementary projects can allow learnings to be shared quickly and the route to DSO to be established more quickly.

*See also Appendix 8, Case Study 12 (CHARGE), Case Study 14 (Re-HEAT), Case Study 19 (FUSION).

**Full details of project benefits are available in each of the websites provided in the footnotes below

Transmission Owners

Our co-ordination of activities for UK energy infrastructure, such as the development of the Eastern Link HVDC project and ScotWind leasing round has resulted in increased collaboration and development between SPD and SPT and with our colleagues in the Transmission Owner businesses at National Grid and SSEN. Collaboration on a range of issues across planning and consenting to technology choice will assist with effective delivery of cross licence and whole UK system planning going forward. We provide full details of the Eastern Link on a dedicated project landing page on our website[13].

[10] Re-Heat: Enabling Renewable Heat
https://smarter.energynetworks.org/projects/nia-spen-0057/
[11] Project CHARGE
https://www.spenergynetworks.co.uk/pages/charge.aspx#tablist1-tab6
[12] Project FUSION
https://www.spenergynetworks.co.uk/pages/fusion.aspx#tablist1-tab1
[13] Eastern Link
https://www.spenergynetworks.co.uk/pages/eastern_link_introduction.aspx

SPT also shares relevant parts of its RIIO-T2 plan with SPD to assess network risk and necessary distribution enabling works. These interactions follow early discussions to determine lowest cost Whole System solutions to network needs.

National Grid Electricity System Operator

The ESO is a key partner in not just ongoing operation and management of the transmission network but also forward looking to future innovation and management of the whole electricity network. We have monthly meetings at senior management level to discuss operational co-ordination where Whole System planning has been a regular agenda item. We have worked effectively with the ESO on their Regional Development Plan and the interaction between active network management (at distribution voltage connections) and generation export management at transmission voltage (Appendix 8, Case Study 15).

Outage Planning

We work with both the ESO team and our customers directly with respect to outage planning and working to implement commercial Whole System solutions for connected customers. We know that our sector supports critical infrastructure and energy in other sectors. For example, we have the INEOS crude oil refinery at Grangemouth which requires coordinated outage planning and access to our local network in that area to avoid risks to production. We coordinate outage planning with the ESO and INEOS to ensure that our outage planning takes the strategic importance of INEOS Grangemouth into consideration.

Nuclear Generation

SPD and SPT have worked closely with EDF, the owner of Hunterson and Torness nuclear power stations, to support the early decommissioning of Hunterston power station, mitigate its impact on the electricity network (including the Western HVDC link) and reduce constraint payments the ESO would have had to make to constrained generators had we not intervened (Appendix 8, Case Study 8). The lessons from this will be used in RIIO-ED2 to support the decommissioning of Torness power station.

6.1.3 With other regulated companies

Network Rail

We are working closely with Network Rail, trying to align our programme of asset refurbishment projects to meet timescales for electrical upgrades required for the East Coast main line. This joint planning approach has resulted in a connections cost saving of around £5m and a connection date two years earlier than would be the case with a standard major upgrade project. We will aim to take this approach forward for further major infrastructure upgrade projects in RIIO-ED2.

6.1.4 With heat, transport and other energy vectors*:*

During RIIO-ED1, we carried out many engagements, projects and studies to understand the potential impacts of heat, transport and other energy vectors both on our network and for our customers. A summary of our key engagements, studies and projects looking at the impacts of heat, transport and other energy vectors and their outcomes is summarised below.

Scottish Government strategic partnerships for the decarbonisation of heat and transport

Our strategic partnership for the decarbonisation of transport with the Scottish Government and SSEN was launched in August 2019[14]. The partnership has led to the establishment of a strategic partnership for the decarbonisation of heat with the same partners, alignment of future plans for the decarbonisation of heat and transport and a number of demonstration and research projects.

Targeted engagement with the Scottish Government on the decarbonisation of heat and transport has led to a deeper understanding of the challenge for all parties. The electricity networks have learned more about the Scottish Government targets and drivers for the decarbonisation of heat and transport, and the Scottish Government has learned more about the impact of large scale decarbonisation of heat and transport on the electricity network. Through this engagement, we have ensured that our Distribution Future Energy Scenarios (DFES) reflect Scottish Government ambitions (as well as UK Government and Welsh Government ambitions).

Research projects delivered by SPEN on behalf of this partnership include:

- EV-Up[15] (Electric Vehicle Uptake Modelling) combined each household's ability to park off street with key demographic information such as age profile and economic activity to give an indication of our customers' likelihood to transition to electric vehicle use. Based on this, the impact of electric vehicle uptake scenarios on the electricity network is modelled.
- Heat Up[16] (Heat Pump Uptake Modelling), developed a property fabric assessment methodology to deliver data on expected peak heat demand and sizing of heat pumps across the SPD and SPM licence areas. The model considers varying quality of property energy efficiency, retrofit and hybrid heat pump characteristics and is used to analyse the peak electricity network demand generated by heat pumps.
- EV-Up and Heat-Up were used to inform our DFES scenarios, based on EV and heat pump adoption rates in line with UK and regional Government targets.
- Centre for Energy Policy (CEP) collaboration with Professor Karen Turner from the University of Strathclyde, conducting research on economic benefits of strategic network investment for LCT transition rather than "just in time"

Demonstration projects delivered by SPEN on behalf of the partnership include:

- PACE (Appendix 8, Case Study 2), led by SP Energy Networks in strategic partnership with Transport Scotland and working closely with two of Scotland's largest Local Authorities, demonstrated the benefits of DNO led site selection and installation of public EV charging infrastructure. The project delivered a potential saving of £1.3-£2.6 million in connection costs across the 44 EV charging hubs installed. Going forward, Transport Scotland requires Local Authorities to engage with the DNO prior to EV charger funding applications being approved.
- Re-Heat (Appendix 8, Case Study 14), led by SP Energy Networks, supported by the Scottish Government, SSEN and delivery partner EON, started in Q3 2021 and will install 150 air source heat pumps with smart controls and thermal storage in customers' homes across three Scottish Local Authority areas (East Ayrshire and East Dunbartonshire in SPEN's area and the Highlands in SSEN's area). The project aims to deliver annual savings of £136 per participating household per year in energy costs as well as carbon savings of 318kT CO_2. Re-Heat is the first demonstrator project to trial heat pumps with smart controls and thermal storage to reduce customer bills and reduce peak demand on the LV network. Outputs from the project will inform Scottish Government heat policies.

14 https://www.spenergynetworks.co.uk/news/pages/new_strategic_ev_partnership_marks_important_step_towards_clean_energy_for_transport.aspx
15 https://www.spenergynetworks.co.uk/pages/evup.aspx
16 https://www.spenergynetworks.co.uk/pages/heatup.aspx

Net Zero North West

Net Zero North West[17] (Appendix 8, Case Study 10) is a partnership of Local Government and industry aiming to transition to Net Zero by 2040. The Net Zero NW region covers seven Local Enterprise Partnerships, including Cheshire & Warrington Local Enterprise Partnership and Liverpool City Region Local Enterprise Partnership as well as five other Local Enterprise Partnerships along the North West up to Cumbria. The partnership is focussed on establishing a low-carbon industrial cluster by 2030 and a net-zero carbon industrial cluster by 2040, underpinned by multi-vectored industrial decarbonisation solutions.

The main industrial cluster is situated in the Ellesmere Port/ Runcorn area of the SPM licence area. This area is the UK's largest concentration of manufacturing and chemical production and is responsible for 5% of the UK's total energy usage. Net Zero NW is targeting 10m tonnes of carbon savings by 2030; and 40m tonnes of carbon savings by 2040.

The transition to Net Zero is centred around 2 key themes, Hydrogen and Carbon Capture, and consists of eight projects.

SPEN is leading on a work package involving the production of high-level budget estimates for all the associated connections to the SPM network, and the provision of feasibility analysis on the potential for flexibility services in the area. The output of the SPEN led workstream for Net Zero North West will inform the electricity connection works that will facilitate significant renewable generation and other decarbonisation projects by 2030, and the requirements for any associated upstream reinforcement. The work will also inform future planning, with our proposed Strategic Optimisers and Whole System planning function heavily involved in developing long term plans for area, including strategic investment ahead of need.

East Neuk Hydrogen Project

This Network Innovation Allowance (NIA) funded project between SPEN and Scotia Gas Networks (SGN) commenced in 2019 and was a cross-vector initiative exploring the viability of future power-to-hydrogen opportunities, focusing on the West Fife area. The project, in partnership with energy consultants E4Tech and Artleys, assessed the potential for the integration of gas and electricity networks in facilitating the generation and distribution of hydrogen, with the aim of increasing renewable generation and advancing decarbonisation. This was achieved through modelling a power-to-hydrogen system using East Neuk in Fife as a case-study area. Key findings and lessons learned from this project included understanding possible levels of curtailed wind, and how hydrogen production could form the basis of low-carbon energy generation in the Fife area.

Cross-vector collaboration of this type is paving the way for Whole System solutions and the exploration of low-carbon technologies. Engagement and initiatives with other energy vectors and external parties is a key pillar of our RIIO-ED2 strategy and will be accelerated as we progress into RIIO-ED2. It is vital that we explore such opportunities for Whole System solutions with other energy vectors, in an effort to discover innovations that enable and drive the adoption of more efficient, and thus less costly, low carbon energy generation and distribution. More information can be found in Appendix 8, Case Study 17.

6.1.5 With customers, communities and local areas

SPT's £20m Green Economy Fund[18], which operated from 2018 to 2021 supported customers and communities in Scotland by delivering projects supporting the uptake of low carbon technologies in our communities, reducing fuel poverty and creating green jobs. The Green Economy Fund explored many of the aspects of Whole System thinking required in the transition to Net Zero including the transition away from fossil fuels to electrified heating and transport, upskilling and trialling innovative solutions to address fuel poverty.

We also provide support to a number of community energy projects, including:

- The Bethesda Home Hub project in North Wales that aims to use a customer-driven flexibility model to support customers who have a need to keep electricity bills to a minimum.

[17] https://netzeronw.co.uk/
[18] https://www.spenergynetworks.co.uk/pages/green_economy_fund.aspx

- CoRE[19] (Community Renewable Energy) Project in East Ayrshire, part of the Ayrshire Growth Deal, which will deliver a Centre of Excellence in Energy Systems Research, two Net Zero Demonstrator Houses (located on the site of the Centre of Excellence) and a programme of low carbon demonstrator projects over the project's lifetime (10 years).

6.2 Transitioning from RIIO-ED1 to RIIO-ED2

We have learned from our experience in RIIO-ED1 that Whole System thinking needs to consider not only solutions that result in efficient investment in our electricity network but also solutions that will support our customers and communities in the journey to Net Zero. The case studies we provide in Appendix 8 illustrate our Whole System achievements in RIIO-ED1 and how we proposed to build on them in RIIO-ED2 guided by our pillars.

Figure 5 maps a selection of our existing RIIO-ED1 initiatives, and some of those we are pursuing into RIIO-ED2. While many of our RIIO-ED1 initiatives adopted some level Whole System thinking, future solutions will integrate both a greater depth and breadth of Whole System thinking: combining an integrated and collaborative approach to the energy and wider system, while also improving the position of our customers, local communities, and society at large.

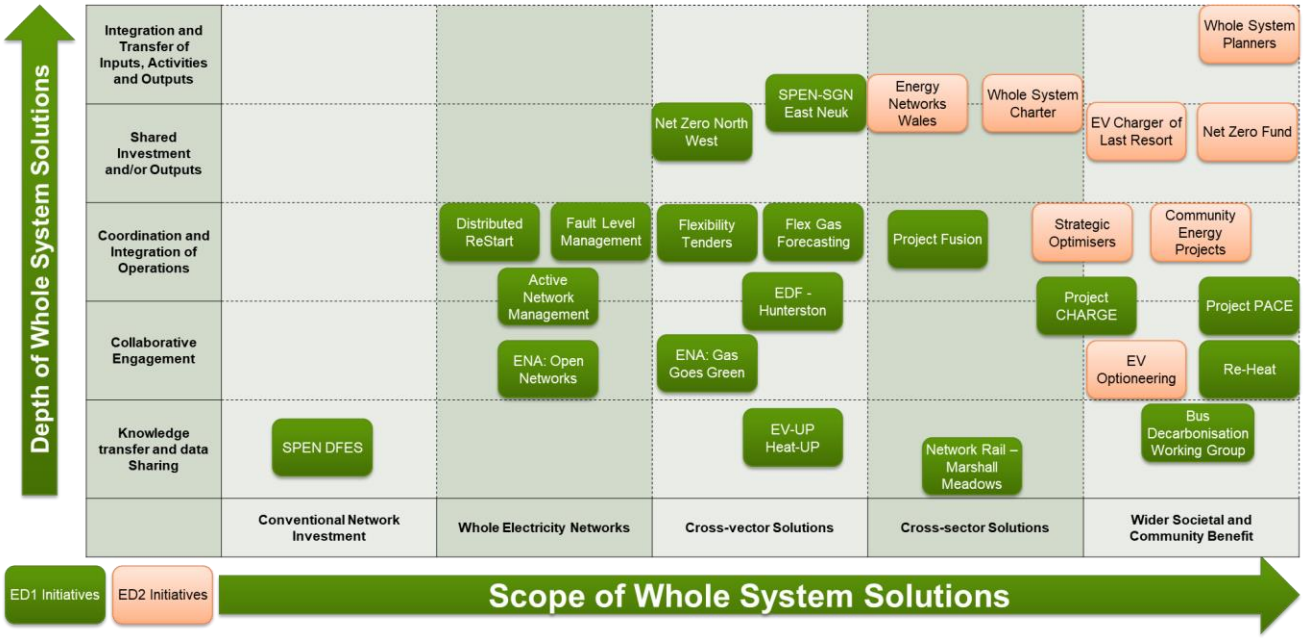


Figure 5: Scope and Depth of our Whole System Solutions

Initiatives such as EV Charger Provider of Last Resort and the Net Zero Fund illustrate that we are actively thinking beyond the electricity sector in RIIO-ED2, engaging with Local Authorities to deliver Whole System solutions and outcomes with a wider societal benefit. As described earlier, there will be a continuum of Whole System activity carrying over from RIIO-ED1 as well as new initiatives commencing in RIIO-ED2 – all of which will be guided by our pillars. A full list of our Whole System activities and how they map to the six guiding pillars can be found in Appendix 10.

6.3 Our RIIO-ED2 Whole System Programmes and Initiatives

Although we have delivered many examples of Whole System planning across our business in RIIO-ED1, we need to go further. Delivering efficient Whole System outcomes as standard is essential to ensuring our network is ready for the Net Zero future and that our customers are supported in their journey to Net Zero.

[19] https://www.east-ayrshire.gov.uk/PlanningAndTheEnvironment/RegenerationAndTownCentreManagement/Community-Renewable-Energy/Core.aspx

We have three overarching programmes of work in RIIO-ED2:

1. Structured strategic engagement,
2. Implementing a Whole System planning function, and
3. Business transformation.

In the sections that follow, we first describe our three programmes of work before outlining in Section 6.4 the initiatives that are derived from these programmes under each of the six pillars guiding our actions.

6.3.1 Setting up structured engagement with electricity network companies and other stakeholders

We have nurtured many strategic relationships throughout RIIO-ED1 with devolved and local governments, house builders, other electricity network companies, community energy groups and more. We plan to build on this by developing structured engagement with the gas, water and telecommunications companies and other electricity network companies as well as working closer than ever with the Local Authorities in our licence areas.

We have initiated this process of structured engagement with other companies beyond that of the electricity sector, such as with SGN and NPG, through our Frameworks for Cooperation and Collaboration (Appendix 4). These bilateral discussions are targeted at joint Whole System coordination and have resulted in a clear terms of reference for future engagement and the exploration of Whole System solutions and outcomes. A key output we are pursuing through these frameworks is a common industry-wide methodology for assessing the split of costs and benefits between Whole System partners in joint activity.

A brief summary of outcomes from bilateral discussions with NPG and SGN is listed below:

NPG:

- Arrangement of further bilateral discussions to discuss coordination on Whole System projects
- Establish engagement sessions and forums at which to share knowledge and discuss Whole System solutions relating to flexibility relationships, demand and network forecasting, and system planning, among other topics.
- Establish quarterly trilateral discussions between SPEN (SPD & SPT), NPG, and the ESO, to engage collaboratively on system planning using a Whole System approach.

SGN:

- Explore where and how SPEN and SGN can collaborate on specific projects, and how a data sharing and management system could inform flexibility relationships and increase understanding of the energy network.
- Determine if such a real-time management system can facilitate cross-vector understanding of the network. We will also join up our work with other partners in the Whole System Charter.

6.3.2 Introduction of a Whole System planning function

At the heart of our plan is the introduction of a new team of specialised Whole System designers and planners who will constitute a Whole System Planning function within our investment decision-making framework. we have delivered many examples of Whole System planning across our business in RIIO-ED1, we need to go further in RIIO-ED2 and beyond. In the same way that setting up a dedicated innovation team drove a step change in innovation, we believe that implementing a dedicated permanent Whole System planning team is the most effective way to drive a step change in Whole System outcomes and solutions to deliver long term value.

The Whole System planning function will have accountability for:

- Identifying opportunities for Whole System solutions internally between licences and externally with partners
- Maintaining key external Whole System relationships
- Providing a key point of contact for stakeholders outside the electricity network

- Maintaining a view of stakeholder plans and ambitions
- Ensuring stakeholder plans are incorporated in our forecasting and decision making.

We describe in Appendix 6 how the Whole System planning function will interface with Strategic Optimisers, the DSO function, data, digitalisation and the ENZ platform in a new target operating model.

6.3.3 Carrying out a Business Change project to embed Whole System thinking across our business

Using established Business Change procedures, we will conduct an in-depth review of policies and procedures across our business to ensure Whole System planning is at the heart of everything we do including our investment processes, system planning and operations. Section 7.2 provides more detail on how the Business Change project will be implemented and managed to support the outcome of integrating Whole System thinking into our organisation.

We plan to co-ordinate this with our DSO vision – Whole System solutions will become part of the functional role of the DSO role. See Our DSO Strategy.

6.4 How we will use our three programmes of work and guiding pillars to deliver Whole System outcomes and solutions

Our three programmes of work lead to the following initiatives that are guided by our six pillars.

6.4.1 Establish strategic partnerships to achieve common Whole System goals.

In RIIO-ED2, we want to build on our existing engagements and take them further by creating structured collaboration across multiple energy vectors (as described in our Whole System topology).

Within the Electricity Sector:

- We will continue to work on a collaborative basis with other network companies to explore and deliver alternative solutions to network issues. We will share the learnings from our value driven approach to issues such as the management of fault level (Appendix 8 - Case Study 1), where we have worked with SPT to deliver a Whole System CBA approach[20] that considers both transmission and distribution options and delivers optimum cost-efficient solutions for our customers as a result.
- We are developing frameworks for effective ongoing bilateral collaboration with our neighbouring DNOs and other local utility companies. For example, we will meet quarterly with Northern Power Grid (NPG) to discuss system planning at the licence border.

Beyond the Electricity Sector:

- We have developed charters for strategic multi-utility engagement in all of the three nations in which we operate:
    - The Whole System Charter in Scotland (including SPEN, SSEN, National Grid, National Grid ESO and SGN) (Appendix 8, Case Study 13)
    - Energy Networks Wales (including SPEN, WPD & Wales & West Utilities) (Appendix 8, Case Study 20)
    - Liverpool City Region, Cheshire West & Chester and Warrington Decarbonisation Pathway with Cadent Gas (Appendix 8, Case Study 11)
- We aim to use these multi-utility engagement forums to align our resources, strategies and ambitions, to:

[20] Other recent examples of our Whole System CBA approach in practice (from our Flexible Networks Project) are listed in Appendix 3.

- Work together, through coordination and cooperation, creating a common set of structures for sharing information
- Manage uncertainty, by working across boundaries to understand the drivers for change and agree the right benchmarks and market indicators that can help underpin investment decisions
- Develop Whole System tools and processes, identifying the key intervention points between gas and electricity networks
- Demonstrate our commitment to Net Zero

We aim to use these strategic engagement forums and newly formed bilateral engagements, as well as existing strategic partnerships and engagement developed in RIIO-ED1 with parties beyond the energy sector, such as the Scottish and Welsh Governments, transport bodies, Local Authorities, academia, and industry, to identify opportunities to collaborate on projects and business as usual activities that deliver Whole System benefits.

Our new Whole System planning function will be responsible for ensuring outcomes from these engagements are communicated throughout our business and that the plans of our strategic partners are included in our Whole System planning.

We will work with the Energy Systems Catapult[21] to help shape our approach and ensure there is continuous improvement, challenge and critique of our plans. Further information on the collaboration principles for our engagement with ESC can be found in Appendix 7.

6.4.2 Use innovation, markets and flexibility to push the boundaries of Whole System thinking

In RIIO-ED1, we delivered Whole System outcomes through ground-breaking innovation projects such as the Dumfries and Galloway ANM (Appendix 8 Case Study 15) and Project FUSION (Appendix 8, Case Study 19). In RIIO-ED2, we will seek to push the boundaries of innovations even further, particularly in the areas below.

DSO & Flexibility

We are exploring markets for flexibility with new and existing customers who are able and willing to control how much they generate or who can control their demand. Flexibility can reduce the need in some areas for costly, and time-consuming traditional reinforcement, eliminate the need to invest in permanent upgrade to meet a temporary spike in demand, accommodate the growth in low carbon technologies and allow consumers to capitalise on the opportunities arising from a transition to a smarter grid.

We have successfully contracted with customers to provide flexibility in RIIO-ED1 (we accepted 140MW of flexibility services in our most recent tender) and we will continue to carry out regular flexibility tenders in RIIO-ED2 to help us to deliver the network of the future, accommodating the rise in low carbon technologies while minimising the need for traditional network reinforcement.

As we deliver our DSO Strategy, our value driven approach will continue to underpin our support for the use of flexibility and non-network solutions, enabling us to optimise network development and investment strategy. By adopting a more expanded and ambitious DSO function, we will be best placed to achieve Whole System outcomes, especially the optimisation of the services provided by the energy network, the utilisation of capacity and flexibility services.

We recognise that becoming a DSO with a customer value and market-based approach will require better actual and forecast data and a much better understanding of local and regional energy loads, as well as new commercial and regulatory models that will allow us to play the role of system “optimiser” and to facilitate flexibility and capacity trading.

The more expansive DSO role will be enabled by the greater use of digital and smart technology to identify, co-ordinate and facilitate energy system optimisation opportunities that increase consumer value. This will lead to the evolution of our current (network and system) service procurement approach into a new and more dynamic market-based model, which will enable energy asset owners and service providers to trade flexibility and

[21] https://es.catapult.org.uk/

capacity to realise Whole System value. This capacity and flexibility market approach will, at its full potential, allow peer-to-peer trading between generators, consumers, and providers of services to the networks.

We are collaborating with other DNOs to implement the Flexible Power Portal. This will enable us to automate some of the processes needed for dispatching, billing, and settling flexibility services. These platforms can facilitate the growth of the services market by clearly setting out our service requirements and provide a secure mechanism for us to coordinate and communicate with our service providers.

In our DSO Strategy we outline the value (and methodology for calculation) of indirect benefits from DSO-specific Whole System activity between SPEN and other organisations.

Active Network Management

The integrated constraint network management scheme in Dumfries and Galloway (D&G) is the first of its kind in the UK, managing transmission constraints over a large distribution network area connected by 11 grid supply points and is the output of extensive Whole System collaboration between SPD, SPT and National Grid ESO. The active network management (ANM) scheme will benefit not only the 90MW of distributed generation (DG) currently connected in the D&G area but it will also facilitate improved connection conditions far in excess of 200MW of DG that is contracted to connect in the future. It will deliver faster connections and reduce levels of constraints. Looking forward to RIIO-ED2, SP Energy Networks will continue to work closely with National Grid ESO, transmission owners and UK DNOs to share more information and set transparent rules regarding responsibilities for network operation and how network access continues to be facilitated to the benefit of all. SPEN is proposing to roll out ANM schemes at 22 constraint management zones across SPD and SPM. RIIO-ED2 and beyond. Figure 6 illustrates how ANM will form a key part of our DSO architecture as the basis for network control.

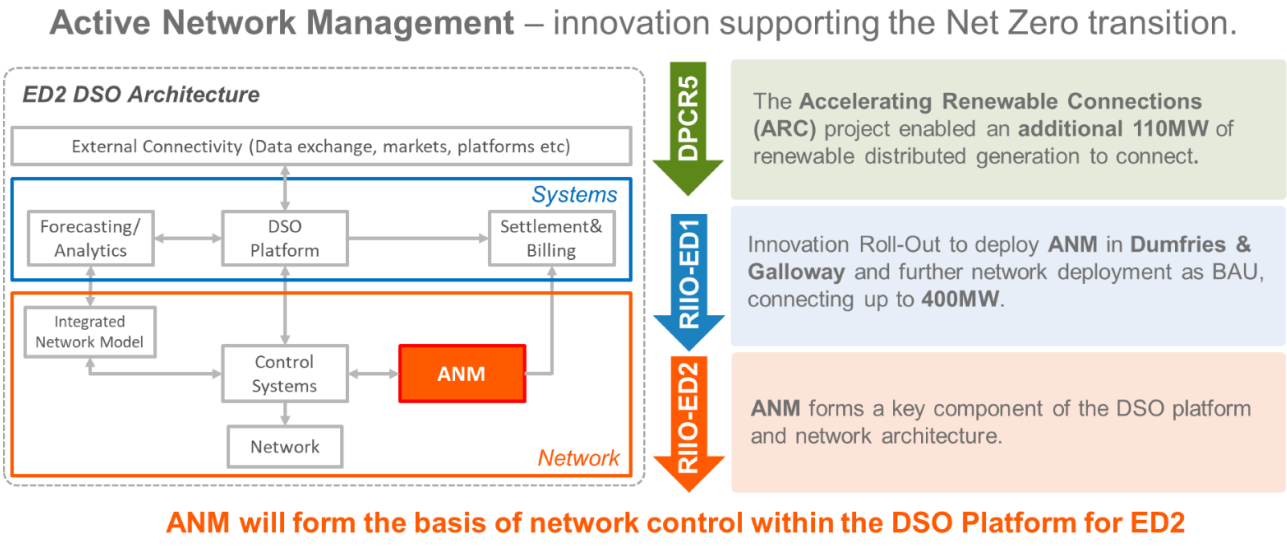


Figure 6: The role of ANM within DSO architecture

Fault level Management

SPEN have been progressing ground-breaking innovations to measure and manage fault level challenges in real-time. Within RIIO-ED1 we have successfully trialled and tested Real-time Fault Level Monitors (RTFLM) and we have ongoing trials of Active Fault Level Management (AFLM). Together these two innovations will give us greater visibility of network fault levels in real-time and enable us to accommodate more generation whilst triggering fewer equipment replacements / network reconfigurations. Within RIIO-ED2, we will build on our ground-breaking RIIO-ED1 innovations. We will roll out fault level monitoring in constrained areas, targeting a total of 38 sites. We will use innovative active fault level management automation systems to facilitate new generation in three fault level constrained areas.

Other initiatives such as the Distributed Restart project (Appendix 8 Case Study 18) will deliver greater Whole System security and reliability of supplies, further reducing the risk of unnecessary investments and costs for our customers.

