



## Appendix 19a: Whole systems strategy - Facilitating Net Zero at lowest cost

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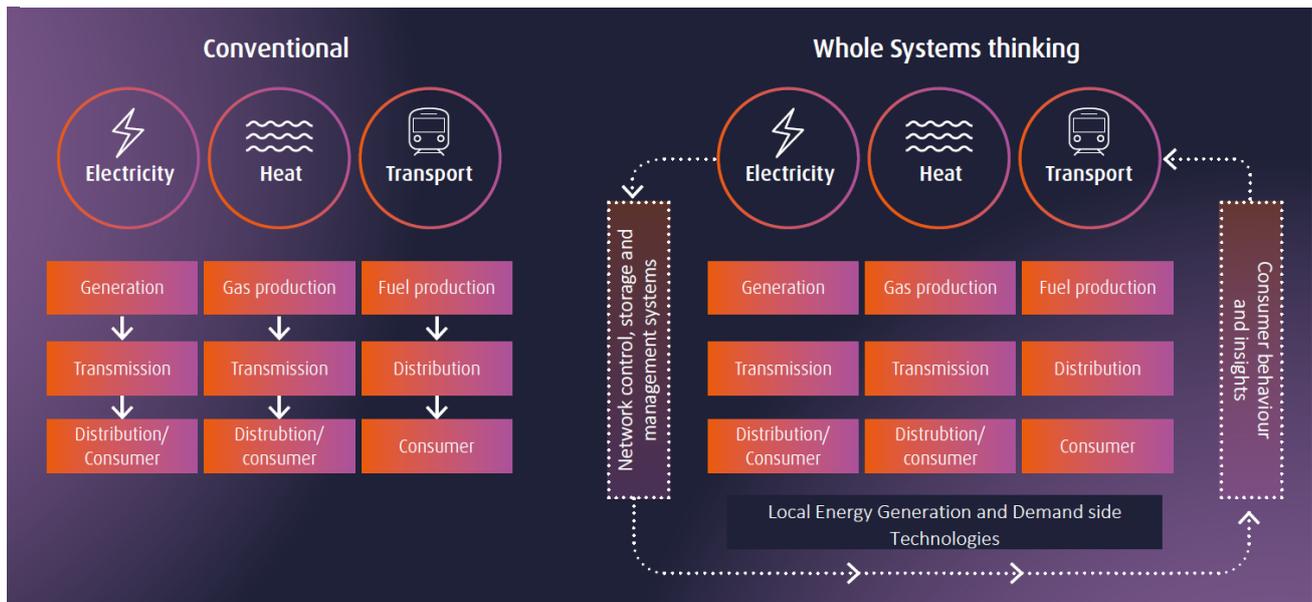
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## Whole Energy System Strategy Introduction

This document sets out our whole systems strategy for facilitating Net Zero for our customers. The strategy for ‘Achieving Net Zero’ for the operation of our own networks business is described in a separate chapter of the business plan.

Ofgem has defined Whole Systems Thinking as “Solutions arising from energy network companies and system operators coordinating effectively, between each other and with broader areas, which deliver value for consumers.”<sup>1</sup>

Figure 1: Conventional & Whole Systems thinking perspectives on the energy system (source: Energy Systems Catapult)



And, Ofgem has asked us to consider a broad definition of whole systems: “For RIIO-ED2 we (Ofgem) will adopt a broad definition of whole systems. In addition to the gas and electricity sectors, the scope of the ‘whole system’ is expanded to apply to all other areas so long as coordination with those areas produces net benefits for the existing and future consumers of the relevant network sector.” The “relevant network sector” is defined as “the distribution, transmission and operation of a single energy source. For example, the ‘gas sector’ includes the firms responsible for gas transmission, distribution, and system operation”<sup>2</sup>.

Following Ofgem’s lead, we are therefore pursuing a broad definition of “Whole Systems Thinking” (which encompasses Ofgem’s definition):

*Solutions arising from working and coordinating collaboratively across the whole value chain (network companies, local authorities, consumers and consumer groups, retailers, tech. firms etc.) to deliver wider societal benefits as well as meeting core objectives of delivering low cost, secure electricity to our customers*<sup>3</sup>.

In other words, in our whole systems strategy, we will seek out whole systems solutions to deliver overall benefits to society and accelerate the net zero transition as well as meeting our core objectives of delivering low cost, secure supply to our customers. As an example, to bring this to life: we would classify an initiative as a whole system project where EV charging provision at railway car parks is supplied via the existing network rail DC network- as opposed to bringing in separate AC grid networks- this way an existing electric transport sector providing energy to an emerging transport sector could be a lower whole system cost outcome for consumers.

In the energy arena, the benefits of a whole systems strategy can be financial (lower costs) and environmental (deeper decarbonisation). Closer collaboration and coordination can also deliver *operational* resilience where e.g., the ESO and DSO combine efforts to overcome shocks to the operation of the overall electricity system. We believe that our whole systems strategy for facilitating net zero can deliver a faster, deeper transition at lowest whole system cost for our customers.

<sup>1</sup> Page 172 of the RIIO-ED2 SSMD.

<sup>2</sup> Page 55 of the RIIO-ED2 SSMD.

<sup>3</sup> This follows more closely the Energy Systems Catapult assessment of the energy decarbonisation transition as a ‘system of systems’ and developed further later: “Systems thinking in the energy system – A primer to a complex world” by Energy Systems Catapult.

## Our ambition to facilitate Net Zero for our customers

### A changing environment

We operate in unprecedented times, with many factors influencing our business and industry, all of which are considered when developing our business plan, for simplicity we cover these in the figure 2 below.

Figure 2: Key factors influencing our business and industry



Climate change is the greatest challenge facing our generation and, as a society, we need to make transformative changes in the ways we use and deliver energy to avoid the impacts of damaging levels of climate change. Critically, we have limited time to act before it is too late.



These are likely to have a significant impact on the daily lives of final consumers and our DER customers, changing their behaviour and energy consumption, and enabling the possibility of their greater participation in the energy system. To expand how we respond to technology improvements, we have added a case study on our latest technology project ‘Constellation’ in the Annexe B to articulate how we adapt and integrate new technologies to improve service.

Through deep engagement with our customers and stakeholders, we recognise that concern for the environment is a high priority but within the context of economic concerns and a desire to keep bills low<sup>5</sup>. We recognise that this is even more important as the long-term economic impacts of COVID-19 unfold. Residential customers have told us that they are concerned about the environment, feel compelled to play their part, and believe that we “must prioritise the environment over short term financial benefits”<sup>6</sup>. Businesses and organisations are moving at different speeds: some have told us they want more guidance on how to transition to Net Zero while others want support for their stretching carbon reduction plans. Our customers have clearly expressed that they want to see leadership on Net Zero and want our role to reflect the growing momentum and urgent need for a transition to Net Zero, but by investing at the right pace<sup>7,8</sup>. Putting this another way, we must find solutions to the energy trilemma: finding the right balance between affordability, sustainability, and energy security for each of the different customer groups.

The regulatory environment is also changing with Ofgem’s decarbonisation plan<sup>9</sup>, the introduction of the DSO role, which is a key enabler of Net Zero, the broader transformation in network company roles, and the development of adaptive regulatory models.

From a systems perspective, this represents a ‘complex system of systems’<sup>10</sup> with multiple interdependences:

- Between electricity, natural gas, and hydrogen fuels.
- Across energy, heat, transport, and other sectors.
- Between policymakers, network and system operators, and multiple agencies.

Taking all these policy, technological, societal, and regulatory changes together, this represents a forward period of unprecedented uncertainty creating a significant challenge for strategy development and network planning.

This means that no one actor is in charge – an enhanced level of collaboration and coordination between actors is vital to deliver the required decarbonisations of particularly heat & transport and so achieve the emissions targets.

Tackling these problems means that we must take a more holistic view of how we interact with other organisations. In fact, to discover and deliver the lowest cost decarbonisation pathways for our customers and so meet the Net Zero targets within the timescales, we must adopt a Whole Systems approach.

## Our Net Zero ambition

*We aim to be the leading DNO in supporting the transition to Net Zero. We will make our networks ready to accommodate LCTs, and we will facilitate this transition. We will also aim to do this in a way that protects customers from higher costs over ED2, while maximising the scope for customer participation through flexibility. As such, our business plan delivers an optimised investment plan which is resilient across a broad range of future scenarios.*

We are at a critical time in the Net Zero transition where decisions and actions taken now will define future success. Our customers and stakeholders are clear: there is no second chance, and any ambition that falls short of meeting the UK government’s targets for 2050 is not acceptable. While customers struggle to articulate what Net Zero means in practice, they feel it is inextricably linked to the survival of the planet.

*“2050 is still 30 years away and if the last few months have taught us anything is that the world is able to move when faced with a common threat/goal. I think that the target could be moved forward. Organisations need to be more ambitious with*

<sup>5</sup> Line of Sight – Whole systems: Insights from our stakeholder co-creation

<sup>6</sup> Line of Sight – Whole systems: I-FNZ1

<sup>7</sup> Line of Sight – Whole systems: How ambitious should we be with respect to facilitating Net Zero?

<sup>8</sup> Line of Sight – Whole systems: What we learned from our customers as a result of our business options testing for Facilitating Net Zero<sup>9</sup> Ofgem decarbonisation programme action plan, Feb 2020

<sup>9</sup> Ofgem decarbonisation programme action plan, Feb 2020

<sup>10</sup> “Systems thinking in the energy system – A primer to a complex world” by Energy Systems Catapult.

*their plans especially when it comes to reducing their own carbon footprint. The lockdowns all over the world have given societies and people a chance to think and look at their consumption regarding fuel, fashion, food etc. so now would be a great time to capitalise on this and make real strides forward.”* **Deeper FNZ Engagement (Phase 2b)**

The policy and technology environment is changing, and we have heard our customers’ needs, concerns, and expectations throughout our RIIO-ED2 customer and stakeholder engagement. Given the scale, complexity, and urgency of the challenge, it is our ambition to be a proactive facilitator to deliver more for our customers and stakeholders to fulfil their Net Zero targets.

The customer journey will differ in relation to low carbon heat and transport choices and for prosumers, and that unique challenges exist for different consumer groups across our distribution area e.g., rural and off-gas grid heating customers, and car owners who do not have a driveway charging opportunity.

*“For the planet and future generations’ survival it feels very important. I think it’s actually more important than something to achieve by 2050, a lot of reports suggest that we need to make a lot of changes in the next decade and 2050 could be too late”* **Phase 4, Consumer, EPN, Age 35-54**

We have worked extensively with our customers through our RIIO-ED2 customer and stakeholder engagement to understand specific customer challenges. For instance, there is an increasingly positive attitude towards EVs in the UK, but concerns about affordability, poor battery life, range and lack of charging points remain barriers to adoption<sup>11,12</sup>. As part of our strategy RIIO-ED2, we are committed to building on the progress achieved in RIIO-ED1 and continuing our customer engagement to ensure that our plans and actions are forward thinking and continually adapted to our customers’ evolving needs. Furthermore, we will actively provide guidance and information, and pursue solutions and provide support for specific customer groups so that they are not left behind in the transition to Net Zero.

Electricity Networks have the privilege of a trusted position and central role in the industry, and it is up to us to use this role effectively to facilitate broader and deeper decarbonisation. Our customers and stakeholders believe it is important for the future energy system to take account of the wider whole system impact and that our approach to the Net Zero transition should be coordinated at a local and national level<sup>13</sup>. Overall, our stakeholders agree that our role in Net Zero is two-fold:

- **Achieving Net Zero:** We must lead by example and decarbonise the management and operation of our electricity network.
- **Facilitating Net Zero:** We must proactively facilitate decarbonisation with our customers and as society strives to meet the stretching Net Zero emissions targets.

Stakeholders have clear expectations that we should take more responsibility in driving awareness, educating customers, and playing a central role as a source of information and support<sup>14</sup>. By engaging closely with our customers and stakeholders, we will ensure that our plans address their specific challenges and needs, and that we are best placed to flexibly accommodate any LCT uptake scenario. As well as being more flexible going forward, strategic and coordinated investment decision making is required through close collaboration with our stakeholders. Through our ambition and strategy, we will play a significant and constructive role in enabling a green and sustainable recovery.

Our DSO will be the driving force behind our whole systems strategy through network planning, through creating new markets for products and services, and through operational coordination e.g., with the ESO to deliver system security. We are planning for implementation by ensuring that our ambition and whole systems strategy to facilitate Net Zero is embedded right across our business: from senior management accountability and support, to ensuring we have the right supply chain to deliver, and to our digital and IT capabilities supporting customer participation and open data exchange.

The Committee on Climate Change studies show electrification is key to enabling Net Zero and achieving wider societal decarbonisation and we understand that our role is provide the infrastructure and services that our customers need. Our networks must therefore be Net Zero-ready and we must support our customers to act. However, we recognise that our

<sup>11</sup> Line of Sight – Whole systems: I-FNZ3

<sup>12</sup> Line of Sight – Whole systems: What we learned from our customers as a result of our business options testing for Facilitating Net Zero

<sup>13</sup> Line of Sight – Whole systems: I-DSO/WS8

<sup>14</sup> Line of Sight – Whole systems: I-FNZ12

customers may not want to commit to everything today as the full pathway to decarbonisation is emerging, but they will want to take further action in future.

We must strike the right balance between ambition and protecting our customers from unnecessary bill increases. In RIIO-ED2, our role will balance unlocking flexibility, least-regrets investment, and coordinated planning to deliver efficiently and seamlessly for our customers, exceeding their expectations, while ensuring we can go at the pace of our customers' fastest decarbonisation pathways. We understand that whole system cost must be minimised and fairly apportioned, and that we must leave no one behind.

*"(customers) who face less attractive options will need to be protected"* **Indepen Virtual Forum Feb '21**

#### **Sidebar: Customer Vulnerability Strategy**

Our role is clear, we must enable a fair and just transition to Net Zero which addresses the needs of customers in vulnerable circumstances. Our Consumer Vulnerability Strategy was developed through extensive engagement with stakeholders through workshops, bi-lateral sessions and webinars. This strategy guides our business-as-usual activities to ensure that addressing Consumer Vulnerability is delivered by design in all our activities.

Through collaboration with the ESO and others, developing markets for flexibility and reactive power will be vitally important and can deliver substantial savings for consumers where these measures defer the need for network development. The Carbon Trust / Imperial College study<sup>15</sup>, which we co-sponsored, estimates that GB can save up to £16.7bn per annum to 2050 through flexibility solutions.

Examples of the facilitation role we will play to accelerate Net Zero include:

- Broadening and deepening our partnership with the ESO.
- Collaborating closely with Local Authorities to help them deliver their stretching carbon reduction targets by co-developing plans with them which contain trigger mechanisms to activate investment as required while maintaining low costs.
- Facilitating the rollout of EV charging infrastructure - for example providing capacity to charging locations on our regional road network, further empowering trusted installers to deliver using our innovative 'Meccano' installation kits<sup>16</sup>.
- Where there is high confidence in the decarbonisation pathway (e.g., for off-gas grid customers; On-street public charging), deliver the required network reinforcement to facilitate their transition to low carbon heating and then work together with third party intermediaries to ensure this opportunity is promoted and utilised.
- Continuing to meet final consumers' preferences and needs for decarbonisation particularly in relation to heat and transport as the policy and technology environment evolves.
- Using engagement to identify further opportunities for collaboration to deliver deeper decarbonisation, greater efficiencies, and new innovations.
- Conducting proactive engagement with decision-makers and policy makers including Ofgem, BEIS, the Committee for Climate Change, and the Energy Networks Association in pursuit of policy clarity, particularly in relation to the decarbonisation of heat.

We are on a long journey to decarbonisation, having started several years ago. During RIIO-ED1 we have applied significant focus in this area, which was acknowledged by a prestigious international award:

***UK Power Networks received the Edison Electric Institute's (EEI's) International Edison Award 2019 in recognition of its innovative work in smart grid development and for enabling Britain's low carbon transition.***

Specific examples of progress include:

- Taking a leadership role in defining and procuring flexibility services. To date, we have procured over 350MW of flexibility.
- Being the first Distribution Network Operator (DNO) to contract flexibility at the Low Voltage level and specifically from EV service providers. Our work in this area provides a blueprint for how we can potentially scale flexibility at domestic level to support the uptake of EVs. This will be a win for customers (who will be able to secure additional value) and a win for networks (who will be able to provide capacity through lower cost interventions)
- Facilitating connection of over 2GW of connected distribution generation (DG).

<sup>15</sup> Flexibility in Great Britain, Carbon Trust, May 2021

<sup>16</sup> <https://www.smarternetworks.org/project-results/1Voyage>

- Unlocking 1.1GW of additional renewable network generation capacity through our pioneering distributed generation capacity programme.
- Delivering the largest portfolio of EV and heat innovation research and demonstration projects to deepen our knowledge of the implications of electrifying transport and heat along with the associated impact on the network **to prove decarbonisation solutions and inform future plans.**

## Our Whole System Strategy

We have already established that the changing environment presents an unprecedented level of uncertainty for the period ahead. From a systems perspective, the decarbonisation transition is a complex system with multiple interdependencies. Whole systems thinking which captures these interdependencies is therefore required to deliver our ambitious strategy to facilitate a faster, deeper, and low-cost transition to Net Zero for our customers.

To achieve the UK's decarbonisation targets, the whole energy system and sector will need to change significantly. The roles of these networks will inevitably change as the way energy is provided and consumed evolves and as other networks emerge, including those carrying heat, hydrogen, and data. We expect the future whole energy system is likely to be cross-vector (electricity, heat and transport interdependently linked), more distributed (local, regional, national), flexible (on-demand, service driven) and smart (dynamic, and automatically controlled). Transformational change is happening at an ever-increasing pace, driven by the need to reduce carbon emissions in the most efficient, cost effective way. There are opportunities for collaboration and innovation in all elements of the whole system including technologies, capabilities, services, people, policies, regulations, and commercial business models.

Our Whole Systems strategy for facilitating Net Zero has been informed by:

- The targets set out by Government and by our stakeholders and partners which determine what we need to achieve going forward.
- Our extensive RIIO-ED2 customer and stakeholder engagement which describes what their needs and concerns are and what expectations they have of the role UK Power Networks should play.
- First-hand experience of, and lessons learned from, many demonstration, innovation, and research projects conducted during RIIO-ED1.
- Looking externally at wider best practice.

Our Whole Systems strategy for facilitating Net Zero consists of four interacting building blocks covering the primary areas of decarbonisation activity together with our Innovation Strategy exploring wider beneficial interactions:

- **Whole Electricity** which focusses on the interactions within the electricity value chain: with the ESO, other DNOs / DSOs, DER generators and storage providers, and final consumers.
- **Whole Transport** which focusses on the interactions with EV owners including final consumers, transport authorities, and via local government.
- **Whole Heat** which is concerned with the decarbonisation of heating.
- Innovation which has responsibility for exploring opportunities to derive consumer benefits from wider, more nascent system interactions including with the water sector (e.g., power for pumping stations), waste sector (e.g., energy from waste), and telecoms amongst others.
- **Whole Systems Planning** where we apply whole systems thinking to draw together all these building blocks into a coherent market and network development plan.

Heat and transport have been given more prominence along with the electricity building block since they represent the main areas requiring decarbonisation and so they will feature highly in the activities delivered by this strategy. Our RIIO-ED2 Whole Systems strategy includes only initiatives which result in some form of electricity network operator action, which aligns with our system actor role. For example, there will not be any initiatives where we play a new role outside of the electricity system- such as heat networks, but rather finding lower cost, more speedy connections of such heat networks.

Our approach goes over and above our business-as-usual role in all areas, for example- our work on providing capacity at the point of use for major trunk road charging stations is facilitating the decarbonisation of the transport system through removing the sole use cost barrier of the electricity system. The same could be said for our strategic interventions on off-gas grid properties, where we could provide co-ordinated energy efficiency support and education ahead of rolling out capacity suitable for rural customers to decarbonise their heating and transport decades ahead of an uncoordinated passive approach- thus decarbonising the heat and transport sector faster than in a 'do nothing' option.

Figure 4: The building blocks of our strategy



The Innovation strategy, where we have a specific theme focussed on whole systems under the accountability of our Head of Innovation, is included within whole systems planning as requiring a ‘watching brief’ so that any material emerging interactions can be incorporated as required. Relevant stakeholders will be included within the engagement programme to understand requirements and to incorporate into future whole system strategies.

**Sidebar: Our RIIO-ED2 Innovation Strategy**

Innovation delivers value to our customers and stakeholders by testing new solutions that may be riskier than traditional methods, demonstrating if they work or not, and deploying at pace the solutions that have demonstrable benefits to our customers. Our RIIO-ED2 Innovation Strategy has six themes: Proactive Optimised Assets & Practices, Flexibility & Commercial Evolution, Whole Energy System, Net Zero & the Energy System Transition, Data and Digitalisation and Consumer Vulnerability. Across all of these themes, we will need to collaborate more widely, working with a wider range of stakeholders, including regional stakeholders and other network companies, to develop and deliver innovative products together. Please refer to our Innovation Strategy for more information.

In each of the four building blocks of our strategy we strive to deliver the transition to Net Zero at lowest cost to our customers - we balance our ambition to accelerate the pace of change with protecting our customers from cost increases. While the Electricity, Heat and Transport building blocks consider the needs of their own areas, Whole Systems thinking is applied to capture the interdependencies with adjacent sectors and seek out the lowest Whole Systems cost solutions.

## Building Block 1 – Whole Electricity

As the energy transition gains pace and technologies and policies mature, our customers' will evolve likely in response to e.g., more choice of EVs or more confidence about heat decarbonisation options. These customers will include renewable generators and storage providers wishing to connect as well as business and residential customers willing to provide flexibility and prosumers with e.g., rooftop solar or wind turbines installed.

We need to adapt our services to meet these changing needs:

- Importantly, providing accessible and useful information to educate our customers on LCTs and explain their decarbonisation options and encouraging them to participate actively in the energy system.
- Training our staff to support our customers through the energy transition.
- Providing helpful digital tools to streamline customer processes including for connection and LCT service upgrades.

In preparing for greater future electrification, there are significant consumer benefits to be gained from whole systems solutions within the electricity value chain and with other sectors including:

- Building on our partnership with NGENSO, extending Regional Development Programmes to other parts of our network area to optimise network development across T&D and offering large savings.
- Promoting and developing markets for flexibility and reactive power to e.g., maximise the flexibility and other services available from distributed generation and connected storage as well as from other sectors such as water in order to defer network build and maintain low costs for consumers.
- Promoting energy efficiency, together with trusted intermediaries, to deliver consumer savings, a smaller carbon footprint, and reduce peak demand growth to defer network build.
- Coordinating with other utilities to align street works activities and so minimise consumer disruption.

Through deeper collaboration with stakeholders and partners, we not only add whole systems value but also help e.g., Local Authorities meet their stretching climate targets and assist the ESO in delivering their target to operate a zero-carbon grid by 2025 and so deliver wider societal benefits.

## Building Block 2 – Whole Transport

The interaction between electricity and transport is a major component of our whole energy systems view – as EV ownership and the electrification of public transport and fleets ramp up, petrol / diesel fuel delivery systems will be gradually substituted by electricity delivered via power networks and charging infrastructure. This transition will deliver a material reduction in carbon emissions and wider air quality and health benefits.