Whole System focus in our innovation strategy:

Whole System thinking is embedded within our innovation strategy. Four themes have been identified within the Whole Energy System section of our innovation strategy. These are as follows:

Theme	Innovation Focus
1. Joined up approaches to regional network planning and forecasting *We need to better understand the interaction between gas and electricity networks, through joint forecasting and planning*	• Developing novel planning methods in conjunction with gas networks and working with cities and devolved administrations to understand local needs and differences. • We intend to develop multi-vector analysis techniques to assist regions in developing their net zero pathways.
2. Distribution and transmission network coordination *In future, resources at the distribution level will support the national system in managing network constraints and balancing.* *We need to develop appropriate interfaces that move beyond the current sector-specific operation and planning practices.*	• Enhancing data communication and visibility across TO-DNO boundary for better utilisation of DERs. • Accurate forecasting of demand through load modelling and forecasting techniques. • Establishment of islanding models to better manage local generation and demand under system restoration conditions building on the Distributed ReStart project.
3. Hydrogen *The hydrogen economy has a big part to play in the future low-carbon economy. It is a whole energy system issue with implications for renewable generation, electricity networks, gas networks and transport.*	• Across multiple scenarios, hydrogen could play a significant role in decarbonising the heat and transport sectors. • Networks need to develop an understanding of the significant impacts on demand and potential benefits of large-scale hydrogen production, from electrolysis and/or steam methane reformation.
4. Whole System co-ordinated cost benefit analysis *There are examples where investment to enable demand side flexibility benefits not only the networks, but also other parts of the whole energy system, for example, by reducing requirements for new generating plant.* *By developing coordinated cost benefit analysis, we will be able to identify the most efficient investment and realise overall financial benefits for customers.*	• Working with partners from other parts of the whole energy system and drawing on academic expertise we will seek to develop co-ordinated cost benefit analysis techniques that consider wider benefits extending to, for example, benefits in the generation sector and population health benefits.

The themes highlighted above illustrate the Whole System focus we will take when embarking on new innovation projects in RIIO-ED2. Within the wider innovation strategy, three of the key innovation areas sit outside the traditional electricity network: hydrogen, electrification of transport and electrification of heat. These will be key focus areas for our Whole System planning function and Strategic Optimisers (through their work

with Local Authorities). We will continue to develop our learnings in these areas by delivering innovation projects via Ofgem's Strategic Innovation Fund[22].

We will continue to play an active role in the annual Energy Networks Innovation Conference (ENIC) where we share updates and learnings on our innovation projects with colleagues from the electricity and gas networks. It is our aim to be transparent and openly share our Whole System learnings.

6.4.3 Think beyond the electricity sector to support other energy vectors including heat, transport and hydrogen.

Based on our DFES scenarios, to achieve Net Zero by 2050, medium to high levels of uptake of electrified heat and transport solutions will be required. In order to ensure the electricity network is equipped to accommodate the increase in demand generated by these low carbon technologies, it is vital that we work closely with devolved Governments, Local Authorities, community energy groups and private companies to help us to understand where and when the demand increase will be required. We can then include local plans and strategies into our forecasting and investment planning to ensure the network has sufficient capacity in the correct locations to support low carbon technologies.

Decarbonisation of transport

- We will use the learnings from our decarbonisation of transport projects - CHARGE (Appendix 8, Case Study 12), PACE (Appendix 8, Case Study 2) and EV-Up as well as from our Green Economy Fund projects - to support our communities and stakeholders in the decarbonisation of transport.
- We will continue to work closely with Transport Scotland to support their decarbonisation of transport ambitions via the strategic partnership, our Strategic Optimisers supporting the Local Authorities with EV charging hub optioneering and the Bus Decarbonisation Working Group.
- We will work with the Welsh Government to identify opportunities where we can support their decarbonisation of transport ambitions.
- We will use our Net Zero Fund to support communities in the transition to electrified transport.

Decarbonisation of heat

- We will use the learnings from our decarbonisation of heat projects Re-Heat (Appendix 8, Case Study 14) and Heat-Up as well as from our Green Economy Fund projects to support our communities and stakeholders in the decarbonisation of heat.
- We will continue to work closely with the Scottish Government via the Heat Electrification Working Group to support their decarbonisation of heat ambitions and identify further opportunities for joint planning.
- Our Strategic Optimisers will work closely with Local Authorities to support them in developing and delivering their plans for the decarbonisation of heat via Local Heat and Energy Efficiency Strategies (LHEES) in Scotland and Local Area Energy Plans (LAEPs) elsewhere
- We will work with other stakeholders including housebuilders and City of Edinburgh Council, to name a few, to support their decarbonisation of heat plans.

Hydrogen

Hydrogen has the potential to play a key role in the transition to Net Zero. Given its capability to both drive and negate network investment, there is benefit in increasing industry's understanding of hydrogen's impact and the role it can play in the Net Zero transition.

We will continue to support existing engagements around hydrogen development including:

[22] https://www.ofgem.gov.uk/energy-policy-and-regulation/policy-and-regulatory-programmes/network-price-controls-2021-2028-riio-2/network-price-controls-2021-2028-riio-2-riio-2-network-innovation-funding/strategic-innovation-fund-sif

- Continuing to support Net Zero North West (Appendix 8, Case Study 10)
- Working with Cadent Gas on the Pathway to Net Zero – Liverpool City Region, Cheshire West & Cheshire and Warrington (Appendix 8, Case Study 11)
- Working with SGN through bilateral engagement and the Energy Networks Charter to build on the learnings from the East Neuk hydrogen project and identify other joint planning opportunities to support the development of hydrogen as an energy vector.

By working closely with the gas networks, we will share data with them on our plans and network capacity and we will incorporate their plans for the development of hydrogen infrastructure into our ENZ platform.

6.4.4 Use Whole System thinking to support our communities and vulnerable customers in the transition to Net Zero - driving energy efficiency and helping those communities who face fuel poverty

We welcome the increased focus on Consumer Vulnerability for RIIO-ED2, recognising our social responsibility in ensuring everyone benefits from Net Zero, and no one is left behind. We will seek to expand the boundaries of our Whole System thinking to include these wider responsibilities, aligning our strategy closely with our Customer Vulnerability RIIO-ED2 commitments and building upon the strong work we do currently as part of our business as usual delivery.

We are proposing to open a new £30m Distribution Net Zero Fund, that will build on the benefits delivered by the Green Economy Fund and will provide further bespoke support to our local areas and communities in the transition to Net Zero. The fund will be aligned to UK Government, Scottish Government and Welsh Government Net Zero targets whilst supporting our cities and local communities' decarbonisation ambitions. The fund will create positive environmental benefits, deliver strong social value, support the most vulnerable in our society, generate shared learnings and boost local economic growth.

Our community energy strategy details the support we will give to community energy projects. All community energy projects will have a SPEN key account manager who will work closely with our Whole System planning function to ensure that community energy schemes are considered within Whole System solutions.

In our role as strategic DNO, we have a key part to play in supporting our customers and communities in the transition to Net Zero, whilst taking into account any considerations for energy efficiency.

- Our new team of Strategic Optimisers will use their extensive network knowledge to support Local Authorities and other stakeholders across the SPD and SPM areas. They will provide crucial advice upfront and help develop plans for decarbonising heat. This includes Local Heat and Energy Efficiency Strategies (LHEES) in Scotland and Local Area Energy Plans (LAEPs) elsewhere. Involving our Strategic Optimisers at the early stages of Local Authorities' heat plans, will allow for adequate consideration of the electricity network, specifically with respect to energy efficiency considerations for public housing stock and office/depot space used by the housing association in the performance of their functions. This will ultimately speed up delivery and reduce connection and reinforcement costs, and early consultation on energy efficiency will make a real impact on vulnerable customers bills as the lower cost of insulation reduces the need for energy consumption and local reinforcement. This early specialist involvement could have major impacts. For example, for a social housing development we can help to determine whether individual heat pumps are suitable, or if a communal 11kV connected heat pump and associated heat network works better – with a control solution optimising network capacity and delivering cost benefits.
- We will carry out optioneering studies for Local Authorities to identify the most suitable locations for new public EV charging hubs, prioritizing areas where the market is not expected to deliver, i.e. which have low average household income and low levels of off-street parking. We will work with Local Authorities to decide where EV optioneering for public EV charging infrastructure would be most beneficial, for example in supporting local communities or areas where regeneration is being planned. We will apply the optioneering methodology developed by Project PACE to complete feasibility studies for the appropriate and cost-effective siting of public EV charging infrastructure informed by the EV-Up data and development priorities of the local authority and wider community. By working with Local Authorities, we will help to enable universal access to public EV charging infrastructure, ultimately making sure that no community is left behind in the Net Zero transition. We have proposed a Consumer

Value Proposition (CVP)[23] for EV optioneering due to the robust evidence base that project PACE provided for connections savings from optioneering.

- We will adopt the role of EV charging infrastructure provider of last resort in line with the new distribution licence was put in place at the beginning of 2021 to reflect the EU's Clean Energy Package that allows DNOs to own and operate EV charging infrastructure as the 'provider of last resort', following a failed market tendering exercise.

6.4.5 Improve our mastery of data, share data easily to unlock Whole System and consumer benefits.

Data and digitalisation will be a key enabler in delivering Whole System solutions. We have begun to explore data and information sharing relationships with those across energy vectors (i.e. with SGN, NPG and within the Energy Networks Charter) as a means of improving our shared understanding of the network and how to address network constraints.

The Engineering Net Zero platform is at the heart of how we are cooperating with external parties to implement a tool that will facilitate a virtual 'twin' mapping of our network, with the aim of facilitating network forecasting, asset health and performance and flexibility requirements. This will allow for more efficient and effective network investment, the creation and maintenance of a more robust energy network, and crucially the avoidance of customer costs through this efficient, targeted, and data-informed process. It is from the ENZ model that we will take extracts of master data to share with our partners and stakeholders.

Importantly, we will not only share our data outwards with our stakeholders. It is also vital that we gather data from our stakeholders to input into our ENZ platform for both internal long term forecasting and short-term operational planning.

Long-term forecasting

- we will build Local Heat and Energy Efficiency Strategies (LHEES) in Scotland and Local Area Energy Plans (LAEPs) in England and Wales into forecasts feeding into the ENZ platform.
- we will work with the gas network companies to incorporate details of their proposed hydrogen infrastructure into forecasts feeding into the ENZ platform.
- we will work with the rail companies to incorporate their plans for decarbonising currently non-electrified lines with electricity or hydrogen) into forecasts feeding into the ENZ platform.
- where other parties have detailed information on LCT uptake such as manufacturers, installers, grant providers or Ofgem's FIT database, we will incorporate this data into forecasts feeding into the ENZ platform.

Short-term operational planning

- we will incorporate outage schedules from the gas companies into our outage plans to minimise disruption to customers.
- When considering temporary or short-term network interventions, we will take into account planned maintenance outages of SPT and neighbouring DNOs.

6.4.6 Embed Whole System thinking in our organisation, culture, and ways of working to deliver long-term value

In RIIO-ED1, we have delivered many examples of co-ordinated working that have delivered Whole System solutions for our customers, such as Dunbar ANM (Appendix 8, Case Study 15). Our integrated distribution and transmission control room facilitate coordinated planning and management and our system design teams work together to achieve Whole System solutions such as Fault Level Management (Appendix 8, Case Study 1).

[23] In RIIO-ED2, CVPs have been introduced to encourage and reward ambitious DNO proposals that clearly deliver additional benefits to consumers, by going above and beyond minimum requirements.

In RIIO-ED2, we will take forward existing Whole System practices, particularly in transmission, and embed them into business as usual across transmission and distribution. We will incorporate stakeholder plans in our policies and procedures to ensure Whole System planning is at the heart of everything we do.

Our Whole System Planners will be pivotal in both capturing and incorporating stakeholder requirements into our decision-making framework, alongside core inputs such as asset data, DFES scenarios and core stakeholder engagement. This will operate in tandem with our major business transformation project to ensure that Whole System thinking is embedded across our organization. Detailed information on how we will deliver our plans and embed Whole System thinking into our business is given in Section 7.

EV Optioneering Consumer Value Proposition (CVP)

As national Net Zero targets become increasingly pressing, the onus on Local Authorities is greater. In RIIO-ED1, we have engaged with as many Local Authorities as possible, with limited resource, to help them with their decarbonisation plans. Many parties appreciate that Local Authorities have growing responsibilities in energy infrastructure, but don't have support readily available to them:

Therefore, with the backing of our stakeholders we want to take a strategic, Whole System approach to help Local Authorities achieve their decarbonised transport plans. We want to help encourage EV uptake to support government targets to decarbonise transport, to ensure our local communities are all able to enjoy the benefits as quickly as possible. We will work with 37 Local Authorities in our area to identify locations where there is no market interest in installing public EV charging infrastructure and where households have limited off street parking or personal charge points. This will help to ensure that there is universal access to EV charging infrastructure, supporting a just transition, whilst also making these areas more commercially feasible for chargepoint operators.

The optioneering reports we produce for Local Authorities can then be used as the basis for a tendering the operation (and potentially ownership) of public EV charging infrastructure.

We will build on and use our experience from our successful RIIO-ED1 project, Project PACE, which trialled a DNO-led site selection and delivery of public EV charging hubs in North and South Lanarkshire[24]. The project is tripling EV charging capacity in the areas involved as well as offering substantial connection and avoided reinforcement cost savings and continues to be strongly supported by Local Authorities, the Scottish Government, Transport Scotland and industry stakeholders such as charging point operators. Since carrying out PACE, we have been approached by several local authorities looking for support with their own EV charging ambitions. A combination of this interest as well as Welsh, Scottish and UK EV targets has prompted the inclusion of this initiative in RIIO-ED2.

6.5 Co-creating our RIIO-ED2 Plans with Stakeholders

6.5.1 Purpose of our engagement

The energy system is evolving at an unprecedented rate. SPEN has a central role to play in facilitating this change and preparing the UK for a Net Zero future. To plan for our Net Zero future, we need to work together with traditional stakeholders – including network users, Ofgem and the Scottish, Welsh and UK Governments- as well as less familiar industry sectors and new market entrants. Robust and strategic stakeholder engagement is vital to inform our plans to take a Whole System approach.

Delivering Whole System solutions implies the need for collaboration in its very concept. A whole is merely the sum of its elements, and a successful Whole System will be contingent on each of these elements – DNOs, generators, customers and stakeholders alike – cooperating and engaging in unison to deliver the energy system of the future. This requires a collaborative and integrative process from every party involved if we are to successfully deliver not just Ofgem's requirements, but our own Whole System ambitions, and crucially a just transition to net-zero.

[24] https://www.spenergynetworks.co.uk/userfiles/file/Project_PACE_fact_card.pdf

6.5.2 How and why we have engaged with our stakeholders

Stakeholder engagement has become an important and regular part of how we conduct business. The development of Whole System solutions is predicated on the concept of engagement – really listening and understanding our stakeholders needs and requirements. In the development of our thinking and planning, we fully understand the need for meaningful interaction with impact – this cannot be done without having conversations with partner organisations, both within our own sector and beyond. Those voices will influence our decision making and allow us to prioritise the challenges we face.

We have gone beyond simply speaking to organisations in our own sector, as we want to capture the range of diverse ideas and thinking that exists within other sectors and systems. In September and October 2021, SPD and SPM hosted a session with a range of stakeholders across the corporate, local authority and third sector organisational landscape. We presented our views on Whole System thinking and planning, outlining why we think that this is important as key enabler to a just transition to achieving Net Zero, and how we could start to convert the theory into practice. As part of this, we held a discussion on what we meant by our definition of "Whole System", recognising that whilst we have credibility as a delivery and strategic partner, we also know that we do not have all the answers to making improvement in our own sector, and how this interacts with other systems. Our definition was agreed by our stakeholders as comprehensive, with some feedback noting that we should make it clearer that we are targeting all communities, and in particular how fuel poor communities and individuals would not be left behind in a world where equal access to technology availability may be difficult.

We discussed the concept of geography and "place", and our stakeholders agreed that our approach on a community, local, regional, national vector was appropriate. How we will use data to inform the mechanics of Whole System thinking, planning and solutions was presented, noting that in our engagement discussions with Scotia Gas Networks, Northern Power Grid and SSEN, the concept of data sharing was high on the agenda. The next phase of engagement is to ensure that these ideas turn into reality, where we can identify what data and information is important and why to enable a sharing process. Equally, our stakeholders, whilst recognising that SP Energy Networks are leading on many of the discussions on Whole System planning, agreed that other organisations need to participate and stimulate ideas from their own sectors and systems. It was important that a team be created, with specialist and dedicated skill sets, to drive this as an outcome.

We recognise that there will be different views on the most effective routes to a Whole System approach. We are confident that the changes we have made to our plan, as a result of our stakeholder engagement, have allowed us to better consider and coordinate our options while remaining flexible enough to address emerging pathways to a Net Zero future.

6.6 Benefits of our plans in RIIO-ED2

We have assessed the benefits of introducing a Whole System planning function using Ofgem's standard cost-benefit analysis (CBA) template. Our calculations show that the function delivers a net present value benefit of between £7.8m to £49.1m over the course RIIO-ED2. The range of benefits arises from sensitivity analysis (low, medium and high forecasts) applied to outputs and associated net benefits from the team.

In terms of our entire package of Whole System initiatives, we have adopted a comprehensive social value measurement framework, which incorporates social return on investment (SROI) modelling and builds upon traditional CBA by also measuring and accounting for typically qualitative, social impacts of a project. We estimate that our package of Whole System initiatives will deliver a net benefit of £18.23 for every £1 spent.

Detailed explanations of our CBA and SROI methodologies and results are provided in Appendix 5.

7. Deliverability of Our Plans

In the previous section we described our Whole System plans for RIIO-ED2. To improve confidence in the deliverability of our plans we have put certain measures in place. This section elaborates on the steps we are taking or have taken to improve the deliverability of our plans. The measures outlined included the following:

- Development of a structure and role specification for the Whole System planning function to prepare for recruitment, training and identification of where the function will be expected to add value.

- The groundwork we have laid for a business transformation programme to ready our business to implement our proposed Whole System initiatives.
- How we propose to deal with uncertainty.
- Plans to grow our frameworks for collaboration and cooperation
- Ongoing and targeted stakeholder engagement
- Implementation of a robust and accredited governance framework.

7.1 Whole System Planning Function

The primary outputs from investment planning activities are our load-related and non-load related plans. By design, these forward-looking plans already include Distribution System Operation (DSO) and Whole System outcomes but we believe the introduction of a Whole System planning function at the forefront of our investment planning process is necessary to create accountability for embedding Whole System thinking, considering requirements beyond the electricity sector, nurturing frameworks for collaboration and cooperation, measuring benefits on an ongoing basis and creating awareness of the impact of our actions on other parties.

Our proposed structure for the Whole System planning is shown in Figure 7 below. It is comprised of two teams – one for SPM and the other for SPD – as we believe that effective Whole System solutions must reflect regional differences. Aspects such as Local Authority plans, network topography, mix of users and communities as well as interacting energy vectors are examples of variables that would require Whole System solutions and outcome tailored to each region. We also believe there should be accountability within the team to enhance coordination with relevant transmission owners and system operators.

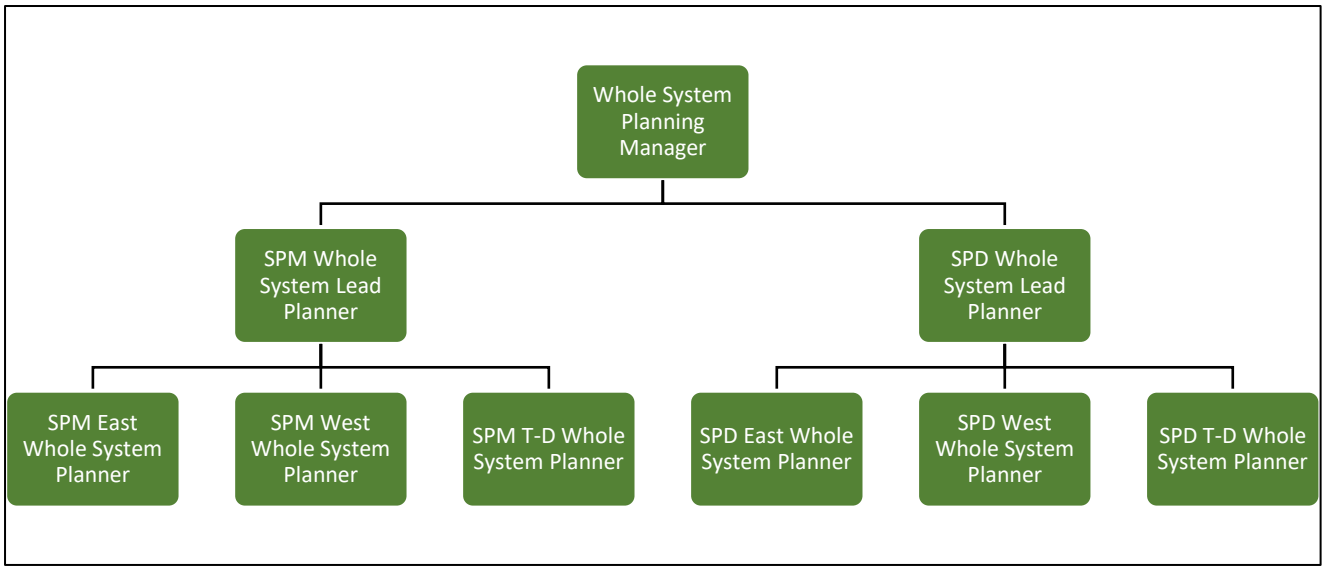


Figure 7: Whole System Planning Team

The introduction of a new team such as the Whole System planning function requires a clear delineation of roles and responsibilities between existing investment planners and proposed Strategic Optimisers. Both are functions that will interact with the Whole System planning function and we set out in Table 3 below the accountabilities of each function.

Table 2: Accountabilities of Investment Planners, Whole System Planners & Strategic Optimisers

Investment Planners	Whole System Planners	Strategic Optimisers

• Operational outage planning • Work with the System Operator to co-ordinate all system users and network outage requirements on SPEN's transmission network • Co-ordinating all system users and network outages on the distribution network • Assist the Control Room with the delivery of all planned Transmission outages • Develop contingency plans and risk mitigation strategies for major planned work	• Being accountable for achieving a step change in Whole System outcomes • Ensuring compliance with the Whole System licence condition (including ownership of the Whole System Coordination Register). • Ensuring that flexibility solutions are considered from the outset. • Developing optimal solutions across transmission and distribution boundaries • Assimilating requirements beyond the electricity sector and from LAs (via Strategic Optimisers) • Maintaining frameworks of cooperation and collaboration with strategic partners.	• Give advice to Local Authority on overall plans to decarbonise heat • Review plans to decarbonise heat alongside network planning requirements • Give indication of any required works and timescales • Work with stakeholders to give technical and connections advice. • Facilitate data sharing where appropriate

7.2 Transforming our business to embed Whole System thinking

We firmly believe that it is necessary to have considered how we will transform our business to incorporate a Whole System planning function that integrates into our existing investment decision-making framework and interacts effectively with our DSO, data and analytics, Strategic Optimisers and delivery functions. We have developed and consulted with stakeholders on a target operating model (TOM) for this purpose (Appendix 6).

In order to move to the next level of detail underpinning the TOM, we have commenced groundwork for a business transformation project to review existing processes and procedures aim of:

- implementing the TOM with minimal disruption to the business
- developing the Whole System operational framework
- delivering obligations under the Whole Electricity System licence condition
- joining-up on systems development and data and digitalisation
- achieving ISO accreditation for our Whole System governance

Our initial view of the structure and timescales for four-phase Whole System business transformation programme is shown in the Figure 8 below. A robust preparation phase as already commenced with the aim of identifying and overcoming obstacles and addressing gaps in our approach. Successful Business Change will be vital in preparing our organisation for the uncertainty inherent in the many pathways to Net Zero, in tandem with the other procedures that we have adopted to embrace this challenge.

In addition to the rigours of a formal change programme, we will ensure that there is a Whole System planning objective embedded into our employees' objectives and we will start each meeting with a Whole System and Climate Change contact. At the end of each assessment period we will require managers to note the examples of Whole System planning and what outcomes and solutions were achieved. This will inform both the formal Whole System coordination register required by Ofgem and also stimulate broader thinking, ultimately providing a repository of solutions that can be tapped into by our engineers, system designers, environmental planners and other colleagues involved in the development and operation of our assets

Whole System planning will have support from the highest level within the business with senior managers attending key external meetings, feeding back to the board and cascading updates down through the business.

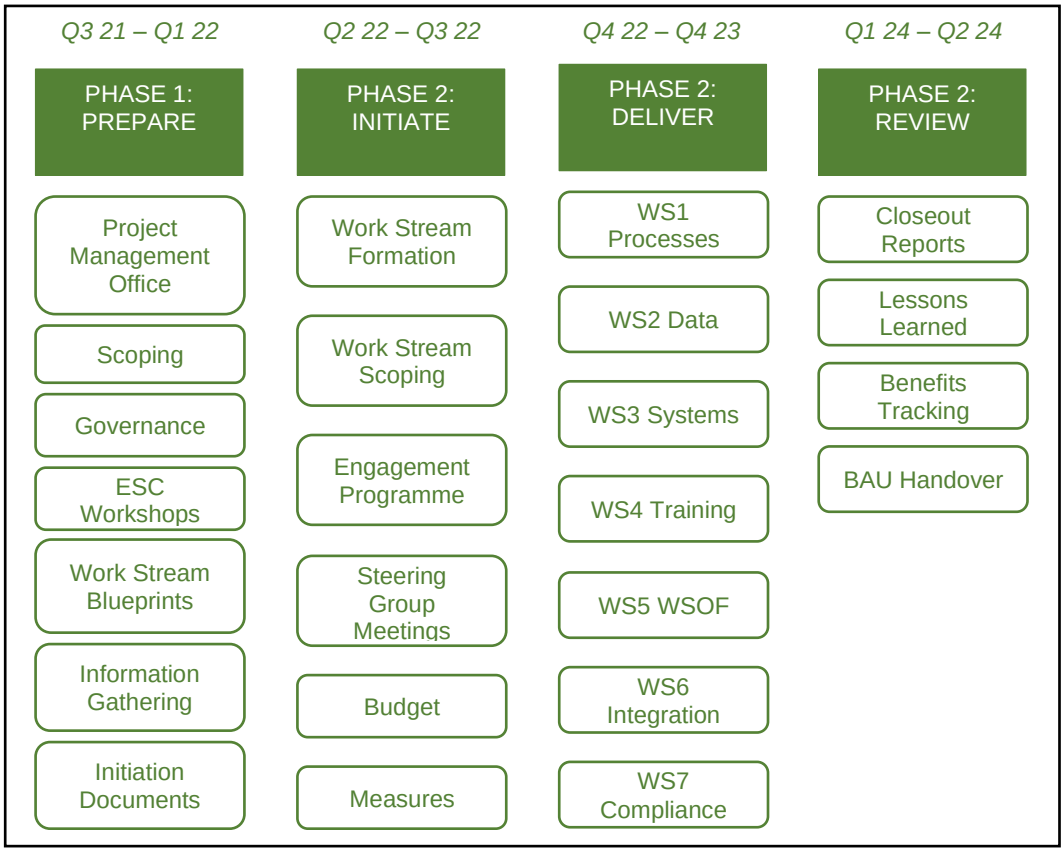


Figure 8 Whole System business transformation programme structure

7.3 Dealing with uncertainty

Whole System Operational Framework (Toolkit of Whole System Solutions)

Given the uncertainties out to 2050, we have developed our Whole System strategy using a long-term planning horizon to drive value for consumers and wider society, while recognising the uncertainties and risks on the path to Net Zero. Our DFES create forecasts for four main energy scenarios which represent differing levels of customer ambition, government and policy support, economic growth, and technology development. Different forecast scenarios will have different network impacts requiring different levels of commitment. In response to this uncertainty, we have established a low scenario, baseline scenario and a high scenario of potential investment requirements. We must have the capability to deliver anywhere between the low and high range of investments.

Therefore, there are any number of pathways that may emerge within this range of network investments and we need to be able to cater for differing Whole System requirements. We intend to develop a 'playbook' of Whole System solutions by energy vector that we could pursue depending on how the short to medium term future unfolds (see Appendix 9 – Whole System Operational Framework). To verify our forecasts and uncertainty quantification we will continue to proactively engage with stakeholders. This will help us make sure forecasts reflect the plans and ambitions of our communities.

The Energy Systems Catapult and other catapults as a 'Critical Friends'

We perceive risks in developing Whole System solutions in isolation. To mitigate this uncertainty, we have signed a Memorandum of Understanding (MOU) with the ESC that sets out three phases of joint working intended to accelerate our Whole System readiness and capability. The MOU can be found in Appendix 7 and contains a commitment from SPEN to openly share our learnings as we undertake the following activities:

We summarise the phases of work in the MOU with the ESC below:

- **Phase 1 - Critical Friend (Up to December 2021)**

A series of workshops where we test our strategies with the ESC. The outputs we are targeting from Phase 1 include an independent assessment by the ESC of our ambition, identification of gaps in our strategies and data, recommendations from ESC on addressing gaps, collaborations (via the ESC) with organisations beyond the electricity sector and an awareness of pitfalls.

- **Phase 2 - Pathways (January 2022 – March 2023)**

  This phase involves scenario planning of Whole System environments to ensure SPEN is ready to deal with a range of uncertainties and outcomes. The main outputs we are targeting are the creation of a 'playbook' of various Whole System solutions we could pursue depending on how the short to medium term future unfolds and a scoping of projects we could take forward with the ESC depending on situation before us.

- **Phase 3 - Delivery (Post April 2023)**

  In our final phase, we intend to embark on ground-breaking projects that push the boundaries of Whole System solutions beyond typical easy-to-reach Whole System projects. Outputs we are targeting are the delivery of Whole System outcomes that involve sectors beyond electricity, conducting live trials and collaborative projects.

The ESC is the first organisation within the catapult network that we have partnered with because of the extensive thought leadership that the ESC provides in Whole System thinking. We have ambitions to explore the potential for joint working with other catapults[25]; in particular, the Connected Places, Digital and Offshore Renewable Energy catapults.

Uncertainty Mechanisms

We have also considered the use of Uncertainty Mechanisms to address the barriers in the delivery of Whole System solutions and outcomes. In particular, the Coordinated Adjustment Mechanism (CAM) is designed to support the implementation of Whole System solutions between network companies and has the potential to overcome barriers in joint projects we identify through our charters, collaborations and structured engagement.

An example of this would be where using electricity distribution network investment is the most efficient solution to resolve a constraint on a neighbouring electricity transmission network. This would require allowances to be transferred between the relevant network companies, with the CAM supporting the process.

The intention is to make sure that the party best placed to deliver a more efficient solution can do so, even where the original price control funding for that activity was allocated to another network company. We intend to explore opportunities to use of the CAM in our frameworks for cooperation and collaboration.

At the moment, the CAM is limited to organisations within the electricity sector. We intend to explore within our frameworks ideas on how consumer funded expenditure of critical infrastructure (regardless of sector) can be shared and optimised.

Engineering Justification Papers and Cost Benefit Analysis

The Whole System planning function will be held accountable for applying the EJP and CBA methodology, in the development of Whole System solutions. This expectation ensures that any Whole System solution that is taken forward to delivery will meet all the same robust requirements for 'non-Whole System' activities and will therefore be similarly resilient to a degree of uncertainty.

7.4 Growing frameworks for cooperation and collaboration

We recognise that joint planning and cooperation is integral to delivery of successful Whole System solutions. Thus, we have embarked on a programme of developing frameworks for cooperation and collaboration on Whole System, to foster external partnerships with organisations and stakeholders that can provide mutual benefit in the identification and delivery of Whole System outcomes and the mitigation of risk. These frameworks outline and detail the scope for future Whole System involvement with external parties and lay the groundwork to describe where and how we hope to both explore and deliver Whole System solutions together.

[25] About the catapult network
https://catapult.org.uk/about-us/why-the-catapult-network/

The frameworks are additional to collaborations we are already participate in such as the Whole System Charter. Our ambition is for these frameworks to be nurtured and maintained by the Whole System planning function and for Whole System solutions to be identified through the joint planning processes that are enhanced through these arrangements.

Should we or a partner company propose an activity which coordinates with, or generates benefits for, any broader area of the economy or society, we will ensure that terms of reference in the partnership requires evidence and quantification of these impacts as part of justified and costed proposals.

As we illustrate in Figure 1, there are multiple touchpoints that will require additional or enhanced frameworks. During Phase 2 (Engagement Programme) of our business transformation programme we will aim to address gaps in partnerships across all energy vectors.

7.5 Ongoing and targeted stakeholder engagement

In addition to the collaboration frameworks above, we will carry out regular stakeholder engagement to ensure our Whole System approach is working for our stakeholders. We are also introducing functionality to our Data Portal to receive Whole System feedback and suggestions from third parties. We intend to capture their ideas and opinions and feed them back into our processes.

Examples of the types of targeted Whole System stakeholder engagement we will undertake to ensure our Whole System approach is working include:

- Strategic stakeholder panels
- Net Zero conferences
- Local Authority feedback either directly or via Strategic Optimisers
- Feedback and suggestions received through our Data Portal
- Our DSO forum

We will also support other parts of the business with stakeholder engagement to ensure wider business initiatives are captured within Whole System planning and also that Whole System thinking is embedded in wider business initiatives. Examples of support we will provide to wider business stakeholder engagement include:

- Supporting community energy key account managers with planning of community energy schemes
- Attending the internal Innovation Board and reviewing proposals for Strategic Innovation Fund (SIF)[26] projects
- Attending the transmission and distribution design review group meetings

In addition, by working with Local Authorities, we will help to enable universal access to public EV charging infrastructure, supporting a just transition to Net Zero.

7.6 Governance

The governance and reporting on Whole System planning and thinking will be critical as an enabler to embed and promote this practice within our organisation. Organisations consistently talk about culture being an enabler to organisational change – we believe that we have the growth mindset to convert Whole System theory into practice.

We will monitor progress using our Whole System coordination register (published annually) and stakeholder feedback. Our senior leadership team comprised of our executive directors will be accountable for reviewing the Whole System Coordination Register to monitor progress against our ambition to achieve a step change in solutions and outcomes.

Our governance will aim to deliver four key objectives:

[26] The Strategic Innovation Fund (SIF) is a funding mechanism for the Electricity System Operator, Electricity Transmission, Gas Transmission and Gas Distribution sectors.

1. Ensuring transparency in our delivery of Whole System solutions
    a. Our engineering and financial approval process will be required to formally note that Whole System planning and thinking has been a factor in determining any specific solution.
    b. We will use the data and information we receive from our stakeholders, cross industry partners, Local Authorities, NGOs and third sector organisations to drive our decision making. For example, in relation to working with the gas sector, data on gas network plans for reinforcement (or termination) comprising geography, legal access, the condition of existing infrastructure and replacement/refurbishment potential will be used by our transmission and distribution system design teams to ensure that our own designs can either complement existing arrangements, or be used to achieve better outcomes (such as providing an option for flexibility).
2. Making real progress towards embedding Whole System thinking in our organisation
    a. Implementing our TOM and WSOF will ensure we turn concepts into tangible outputs for our stakeholders and customers. We will change our approvals and governance to facilitate this, and by delivering our business transformation programme, we will drive and embed a culture of continuous progress on Whole System thinking.
    b. We recognise the wider societal benefits of this and are open minded as an organisation. We will welcome ideas, challenge, lessons shared by other organisations and feedback. Our senior leadership team will be sighted on the extent to which we have acted on these inputs.
    c. As we move towards a DSO model, Whole System solutions will be further complemented by highly skilled personnel and systems that can unlock further technological improvements – as monitoring equipment becomes more sophisticated and improvements in data capture, information quality and analysis.
3. Ensuring customers and communities in vulnerable circumstances are supported
    a. We know the impact that energy bills have on our customers. Through our frameworks and partnerships, we will drive a common methodology for quantifying costs and benefits of Whole System to generate confidence in the savings delivered by coordinated activity.
    b. We will publish information to raise the profile of our Whole System planning function to ensure that our customers are able to communicate directly with a team accountable for delivering Whole System outcomes.
    c. We will build on existing data sets and continue to gather data that enables us to target support for all customer cohorts.
    d. In the development of the WSOF, we will build controls to ensure our assessment of solutions avoids curtailing choice. For example, recognising in our assessment of solutions where the upfront cost of low carbon technology is prohibitive or locks consumers in for periods such that market choice is eliminated.
4. Inclusion of science-based targets (such as equivalent carbon emissions) to ensure our Whole System thinking includes understanding the impact of our actions on the environment.
    a. We will join-up with SPT to align, where possible, on the use of science-based targets. For example, there are potential opportunities for us to explore join identification, and subsequently monitoring, metrics to track progress towards science-based carbon reduction targets.

The monitoring and governance we develop and implement will be the framework for how we measure success in our own performance. Therefore, we believe it is crucial to ensure our governance framework meets the highest standards. We will seek ISO accreditation to ensure that our governance focusses on meeting our customer requirements, enhancing their satisfaction and documenting the quality of our organisation's processes.

8. Tracking Progress

8.1 Our Whole System Commitments

We pledge to deliver on the following commitments:

1. We will implement a dedicated Whole System planning function. Using Whole System planning at the start of the investment process, this team will ensure Whole System solutions are considered in each of critical decision-making junctures (for example on system design for connections). This will achieve a step change in Whole System planning, solutions and outcomes over the RIIO-ED2 period.
2. We will use a structured process to review our existing policies and procedures, identify gaps and implement required changes, to fully embed Whole System planning as business as usual. This will have oversight at director level with accountability and reporting to our senior executives. We will use this to engage strategically with other electricity network companies, National Grid ESO and licenced utility companies to work towards achieving Whole System outcomes throughout RIIO-ED2.
3. We will engage with all local authorities in SPD and SPM to support the strategic siting of public EV ChargePoint hubs, utilising our extensive network knowledge and working collaboratively with local stakeholders in optioneering, to identify the optimal locations. We will publish a report on our work at the end of the price control, reporting the number of optioneering reports we completed with local authorities and the consumer benefits delivered in relation to reduced connection charges.
4. We will provide a dedicated team of specialists (Strategic Optimisers) that will partner with Local Authorities (and regional Governments) to support the development and implementation of Local Heat and Energy Efficiency Strategies (LHEES) and Local Area Energy Plans (LAEPS).

8.2 Monitoring progress and measuring success

We set out below and in Table 4 measures on how we will track the impact of Whole System thinking, planning and delivery. We will also ensure that specific directorate oversight is provided and ensure co-ordination with our future DSO function. This will result in executive oversight and will drive a culture of accountability and responsibility.

Innovation and the evolution of low carbon technologies will also be included in our measures. We expect that with the electrification of energy vectors at scale (and in conjunction with smart appliances and monitoring equipment), we will gain further insights into how these can be monitored effectively.

As an organisation we are used to reporting on operational performance. Whole System planning will follow the principles we use, providing a record for internal management but also to ensure that performance can reported externally as we have committed to do via an annual summit and report. This is incremental to the formal reporting lines that Ofgem have decreed.

In addition to challenge from the ESC, we will implement a balanced score card which will be reviewed by our executive directors each month. The key performance indicators (KPIs) will be initially devised by us based on stakeholder feedback but we plan to ensure that this is reviewed annually as Whole System planning becomes ever more a “business as usual” approach to our decision making.

Our scorecard is initially designed to report the following KPIs:

KPI1: **CHARTER AND COLLABORATION AGREEMENTS – ENERGY SECTOR**. Monthly tracking of number of charters and collaboration agreements across the energy sector (including gas) - we are measuring the effectiveness of our external engagement and cross vector impact

KPI2: **CHARTER AND COLLABORATION AGREEMENTS – NON-ENERGY SECTOR** Monthly tracking of number of charters and collaboration agreements across non energy sector. - we are measuring the effectiveness of our external engagement and impact on organisations beyond our industry (such as with Local Authorities and NGOs).

KPI 3: DATA SHARING AGREEMENTS AND DATA EXCHANGE. Monthly tracking of data sharing arrangements in place, with a subset of data sets identified for both incoming and outgoing data sharing arrangements – we are measuring and monitoring the impact that data sharing is having and identifying where further subsets of data should be agreed with third parties.

KPI4: **WHOLE SYSTEM INVESTMENT PLANNING**. Monthly tracking of the number investment planning and engineering justification papers across all voltage levels that (1) include a Whole System solution and (2) have ruled out a Whole System solution.

KPI5: **WHOLE SYSTEM VALUE**: Establish the value of Whole System solutions versus a conventional counterfactual, split between transmission and distribution voltages – we will measure the value of our decision making in economic terms and demonstrate that value for our customers.

KPI6: DEPLOYMENT OF LCT: We will capture the number of low carbon technologies being deployed on our network – we will measure where we have been effective in the transition to Net Zero. This can also identify trends in technology but also where certain geographic areas may not be deploying in line with expectation or an agreed benchmark with others.

Table 4: How we will measure success

Initiatives/Commitments	Measure
We will implement a Whole System planning function	Recruitment and training of WS planners – rising from six in 2023 to nine by 2030
We will establish strategic partnerships.	No. of frameworks for cooperation and collaboration that are in place
We will carry out an extensive business change project to fully embed Whole System planning into our policies and procedures.	Percentage of policies and procedures updated
We will provide a dedicated team of technical specialists that will partner with Local Authorities and regional Governments to support the development and implementation of Low Carbon Technology roll-out and Local Area Energy Planning.	Feedback from Local Authorities and outputs in terms of LCT rollout and successful implementation of regional plans
We will carry out optioneering studies for Local Authorities to identify the most suitable locations for new public EV charging hubs,	No. of optioneering studies that lead to identification of suitable locations
We will work with Local Authorities to assist in their EV chargepoint rollout by serving as the EV charging infrastructure provider of last resort in areas where the market does not deliver.	No. of events acting as EV chargepoint provider of last resort
We will host an annual summit with key stakeholders, customers and Whole System partner organisations to perform a look back on Whole System plans, deliverables and outcomes, together with a look forward to future opportunities and requirements	Hosting of an annual summit
We will report annually on the positive impact of both planning and outcomes across an agreed set stakeholder lead metrics	Publication of report
We will ensure there is independent audit and challenge on our Whole System thinking, planning and solutions.	Publication of audit findings
We will look to achieve ISO accreditation for our new governance process so that it can be audited and benchmarked.	ISO accreditation received

9. Appendices

9.1 Appendix 1 – BPI signpost

Ofgem BP Guidance No	Page Number
Paragraph 4.29 Plans and processes for joint planning with other network companies and/or the system operator (and evidence of that already undertaken).	• Page 8 – Figure 1 is an 'at-a-glance' illustration of planning and data touchpoints within and beyond the electricity sector that we are enhancing for Whole System planning. • Pages 10/11 – Our Whole System strategy and the three overarching programmes of work to engage in a structured manner, implement a Whole System planning function and undertake business-change to embed Whole System thinking as business as usual activity. • Page 43 – Appendix 4 – Provides evidence of frameworks for cooperation and collaboration within and beyond the electricity sector • Page 67 – Appendix 8 - We have developed extensive strategic engagement to facilitate joint planning within the electricity sector, regularly co-ordinating with National Grid ESO, National Grid TO, SSEN and other DNOs (such as through the Whole System Charter (Appendix 8, Case Study 13)) as well as outside our industry including our strategic partnerships for the decarbonisation of heat and transport with the Scottish Government and SSEN (Appendix 8, Case Study 14) • Page 90 – Appendix 9 - we describe our investment decision-making framework and how it will change in RIIO-ED2 to accommodate a Whole System Operational Framework (WSOF). The WSOF sets out how we will operationalise our Whole System thinking and outcomes we are targeting by energy vector.
Paragraph 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.	• Page 12/13 – Section 6 Our Track Record in RIIO-ED1 and Plans for RIIO-ED2 • Page 47 – Appendix 5 – Methodology for quantification of benefits • Page 67 – Appendix 8 – We provide 20 Case Studies of Whole System solutions and approaches we have adopted
Paragraph 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 (see section 5 'Forecasts and scenarios').	• Pages 10/11 – Our Whole System strategy to implement a new team with accountability for Whole System solutions and outcomes • Page 29 – Section 7 Deliverability of Our Plans – discusses how we will mitigate uncertainties and put controls in place to ensure progress • Page 47 – Appendix 5 – Methodology for quantification of benefits

	• Page 55 – Target Operating Model for how we will organise our business for long-term delivery
Paragraph 4.29 Demonstrable cross-sector engagement, optioneering, and planning with sectors other than their own.	• Page 12/13 – Section 6 Our Track Record in RIIO-ED1 and Plans for RIIO-ED2 • Page 43 – Appendix 4 – Provides evidence of frameworks for cooperation and collaboration within and beyond the electricity sector • Page 67 – Appendix 8 (Multiple Case Studies)
Paragraph 4.30 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:	*(See references to each bullet point in 4.30 below).*
Paragraph 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.	• Page 12/13 – Section 6 Our Track Record in RIIO-ED1 and Plans for RIIO-ED2 • Page 33 - Engineering Justification Papers and Cost Benefit Analysis • Page 47 – Appendix 5 – Methodology for quantification of benefits
Paragraph 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).	• Pages 8/9 – Section 4.3 Why Whole System thinking matters • Page 67 – Appendix 8 (Multiple Case Studies) • Page 90 – Appendix 9 Whole System Operational Framework with targeted outcomes by energy vector
Paragraph 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 (eg telecommunications).	• Page 47 – Appendix 5 – Methodology for quantification of benefits
Paragraph 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	• Page 43 – Appendix 4 – Provides evidence of frameworks for cooperation and collaboration within and beyond the electricity sector

costs and benefits between the company and the Whole System partner(s) are appropriate.	• Page 60 – Appendix 7 – Memorandum of Understanding with the Energy Systems Catapult
Paragraph 4.30 why a market solution could not, or should not, be utilised to deliver the activity, and that all options have been considered on a level playing field.	• Pages 10/11 – Our Whole System strategy • Page 21 – Flexibility Assessment Methodology • Page 90 – Appendix 9 Whole System Operational Framework
Paragraph 4.30 that the activity is not BAU, and expenditure which sets the activity as above BAU should be clearly identified and delineated.	• Page 47 – Appendix 5 – Methodology for quantification of benefits • Page 55 – Target Operating Model for how we will organise our business
Paragraph 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.	• Pages 12/13 – Section 6 Our Track Record in RIIO-ED1 and Plans for RIIO-ED2 • Page 67 – Appendix 8 (Multiple Case Studies)
Paragraph 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.	*(Not relevant – SPEN has identified potential opportunities)*
Paragraph 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.	• Page 23 – Whole System focus in our innovation strategy • See Our Innovation Strategy

9.2 Appendix 2 - Terminology

We believe the interconnection of the electricity network with heat, gas, transport, water and other energy vectors leads to a single 'eco-system' i.e. one interconnected mesh that requires joined up thinking. It is for this reason that we refer to 'Whole System' rather than 'Whole Systems'.

In general, the terminology we use for Whole System is based on the standard components of solution development. The diagram and table below contain a quick guide to terms used.

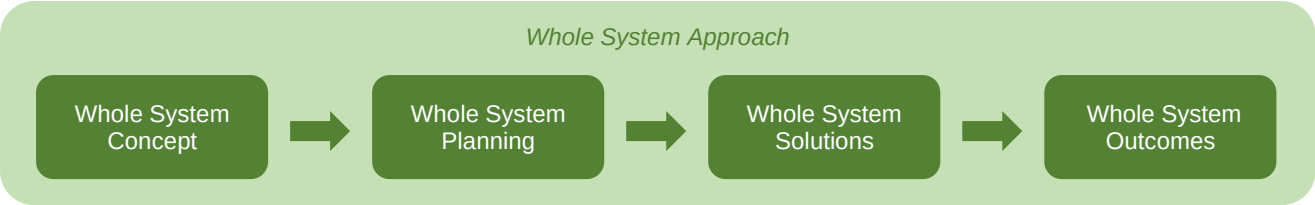


Figure A2-1: Our Whole System Approach

Table A2-1: Whole System Definitions

Terms	Description
Whole System Concept	As described in section 4.1.
Whole System Planning	The scoping and specification of Whole System requirements.
Whole System Solutions	The consideration of options to meet Whole System requirements.
Whole System Outcomes	The output from the implementation of Whole System solutions. These typically arise from actions taken between two or more parties that result in both: • an investment in the Whole System representing best value for money • improving or, at a minimum maintaining the services and benefits received by customers within the Whole System
Whole System Approach	The overarching approach from concept to outcomes.

9.3 Appendix 3 – Analysis of Stakeholder Engagement

Table A3-1: Stakeholder Feedback

Stakeholder Feedback
Feedback on Whole System mission statement - There was broad support for SPEN's Whole System mission statement - 33% of stakeholders strongly agreed, and 50% agreed, 17% of stakeholders felt neutral and none disagreed. - Stakeholders provided some examples of how the mission statement could be improved. Suggestions varied from wording changes and provision of additional information to improve clarity to further actions, such as being more proactive with local renewable generation groups and supporting low-income households in accessing low carbon technology. Additionally, one stakeholder highlighted that SPEN should recognise that customer solutions might change over time, so SPEN should be careful not to prejudice future customers, and that vulnerable customers need to have specific considerations. Finally, a stakeholder expressed support for the mission statement but believed it would be difficult for SPEN to achieve it in reality.
Feedback on the Whole System six guiding pillars - Stakeholders also clearly believed that the six-pillar strategy presented by SPEN would enable the delivery of Whole System solutions (17% strongly agreed, 75% agreed and 8% stakeholders felt neutral with respect to this question). - Stakeholders provided only two suggestions for additional pillars that they believe SPEN should consider: (i) reduction of visible impact of new infrastructure, such building aesthetically pleasing substations, and (ii) the inclusion of other partners beyond energy sectors to get a more holistic overview of the existing supply chain.
Feedback on delivering the Whole System strategy - Of all stakeholders engaged, 8% strongly agreed, 75% agreed, 17% felt neutral (but none disagreed) that the practical steps proposed by SPEN to deliver the Whole System strategy are appropriate.
Feedback on Whole System Target Operating Model - When stakeholders were asked if they agree with SPEN's Target Operating Model they propose will be effective and efficient in delivering Whole System outcomes, 75% of stakeholders agreed. Further 17% of stakeholders felt neutral and 8% disagreed. - Stakeholders broadly agreed that the Target Operating Model looks strong and praised the inclusion of the strategic optimisers in particular. One stakeholder that disagreed, however, believed that there was not enough emphasis on rapid small-scale response within the Target Operating Model. Furthermore, stakeholder that felt neutral mentioned that stakeholder engagement is critical for the TOM, but it is also important for SPEN to be represented and take part in wider national groups in relation to national infrastructure, helping with master planning specific wider sites and also whole Council areas. Additional suggestions included clarifying the points around data sharing (between steps 5 and 6) and simplifying the model to make it more comprehensible for the general audience. - Finally, a stakeholder mentioned that at present, the cost for network improvement is heavily reliant on the customer, for example, if a customer requires a 300kVa supply, they need to pay for a 500kVa substation, leaving SPEN additional capacity to sell on to other customers. Therefore, they highlighted that a fairer cost model would be welcomed.
Feedback on the proposed Whole System initiatives - SPEN presented a range of initiatives it is proposing to deliver as part of the RIIO-ED2 Business Plan and asked stakeholders whether delivering these (or similar initiatives) would lead to the desired Whole System outcomes for customers and communities. There was broad support for these initiatives with 8% of stakeholders strongly agreed, and 67% agreed. Further 17% of stakeholders felt neutral and none disagreed.

9.4 Appendix 4 – Frameworks (To Date) for Cooperation and Collaboration

1. SPEN & NPG Framework for Whole System Cooperation and Collaboration

Date: 21.09.2021

This page describes our charter for collaborating and cooperating with SGN to explore Whole System solutions, deliver Whole System outcomes, and fulfil Whole System License obligations.

Introduction:

Existing collaboration between SPEN and SGN, such as the East Neuk power-to-hydrogen project and the Whole System Charter, highlights the willingness and appetite of both parties to cooperate and engage to explore initiatives in tandem, and deliver Whole System outcomes.
SPEN and SGN concur that the Whole System concept must consider the intricate complexity of a true cross-vector energy system; there is recognition of the multiple-order consequences that arise from any decision, and that the impact of these decisions on the customer must be carefully analysed and considered.

Objectives:

- Develop the basis for future discussion, engagement, and delivery of relevant Whole System solutions.
- Where possible and practical, agree achievable Whole System outputs that will emerge through cooperation and collaboration.
- Achieve Whole System solutions that provide flexibility and decision-making capability for the customer.

Plans and Processes:

Explore future Whole System involvement in specific projects, notably related to the exchange and management of data, and the potential for such data sharing to inform and facilitate management of constraints and surpluses between electricity and gas/hydrogen networks.

a. Determine if and how a (real-time) data sharing and management system could support cross-vector understanding of energy constraints and surpluses.

b. Explore the potential for data protocol projects and sharing of data with peaking plants to improve awareness and understanding of network performance and potential network constraints.

Conduct feasibility studies into the potential to assist Local Authorities and community groups, from a Whole System perspective, in their efforts to decarbonize and achieve net-zero ambitions.
Establish appropriate methods to assess deliverability and the measurement of success.

Actions:

Reconvene at the end of October 2021 to discuss the types of data that both SPEN and SGN would benefit from sharing with each other.
Arrange a further bilateral discussion between SGN and SPEN for October/November 2021, involving the SPEN innovation and flexibility teams.
SGN will organize an Energy Networks Charter meeting prior to the end of 2021, with SPEN and SGN to jointly establish the meeting agenda.

SPEN Attendees	SGN Attendees
Gareth Hislop, Laura Dunn, James Soundraraju, Fergus Gunn	Colin Thomson, Ryan Smith, Angus McIntosh, Jeremy Deveney, Fergus Tickell

2. SPEN & NPG Framework for Whole System Cooperation and Collaboration

Date: 06.10.2021

This page describes our charter for collaborating and cooperating with NPG to explore Whole System solutions, deliver Whole System outcomes, and fulfil Whole System License obligations.