At the highest level, decarbonisation of transport is a whole systems solution forming part of the transition to Net Zero. Vehicles fuelled by petrol and diesel will be substituted by EVs or fuel cell vehicles (FCV) making a switch from fossil fuels to low carbon electricity (or green hydrogen). Cost (or performance) may be a determining factor in choosing between EV and FCV solutions, particularly for e.g., buses and HGVs, but EV solutions are further developed and uncertainties about hydrogen availability, delivery, and cost may mean that FCVs can only develop as a viable option later. This transition profoundly impacts several systems including electricity, transport, emerging hydrogen, and petrol / diesel supply (and so too oil refining and production).

Our whole transport strategy, described further in the Whole Transport section, focusses on the proactive steps we are taking to overcome barriers in order to deliver this decarbonisation of transport. Another important part is concerned with the innovative work being conducted, in collaboration with several energy suppliers, to understand and identify appropriate viable solutions for vehicle to grid flexibility from EV owners which has huge potential given the forecast levels of EV ownership. This will be important in slowing the growth of peak network demand and so the need for network development.

As the utilisation of the network is maximised, it will be essential for us to invest in new network capacity at the right pace to meet customers' needs while keeping costs down. Whilst the speed of uptake of EVs is uncertain, customers expect us to be ready. To meet this challenge, we are adopting a flexible and scalable approach:

- We will plan to meet a base level of network demand, consistent with the “Consumer Transformation” demand scenario (compliant with the Government’s Net Zero target for 2050 and explained in greater detail in our DFES chapter), through a combination of network build, flexibility, and other smart solutions.
- We will work closely with Local Authorities & County Councils to develop plans to meet their climate targets, but with investment triggers to be actioned when a prescribed level of confidence in consumer demand is achieved.
- We will proactively invest to address areas of market failure, such as for on-street public charging, backed up by uncertainty mechanisms and other adaptive regulatory measures.
- Adopting a ‘one touch’ approach to fuse and service upgrades that will be sufficient for both an EV and electric heating (heat pumps) irrespective of which customer need comes first.

This approach, and particularly close collaboration with Local Authorities and Transport Authorities, will enable us to calibrate our investment response at the right level, so that we do not over-invest, consistent with the concerns expressed by customers as part of our EV business options testing, but have the ability to respond proactively, should demand increase in line with the more transformative scenarios.

### Building Block 3 – Whole Heat

Heat is the single biggest source of greenhouse gas emissions in the UK<sup>17</sup>, with over 85%<sup>18</sup> of the population currently relying on natural gas to meet their heating requirements and a further four million off-gas grid consumers who burn oil or solid fuels to maintain their comfort. Considering the environmental impact of this sector, decarbonising heat will be key to meeting the national Net Zero targets.

Given that heat is delivered through a combination of the gas and electricity systems, a whole systems approach is critical for the transition to Net Zero heating together with close cooperation with Gas Distribution Networks (GDNs). Heating provided by natural gas will be substituted largely by either (low carbon) electric heat pumps (or possibly electric storage heaters) or green hydrogen heating – depending on the decarbonisation pathway selected locally and on a national level. National policy is required on the pathway because a decision is required on whether or not to repurpose the national natural gas network to deliver hydrogen. The pathway for off-gas grid customers is clearer: oil / solid fuel heating substituted by low carbon electric heat pumps. This transition profoundly impacts several systems including electricity, natural gas, emerging hydrogen, and heating oil / solid fuel supply. The housing stock ‘system’ will also be impacted to improve thermal efficiency, reducing the carbon footprint of heating, and helping to create headroom within existing network capacity.

Our Whole Heat strategy is focussed on delivering network capacity where the heat decarbonisation path is clearer and addressing the barriers to transition where it is not. The main components are:

- Delivering fuse / service upgrades and the required network capacity to the majority (71%) of off-gas grid customers (where there is no viable prospect of e.g., hydrogen heating).
- Promoting an information campaign, together with trusted intermediaries, to raise awareness of heat decarbonisation, energy efficiency benefits, and the available options so as to help consumers make informed decisions about their transition.
- Engage with policy makers and decision makers, directly and via the ENA, to gain policy clarity on the appropriate heat decarbonisation pathways.
- Continue to explore potential solutions via innovations projects such as the hybrid heat pump initiative which is investigating potential solutions for vulnerable customers.

### Building Block 4 – Whole System Planning

This function will be delivered by the DSO (role 1) and is where Whole Systems thinking is applied to capture and understand the interactions between all the relevant systems as a basis for determining the required network intervention whether that be a build or non-build solution. To improve confidence in our plans, we will continuously collaborate widely with our customers and stakeholders to understand how their plans and ambitions are evolving during RIIO-ED2 as the technology and policy landscape evolves. Through a structured engagement plan, supported by regional consultations as required, we will share planning and other data through our open data strategy and new digital tools to inform these discussions and enable robust joint development of plans.

<sup>17</sup> BEIS “Clean Growth - Transforming Heating” Overview of Current Evidence, Dec 2018

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/766109/decarbonising-heating.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/766109/decarbonising-heating.pdf)

<sup>18</sup> ENA Gas Goes Green “Delivering the Pathway to Net Zero”, 2021 <https://www.energynetworks.org/industry-hub/resource-library/gas-goes-green-2021-launch-document.pdf>

Our detailed geographical and technology-specific Distributed Future Energy Scenarios (DFES) will be helpful for both us and our stakeholders to create detailed network development plans given our assumptions about likely customer / stakeholder requirements going forward.

Our whole systems approach will identify all relevant systems and will employ the Cost-Benefit Analysis, Societal Return on Investment, and other tools developed through the Energy Networks Association to assess whole systems value.

For example, we will work with partners including local authorities to co-develop and understand their energy plans. We will match their ambition and work with them as part of our DSO and whole energy planning team, pushing the boundaries of our role, by employing a first-of-a-kind dedicated expert planning team and associated framework to deliver investments where a prescribed level of confidence is reached. In addition, we will take a proactive role in addressing market failures, particularly in relation to on-street and en route EV charging, working with national and local government and Ofgem. We have included specific programmes within our strategy to address market failures in these areas.

Furthermore, due to the complex interdependencies, we will employ horizon scanning and the inspection of leading (and lagging) indicators to capture when there may be changes in decarbonisation trends and pathways to maintain confidence in our plans.

In transitioning to Net Zero, we have a clear responsibility to leave no customer behind; both customers and stakeholders are concerned about this, with stakeholders stressing our responsibility (jointly with other stakeholders) to protect and support such customers<sup>19</sup>. Our RIIO-ED2 Business Plan recognises this responsibility, and our actions will be underpinned by transparent and robust investment cases demonstrating clear customer need. In our Consumer Vulnerability Strategy, we articulate our response to ensure no-one is left behind in this changing energy system, which is backed by an intervention to invest £11m into a UK Power Networks foundation to support a fair and just transition for all.

Our RIIO-ED2 Innovation strategy supports this pillar through a dedicated innovation theme on whole systems, where we will focus on other system intersections and dependencies such as water, telecoms, and rail. This means we will be able to trial new ways and means to deliver a better outcome for society through co-ordinated working.

A good example of this in action is our work with the telecoms fixed and mobile broadband networks in areas we have targeted our off-gas grid interventions to find synergies in common areas, through our partners in Vodafone we have linked in with Ofcom's Shared Rural Network programme where the UK's four mobile network operators (MNOs) – EE, O2, Three and Vodafone expect to:

- Provide coverage to an additional 280,000 premises and for people in cars on an additional 16,000km of the UK's roads.
- Improve geographic coverage to 79% of Areas of Natural Beauty, up from 51%, and 74% of National Parks from 41%, benefitting millions of visitors every year.

By upgrading their existing networks and working together on shared infrastructure and new sites, the MNOs and Government will transform mobile coverage in rural areas. Individually, each operator will reach 90% geographic coverage, which will result in 84% of the UK having 4G coverage from all four operators, increasing choice and boosting productivity in rural areas.

To deliver the programme, MNOs will invest £532m to eliminate the majority of 'partial not-spots' – areas which receive coverage from at least one, but not all, operators. The UK Government will provide a further £500m to build new masts to eliminate 'total not-spots' – hard to reach areas where there is currently no coverage at all. The SRN is a sustainable approach to the challenge of delivering rural mobile coverage. The programme will transform 4G coverage without duplicating infrastructure, minimising the impact on the countryside.

Our approach for Off-Gas grid communities is to ensure we coordinate with the SRN and MNO's to deliver a seamless lowest cost delivery of capacity and comms for our South East rural communities.

### Our Whole System Interventions

We have developed a set of specific RIIO-ED2 interventions related to unlocking benefits from implementing Whole System solutions. These interventions reflect programmes that will require us to perform effective planning and collaboration with other parties and will deliver direct and indirect savings to our customers, as well as those served by a range of other

<sup>19</sup> Line of Sight – Whole systems: I-FNZ2

sectors. Some examples of these are given as case studies across this document. We articulate our interpretation of an optimised whole systems community in Figure 5 below, where we overlay investment interventions on an example of an optimised whole system community.

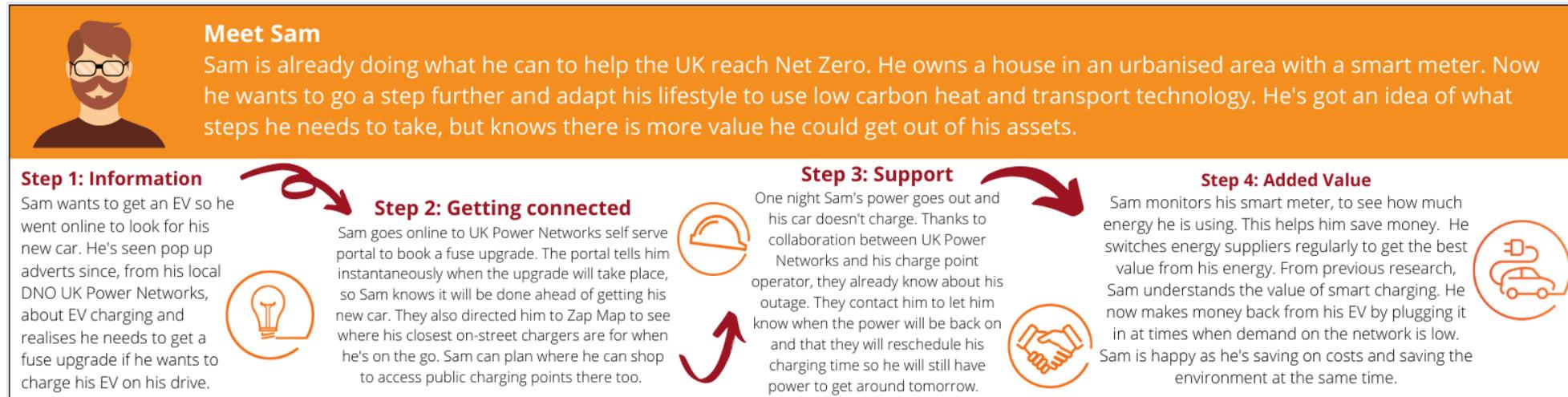
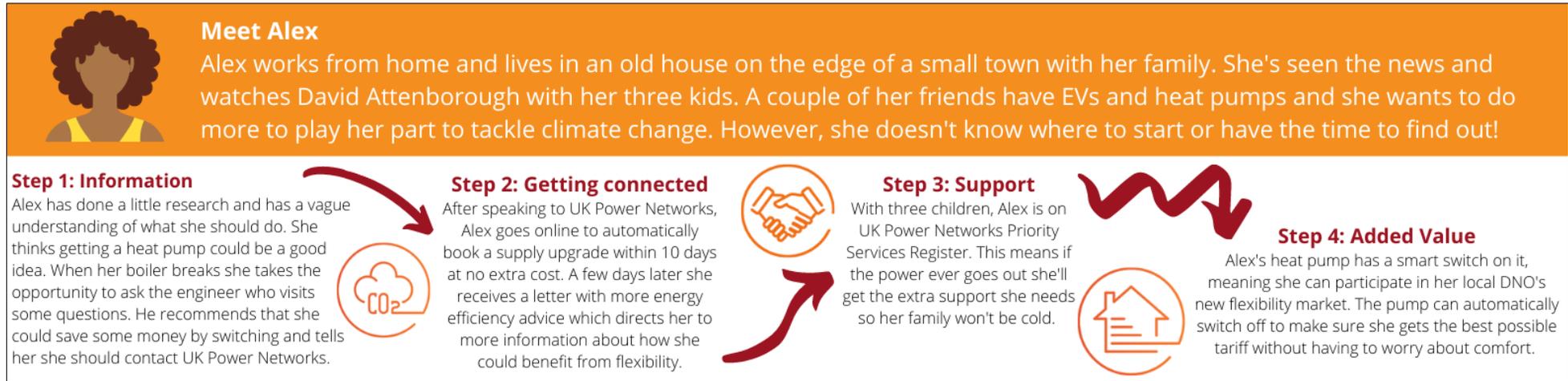
*Table 1: Our Whole System Interventions*

|                                |  |
|--------------------------------|--|
| <b># Whole Electricity</b>     |  |
| 1                              | We will expand the geographic area of our South East Regional Development Programme (RDP) in RIIO-ED2 and deliver an RDP in East Anglia by 2024, as agreed with the ESO. We will unlock up to £130m of whole system benefits during RIIO-ED2.  |
| 2                              | We will work with the ESO to expand the Power Potential trial to be a business as usual offering across our EPN and SPN regions by 2028. This will be a world-first large scale rollout of a whole system reactive power management solution.  |
| 3                              | Over RIIO-ED2 we will deliver 1GW of DER capacity at no more than £8m, using smart interventions and new innovations, reporting progress in our annual business plan.  |
| 4                              | We will make our connections process faster and easier for our residential customers connecting low carbon technologies. We aim to instantaneously process 80% of general enquiries (GE) supply upgrades via self-service offerings, delivering a 9/10 experience over RIIO-ED2.                     |
| 5                              | For each year of RIIO-ED2, we will develop high quality marketing information which can be used by third party intermediaries, to encourage an increase in customer use of low carbon technologies, unlocking greater participation in flexibility markets.  |
| 6                              | We will develop an energy efficiency flexibility product, running tenders every 6 months, starting in 2023.  |
| <b># Whole Transport</b>       |  |
| 7                              | We will assess and if necessary upgrade supplies for 728,000 homes free of charge to accommodate connecting LCT's by coordinating with installers.   |
| 8                              | We will create an additional 248MW of LV network capacity to unlock LCT related demand across our networks.  |
| 9                              | We will reduce street-works costs and transport disruptions in London by collaborating with other statutory bodies on at least 40 collaboration projects in RIIO-ED2.  |
| 10                             | We will use well-defined uncertainty mechanisms to prepare for a possible accelerated LCT uptake by ensuring capacity is released in a timely manner and facilitating an additional 847MW of LV capacity for LCT uptake and support an additional 1.1m homes connecting an LCT.                      |
| 11                             | We will run a process to identify and address market failures with respect to the provision of on-street charging, unlocking over 2,400 public charge points in areas of market failure by the end of RIIO-ED2.  |
| 12                             | We will run a process to identify and deliver an additional 7-8MW of capacity in areas located near 14 motorway and trunk road service stations, by running a call to market in 2024 and 2025, ensuring a maximum of 30 miles between charging across our regions.                                   |
| <b># Whole Heat</b>            |  |
| 13                             | By 2028 we will proactively provide LCT and energy efficiency information to 1,4m of our customers located within zones earmarked for electrified heating.   |
| 14                             | We will ensure that 71% of off-gas grid homes in our regions have the suitable capacity to decarbonise their heating and transport by the end of RIIO-ED2.   |
| <b># Whole System Planning</b> |  |
| 15                             | We will engage with all 127 regional and local planning authorities on their climate plans each year of RIIO-ED2, offering a three-tiered support service utilising a framework to assess, develop action plans and deliver investments where a prescribed level of certainty is achieved in period. |
| 16                             | By 2024, we will provide core planning datasets via an on-line self-service energy planning tool to support the planning process for our local authorities, helping them make the best choices for their communities.  |
| 17                             | We will provide proactive services to our DER by expanding our digital outage planning and automatic restoration tools, to minimise disruption and maximise their system access throughout RIIO-ED2.   |
| 18                             | We will embed a requirement to have explicitly considered whole system solutions as part of our investment planning and investment governance by the start of RIIO-ED2.  |

Figure 5: Our interpretation of optimised whole system communities, along with our support programmes



Figure 6: How our plan will support customers as they decarbonise





### Meet Rashid

Rashid is a small business owner in a major city with a fleet of five diesel vehicles. He knows that if we are to reach Net Zero by 2050, companies of all sizes need to do what they can to help. Rashid's profit margins are tight at the moment too and he's seen that other SMEs are benefiting from switching to EVs.

#### Step 1: Information

Rashid looks on the FSB's website which tells him how he can participate in flexibility. He also finds out about a UK Power Networks Innovation project called White Van Plan. He wants to participate so contacts the third party intermediary to find out more. They tell him about the recently completed national network of EV chargers at motorway service stations so he has confidence he'll have charge for longer journeys.



#### Step 2: Getting connected

Rashid uses UK Power Networks digital tools to help understand the optimum way to electrify his fleet and decarbonise his business. He realises that due to the size of his business he qualifies for a free fuse upgrade. This reassures Rashid that his electricity connection will be reliable and fast.



#### Step 3: Support

Rashid can sign up for extra support through the register for smaller enterprises. He knows that he will get help during outages and be issued with free charging vouchers for the nearest public charging point to ensure he can still charge his EV if power is out for a long period of time.



#### Step 4: Added Value

Rashid's vehicles are not being used for 16 hours a day, during peak times for his local electricity network. This means he has an opportunity to be a flexibility services provider during this time and earn a return on his vehicles. Now Rashid's business has another income stream and benefits from fuel savings. He's ahead of the game and doing his bit to reach Net Zero carbon emissions.



### Meet Jo

Jo's grandchildren keep talking about climate change, but it's all a lot for Jo to take in. She has a small house in a rural village which is off gas and struggles to pay her energy bills. All this new technology is even more expensive and it's very daunting.

#### Step 1: Information

Jo sees a poster in her village hall about her local energy group and attends the next town meeting. Whilst there she hears from UK Power Network representatives who share their plans to help the village go green. They also tell her about extra support on offer such as the PSR and help accessing different financing options.



#### Step 2: Getting connected

UK Power Networks follow up with Jo, offering 1-2-1 support tailored to help her bring the cost of her energy bills down. They also tell her about the UKPN Foundation who can help her fund a heat pump and talk her through the technology so she understands what a smart meter is. Jo is now ready to go electric.



#### Step 3: Support

UK Power Networks know that Jo is a vulnerable customer and so she is on the Priority Services Register. This means if her power ever goes out, engineers work extra fast to fix the problem. She can also get hot meals and even a night in a hotel if the problem can't be fixed quickly.



#### Step 4: Added Value

Thanks to the support Jo received to improve her digital skills she can now use her smart meter to save money. Jo noticed it's cheaper to cook her dinner slightly earlier in the evening so now eats at 5pm instead of 7pm. She no longer has to worry about her energy bills and even feels better as she has more time to digest her food!

## A strategy shaped by customer and stakeholder engagement

Our Whole Systems Strategy for facilitating Net Zero has been developed based on our extensive RIIO-ED2 customer engagement, our deep understanding of the policy and technology environment, and the progress we have already made on the Net Zero journey in RIIO-ED1. The objective of our engagement was to ensure that we are ready to meet customers' needs at the lowest cost, while maintaining a suitably ambitious plan to accelerate Net Zero with our stakeholders.

As part of our core engagement, we asked customers and organisations what they want and expect from us, what their priorities are, and what they will be willing to pay for. We drew insight from over 16,000 customer interactions including large demographically representative surveys covering residential and business customers across our regions. To deepen our understanding from these, 83 focus groups and 160 in-depth interviews were held to draw qualitative insight including with hard to reach groups. You can read more about our engagement process later in this document and in our core business plan engagement chapter.

Key messages from our engagement, on which we have centred our strategy, are summarised below.

1. We understand that **we need to prepare our network ready for LCTs and we cannot take a passive role. Waiting for the scale of uptake in RIIO-ED3 is too late.** Our strategy commits to **go above and beyond, proactively facilitating Net Zero and accelerating our customers' decarbonisation.**

*“Even with all of my questions, I would still be aiming for exactly the same level of ambition. We should go as far up as we can - things need to change and we aren't going to get there unless we start now. 30 years will go with a blink of an eye, and although I won't be here for it, I want my grandchildren to be able to enjoy their time on our planet.”* **Phase 2b Research - Empty Nester, Rural.**

2. Our customers told us that **facilitating Net Zero is a top priority and that we should lead the way, but that they are concerned that we will over invest ahead of demand growth.** Our strategy commits to **invest efficiently in areas of higher confidence, use flexibility to unlock additional capacity, and use uncertainty mechanisms to unlock deeper decarbonisation to ensure we are proactive in delivering efficient measurable Net Zero outcomes.**

*“it's really important to educate people about the impact that all these changes will have, because again, they are going to spend some money on making things possible, but if people are not willing to switch to those services, then it's kind of a waste of money. So, it goes hand in hand. It's about having a joint plan of how to make things possible but also to encourage people to just understand the benefits. You know, you might be spending a little bit more, but you are actually going to save, this is the impact on your health and, you know, just all those benefits.”* **Phase 4 Research - Consumer, SPN, 55+.**

3. Our stakeholders want us to **provide a trustworthy and transparent plan that delivers tangible, measurable outcomes for our customers.** Our strategy commits to **provide clear targets for our actions to justify investment.**

*“I can understand it is good for the environment, so do a lot of people, but there needs to be comprehensible information out there that shows savings and benefit to the environment”* **Phase 4 Research Business, EPN, 50-249 employees.**

4. We can't do this alone. **We understand that we cannot achieve success in isolation and as leaders we have a responsibility to collaborate with partners to facilitate Net Zero together.** Our strategy commits to **work as part of an ecosystem to help facilitate our customers' Net Zero ambition.**

*“I think everybody's got to do their bit and it's a 3-pronged attack - although the big infrastructure changes that need to be made have to be done by the government and energy companies. We all need to work together.”* **Phase 2b Research - Family, Urban.**

5. Our customers **said that it is critical that the energy transition is just and inclusive for all our customers.** Our strategy commits to **provide support and guidance to customers in vulnerable circumstances to ensure that no one is left behind during the energy transition.**

*“This year UK Power Networks has challenged itself to go further in ensuring its engagement work delivers tangible value for customers, especially the most vulnerable. They continue to enhance their partnership with other utilities and beyond, helping them shape and evolve initiatives to serve their customers.”*

**Jessica Harmer, Managing Associate AccountAbility (SECV).**

As we deliver on this plan, we are also clear that our confidence will reduce uncertainty for others, meaning that we will continue to work hard to understand our customers’ and stakeholders’ needs, to adopt innovative and collaborative solutions for our network, and to understand the data available to inform and support our customers and stakeholders. We also understand that this phase of decarbonisation is going to have a significant impact on our customers’ day-to-day lives and success cannot be achieved without active customer participation and engagement. Later in this document, we provide additional detail on the collaborative effort that will be required together with our stakeholders and partners.

To unlock further Whole System value, we have developed an approach which we cover in more detail in the ‘Our Whole Systems approach’ section, which involves:

- Engaging widely with a range of stakeholders to identify Whole Systems challenges and means of addressing them, including roles for UK Power Networks. e.g. this may include collaborative research.
- Testing potential Whole System solutions through our own analysis and further engagement with wider stakeholders. This may involve further R&D, including pilot projects.
- Analysing the impacts of the identified solutions, including costs and benefits, uncertainties, and value for consumers. The analysis will be based on tools developed in coordination with the industry through the ENA, and captures direct customer benefits, as well as wider societal benefits. It also includes examination of situations where there is an asymmetric split of costs and benefits, and therefore a collaborating party would not have a clear incentive to be involved without a pricing transfer or some other mechanism to manage their cost exposure.
- Developing routes to implementation for the identified solutions, capturing timescales, dependencies, and stakeholder impacts, and using these to support decision making.