Introduction:

SPEN and NPG recognise the significant challenge inherent in the electrification of the energy network, and in understanding how and where load-growth will impact the network in the future.
It is thus vital to make best use of network data to support future investment decisions, and to forecast and model the uptake in LCTs such as EVs and heat-pumps.
SPEN and NPG recognise their role and responsibility in guiding and assisting, but not dictating, Local Authorities and their approach to achieving net-zero targets.

Objectives:

- Develop the basis for future discussion, engagement, and delivery of relevant Whole System solutions.
- Where possible and practical, agree achievable Whole System outputs that will emerge through cooperation and collaboration.
- Achieve Whole System solutions that provide flexibility and decision-making capability for the customer.

Plans and Processes:

Cooperation on Distribution, especially where the license areas of SPEN and NPG converge, will be of particular value to both parties. This will be facilitated through quarterly meetings to discuss system planning. Identifying and communicating the needs and issues of the network and at respective GSPs will facilitate SPEN and NPG working collaboratively to achieve Whole System solutions to the challenges that emerge.

Actions:

Both parties will pull together lists of contacts for which to facilitate future discussions and bilaterals
Establish a bilateral coordination meeting between SPD and NPG for week commencing 13th December 2021.
Arrange an initial discussion (week commencing 1st November 2021), to explore future quarterly trilateral engagements between SP Transmission, NPG, and the ESO, regarding wider system planning.
Establish future engagement sessions and knowledge-sharing forums to discuss Whole System solutions based on:

c. Flexibility relationships and enabling flexibility
d. Demand and network forecasting
e. Sharing of knowledge and information regarding network planning and strategic partnerships (house builders, Local Authorities and Local Area Energy Plans)

SPEN Attendees	NPG Attendees
Gareth Hislop, Laura Dunn, Nick Evans, Fergus Gunn	Simon Jesson, Ryan Place

3. Whole System Charter

Date: 25.05.2021

This page describes a Whole System Charter to promote gas and electricity companies (SPEN, SSEN, SGN, NGET, NGG, ESO) working together to deliver Whole System goals.

Introduction:

SPEN (Distribution and Transmission) has entered into an Energy Networks Charter with SGN, SSEN (Distribution and Transmission), National Grid Electricity Transmission, National Grid Gas Transmission and National Grid ESO to establish shared commitment to work together to deliver Whole System solutions and outcomes.

Objectives:

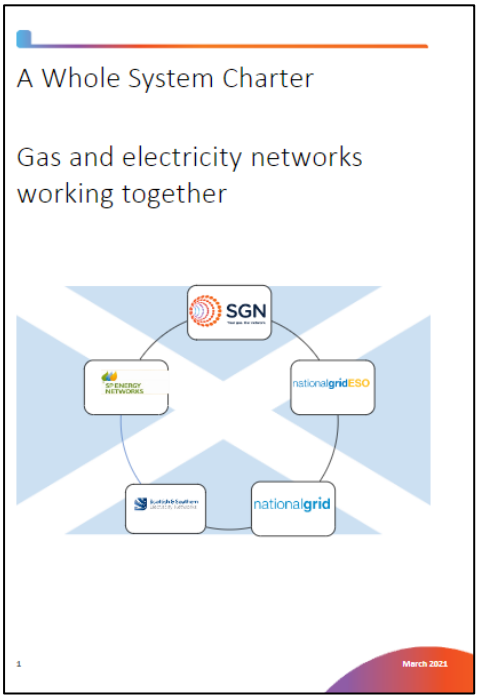
- Work together, through coordination and cooperation
- Manage uncertainty
- Develop Whole System tools and processes
- Demonstrate our commitment to Net Zero

Plans and Processes:

We intend to create a common framework for sharing data and information to formulate a Whole System approach. In addition, we aim to identify opportunities to collaborate on Whole System solutions and outcomes.

Actions:

All parties will formalise points of contacts for future discussions and begin a series or themed discussions to progress the objectives set out above.



4. Decarbonisation Pathway Support for North West Districts

Date: July 2021

This page describes a partnership between SPEN and Cadent Gas to support the decarbonisation ambition of eight districts in the North West.

Introduction:

The eight districts in the North West making up Liverpool City Region, Cheshire West & Chester and Warrington ("the region") all recognise the challenges of unlocking the local potential for action to decarbonise, and quality of life improvements and the economic opportunities this successful decarbonisation would yield when implemented in a resilient and equitable way. As key stakeholders, operators of critical energy infrastructure and knowledge partners for the region, Cadent Gas and Scottish Power Electricity Networks (SPEN) have partnered up to contribute to the achievement of these decarbonisation ambitions and the required action and investment.

Objectives:

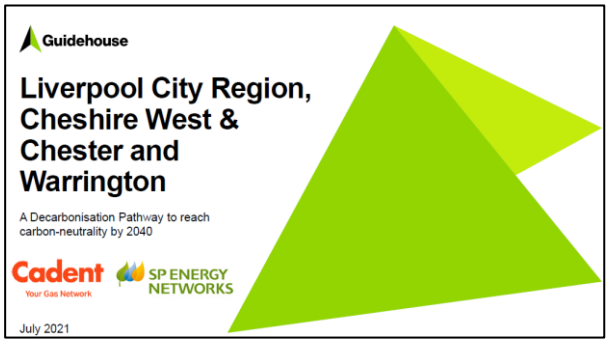
- Cadent Gas and Scottish Power Energy Networks (SPEN) wish to contribute to the achievement of the decarbonisation ambitions and the required action and investment
- A common view on how to reach net zero by 2040 enables taking timely and effective energy transition steps

Plans and Processes:

We will build a single Whole System view of the current and future energy demand and supply of the Liverpool City Region, Cheshire West & Chester and Warrington region ("the region") to create a pathway to achieve the 2040 net-zero ambition established by regional authorities.

Actions:

We have commissioned experts to undertake analysis and modelling across several energy vectors and to recommend pathway actions.



9.5 Appendix 5 – Quantification of Benefits

1. Social Return on Investment (SROI) assessment of our Whole System initiatives

We set out to assess the broader impacts of our package of Whole System initiatives on customers and stakeholders. Given the nature of this strategy and the high degree of positive externalities that will stem from the initiatives within it, we considered it appropriate to measure its impact beyond a traditional cost benefit analysis (CBA). These analyses typically focus on quantitative (strictly financial) costs and benefits to the organisation and allow for the standardised comparison of projects. However, the value of projects with additional, traditionally qualitative impacts, are difficult to measure and compare using traditional CBA methods.

In response, we have adopted a comprehensive social value measurement framework, which incorporates social return on investment (SROI) modelling (via an Excel-based social value tool) and builds upon traditional CBA by also measuring and accounting for typically qualitative, social impacts of a project. This is done by using financial proxies to quantify societal benefits that are not generally monetised.

The method we have adopted incorporates both traditional CBA and SROI methods. Combining these two approaches allows us to demonstrate the total economic value, including both the financial and social impact of a project. In addition to the Whole System strategy, we used this method to assess the wider impact of several elements of our RIIO-ED2 Business Plan including Consumer Value Propositions (CVPs), Output Delivery Incentives (ODIs), our Environmental Action Plan and other specific commitments.

It is important to note that the method adopted is fully aligned with the industry-wide SROI methodology agreed by all DNOs and developed with key stakeholders including Ofgem in 2020.

The value of our Whole System strategy to customers and stakeholders

The value of our Whole System strategy is determined by the initiatives contained within it. While the strategy contains over 25 initiatives, we measured the value of eight of these. In the interest of presenting a conservative and realistic picture of the strategy's benefits, we only considered initiatives with well-defined costs as well as specific and measurable outputs supported by evidence gathered during projects or trials. The overall value of the Whole System strategy is, therefore, likely to be considerably larger than the estimates presented below.

In line with our objective to present a conservative picture of the strategy's benefits, we also limited our assessment to the RIIO-ED2 period. Several of the initiatives measured span several years – while some were rolled out in RIIO-ED1 and will continue to benefit customers for years to come, others will only be introduced in the coming years. In other words, the impact figures presented below only capture benefits over a limited timeframe.

Initiative	Gross Present Value[27]
Strategic Optimisers, Local Heat and Energy Efficiency Strategies (LHEES), Local Area Energy Plans (LAEPs) and energy efficiency considerations.	£20.19m
Net Zero Fund	£1.67m
Project FUSION	£2.70m
Project CHARGE	£1.46m
Dumfries & Galloway Active Network Management	£23.77m
Distributed Re-Start	£15.25m
Re-Heat	£8.29m
Fault Level Monitoring	£31.43m
Total RIIO-ED2 GPV = £104.76m	

[27]Gross Present Value (GPV) represents a combination of any avoided costs to the network (that are therefore accrued to customers), financial benefits for customers and societal benefits that are generated as a result of our initiatives.

How the methodology accounts for uncertainty

In order to account for uncertainty, we have discounted benefits and taken a conservative view of proxies in the following manner:

- Wherever relevant, we have attributed a proportion of any benefits to SPEN in line with our indicated proportion of project funding. This can be as low as 2.48% of the total benefits of a project.
- Where benefits have been calculated at GB-wide and licensee scale, we have considered only licensee scale benefits in our calculations. This can be the difference between inputting £30m+ in benefits vs. £1m by 2030 (for example).
- We have discounted the success rates (i.e. the likelihood that a given benefit will materialise) where relevant based upon research conducted by leading and reputable organisations. For example, where a benefit associated with receiving energy efficiency advice may materialise, we assumed that 64% of customers will take action on the back of being provisioned this advice – this is in line with Energy Saving Trust evaluations[28].

2. Cost-Benefit Analysis (CBA) of our Whole System planning function

We have assessed the benefits of introducing a Whole System planning function using Ofgem's standard CBA template. Our calculations show that the function delivers a net present value (NPV) benefit of between £7.8m and £49.1m over the course RIIO-ED2. The range of benefits arises from sensitivity analysis (low, medium and high forecasts) applied to outputs and associated net benefits from the team.

The analysis has been performed using the CBA template for RIIO-ED2 as published by Ofgem and we have complied with Ofgem's CBA guidance within our assessment. This economic assessment will monetise the relevant Whole System solution benefits delivered by the team over the course of the RIIO-ED2 price control by netting them against the cost of the team, and then appropriately amortising and discounting these cost and benefit streams to arrive at the NPV.

In line with Ofgem's CBA guidance, we have utilised the Spackman approach within the CBA for the Whole System Planner team, having used the following assumptions in the analysis:

Table A5-1: Whole System Planner Team CBA Standard Input Assumptions

Assumption	CBA model
Capex depreciation period	45 years. Reflects the economic life of our investments and is consistent with asset life assumptions used in the RIIO-ED2 finance model.
Cost of Capital (pre-tax)	3.60% (in line with RIIO-ED2 SSMD)
Discount Rate	Social time preference rate of: 3.5% (less than and equal to 30 years) and 3.0% (greater than 30 years)
Base year	2023/24
Price base	2020/21
Cost of carbon (£/tonneCO2e)	BEIS short-term traded carbon values for policy appraisal. Beyond 2030, use DECC target-consistent approach to carbon values.
Capitalisation rate	70%. In line with the rate applied in our CBA submissions in our RIIO-ED2 business plan.

We have entered costs and benefits within the CBA on an incremental or relative basis i.e. how much more the Whole System planner team cost / deliver *in addition* to BAU operations. For clarity, this means that no baseline scenario has been conducted (i.e. where Whole System assessments are undertaken in line with RIIO-1 operations) in order to simplify the analysis and to more easily showcase the additional value the team are anticipated to deliver over the course of RIIO-ED2 and beyond.

[28]http://data.parliament.uk/WrittenEvidence/CommitteeEvidence.svc/EvidenceDocument/Energy%20and%20Climate%20Change/Home%20energy%20efficiency%20and%20demand%20reduction/written/22855.html

Many of the benefits associated with the team's anticipated operations are unfortunately challenging to quantify at this stage as they would be realised on a system-wide level and are dependent on interactions between multiple parties within and outwith the electricity sector. Given the challenges associated in the quantification of these benefits, they have not been included within the CBA assessment of the Whole System Planner team.

Given that we have not factored in all associated Whole System benefits, the outcome of the Whole System Planner CBA is therefore a conservative estimate of the expected benefits realised by the team.

To keep the analysis proportionate, we have focused our analysis on a subset of more-easily quantifiable benefits associated with the team's planned operations. We have included the following three main quantifiable benefits within our Whole System Planner CBA assessment:

- **Asset Build Savings:** the net savings benefit from the avoided build of a conventional solution on the network to alleviate a specific issue, following the identification of a more optimal Whole System (i.e. cross-sector) solution.
- **Specialist Team Solutions:** the RIIO-T2 framework has allowed for the development of a process which allows SPT to work closely with the ESO to identify opportunities to save the end consumer money through reduced constraint costs. The Whole System Planner team is expected to deliver similar types of specialist solutions on the distribution network, but on a smaller scale.
- **Flexibility Solutions:** the identification of areas on the network where flexibility services could be utilised to manage network constraints rather than committing to traditional reinforcement to increase network capacity.

As the actual benefits delivered by the team will depended on a range of factors within and beyond our control, we have conducted a sensitivity analysis around the scale and deliverability of the team's quantifiable outputs. This has allowed us to determine a reasonable benefit range for each quantifiable benefit category. For each benefit category, we have set out Low, Medium and High assumptions around the underlying estimation inputs. We detail these input assumptions within the methodology description behind each benefit category.

Asset Build Savings

The Whole System planner team is expected to collaborate with other energy networks and relevant stakeholders to apply a more Whole System approach to network planning and design; helping to identify more optimal cross-sector solutions to network issues. Incorporating Whole System thinking into our investment decision-making processes will help ensure more efficient investment from a Whole System perspective with the delivery of both asset cost and environmental benefits to our customers through the team's identification and delivery of more optimal Whole System initiatives.

Methodology

For the purposes of the CBA, we have only analysed the cost and carbon savings associated with our synergistic electricity transmission / distribution solutions that we have planned for in RIIO-T2 (i.e. where an SPT solution was put in place to provide SPD benefits) as this is the only reliable data relating to Whole System solutions that we have access to. We have extrapolated these values across an assumption of the number of synergistic transmission and distribution solutions that the WS planner team are able to identify and deliver over RIIO-ED2 in addition to those delivered under BAU.

Unfortunately, the expected cost and environmental savings associated with other cross-sector Whole System solutions (i.e. interactions with GDNs and DNOs) are incredibly difficult to quantify at this moment; we do not have access to the required data to monetise these benefits. As such, the value of this benefit category is a low estimate of the true financial outcomes that could be achieved by the team from Whole System solutions through cross-sector collaborations.

We have also not factored in the benefits associated with the team's impact on network planning for the RIIO-ED3 price control. There will be additional capability to identify and promote more Whole System options for the subsequent price control period.

The assumptions underpinning this benefit category are as follows:

Table A5-2: Asset Build Savings Benefit Assumptions

Assumption	Justification
First ET/ED Whole System projects would be delivered in year 4 of RIIO-ED2.	This is a conservative assumption around the timelines and feasibility of the team to identify and deliver synergistic ET/ED solutions over the RIIO-ED2 period.
Asset cost savings per project: • **Low: £1.53m** • **Medium: £1.93m** • **High: £3.28m**	Based on the cost savings between the preferred SPT solution and the counterfactual SPD solution from SPT's RIIO-T2 GSP projects. The Medium scenario is based on the average of the present value of cost savings observed, with Low and High scenarios based on the lower and upper quartiles of the range, respectively.
Deliverability of number of projects: • **Low: 4 (2 in yr 4 and 2 in yr 5)** • **Medium: 6 (3 in yr 4 and 3 in yr 5)** • **High: 7 (3 in yr 4 and 4 in yr 5)**	Internal assumption around the team's estimated capacity to deliver additional ET/ED Whole System projects.
Overall carbon abatement savings per project: • **Low: £1.99m** • **Medium: £2.54m** • **High: £2.87m**	Based on the carbon abatement differences between the preferred SPT solution and the counterfactual SPD solution from SPT's RIIO-T2 GSP projects. Values have been updated to reflect the traded carbon price as included in the Ofgem RIIO-ED2 CBA. The Medium scenario is based on the average of the present value of net carbon abatement benefit observed, with Low and High scenarios based on the lower and upper quartiles of the range, respectively.
Number of projects that will deliver a carbon abatement benefit: • **Low: 2 (1 in yr 4 and 1 in yr 5)** • **Medium: 3 (1 in yr 4 and 2 in yr 5)** • **High: 4 (2 in yr 4 and 2 in yr 5)**	Some of the observed GSP projects exhibited a zero net figure for the differences in carbon abatement benefit between the SPT and SPD solutions (i.e. both solutions have identical benefit figures). We have therefore made an internal assumption around the number ET/ED Whole System projects delivered by the WS Planner team that are able to provide a net positive carbon abatement benefit.

Benefits

Based on the extrapolated savings from observed RIIO-T2 ET/ED Whole System related projects, we estimate the total benefits in this area in the below table.

Table A5-3: Asset Build Savings Outputs

£m, 20/21	Year 1	Year 2	Year 3	Year 4	Year 5
Asset cost savings					
Low	-	-	-	3.06	3.06
Medium	-	-	-	5.78	5.78
High	-	-	-	9.84	13.12
Carbon cost savings					
Low	-	-	-	1.66	1.66
Medium	-	-	-	2.34	4.69
High	-	-	-	5.81	5.81

Specialist Team Solutions

We are trying to learn from the good processes identified and implemented in the second half of RIIO-T1, and RIIO-ED1, and carry these forward into RIIO-ED2. SP Transmission (SPT) have developed a process along with other Transmission System Operators (TSO) and the Electricity System Operator (ESO) which allows SPT to work closely with the ESO in identifying Whole System opportunities to save the end consumer Balancing System mechanism costs. We believe that if we adopt the same type of Whole System thinking on the electricity distribution network, cost savings to the end consumer could be identified and realised. We would expect a WS team to identify and deliver Whole System solutions that could generate savings of around 5-20% of those identified and forecast in RIIO-T2. It is important to note that these benefits would not have been identified, in RIIO- T2, if SPT did not have specialist staff looking for Whole System opportunities.

The recent SPT Dunbar GSP and the Wishaw 275kV switchgear replacement projects are successful examples of WS collaboration and operation taken from RIIO-T1. The Dunbar GSP project involved collaboration between SPT, SPD, the ESO and importantly a number of embedded generators and HV customers. This collaboration ensured the project was delivered in an efficient, timely manner, while maintaining security of supply to our customer group and ensured the embedded renewable generations maximised their generation output during the project outage period. By using a Whole System approach during the Wishaw 275kV switchgear replacement project, SPT identified an outage sequence in the later stages of the project that would seriously affect the ability of a Transmission connected generator to generate. This Whole System analysis identified in 2016 that during the 2020 stages, the windfarm would need to be de-energised for 26 weeks. SPT, working with the ESO and the connected generator, developed a process where the project stages could be changed. SPT's extra costs were covered by the generators and the outage duration was reduced to 10 weeks. This innovative thinking by SPT resulted in a reduction in the generator's turnover losses in the region of £7 million. SPT and their support departments were only able to deliver this type of service due to the relevant staff allocated to Whole System thinking and analysis.

For SPD to deliver a similar level of service, they will require to have dedicated staff focussed on Whole System opportunities. Over the course of RIIO-ED2, we also expect the WS team to deliver at least one 'major project' of relative scale to the SPT examples above. These opportunities will not be identified unless there are a sufficient number of specialist staff able to closely monitor the technical aspects of our RIIO-ED2 plan and work in close collaboration with internal and external parties, especially our connected customers and generators.

Methodology

We use a conservative estimate, of between 5-20%, and apply it to the forecasted savings from Whole System solutions for RIIO-T2. This is not a saving to SPEN; this is a saving to our connected customers by more efficient working on the distribution system. Distribution projects are not the same magnitude as their Transmission counterparts, which is why we expect the Whole System savings to be smaller. A large Transmission Major Project would have spend in the region of £20m-£30m; whereas a large Distribution Major Project would have spend in the region of £2m-£3m. Consequently, we chose a 10% factor for our medium estimate, which halves to 5% for the Low estimate and doubles to 20% for the High estimate. However, this is counterbalanced slightly by the size of the respective Transmission and Distribution teams; for RIIO-T2 the network planning team have 2 FTE staff working on WS activities in Transmission, while for RIIO-ED2, a team of between 6 and 9 FTEs has been requested to identify Whole System solutions. Our aim is that the larger distribution team will produce more benefits. Our analysis for RIIO-T2 shows that for a new team, in the Transmission world, most projects take between 3-4 years to deliver from cradle to grave. However, this is generally due to the magnitude of these projects. In the Distribution world the projects are much smaller, as shown above, and benefits should be realised on a quicker scale than Transmission's 3-4 years.

In addition to this, we expect the WS team to deliver one 'major project', of a similar relative magnitude to the Dunbar GSP, or Wishaw 275kv switchgear generator replacement project, across the RIIO-ED2 period. We will consider that for every successfully delivered project, we may need another four in the planning pipeline. A conservative approach would be to expect the team to deliver one 'major project' of this relative magnitude.

However, there is also huge upside potential for the WS team. If they instead managed to deliver a project of relative size to the Western Link HVDC, the benefits of the team would be significantly higher. While the HVDC Link example is a one off, the principle behind how it was identified is Whole System Thinking. Without this, these benefits would not have been realised. The estimates used throughout this CBA have been consistently conservative, but it is important to note the massive potential benefit to consumers of this specialist team.

Benefits

Constraint cost savings from standard WS solutions – based on extrapolated savings from 2 of the WS projects in the STCP 11.4 spreadsheet (Tongland and Windyhill at a total savings figure of £9.8m). Using a deliverability discount assumption per scenario (5%, 10%, 20%) to account for WS solution benefits on the distribution network being of smaller scale relative to those realised in ET. Benefits realised over 2 years, 3 years, and 4 years for the low, medium, and high scenarios respectively, as shown below.

Table A5-4: Constraint cost savings from standard WS Solutions (£m, 20/21)

£m, 20/21	Year 1	Year 2	Year 3	Year 4	Year 5
Low	-	-	-	0.49 (5%)	0.49 (5%)
Medium	-	-	0.98 (10%)	0.98 (10%)	0.98 (10%)
High	-	1.97 (20%)	1.97 (20%)	1.97 (20%)	1.97 (20%)

Savings to generators from WS solutions – based on extrapolated financial savings of £7m from Wishaw 275kv switchgear replacement project. Discounted using a deliverability discount assumption per scenario (5%, 10%, 20%) to account for WS solution benefits on the distribution network being of smaller scale relative to those realised in ET. Benefits realised over 2 years, 3 years, and 4 years for the low, medium, and high scenarios respectively, as shown below. We have not factored in environmental benefits of renewable capacity taken off the network. The more renewable generation that we allow access to the network will offset the use of CCGT gas.

Table A5-5: Savings to Generators from WS Solutions (£m, 20/21)

£m, 20/21	Year 1	Year 2	Year 3	Year 4	Year 5
Low	-	-	-	0.35 (5%)	0.35 (5%)
Medium	-	-	0.70 (10%)	0.70 (10%)	0.70 (10%)
High	-	1.40 (20%)	1.40 (20%)	1.40 (20%)	1.40 (20%)

Constraint cost savings from "Major Project" WS solutions – team identifies and delivers one "Major Project" based on savings relative to the Western Link HVDC (total savings figure of £50m). Discounted using a deliverability discount assumption per scenario (5%, 5%, 10%) to account for the acknowledgement that WS solution benefits on the distribution network will be of a smaller scale relative to those realised in ET. To be conservative with this benefit, given the scale of realised savings from WL HVDC, we assume that benefits are only realised for 1 year at 5% discount factor for the low scenario, and at 3 years at 5% discount factor for the medium scenario. For the high scenario, we have assumed a 4 year period at 10% discount factor.

Table A5-6: Constraint cost savings from "Major Project" WS Solutions (£m, 20/21)

£m, 20/21	Year 1	Year 2	Year 3	Year 4	Year 5
Low	-	-	-	2.50 (5%)	-
Medium	-	-	2.50 (5%)	2.50 (5%)	2.50 (5%)
High	-	4.99 (10%)	4.99 (10%)	4.99 (10%)	4.99 (10%)

Flexibility Solutions

Flexibility services are where we procure third parties and customers to actively manage their demand or generation. This allows us to defer or avoid upgrading the network for new capacity to help avoid the

challenges during periods of constraints on the network. Given customers' needs on the network are constantly evolving and changing, flexibility services provides us with a shorter-term (and faster) solution to resolve urgent and unexpected network needs.

It is anticipated that the Whole System planner team, through its strategic interaction with relevant partners (i.e. neighbouring DNOs, ESO, local authorities, etc), would identify additional areas where flexibility services could be utilised to manage network constraints. They would further assist system designers and our current flexibility services team in developing a stronger market for flexibility.

Methodology

In quantifying this benefit category within the CBA, we have taken a view of the typical annual cost of flexibility services and compared it against a range of traditional reinforcement costs (i.e. the counterfactual cost of flexibility). We have taken information from observed sites where we would realistically tender for flexibility services to manage constraint issues on the network to derive these general flexibility and reinforcement values.

Utilising this tender site information, we observe the flexibility capacity required for each site every year on a MWh basis and multiply with an average utilisation rate to arrive at the annual cost of flexibility services for that site. Looking across the various tender sites, we take an upper bound estimate (in this case 80th percentile) from the range of annual flexibility cost values where we would proceed with a flexibility solution to derive the typical annual cost of a flexibility solution. There are sites where for some years we would not tender for flexibility services and instead decide to reinforce the network due to the high annual flexibility service costs caused by the significant capacity required for that site.

We assume in the calculations that flexibility is required for 2 years i.e. we are able to defer a reinforcement solution by 2 years. This is a conservative and reasonable assumption around the required length of flexibility given our past experience procuring flexibility service on our network. We compare this typical flexibility cost against a Low to High range of counterfactual reinforcement costs derived from our tender site information. We also take an assumption per scenario on the number of flexibility projects that the Whole System planner team are able to identify and deliver over RIIO-ED2.

To summarise, the assumptions underpinning this benefit category are as follows:

Table A5-7: Flexibility Benefit Assumptions

Assumption	Justification
Flexibility services required for 2 years.	Based on our experience of the below-average tender we procure from flexibility providers.
Utilisation rate of £300/MWh	Based on the average utilisation charge rate that we (and other DNOs) have paid flexibility providers for their services.
Annual cost of typical flexibility solution of £20,000	Based on 80th percentile of the range of sites where flexibility would be utilised.
Counterfactual reinforcement cost: • Low: £1.10m • Medium: £1.91m • High: £2.13m	Based on LQ, mean and UQ of range of considered flexibility tender sites. The mean value is also consistent with the average reinforcement cost from previous tender sites.
First flexibility solution projects delivered in year 3 of RIIO-ED2.	This is a conservative assumption around the timelines and feasibility of the team to identify and deliver flexibility solutions over the RIIO-ED2 period.
Deliverability of number of flexibility solutions: • **Low: 2 (1 in yr 3 and 1 in yr 4)** • **Medium: 4 (2 in yr 3 and 2 in yr 4)** • **High: 6 (3 in yr 3 and 3 in yr 4)**	Internal assumption around the team's estimated capacity to deliver additional flexibility projects.

Benefits

The key benefit, of flexibility solutions, is the time value of money from deferring large network reinforcement expenditure to some point in the future. The below table shows the amount of reinforcement expenditure which has been deferred through flexibility solutions for our three scenarios. It is worth noting that this expenditure will still occur at a later date – the discounted cash flows for a deferred capital project are lower compared to those if the capital project had not been deferred, hence there will be a positive net benefit.

Table A5-8: Flexibility Benefit Output

£m, 20/21	Year 1	Year 2	Year 3	Year 4	Year 5
Low	-	-	1.10	1.10	-
Medium	-	-	3.82	3.82	-
High	-	-	6.38	6.38	-

Whole System Planning Function CBA Full Output

Based on our above analysis, the team can be expected to deliver a net present value benefit of between £7.8m to £49.1m over the course RIIO-ED2, depending on the range of sensitivity scenarios (i.e. low, medium and high forecasts).

Even under the Low scenario, which consistently uses our most conservative assumptions around the outcomes delivered by the team, the CBA indicates that the Whole System planner team will deliver a positive NPV over the RIIO-ED2 period, and over the whole project life. The Medium and High scenarios are included to show the large potential upside from the implementation of the team. Given that we have not factored in all associated Whole System benefits, as well as having adopted a conservative approach in our calculation of quantifiable benefits, the outcome of the CBA is therefore a conservative estimate of the expected benefits realised by the Whole System planner team.

Table A5-9: Whole System Planning Function NPV (£m, 20/21)

	5-year	10-year	20-year	45-year
Low	7.8	8.0	8.6	9.3
Medium	21.3	21.7	23.4	25.2
High	49.1	50.6	54.7	59.0

9.6 Appendix 6 – Target Operating Model

The Figure below illustrates our Whole System Target Operating Model (TOM). It is a blueprint of how our business aims to integrate investment planning, distribution system operation, data, digitalisation, the role of Strategic Optimisers, targeted stakeholder engagement and a Whole System planning function to deliver Whole System solutions and outcomes

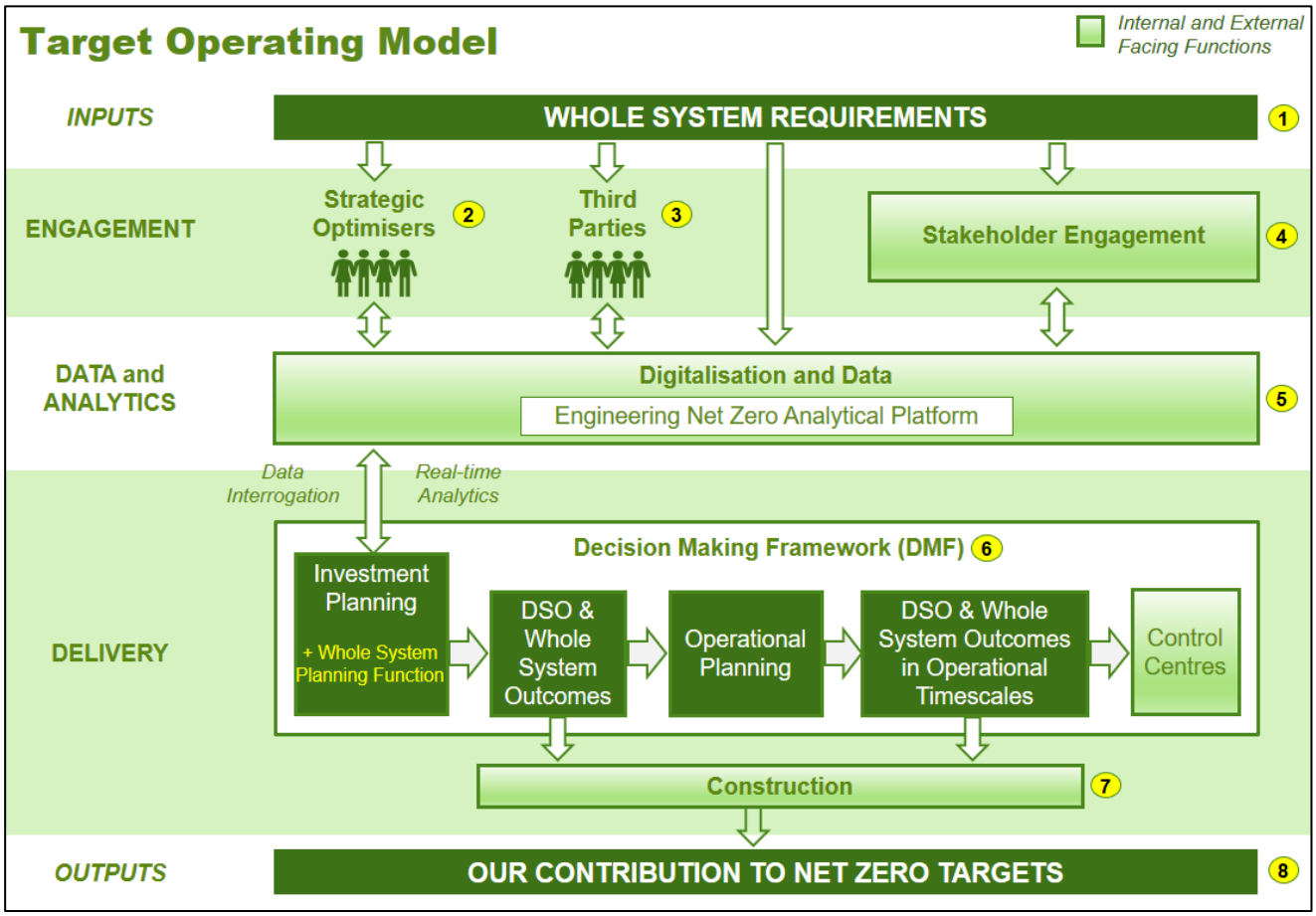


Figure A6.1: Target Operating Model

The TOM is comprised of five function blocks: Inputs, Engagement, Data and Analytics, Delivery and Outputs. We describe the key components[29] of each block in the sections below and list them in Table 6:

Table 3: Target Operating Model Function Blocks and Key Components

Block	Key Components
Inputs	1. Whole System Requirements
Engagement	2. Strategic Optimisers 3. Third Parties 4. Stakeholder Engagement

[29] These are key components from a Whole System perspective. Other major components exist but are not required for the purpose of this explanation.

Data and Analytics	5. Digitalisation and Data
Delivery	6. Decision Making Framework 7. Construction
Outputs	8. Our Contribution to Net Zero Targets

A fuller explanation of some of these components can be found in relevant sections of our business plan. Below describes how we will organise our business to deliver Whole System solutions and outcomes with respect to the TOM.

INPUTS

1. Whole System Requirements

We will identify Whole System requirements from a variety of sources including our Strategic Optimisers, data sharing, suggestions from third parties, stakeholder engagement, investment planning processes and feedback from our control centres.

Whole System requirements encompass a range of inputs such as network and system needs[30], thinking beyond the electricity sector (e.g. integration of heat and transport systems), consideration of environmental impacts, creation of new markets, upskilling our workforce and collaborating with key partners.

ENGAGEMENT

2. Strategic Optimisers

We plan to set up a team of Strategic Optimisers who will use their extensive network knowledge to support Local Authorities and other stakeholders across our two licence areas. They will provide crucial advice upfront and help develop plans for decarbonising heat. This includes Local Heat and Energy Efficiency Strategies (LHEES) and Local Area Energy Plans (LAEPs). Strategic Optimisers will coordinate closely with our proposed Whole System planning function (see Delivery section below) to allow for adequate consideration of the electricity network in the early stages of Local Authorities' heat and decarbonisation plans.

3. Third Parties

The adoption of a Whole System approach to managing our business challenges us to think beyond our immediate boundaries. It requires us to consider the full range of solutions and implement a hybrid of traditional and alternative solutions to address the issues our networks and customers face. As set out in the joint BEIS/Ofgem Smart Systems and Flexibility Plan[31], this approach is dependent not only on the role that regulated entities play, but also on effectively harnessing the contribution that can be made by other parties.

We will add functionality to our Energy Data Hub[32] to publish Whole System requirements and to receive suggestions from third parties on potential solutions.

[30] Examples of network needs include connections, reinforcements, extensions, diversions, asset replacement, maintenance and outages. System needs could include alleviating thermal, voltage and stability constraints.
[31] Transitioning to a Net Zero energy system: smart systems and flexibility plan 2021 https://www.gov.uk/government/publications/transitioning-to-a-net-zero-energy-system-smart-systems-and-flexibility-plan-2021
[32] Our open data platform that houses all data that SP Energy Networks currently shares openly in the public domain.

4. Stakeholder Engagement

Dialogue with our stakeholders may identify Whole System opportunities and barriers for us to address. It is also a channel for us to seek feedback on progress we are making towards delivering Whole System outcomes. Part of our engagement activity going forward will include a targeted external stakeholder forum which aims to provide our customers and stakeholders with visibility and awareness of how we operate the system.

We intend to establish frameworks for cooperation and collaboration to ensure plans and processes for joint planning with organisations such as other network companies, system operators and other strategic partners will be in place.

DATA and ANALYTICS

5. Digitalisation and Data

Digitalisation and the better use of data present a significant opportunity for us to drive modernisation and decarbonisation of our energy system[33]. By collecting Whole System requirements, analysing data and using technologies like digital twins[34], we will build a far more detailed understanding of our network's capacity to support the connection of low carbon technologies and facilitate decarbonisation of transport and heat through the use of flexibility services.

Our Energy Data Hub will be used to publish short to long term network and system needs and have the functionality to accept suggestions, ideas and solutions from any external party. In addition, we intend to share information on the Energy Data Hub that may be useful to other organisations (such as emergency services and Local Authorities).

As part of our digitalisation and data innovation, we have introduced an analytical platform known as the Engineering Net Zero (ENZ) model. It is an integrated real-time network platform that will help us safely plan and operate more dynamic and complex networks, facilitate LV flexibility service use, and improve the identification and sharing of network constraints. The ENZ model creates a digital twin of the real network and is a tool that enables us to analyse Whole System requirements, develop options and formulate Whole System outcomes.

We are also implementing a customer data portal, customer data line and building on our strong governance of data relating to customers in vulnerable circumstances. Through this, customers in vulnerable circumstances will only need to 'register once', have their status shared (subject to customer consent) securely with other utilities and benefit from central coordination of support and customers services. We also intend to use Whole System thinking to support Community Energy Schemes and customer cohorts that may be in vulnerable circumstances.

DELIVERY

Section 4A.1 (Develop the Network of the Future) of our draft RIIO-ED2 business plan describes in detail how we will deliver a step change in network capacity, operability capabilities, and Whole System coordination. In this narrative, we provide a high-level description focussing on our decision-making framework and construction activity with the aim of highlighting our proposal to introduce a Whole System planning function to drive Whole System solutions and outcomes.

[33] Our Digitalisation Strategy provides the solutions that will deliver our Data Strategy. Our Data Strategy establishes the framework to ensure that we carefully collect, manage, share and extract maximum value from data.
[34] A digital twin is virtual representation of a physical object or process that simulates relevant aspects of behaviour to enable forecasting, scenario modelling and optimisation.

6. Decision-Making Framework (DMF)

The decision-making framework (DMF) is used to support our investment and operational planning processes. The basis of the decision-making framework is our established, strongly governed, investment process. To input to this process, the Whole System planners will draw on real-time analytics[35] from the ENZ model to deliver outputs over different time horizons.

Investment Planning with a Whole System Planning Function

The primary outputs from our investment planning are our load-related and non-load related plans over the course of the price control and beyond. By design, these forward-looking plans already include Distribution System Operation (DSO) and Whole System outcomes but we believe the introduction of a Whole System planning function at forefront of our investment planning process is necessary to embed Whole System thinking, create accountability for thinking beyond the electricity sector and meet evolving Whole System requirements.

The Whole System planning function will bring a combination of economic, regulatory, engineering, environmental and operational expertise to assess the full range of solutions available to meet Whole System requirements. This function will operate alongside our existing portfolio of planners and designers but will have additional responsibilities such as:

- assimilating requirements beyond the electricity sector,
- being accountable for Whole System outcomes,
- ensuring compliance with the Whole System licence condition (including ownership of the Whole System Coordination Register[36]),
- ensuring that flexibility solutions are considered from the outset,
- working across transmission and distribution boundaries, and
- maintaining frameworks of cooperation and collaboration with strategic partners.

DSO and Whole System Outcomes

In formulating our load and non-load related plans, our planners and designers consider a range of intervention options to deliver DSO and Whole System outcomes. These interventions[37] include energy efficiency, flexibility services, network reconfiguration, smart solutions (such as LV automation, onload tap changers, monitoring, and solid-state transformers), enhanced asset ratings, and network reinforcement.

Operational Planning

Operational planning is a short, medium and long-term function delivered by the DSO. It enables us to deliver our programme of load, non-load and smart grid requirements while ensuring the network is operated in a safe, secure and economic manner. For instance, operational planning considers how individual circuits can be switched off to enable work to be done on them without compromising security of supply from the network. This function requires close collaboration between the DSO's control centres, investment planning teams and delivery department as well as other system operators and connected customers.

[35] Automated power flow analysis for the entire network in near real-time using four data inputs (monitoring, smart meter, forecasting and asset condition data).

[36] A licence requirement to capture progress toward achieving Whole System cooperation and collaboration.

[37] Described in more detail on page 44 of our draft business plan (Identifying and selecting the right interventions)

DSO and Whole System Outcomes in Operational Timescales

Due to the nearer-term nature of operational planning, there may be a need for network interventions based on prevailing network conditions (e.g. planned and unplanned outages or changes in demand and generation patterns). Therefore, an output of operational planning may be additional DSO and Whole System outcomes to cover operational timescales.

DSO Control Centres

Within SPEN, we operate two network control centres to manage our networks, one at Scottish Power House in Glasgow and one at our Prenton offices. As we move towards the deployment of DSO, and the use of flexibility increases across our network, it will be the role of staff in our control centres to manage and deploy these active network management tools, to ensure that the network continues to meet the needs of our consumers.

7. Construction

Our field-based engineering teams will deploy the interventions mentioned above in delivering our load and non-load related plans as well as smart grid requirements.

OUTPUTS

8. Our Contribution to Net Zero Targets

By developing our planning capabilities, evolving our DSO infrastructure, and using a toolkit of solutions (including Whole System planning) and ‘Whole System’ thinking, we will develop a network that is ready for Net Zero.

9.7 Appendix 7 – Memorandum of Understanding with Energy Systems Catapult

ENERGY SYSTEMS CATAPULT LIMITED MEMORANDUM OF UNDERSTANDING

This **MEMORANDUM OF UNDERSTANDING** ("**MOU**") is made on **24 November 2021.**

Between:

(1) **ENERGY SYSTEMS CATAPULT LIMITED** incorporated and registered in England and Wales with company number 08705784 whose registered office is at Cannon House, 7th Floor, The Priory Queensway, Birmingham, B4 6BS (the "**ESC**");

and

(2) **SP TRANSMISSION PLC,** incorporated and registered in Scotland with company number SC189126 whose registered office is at 320 St. Vincent Street, Glasgow, Scotland, G2 5AD;

(3) **SP DISTRIBUTION PLC,** incorporated and registered in Scotland with company number SC189125 whose registered office is at 320 St. Vincent Street, Glasgow, Scotland, G2 5AD; and

(4) **SP MANWEB PLC,** incorporated and registered in England and Wales with company number 02366937 whose registered office is at 3 Prenton Way, Prenton, CH43 3ET

with Parties (2), (3) and (4) collectively being referred to in this MOU as "**SPEN**",

each a "**Party**" and together the "**Parties**".

1 Background

1.1 SPEN and ESC wish to establish a collaborative relationship focused on using whole system approaches to achieving Net Zero. ("**Collaboration**")

1.2 In this Collaboration SPEN wishes to work with ESC on development of its ambition and plan for using a whole system approach in its transition to Net Zero. SPEN also wishes to work with ESC to support delivery of this ambition and plan.

2 Purpose

2.1 This MOU sets out the Parties' broad intentions to work together in the future including, but not limited to, the following areas:

2.1.1 to collaborate generally on the development of whole systems approaches and for using whole system approaches to achieve Net Zero including building an understanding of how these could be applied in SPEN.

2.1.2 to undertake a programme of work to be delivered as projects structured in three phases:

- Critical Friend Phase: A series of workshops where SPEN will test specific aspects of its whole system approach with ESC delivering key outputs including: Identification of gaps and recommendations from ESC on addressing these gaps (by March 2022).
- Pathway Phase: Designing an optimal pathway to ensure SPEN is prepared to deploy its whole system transition plan from April 2023 delivering key outputs including a blueprint for optimising our collaboration with strategic partners and scoping of joint projects (April 2022 – March 2023).
- Delivery Phase: Delivery of joint ESC/SPEN projects (Post April 2023).

2.1.3 to discuss the potential to enter into a commercial and contractual arrangement (the "**Collaboration Agreement**") setting out the relationship between SPEN and ESC.

2.1.4 to discuss the potential to enter into commercial and contractual arrangements ("**Project Agreement**") for each of the projects undertaken as part of the Collaboration.

2.2 The principles of the Collaboration are set out in summary in Annex 1.

2.3 The anticipated work to be undertaken in the Critical Friend Phase is set out in summary in Annex 2.

2.4 SPEN wishes to share the outputs from the Collaboration, the Collaboration Agreement and the Project Agreement with other industry stakeholders subject to any arrangements agreed for Intellectual Property Rights and to be set out in the Collaboration Agreement.

2.5 This sub-paragraph 2.5 is legally binding. Nothing in this MOU is intended to, or shall be deemed to, establish any partnership or joint venture between any of the Parties, constitute any Party the agent of another Party, nor authorise any Party to make or enter into any commitments for or on behalf of any other Party, neither shall this MOU prevent, impair or restrict any Party hereto from continuing to engage in its business otherwise than in breach of the terms of this MOU. The MOU does not create any commitment or liability (contingent or otherwise) to enter into the Collaboration Agreement or the Project Agreement.

3 Confidentiality

3.1 This paragraph is legally binding.

3.2 Each Party undertakes that it shall not for a period of five (5) years after the date of this letter disclose to any person any confidential information concerning the business, affairs, customers, clients or suppliers of the other Party, except as permitted by paragraph 3.4.

3.3 Each Party shall treat all confidential information as confidential and safeguard it accordingly.

3.4 Each Party may disclose the other Party's confidential information:

3.4.1 to its affiliates, employees, officers, representatives or advisers who need to know such information for the purposes of the evaluation of the collaboration and the negotiation of the Collaboration Agreement. Each Party shall ensure that its employees, officers, representatives or advisers to whom it discloses the other Party's confidential information comply with this paragraph 3; and

3.4.2 as may be required by law, a court of competent jurisdiction, any governmental or regulatory authority (including Ofgem) or the operation of the Freedom of Information Act or the Environmental Information Regulations.

3.5 Clause 3.3 shall not apply to the extent that the receiving Party can demonstrate (to the reasonable satisfaction of the disclosing Party) that:

3.5.1 such information was in the possession of the receiving Party by being recorded in its files without obligation of confidentiality prior to its disclosure by the disclosing Party;

3.5.2 such information was obtained from a third party without obligation of confidentiality;

3.5.3 such information was already in the public domain at the time of disclosure otherwise than by a breach of the MOU and/or the Collaboration Agreement; or

3.5.4 such information was independently developed without access to confidential information.

3.6 No Party shall use the other Party's confidential information for any purpose other than the collaboration and the negotiation of the Collaboration Agreement.

3.7 Without prejudice to any other rights or remedies that either Party may have, each Party acknowledges and agrees that damages alone would not be an adequate remedy for any breach of this paragraph by the other Party. Accordingly, the non-defaulting Party shall be entitled to the remedies of injunction, specific performance or other equitable relief for any threatened or actual breach of this paragraph.

4 Prevention of Corruption

4.1 This paragraph is legally binding.

4.2 Each Party shall:

4.2.1 comply with all applicable laws, regulations, codes and guidance relating to anti-bribery and anti-corruption, including but not limited to the Bribery Act 2010 ("**Relevant Requirements**"); and

4.2.2 have and shall maintain in place throughout the term of the MOU and enforce where appropriate, its own policies and procedures to comply with the Relevant Requirements, including but not limited to adequate procedures under the Bribery Act 2010.

4.3 ESC shall:

4.3.1 promptly report to SPEN any request or demand for any undue financial or other advantage of any kind received by ESC in connection with the performance of the Collaboration Agreement and/or Project Agreement; and

4.3.2 immediately notify SPEN if a foreign public official exerts a direct or indirect influence over the performance of the Collaboration Agreement and/or Project Agreement.

4.4 ESC shall not:

4.4.1 offer or agree to give any person working for or engaged by SPEN or any other ScottishPower group company any gift or other consideration which could act as an inducement or a reward for any act or failure to act connected to the Collaboration Agreement and/or Project Agreement, or any other agreement between ESC and SPEN or any ScottishPower group company, including its award to ESC and any of the rights and obligations contained within it; nor

4.4.2 enter into the Collaboration Agreement and/or Project Agreement if it has knowledge that, in connection with it, any money has been, or shall be, paid to any person working for or engaged by SPEN or any other ScottishPower group company by or for ESC, or that an agreement has been reached to that effect, unless details of any such arrangement have been disclosed in writing to SPEN and has been approved by SPEN before execution of the Collaboration Agreement and/or Project Agreement.

4.5 ESC shall ensure that any person associated with ESC who is providing works in connection with the Collaboration Agreement and/or Project Agreement does so only on the basis of a written contract which imposes on and secures from such person terms equivalent to those imposed on ESC in this clause 4 and ESC shall ensure the compliance by such persons with such terms.

4.6 In the event of a breach of this clause 4 by ESC, SPEN may (without prejudice to its other rights under the Collaboration Agreement and/or Project Agreement and/or at law):

4.6.1 terminate the Collaboration Agreement and/or Project Agreement immediately by written notice, and/or

4.6.2 withhold payment of all or any part of the payments due to ESC; and/or

4.6.3 suspend the Collaboration Agreement and/or Project Agreement at any time and without liability for such time period as required by SPEN.

4.7 For the purpose of this clause 4, the meaning of adequate procedures and foreign public official and whether a person is associated with another person shall be determined in accordance with section 7(2) of the Bribery Act 2010 (and any guidance issued under section 9 of that Act), sections 6(5) and 6(6) of that Act and section 8 of that Act respectively. For the purposes of this clause 4 a person associated with ESC includes but is not limited to any subcontractor or agent of ESC.

5 Prevention of Modern Slavery

5.1 This paragraph is legally binding.

5.2 Each Party represents and warrants that:

5.2.1 it has not been and is not engaged in any practices involving the use of child labour, forced labour, the exploitation of vulnerable people, or human trafficking, including any activity or practice that would constitute an offence under s.1, s.2 and s.4 of the Modern Slavery Act 2015, if carried out in the UK ("slavery and human trafficking");

5.2.2 it's personnel and all other employees and agency workers are paid in compliance with all applicable employment laws and minimum wage requirements;

5.2.3 it will take reasonable steps to prevent slavery and human trafficking in connection with its business;

5.2.4 it will include in its contracts with its subcontractors and suppliers in connection with this Collaboration Agreement and/or the Project Agreement slavery and human trafficking provisions that are at least as onerous to the subcontractor or supplier as those set out in this Collaboration Agreement and/or the Project Agreement; and

5.2.5 it will respond to all reasonable requests for information required by any other Party for the purposes of completing such other Party's annual anti-slavery and human trafficking statement.

5.3 Any instances of slavery and human trafficking connected to another Party will entitle a Party to immediately terminate the Collaboration Agreement and/or the Project Agreement on providing notice to ESC (and without any liability by the terminating Party).

6 Costs

6.1 This paragraph is legally binding.

6.2 Subject to paragraph 6, each Party shall pay its own costs incurred in connection with the preparation and negotiation of this MOU and any future formal agreement.

7 Governing law and jurisdiction

7.1 This paragraph is legally binding.

7.2 This MoU, and all disputes or claims arising out of or in connection with them or their subject matter or formation (including non-contractual disputes or claims) shall be governed by and construed in accordance with the law of England and Wales and the courts of England and Wales shall have the non-exclusive jurisdiction to settle any dispute or claim arising.

8 General

8.1 Neither Party shall make any announcement or public statement on behalf of the other without prior written consent.

8.2 SPEN may share in its RIIO-ED2 Business Plan that it is collaborating with ESC on whole system transition and is permitted by ESC to share this MOU with Ofgem as part of that submission. SPEN will provide ESC sight of the material describing this collaboration before submitting their Business Plan.

8.3 This MOU is non-legally binding, except where specifically stated. It is the Parties' intention that projects arising from the collaboration will be the subject of a separate Project Agreement(s), as directed by that particular project or joint work and that those binding Project Agreement(s) will be drawn up on the basis of the principles set out in this MOU.

Signed by:	**Eric Brown**	
for and on behalf of	**ENERGY SYSTEMS CATAPULT LIMITED**	on 24th day of November 2021
Signed by:	**Scott Mathieson**	
for and on behalf of	**SP TRANSMISSION PLC**	On 24th day of November 2021
Signed by:	**Marc Rossi**	
for and on behalf of	**SP TRANSMISSION PLC**	On 24th day of November 2021
Signed by:	**Scott Mathieson**	
for and on behalf of	**SP DISTRIBUTION PLC**	On 24th day of November 2021
Signed by:	**Marc Rossi**	
for and on behalf of	**SP DISTRIBUTION PLC**	On 24th day of November 2021
Signed by:	**Scott Mathieson**	
for and on behalf of	**SP MANWEB PLC**	On 24th day of November 2021
Signed by:	**Marc Rossi**	
for and on behalf of	**SP MANWEB PLC**	On 24th day of November 2021

Annex 1: Collaboration Principles

Potential ESC Role/Contribution	Outputs
• An assessment of our investment planning decision-making framework to identify any gaps in relation to Whole System planning. (or) • An assessment of our Strategic Optimiser (dedicated Local Authority support) function to identify any potential strengthening of the role in delivering Whole System outcomes.	• Report identifying gaps and recommending potential improvements.
• Critique our Data and Digitalisation strategies (under and MOU with non-disclosure clauses) and help us shape our delivery programme to digitally transform our organisation to be one that is driven and underpinned by data.	• Guidance on moving from our D&D strategies into actual activity and deliverables that will align with the direction of change being driven by the ESC.
• Provide an insights on how a DSO and ESO can coordinate to achieve Whole System outcomes. • Development of future flexibility products, this could potentially include energy efficiency.	• A potential blueprint for DSO-ESO coordination, aligning with ENA work to date. • Report identifying potential future flexibility products.
• Identifying projects under the 'Whole System' banner that could be taken forward under our NZ fund.	• Ideas for 'Whole System' projects that would qualify for the NZ fund and organisations we may wish to approach to deliver these projects.

Annex 2: Critical Friend Phase Principles

The Critical Friend Phase would be structured as a series of workshops including:

- Workshop 1: Systems Approach intro and discussion with SPEN team what it means for them
- Workshop 2: Assessment of Investment planning/Strategic Optimiser
- Workshop 3: Data and Digital
- Workshop 4: DSO/ESO/Flexibility
- Workshop 5 How it all fits together and what projects SPEN should do

A Summary Report would be delivered.