Figure 7: Our Whole Systems Thinking Stakeholders



## Learning from good practice

As we have prepared for RIIO-ED2, we have looked at the work we have done in RIIO-ED1 to identify Whole System initiatives that we can continue and develop, as well as identifying new initiatives through stakeholder and customer engagement. Our engagement in the area of Whole System solutions has covered a wide range of stakeholders and customers across several types of fora.

We have also acknowledged in our engagement that Whole System solutions are applicable elsewhere in our plan, and naturally there is a clear correspondence between our Whole System strategy and our DSO Strategy since the DSO will be responsible for implementing Whole Systems Planning (role 1) as well as applying whole systems approaches to operational security in its close collaboration with the ESO. Other areas of strong dependence are in Innovation and almost all actions to facilitate Net Zero. Further details of the range of customers and stakeholders with whom we have engaged and the lessons we have learned are available in our Engagement Summaries.

To check our approach to Whole Systems, we have also looked at the Whole System approaches of other companies to identify good practice, including other network companies and system operators. We have also looked at what has been judged to be good practice in this area (for example, through looking at comments of the RIIO-ED2 Challenge Group). From our review of activities in the wider landscape and considering the feedback from stakeholders such as Citizens Advice on consistency of service provision across networks and regions, we have defined good practices that we want to follow, as well as actions that we will take to ensure we carry them out.

This is demonstrated by our collaborative work with Energy Networks Association (ENA) at the LCT Working Group, where we continue to coordinate with other electricity and gas networks to develop a consistent and standardised approach to facilitate the uptake of low carbon technologies, such as the process for fuse and service upgrades. The forum is also used to share and learn good practice and identify novel solutions that can further enhance network operability and customer experience. For instance, we have agreed to adopt Scottish Power Energy Network's (SPEN) iIdentify smart phone app, powered by artificial intelligence, which will recognise network assets for efficient data and asset information collection<sup>20</sup>.

**Table 2: Whole System approach good practice**

| What good practice is  | What we are doing about it   |
|--|--|
| The scope of Whole System thinking, and engagement must go beyond the sector and geography of the organisation's core activities in order to develop an approach to assessing and progressing projects at the interfaces between sectors | We have performed a wide programme of engagement that has led us to developing an approach to Whole Systems that focuses on four key areas: <ul style="list-style-type: none"> <li>• Whole Electricity</li> <li>• Whole Heat</li> <li>• Whole System Planning</li> <li>• Whole Transport</li> </ul> We have established structured engagement processes for stakeholders, partners, and other organisations that will allow us to identify and exploit Whole System opportunities outside our core business (for example, through Regional Development Programmes) |
| Whole systems thinking requires imagination and innovation as well as wide engagement, but solutions must also be grounded in practicality. Research and development help identify solutions which work                                  | Our Innovation strategy focuses overwhelmingly on collaborative innovation at the boundaries of our operations. We will invest to test ideas and launch pilots to determine future full-scale projects which are likely to deliver benefits to customers   |
| All initiatives proposed should be fully assessed using a robust set of tools and processes  | We have created an assessment process that utilises the ENA CBA, which ensures coordination with other DNOs, and investment tracking tools that assist in comparing different prospective initiatives. We will also use a suite of additional tools where required - further details of these tools are described in a subsequent section  |
| Whole System thinking should reflect the different possible Net Zero pathways and scenarios proposed in our plan   | Our scenarios are informed by Government targets and the CCC's Sixth Carbon Budget as well as by our bottom-up, granular assessment of demand across a range of plausible outcomes (DFES). In many areas (on-street EV connections, hybrid heating), the timing, extent, and cost-effectiveness of investment to pursue whole systems objectives remains uncertain throughout RIIO-ED2, but we must continually engage with partners to update   |

<sup>20</sup> Developing industry first app to identify network assets - SP Energy Networks

| What good practice is  | What we are doing about it  |
|--|---|
|  | <p>plans and share planning information and be prepared to respond quickly once policy is set.</p> <p>For more information related to the different scenarios and pathways we have considered, please refer to our DFES core business plan chapter.</p>   |
| Whole System thinking should be embedded in our culture and throughout our plan          | <p>The DSO will be the driving force of our Whole Systems Strategy. Whole systems thinking also infuses our research and innovation activities, which are increasingly focused on collaborative projects on developing smart markets and on facilitating Net Zero objectives (see our Innovation Strategy). It also requires us to engage with Local Authorities on a constant and structured basis to assist with the development of Local Authority Energy Plans (LAEPs).</p> <p>We have made a commitment in our plan to make a Whole System assessment a part of our business decision process, which will identify which other stakeholders are involved and require an analysis of the potential scope for a Whole System solution.</p> |
| Wherever possible, coordinated actions across regulated companies should be investigated | We have worked with collaborative bodies, such as ENA, to ensure a joined-up approach to Whole System project assessment across the sector. We have also developed a joint planning process with National Grid.   |

### Building upon our track record in Whole System planning and delivery

Since the significant rise of DER started, now over a decade ago, we have increasingly undertaken activities that consider impacts on the wider energy system. These activities range from joint network planning with other licensees to partnerships with new stakeholders to unlock the full range of benefits that smart and flexible technologies can offer.

Our initiatives have included:

- Coordination and planning activities undertaken with DNOs, TOs and the ESO to identify and assess Whole System impacts within the electricity vector and to identify value-additive opportunities and potential solutions.
- Initiatives with energy-based stakeholders, including gas networks, to research and deliver joint solutions across energy vectors and actors.
- Initiatives with non-energy-based stakeholders, including industry bodies, Local Authorities and Transport Authorities, to understand how we interact with and support their wider activities and achievement of their carbon reduction targets.

These have allowed us to develop a richer understanding of Whole Systems interactions with UK Power Networks business and, through collaborative action, to deliver a range of customer benefits that include:

- Lowering operational costs and improving reliability.
- Improved customer and stakeholder experience.
- Decarbonisation at lowest cost and disruption.

*Table 3: RIIO-ED1 Initiatives addressing Whole Systems problems*

| Outcome Type   | Activity  | Description and Examples   |
|--|---|--|
| Lowering operational costs and improving reliability | The Loss of Mains programme                       | Have proactively participated in a national programme led by the ESO, having previously co-led on a more localised programme in the South. This programme is working to enhance the electrical protection of distributed generators. This has made generators less prone to unplanned disconnection due to national frequency or voltage events, and so has reduced the associated balancing costs incurred by the ESO and increased the low carbon generation delivered to the system |
|  | Lessons learnt following the 9th August power cut | Following the event, we have undertaken detailed analysis of the Low Frequency Demand Disconnection (LFDD) process and made improvements on how we manage future events and enabled closer operational coordination between the DSO and ESO.   |

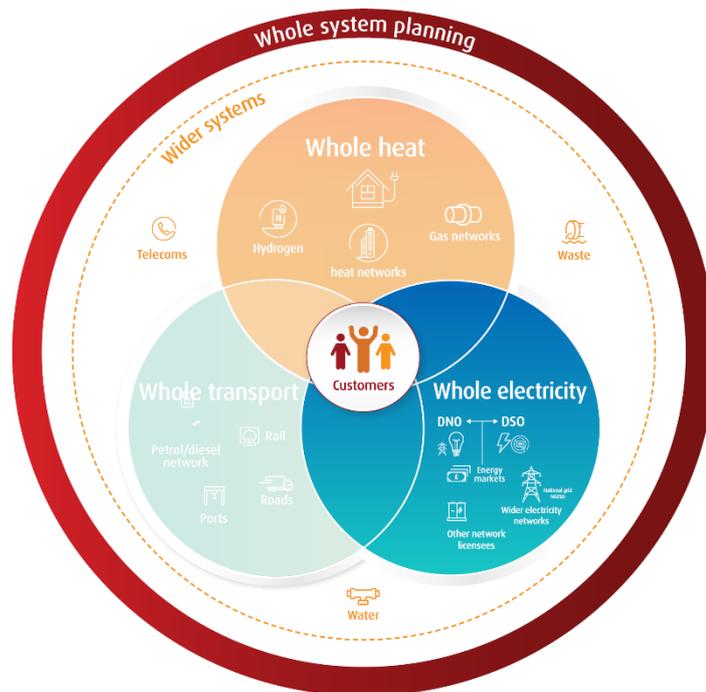
|   |  |  |
|---|--|--|
|   | Managing the impacts of COVID-19   | Have worked closely with the ESO to ensure that changes in demand are managed efficiently and any risk to the system is minimised. We supported the development of the Optional Downward Flexibility Management (ODFM) service to provide extra resilience during summer 2020  |
|   | The Regional Development Programme                                       | An ongoing collaboration with the ESO since Aug 2016: we have delivered the framework for an improved transmission network assessment process and operational solution that has facilitated continued access to the South Coast area of the network for DER. We were the first DNO to commission a coordinated visibility and control system (N-3 protection) with the ESO to enable additional connection capacity in the South East of England   |
| Better customer and stakeholder experience    | Developing Future Energy Scenarios                                       | Led the ENA's Open Networks Project (ONP) Workstream 1B Product 2 to ensure licensees' Future Energy Scenarios (FES) align for business planning purposes  |
|   | Developing a Whole System's investment planning process                  | Led the ENA's ONP Workstream 1B Product 1 to improve current planning processes and have been feeding into Workstream 4 that is developing a Whole Systems CBA and option framework  |
|   | Data exchange  | Have had a lead role in the ENA's ONP Workstream 1B Product 3 to develop real-time data sharing across T&D and have also actively participated in Product 4 which aims to enhance data sharing in planning timescales across T&D   |
|   | Engagement with other licensees to deliver Whole System outcomes         | We were involved in several initiatives, such as Distributed Restart with the ESO, Power Potential with the ESO, Distributed Ledger Technology with SPEN and SSEN, Eye in the Sky with NGET and other DNO partners, Green City Vision with WWU and SSE, and Real-time Fault Level Monitoring with SPEN. We are also working collaboratively with our DNO and ESO colleagues across GB to pool our learnings and outputs from ongoing RDPs. In tandem with WS4 of the Open Networks Project we are also engaging and sharing data with our colleagues in the gas sector (Cadent) to optimise a development in the Isle of Dogs area |
| Decarbonisation at lowest cost and disruption | Engagement with local stakeholders                                       | Partnership with Cadent, Tower Hamlets, the GLA and the Energy Systems Catapult has created an optimised infrastructure plan to support the growth of 30,000 homes as part of the Isle of Dogs redevelopment plan  |
|   | Analysis to deploy public charging infrastructure in strategic locations | Have undertaken analysis on the regional road network across our network to estimate the costs to facilitating chargepoints that meet the government's objectives. Similarly, we have worked with local government to ensure our network is ready to connect chargepoints in locations where they are needed but where connection costs are a barrier  |
|   | Analysis to feed into the CCC's recommendations                          | Helped the CCC understand how achievable their deployment scenarios are by analysing the impact they would have on our networks - this informed their sixth carbon budget balanced scenario  |

## Our proactive approach to enable the transition

### Whole Electricity

| Objective  |  |
|--|--|
| Delivering whole systems solutions within the electricity vector in order to facilitate Net Zero at lowest cost to customers   |  |
| Strategic challenges   | Our proposed solutions   |
| <ul style="list-style-type: none"> <li>Coordinate and collaborate across the transmission and distribution boundary to operate a high DER system securely at lowest cost</li> <li>Optimising network development across the transmission and distribution boundary during a period of significant change</li> <li>Enable efficient management of voltage and thermal constraints across the networks through the development of markets and cost-effective investment</li> <li>Maximise access for customers connected on the distribution network for export of power and participation in national ancillary services</li> </ul> | <ul style="list-style-type: none"> <li>Pursue solutions that deliver the lowest whole systems costs for customers even where these may traditionally have required primary delivery by others</li> <li>Build upon our partnership with the ESO to identify and deliver cost efficient whole systems solutions for                             <ul style="list-style-type: none"> <li>optimised T&amp;D network investment (RDPs)</li> <li>flexibility</li> <li>reactive power and voltage support (Power Potential)</li> <li>enhanced operational security</li> </ul> </li> <li>Streamline connection processes and enhance support to enable more rapid and cost-effective connection of DG and storage</li> <li>Deliver both build and non-build solutions to reduce curtailment despite increasing installed DG capacity</li> <li>Develop investment plans jointly with stakeholders (e.g., LAs) containing trigger mechanisms to unlock network investment at the right pace to meet stakeholder needs</li> <li>Collaborate with suppliers and energy service companies (ESCOs) to develop flexibility solutions from final consumers by leveraging increasing penetration of smart meters and home automation (Project Shift<sup>21</sup>)</li> <li>Proactively promote demand side participation particularly amongst residential customers</li> </ul> |

Figure 8: Key whole systems interactions within the electricity vector



<sup>21</sup> UK Power Networks Project Shift <https://innovation.ukpowernetworks.co.uk/projects/shift/>

Key interactions within the electricity vector are those between DNO and DSO, with wider electricity network operators such as NGENSO, and other network licensees. All working collaboratively to delivering the most efficient and effective outcomes for our customers..

For the Whole Electricity part of our strategy, we have focused on the whole electricity system as the end-to-end supply chain of electricity systems. Within this is a set of key interfaces that require sector coordination and collaboration to ensure the best outcomes for consumers:

1. **Transmission to distribution interface** – this is the most significant and best understood interface. The rise of distribution-connected generation over the period 2010-2020 created several system operability challenges whose resolution required the electricity network owners and system operators to work together over the course of RIIO-ED1. Our own Power Potential and Regional Development Programmes are great examples of the progress that has been made to collaborate and address these across the T-D boundary.
2. **Distribution to distribution interface** – collaborating with electricity distributors to address collectively the energy transition challenges and set common, national standards that make it easier and cheaper for our customers to connect and to participate in the electricity system to resolve whole system issues. As summarised in various reports including the BEIS Ofgem Smart Systems and Flexibility Plan and the Open Networks 2020 Flexibility consultation, commonality across DNO approaches is critical to reducing barriers to entry, lowering costs and maximising participation in new commercial propositions such as flexibility markets. The establishment and running of the Open Networks Project is a prime example of successful distribution collaboration. In addition, we have been working closely with our neighbouring DNOs to identify and resolve whole system D-D boundary issues.
3. **Distribution to DER and customers interface** – there are distinct areas here which are key to our Whole Systems, DSO, and Connections strategies:
  - Enabling more efficient connection of renewable generation and storage to the distribution network to support greater decarbonisation.
  - The development and promotion of markets for flexibility and other services to defer network investment and maintain low costs for consumers.
  - As a last resort, stepping in to address market failures where for example the existing charge point operator leaves the market or the Local Authority is unable to appoint a charge point operator: this is the subject of a new License Condition (LC31F) and in such circumstances and where approved by Ofgem, UK Power Networks will take over until an appropriate replacement charge point operator is appointed.

From a Whole Systems perspective, there are important interactions (beyond electricity, heat, and transport) with other systems and sectors that can deliver benefits for customers. For example, engagement, optioneering, and planning with other utility sectors outside energy would enable a more efficient whole system that delivers value for money for consumers.

#### **Sidebar: Enabling flexibility from the Water and Waste sectors**

As part of our flexibility programme, we are always proactively engaging with customers and stakeholders to identify potential flexibility solutions that can help us manage our network needs at a reduced cost compared to traditional network reinforcement. This approach enabled us to work together with water and waste companies in order to identify how flexibility, already built in their portfolio, can deliver benefits to consumers via our DSO flexibility services.

We have engaged with four waste and water companies, both directly and through aggregators. We helped these companies with their feasibility analysis to explore ways of participating in our flexibility tenders, while at the same time improving their understanding of the service offering and operation.

In addition, we worked very closely with one of these water and waste companies to conduct a full mapping exercise of their sites against our published flexibility requirements. The result of this exercise enabled this company to further review the technical and commercial viability of its sites and led to the identification of 228 eligible sites for DSO services out of the 6,985 totally reviewed.

This is a great example of how a proactive joint planning process can be implemented in the future, through which we can identify and adopt whole system solutions.

During RIIO-ED1, we have worked closely with the water and waste sectors to enable them to participate within our flexibility initiatives and so deliver value to consumers (see sidebar).

### Working with transmission network and system operators

There are significant whole systems benefits for the customer to be gained from UK Power Networks close collaboration with the TSO & ESO including:

- Optimisation of network development across transmission and distribution systems.
- Lowest cost development of investments to address constraints.
- Development of market solutions for reactive power and flexibility.
- Close coordination to ensure operational security across both networks and enhanced measures to support ESO commitment on a carbon free grid by 2025.

We have regular ongoing engagement at multiple levels with the ESO and ETO to identify, discuss and resolve whole system challenges:

- Monthly engagement with the ESO/ETO as part of our Joint Planning meetings that review detailed operational issues but also discuss upcoming developments.
- Monthly executive level engagement with the ESO to monitor progress across current operability issues such as the work under Regional Development Plans or the national loss of mains programme – we use this forum to proactively identify whole system issues and agree plans of actions.
- Engaging through the ENA Open Networks Project to develop the form of statement for the new Whole Electricity System Licence condition (LC7A). As part of this new licence condition that went live in May 2021, we will produce an annual register of whole system actions that we have coordinated with transmission and distribution network licensees.<sup>22</sup>

We carried out a specific engagement with the ESO, focused on our RIIO-ED2 proposals using deep dives into the specific proposals for the DSO and Whole System sections.

### Regional Development Programme delivering benefits

Our ongoing partnership with the ESO on the Regional Development Programme for the South East is an excellent example of whole systems collaboration to deliver lower costs for the consumer.

The Regional Development Programme (RDP) has provided a blueprint for transmission-distribution coordination. It uses an adaptive testing or “design by doing” approach that supports the effective management of the electricity network on a Whole System basis and supports the continued evolution of DSO capabilities. This is achieved through a joint Transmission & Distribution (T&D) process, which proactively identifies key areas of development and collaboration, resulting in coordinated and efficient joint actions and consequent reduction of whole electricity system costs.

Following over five years of partnership with National Grid via the RDP, we have unlocked more than 1GW of capacity on the transmission network to connect DERs at the same time as avoiding the need for £1bn of infrastructure spending in our SPN region. We have also improved the customer experience through early visibility of the assessment process, providing faster and cheaper connections and new revenue streams for DER. In addition, we were the first DNO to commission a coordinated visibility and control system (N-3 protection) with the ESO to enable additional connection capacity in the South East of England.

The South East coast RDP between NGESO and UK Power Networks, covering the areas of Kent and Sussex, is developing new markets for transmission thermal constraint management services. This is a ground-breaking whole system programme, which examines the future operability of the South East coast area over the next 10 years, and will involve the development of a co-ordinated IT solution that will deliver:

- Visibility and data exchanges in both directions to facilitate efficient service coordination.

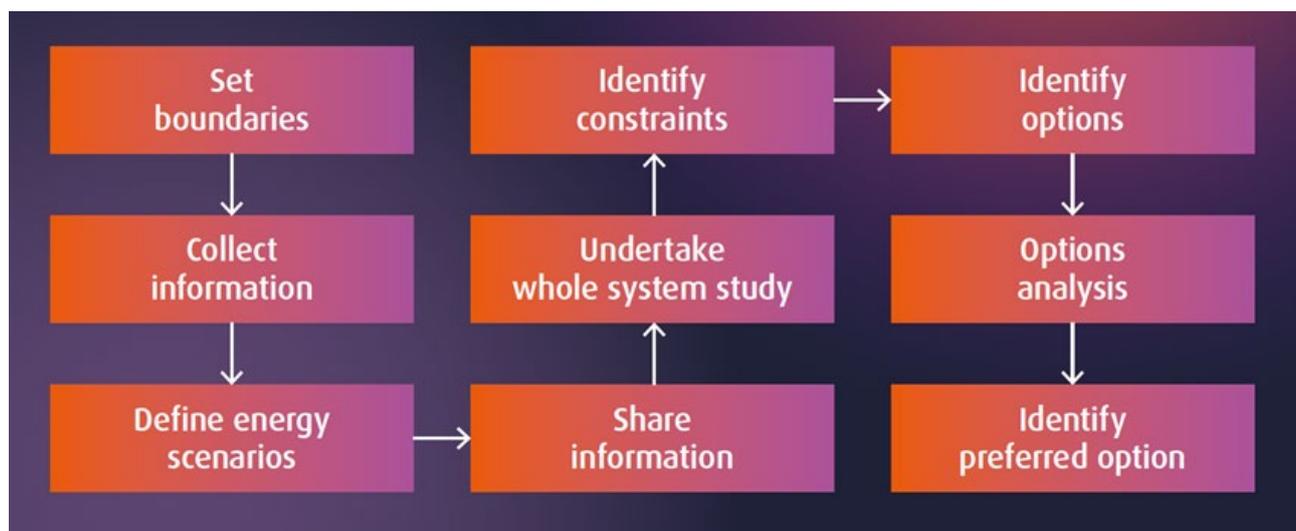
<sup>22</sup> Ofgem - Whole Electricity System Licence Condition 7a “Whole Electricity System Obligations”  
<https://epr.ofgem.gov.uk/Content/Documents/Electricity%20Distribution%20Consolidated%20Standard%20Licence%20Conditions%20%20-%20Current%20Version.pdf>

- Management of DER to allow constraints on transmission and distribution networks to be managed efficiently, whilst ensuring the safe operation of the distribution network.
- A coordinated service and dispatch methodology allowing DER to participate in new markets and ensure that we have identified the cheapest solution for the GB consumer.
- Coordination and service conflict resolution methodologies.

Hence, as part of enhancing our coordination with other licensees we will extend our Regional Development Programmes to other parts of or distribution network area and annually report the progress.

From this successful endeavour, we have developed a structured engagement process to use a model for further RDPs during RIIO-ED2 and it is shown below.

Figure 9: How we have defined a joint planning approach as part of a Regional Development Programme



This process relies on regular and structured engagement and builds on key outputs of the Regional Development Programme and the Open Networks Project such as the Whole System FES, ESO – DSO data exchanges, and coordination processes.

#### Rolling out successful innovation in reactive power management

Our whole electricity system approach for T&D enhanced coordination also includes reactive power services, as we have successfully demonstrated via Power Potential, our joint procurement trial with the ESO. Through Power Potential, we have developed the world's first regional reactive power market, showing how actions at the *distribution* level by the DSO can facilitate DER to provide reactive power to efficiently meet *transmission* needs. This initiative is described more fully in the 'Developing markets to deliver whole systems benefits for consumers' section later.

#### Collaborating with the ESO on operational security

We're working with National Grid ESO and other UK DNO's to help accelerate the required changes to Loss of Mains protection by offering funding to generation owners through a payment programme. Generation owners can apply online to take part in the payment programme, where funding can be made available to help meet the costs of making these changes. The DNOs are responsible for delivering this change which in turn delivers reductions in national balancing costs.

The drivers to this change are mainly: the general decline in system inertia, volatility of system frequency, and inadvertent tripping of vector shift relays due to secured events on the transmission system. It is estimated that the programme will cost in the region of £100 million nationally and will run for two to three years. The benefit will amount to a total savings in balancing costs, over the next five years, of approximately £600 million. Ofgem approved the programme in September 2019, which now requires all existing generators to be compliant by September 2022.

Similar levels of collaboration are now the norm in all our areas of interaction with ESO. We engaged proactively with the ESO

at the beginning of the COVID pandemic to run multiple studies on the impact of low demand on our network. These studies informed the ESO of the up to 20% demand drop that was experienced in the first six months of the pandemic.

Similarly, we supported the introduction of the Optional Demand Frequency Management product that was introduced in record speed timescales to deal with the need for turning down embedded generation as an additional tool in managing low demand conditions. Our control room worked with the ESO's control room to notify issues, identify constraints, and support embedded generation management in operational timescales.

The above RIIO-ED1 activities have set out the foundation for building out a full common framework in line with Ofgem's 3 DSO roles as described in the ESO's DSO Strategy<sup>23</sup> and in UK Power Networks RIIO-ED2 DSO Strategy.

### Enabling DNO – DNO collaboration

UK Power Networks is playing a leading role in the Open Networks Project, an Energy Networks Association initiative to produce national standards and common approaches to developing rapidly a smart, flexible energy network. UK Power Networks is currently the Chair for the project and leader on several products and initiatives.

Some of the examples of the successes of the DNO collaboration in the Open Networks Project are:

1. All DNOs agreed to standardise their DFES on a single set of scenario frameworks based on the National Grid ESO Future Energy Scenarios<sup>24</sup>. A key benefit of this is to ensure that all companies present the information in a common framework for stakeholders, a big stakeholder ask. UK Power Networks published updated DFES in December 2020 that were based on this agreed framework.
2. All DNOs have published a register of connected DER assets with capacity over 1MW to provide increased transparency of what is connected to our networks. However, we went beyond this, and have been collaborating with the ESO to build a blockchain-based register of assets that could become a future standard to use by Distribution Network Operators and other energy stakeholders. Again, this has been a key stakeholder ask, and driven by further feedback, an initiative is underway to expand the register down to 50kW.
3. Standardising products and services with other DSOs (which currently focus on the definitions for Secure, Sustain, Dynamic and Restore services), and with the ESO on making it easier for DERs to access their markets.

The current work plan for 2021 for the Open Networks Workstream 1A (Flexibility Services) includes elements relating to developing a set of principles and dispatch primacy rules with ESO for addressing flexibility service conflicts (T-D). We will continue to be part of this working group to help support elements of the decision-making framework around T-D coordination.

Additionally, we are in close collaboration with neighbouring DNOs to understand and assess whole system opportunities. One of the examples is our joint work with Scottish and Southern Electricity Networks (SSEN) on losses<sup>25</sup>. SSEN and UK Power Networks investigated opportunities where coordinated action across the boundary could lead to a reduction in network losses. The opportunity areas identified were:

- 1) Reconnection of SSEN/UKPN LV "convenience customers",
- 2) Possible reinforcement links spanning DNO borders,
- 3) Analysis of losses comparisons between alternative major customer connection offers near the SSEN/UKPN border.

In the case of the convenience customer's investigation, the results suggest further work would be unnecessary and there would be little benefit in pursuing the matter further. As an output from the cross-border reinforcement investigation, we have increased sharing information across DNO borders to facilitate potential future cross-DNO interconnections. In the case of the investigated major customer connection, the difference in whole-life losses value of the project was found to be significant and was highlighted as an area that should be considered in the network planning assessments.

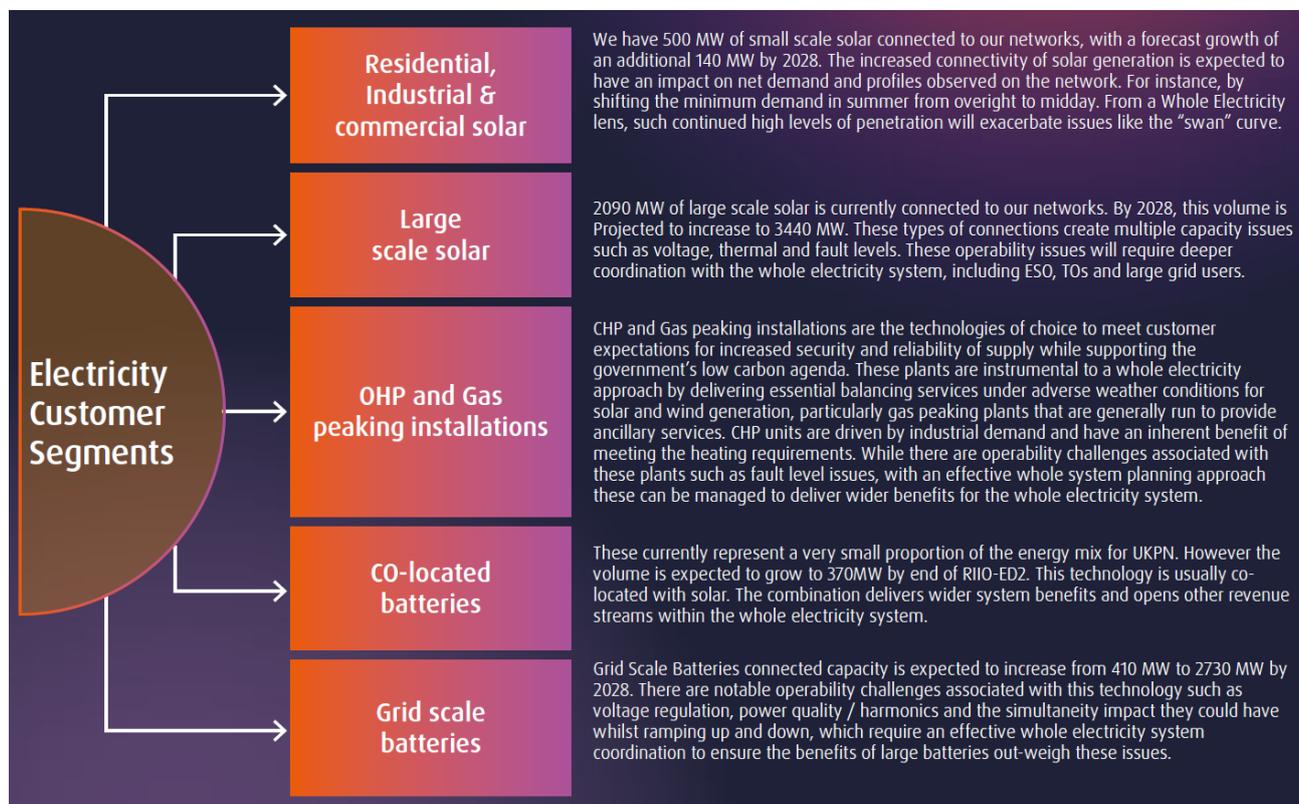
<sup>23</sup> National Grid ESO "Enabling the DSO transition" <https://www.nationalgrideso.com/document/190271/download>

<sup>24</sup> National Grid "Welcome to the ESO Future Energy Scenarios" <https://www.nationalgrideso.com/future-energy/future-energy-scenarios>

<sup>25</sup> UK Power Networks "Collaboration Project with Scottish and Southern Energy" <https://www.ukpowernetworks.co.uk/losses/static/pdfs/uk-power-networks-collaboration-project-with-scottish-and-southern-energy.6048377.pdf>

## Enabling Distributed Energy Resources at lowest whole system cost

Figure 10: Current and future connected DER segments



The DG sector has been the fastest LCT domain to grow and mature over the last 15 years. We have connected over 9 GW of our customers' generation to the distribution network already, including 7.4 GW of renewables and we expect this to continue growing to meet the needs of electrified transport and heating<sup>26</sup>. We expect that by 2028, approximately half of DG connections to our networks will be renewables. By 2030 we have forecasted that over 8GW of renewable generation capacity could be connected to the distribution network.

However, today, our customers and stakeholders tell us they still face the following barriers in connecting to our network:

- 1 **Information:** Provision of detailed, accurate, and timely data to inform applications and develop decisions
- 2 **Market Access:** Access to wider markets with a constrained contract
- 3 **Constrained Network:** The cost to connect (per MW) in constrained areas can be prohibitive
- 4 **Curtailment:** There are numerous areas with a high proportion of flexible connection offers having curtailment levels exceeding 20%.

Our role is clear, it is to help our stakeholders overcome the current barriers to connection. Creating additional network capacity to unlock generation across our networks, ensuring we realise the decarbonisation opportunity of electrified heat and transport, and providing sufficient information for our partners to make informed investment decisions. Our RIIO-ED2 plan is designed to alleviate our customers' barriers and to accelerate solar and battery technology connections to our network.

### Developing markets to deliver whole systems benefits to consumers

Developing markets for flexibility and reactive power can deliver substantial savings for consumers where these measures defer the need for network development. The Carbon Trust / Imperial College study<sup>27</sup>, which we co-sponsored, estimates that GB can save up to £16.7bn per annum to 2050 through flexibility solutions.

<sup>26</sup> Line of Sight – Whole systems: What we achieved in RIIO-ED1, Whole Electricity

<sup>27</sup> Flexibility in Great Britain, Carbon Trust, May 2021

We describe two examples where we have collaborated to deliver pioneering market solutions delivering substantial whole systems benefits for consumers:

- Power Potential
- Energy Exchange

#### A pioneering market in reactive power – Power Potential

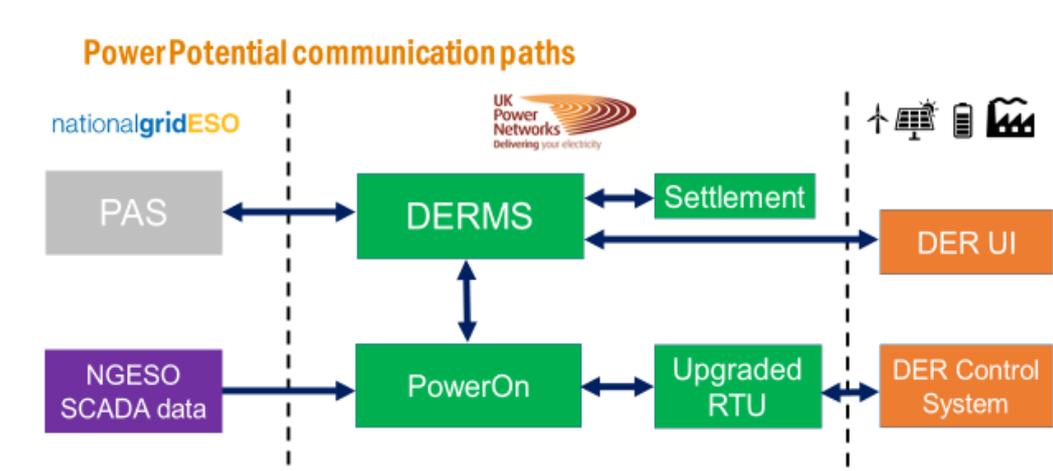
Our whole electricity system approach for T&D enhanced coordination also includes reactive power services, as we have successfully demonstrated via Power Potential, our joint procurement trial with the ESO. Through Power Potential, we developed the world-first regional reactive power market, showing how a DSO can facilitate DER to provide reactive power to meet increasing transmission needs<sup>28</sup>.

The project aimed to create market access for DER to participate in ancillary service provision to NGENSO via UK Power Networks' coordination. It was envisaged that the services provided by DER can provide dynamic voltage support to alleviate transmission constraints, while respecting constraints in the distribution network. This can unlock whole system benefits such as additional network capacity and operational cost savings to customers. The trial demonstrated that Power Potential can provide a more economic and efficient way to access reactive capability.

This enhanced coordination can reduce conflicts of services for both active and reactive power and enable whole system optimisation, while ensuring safe and intact operation of the distribution network without additional costs. Our Power Potential trials have shown that the efficient roll-out of regional reactive power markets could save around £100m up to 2050 and unlock 1.5GW of additional capacity in the South East region.

In a similar manner to RDPs, we are designing our systems and processes in collaboration with the ESO to increase system flexibility by using more DERs and provide coordinated and optimised network support at both transmission and distribution level. We will therefore look to unlock this benefit in RIIO-ED2 by committing to co-develop reactive power markets with the ESO.

Figure 11: The simplified Power Potential solution overview



Further description of Power Potential is given in the separate case study 'Whole system RIIO-ED2 intervention – Power Potential'.

#### A market in curtailment trading – Energy Exchange

In 2015 we began to roll out flexible connections through our Flexible Distributed Generation (FDG) product, which allows generators to connect to the network for a much lower up-front cost in return for agreeing to export less electricity to the network (i.e., curtailment) at the few times of the year where supply exceeds demand. Flexible connections have increased rapidly in subsequent years. Hence, to further facilitate the connection of DG in the future, we are currently deploying our

<sup>28</sup> Voltage constraints costs have increased almost three times since 2018, from £3.2m to £9.2m for the South East of England (Power Potential area).

Distributed Energy Resource Management System (DERMS), an advanced network management system that can support the energy system of the future.

The Energy Exchange project will design, devise and test different market solutions that will make system operation more efficient – and potentially more profitable for customers with a flexible connection.

When our network is running at full capacity, FDG customers are curtailed on a ‘last-in, first-out’ basis and not any other criteria such as geography, need, or whether a customer was willing to pay extra not to be curtailed. Energy Exchange is exploring distributed generators trading their ‘place in the queue’, or swapping the actual curtailment levels, in exchange for a financial incentive.

Our market options will explore curtailment trading between UK Power Networks and DG customers and between DG customers only. They will also look at auctioning and trading capacity rights, creating a new local ‘host’ energy market, and flexible connection customers trading their place in the queue.

Energy Exchange represents our first trial of market-based solutions for flexible connection customers and is an important step in fulfilling the complete DSO role. If the market trials are ultimately proved to support FDG through increased profitability and / or lowered curtailment, market-based curtailment management will pave the way to more low-carbon renewable energy.

We will therefore look to unlock this benefit in RIIO-ED2 by committing to manage curtailment for planned and unplanned outages and explore how we can incorporate this market mechanism into our current and future RDPs with NGENSO.

### Supporting Energy Efficiency

The CCC has identified the deployment of energy efficiency measures as one of four key priorities if the UK is to stay on track to meet its 2050 Net Zero target. The CCC recommend that by 2035 all buildings should have achieved EPC C rating or above and that all social housing meets the same target by 2028 to help tackle fuel poverty. Energy efficiency is one of the most important whole system solutions available as demonstrated by a recent report by Laura Sandys that showed energy efficiency and Demand Side Response (DSR) as offering the greatest whole system value when compared to a wide range of options for meeting Net Zero. From an energy system perspective, energy efficiency can:

- Reduce peak demand and therefore spend on network reinforcement or the need to purchase flexibility.
- Reduce the need for carbon intensive generation to meet peak demand.
- Reduce local air pollution associated with boilers.
- Reduce system losses.
- Reduce energy bills, which in turn helps reduce fuel poverty.

Almost 5% of the customers we serve are using oil-based heating, which is over twice as carbon intensive as using electricity. Addressing this is a priority is critical to achieving the government’s decarbonisation targets. As the GB’s electricity system is now less carbon intensive than gas there is a strong incentive to start electrifying heat at an even bigger scale, with heat pumps currently representing the best means for doing this e.g., in the case of off-gas grid customers and early adopter on-gas grid customers. However, the UK’s housing stock is one of the least energy efficient in Europe, particularly in terms of thermal insulation. Homes will require heat pumps to run over prolonged periods to maintain the required comfort, resulting in higher than average bills. This is a major barrier to mass deployment. Our Heat Street project has also demonstrated that energy efficiency plays an important role in reducing bills and carbon emissions by reducing a household’s heat demand on average by 10%.

Government support is key to driving energy efficiency improvements and has signalled the introduction of new grant schemes based upon the learnings from the recent Green Homes Grant. From our perspective, we know that energy efficiency can impact the extent to which we have to upgrade our networks, therefore we have sought to understand how we can encourage energy efficiency measures in areas of our network where it can help us manage load uncertainty, much in the same way we consider the impact of flexibility solutions. As part of this, we looked at international initiatives that network companies have delivered on energy efficiency and a summary of our findings is given in table 4 below. We have also taken learnings from SSEN’s project SAVE that found DNO-led energy efficiency reduced domestic peak demand by over 7%, but also confirmed that under current arrangements third party intermediaries need to be responsible for the delivery of measures, which can be carried out on behalf of DNOs.

Table 4: International experience of energy efficiency (EE) programmes deployed by network companies

| Lead Entity                      | Con Edison  | Puget Sound Energy                    | SIG  | PG&E  |
|----------------------------------|---|---------------------------------------|--|---|
| Energy Efficiency (EE) Programme | BQDM  | Bainbridge Island                     | éco21  | OCEI  |
| Location                         | New York, NY, USA                                       | Bainbridge, WA, USA                   | Geneva, Switzerland  | Oakland, CA, USA                                  |
| EE Measures                      | EE incentives and rebates, LED lighting, EE assessments | Appliance incentives & rebates        | EE incentives (Residential, Commercial & Industrial), EE services / solutions, low-income lighting | EE data, rebates, incentives                      |
| Regulatory Model                 | Investor owned, vertically integrated                   | Investor owned, vertically integrated | Publicly owned, distribution provider  | Investor owned, vertically integrated             |
| Network Impact Objective         | Defer grid investment                                   | Reliability, defer grid investment    | Reduce energy consumption & CO2 emissions  | Retiring aging power plant, defer grid investment |
| Procurement Model                | Request for Proposal (RFP), auction                     | Internal programmes, RFP              | éco21 Partners programmes  | Competitive solicitation                          |

Through our engagement programme on heat, which is covered in our Whole Systems Line of Sight document (Annexe A), customers and stakeholders have told us that we should show leadership on energy efficiency. Recognising the value that energy efficiency can provide, both directly for our customers and in helping us to defer network reinforcement, we will create a new dedicated DSO product that will provide a revenue stream for parties that can offer energy efficiency delivery in areas for which we tender. This will be alongside tenders for flexibility and will effectively increase competition to cater for our needs.

We will publish and consult on a valuation methodology that demonstrates the neutrality of our decision making and ensures market providers have confidence in our procurement process. We will also factor in the social benefits associated with energy efficiency measures – our CVP appendix explains how we have used the SROI framework to quantify the societal value we will unlock by creating a new product for energy efficiency.

### Our RIIO-ED2 Whole electricity interventions

In the context of a whole systems approach, our Whole Electricity interventions are:

|  |  |   |
|--|--|---|
| <p>We will expand the geographic area of our South East Regional Development Programme (RDP) in RIIO-ED2 and deliver a RDP in East Anglia by 2024, as agreed with the ESO. We will unlock up to £130m of whole system benefits during RIIO-ED2.</p>                                | <p>We will work with the ESO to expand the Power Potential trial to be a business as usual offering across our EPN and SPN regions by 2028. This will be a world-first large scale rollout of a whole system reactive power management solution.</p>               | <p>Over RIIO-ED2 we will deliver 1GW of distributed energy resources (DER) capacity at no more than £8m, using smart interventions and new innovations, reporting progress in our annual business plan.</p> |
| <p>We will make our connections process faster and easier for our residential customers connecting low carbon technologies. We aim to instantaneously process 80% of general enquiries (GE) supply upgrades via self-service offerings, delivering a 9/10 experience over ED2.</p> | <p>For each year of RIIO-ED2, we will develop high quality marketing information which can be used by third party intermediaries, to encourage an increase in customer use of low carbon technologies, unlocking greater participation in flexibility markets.</p> | <p>We will develop an energy efficiency flexibility product, running tenders every 6 months, starting in 2023.</p>  |

**We will expand the geographic area of our South East Regional Development Programme (RDP) in RIIO-ED2 and deliver an RDP in East Anglia by 2024, as agreed with the ESO. We will unlock up to £130m of whole system benefits during RIIO-ED2.**

As a result of the manifest benefits and in keeping with our partnership with ESO, it was clearly beneficial to expand our work on Regional Development Programmes. Consequently, we have committed to expand RDPs to other parts of our network and so aligning our plans with a commitment in the ESO RIIO-ED2 business plan<sup>29</sup> to expand the RDP programme across their networks.

ESO's Whole System Manager – Andy Wainwright said *“We have worked closely with UK Power Networks in developing and reviewing these proposals, we are fully supportive of the RDP programme and believe that will deliver whole system savings for electricity consumers”*

The RDP programme has been regularly presented at our DER Forum where stakeholders have further supported the ongoing expansion of the programme<sup>30</sup>.

Our implementation plan would look to offer the service to more DER in SPN, and then a staged expansion would look to implement this service provision in EPN. We have already been exploring enhanced coordination with NGESO and NGET through the RDP, which is aligned with recent policy and whole system industry developments. In addition to this we have also been working collaboratively with our neighbouring DNOs to explore whole system opportunities across multiple networks/interfaces. This approach enables whole system optimisation, minimises service conflicts and maximises the value of the coordinated approach to jointly procure DER services.

By building up on the learnings from our work in ED1, UK Power Networks will facilitate the expansion of the RDPs in RIIO-ED2 to deliver more efficient network and system management, lower overall system costs and value for money for consumers.

As evidenced via the Power Potential project, there are potential savings to consumers if DER can deliver voltage constraint management services for the transmission network compared to building additional network assets. Additional benefits also include unlocking extra network capacity and potential cost savings for consumers from greater competition with existing market providers. These service savings result from DER market behaviour and increased effectiveness to resolve locational issues compared to other market options available to NGESO.

Whilst we will continue delivering these projects in RIIO-ED1, we are proposing step change rollouts as part of our RIIO-ED2 plan that can deliver high confidence whole system savings.

The costs for DSO systems enabling RDP in the current regulatory period were funded through the RIIO-ED1 allowances, and the costs of supporting, improving and integrating new features of the BAU service will be built into our RIIO-ED2 business plan.

**Table 5: Our actions for expanding Regional Development Programme**

| Quantified benefits to our customers:  |   |  |   |
|--|---|--|---|
| £11m per annum on an ongoing basis reflecting reduced national balancing costs |   |  |   |
| #  | Our planned actions   | What our stakeholders said   | Qualitative benefits to our customers             |
| 1  | We will continue expanding the geographic area of our South East of England RDP during RIIO-ED2 | There is support from Distributed Energy Resource (DER) customers to continue developing greater opportunities for market access, through co-ordination between transmission and distribution networks.<br><b>Key insight I-DSO/WS9</b><br>Further key insight links: I-FNZ1, I-DSO/WS2 and I-DSO/WS8. | 1) More local renewable energy, and market access |

<sup>29</sup> National Grid ESO “Facilitating the transition to a flexible, low carbon energy system”, Dec 2019 <https://www.nationalgrideso.com/document/158051/download>

<sup>30</sup> UK Power Networks “Distributed Energy Resource (DER) Forum”, Sep 2020 <https://www.ukpowernetworks.co.uk/-/media/files/connections-ice/der-forum-presentation-v1-for-publication.ashx>

**We will work with the ESO to expand the Power Potential trial to be a business as usual offering across our EPN and SPN regions by 2028. This will be a world-first large scale rollout of a whole system reactive power management solution.**

Our whole electricity system approach for transmission – distribution coordination also includes reactive power services, as we have successfully demonstrated with our Power Potential innovation project (our joint service procurement trial with the ESO). Through Power Potential, we have developed a world-first regional reactive power market, showing how actions at the distribution level by the DSO can help DER to provide reactive power to efficiently meet transmission voltage needs. We will unlock the full value of Power Potential by further working with NGENSO to expand the service offering across our network. This whole system solution is a win for the electricity system through lower operating costs, a win for DER through maximised market access, and a win for society through strengthening the business case for increased renewables.