9.8 Appendix 8 – Whole System Case Studies

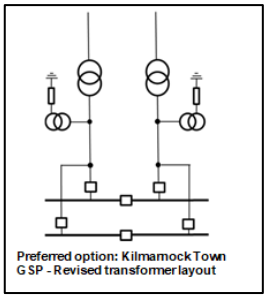
While the concept of Whole System may be new, SP Energy Networks has a remit of existing evidence to illustrate how Whole System thinking and approaches have been nurtured within our business throughout the RIIO-ED1 period. Yet we have the desire and ambition to go further as we enter into RIIO-ED2, and a step change and evolution in our approach is needed to fully embed Whole System across our organisation, our culture, and our way of thinking and working, to ultimately achieve a just transition to net-zero. These case studies demonstrate both our existing successes, but also how and where we are changing or need to change to successfully deliver a Whole System.

The case studies are included in this appendix:

- Case Study 1 : Fault Level Collaboration
- Case Study 2 : Project PACE
- Case Study 3 : Smart Storage Heater Optimisation Study
- Case Study 4 : Dunbar GSP Reinforcement and Modernisation
- Case Study 5 : Black Law Wind Farm
- Case Study 6 : Integrated Constraint Network Management: Dumfries and Galloway
- Case Study 7 : Our Expanding Flexibility Tenders
- Case Study 8 : Hunterston B Decommissioning and Western HVDC
- Case Study 9 : Flexible Gas Generation Forecasting
- Case Study 10 : Net Zero NW Cluster Plan
- Case Study 11 : Pathway to Net Zero Liverpool City Region, Cheshire West & Chester and Warrington
- Case Study 12 : Project Charge
- Case Study 13 : Whole System Charter
- Case Study 14 : Project Re-Heat
- Case Study 15 : Joint Operations Active Network Management (ANM) in Dunbar
- Case Study 16 : Collaborating with House Builders and Homes for Scotland
- Case Study 17 : East Neuk Power-to-Hydrogen
- Case Study 18 : Distributed ReStart
- Case Study 19 : Project FUSION
- Case Study 20 : Energy Networks Wales

Case Study 1 – Fault Level Collaboration

During RIIO-ED1, the increasing volume of Distributed Generation (DG) connections necessitated the requirement to review the impact on fault level infeed (the surge in electricity following a short circuit) at several 275/33kV Grid Supply Point (GSP) sites in Scotland. This review highlighted the requirement for action to be taken at sites, including Portobello GSP, Charlotte Street GSP, East Kilbride South GSP, Kilmarnock Town GSP and Newarthill GSP.



Each of these sites required an enduring reinforcement solution to reduce the risks caused by the potential for overstressed equipment (where fault currents may reach the limits of the equipment's capability to function safely) and to increase the fault level headroom available for new connections.

Coordinated action between SPT and SPD resulted in a joint technical appraisal of a range of options, including consideration of replacement of assets; reconfiguration of the network; fault current limiters and other innovative hardware; protection-based solutions; and active fault level management. A comprehensive cost-benefit analysis was undertaken to identify the most economic and efficient Whole System solution for each.

The approach taken for each site:

1. assessment of maximum demands
2. assessment of generation activity
3. assessment of fault level
4. range of potential options (T&D) developed and costed including an estimate of their respective timescales to complete
5. assessment of each option for its impact on reducing fault levels across a range of scenarios
6. assessment of each option against a range of other considerations relevant to the final decision-making process including outage requirements and their impact on the network; online/offline build options; the age of any assets subject to renewal; environmental considerations; the availability of space and impact on system losses.

Key Findings and Outcomes:

- Process developed for the assessment of options across transmission and distribution from which wider learning can be applied:
- Adoption of comprehensive coordinated Transmission and Distribution CBA approach
- Approach allowed technical consideration of variables including:
    - Online/offline builds
    - Timeframes
    - Operational considerations
    - Environmental considerations
    - System losses

In RIIO-ED2, we will embed the process developed for the assessment of options across transmission and distribution as business as usual. As part of trials we are running, prototype monitors are installed in substations across Chester, Warrington and Liverpool, allowing us greater visibility of the entire electrical network at any given time.

Case Study 2 – Project PACE

In RIIO-ED1, we completed Project PACE, a major project that has evolved from the strategic partnership between the Scottish Government and SP Energy Networks for the decarbonisation of transport. The Project PACE team is working in collaboration with Transport Scotland and Local Authorities to deliver 167 new public chargers in 44 locations across Lanarkshire, targeting areas and communities where the commercial market has not yet delivered and is unlikely to in the short to medium term.

Project PACE is exploring the benefits of having a distribution network operator (DNO) involved in the various stages of deploying universally accessible public EV charger infrastructure, including costs and delivery timescales.

The rollout of public Electric Vehicle (EV) charging infrastructure is essential to meeting the Scottish and UK Governments' Net Zero and carbon reduction targets as this will support customers and communities' adoption of electric vehicles. Project PACE helps to achieve these goals by delivering a strategic network of public EV chargers across North and South Lanarkshire whilst piloting an innovative electricity Distribution Network Operator (DNO) led delivery model.

Project PACE is jointly funded by the Scottish Government (via Transport Scotland) and SP Energy Networks. This funding is utilised as follows:

- Transport Scotland grant funding will be used to fund EV charging infrastructure and connections
- SP Energy Networks is providing match funding for:
  - Optioneering study
  - Electric Cars, people carriers and minibuses for community transport charities within Lanarkshire
  - Supporting and complimentary electric vehicle innovation projects including:
    - Electric Vehicle Uptake Modelling (EV Up), which will improve our understanding of customers' ability to transition to EVs based on availability of off-street parking and customer demographics
    - Network Connectivity Early Warning System (NCEWS), our LV connectivity model, which will allow us to better understand, manage and forecast what is happening on our LV network
    - Centre for Energy Policy (CEP) collaboration with Professor Karen Turner from the University of Strathclyde, conducting research on economic benefits of strategic network investment for LCT transition rather than "just in time"

Project PACE is delivering 167 EV chargers across more than 40 EV charging hubs in North and South Lanarkshire in just one year. This is targeting an increase in the number of public EV chargers for Lanarkshire communities by over 200% and increasing the number of public EV chargers in Scotland by around 14%. The additional ca.10MW of EV charging capacity is expected to accommodate the charging of over 4,000 additional EVs.
The first phase of the project included a sophisticated site selection study to provide a blueprint for best practice and collaboration. SP Energy Networks utilised its extensive knowledge of the electricity network and customers and worked collaboratively with local stakeholders to identify the optimal locations for the community EV charging hubs.
Successful outcomes included:
By choosing charging locations that make effective use of the existing electricity network, Project PACE is expected to achieve between £30,000 and £60,000 average savings on electricity grid connection costs per new location. This equates to a total of between £1.3million to £2.6million of taxpayer money saved across all the planned sites. Scaling up the innovative site selection approach across other regions could lead to £26million of connection savings in Scotland and £310million of the same savings across the UK.
https://www.transport.gov.scot/news/first-ev-charging-hub-delivered-through-project-pace/

Going forward into RIIO-ED2:

We will create a team of strategic optimisers to support all Local Authorities in our area with DNO led site selection for public EV chargers, focussing on areas that are unlikely to be served by the commercial market. Becoming the provider of last resort for communities where the commercial market will not provide public EV charging infrastructure

Case Study 3 – Smart Storage Heater Optimisation Study

During the DPCR5 and RIIO-ED1 price control periods, we developed and implemented our Rising and Lateral Mains (RLM) modernisation programme, focused at targeting an ageing legacy asset installed within multi-occupied properties across our SPD and SPM network areas. As we transition into RIIO-ED2 we will seek to further improve our service to these customers, with a primary focus on heating.

Many of these customers are traditionally not serviced by the gas network and are reliant upon electric storage heating (approximately 140,500 households in the SPD network area and 75,000 households in the SPM network area). Our Smart Storage Heater Optimisation Study, recently concluded with Delta EE, investigating the tariff arrangements for smart storage heaters, together with optimisation, commercial and regulatory issues around how smart storage heaters can move from demonstration to roll-out.

The key findings from this study were:

- **There is a clear appetite from stakeholders for flexible smart storage tariff**
  - Stretched E7/E10 type most appropriate in next 5-7 years
  - Capture value from flex market and share with customers
  - Retailers, aggregators and control providers all have a role to play
- **A number of options available to enable charging meets DNO needs**
  - Revised red band DUoS wrapped into tariff as present situation
  - Continue flexibility tenders within CMZ
  - Arrangement with retailer/aggregator to avoid red band
  - Direct overriding signals (ANM)
  - Working with local energy market using price signals
  - Ultimately a combination of these approaches will be required
- **Next step would be a trial**
  - Multiple groups of storage heaters across Glasgow
  - Each group provided with simulated constraint
  - 2-3 retailers per trial
  - ESO involvement
  - Under a sandbox arrangement

What will be achieved by the end of RIIO-ED1

We are working with Glasgow Housing Association (GHA) and Connected Response to demonstrate how smart storage can support the network's flexibility needs whilst also bringing financial benefit to customers. Our NIA project Flexible Tower, due for completion in May 2022, aims to show through simulation that shifting of demand using thermal storage heaters is feasible. The project aims to show that this demand shift can support increasing local EV charging requirements and wider use of constrained wind.

After the Flexible Tower project completion but prior to the end of RIIO-ED1 we plan to:

- Work with Retailers, Aggregators and Supplier to develop an appropriate commercial mechanism to unlock the revenue streams available for customers with storage heating.
- Understand how storage heaters respond to market signals and novel commercial tariffs.
- Expand the work within Flexible tower block to other properties within GHA's portfolio.

Going forward into RIIO-ED2

Moving into the RIIO-ED2 price control period we hope to see the present barriers preventing flexible use of storage heaters to be removed enabling the technology to make an important contribution to our flexibility needs at LV. We hope that storage heating will be able to be used proactively to avoid local constraints and congestion for example where high EV uptake occurs.

The potential to use flexibility within storage heating has been recognised through other initiatives including the 4D heat project which estimated there could be benefits to the ESO through avoiding curtailment payments to wind generators of £26m by 2030. However, at times of high wind and high local demand conflicts may occur which is a challenge that will be exacerbated as more EVs and HPs are connected to the network. We hope that within the RIIO-ED2 period we can overcome these conflicts to deliver an optimised solution for the customer considering their comfort and warmth as a priority but also seeking to bring benefits from BM revenue streams and LV flexibility.

Case Study 4 – Dunbar GSP Reinforcement and Modernisation

During the DPCR5 and RIIO-ED1 price control periods, Dunbar GSP required multiple instances of network reinforcement and modernisation to facilitate additional firm connections and allow four generators unrestricted access to generate on the system, this required:

- The addition of two 132/33kV transformers and switchgear
- An SPD project to install a seven-panel 33kV switchboard
- Uprating the Innerwick overhead line section, re-tensioning the existing conductor to obtain a minimum summer rating of ~108MVA.

These projects were all pulled together and managed under Customer Service, who were tasked with delivering the project safely, securely, and economically, with minimal impact on generation. With a broad range of stakeholders including SPT, SPD, RTS ANM, and embedded generation and demand customers, active stakeholder engagement was essential to successful project delivery. Weekly meetings enabled clear and consistent communication, the opportunity to discuss progress, timelines, and proactively address any emerging issues that could affect operations or security of supply.

Communication between SPD, SPT and demand customers allowed for suitable outage periods to be arranged, to allow for reinforcements and circuit transfers to occur with minimal disruption. For example, transferring demand customers onto the Dunbar ANM allowed for additional generation during low-demand, high-generation periods when the transformers could otherwise have been overloaded. This helped avoid any additional outages and disruption to customers and generation.

This collaborative process facilitated more efficient delivery of multiple projects in the same area, mitigating outage periods and resulting in a high level of customer satisfaction from the post-reinforcement outcomes.

Key findings and Outcomes:

- Central coordination of multiple projects allowed for a more collaborative approach to delivering all projects in tandem, minimising disruption and maximising project efficiency.
- Collective discussion and deliberation over the reinforcement and outage periods identified where and how adverse impacts on customers and generators could be minimised.
- The dedicated Outage Planning team within Transmission allowed for resources to be used to explore, coordinate, and implement a solution that reduced costs both in terms of generation and project delivery, with costs estimated at £150,000, while delivering savings of £2 to £3 million.
- Efficient delivery of the project while enabling maximum renewable generation, offsetting higher cost generation, and non-renewable generation, that would otherwise have to have been utilised.

Going Forward into RIIO-ED2:

A holistic approach to planning and stakeholder engagement as was the case in this Transmission example, will be integral to SPD's approach to Whole System, allowing exploration of solutions to ensure future network investment that considers the impact on customers and works towards mutually beneficial processes and outcomes.

Modernisation, reinforcement and connection work that will occur during RIIO-ED2 to accommodate for the energy network of the future requires a robust and long-term perspective to planning, engagement and implementation. Identifying opportunities to deliver efficiencies and a robust and efficient network for the future requires a specialist team within Distribution as a source of dedicated resources responsible for the discovery, coordination, and delivery of innovative and flexible Whole System solutions with partners and stakeholders.

Case Study 5 – Black Law Wind Farm

During RIIO-ED1, concerns were raised at a regular SP Transmission outage forum over disruption to Black Law windfarm set to occur due to upgrades required at one of SPT's largest substations. This shutdown at Black Law was anticipated to last at least five months while the network modernisation project was being undertaken, with significant financial costs to be incurred by the generator.

SPEN actively engaged with SPR to find a solution to these concerns, with discussions highlighting the importance of the windfarm remaining operational where possible during the high-wind winter months. The solution, employing the Enhanced Service Provision Feature, was to implement a non-firm connection and install a temporary transformer connection at the Grid Supply Point. This more than halved the anticipated shutdown period from 22 weeks, to just 10 weeks. SPEN provided this solution at roughly one-seventh the cost of the alternative, had these processes not been implemented.

Key findings and outcomes:

- By engaging with and understanding the needs and concerns of SPR, the implementation of a practical, innovative, and efficient solution was made possible.

- Savings of around £7 million to the generator were possible due to the reduction in this outage period. This is in addition to estimated CO_2 savings of 21,209 tonnes, compared to the original course of action.
    - Intelligent asset investment and outage planning solutions, made possible by Enhanced Services and the cooperation between SPT and connected customers, yielded significant financial and environmental savings.

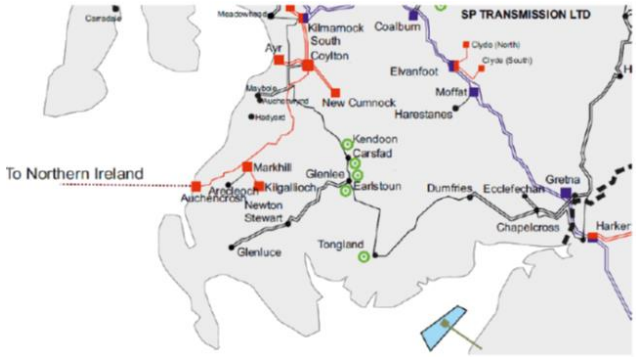
Going Forward into RIIO-ED2

Engaging with stakeholders and employing innovative solutions to achieve mutually beneficial goals are key pillars of the Whole System strategy. Such thinking is already recognised as an asset within Transmission and will continue to be developed in Distribution in RIIO-ED2 and beyond, through the Whole System Planning function. We are already cognisant of the needs of other stakeholders beyond those of our own, and of achieving solutions that benefit not just the business, but the climate, community, and all stakeholders.

The solution employed by SPEN demonstrates not just the value that can be derived through cost savings, but also the environmental and social benefits that Whole System planning could facilitate, through identification of solutions that minimises outage periods for renewable generation and the reliance on more expensive, non-renewable energy generation sources.

Case Study 6 – Existing Constraint Network Management: Dumfries and Galloway

The integrated constraint network management scheme in Dumfries and Galloway is the first of its kind in the UK, managing transmission constraints over a large distribution network area connected by 11 grid supply points. It replaces an existing Load Management Scheme (LMS) with an Active Network Management (ANM) scheme and is the output of extensive Whole System-type collaboration between SPD and the transmission network owners and operators, SPT and National Grid ESO. It is a prime example of where SPD has worked with other network companies to develop a common understanding of a cross-network issue and produce and deliver the optimal solution for the benefit of its customers.



The issue:
The incumbent LMS scheme protects against transmission constraints via application of an intertrip, disconnecting DG when there is a transmission fault or constraint. Due to the nature of its operation, however, the LMS frequently disconnects more generation output than is necessary and is as a result considered to be a barrier to new DG connections in the Dumfries & Galloway network area.

The solution:
The replacement ANM scheme will monitor the transmission and distribution network in real time, calculating the actual capacity of the network at any given moment. It will reduce constraints by directly interacting with DG to ramp down exports during times of system constraints. It will do this in a more targeted and intelligent way by continuously calculating the minimum volume of DG needed to be constrained to manage a fault or constraint (a value that will constantly vary depending on local demand and generation levels).

The ANM scheme will benefit not only the 90MW of DG currently connected in the D&G area but it will also facilitate improved connection conditions for in excess of 200MW of DG that is contracted to connect in the future. It will deliver faster connections and reduce levels of constraints.

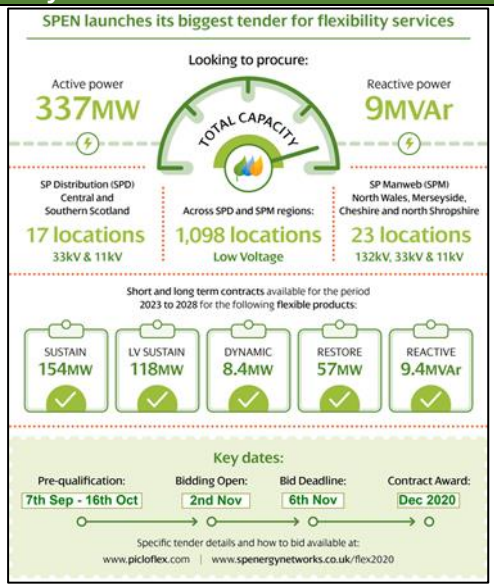
Successful outcomes included:
- Improved service to customers through reduced constraints on connections.
- Increased renewable DG connections bringing benefits of £40m to customers.
- Facilitation of connection of zero-carbon DG contributing to a reduction in CO2 emissions of 522k tonnes by 2031.
- Ensuring the distribution network is ready to respond with pace to new customer requirements as we move to a low carbon economy.
- More efficient utilisation of our existing network assets, reducing costs for customers.

Going Forward into RIIO-ED2:

The transmission-distribution boundary challenge has been central to SP Energy Network's development of ANM, helping inform wider debate around its implementation and its effect on the transmission system. Significant progress has been made as a result towards the development of a more flexible distribution network with potential for local and regional distribution system operation.

Looking forward to RIIO-ED2, SP Energy Networks will employ Whole System thinking and planning, continuing to work closely with National Grid ESO, the transmission owners and UK DNOs to share more information and set transparent rules regarding responsibilities for network operation and how network access continues to be facilitated to the benefit of all.

Case Study 7 – Our Expanding Flexibility Tenders



Our flexibility is procured via an auction-based tender process which has increased transparency and created the opportunity for many more participants to provide flexibility services.

The scope of flexibility services has also been widened. Initially focused on the provision of very specific (location and time-boxed) constraint back-up for higher voltage assets, flexibility is now beginning to be used as a more ubiquitous and enduring service that will become an intrinsic part of systems operation.

Although at a local level, markets are relatively shallow, with fewer participants, the sources of flexibility are becoming more diverse. In addition to generation or storage assets, flex services could be provided by demand side response enabled by energy efficiency, smarter systems and agile tariffs.

Our flexibility tenders have greatly widened in scope. Significantly, tenders have now been run for locations on the low voltage network, although the response so far suggests that market "shallowness" is an on-going issue.

Through our engagement on the ENA Open Networks Project we are developing a roadmap for future flexibility:

a) opening local flexibility markets to demand response, renewable energy and new low-carbon technology and removing barriers to participation
b) providing opportunities for flexibility providers to connect to our networks faster
c) opening data to allow these flexibility providers to identify the best locations to invest
d) delivering efficiencies between the network companies to plan and operate secure efficient networks

Going Forward into RIIO-ED2:

Our DSO strategy is working towards a model in which, enabled by digital platforms, networks can act as a neutral market facilitator, identifying opportunities to increase the utilisation of network assets, and to facilitate new markets and business models for whole energy solutions and services.

Benefits include:

- Reducing the need in some areas for costly and time-consuming traditional reinforcement, eliminating the need to invest in permanent upgrades to meet a temporary spike in demand.
- Accommodating growth in low carbon technologies.
- Allowing consumers to capitalise on the opportunities arising from a transition to a smarter grid and to participate in the low carbon future.

A Whole System approaches aims to facilitate cross-vector management of network constraints and surpluses through the sharing, aggregation and utilisation of data across energy networks. Discussions are ongoing to explore the potential for such network constraint management with the hydrogen network, and how SPEN and those within the gas sector can support each other's networks.

Case Study 8 – Hunterston B Decommissioning and Western HVDC Link Reinforcements

The decommissioning of Hunterston B set to commence in January of 2022 brings with it a fundamental change to the existing network and the Western HVDC link. With no intervention, the ESO were forecast to pay £200 million of constraint payments, from having to restrict generators with the reduction of capacity onto the HVDC link. However, SPEN was able to reach a solution with ESO and deliver it by the end of 2019, at a cost of only £150,000.

Certain challenges include that of land rights with Hunterston B have been complicating the installation of cable routes back to the site for the primary transformers. At an operational level, plans and processes are complicated by the dated and poor condition of certain assets, and the location of substations facilitating the need for physical infrastructure reinforcement.

Key findings and outcomes:

- SPEN collaborated with the ESO to reach a solution to the reduced capacity and increased constraints on transmission and distribution that will arise from the decommissioning of Hunterston.
- SPEN's cooperation with ESO highlights the value of engagement and collaboration with stakeholders in exploring cost-effective and innovative solutions.
- Plan early and plan well: The complexities of a nuclear power station complicate processes and highlight the benefits that could be harnessed through a dedicated team of Whole System planners who specialise in these functions.

Going Forward into RIIO-ED2:

The collaborative and innovative approach taken at Hunterson will serve as a good example of how we can deal with the decommissioning of other large power plants (such as Torness) in future.

Case Study 9 – Flexible Gas Generation Forecasting

The predicted path to Net Zero and the decarbonisation of the energy system will include increased reliability on the use of electricity for transport and heating. Increasing volumes of intermittent renewable DG will connect throughout RIIO-ED2 and beyond. To meet these challenges DNOs are encouraged to make more efficient use of new technologies, providers and solutions as part of their evolution to Distribution System Operators (DSOs). Further, there is an increasing need for all energy network companies to work together to deliver optimum outcomes for the energy system as a whole.

Elsewhere, on the gas network increasing numbers of flexible gas generation sites are connecting, helping to bridge gaps in the intermittency of renewable power. These connections are however impacting on the accuracy of forecasting models used by the Gas Distribution Networks (GDNs) to predict gas usage. This is becoming a key challenge for the GDNs as they are driving more volatile and difficult to predict gas demand in the very short term (<48 hours), which is having operational and cost impacts for the Whole System.

Improved modelling capability of flexible gas generation is required to support GDNs. Improved data is also necessary to support improved forecasting of gas demand for flexible generation. Whilst much of this data may already exist, and be held by the electricity network companies, it is currently not possible currently for the GDNs to access this data.

During RIIO-ED1, The Flexible Gas Generation Forecasting project sought to identify the key drivers and relevant datasets that would enable GDNs to more accurately forecast flexible generation operation on their networks. The core objectives of the project were to:

- Develop a robust model that can accurately forecast flexible generation plant operation 48 hours ahead.
- Identify the key drivers and relevant datasets that will enable GDNs to more accurately forecast flexible generation operation on their networks.
- Demonstrate a clear business case for improved data sharing between the UK network operators.
- Take a collaborative approach – involving other GDNs, NGGT, DNOs and ESO
- Identify and summarise current best practise approaches / modelling capability in the UK with respect to forecasting flexible generation operation
- Share key learnings and best practise with other UK GDNs & DNOs – to improve Whole System forecasting and network planning / operation in close to real time.

SPEN supported of the Flexible Gas Generation Forecasting project, recognised the challenges faced and the Whole System benefits that can be realised by cross energy sector collaboration and is working closely with Wales and West Utilities (WWU), ESO and Northern Gas Networks to further the aims of the 4 project workstreams:
WP1 – to review the current modelling capabilities for flexible generation
WP2 – to scope the key drivers and identify data needs and availability
WP3 – model scoping and development
WP4 – to demonstrate the value of data sharing

Successful outcomes have included:

- Improved capability to forecast flexible generation and data sharing between network companies, enabling:
  - GDNs to operate and manage their networks better; and
  - Increased understanding of flexible gas generation by all parties, opening opportunities for improved operations (and ultimately cost savings for customers)

Going into RIIO-ED2, WWU have adopted this forecasting model as business as usual and will use it in conjunction with our SPEN control room whenever they have a customer connection in our licence area. In addition, NPG and SGN have taken the learnings from this project and are developing similar flexible gas generation forecasting models of their own.

Case Study 10 – Net Zero NW Cluster Plan

Net Zero North West is a partnership of local government and industry aiming to transition to Net Zero by 2040. The Net Zero NW region covers 7 Local Enterprise Partnerships, including Cheshire & Warrington Local Enterprise Partnership and Liverpool City Region Local Enterprise Partnership as well as 5 other Local Enterprise Partnerships along the North West up to Cumbria.

The main industrial cluster is situated in the Ellesmere Port/ Runcorn area of the SPM licence area. This area is the UK's largest concentration of manufacturing and chemical production and is responsible for 5% of the UK's total energy usage. Net Zero NW targets:

- 10m tonnes of carbon savings by 2030; and
- 40m tonnes of carbon savings by 2040.

The transition to Net Zero is centred around 2 key themes, **Hydrogen and Carbon Capture**. Following these themes, 8 projects are being progressed with an associated £4bn investment and a forecast potential of 33,000 new jobs in the in the Industrial Cluster area.

1. E-Port – will deliver a blueprint for unlocking capital investment in a Net Zero carbon industrial cluster in the Ellesmere Port region over a 10-year period.
2. HyNet – the UK's leading low carbon hydrogen and CCUS project offers a low cost, low risk route to decarbonise the North West industrial cluster and other sectors of the regional economy.
3. Protos – a strategic cluster of energy generation and energy intensive industry in Cheshire boosting opportunity for carbon capture and storage and provision of multi-energy vector local networks to support energy intensive industry.
4. Mersey Tidal Power Project – in early stage development the high tidal range in Liverpool Bay and Mersey estuary provides a unique opportunity to reliably generate long-term renewable energy.
5. Project Vanguard – building a hydrogen refuelling station in Middlewich, the facility aims to produce hydrogen in the greenest way possible, from an electrolyser connected to solar panels.
6. HySecure – a bespoke solution mined hydrogen storage salt cavern capable of storing 50GWh of energy (1100 tonnes of hydrogen working gas volume).
7. Centurion – "Power to Gas" 100MW demonstration project to capture under-utilised green electricity, convert to hydrogen, storage and export to gas grid when required.
8. Carbon Capture & Utilisation – capturing flue gases from a local CHP power plant for use as a raw material for high-grade sodium bicarbonate manufacture in Cheshire.