We will unlock the full value of Power Potential by further working with NGENSO to expand the service offering across our network.

Our implementation plan would look to offer the service to more DER in the trial Grid Supply Points (GSPs) (i.e., Canterbury North, Sellindge, Ninfield and Bolney). Then, a staged expansion would look to implement this service provision in the remaining GSPs in SPN, and subsequently to the other two UK Power Networks licence areas EPN and LPN.

This expansion would be supported by:

- Increased coordination regarding data exchanges and network modelling info.
- DER dispatch optimisation and resolution of service conflicts.
- Network reconfiguration and active network management actions.
- Further developing functionalities such as load-flow analyses.

For detail on this initiative can be found in the investment case in Annexe B

**Table 6: Our actions for expanding the Power Potential offering**

| <b>Quantified benefits to our customers:</b>  |  |   |  |
|---|--|---|--|
| We will target £29m of wider whole system benefits by 2040 in line with Power Potential CBA <sup>31</sup> . |  |   |  |
| <b>#</b>  | <b>Our planned actions</b>   | <b>What our stakeholders said</b>   | <b>Qualitative benefits to our customers</b>       |
| 1   | We will work with the ESO to expand the Power Potential offering across our EPN and SPN by the end of RIIO-ED2 | There is support from Distributed Energy Resource (DER) customers to continue developing greater opportunities for market access, through co-ordination between transmission and distribution networks. <b>Key insight I-DSO/WS9</b><br><br>Further key insight links: I-FNZ1, I-DSO/WS2, I-DSO/WS8 and I-DSO/WS16. | 1) Reduced Active and Reactive power market costs. |

<sup>31</sup> National Grid ESO, Power Potential webpage <https://www.nationalgrideso.com/future-energy/projects/power-potential>

***Over RIIO-ED2 we will deliver 1GW of distributed energy resources (DER) capacity at no more than £8m, using smart interventions and new innovations, reporting progress in our annual business plan.***

Connecting distributed generation and storage will be vital to meet the Government's Net Zero ambitions. Decarbonising transport and heat will require new low carbon generation plant to come online. Where this low carbon generation can connect at the distribution network (closer to sources of demand), it avoids the alternative of connecting larger scale renewables to the transmission network e.g., offshore wind. While many factors impact the overall cost of renewable generation, proximity of generation connection to the customer load, when comparing like for like, will reduce electrical losses on the network and the need for T&D network development and so deliver benefits. Consequently, helping to accommodate connections of DG and storage to the distribution networks is a key enabler of net zero at affordable costs.

Our strategy is to facilitate the rapid connection of DG and storage to our networks at lowest cost. To do this, we will make the most of our existing assets and use a mixture of low regret interventions and market solutions. We will maximise the use of these tools in RIIO-ED2 but also monitor where they are not proving effective, triggering funding if and when it is clear that there are emerging barriers to connection. Maximising distribution connected generation capacity provides wider system value and options for system balancing.

Through our engagement, it was clear that we need to balance facilitating LCT growth and network reliability. Many customers highlighted that local distribution network constraints, and the consequential time taken to complete required reinforcement work, may hold others back in enabling LCT connections. However, a concern voiced by our stakeholders was that the integrity and reliability of the network must not be compromised when integrating renewables into the system. As a network operator we must meet our customers' expectations but also be a key player in the energy transition. Therefore, as part of our role, we must ensure that renewables can be integrated into the system without affecting performance. This is backed up by our Willingness to Pay (WTP) research. From our WTP analysis we saw that customers are willing to pay for pre-emptive investments to accelerate achievement of Net Zero.

Stakeholders have confirmed that they want to be able to choose between firm and non-firm connection products. However, to make the non-firm (or flexible) connection offers more attractive they want assurances on the maximum curtailment they will experience and what will happen if this is exceeded.

Consequently, we are committing to being able to accommodate an additional 1.2GW of generation capacity, which will involve targeted interventions to unlock extra capacity and ensure we facilitate timely and affordable access to the system. This will initially focus on smart solutions that reduce the sole use costs of connecting renewables to the network as further covered in our DSO strategy.

For example, we will use market-based solutions to enable curtailment obligations trading. If we cannot offer a connection that has a forecasted curtailment below a reasonable level, or if we have an existing non-firm connection with excessive curtailment levels, we will then reinforce the network to address this.

***“UK Power Networks must ensure that renewables could be integrated into the system without losing reliability and share renewable knowledge”. P2b Core Engagement.***

As part of our RIIO-ED2 business plan, the 1.2GW of capacity that we will create for distributed generation will drive down connection costs (sole use elements) and reduce curtailment, thereby strengthening the business case and utilisation of renewable generation. Previously in RIIO-ED1, we unlocked 700MW of additional capacity in EPN and 400MW of generation capacity in SPN through our pioneering DG capacity programme<sup>32</sup>. The programme looked at the best value per unit cost solutions to deliver DG capacity and incorporated interventions in protection systems, better data and visibility of the network, and targeted local upgrades.

The table below expands on each of these actions to provide more detail on what our stakeholders said, the benefits they will deliver to our customers, and the planned expenditure.

<sup>32</sup> Line of sight – Whole Systems: What we achieved in RIIO-ED1, Whole Electricity

Table 7: Our actions for creating more renewable capacity

| Quantified benefits to our customers:   |  |  |   |
|---|--|--|---|
| Quantified benefits to our customers of creating more capacity (present value over 10 years): |  |  |   |
| 1) £3.8m Societal benefits – CO2 reduction from reduced renewable curtailment                 |  |  |   |
| 2) £33.8m Customer financial benefits – Savings from reduced renewable curtailment            |  |  |   |
| #   | Our planned actions  | What our stakeholders said   | Qualitative benefits to our customers   |
| 1   | Release 1.2GW (associated with the highest scenario of grid scale solar and battery uptake) of additional capacity through a combination of DSO-led solutions and market-based curtailment trading over RIIO-ED2 for no more the £8m | Stakeholders agree with the need for targeted network reinforcement to facilitate access to our network for distributed generation resources. Through our co-creation work, stakeholders supported targeted network reinforcement where curtailment exceeds 10%. <b>Key insight I-FNZ16</b><br><br>Further key insight links: I-FNZ1, I-FNZ7, I-FNZ8, I-FNZ15, I-DSO/WS2, I-DSO/WS13 and I-DSO/WS16. | 1) Greater volumes of local renewable energy provision. See ED2-EJP-NP-004<br>2) Reduced connections costs for DER.<br>3) Increase market opportunity for DER.<br>4) CO <sub>2</sub> savings from reduced curtailment |

**We will make our connections process faster and easier for our residential customers connecting low carbon technologies. We aim to instantaneously process 80% of general enquiries (GE) supply upgrades via self-service offerings, delivering a 9/10 experience over RIIO-ED2.**

For our customers, the connections process is often their first material interaction with their network operator. They see us as a trusted expert in electrification. As the first interaction, the process for connecting LCTs to the network needs to be efficient and cost effective. We must facilitate access to our network in the smartest, cheapest way to encourage engagement, and promote LCT adoption. With this in mind, we are committing to providing smart connection offers and self-serve tools for quotations and connections to reduce the time and cost to connect LCTs.

From our research we know that stakeholders want us to be ambitious with the information we provide, and to facilitate access to our network in the most customer centric way possible. Our customers want visibility of network locations where they can quickly and affordably connect to the network, as well as the tools that enable them to swiftly understand costs and constraints of a connection. Importantly, our stakeholder focus groups highlighted the desire for tools that can produce an automated quote based on site-specific needs at the paving slab level while offering alternative connection options that might be cheaper.

**Connections customers for, or installers of, low carbon technologies want a fast and simple connections process that is tailored to low carbon technologies and provides accessible information regarding existing capacity Key insight I-FNZ9**

Our engagement has shown us that connections is a critical customer interaction. To ensure that we continue to provide the best possible service to customers as LCT volumes increase, we will enhance, streamline, and accelerate the connections process. We believe that this will lead to a faster, more consistent, and scalable connection process that improves customer satisfaction and optionality, while reducing manual handling.

In delivering these actions, we will build on our expertise developing digital LCT channels in RIIO-ED1. Most notably, we simplified the connection process through our Smart Connect portal that assesses the connections of all residential LCTs including heat pumps, and we developed a “Timed Connections” offer that has saved customers more than 80% of the potential cost of their connection. Additionally, we led on the development of a common industry process for V2G connections across the UK.

The table below expands on actions to provide more detail on what our stakeholders said, and the benefits they will deliver to our customers.

Table 8: Our actions to accommodate high volumes of LCT applications

| # | Our planned actions  | What our stakeholders said  | Qualitative benefits to our customers  |
|---|--|---|--|
| 1 | Deliver new instantaneous self-service offerings for GE supply upgrades (target 80%)<br><br>(End of RIIO-ED1 target is 40%)  | Connections customers for, or installers of, low carbon technologies want a fast and simple connections process that is tailored to low carbon technologies and provides accessible information regarding existing capacity. <b>Key insight I-FNZ9</b><br><br>Further key insight links: I-FNZ1,I-FNZ5 and I-FNZ7 | 1) Greater convenience and choice for customers<br>2) Avoided costs to produce significantly more quotes |
| 2 | Developing faster and lower cost self-service channels for single phase customers to book a fuse or supply upgrade on the date, and at a time of their choice, within minutes. For further details on this action please refer to the customer service business plan chapter   | As above.<br><br>"UK Power Networks <i>should facilitate access to the network in the smartest, cheapest way to encourage activity.</i> " <b>Net Zero Council</b>   | 1) Reduced time<br>2) Lower total cost of ownership<br>3) Improved customer satisfaction                 |
| 3 | Offering new customer support tools for connecting customers such as our depot EV capacity calculation tool for fleet operators, resulting in customers asking for the most efficient connection capacity from the outset. For further details on this action please refer to the major connection's strategy Appendix 9 | Customers have demonstrated a willingness to pay for initiatives that facilitate the transition to Net Zero, by facilitating low carbon technologies through investment, socialisation of LCT connection costs, and LCT information provision. <b>Key insight I-FNZ7</b>  | 1) Improved customer satisfaction  |

**For each year of RIIO-ED2, we will develop high quality marketing information which can be used by third party intermediaries, to encourage an increase in customer use of low carbon technologies, unlocking greater participation in flexibility markets.**

Through our engagement, we learnt that our business customers and stakeholders want open, accessible, and accurate information that is shared proactively, to inform their decisions on investments. It was also understood that we should work closely with third party intermediaries, such as charge point installers, to ensure we articulate the value of participating in energy services at the same time ensuring the end customer connection experience is seamless.

We learned from our engagement, that customers were more aware of their supplier than their network operator due to the relationship via the energy bill, however it is also clear from our DSO stakeholders that we have a role to develop products and solutions which present value to our consumers in return for their flexibility.

Through innovation projects such as Skyline<sup>33</sup> and Shift<sup>34</sup>, where we partnered with forward thinking intermediaries, we learned that our position was in support of the intermediaries to deliver a great customer outcome. As such, we will continue to develop products, materials, and value, which we can pass through intermediaries to deliver a better end customer value.

We will do all we can to inform and share the benefits of adopting low carbon technologies. We will work in partnership with intermediaries to develop material which helps our customers close "the knowledge gap" and understand the benefits of LCTs. We will also partner with trusted third parties to help educate our customers.

The table below expands on each of these actions to provide more detail on what our stakeholders said, and the benefits they will deliver to our customers.

33 <https://innovation.ukpowernetworks.co.uk/projects/skyline/>

34 <https://innovation.ukpowernetworks.co.uk/projects/shift/>

Table 9: Our actions for expanding our marketing information

| Quantified benefits to our customers:  |   |   |  |
|--|---|---|--|
| Quantified benefits to our customers of expanding our marketing information (present value over 5 years) |   |   |  |
| 1) £546k Societal benefits - Value of educating customers about low carbon technologies                  |   |   |  |
| #  | Our planned actions   | What our stakeholders said  | Qualitative benefits to our customers  |
| 1  | <p>Annually we will produce useful information, which explains to customers (delivered through third parties) the benefits of LCT information and how it benefits them</p> <p>We will work in partnership through intermediaries to deliver and market this information</p> | <p>Stakeholders think that we should play a central, collaborative, role in raising awareness and educating customers about LCTs. <b>Key insight I-FNZ12</b></p> <p>Stakeholders want to receive more information, especially in relation to LCT. This includes greater provision of network data and a specific focus on flexible connections to encourage greater participation. <b>Key insight I-DSO/WS6</b></p> <p>Further key insight links: I-FNZ1, I-FNZ5, I-FNZ7, I-FNZ8 and I-DSO/WS10</p> | <p>1) Helps customers to bridge the knowledge gap and be better informed about LCTs.</p> <p>2) Increases participation in flexibility markets.</p> |

### **We will develop an energy efficiency flexibility product, running tenders every 6 months, starting in 2023**

As part of our engagement on low carbon heat many of our stakeholders want us to take a greater role in encouraging energy efficiency, to reduce the costs associated with a transition to electric heat<sup>35</sup>. Our commitment to introduce energy efficiency solutions in our DSO programme can help us defer network upgrades, thereby removing decarbonisation barriers whilst reducing bills and fuel poverty.

The CCC has identified the deployment of energy efficiency measures as one of four key priorities if the UK is to stay on track to meet its 2050 net zero target. The CCC recommends that energy efficiency interventions are made so that all buildings achieve EPC C rating or above by 2035 and that all social housing meets the same target by 2028 to help tackle fuel poverty<sup>36</sup>. Energy efficiency can also lower customer bills by reducing usage and by reducing peak demand.

On specific DSO propositions, stakeholders support increased focus on energy efficiency solutions. There was strong support for a flexibility first approach and undertaking work to increase the accessibility of such opportunities. Customers also provided views on the potential barriers to wider adoption of energy efficiency solutions, including a lack of understanding, location specific needs and the availability of revenue streams.

Hence, by acting on stakeholders' feedback, we identified that we needed to highlight that our flexibility programme is technology agnostic and does not preclude energy efficiency solutions from participating. Our aim is to keep facilitating new flexible solutions to come online and help them towards developing their business case with open, transparent, and accessible market information.

In order to provide further clarity and create new opportunities for flexibility providers, we have taken the necessary steps to explicitly introduce energy efficiency solutions in our February 2021 procurement round. We achieved this by working together with our customers to co-design and further improve our offering for energy efficiency solutions by addressing key challenges and barriers to entry.

However, we recognise that energy efficiency is different to flexibility services. For RIIO-ED2, we will ensure our investment planning and flexibility processes continue to be inclusive of the opportunities energy efficiency can bring by designing and offering to market a bespoke energy efficiency product. This will create a locational price signal that can be used to inform

<sup>35</sup> Ofgem has updated the distribution licence to enable DNOs to have a greater role in using energy efficiency [https://www.ofgem.gov.uk/system/files/docs/2020/12/annex\\_2\\_-\\_keeling\\_schedule\\_electricity\\_distribution\\_v2.pdf](https://www.ofgem.gov.uk/system/files/docs/2020/12/annex_2_-_keeling_schedule_electricity_distribution_v2.pdf)

<sup>36</sup> <https://www.theccc.org.uk/wp-content/uploads/2020/12/The-Sixth-Carbon-Budget-The-UKs-path-to-Net-Zero.pdf>

decisions on where to fund energy efficiency investments. This will result in overall lower capital costs. Benefits are captured in our DSO CBA.

*Table 10: Our actions for developing an energy efficiency flexibility product*

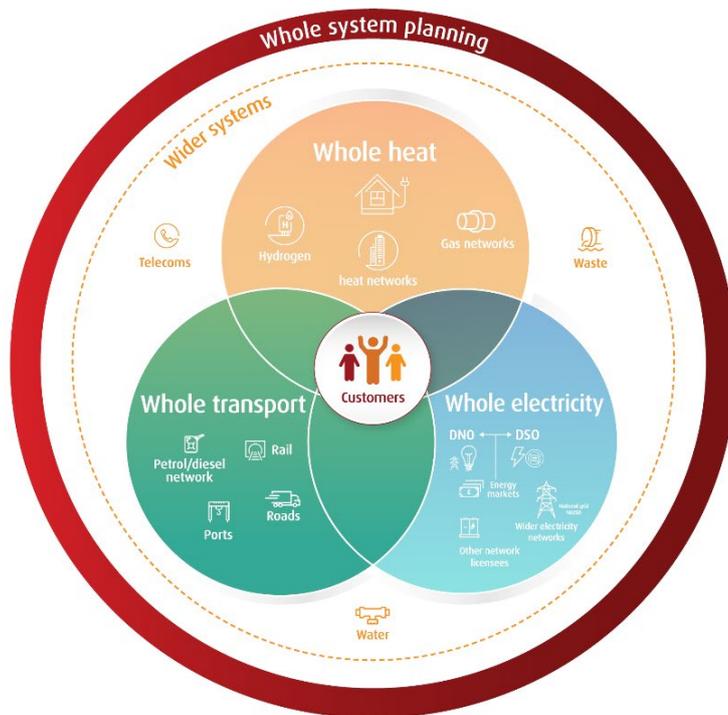
| # | Our planned actions  | Insights from engagement  | Qualitative benefits to our customers  |
|---|--|---|--|
| 1 | <p>Run 6 monthly energy efficiency tenders from 2023 as part of our flexibility programme</p> <p>Develop explicit CBA assessment at investment planning stage.</p> | <p>Stakeholders support increased focus on energy efficiency solutions, but have identified a range of barriers to adoption, including a lack of understanding, location specific needs and the availability of revenue streams.</p> <p><b>Key insight I-DSO/WS11</b></p> <p>Further key insight links: I-DSO/WS16.</p> | <p>Facilitate a net zero-compliant scenario whilst achieving the totex cost savings described in the DSO section.</p> <p>Also leads to additional value for end consumers by lowering bills and improving thermal comfort.</p> |

## Whole Transport

The table below states the objectives and the strategic challenges and solutions for Whole Transport.

| Objective   |   |
|---|---|
| Delivering whole systems decarbonisation solutions in the transport sector in order to facilitate Net Zero at lowest cost to customers  |   |
| Strategic challenges  | Our proposed solutions  |
| <ul style="list-style-type: none"> <li>Overcoming barriers to delivering sufficient and convenient charging infrastructure:                             <ul style="list-style-type: none"> <li>Up front capital hurdles on-street / en route</li> <li>Time to connect (fuse / service upgrades)</li> <li>Convenient footprint of charging infrastructure at home for renters, flats owners</li> <li>Commercial arrangements with charging operators</li> <li>Variable LA policies</li> </ul> </li> <li>Overcoming barriers to EV uptake                             <ul style="list-style-type: none"> <li>High upfront cost (fuel poor, vulnerable)</li> <li>Range anxiety</li> <li>Knowledge about technical requirements for home charging</li> </ul> </li> <li>Meeting the significant demands for network investment to satisfy customer demands when EV uptake accelerates within challenging timescales while achieving cost efficiencies</li> <li>Promoting sufficient demand side participation in the system</li> </ul> | <ul style="list-style-type: none"> <li>Collaborate with LAs to plan coordinated rollout of on-street / en route / MSA charging infrastructure at the right pace</li> <li>Develop high quality information, to address the knowledge gap for our customers about LCTs and provide information about demand side participation (V2G)</li> <li>Streamline the connections process for LCTs (Smart Connect)</li> <li>Collaborate with trusted intermediaries to install charging infrastructure at MSAs using innovative ‘meccano’ toolkits</li> <li>Work with Govt., Ofgem etc. to find solutions to the capital cost market failure in relation to at home on street / en route charging and inform policy regulation</li> <li>Proactively promote V2G (smart charging, Project Shift) to spread charging demand and delay network reinforcement - targeting non built solutions</li> <li>Provide free fuse / service upgrades to enhance LCT uptake</li> </ul> |

Figure 12: Key whole systems interactions relating to the decarbonisation of transport



We anticipate that key whole systems developments relating to the decarbonisation of transport over the RIIO-ED2 period and beyond will include:

- ICE cars & vans will be largely replaced by EVs being charged at home, on street, at work, en-route and at destination.
- Some ICE vehicles will be replaced by fuel cell vehicles (FCVs), particularly for heavy duty vehicle uses, and will require green hydrogen production and a hydrogen delivery network to be established.
- The petrol and diesel supply network will be eventually be reduced to only niche end uses.
- Smart charging and V2G solutions will provide an important source of flexibility to support electricity networks.

At the highest level, decarbonisation of transport is a key whole systems solution for the transition to Net Zero. Vehicles fuelled by petrol and diesel will be substituted by EVs (or FCVs) making a switch from fossil fuels to (low carbon) electricity (or green hydrogen), this was further confirmed in the recent UK Hydrogen Strategy<sup>37</sup> - published 17 August 2020 where BEIS confirms no substantial expected use of hydrogen in car and van transport, citing strategic investment in EV charging infrastructure, where justified, can be considered low regrets. Cost (or performance) may be a determining factor in choosing between EV and FCV solutions but EV solutions are further developed and uncertainties about hydrogen availability, delivery, and cost may mean that FCVs can only develop as a viable option later and for specific vehicle categories. This transition profoundly impacts several systems including electricity, transport, emerging hydrogen, and petrol / diesel supply (and so too oil refining and production).

The whole transport building block, described in the rest of this section, focusses on the proactive steps we are taking to overcome barriers to deliver this decarbonisation of transport and build the necessary infrastructure to support this radical shift. Another important part is concerned with the innovative work being conducted to understand and identify appropriate viable smart charging solutions and vehicle to grid flexibility from EV owners.

#### **Sidebar: The role that VXG energy technologies will play in a future energy system – Innovation**

The potential of V2X energy technologies such as smart charging (V1G) and vehicle to grid (V2G) to provide whole systems benefits are well documented. Innovative incentives and tariffs can be used to shift demand and change consumption behaviours to better suit network conditions and address constraints. V2G could provide more secure, reliable, and resilient future services through management of voltage and frequency as well as act as an additional energy source to meet increased demand beyond current grid supported levels. V1G and V2G give EVs the ability to absorb high levels of unpredicted excess renewable generation, which could reduce the need to curtail renewables, smooth wholesale price volatility and increase the level of renewables that can be deployed. Multiple sectors stand to benefit from the reduced cost of power and potential revenue opportunities these technologies offer. To reap these whole systems benefits a whole systems response is necessary.

Collaboration with energy suppliers and aggregators, vehicle and charge point manufacturers, and electric vehicle owners and operators have allowed us to test these technologies and shape our response through our innovation projects Optimise Prime, Shift, Transpower, Charge Collective and Enable. In Optimise Prime, the world's largest trial of commercial EVs, we are developing and testing innovative solutions to understand the potential savings from smart charging commercial fleets. Meanwhile, Shift has developed different smart charging customer propositions to explore how these influence domestic customer behaviour and what benefits these offer the network. Powerloop and Scirus trials that form part of our Transpower programme have done the same for V2G technologies developing new tariffs that include import and export options. Our engagement with customers through our Charge Collective and Enable trials has demonstrated appetite for smart charging services for those using public charge points, with an appreciation of both the financial and environmental impacts. At the same time, our network impact modelling has shown the potential network benefit from enabling smart charging from this segment. Project Shift has demonstrated that V1G can shave peak demand and defer costs of network reinforcement and, as a direct result, UK Power Networks has procured 284MW of capacity from EV batteries in its most recent flexibility tender.

There remains plenty of opportunity to innovate, collaborate and integrate these technologies into our operations to ensure that all customers can benefit, regardless of how and where they charge. As technologies, optimisation platforms, and business models mature we expect the business case for mass adoption to improve and these technologies to provide solutions needed to address our whole systems challenges.

<sup>37</sup> <https://www.gov.uk/government/publications/uk-hydrogen-strategy>

## Background

The mass adoption of EVs continues to gain pace. More and more drivers and businesses are making the switch to cleaner modes of transport. One in seven cars sold in the first four months of 2021 had a plug, up from one in ten in 2020, and one in thirty in 2019. As of March 2021, an estimated 149,000 EVs<sup>38</sup> were registered within our networks and we have forecast up to 4.5 m by 2030<sup>39</sup> – 1 million higher than our forecast the previous year. This acceleration is fuelled by government policy, technological advancement, and changes in public sentiment as awareness and confidence in the charging infrastructure needed to support this transition grows.

In their Ten Point Plan published in November 2020, the UK government pledged a £2.8 billion package of measures to encourage industry and drivers to make the switch to cleaner vehicles. Almost half of this, £1.3 billion, will be invested in the roll out of charging infrastructure, targeting support for rapid charge points on motorways and major roads and installing more on-street charge points. In March 2021 the government moved their ban on sales of petrol and diesel cars forward from 2040 to 2030. Some vehicle manufacturers are going further and are committing to stopping their sale and manufacture of petrol and diesel cars sooner than 2030.

EVs are becoming more accessible and affordable to motorists as vehicle costs, often cited as one of the main barriers to EV adoption, continue to fall with government grants for EVs extended from 2022 to 2023. Advancements in battery technology have not only been a factor in these price reductions but have also led to an increase in driving range for motorists, allowing them to travel longer distances on a single charge. Energy suppliers are offering EV specific tariffs and developing products that give drivers more control over when and where they can charge.

We have played our part, and have taken a proactive rather than passive approach, going beyond our traditional role of providing network capacity where needed. We have engaged with our customers and stakeholders at every opportunity to understand their needs and tailor our services; identified and tackled barriers to customer adoption whether they are at home, on-street, at work, en route or at their destination; helped shape innovative business models and provided the tools necessary to accelerate the transition; and taken a whole systems approach and developed smart charging and vehicle to grid models that offer benefits to the consumer and maximise utilisation of our existing infrastructure. This approach strategically aligns with the Smart Systems Package<sup>40</sup> published 20 July 2021, where it calls for Ofgem to ensure half-hourly settlement and that equipment is designed for smart charging- enabling critical mass of smart charging to develop on time.

Through the ENA we have worked closely with other DNOs to establish a strategy to answer the key question of how we ensure enough provision of public EV charge points at a local level, both on-street charging and local EV charging hubs, to ensure no-one is left behind in the Net Zero transition. In consideration of the challenges faced by consumers, investors, and Local Authorities a variety of solutions will be proposed that range in complexity and cost. These are all solutions UK Power Networks are working on now or form part of our whole transport strategy for RIIO-ED2. They include common digitalised connection tools and open data provision to strategic tendering approaches that leverage public and private funding.

This paints a positive picture of progress towards decarbonising the transport sector, but uncertainty remains. Difficult policy decisions are still to be made. Consultation on phasing out the sale of new non-zero emission HGVs is underway. Further legislation, partly in response to the Smart Systems Package, is expected in 2021 mandating that private charge points must be smart. The pace of technological change will fluctuate, and hydrogen may emerge as a more suitable alternative to electricity for public transport, heavy goods vehicles, and road freight. Public attitudes and behaviours are also likely to change as we emerge from the pandemic. As an enabler of this transition, we must be flexible and agile in our response to these changes.

In this context, we have shaped our RIIO-ED2 priorities to reflect those of government, our customers and stakeholders. We will build upon all we have achieved in RIIO-ED1 and continue playing an active role in informing and influencing policy. New network infrastructure will undoubtedly be necessary, but this will require locally targeted support and innovative solutions that consider regional diversities. Our whole transport building block has been informed by comprehensive and targeted engagement throughout RIIO-ED1 and in planning and preparing for RIIO-ED2. Prioritising ongoing engagement throughout the RIIO-ED2 period will be critical in gauging public sentiment and changing priorities to ensure positive outcomes for all our customers and wider communities.

<sup>38</sup> Line of sight – Whole Systems: What we achieved in RIIO-ED1, Whole Transport

<sup>39</sup> DFES 2021 Consumer Transformation scenario – Electric cars and vans in 2030

<sup>40</sup> <https://www.gov.uk/government/publications/transitioning-to-a-net-zero-energy-system-smart-systems-and-flexibility-plan-2021>

**Our role in unlocking our customers’ barriers**

Our engagement and research have shown us that there is an increasingly positive attitude towards electric vehicles in the UK but concerns about the availability of charging infrastructure and cost remains a barrier to adoption. Over the past decade, we have been researching the infrastructure requirements across the whole transport space. To recognise the specific charging needs of our customers across the transport sector, we have developed five main charging segments in collaboration with our stakeholders. We have conducted detailed modelling to understand the proportion of charging events across each segment (as highlighted in the figure below) by the end of RIIO-ED2 and the associated charging infrastructure required to serve these customers.

*Figure 13: Forecasted breakdown of charging segments in 2028 (source: UK Power Networks EV strategy)*



We recognise that the needs of our stakeholders and barriers to adoption vary substantially across the different EV charging segments. Our whole transport building block has considered each charging segment, the associated barriers our customers face today, and how we can help overcome them. Customers and stakeholders have a clear expectation that we should step up and support the roll-out of EV charging infrastructure. They recognise that a lack of on-street charging infrastructure for EVs is a significant barrier to EV uptake and we should be ambitious in relation to the delivery of en route charging infrastructure and, more broadly, supporting Local Authorities with their local area energy planning.

They also called for forward planning and coordination with Local Authorities and other utilities to ensure a dig once approach. However, views are mixed on how proactive we should be. Whilst earlier engagement suggests that we should be “on the front foot” and do “as much as possible”, our Business Option Testing (BOT) engagement favoured a relatively more conservative approach, whilst qualitative engagement suggests support for addressing on-street and en-route charging as well as driveway charging. More details on customer and stakeholder responses are given in the table below.

*Table 11: Our role in facilitating Whole Transport*

| Segment            | Stakeholders said:  | Our Role  |
|--------------------|---|---|
| At home off-street | To support the transition to Net Zero, customers and stakeholders believe that we should focus on: information provision; | Within the at home off-street charging segment our role is to proactively help our customers to transition to electric transport. To achieve this, we will: <ul style="list-style-type: none"> <li>Identify and support customers when they first consider an EV, ahead of the car arriving, so that we can proactively upgrade their supply</li> </ul> |

|                      |   |   |
|----------------------|---|---|
|                      | <p>collaboration (particularly with Local Authorities); and relieving capacity constraints to enable supporting infrastructure like EV charging points. <b>Key insight I-FNZ8</b></p>   | <ul style="list-style-type: none"> <li>• Provide the information our customers need to bridge the “knowledge gap” and understand what they need to do to get connected</li> <li>• Ensure that our customers’ homes are ready for EVs and work with industry to deliver a great connection experience for our customers</li> <li>• Collaborate with aggregators and service providers to support the development and adoption of smart EV charging customer propositions, by providing price signals on capacity needs in a way that is easy to understand and interact with.</li> </ul>   |
| At home on-street    | <p>Both customers and stakeholders recognise that a lack of on-street charging infrastructure for EV charging is a significant barrier to EV uptake. <b>Key insight I-FNZ4</b></p>  | <p>Our role is to support connecting customers with quick and affordable connection options, whilst working with the regulator to unlock areas of market failure. To achieve this, we will:</p> <ul style="list-style-type: none"> <li>• Play a coordinating role between charge point operators and local authorities to support and facilitate local charging infrastructure</li> <li>• Build upon the experience gained from our Green Recovery programme and our innovative Charge Collective project that demonstrate how we can successfully work with the regulator and local authorities to plan local, public charging networks</li> <li>• Collaborate with local authorities to ensure there are appropriate disabled EV charging bays</li> <li>• Provide information on network requirements to support investment in charge point infrastructure</li> <li>• Work with government and Ofgem to inform policy regulation to ensure the public EV charge point market develops in line with transport demand</li> <li>• Develop products and services to support our customers in the event of an outage (e.g., proactive notifications).</li> </ul> |
| En route /MSAs       | <p>There is an increasingly positive attitude towards electric vehicles in the UK, but concerns about the availability of charging infrastructure, cost and range remain barriers to adoption. <b>Key insight I-FNZ3</b></p> <p>Further evidence in key insight I-FNZ14 and I-FNZ17</p> | <p>Improving the en-route charging infrastructure is a critical next step in the adoption of EVs. Our role will be to:</p> <ul style="list-style-type: none"> <li>• Collaborate with industry and government to ensure there is sufficient capacity increasing confidence in EV charging infrastructure, reduce range anxiety, and drive up EV adoption</li> <li>• Build upon the experience gained from our Green Recovery programme that demonstrates how we can successfully develop a framework for tackling market failures preventing EV infrastructure upgrades on the Strategic Road Network</li> <li>• Provide access to our network information and requirements to inform charge point infrastructure investment decisions</li> <li>• Work with government and Ofgem to inform policy and regulation ensuring public EV charge point market develops in line with demand</li> <li>• Continue to innovate to drive down costs and time to connect new en-route charging infrastructure</li> <li>• Develop products and services to support our customers in the event of an outage (e.g., proactive notifications).</li> </ul>                      |
| At Work/ Destination | <p>Our stakeholder engagement has shown that connections customers for LCTs want a fast and simple connections process that is tailored to LCTs. <b>Key insight I-FNZ9</b></p>  | <p>For this customer segment our role is to support customers wanting to uprate their connections to accommodate more LCTs. We will:</p> <ul style="list-style-type: none"> <li>• Develop new innovative connection products and tools to drive down cost to connect and provide alternative connection options that may be more cost-effective</li> <li>• Provide information to educate customers on infrastructure requirements, supporting investment and installation of charging infrastructure</li> <li>• Streamline and simplify the connections process</li> <li>• Provide information to help our customers to understand how they can engage with flexibility markets and the potential value</li> <li>• Develop products and services to support our customers in the event of an outage (e.g., pro-active notifications)</li> </ul>  |

### Our RIIO-ED2 Whole Transport action plan

Throughout our RIIO-ED2 planning and preparations we have listened to our customers and wider stakeholders who believe that addressing network infrastructure and operational constraints are critical to successfully facilitating the EV transition. However, the speed and scale of uptake for EVs remains uncertain, and customers have expressed concerns about investment getting too far ahead of this uncertain demand. We have developed a systematic approach to evaluating proposed expenditure considering Ofgem’s guidance in the RIIO-ED2 sector specific methodology.

Our approach adopts whole Systems Planning principles to ensure we will invest in the right places at the right times, investing at the pace that our customers are moving, based on their adoption of EVs and our forecasts. Without these investments our government’s and the transport sectors’ ambitions and our common Net Zero goal will not be achievable. We have aligned our investment proposals to Ofgem’s regulatory mechanisms, to ensure that cost and volume uncertainty are appropriately managed, and customers are protected.

We have split out priorities into areas where we have high confidence and when there is less certainty. This results in three priorities aligned to baseline allowances and three to volume drivers, flexing allowances as the need arises.

#### Interventions associated with high confidence

We will assess and if necessary upgrade supplies for 728,000 homes free of charge to accommodate connecting LCT’s by coordinating with installers.

We will create an additional 248MW of LV network capacity to unlock LCT related demand across our networks

We will reduce street-works costs and transport disruptions in London by collaborating with other statutory bodies on at least 40 collaboration projects in RIIO-ED2

#### ***We will assess and if necessary upgrade supplies for 728,000 homes free of charge to accommodate connecting LCT’s by coordinating with installers.***

We understand that property level intervention will be needed to enable our customers to connect LCTs at home. Our stakeholders told us that “we need to undertake a combined, coordinated approach across the industry to be effective”. Through a whole system planning approach, we will be able to provide both the infrastructure investment and high quality of service needed to reach the LCT uptake numbers necessary to achieve our nation’s decarbonisation targets. From our 2021 DFES forecast we know that customers are going to connect significant volumes of LCTs to our network, in May 2021 we have over 175,000 EVs connected to our network, we have applied our RIIO-ED1 assessment and intervention rates, and estimate 728,000 homes will require intervention under our chosen scenario.

We are committing to provide all customers who contact us a free LCT readiness supply check. If needed, we will provide free fuse and supply upgrades of up to 100A. We appreciate these volumes of interventions may vary from the current intervention rate, as such we have proposed using a volume driver on these, like that used for smart meters to manage this uncertainty. In addition, we have added an additional 1.1m of these interventions in an action later in the section to help with vehicle volume uncertainty.

These electricity service upgrades benefit the transport and heat sectors alike. They future proof homes, allowing customers to install LCTs depending on their circumstances and their preferences. Whilst our DFES scenarios show that the uptake of EVs is expected to be higher in overall volume than heat pumps over the RIIO-ED2 price control period, customers in certain locations are likely to favour heat pump installation ahead of buying an EV. Whether they install an EV charger or a heat pump at home first, these upgrades allow customers to install LCTs giving them confidence that they can install additional LCTs without further disruption from repeat visits and reducing overall costs, further supporting a “touch the network once” approach.

In terms of the level of expenditure to include in ex-ante allowances, we believe that a consistent and coordinated approach across EVs and low carbon heating is appropriate. Across RIIO-ED2, we will continuously innovate to ensure that we refine and streamline the way we work with installers and deliver LCT ready homes for our customers. As outlined later in this section, we will use well-defined uncertainty mechanisms (like the smart meter volume driver), in tandem with our workforce resilience and supply chain strategies, to support assessments and home upgrades above and beyond 728,000 to a

maximum cap set by our most aggressive DFES scenario. This approach will deliver faster connections of LCTs for customers who require a service upgrade and save money for the end customer by reducing overall costs and disruption.

Over recent years, our customer satisfaction scores have been very high, at 94%, for providing free fuse upgrades to residential customers requiring greater capacity for their LCTs. This confirms that during RIIO-ED1, this has been a beneficial service that is valued by our customers. We also launched an automated self-service connections portal for installers. It brings together the application and fuse upgrade processes for domestic LCTs into a single digital journey. Automation provides faster connections and ensures we can manage the scale of applications in the most efficient way. We will build on this success and innovation in RIIO-ED2 as LCT application volumes increase.

*Table 12: Our actions to prepare our customers’ homes for connecting LCTs*

| <b>Quantified benefits to our customers:</b>   |   |   |   |
|--|---|---|---|
| <b>Quantified benefits to our customers of preparing our customers’ homes for connecting LCTs (present value over 5 years)</b> |   |   |   |
| 1) £19.2m Customer financial benefits – Savings for customers of avoided cost from service alterations.                        |   |   |   |
| 2) £48.5m Societal benefits - CO2 reduction from enabled domestic LCT uptake by customers.                                     |   |   |   |
| 3) £409k Societal benefits - Reduced face time required for customers to interact with DNO due to improved digital channels.   |   |   |   |
| 4) £12k Societal benefits - Customer feels in better control of their life due to time saved from the connections process.     |   |   |   |
| #  | <b>Our planned actions</b>  | <b>What our stakeholders said</b>   | <b>Qualitative benefits to our customers</b>  |
| 1  | Promote home fuse upgrades and service alterations through better coordination with industry. | Customers have demonstrated a willingness to pay for initiatives that facilitate the transition to Net Zero, by facilitating low carbon technologies through investment, socialisation of LCT connection costs, and LCT information provision. <b>Key insight I-FNZ7</b><br><br>Further key insight links: I-FNZ1, I-FNZ5, I-FNZ8, I-FNZ17 and I-FNZ18. | 1) Reduce overall costs by spreading out the work more efficiently to reduce risks of deliverability issues in the future such as resourcing of labour during RIIO-ED2 and RIIO-ED3.<br><br>2) Future proof homes which will minimise customer disruption from repeat visits. |

**We will create an additional 248MW of LV network capacity to unlock LCT related demand across our networks.**

We know that customers want us to facilitate Net Zero, however we need to be efficient and take a low regrets approach to investment. Where we expect high uptake of LCTs we are committing to deliver network capacity release programmes. From our engagement, we understand that our stakeholders would rather UK Power Networks be ultra-ambitious in ensuring the network is ready for mass installation - particularly for rural customers. They highlighted the value in future proofing our investment to ensure that the lifecycle cost is minimised. This is backed up by the CCCs recommendation that “future-proofing investments by oversizing network infrastructure is a ‘very low-regrets’ option”.

*“Cables should be as big as possible as most of the cost is digging up the roads. Need a strategic approach to network investment instead of an incremental approach. Optimise across a longer time period but not 5 years”. - Net Zero Council*

To support this view, we heard from the Net Zero Council that “learning from previous technologies boom curve, UK Power Networks needs to be an enabler for access, investing ahead of time, in systems, people etc.” With this in mind, we are committed to ensuring there is always sufficient capacity to meet the LCT demand. However, we recognise that being ultra-ambitious at any cost, will not facilitate Net Zero at least cost for our customers. Our strategy needs to be suitably ambitious, while also investing efficiently. To achieve this, our approach is clear. We will only invest in additional network capacity when we have explored other opportunities such as maximising utilisation of existing network headroom, considered the impact of after diversity maximum demand (ADMD), and taken advantage of opportunities to mesh and share loads. Only then will we look to create additional network capacity through upgrades to three phase supplies, small bore LV cables and transformers, should this be assessed as the best whole system option.

*“Local distribution network constraints and required reinforcement work are holding us back in enabling LCT connections”. - Net Zero Webinar*

From our DFES forecasting we know that customers are going to connect significant volumes of EVs and heat pumps to our network and we must be proactive in our approach to supporting connections. Based on our analysis and forecasted LCT demand under our “Consumer Transformation” scenario, following fully utilising existing network capacity, we will create a minimum of 248MW of additional LV capacity.

Throughout RIIO-ED2, we will proactively monitor the volume of LCTs being deployed to the network. Where demand increases above our “Baseline view” and we have exhausted flexibility and other options, we propose to meet this additional demand using well-defined uncertainty mechanisms. We continue to enhance our forecasting and monitoring tools that give us the confidence to invest in the right places at the right times, where we know the highest volume of LCTs will connect to the network during the regulatory period. Our workforce resilience plans reduce the risk of future deliverability issues and ensure there is sufficient capacity in the network, so customers do not need to wait to connect.

In RIIO-ED1, we were the first DNO to fully rollout flexible connections across our area resulting in over 200MW of operational capacity saving over £70m for connecting customers and 800MW of contracted capacity, all while maintaining best in-class customer service, with 90.5% customer satisfaction for DG connections customers<sup>41</sup>.

Building on this, in RIIO-ED2 we have identified three actions that will enable us to deliver on this priority.

**Table 13: Our actions to create additional network capacity to unlock LCT related demand**

| # | Our planned actions  | What our stakeholders said   | Qualitative benefits to our customers   |
|---|--|--|---|
| 1 | Proactive load related network / flexibility investment to facilitate capacity required for residential LCT volumes in the period and where accelerated uptake is forecast including upgrading single to three phase programmes, smallest pole mounted transformers of 50kVA and small-bore LV cable upgrades. | <p>“Learn from previous technologies boom curve. As an enabler for access, we need to invest ahead of time, in systems, people etc.” <b>Net Zero Council.</b></p> <p>Stakeholders think that we should ensure sufficient network capacity ahead of need, and coordinate network reinforcement so that we only “dig the road once”. <b>Key insight I-FNZ15</b></p> <p>Further key insight links: I-FNZ1, I-FNZ5, I-FNZ7, I-FNZ8, I-FNZ17 and I-FNZ18.</p> | <ol style="list-style-type: none"> <li>1) Reduced connection costs.</li> <li>2) Reduction in cost, time, and disruption as we only touch the network once.</li> <li>3) Reduce risks of deliverability issues in the future.</li> <li>4) Provide sufficient network capacity to connect LCTs in advance, so customers do not need to wait for upgrade and reinforcement works.</li> </ol>  |
| 2 | Making reactive service upgrades to three phase supply triggered by phase imbalance caused by LCTs on the network.   | <p>“Proactively increase the density of three-phase supplies as and when other interventions are being carried out”. <b>Heat Focus Group.</b></p>  | <ol style="list-style-type: none"> <li>1) Reduction in overloads and potential faults.</li> <li>2) Minimise the requirement for staff to locate and fix faults, delivering a reduction in OPEX.</li> <li>3) Reduction in customer interruptions, customer minutes lost, probability of injury (fatal or non-fatal).</li> <li>4) Improves customer confidence in switching to electricity as the primary fuel for transport and heat. Measured by the increased uptake rate as compared to the forecasts.</li> </ol> |

<sup>41</sup> Line of Sight – Whole systems: What we achieved in RIIO-ED1, Whole Electricity

| # | Our planned actions   | What our stakeholders said  | Qualitative benefits to our customers  |
|---|---|---|--|
| 3 | Employ our forecasting and monitoring tools to give us the confidence to invest in the right places at the right times, where we know the highest volume of LCTs will connect to the network during the regulatory period. Refer to our DSO chapter of our business plan for further details. | Stakeholders want to see a focus on enabling monitoring to provide sufficient information to industry. There is strong appetite for this at the low voltage network level, but there is agreement that the business case for monitoring needs to stack up | 1) Reduced connection costs.<br>2) Reduction in cost and labour as we only touch the network once and less disruption. |

***We will reduce street-works costs and transport disruptions in London by collaborating with other statutory bodies on at least 40 collaboration projects in RIIO-ED2.***

According to Transport for London the congestion caused by street-works costs the London economy over £1bn per year<sup>42</sup>. The GLA has asked us and other utilities to collaborate to bring these costs down whilst our customers have made it clear that we should take a dig once approach and seek economies of scale through proper forward planning and coordination. These stakeholders have also told us that the three key areas important to them are planned growth, electric vehicles, and flexibility.

***Stakeholders think that we should ensure sufficient network capacity ahead of need, and coordinate network reinforcement so that we only “dig the road once.” Key insight I-FNZ15***

It is part of our statutory duty to maintain a safe and reliable electricity distribution network. This frequently involves work on the network, which in many cases involves essential street works. Every year, we need to carry out in excess of 100,000 excavations across our network areas, which we do for four main reasons:

- **Maintaining** the safety, security, and reliability of the electricity network
- **Connecting** new customers' premises to electricity
- **Extending** and upgrading the network to meet changing needs
- **Rerouting** the network to assist infrastructure and urban regeneration projects

London is unique in that it has the highest and fastest growth load density in the UK with 99.95% of circuits underground. On average over 3,300 network connection applications for major development were analysed and offered in 2019 alone. This regional differentiation leads to higher costs of delivering works in London and requires a different approach to street work planning.

Since the RIIO-ED1 price control, we have worked in partnership with Thames Water, Cadent Gas, NERA and Arcadis to evaluate the higher costs or environment related productivity impacts of running a Network in the London region. The report titled, 'Understanding the Baseline Level of Efficiency in London', has identified key factors affecting the cost of performing utility services in London, as compared to other parts of the country, providing an expert view quantifying the effect of these differences on overall costs (see Managing Uncertainty).

***Stakeholders think there are economies of scale if we engage by location, with proper forward planning and a dig once approach. - FNZ EV Focus Group***

To carry out works as safely, efficiently, and considerately as possible, we liaise with Developers, City Councils, Borough Councils, and the Greater London Authority before starting any works. We co-ordinate works between us, them, and other utilities, to keep disruption and environmental impact to a minimum, which is also one of the requirements under the New Roads and Street Works Act 1991 and the Traffic Management Act 2004.