<u>SPEN's role in Net Zero NW Cluster Plan</u>
There are 8 Work Packages associated with the Net Zero NW Cluster Plan. SPEN is leading Work Package 8 and has commitments in Work Packages 4, 5, 6 and 7.

Work Package 4 and 5:
These two work packages completed by Engie and Progressive Energy involve the development of a recommendation report for Green Hydrogen production in Ellesmere Port next to ESSAR Oil Refinery. SPEN's role in these work packages is to provide high level budget estimates and feasibility study for the proposed connection to the SPM network – up to 72MW.

Work Package 6:
This work package focuses on the integration of the hydrogen production and storage in the North East and North West of Wales, into the Net Zero NW industrial cluster.

SPEN are working closely with Uniper on the green hydrogen production at Connahs Quay and the associated infrastructure requirements. SPEN also sit on the Welsh Government Hydrogen Reference Group, specifically looking at the projects in HyCymru and Ynys Mon Hydrogen Island.

Work Package 7:
The Cadent Gas innovation project HyNet will see the construction of the UK's first Hydrogen Network - capable of delivering 30TWh/annum by 2030. SPEN is working closely with Cadent to determine the requirements on the SPM network.

Work Package 8:
SPEN is leading on this work package, which entails the production of high-level budget estimates for all the associated connections to the SPM network, and the provision of feasibility analysis on the potential for flexibility services in the area.

https://netzeronw.co.uk/

Key objectives:

- Establishing a low-carbon industrial cluster by 2030
- Establishing a net-zero carbon industrial cluster by 2040, underpinned by multi-vectored industrial decarbonisation solutions.

Going forward into RIIO-ED2, the outcome of Work Package 8 will inform the electricity connection works that will enable 35MW of hydrogen production at Essar by 2025, 90MW by 2030 and associated upstream reinforcement. The work will also inform future planning, with our Strategic Optimisers and Whole System planners heavily involved to inform long term plan for area, including strategic investment ahead of need.

Case Study 11 – Pathway to Net Zero
Liverpool City Region, Cheshire West & Chester and Warrington

During RIIO-ED1, in 2019, many Local Government areas in the North West including Liverpool City Region Combined Authority, Cheshire West & Chester Council and Warrington Borough Council declared climate emergencies. These resulted in the setting of decarbonisation goals, ranging from Warrington - carbon neutral in its operations and activities by 2030; Cheshire West & Chester - Net Zero by 2045; and Liverpool - Net Zero carbon city by 2030. Additionally, Liverpool City Region has set a target to become zero-carbon by 2040 and Net Zero North West is aiming to be the UK's first low carbon industrial cluster by 2030.

As a key stakeholder and operator of critical energy infrastructure in the region SPEN, in collaboration with Cadent Gas, commissioned Guidehouse (formerly Navigant) to help develop a combined pathway for helping the region reach carbon-neutrality building on insights derived from work already undertaken by the region, as well as:

- Cadent's Developing networks for the future;
- SPEN's 2020 Distribution Future Electricity Scenarios;
- National Grid's Future Energy Scenarios;
- ENA's Pathways to Net Zero report; and
- Navigant's Decarbonisation Pathway for Greater Manchester report.

These reports, together with local data made available by stakeholders, and national level data from BEIS and ONS, informed a unified "whole-system" view of the current and future energy demand and supply of the region. This will be used to create a pathway to achieve the 2040 net-zero ambition established by regional authorities. This work will involve a balance of low carbon gas and electricity with the aim of focusing on the challenges ahead and developing a joint action plan to enable the regional authorities, and the gas and electricity networks to tackle this together.

This jointly commissioned work concludes with a schedule of key actions for the regions, Local Authorities, SPEN, Cadent and other relevant parties to deliver leading up to 2040. These action focus on key areas including: reducing and transforming energy demand; transport; industry; hydrogen and electricity.

E.3.2 Electricity

	Key Actions	ID
2021-2025	Local authorities should develop a plan for local renewable generation development including an assessment of the future potential for solar PV and onshore wind in the region.	D8
	Local authorities should develop a strategy to support local renewable development through the identification of dedicated sites in local spatial plans, streamlining of planning and permitting processes and the introduction of incentives for renewable investment.	D9
	Local authorities and business groups should influence central government to secure support for tidal energy so that project development can start before 2025.	D10
	SPEN will work with local authorities and energy users to understand future energy demand and plan the development of the electricity distribution grid to meet increased peak demand	D11
2026-2030	Local authorities should continue to incentivize investment in distributed renewables, as well as behind-the-meter storage for electricity and heat. Like Cheshire West and Chester and Warrington, LCR can lead by example by setting a target date for 100% renewable electricity consumed within council buildings and investing in low-carbon installations.	D12
	Local authorities should stimulate collaboration between energy retailers, aggregators, energy solution providers and SPEN to trial Local Energy Markets and test peer-to-peer trading of local electricity.	D13
2031-2035	Local authorities should work together with residents and local businesses to ensure the full distributed renewable potential in the region is realized by 2035.	D14
	SPEN should continue electricity network reinforcement to support demand electrification.	D15
6-2040	In a scenario where national wholesale market is not full decarbonised by 2040, local authorities will need to select the best available option to manage the impact of carbon emissions related	D16

Successful outcome:

- informed a unified view on what is required for the Liverpool City Region, Cheshire West & Chester and Warrington to jointly become fully decarbonised by 2040.

Going forward into RIIO-ED2, the outcomes of this study will inform SPEN's work package 8 of the Net Zero NW cluster plan (Case Study 10). In addition, senior level conversations are currently going on to commission a combined study with the gas network, based on the outcome of this study, that considers the whole of the North West of England region.

Case Study 12 – Project Charge

During RIIO-ED1, the Charge Project is bringing together transport and energy planning to accelerate the investment and deployment of public EV charging infrastructure, benefiting all EV users, whether they live in residential areas with no off-street parking, or those looking for charging facilities en route or at destinations. The location for our Charge Project is Merseyside, Cheshire, North Shropshire, North & Mid Wales.

The Charge Project combines transport and electricity network data to highlight the best locations for EV chargepoints and seeks to identify how they can be connected at the lowest cost. It is running a number of targeted network trials to understand how best to charge vehicles in areas that currently lack publicly accessible charging points. Terraced houses and flats with limited on-street parking is a particular area of focus. Further, the Charge Project seeks to utilise smart network management technologies to ensure EV charging operates in harmony with the distribution network.

Project Partners – Smarter Grid Solutions (SGS)
Through our partnership with SGS, the Charge Project is developing projections for how traffic and networks will evolve, enabling us to anticipate the needs of drivers in the future, as well as today. Such insight, and sharing beyond our own network boundaries, will enable those responsible for the siting of EV chargepoints to make optimum cost-effective planning decisions, both in project trial area and beyond.

Project Partners – EA Technology
One of our primary objectives with the Charge Project is to share information with councils, businesses, communities and anyone with an interest in EV infrastructure. We will facilitate the sharing of information through the project's interactive online tool, ConnectMore. ConnectMore will be a user-friendly web application that will show people where EV charging demand is, and where the electricity network has the capacity to support installations. It will also consider the benefits that smart charging can offer in managing network demand.

Successful outcomes include:

- Businesses quickly able to see cost estimates for connecting new EV chargepoints at their sites,
- Councils able to see where the electricity network could support chargepoints needed to serve shopping or community centres, and
- Ability for Local Authorities to create long-term plans for wide-area rollouts of infrastructure and ensure they achieve the best value for their chargepoint deployments.

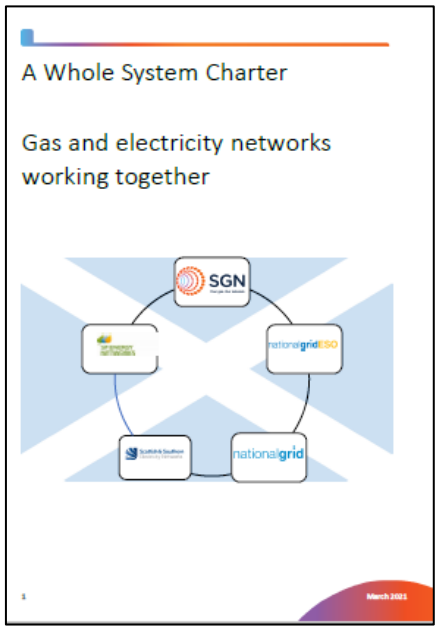
Going Forward into RIIO-ED2:

The ConnectMore tool will be rolled out as business as usual across SPD and SPM to allow customers to get an initial idea of electricity network connections costs. This could be beneficial in helping private companies such as EV chargepoint providers in selecting suitable sites for development efficiently.

Project Charge embodies Whole System thinking; cross-vector planning and cooperation such as this demonstrates our commitment to consider solutions beyond that of the electricity network, with an ambitious vision for a whole energy system that incorporates Local Authorities, utilities, and public services. Project Charge demonstrates SPEN's commitment to developing projects and infrastructure that benefits our customers, communities, and society at large, through increased provision of more accessible public EV charging locations.

Notwithstanding these societal benefits, data and information sharing partnerships that are currently being explored with a variety of parties, will accommodate more efficient and integrated network investment through a Whole System approach.

Case Study 13 – Whole System Charter



In April 2021, SGN, SPT, SPD, Scottish & Southern Networks, NG Gas Transmission and ESO signed up to a Whole System Charter.

Purpose

"The purpose of our charter is to set out the commitment between gas and electricity network companies to work together in delivering Net Zero through our Whole System principles, underpinned by the foundational themes, from immediate real-time incident management to long term investment planning. Creating a common set of structures for sharing information across these themes will support a robust whole energy system in its planning, development and operation.

Our Whole System Charter provides a platform to align our aspirations to help meet Scotland's Net Zero emissions targets in 2030 and 2045, including transport, underpinned by the Scottish Government Principles that recognise the energy networks role in enabling Scottish energy policy, including the delivery of local authority and community ambitions whilst giving due consideration to the interests of different consumer groups and the trade-offs between them. In time, we anticipate this charter can be extended to include other network companies in GB, enabling further Whole System solutions and the delivery of Net Zero at a UK level by 2050."

Going Forward into RIIO-ED2:

The timing of the parties signing the Charter coincided with the Scottish Government publishing a set of principles agreed with Scotland's energy networks (including SPEN), the ESO and Ofgem, setting out how Scottish energy policy should be taken into account in plans and decisions about investment in network infrastructure. SPEN has been at the heart of, and has actively supported the development of, both the Charter and the Principles for the development of Scotland's gas and electricity networks.

Both initiatives, in conjunction with our Frameworks for Cooperation and Collaboration on Whole System processes, give SPEN a strong foundation for working with parties within and beyond the energy sector to develop innovative Whole System solutions.

Gas and electricity networks: development principles - gov.scot (www.gov.scot)

Case Study 14 – Project Re-Heat

Roughly 21% of the UK's carbon emissions originate from current heating and hot water solutions that are predominantly catered for by fossil fuels. Tackling this to achieve Net Zero targets requires ambitious and innovative Whole System solutions, such as Project Re-Heat.

Established in RIIO-ED1, Re-Heat is the first demonstration project being delivered by the Heat Electrification Strategic Working Group, an ongoing strategic partnership between SP Energy Networks, SSEN and the Scottish exploring how electricity networks can respond flexibly to support the increase in electricity demand expected as the decarbonisation of heat progresses.

There are two key challenges involved in the heat decarbonisation process and the proposed solution of installing these air-source heat pumps. Re-Heat is exploring intelligent and innovative solutions to ensure that the network is robust enough to handle the ongoing and future challenges of network supply and demand.

Challenge 1
Right now, the winter peak heat demand can be five times that of electricity demand. This additional demand would overload many local electricity networks. To be able to cope with the additional load the electricity network will require major upgrades. A report for the Committee on Climate Change in 2019 estimated the cost of these upgrades to be £47billion by 2035 which will ultimately be funded by customers. We want to develop innovative solutions to reduce these costs for customers.

Challenge 2
The power produced by wind farms in Scotland often exceeds the export capacity of the transmission network. Wind farms are being paid to switch off at a cost to customers of over £100m per year. If electricity required for heat could be better matched to wind farm production then these costs could be reduced.

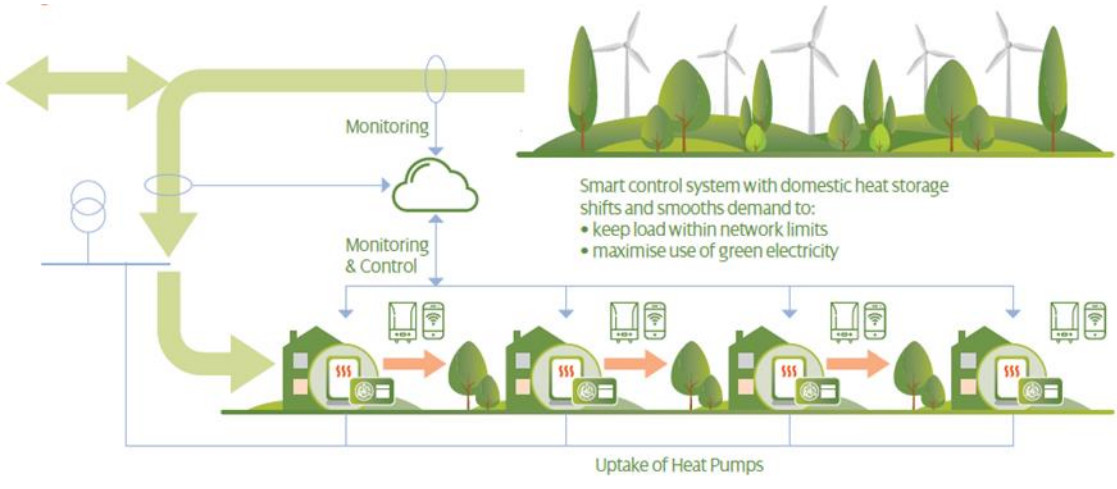
We need to invest in innovation now to enable our electricity network to successfully meet these challenges, in turn enabling the transition to net zero and the potential to significantly reduce costs to customers.

Core objectives of the Re-Heat project include:

- Conduct a large-scale trial to demonstrate technical solutions that reduce peak demand on the electricity network. Identify solutions that reduce or postpone the need for network upgrades, thus reducing customer costs.
- Build on the learning outcomes of the trial and develop recommendations for commercial and regulatory enablers that allow for the delivery of electrified heat solutions, at scale.

Crucially, this contributes to ensuring that our vulnerable communities are not forgotten, and that no one is left behind during the heat decarbonisation process, and the wider Net Zero transition.

Figure A8.1: An Overview of the Re-Heat Project



Key benefits from the project will include:

- Identification of alternatives to traditional network upgrades; reduced or avoided customer costs.
- Development of toolsets for network operators and stakeholders that can support the electrification of heat. Such toolsets will allow for:
    1. Assessment of the network impact from the electrification of heat
    2. Exploration of alternative solutions to mitigate and limit network impacts
    3. Analysis of the costs associated with network impacts
    4. Area-specific strategies for the electrification of heat, through the information provided by the other toolsets.

Accelerated customer transition to renewable heating solutions

Going Forward into RIIO-ED2:

Re-Heat will provide learnings on the benefits of smart controls and thermal storage in reducing peak electricity network demand and reducing customer heating bills. The learnings will be shared with other DNOs, UK and Devolved Governments and could inform future heat policies. The learnings will provide a good foundation for further heat innovation projects delivered via Ofgem's SIF mechanism.

Case Study 15 – Joint operations
Active Network Management (ANM) in Dunbar

Managing the increasing complexities and interactions between transmission and distribution assets is now embed as a Whole System activity. This covers a wide range of activities including, managing bi-directional power flows due to increased levels of embedded generation, coordinated provision and use of flexibility services, as well as technical innovation areas around power quality, reactive power, frequency and black start. There are several project examples of T and D integration including projects Visor, Synthesis and the work being done on Accelerated Loss of Mains in collaboration with National Grid Electricity System Operator (ESO). This is in addition to knowledge sharing and coordination of maintenance, reinforcement planning, innovation and health and safety all embedded within SPEN.

In collaboration with National Grid ESO, our Distribution and Transmission colleagues are also working towards the development of regional constraint management markets, as part of Regional Development Programme (RDP) planning, which "will be integrated with ESO and DNO systems, providing flexibility, visibility and co-ordinated control through appropriate systems and processes".

The recent experience of deploying Active Network Management (ANM) through the Accelerated Renewables Connection (ARC) project located in East Lothian, is an excellent example of Whole System collaboration and operation. ANM is a system which allows us to connect new generators to the power network more quickly and cheaply where previously the network was believed to be at fully capacity. The ARC project delivered tangible benefits to connecting customers and the wider economy by deploying a ground-breaking ANM system to enable greater volumes of embedded generation to connect into a highly constrained network several years ahead of planned network reinforcement.

Accelerating Renewable Connections (ARC): Dunbar ANM

The success of the project was only made possible through positive coordination and cooperation with a range of stakeholder including connecting customers, National Grid ESO and SP Transmission. Working together to better understand the issues present and to develop solutions. An example being the development of a commercial framework that would permit Distributed Generation (DG) access to the network several years ahead of planned reinforcements. Through positive interaction with National Grid ESO and the connecting Customers, a two-staged connection agreement was developed, facilitating both the implementation of ANM and a clear investment signal for the reinforcement of the transmission network.

The enduring learnings from the ARC project are significant. It was utilised as part of a trial of a new Statement of Works (SoW) process through the ENA Open Networks Project. It was expanded to enable further new DG connections against transmission boundary constraints at Berwick GSP. Learnings were applied to the development of the wider-scale ANM schemes in Dumfries & Galloway and North Wales.

Successful outcomes included:

- Accelerated network access to accommodate DG.
- Acceleration of the time to connect in advance of the completion of transmission reinforcements.
- Increased understanding of how the use of flexible network technology to enable the connection of DG around constraints; and
- Creation of an enduring process and learning capable of being rolled out across GB.
- Accelerating the capital investment in the rural economy of East Lothian and creation of highly skilled local jobs

Going forward into RIIO-ED2, the learnings from the ARC project are being built upon as we install active network management at 22 constraint management zones across SPD and SPM.

Case Study 16 – Collaborating with House Builders and Homes for Scotland

During RIIO-ED1, SPEN established a strategic partnership with CALA homes and undertook a monitoring project to gain empirical data on the increase in electricity demand at a secondary substation as customers adopted EVs and heat pumps.

Founded on this initial engagement with CALA homes, we established regular engagement with a group of housebuilders including Bellway Homes, Robertson Homes and Homes for Scotland. In 2018, we held the Homes for the Future conference to provide information on targets for decarbonisation in Scotland, the impact of low carbon technologies on the electricity network for housebuilders, IDNOs, Local Authorities and public bodies.

To help the housebuilders to develop robust electricity network connection requests that accommodated housing developments with heat pumps and EV chargers, SPEN and SSEN worked in collaboration to develop a calculator to model the required energy demand that would arise through the adoption of Low Carbon Technologies (LCTs) such as heat pumps and EVs. The *After Diversity Maximum Demand (*ADMD) calculator[38] enables house builders to determine the capacity required for developments of 20 houses or more, thus informing future quotes and creating a more accurate and streamlined process.

Going Forward into RIIO-ED2, we will continue to support the housebuilding sector through regular engagement.

[38] https://www.spenergynetworks.co.uk/pages/admd_calculator.aspx

Case Study 17 – East Neuk Power-to-Hydrogen

This NIA project involving SPEN and SGN, in addition to E4Tech and Artelys, occurred between March 2019 to March 2020; the project used the Fife area as a case-study to explore power-to-hydrogen opportunities, and assess the potential for cross-vector integration of the electricity and gas networks in facilitating the generation and distribution of hydrogen.

Seven scenarios were modelled to explore how hydrogen production could be facilitated by the electricity network, based on current (2019) and future (2040) time periods, and the 'Two Degrees' scenario outlined by Ofgem in their Future Energy Scenarios (FES).

In addition to this modelling, which assessed the viability of hydrogen production in the Fife area, a review of existing regulation and legislation, and industry reports & academic papers was conducted to determine the current and future trajectory of power-to-hydrogen, and to assess the barriers and enablers to the implementation of future projects.

The project and its recommendations may inform future pilot or demonstrator schemes, in addition to the SPEN FUSION project, and illustrate the value of collaboration and thinking on a Whole System level to identify potential solutions to decarbonisation and the future energy network.

Going Forward into RIIO-ED2:

As evidence of existing cross-vector and Whole System engagement, the outputs and lessons learned from the project can act as a guide for future integration of the energy system and advancing towards a Whole System. Beyond this, identifying opportunities and implementing Whole System solutions that drive decarbonisation, realise more efficient network investment, and help avoid or lower customer bills, are integral to our ethos as we enter into RIIO-ED2.

As outlined in the closure report, and in line with Whole System thinking, facilitating cross-vector network integration requires collaboration from a dearth of stakeholders and external parties: from licensed organisations such as ourselves, to regulatory bodies and those involved in implementation and review of the policies and legislative framework that could act as an enabler of future power-to-hydrogen opportunities, and support our overarching efforts to decarbonise. Achieving an efficient and just Net Zero transition through a Whole System approach is incumbent on engagement, collaboration and cooperation on all levels.

Key findings and outcomes which could inform future projects during RIIO-ED2 include:

- Low-carbon and renewable power generation could form the basis of hydrogen production in Fife. This could be provided in part by curtailed electricity generation.
- Existing and future electricity constraints could be avoided if the network were used to support hydrogen production. Network upgrades that would otherwise be required could be avoided if excess generation were used in the production of hydrogen.
- Low-cost electricity generation will be a key enabler to future power-to-hydrogen opportunities. Establishing incentives and a market framework that facilitates both this, and the ability to utilise curtailed renewable generation, could help provide the necessary changes to enable use of both curtailed and dedicated renewables in realising power-to-hydrogen opportunities.

Case Study 18 – Distributed ReStart

The Distributed ReStart project is a partnership with National Grid ESO and TNEI, which is exploring how distributed energy resources (DER) can be used to restore power in the event of a total or partial shutdown of the National Electricity Transmission System (NETS). The relevance of this option has become more vital as the UK transitions to increasingly more decentralised forms of electricity generation and with the introduction of the new Electricity System Restoration Standard (ESRS). Whilst the growth in DER presents an opportunity to develop a radically different approach to system restoration it also presents significant new technical, organisational and commercial challenges.

The project has been delivered in three main work streams:

- The Power Engineering & Trials work stream was concerned with assessing the capability of GB distribution networks and installed DER to deliver an effective restoration service. It has set out the technical requirements in detail, highlighted a number of technical problems and identified solutions, and delivered live trials on SPEN networks that tested and demonstrated DER-based restoration. The project also produced specifications for and conducted hardware-in-the-loop testing of a Distribution Restoration Zone Controller (DRZC), which builds on previous forms of distribution network management to deliver more advanced control capability.
- The Organisational & Systems and Telecoms work stream considered the different roles, responsibilities and relationships needed across the industry to achieve distribution restoration at scale. It specified the requirements for information systems and telecommunications, recognising the need for resilience, cyber security and the challenges of coordinating black start across many parties. The work stream delivered a series of innovative “Desktop Exercises” using a specially-designed online tool to support testing of the restoration process by a wide array of stakeholders. This will inform future training and testing processes in the industry, and not just in black start from DER.
- The Procurement & Compliance work stream considered the best way to deliver the concept for customers, how to ensure effective engagement by service providers, and the changes needed in industry codes to support this new approach to system restoration. This included exploring the options and trade-offs between competitive procurement solutions and mandated elements, working closely with the other work streams to ensure the commercial, technical and organisational designs were all aligned. The work stream engaged widely, including through a mock tender event that invited “bids” from possible service providers, testing the proposed processes, information provision, requirements and assessment methods.

Going Forward into RIIO-ED2:

Project findings are captured in the formal reports and several other forms of communication, such as podcasts and online events. The final reports will be published in summer 2022.

The solutions developed in the project were further developed in a SPEN Green Recovery Fund project with deployments in Galloway and Fife. The distribution restoration zone concept is expected to be applied in the procurement of new black start services in south-east England, with service delivery from the mid 2020s onwards.

Case Study 19 – Project FUSION

FUSION is an ongoing project as part of our DSO transition, in coordination with the ENA Open Networks Project, and through cooperation with SSEN, ENWL, WPD, and other partners, including Fife Council, the University of St. Andrews, and Imperial College London.

With both network load and complexity increasing in tandem with the uptake of LCTs and DERs, FUSION seeks to maintain and strengthen the distribution network through a more intelligent and innovative approach to flexible network operation, promoting stability and security of supply while supporting the uptake of LCTs. Facilitating demand-side flexibility through a neutral market, FUSION will enable all market participants to procure and commoditise flexibility

Going Forward into RIIO-ED2:

As demand for LCTs continues to increase, and consequently the load requirement on the distribution network, collaboration with other DNOs and external partners (such as Councils and Universities) is a demonstration of our existing Whole System thinking, and will be pivotal to successful delivery of future Whole System solutions and outcomes, and the transition to Net Zero.

The lessons from Project FUSION, set to culminate in December 2023, will be communicated to all parties and stakeholders, and will inform future projects as we enter RIIO-ED2 and evolve into a DSO. FUSION will enable a Whole System approach to network flexibility and further facilitate both the use of renewable sources of energy, and the uptake of LCTs.

Additional information on Project FUSION can be found on our website through the following: Fusion - SP Energy Networks.

Case Study 20 – Energy Networks Wales

The ambitious target set by the Welsh Assembly of providing 70% of Wales' electricity demand from renewable sources is made more challenging by the limited existing network infrastructure in Mid Wales. Emerging grid capacity concerns are threatening successful delivery of this target and the deployment of renewable energy generation across Wales and may hinder Wales' wider Net Zero ambitions.

Going Forward into RIIO-ED2:

Existing close collaboration with the Welsh Government and other stakeholders will be developed and strengthened in RIIO-ED2 through the introduction of a dedicated and specialist team to engage with stakeholders and formulate the strategy required. We are proving our commitments, to both support the energy network in Wales and help deliver on the goals of the Welsh Assembly, and to our pursuit of Whole System solutions, helping to ensure a robust and fit for purpose future energy infrastructure in Wales.

We will achieve this through comprehensive Whole System engagement with other DNOs – WPD, NG, NGESO, WWU – Local Authorities, and the Welsh Government. Through this combined engagement we will undertake the required assessments and analysis (e.g. optioneering, pre-engineering, and environmental studies) to then create and deliver on a strategic plan for future energy infrastructure.

9.9 Appendix 9 – Whole System Operational Framework (WSOF)

Introduction

In this appendix we describe our investment decision-making framework and how it will change in RIIO-ED2 to accommodate a Whole System operational framework (WSOF). This framework provides a template containing more details on tangible Whole System operational considerations and activity for each energy vector. The WSOF is intended to set out an initial view on 'how' we will operationalise our plans.

Our objective would be to take this framework forward into a fully established framework by the end of the first year of RIIO-ED2 subject to the finalisation of aspects such as the Whole System planning function and Strategic Optimisers.

The first section below describes at a high level our existing investment decision-making framework. The section that follows describes the WSOF and the final section illustrates how it will feature in our investment decision-making framework in RIIO-ED2.

Overview of existing process

Our investment decisions employ a series of investment phase (IP) gates in our process to ensure we correctly evaluate, challenge and ultimately deliver the best value solution for all our stakeholders. The first half of that process (IP1 – IP3-1) is shown in Figure A9.1 below and illustrates the main elements of our stage gate process.