By working with the GLA and the gas networks covering Greater London as part of a street-works coordination group, combined we have already saved our customers over £766,000 in RIIO-ED1. There remains further scope to unlock

<sup>42</sup> Transport for London "Understanding and Managing Congestion", Nov 2017 <http://content.tfl.gov.uk/understanding-and-managing-congestion-in-london.pdf>

consumer value that goes beyond totex savings. For RIIO-GD2 Cadent, SGN and the GLA have quantified the social benefits of collaborating on street-works<sup>43</sup>. We will use the same methodology to realise these benefits for customers we serve in London and have engaged with the above as part of developing a new Output Delivery Incentive (ODI) on street works in RIIO-ED2.

We are confident that the same framework that Ofgem agreed as part of the RIIO-GD2 ODI on street-works can be applied to us for RIIO-ED2. This would ensure that the regulatory process is equivalent for gas and electricity and we have the same level of incentive to collaborate on projects, for the benefit of all customers in the London area. The social value associated with partnerships on projects is now well understood and aligned to the HM Treasury Green book; a part of this translates into compensation for licensees. According to the minimum criteria of what forms an eligible project, part of which has been taken from the GLA’s Collaboration manual, we are will undertake 40 collaborative schemes during the RIIO-ED2 period. This will result in an estimated £12.2m of social benefit. We will work with the GLA, Cadent and SGN to define the criteria of an eligible project ahead of the period.

Table 14: Our actions to reduce street-works costs in London

| Quantified benefits to our customers:   |   |  |  |
|---|---|--|--|
| 1) £305,000 per project saved, reducing the bill for customers. <sup>44</sup> - Expected £12.2m |   |  |  |
| #   | Our planned actions   | What our stakeholders said   | Qualitative benefits to our customers  |
| 1   | To complete at least 40 collaborative street-works projects in RIIO-ED2<br><br>We will report against this target in our annual business plan | Stakeholders think that we should ensure sufficient network capacity ahead of need, and coordinate network reinforcement so that we only “dig the road once”. <b>Key insight I-FNZ15</b><br><br>Further key insight links: I-FNZ13 and I-DSO/WS8 | <ol style="list-style-type: none"> <li>1) Reduced traffic congestion and related costs.</li> <li>2) Reduce disruption, noise levels and damage to trees in the area surrounding the excavation</li> <li>3) Decreases in the volume of excavated waste materials that must be recycled or sent to landfill</li> </ol> |

Interventions with funding linked to uncertainty mechanisms

|  |  |   |
|--|--|---|
| <p>We will use well-defined uncertainty mechanisms to prepare for a possible accelerated LCT uptake by ensuring capacity is released in a timely manner and facilitating an additional 847MW of LV capacity for LCT uptake and support an additional 1.1m homes connecting an LCT.</p> | <p>We will run a process to identify and address market failures with respect to the provision of on-street charging, unlocking over 2,400 public charge points in areas of market failure by the end of RIIO-ED2.</p> | <p>We will run a process to identify and deliver an additional 7-8MW of capacity in areas located near 14 motorway and trunk road service stations, by running a call to market in 2024 and 2025, ensuring a maximum of 30 miles between charging across our regions.</p> |
|--|--|---|

**We will use well-defined uncertainty mechanisms to prepare for a possible accelerated LCT uptake by ensuring capacity is released in a timely manner and facilitating an additional 847MW of LV capacity for LCT uptake and support an additional 1.1m homes connecting an LCT.**

As outlined, we have proposed that the investments needed to respond to the “baseline” demand scenario of 728,000 homes and an additional 248MW of LV capacity should be treated as certain given the high confidence in their need.

<sup>43</sup> Ofgem “RIIO-2 Final Determinations – GD Sector Annex (REVISED)”, Feb 2021  
[https://www.ofgem.gov.uk/system/files/docs/2021/02/final\\_determinations\\_-\\_gd\\_annex\\_revised.pdf](https://www.ofgem.gov.uk/system/files/docs/2021/02/final_determinations_-_gd_annex_revised.pdf) (pg.41)

<sup>44</sup> SIMETRICA “Valuation of the impact of works disruptions and supply interruptions using the wellbeing valuation method” Oct 2019  
<https://www.sgnfuture.co.uk/wp-content/uploads/2020/01/SGN-023-Supinfo-Annex-of-Social-value-regression-analysis.pdf>

However, our DFES scenario forecast highlights that there is a broad range of future energy demand volumes that depend on the decarbonisation pathways society takes, most notably in the uptake of LCTs during RIIO-ED2 and the success level of appliance and thermal energy efficiency measures. We are proposing that the additional investments consistent with the highest credible demand scenario should be provided for via volume drivers. This will ensure customers are protected should this level of demand not materialise, while providing the flexibility for further investment if demand rises above the level assumed under the baseline scenario. We believe this to be a good level of risk sharing with customers.

We are committing to provide all customers who contact us a free LCT readiness supply check. If needed, we will provide free fuse and supply upgrades of up to 100A. We appreciate these volumes of interventions may vary from the current intervention rate, as such we have proposed using a volume driver on these, like that used for smart meters to manage this uncertainty. In addition to the 728,000 interventions in the action above, we expect a maximum of 1.1m additional assessments and interventions should our highest uptake scenario manifest.

Our engagement found that most customers see getting to Net Zero as a priority but there were mixed views on how proactive UK Power Networks should be due to the level of uncertainty surrounding the speed of the transition. Some stakeholders were cautious that UK Power Networks may risk overextending itself and investing more than is required compared to overall uptake. A recent report published by ENWL exploring barriers to adoption emphasised this uncertainty and highlighted the uncertainty around return on investment for renewable asset owners, indicating this challenge of uncertainty extends the boundaries of networks.

*“Until policy has been decided, UK Power Networks should be doing what they can to prepare for this potential future, but not go so far as to start spending money in infrastructure that is not yet certain or defined.”* **FNZ Phase 2b Engagement**

Our strategy includes the regulatory volume driver mechanisms to automatically draw down additional investment based on the uptake volumes of LCT over the coming years. Taking this approach ensures that we have the flexibility to efficiently increase investment in-line with the needs of our customers as policy, technology and consumer trends become clearer.

In RIIO-ED2, we propose the following two actions to support achieving this intervention:

**Table 15: Our actions to facilitate accelerated LCT uptake**

| # | Our planned actions  | What our stakeholders said   | Qualitative benefits to our customers                               |
|---|--|--|---|
| 1 | Facilitate accelerated LCT uptake by ensuring an extra 847MW LV capacity is released in a timely manner. | <p>“Learn from previous technologies boom curve. As an enabler for access, we need to invest ahead of time, in systems, people etc.” <b>Net Zero Council</b></p> <p>Customers have a clear expectation that we should step up and support the development of EV charging infrastructure and low carbon heating. However, views are mixed on how proactive we should be. <b>Key insight I-FNZ17 and I-FNZ18.</b></p> <p>Further key insight links: I-FNZ1, I-FNZ5, I-FNZ7 and I-FNZ8.</p> | See above associated ex-ante intervention for qualitative benefits. |

#### Quantified benefits to our customers:

##### Quantified benefits to our customers of preparing our customers’ homes for connecting LCTs (present value over 5 years)

- 1) £20.8m Customer financial benefits – Savings for customers of avoided cost from service alterations.
- 2) £52.4m Societal benefits - CO2 reduction benefit from enabled domestic LCT uptake by customers.
- 3) £440k Societal benefits - Reduced face time required for customers to interact with DNO due to digital channels
- 4) £13k Societal benefits – Customer feels in better control of their life due to time saved from the connections process.

| # | Our planned actions | What our stakeholders said | Qualitative benefits to our customers |
|---|---------------------|----------------------------|---------------------------------------|
|---|---------------------|----------------------------|---------------------------------------|

|   |   |   |   |
|---|---|---|---|
| 1 | We will also ensure up to additional 1.1m homes are ready for LCT adoption. | Customers have demonstrated a willingness to pay for initiatives that facilitate the transition to Net Zero, by facilitating low carbon technologies through investment, socialisation of LCT connection costs, and LCT information provision. <b>Key insight I-FNZ7</b><br><br>Further key insight links: I-FNZ1, I-FNZ5, I-FNZ7, I-FNZ8, I-FNZ17 and I-FNZ18. | See associated ex-ante intervention for qualitative benefits. |
|---|---|---|---|

***We will run a process to identify and address market failures with respect to the provision of on-street charging, unlocking over 2,400 public charge points in areas of market failure by the end of RIIO-ED2.***

We have a clear ambition to be a proactive enabler of the infrastructure that will enable our customers to achieve their ambitious Net Zero targets. We understand that a key barrier to transport decarbonisation is charging infrastructure. Public charge points will become the safety net of the EV transport sector. This priority forms a critical part of our “Whole systems approach” giving customers the confidence to switch to electric vehicles if they do not have off-street parking.

*“I think all of these areas are important. How many chargers are they planning to have around, and will that be enough for people not to be stuck in queues, waiting to charge their car?” - FNZ Phase 2b research*

Our customers expect us to step up and support the development of EV charging infrastructure. However, as noted by our stakeholders, at the Net Zero Forum and as part of our co-creation work, there are market failures associated with deploying public EV charging infrastructure in line with the Government’s Net Zero target. They think that we should pursue an ambitious approach in seeking to address such market failures.

*“30 years might seem a bit long but actually when you think about the timescales governments need and also when you think about infrastructure projects in general, they have a long lead in time and they certainly require a lot of investment, so you do need to plan well ahead”. - FNZ Phase 2b Engagement*

At present, the cost of upgrading the network for off-street charging points is socialised. However, public charge points are faced with different circumstances – a combination of low utilisation and significant upfront connection costs can act as a barrier to investment. This market failure results in fewer charge-points being installed than is needed to meet our customers’ demand. Moreover, not everyone has access to off-street charging and there is a risk that some customers are left behind in the transition to EVs because of this market failure.

This is borne out in a report from the Public Accounts Committee in May 2021 who warned that the government has a “mountain to climb” to make all cars and vans sold in the UK low emissions by 2030. The report urged the Department for Transport to address the remaining barriers to expanding the network and the availability of chargers where drivers do not have off-street parking<sup>45</sup>. Our approach aligns well with Ofgem’s EV Strategy<sup>46</sup> – published 4 September 2021, where Ofgem states that DNOs should work with stakeholders to anticipate the likely need for public charging infrastructure, so that network investment is timely and efficient.

*“Most segments prone to market failure are obvious. The clearest is on-street public residential...yet most cities and towns will require significant provision of this charging to support EV transition”. - Net Zero Forum*

The upfront capital hurdle to investment in public charge points, one of the key barriers to the deployment of public charging, can be addressed by socialising some of the non-contestable sole use costs of network upgrades in specific circumstances. This approach will deliver greater social value to communities, by ensuring no one is left behind in the Net Zero transition and accelerating the uptake of EVs in areas where people do not have access to off-street parking. We have demonstrated this approach, and its benefits, through our “Charge Collective” innovation trial.

We will work with Local Authorities to plan where the most effective location for on-street chargers should be, based on a framework that we have co-developed with our Local Authority partners. Through the Charge Collective innovation trial, we undertook a competitive tender process to reveal the connection costs that market participants are willing to pay to invest in

<sup>45</sup> UK Parliament, Committees News Article <https://committees.parliament.uk/committee/127/public-accounts-committee/news/155231/from-11-to-100-zero-emission-cars-in-14-years-government-lacks-plan-for-huge-challenge-of-social-and-economic-transition/>

<sup>46</sup> Enabling the transition to electric vehicles: The regulator’s priorities for a green, fair future, Ofgem, September 2021

public chargepoints in a range of areas. This has provided us with evidence of the level of socialisation needed in different circumstances to facilitate investment in public charging. This approach can be applied throughout our license areas in RIIO-ED2 to ensure we work with Local Authorities to tackle this market failure, ensuring these communities are not left behind. We believe that scaling this approach to cover those areas that are at risk of being left behind could deliver £20m in savings over 25 years from a coordinated, anticipatory approach to network investment while ensuring equality of access to charging infrastructure. Our analysis demonstrates that this initiative delivers an SROI of 1.92.

While Government support can help to address the barriers, this is currently limited, and insufficient to meet the required levels of EV adoption planned. We will take a proactive role in tackling this with Ofgem and Government and continue to address these market failures by identifying the fairest and most efficient way to promote EV infrastructure investment. Operation and ownership of these chargers will be via a third party, it is not our intention to own or operate any chargers as part of this initiative.

While a large portion of the wider reinforcement cost barrier to investment in public charging will be addressed by the change in the connection boundary, if the recommendations of the Significant Code Review are implemented, we believe market failure will remain in the most uninvestable locations. We aim to address this remaining cost barrier by socialising part of the non-contestable sole use costs necessary to facilitate widespread public charging.

This intervention will apply a proactive, whole systems approach to address this market failure. We will intervene to unlock network capacity and reduce connections costs, enabling a minimum of 2,400 on-street EV charge points to connect that would not otherwise be commercially viable yet are of benefit to society. This will represent a sizeable addition to the on-street charging network in our regions, which currently numbers approximately 12,000<sup>47</sup>. We will deliver this by adopting a regional approach, mitigating the risk of “charging deserts” emerging in hard to solve locations where connection costs are high, but demand may be lower. We will share our ideas and our learning to promote the development of charging infrastructure outside of London and address the “postcode lottery” that the CMA also highlighted as a barrier to national uptake of EVs in the same report<sup>48</sup>.

The following initiatives associated with achieving this commitment leverage our Charge Collective project<sup>49</sup> to deliver specific, quantifiable benefits to the communities that we serve, adopting a new innovative approach - an industry first:

- Coordinated planning to enable the provision of on-street charge points that would not otherwise be installed: We will work with local authorities to identify areas with market failure where intervention would yield societal benefits (by considering factors such as the proportion of on-street parking; connection costs; air quality; and customer vulnerability). By looking at areas with the worst air quality in the country (something that cannot be priced into investment costs) where we believe we can reduce connection costs within the regulatory framework, we estimate that 2% of on-street charge points in areas with limited off-street parking available will be subject to market failure<sup>50</sup>. We will support local authorities in scoping their capacity and charging needs. This collaboration will allow us to ensure that grid connection works are optimised to minimise disruption and deliver efficiencies for the benefit of both current and future customers throughout the energy transition.
- Socialising a proportion of connection costs: We will build on the Green Recovery fund approach and our innovative Charge Collective approach by coordinating with local authorities to socialise a big enough proportion of the connection costs to make investments commercially viable. While the change in the connection boundary will socialise any reinforcement costs necessary to connect, evidence from our Charge Collective trial has shown that high sole use costs are still a barrier to investment. We expect the discount applied to total connection costs<sup>51</sup> to be 20% on average, based on the predicted level of non-contestable sole use costs in these areas. This discount and will be determined by key metrics which help us to predict charge point utilisation levels (such as levels of car ownership and early EV adoption). This will ensure greater fairness in the energy transition, levelling the playing field to ensure that no-one is left behind.

<sup>47</sup> 12,000 volume of chargers in UK Power Networks areas as of June 2021

<sup>48</sup> Building a comprehensive and competitive electric vehicle charging sector that works for all drivers, CMA, July 2021

<sup>49</sup> Charge Collective is a pilot project working in partnership with local councils in Cambridge, Norwich and the London Borough of Redbridge to help ensure that no one is left behind in the EV revolution.

<sup>50</sup> This is detailed further in our Public Charging Investment Case in Annexe B

<sup>51</sup> Including the network extension required to connect the charge-points to the main system, the cost of any reinforcement of existing assets needed to accommodate the additional load generated by charge-points and the sole use asset costs for the final point of connection to the network.

The cost for these actions has been included in our business plan under an uncertainty mechanism allowing us an opportunity to work with Government, Ofgem, industry and stakeholders<sup>52</sup> to develop and implement the changes resulting from the Access and Forward-looking Charges Significant Code Review (SCR) ahead of us drawing down investment.

Testing of the appropriate connection boundaries being undertaken by our Charge Collective trial is just one of a variety of factors that will determine the extent of any funding that is necessary for this intervention. The size of our potential revenue exposure, the customer behavioural response, and the degree to which flexibility markets will be able to respond to the changes driven by the SCR decision are other factors.

See Annexe B of this document for the public charging investment case.

**Table 16: Our actions to engage and work with Government, Ofgem and Local Authorities to address market failures**

| <b>Quantified benefits to our customers:</b>   |   |   |   |
|--|---|---|---|
| <b>Quantified benefits to our customers of addressing market failures (present value over 25 years):</b>                       |   |   |   |
| 1) £1.2m Customer Financial benefits – Fuel savings for customers from EV to ICE transition enabled due to on street charging. |   |   |   |
| 2) £10.0m Societal benefits - CO2 reduction benefit from additional uptake of EVs by customers.                                |   |   |   |
| 3) £8.8m Societal benefits - Air quality improvement benefit from additional uptake of EVs by customers.                       |   |   |   |
| <b>Quantified benefits to our customers of addressing public charging market failures (present value over 10 years):</b>       |   |   |   |
| 4) £1.0m Customer Financial benefits – Fuel savings for customers from EV to ICE transition enabled due to on street charging. |   |   |   |
| 5) £7.7m Societal benefits - CO2 reduction benefit from additional uptake of EVs by customers.                                 |   |   |   |
| 6) £7.4m Societal benefits - Air quality improvement benefit from additional uptake of EVs by customers.                       |   |   |   |
| #  | Our planned actions   | What our stakeholders said  | Qualitative benefits to our customers   |
| 1  | Engage 127 regional and local planning authorities and identify 2 of areas where public charging market failures exist. | <p>“Most segments prone to market failure are obvious. The clearest is on-street public residential...yet most cities and towns will require significant provision of this charging to support EV transition”. <b>Net Zero Forum</b></p> <p>There is an increasingly positive attitude towards electric vehicles in the UK, but concerns about the availability of charging infrastructure, cost and range remain barriers to adoption. <b>Key insight I-FNZ3</b></p> <p>Further key insight links: I-FNZ1,I-FNZ4, I-FNZ8, I-FNZ15, and I-FNZ17</p> | <p>1) Identify charge point locations that deliver the greatest benefits to customers immaterial of market failures due to connection cost.</p> <p>2) Minimising civils and disruption from digging once through coordination and planning.</p>   |
| 2  | Run tenders in 2% of total areas, supporting in areas of market failure only.   | <p>Both customers and stakeholders recognise that a lack of on-street charging infrastructure for EV charging is a significant barrier to EV uptake. <b>Key insight I-FNZ4.</b></p> <p>Further key insight links: I-FNZ1, I-FNZ3, I-FNZ2, I-FNZ8, I-FNZ15, and I-FNZ17</p>  | <p>1) Remove the upfront capital hurdle barrier to on-street charge point investment.</p> <p>2) Futureproofing and coordination leading to lower cost network investment, as we will socialise only the necessary proportion of network reinforcement, with the rest funded by the market.</p> <p>3) Criteria will focus in areas that are currently left behind, so high societal benefit in terms of equality of access to charging infrastructure so no one is left behind.</p> <p>4) Minimise the chargepoint network connection and reinforcement costs that are socialised.</p> |

<sup>52</sup> Ofgem has granted us an Energy Regulation Sandbox (reference ERS/004) that has allowed us to trial the partial socialisation of connection costs through the Charge Collective project.

|   |   |           |   |
|---|---|-----------|---|
| 3 | Unlock market to deliver a minimum of 2,400 public chargers across the period | As above. | <ol style="list-style-type: none"> <li>1) Improved on-street charge point visibility leading to increased EV adoption.</li> <li>2) Provide on-street charging options for those without off-street parking to avoid them being left behind.</li> <li>3) Improved air quality in local areas as drivers switch to EVs - Those on lowest incomes have highest exposure to poor air quality. Focusing on areas with poor air quality also targets more disadvantaged customers and has greater positive impact from air quality improvements.</li> </ol> |
|---|---|-----------|---|

***We will run a process to identify and deliver an additional 7-8MW of capacity in areas located near 14 motorway and trunk road service stations, by running a call to market in 2024 and 2025, ensuring a maximum of 30 miles between charging across our regions.***

In 2018, McKinsey reported that a lack of access to charging stations was the most significant barrier to EV purchasing after price and driving range. Since then, recharging concerns have come to the fore as a scarcity of charge points and time taken to recharge are perceived as some of the biggest disadvantages to EVs according to the DfT's Transport and Technology Public Attitudes Tracker report in Nov 2020.

We received a strong and consistent message early in our RIIO-ED2 engagement when customers told us that prioritising the facilitation of EV charge points across the region and focusing on high-speed charging was our most important and ambitious initiative. There was unanimous support at our FNZ EV focus group for a "driving force" approach to en-route charging infrastructure. This view was endorsed by our Next Zero Council whilst the CCC reported that future-proofing investments by over-sizing network infrastructure is a very low-regrets option.

***It is important to have this public infrastructure available for EVs as users are still concerned there are not enough charging points available which delays penetration/uptake. - Net Zero Council***

Local Authorities explained in subsequent engagement that we should consider focusing this capacity related intervention on 'somewhere places' where social and economic growth is planned. A proposed industrial & commercial development on a major road near Luton Airport was given as an example location of future demand growth. By siting charge points at this location and sizing the network capacity when doing so we could reduce the cost of connection and minimise disruption. Our plans to engage with Local Authorities, described under our Whole System Planning section, will deliver the close coordination necessary to avoid, where possible, locating charge points in 'nowhere places' and failing to realise the potential additional benefits of this harmonised approach.

Over 95% percent of people use the Strategic Road Network at least once a year. In their Energy White paper, the UK Government pledged to deliver a total of 2,500 high powered charge points installed across these sites by 2030 which equates to an average of six charge points at every site. Whilst we believe this intervention is complementary to the rapid charging fund, we're conscious there is more work to be done to align the schemes. By offering a regional product that is informed by regional plans we can identify areas where load growth is anticipated and where capacity provision can meet future demand to fill genuine gaps in en-route charging provisions. We see this initiative as complementary to Project Rapid, as it aims to achieve the same objective, but at a regional level on busy trunk roads.

This places a dependency on the electricity networks for the government and transport sector to achieve their EV uptake and decarbonisation targets. Due to the remote nature of these sites and the large power requirement of en-route charging infrastructure the upfront connections costs can be a barrier to investment. The time to connect and the footprint of equipment have also been cited as barriers. Cheaper, faster, and more compact connections solutions are required to support deployment of sufficient en-route charging infrastructure that will build range confidence and give drivers peace of mind to transition to cleaner, greener transport.

During RIIO-ED1, multiple parties across thirteen motorway and trunk road service areas applied to our Green Recovery programme to fund the installation of rapid EV charging infrastructure at their sites. Eleven sites were approved by Ofgem with the remaining two requiring further whole system analysis to determine the lowest cost option between transmission and distribution. The successful projects will provide 366MW of network capacity that will enable an initial installation of 850 rapid chargers and offer sufficient headroom to prime the market beyond this decade. Working collaboratively, we will bring

drivers on motorways and trunk roads across our licence area closer to charge points and offer whole electricity opportunities by providing capacity for demand and generation growth in areas that otherwise had limited capacity.

We have set a target of ensuring that drivers will never be further than 30 miles from a charging location which matches the ambition of government and their rapid charging fund. To achieve this target, we have identified 40 sites on the road network within UK Power Networks' licence areas. Each of these sites sits within a 15-mile radius of another. This approach increases driver's range confidence by minimising their need to deviate from their chosen route to charge and provides resiliency in the event of infrastructure failure or charge point congestion as EV uptake grows.