Figure A9.11 – IP1 to IP1-3 Stages

Development of plans start with the identification of a Network Need, in other words a requirement to conduct activity on the network. These needs generally arise from:

- Customer request - A new connection to the network
- Changes to the power flows on the network due to changes in generation or demand patterns - a modification to the network for compliance with the various standards
- Maintaining the reliability of the network – Ongoing monitoring of network assets to determine their condition
- Legal, safety or environmental requirements – if assets present an unacceptable risk
- Whole System initiatives – Opportunities for coordinated network development involving our distribution and transmission businesses and/or collaborations with the ESO and other utilities.

We consider many factors to determine the significance of each network need and this early stage of the process is essentially just an idea until it passes the Concept Approval (IP1) phase gate. At this stage the idea becomes an actual project having passed the first stage of validation.
We then complete a Technical Approval (IP2), reviewing the available options to satisfy the network requirement which where possible will be supported by a Cost Benefit Analysis. Upon agreement of the most efficient solution, approval for initial funding for the project is then sought using the Pre-Construction Development (Seed) Funding approval (IP3-1). Approval at IP3-1 stage is a significant project milestone essentially moving the project from Concept/ Design into the Delivery Phase, allowing preliminary works to commence and spend to be incurred on the project.
Development of the System Construction Authorisation (SCA) document defines the full extent and design intent to be undertaken during the Delivery Phase. This is a key step in our process following approval of IP3-1 that helps solidify the necessary expenditure requirement, in preparation for Full Funding approval (IP3-2).

The second half of this stage gate process (IP3-2 – IP6) is shown below.

It is not unusual for the approved project Scope of Works defined in the SCA document to require some modification through the duration of the project. The timescales involved in delivery of Transmission projects can be significant. During project delivery a lot can happen both on the network itself and with other outside influences that may impact on the planned activity of an already approved project. For this reason, we have a Change Control approval mechanism (IP4) to facilitate and approve any deviations from the original planned scope, regulatory volumes, and financial deviations. In addition, every project runs with a degree of risk. We approve the risk allocation as part of the total project funding at IP3 stage. The drawdown of that available risk funding requires Risk Management (IP5) approval. Upon completion of the site works, our Project Closure Process (IP6) ensures that the project is complete both technically and financially.

At each stage two fundamental questions are posed:

1 Is this network need still valid?
2 Does the option being proposed today offer the best available balance of all the factors?

Proposals must pass these two tests first before any further considerations.

High-Level Whole System Operational Framework

The table below contains a framework that will guide Whole System operational activity by energy vectors. It is a pilot template that be used to embed Whole System thinking into operational processes, procedures, assessments, training and data requirements.

Table A9-1: Template for the Whole System Operational Framework

Energy Vectors	Electricity System Interaction	Whole System Considerations	Whole System Operational Activity	Target Outcomes
Electricity	The UK Government has committed to decarbonise the electricity system by 2035. It brings forward by 15 years the Government's original commitment to a fully decarbonised power system by 2050. Home-grown technologies – from offshore wind, hydrogen and solar, to nuclear, onshore wind and Carbon Capture and Storage – will be deployed to support the UK to transition away from reliance on fossil fuels.	Effective coordination and data sharing between network companies, ESO and relevant stakeholders is likely to be a key enabler in achieving additional network capacity at minimal cost to consumers. Data sharing and joint analysis between electricity companies and the ESO will facilitate a real-time, joined-up view of the power system which will reduce the costs of balancing actions and balancing services. Resources connected to our networks could provide both additional capacity and additional generation to assist in key areas that have specific challenges during periods of network constraint. Suggestions from third parties have the potential to reveal hitherto unknown solutions to network constraints.	We will implement a Whole System planning function at the forefront of our investment decision-making framework. We will introduce a team of Strategic Optimisers who will provider dedicated specialist support to all our Local Authorities. We will involve representatives from both our distribution and transmission businesses in IP gateway decisions. We will explore markets for flexibility with new and existing customers who are able and willing to control how much they generate or who can control their demand. We will continuously test and challenge our approach by working with the Energy Systems Catapult (ESC). We will innovate bespoke Whole System training packages (potentially with input from the ESC) for our staff and conduct two integrated DSO/Design/Whole	Consideration of flexible and market solutions at the outset and a step change in the deployment of Whole System solutions. Investment plans and procedures updated to incorporate the Whole System Assessment Framework. Cost-saving solutions on the distribution network to alleviate transmission or ESO constraints (and vice versa). ISO accreditation over our Whole System governance process. Publication of a Whole System Coordination register by March 2022. Local Authority plans at the heart of our scenario planning. Availability of information, data and points of contact for network users.

		Our ENZ Platform will be at the heart of our data-driven network planning. It will integrate a very wide variety of data sources and combine them with a full network connectivity model, to provide an integrated data and analytical system covering the entire network. Data sources include network monitoring, Smart Meter, LCT notifications, forecasts including DFES and EV/Heat-up, asset data including condition, data on faults, and operational network state, asset alarms etc.	System symposiums embed Whole System thinking in our organisation. We will adopt a principle of open data and create a portal to share system requirements as well as to receive suggestions from third parties. We will continue to engage with stakeholders while providing targeted support and expert advice to Local Authorities, House Builders, Community Energy Schemes and network users in general. The ENZ platform will be central to managing the scale of LCT uptake, increased LV network visibility and greater connections and design volumes. We will use it to bring data-driven visibility, including for the LV network, that will enable much more informed investment and operational decisions.	
Gas	The UK's Hydrogen Strategy has set an ambition for 5GW of low carbon hydrogen production capacity by 2030 – the equivalent of replacing natural gas in powering around 3 million UK homes each year as well as powering transport and businesses, particularly heavy industry.	The use of hydrogen will require new networks and storage, as well as integration with CCUS, gas and electricity networks. Coordination is needed with gas utilities, where their planned outages will increase electricity demand at times where our networks might already be close to peak demand.	We will establish joint planning, innovation and data sharing through our Whole System Charter with SGN, ESO, NGET and SSEN. SPEN and Cadent Gas will contribute to the achievement of the decarbonisation ambitions and the required action and investment. We will work together to develop a common view on how to reach	Manage uncertainty and develop Whole System tools and process through the Whole System Charter. A Decarbonisation Pathway to reach carbon-neutrality for the Liverpool City Region, Cheshire West & Chester, Warrington and Greater

			net zero by 2040 for the Liverpool City Region, Cheshire West & Chester, Warrington and Greater Manchester area combined. When receiving a connection application within a hydrogen cluster, we would make contact with the relevant entity involved in the local gas or hydrogen network to check if these organisations had any available plans that the connection could be relevant to. We would progress this line of enquiry in parallel with progressing the connection offer in order to meet licence timescales while providing options informed by a full range of knowledge. Collect data on forward plans for the scaling up of electrolytic production. Engage closely with the Government's Hydrogen Strategy roadmap to developing the hydrogen economy to anticipate how government and industry will need to coordinate and deliver activity across the value chain and supporting policy, and how this will evolve over time.	Manchester area combined. Joining-up of local heat requirements and plans to develop hydrogen as a fuel-source.
Heat	The Heat and Buildings Strategy set out a high electrification pathway to get on track with the	In scenarios where heat is mostly decarbonised via hydrogen, that hydrogen could come mainly from	For any heat related connection application, we would make contact with the relevant gas distribution network	Connect heat requirements with hydrogen as a potential fuel solution.

	Government's aim of 600,000 heat pump installations per year by 2028. This includes a new Boiler Upgrade Scheme with a budget of £450 million and running over three years from April next year, with upfront grants of £5,000 (Air Source Heat Pump) and £6,000 (Ground Source Heat Pump). More electric heating could see higher peak electricity demand.	electrolysis using renewable electricity ('green' hydrogen) or mainly from natural gas reforming with Carbon Capture Use and Storage (CCUS) ('blue' hydrogen). In scenarios where heat is mostly decarbonised via electric heat pumps more electricity system flexibility will be required, that flexibility could mainly come from supply or demand.	in our area to see if there are any plans for the use of hydrogen. Collect data from Local Authorities, gas companies, developers and other stakeholders to understand where heat is to be decarbonised by green hydrogen, blue hydrogen or heat pumps.	Plans in place to react to emerging heat decarbonisation pathways.
Transport	The electricity system will have to expand in an agile manner to enable the mass uptake of EVs and the provision of charging infrastructure.	Ensuring that consumers can connect to the grid in a timely and convenient way While many EV users will rely on home-charging for their vehicles, lower-income households are less likely to have access to off-street parking. This therefore creates an additional barrier on top of the purchase price of an EV. For larger connections where multiple chargepoints are installed, such as at depots or in car parks, a new or upgraded connection may be required to cope with the new demand, and this can sometimes create a need for wider network reinforcement works. The process	Early consideration of timely, efficient, and affordable connections and other electricity network requirements to complement and inform EV optioneering work that Strategic Optimisers undertake with all Local Authorities. Whole System planning function to provide expertise and guidance on the connection process and targeted support for urban and rural councils. Collecting data on fleet electrification plans of various organisations and proposing opportunities and solutions for sharing and optimising charging infrastructure. Build on our partnerships with	Lowering barriers to fleet electrification through operational readiness for concurrent programmes of fleet conversion. Providing just-in-time optioneering for Local Authorities seeking to provide charging facilities for customers in vulnerable circumstances or lower-income households. Lowering CO_2 emissions by accelerating mass uptake of EVs. Creating opportunities to share and optimise charging infrastructure utilisation.

		and cost of connecting charging infrastructure to the electricity network can be a major barrier to roll-out.	Lothian Buses and First Bus to scenario-planning for concurrent fleet electrification by organisations serving urban and rural areas. Collecting data to understand where sufficient public and shared charging facilities can contribute to overcoming the barrier lower-income households may face with respect to home-charging facilities. Collecting data from rail companies on how they plan to decarbonise currently non-electrified lines. The two options (make them electric or use hydrogen trains) will have very different network impacts and we will seek to understand forward plans for rail. Innovate real-time tools to provide stakeholders with transparency over known transport development plans.	
Water and wastewater[39]	The water industry is energy intensive, driven by processes related to drinking water treatment and distribution and wastewater treatment and collection as well as processes to ensure water quality and	The relationship between energy and water (the energy–water nexus) is interdependent such that energy savings and water savings can be synonymous. Lead times and costs associated with access to the grid may present	Gather data from partnerships with water utilities (Scottish Water, United Utilities and Severn Trent) on water supply needs when planning electricity network provision to provide different pathways to water utilities for grid access as well as	Network readiness and optioneering ahead of the connection of new water plants. Lowering of barriers to the export of renewable energy from water utility sites.

[39] Information Source – Environmental Agency https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/291637/scho1209brof-e-e.pdf

	reliability standards are met. Water and waste companies utilise on-site wind, hydro power and direct combustion and anaerobic digestion to generate electricity and heat.	barriers to the export of energy. Significant potential for energy savings in the water sector if all the economically available energy efficiency and energy recovery potentials in the water sector are harnessed. Diminished freshwater resources can lead to a greater reliance on energy-intensive sources of water supply such as desalination or inter-basin transfers.	storage and export of renewable electricity. Explore with water companies the use of flexible solutions and demand turndown at peak periods to optimise existing network capacity and/or reduce the costs of connection. Innovate jointly with water utilities tools to aid decision-making regarding the management of water and energy resources at a utility or residential level. Combine data on forward plans for local heat networks and water supply works to identify opportunities to join-up combined heat-and-power output from the water industry with local heat requirements.	Opportunities to join-up planning of local heat requirements with CHP output from water companies.
Telecoms	The telecom sector's overall electricity consumption is mainly due to data centres and telecom devices. But both fixed networks (fibre, cable or copper) and mobile networks (3G, 4G or 5G) also need energy to operate. Telecommunication infrastructure enables the control of electricity networks through centralised dispatch from regional and national control	Telecommunications Infrastructure will play a pivotal role in enabling DNOs' transition to a smarter electricity network and ultimately a UK-wide low carbon economy. The 2018 National Infrastructure Assessment (NIA) and the Future Telecoms Infrastructure review back the increased use of infrastructure sharing to push full fibre rollout further. This includes the possibility of sharing existing electricity poles.	We will partner with telecoms providers to deploy and optimise available communications solutions to maintain an effective, efficient and sustainable power distribution system that is resilient to cyber security threats. At the same time, we will explore the potential of sharing our telecommunication infrastructure to widen digital connectivity of local communities. Enhanced engagement and joint innovation to reverse the trend of DNOs and BT continuing to	Identify pathways to contribute to a higher coverage of full fibre network through sharing of fibre networks in our SCADA systems. Support telecom deployment in rural areas though the use of electricity poles and ducts. Understand the potential, if any, of achieving savings through knowledge sharing, maintenance and sourcing of poles. Proactive development of

	centres, where Supervisory Control and Data Acquisition (SCADA) systems are widely used. BT has taken the decision to retire the Public Switched Telephone Network (PSTN) by December 2025 and other providers plan to follow a broadly similar timescale. This means that in future, landline calls will be delivered over digital technology called Voice over Internet Protocol (VoIP), which uses a broadband connection[40].	The Energy Data Taskforce recommended in 2019 the establishment of a unified Digital System Map to increase visibility of energy system infrastructure and assets, to promote infrastructure sharing. The deployment of Artificial-intelligence-driven sleep and shutdown of systems previously in constant use (eg fixed networks, data centres) will change the profile of telecoms energy consumptions significantly. Energy is the primary source of cost savings when decommissioning legacy networks such as energy-intensive 2G networks. Ofcom has rules in place to ensure all telecoms providers identify and support customers in vulnerable circumstances ahead of the PSTN switch-off. In the energy sector, the Priority Services Register is a free support service to help people in vulnerable situations.	have separate ways of organising and managing electricity and telecoms infrastructure. For example, all electricity distribution poles in the UK are owned by DNOs. BT also own poles. Most DNOs have fibre installed for their own SCADA and protection circuits but this tends to be limited to electricity pylons and substations. Collect data on the decommissioning of legacy networks, the deployment of sleep and shutdown technology as well as forward plans for the creation of data centres. Explore with telecoms providers whether there are what support we can offer to the telecoms sector in relation to the PSTN switch-off and the identification of customers who may require support – via our well understood and robust business as usual processes, or via innovation (on the understanding working with the telecoms industry will provide further access to their whole system thinking).	grid-access options for the connection of new data centres. Coordinated identification of customers in vulnerable circumstances by analysing and cross referencing the data we hold for customers with that of telecom providers. By targeting those where we only hold a landline number we will be able to identify potential “at risk” customers. Once this assessment is complete it will allow us to determine the scope of any future procurement of data, close out the support plans for the switch off, and allow us to determine how many landline customers that require to have an alternative method of contact (mobile phone or carer / alternative person).
Refuse	Anaerobic Digestion plants take organic waste and turn it into renewable energy	Deployment of anaerobic plants is part of a coherent sustainable waste policy that heats and powers UK homes.	Participation in a cross-sectoral forum to consider the appropriate location of anaerobic infrastructure.	Opportunities to join-up planning of local heat requirements with outputs from anaerobic plants.

[40] Ofcom https://www.ofcom.org.uk/about-ofcom/latest/features-and-news/upgrading-landlines-to-digital-technology

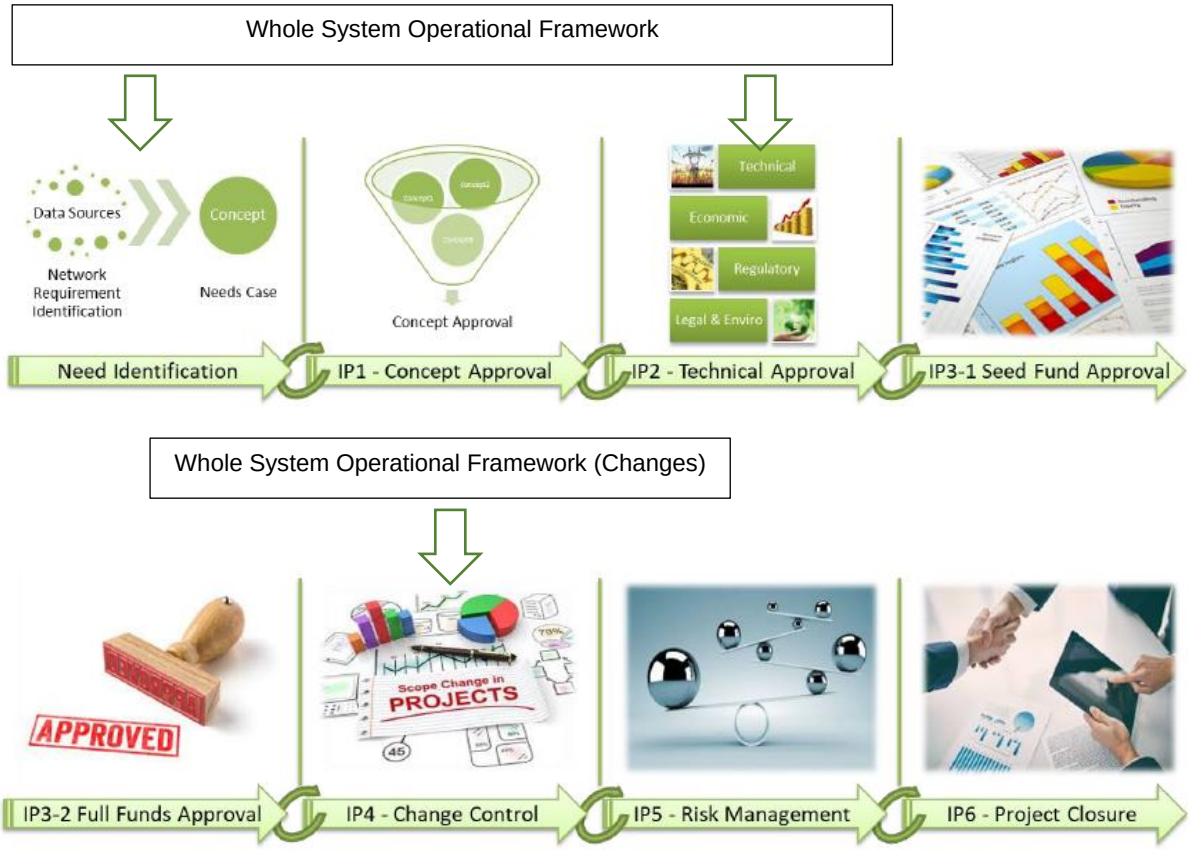
	and nutrient-rich biofertilisers		Provision of expert advice on grid access and known heat development plans to Local Authorities considering the siting and development of new anaerobic plants.	Reduction in costs for the deployment of anaerobic plants.
Cross-Vector	A common, high cost element of projects is civil expenditure.	A system across utilities to communicate, cooperate and coordinate digging up of roads ('dig-once' principle) has the potential to save significant costs.	Innovate and promote a cross-sectoral solution to coordinate and identify synergies in road excavations and reinstatement.	A reduction in consumer bills from efficiencies in civil costs.

Incorporating the WSOF into our Investment Decision-Making Framework for RIIO-ED2

We envisage the WSOF being deployed during 'Need Identification' (Pre IP1) and 'Technical Approval' (IP2) phases as these are key phases influencing the nature of any intervention on the network we propose to take forward. However, these inputs would be based on medium to long-term data and information.

As mentioned above, changes can occur during delivery of a project. From time to time, near-time and real-time **operational** data shared across the Whole System (e.g. gas companies telling us if they have an outage, warning the ESO about constraints that may affect their DER service use, data sharing from suppliers on which DER they plan to dispatch, etc) would require a reassessment of Whole System initiatives that are already in progress. In these instances, a further iteration of the WSOF may be required during the Change Control approval mechanism (IP4).

We illustrate below the interaction of the WSOF we anticipate will be required in our RIIO-ED2 investment decision-making framework.


Whole System Operational Framework
Data Sources
Concept
Network Requirement Identification
Needs Case
Concept Approval
Technical
Economic
Regulatory
Legal & Enviro
Need Identification
IP1 - Concept Approval
IP2 - Technical Approval
IP3-1 Seed Fund Approval
Whole System Operational Framework (Changes)
APPROVED
Scope Change in PROJECTS
IP3-2 Full Funds Approval
IP4 - Change Control
IP5 - Risk Management
IP6 - Project Closure

9.10 Appendix 10 – Our Whole System activities mapped to strategic pillars

		Develop a network that's ready for Net Zero			Be a trusted partner for our customers, communities and stakeholders	Ready our business for a digital and sustainable future	
Initiative	**Status**	Establish strategic partnerships to achieve common Whole System goals	Using innovation, markets and flexibility to push the boundaries of Whole System thinking	Thinking beyond the electricity sector to support other energy vectors including heat, transport and hydrogen	Using Whole System thinking to support our communities and vulnerable customers in the transition to Net Zero	Improve our mastery of data, sharing data easily to unlock Whole System and consumer benefits	Embedding Whole System thinking in our culture and ways of working
Energy Networks in Wales	ongoing	✔		✔	✔		
Hydrogen Reference Steering Group	ongoing			✔			
Anglesey Enterprise Board	ongoing	✔			✔		
Advisory Role to Deeside & Snowdonia Enterprise Zone Boards	ongoing				✔		
Anglesey Energy Island Steering Group	ongoing				✔		
North Wales Economic Ambitions Group **- Transport Working Group** **- Economic Growth Planning Group** **- Smart Local Energy Systems Project**	ongoing			✔	✔		

~~Growing Mid-Wales~~ Partnership - Growth Deal Planning Group	ongoing	✔			✔		
Ynys Mon Hydrogen Island Steering Group	ongoing			✔			
HyCymru Trade Association Steering Group	ongoing	✔					
Natural Resources Wales - Mid Wales Steering Group	ongoing	✔		✔			
Bethesda Home Hub Community Energy Project	ongoing	✔		✔	✔		
Shropshire Climate Action Partnership	ongoing	✔			✔		
Marches Local Enterprise Partnership Energy Group	ongoing	✔			✔		
Marches Local Enterprise Partnership Transport Group	ongoing	✔		✔	✔		
Liverpool City Region Clean Growth Board	ongoing	✔			✔		
Mersey Tidal Commission Steering Group	ongoing	✔	✔	✔	✔		
Net Zero North West Steering Group	ongoing	✔	✔	✔	✔		
Liverpool Energy Exchange Steering Group	ongoing	✔	✔	✔	✔		
Liverpool City Region Climate Action Partnership	ongoing	✔		✔	✔		
Liverpool City Region Local Enterprise Partnership Built Environment Board	ongoing	✔			✔		
Wirral MBC Cool Wirral Partnership	ongoing	✔		✔	✔		
Wirral Zero Carbon Buildings & Infrastructure Taskforce	ongoing	✔		✔	✔		

Cheshire & Warrington Local Enterprise Partnership Sustainability & Inclusive Growth Commission	ongoing	✔		✔	✔		
Cheshire Energy Hub	ongoing	✔	✔	✔	✔		
Cheshire & Warrington Local Enterprise Partnership Strategic Infrastructure Board	ongoing	✔		✔			
REWIRE NW project	ongoing	✔	✔	✔			
CWAC Climate Action Planning Group	ongoing	✔		✔			
Cheshire East Council Transport Group	ongoing	✔		✔	✔		
CHARGE	ongoing	✔	✔	✔	✔	✔	✔
Angle-DC	ongoing		✔	✔	✔		
Dumfries & Galloway ANM	ongoing		✔			✔	✔
FUSION	ongoing		✔	✔	✔	✔	✔
Distributed Re-Start	ongoing		✔			✔	✔
PACE	ongoing	✔	✔	✔	✔		
Re-Heat	ongoing	✔	✔	✔	✔		
NERD / Now CoRE (Community Renewable Energy)	ongoing			✔	✔		
Green Economy Fund	completed			✔	✔		
Net Zero Fund	ongoing			✔	✔		
NAVI platform	completed		✔	✔		✔	
flexibility tenders	ongoing		✔	✔		✔	✔
Borderlands	ongoing			✔	✔		
Green Recovery	ongoing			✔	✔		
Strategic Partnership with CALA homes	ongoing	✔		✔	✔	✔	

~~Strategic Partnership with~~ Bellway homes	ongoing	✔		✔	✔		
Strategic Partnership with Robertsons Homes	ongoing	✔		✔	✔		
Strategic Partnership with GTC	ongoing	✔		✔	✔	✔	
EON Innovation Strategic Partnership	ongoing	✔	✔	✔	✔	✔	
Bandeath Energy Holdings (new IDNO / IDSO)	ongoing			✔	✔	✔	
Regular engagement with Homes for Scotland, house builders and SSEN	ongoing			✔	✔	✔	
Maidenhill smart solutions	ongoing		✔	✔		✔	
CALA Wellington	ongoing		✔	✔		✔	
St Andrew's University Eden Campus	ongoing			✔	✔		
St Andrew's University Simulation Data Share partnership	ongoing		✔	✔	✔	✔	
St Andrews University Established Campus Net Zero Strategy Partnership	ongoing		✔	✔	✔		
Clyde Gateway	ongoing		✔	✔	✔		
monthly engagement with Scottish Water	ongoing			✔			
Bandeath waste heat recovery / community private wire hub	ongoing		✔	✔	✔	✔	
East Coast Net Zero partnership	ongoing		✔	✔	✔	✔	✔
ADMD calculator development	ongoing			✔			
Scottish Government bus decarbonisation task force	ongoing	✔		✔	✔		

~~Scottish Government~~ strategic partnership for the decarbonisation of transport	ongoing	✔		✔	✔		
Scottish Government strategic partnership for the decarbonisation of heat	ongoing	✔		✔	✔		
Northumberland Council Net Zero strategy	ongoing			✔	✔		
SPT / SPD stakeholder engagement managers meeting	ongoing					✔	✔
Sheriffhall upgrade (SPD & SPT)	ongoing				✔		✔
Edinburgh Castle green	ongoing			✔	✔		
City of Edinburgh Council Net Zero Strategy partnership	ongoing	✔		✔	✔	✔	
City of Edinburgh Council Housing development Strategy partnership	ongoing			✔	✔		
Edinburgh, Borders and South East Scotland net zero strategic partnership	ongoing	✔		✔	✔		
Strathclyde university & East Ayrshire council, Cumnock mine shaft heat network Innovation	ongoing		✔	✔	✔		
	ongoing						
Edinburgh University super-computer waste heat recovery	ongoing		✔	✔	✔	✔	✔
Contributing to Scottish Government (Improvement Services) spacial hub data sharing platform with all 32	ongoing			✔		✔	

local authorities Scot. Water and SGN							
working with BT Openreach and Virgin to make sure their critical infrastructure is identified on our GIS maps and reenergised as quickly as possible following a fault	ongoing			✔		✔	✔
Smart heater storage optimisation	ongoing		✔	✔	✔		
Heriot Watt University real time Fault level monitoring with ANM Innovation partnership	ongoing		✔				✔
regular engagement with EDF	ongoing			✔			✔
regular engagement with Network Rail	ongoing			✔			✔
Energy Networks Charter (Scotland)	ongoing	✔		✔	✔		
coordinated outage planning	ongoing						✔
strategic engagement with NGESO, NGET and SSEN	ongoing						✔
bilateral engagement with NPG	ongoing						✔
bilateral engagement with SGN	ongoing			✔			✔

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