Our knowledge of connections coupled with the experience gained from our work on Project Rapid and the Green Recovery programme leads us to believe that 26 of the 40 sites identified have sufficient capacity to meet the required charging infrastructure. Or, where capacity is insufficient, they have been earmarked to be suitable for Project Rapid, will have already been served by our Green Recovery programme, or will require whole systems analysis to assess transmission alternatives. The remaining fourteen will require us to efficiently deliver capacity to them in RIIO-ED2 through coordination with government, charge point installers, service area operators and landlords.

To ensure capacity is delivered to these 14 sites before the end of RIIO-ED2 we plan to run two programmes similar in nature to Green Recovery in years two and three of the price control period. In readiness, we have developed a new substation design that fits in a single parking space and is delivered in kit form for rapid deployment. The scalable design allows capacity to be added in 1.5 MW blocks to match growing demand or accommodate multiple charge point operator's onsite, providing flexibility to expand while lowering upfront investment.

We are placing this investment under an uncertainty mechanism whilst we await the outcome of Ofgem's Access and Forward-looking Charging Review that is anticipated in December 2021. Doing so also allows us to coordinate with the Project Rapid scheme as well as Local Authority growth and decarbonisation plans.

For each charging location, we will take the actions set out in the table below (for more detail see Annexe B for the detailed investment case for regional road network charging infrastructure):

**Table 17: Our actions to deliver an additional capacity to our regional road network**

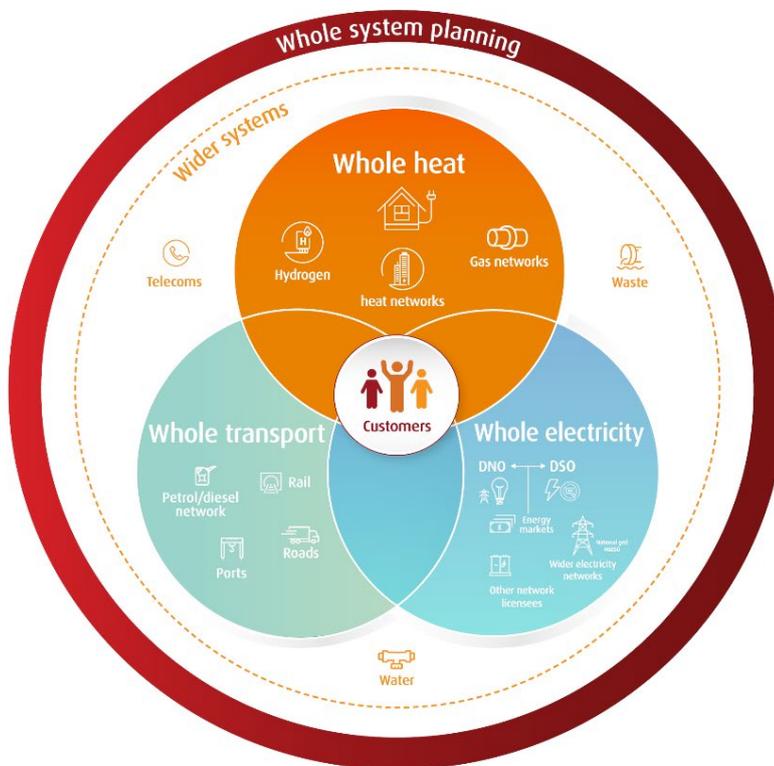
| # | Our planned actions  | What our stakeholders said   | Qualitative benefits to our customers  |
|---|--|--|--|
| 1 | Using our Green Recovery approach, we will run two calls to market rounds in Y2 and Y3, to request applications, and assess and select regional road network sites that provide most value to customers. | Stakeholders think that we should be ambitious in relation to the delivery of en-route charging infrastructure. <b>Key insight I-FNZ14</b><br><br>Further key insight links: I-FNZ1, I-FNZ3, I-FNZ8, I-FNZ15, and I-FNZ17  | <ol style="list-style-type: none"> <li>1) Enable rapid charging on the strategic road network at 14 charging locations in the East / South East of England.</li> <li>2) Improved range confidence leading to greater EV adoption and improved range confidence.</li> <li>3) Improved air quality across our areas as drivers switch to EVs.</li> </ol> |
| 2 | Deliver network capacity/extension programmes of 7-8MW at the closest point of our network to the 14 regional road network sites selected.   | Stakeholders think that we should ensure sufficient network capacity ahead of need, and coordinate network reinforcement so that we only "dig the road once". <b>Key insight I-FNZ15</b><br><br>Further key insight links: I-FNZ1, I-FNZ3, I-FNZ8, I-FNZ14 and I-FNZ17 | <ol style="list-style-type: none"> <li>1) More accessible and cheaper EV charging due to faster and cheaper connections for charge point operators and regional road network customers.</li> </ol>   |
| 3 | Future-proof all the above regional road network connections by laying 33kV cables to 11kV supplies.   | As above.<br><br>"Cables should be as big as possible as most of the cost is digging up the roads. Need a strategic approach to network investment instead of an incremental approach. Optimise across a longer time period but not 5 years" – <b>Net Zero Council</b> | <ol style="list-style-type: none"> <li>1) Cost and disruption reduced by ensuring investment is future proofed to facilitate more charge points as demand increases.</li> <li>2) Reduction of cost of connection for distributed generation and demand growth within locality of our regional road network.</li> </ol>                                 |

## Whole Heat

The table below states the objectives and the strategic challenges and solutions for Whole Heat.

| Objective  |   |
|--|---|
| Delivering whole systems decarbonisation solutions in the heat sector in order to facilitate Net Zero at lowest cost to customers.   |   |
| Strategic challenges   | Our proposed solutions  |
| <ul style="list-style-type: none"> <li>Dealing with the uncertainty of the appropriate pathways for the decarbonisation of on-gas grid customers: electrification, clean gas/hydrogen, or hybrid</li> <li>Network capacity and capability to manage the uptake of heat pumps as the technology of choice</li> <li>Addressing the poor thermal efficiency of our housing stock</li> <li>Overcoming the barriers of lack of consumer awareness about the implications of heat decarbonisation</li> <li>Supporting a just transition for our customers, particularly for those in vulnerable circumstances</li> </ul> | <ul style="list-style-type: none"> <li>Build evidence to inform the local authority decarbonisation plans for the uptake of energy efficiency measures, particularly to support those in vulnerable circumstances</li> <li>By the end of RIIO-ED2, make 71% of the homes in off-gas grid communities ready for electrification of heat and transport</li> <li>Coordinate the delivery of energy efficiency measures ahead of off-gas grid transition programmes</li> <li>Using a 'one touch' approach, deliver service upgrades that will support <i>both</i> EVs and heat pumps when consumers request any LCT connection</li> <li>Provide general LCT guidance to all connecting customers and enhanced support to customers in vulnerable circumstances</li> </ul> |

Figure 14: Key whole systems interactions relating to the decarbonisation of heat transport



We anticipate that key whole systems developments relating to the decarbonisation of heat over the RIIO-ED2 period and beyond will include:

- Heating for off-gas grid customers, currently provided by oil or solid fuels, will be largely replaced by electric heat pumps.
- For the majority of consumers with natural gas fired heating, this will be replaced by either electric heat pumps in homes or as a heat network, hybrid heat pumps, or hydrogen fired heating boilers requiring green hydrogen production and a hydrogen delivery network to be established – the specific pathway will require national policy guidance.
- Depending on the chosen pathway, the volume through the natural gas network will either be massively reduced leaving only e.g., industrial (chemical) end uses or totally substituted if it is repurposed to deliver hydrogen.
- In conjunction with either heat decarbonisation pathway, significant improvements to the thermal efficiency of the housing stock is required.

At the highest level, decarbonisation of heat is a whole systems challenge for the transition to Net Zero. Heating provided by natural gas will be substituted largely by either (low carbon) electric heat pumps or green hydrogen heating – depending on the decarbonisation pathway selected locally and nationally. This was further signalled in the recent UK Hydrogen Strategy<sup>53</sup> - published 17 August 2020 where BEIS confirms limited ambition and continuing uncertainty in respect of hydrogen for heat with forecasts of a maximum 45 TWh by 2035 and 0-210 TWh by 2050 out of total UK heat of 760 TWh. The pathway for off-gas grid customers is more certain: oil / solid fuel heating substituted by low carbon electric heat pumps. National guidance is required on the pathway as a decision is required on whether to repurpose the national natural gas network to deliver hydrogen. This transition profoundly impacts several systems including electricity, natural gas, emerging hydrogen, and heating oil / solid fuel supply. The housing stock 'system' will also be impacted to improve thermal efficiency and so reduce the carbon footprint of heating.

The Whole Heat strategy, described in the rest of this section, focusses on the proactive steps we are taking to overcome barriers in order to deliver this decarbonisation of heat.

### Background

Heat is the single biggest source of greenhouse gas emissions in the UK<sup>54</sup>, with over 85%<sup>55</sup> of the population currently relying on natural gas to meet their heating requirements and a further four million off-gas grid consumers burn oil or solid fuels to maintain their comfort. Considering the environmental impact of this sector, decarbonising heat will be key to achieving Net Zero targets of 2050.

With policy still under development, and research continuing to explore alternative energy sources such as hydrogen, there is significant uncertainty in the future direction and pathways for the decarbonisation of heat. Due to heat being a nascent market, compounded by high uncertainty in pathways, some of the key stakeholders in the sector have been unable to commit resources for targeted decarbonisation focussed activities. For instance, manufacturers have set modest targets for heat pump production and sales, installers have not upskilled their workforce to commission low carbon heating technology and thermal efficiency measures at scale, and local authorities with ambitious climate targets and emergencies have not been able to mobilise resources. As a result, consumers have either remained largely uninformed and unaware of the carbon footprint of their current heating systems or felt unsupported in understanding the available options, process and the impact of the low carbon transition on their pockets and lifestyles.

However, there is increasing evidence that electrification of heat has the potential to deliver significant reductions in carbon emissions and serves as the least regret option while other potential heat sources navigate through the feasibility challenge. Our DFES Consumer Transformation scenario forecasts the uptake of 712,000 heat pumps across our regions by the end of this decade, in comparison to approximately 27,000 heat pumps installed over the last decade. Though the progress against the target trajectory has been slower to date, an accelerated and coordinated effort is now required to get back on track. These efforts will need to be supported by government policy to facilitate the uptake of low carbon technology, grants, and green funding, increased public awareness, innovative technological and deployment solutions, and a whole system view to minimise disruption and cost for consumers.

As such, positive trends have been emerging on the policy front. The government, through the consultations on Future Homes Standard<sup>56</sup> and Clean Heat Grant<sup>57</sup>, has signalled to ban fossil fuel heating in new builds from 2025, and release grants to replace fossil fuel heating with low carbon heating solutions and to improve energy efficiency of homes. The Prime Minister's Ten Point Plan for a Green Industrial Revolution<sup>58</sup> and the UK's new ambitious targets that aim for at least 78%

<sup>53</sup> <https://www.gov.uk/government/publications/uk-hydrogen-strategy>

<sup>54</sup> [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/766109/decarbonising-heating.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/766109/decarbonising-heating.pdf)

<sup>55</sup> <https://www.energynetworks.org/assets/files/news/publications/GAS%20FAST%20FACT%20CARDS%20-%20ALL.pdf>

<sup>56</sup> <https://www.gov.uk/government/consultations/the-future-homes-standard-changes-to-part-l-and-part-f-of-the-building-regulations-for-new-dwellings>

<sup>57</sup> <https://www.gov.uk/government/consultations/clean-heat-grant-further-policy-design-proposals>

<sup>58</sup> <https://www.gov.uk/government/news/pm-outlines-his-ten-point-plan-for-a-green-industrial-revolution-for-250000-jobs>

reduction in greenhouse gas emissions by 2035 compared to 1990 levels<sup>59</sup> have further catalysed the drive to achieve Net Zero. Through the £12 billion Ten Point Plan, the government has committed to invest in numerous sectors including low carbon heating, which has been identified as the area that needs to be fast-tracked through an improvement of thermal efficiency of the UK building stock and the installation of 600,000 heat pumps a year by 2028.

These announcements coming before the beginning of RIIO-ED2 provided us an opportunity to co-develop sector-specific options with our customers and stakeholders aligned with this policy direction. One of the consistent key findings of this extensive engagement suggests that customers view environment as a high and growing priority, but within the context of economic concerns i.e., a desire to keep bills low. As such, they want us to act now particularly in areas where there is a relatively high confidence to ensure that the impact on customer bills is not disproportionate to environmental benefits.

Additionally, there is an increasing support and evidence from key stakeholders across the industry for networks to take action to ensure readiness for the Net Zero transition. External research, such as those led by Energy Systems Catapult<sup>60</sup>, Citizens Advice<sup>61</sup>, and Committee on Climate Change<sup>62</sup>, also confirms customer priorities identified by our engagement, as well as barriers that need to be overcome to accelerate heat decarbonisation.

We therefore believe that the RIIO-ED2 period spans a critical time in the transition to Net Zero. It is critically important for us to ensure that our network is not just ready to accommodate these LCTs, but able to actively facilitate greater uptake to achieve society’s Net Zero ambitions. Most importantly, we will need to consider a Whole System Planning approach to ensure coordination with all energy and utility vectors, and central and local governments to coordinate the delivery of a cost efficient and least disruptive transition. There is an opportunity for significant improvement in coordination and planning between Gas Distribution and Electricity Distribution networks over RIIO2.

Our engagement and research tell us that one size does not fit all for our customers. Recognising the specific needs of our customers across the heat sector, in collaboration with our stakeholders we have developed six main customer segments. We then conducted detailed modelling to understand the proportion of each segment as at the end of RIIO-ED2. This enabled us to engage with the relevant stakeholders to understand their specific needs, priorities, and challenges.

Figure 15 provides an introduction to the heat customer segments which helps determine our role in unlocking barriers.

Figure 15: Heat Customer Segments



<sup>59</sup> <https://www.gov.uk/government/news/uk-sets-ambitious-new-climate-target-ahead-of-un-summit>

<sup>60</sup> <https://es.catapult.org.uk/reports/net-zero-a-consumer-perspective/>

<sup>61</sup> [https://www.citizensadvice.org.uk/Global/CitizensAdvice/Energy/Energy%20Consultation%20responses/Zero%20sum%20\(2\).pdf](https://www.citizensadvice.org.uk/Global/CitizensAdvice/Energy/Energy%20Consultation%20responses/Zero%20sum%20(2).pdf)

<sup>62</sup> <https://www.theccc.org.uk/wp-content/uploads/2019/05/20200418-CCC-Accelerated-Electrification-final-report.pdf>

### Our role in unlocking our customers' barriers

To ascertain an effective Net Zero transition, we engaged with customers and stakeholders to understand the barriers they are facing that we can break down if we invest correctly in RIIO-ED2:

1. **Information and Education:** Broadly, customers lack the awareness of the impact of heating emissions, what it takes to transition, and the cost of low-carbon heating. *Key insight I-FNZ12*
2. **Energy Efficiency:** There is a need for energy efficiency measures in parallel with electrifying heat. *Key insight I-FNZ10*
3. **Availability of network capacity:** We need to ensure there is sufficient network capacity to decarbonise heating. Ensuring there is sufficient network capacity to transition off-gas grid customers in rural areas. *Key insights I-FNZ15 and I-FNZ18*
4. **Uncertainty:** The decarbonisation pathways and technologies for on gas grid customers are uncertain.
5. **Leave no one behind:** Upfront and operational costs of technology are a barrier to the Net Zero transition today. *Key insight I-FNZ2*
6. **Heat Pump Ready:** Our customers don't know if their homes supply is ready for electric heating. *Key insight: I-FNZ5*

Our customers' lack of awareness / knowledge and concerns about the difficulty and expense of installing low carbon heating solutions remain significant barriers to adoption. In our deep engagements through Heat Focus group and Net Zero webinar, stakeholders said we should participate in national campaigns to educate people and raise general awareness of the technology, especially on electrification of heat. Participants encouraged us take up a collaborative approach with communities, private and public sectors in local area energy planning. Particular emphasis was laid on coordinating with local councils and housing associations to deliver low carbon heat and energy efficiency for those most at risk. Consequently, we need to play a central, collaborative, role in raising awareness and educating customers about heat decarbonisation, ensuring that their homes are ready, and coordinating energy efficiency and financial support, in particular, for those that may be in vulnerable circumstances.

In our engagements, stakeholders told us to invest ahead of need in areas of high uptake confidence by approaching it with a 'touch the network once' approach. We have engaged with gas networks, local authorities, and other relevant stakeholders, with a whole systems lens, to validate our forecasts and confidence levels for the electrification of regions we serve. As an example, we are continuing to work with regional Hydrogen groups such as Hydrogen East and Hydrogen Sussex to explore the potential use of other green fuels in the energy mix to decarbonise certain regions at the lowest possible cost.

There are other areas where a mix of green fuels is not a cost-effective option, mainly due to the cost of setting up and building new infrastructure over long distances; this include customers who are currently not connected to the gas grid.

Therefore, we have specifically focussed on our off-gas grid customers using oil or solid fuel for heating; this segment is primarily in rural locations and represents 341,000 homes across our networks. There is a high degree of confidence that electrification will be the pathway for the majority of these customers as there are limited feasible alternative decarbonisation pathways. We are proposing a strategic investment to ensure that their journey to electrified heat is supported.

Broadly, our customers have a clear expectation that we should support the development of low carbon heating. This is evidenced by our engagement in Phase 4 (Willingness to Pay), where customers have positively responded to our proactive actions to increase awareness and supporting off-gas grid communities to transition to electric heating. Table 18 provides an overview of the role we expect to play to support the transition for each of our heat customer segments.

Table 18: Our role in facilitating whole heat

| Segment      | Stakeholders said:  | Our Role  |
|--------------|---|---|
| Off-gas grid | Customers have a clear expectation that UK Power Networks should support the development of low carbon heating. However, views are mixed on how proactive UK Power Networks should be. Whilst our engagement urged us to tread cautiously when implementing shifts to electric heating ahead of government policy, our BOT engagement supported proactive action by UK Power Networks to increase awareness and support households (including off-gas grid customers) to switch to electric heating. <b>Key insight I-FNZ18</b> | Off-gas grid heating is a segment of high confidence due to the lack of alternative decarbonisation pathways. In this customer segment our role is: <ul style="list-style-type: none"> <li>To support households to switch to electric heating (e.g., heat pumps) by coordinating network capacity release programmes focussed on off-gas grid communities.</li> <li>To provide free power upgrades when customer households actively request it (e.g., new fuses and cables).</li> <li>To provide the information our customers need to bridge the “knowledge gap” and understand what they need to do to transition to electric heating, how they can make their homes more energy efficient, and the potential costs.</li> <li>To coordinate wider social support with local authorities and community energy groups to support consumers in vulnerable circumstances during the transition to ensure no one is left behind. Where appropriate, we will coordinate energy efficiency and financial support.</li> <li>To take a whole systems approach, working in collaboration with relevant gas networks, to ensure that electrification for each of these communities is the optimal decarbonisation pathway.</li> <li>To develop products and services to support our customers in the event of an outage (e.g., proactive notifications).</li> <li>To streamline and simplify the connections process.</li> </ul> |
| On-Grid Gas  | A lack of awareness / knowledge and concerns about the difficulty and expense of installing low carbon heating solutions remain significant barriers to their adoption. For developers, a lack of electricity capacity is an additional concern. <b>Key insight I-FNZ5.</b>   | In areas where there is less certainty of heat electrification, such as on-gas our role is to: <ul style="list-style-type: none"> <li>Provide information, support, and guidance on Heat electrification</li> <li>Provide free power upgrades when customer households actively request it (e.g., new fuses and cables)</li> <li>To ensure no customers are left behind, coordinate wider social support with local authorities and community energy groups support to provide energy efficiency and financial support for customers in vulnerable circumstances</li> <li>Coordinate with local authorities and key stakeholders to identify least regret pathways, and support the development of local area energy plans for the decarbonisation of heat</li> <li>Develop products and services to support our customers in the event of an outage (e.g., pro-active notifications)</li> <li>Streamline and simplify the connections process.</li> </ul>  |
| I&C          | “Everyone needs heating in the UK. So therefore, it affects everyone, and you are likely to have better buy in. And hopefully this could lead to some savings at some point if they are more efficient”. <b>Business, SPN, 50-249 employees.</b>  | Our role will be to support our I&C customers to transition to electric heating. We will: <ul style="list-style-type: none"> <li>Provide information, support and guidance on Heat electrification and energy efficiency</li> <li>Develop new innovative connection products and tools to drive down cost to connect and provide alternative connection options that may be more cost-effective (for example, identifying opportunities to reduce waste heat).</li> <li>Streamline and simplify the connections process</li> <li>Provide information to help our customers to understand how they can engage with flexibility markets and the potential value</li> <li>Develop products and services to support our customers in the event of an outage (e.g., proactive notifications)</li> <li>We recognise that within the Industrial &amp; Commercial segment, SMEs may have very different requirements to large multi-nationals.</li> </ul>   |

|                                 |   |   |
|---------------------------------|---|---|
|                                 |   | We will tailor our products, information, and markets accordingly. Additionally, SME single phase customers will receive free service upgrades up to 100A.  |
| District Heating and New Builds | Customers have a clear expectation that UK Power Networks should support the development of low carbon heating. However, views are mixed on how proactive UK Power Networks should be. Whilst our engagement urged us to tread cautiously when implementing shifts to electric heating ahead of government policy, our BOT engagement supported proactive action by UK Power Networks to increase awareness and support households (including off-gas grid customers) to switch to electric heating. <b>Key insight I-FNZ18</b> | For customers that operate and invest in district heating and new builds our role is to: <ul style="list-style-type: none"> <li>• Provide information, support, and guidance to developers on heat electrification and energy efficiency</li> <li>• Provide access to our network information and requirements to inform district heating and new build investment decisions</li> <li>• Develop new innovative connection products and tools to drive down cost to connect and provide alternative connection options that may be more cost-effective</li> <li>• Streamline and simplify the connections process</li> <li>• Provide information to help our customers to understand how they can engage with flexibility markets and the potential value.</li> <li>• Develop products and services to support our customers in the event of an outage (e.g., proactive notifications).</li> </ul> |

### Our RIIO-ED2 Whole Heat interventions

It is evident from the summary in Table 18 that decarbonisation of heat requires a coordinated Whole System approach with vertical and horizontal vectors of the energy, wider utility, supply chain, and central and local government sectors fully aligned to ensure a just and cost-effective transition for all customers. As such, we have identified two key priorities to facilitate our Whole Heat action plan in RIIO-ED2.

The actions delivering these priorities are not exclusively applicable to Heat. From a DNO perspective, all LCTs, including EVs and electric heat, are loads with similar attributes that require similar actions for connection to the electricity network. Therefore, some of the activities in this section may also facilitate the uptake of other LCTs as a secondary benefit, which encapsulates the true essence of undertaking a Whole System approach.

By 2028 we will proactively provide LCT and energy efficiency information to 1.4m of our customers located within zones earmarked for electrified heating.

We will ensure that 71% of off-gas grid homes in our regions have the suitable capacity to decarbonise their heating and transport by the end of RIIO-ED2.

### ***By 2028 we will proactively provide LCT and energy efficiency information to 1.4m of our customers located within zones earmarked for electrified heating***

Heat is intimate for consumers as they rely on it for their comfort, and every individual consumer has a different requirement to another. This difference is not just based on personal preferences and locational variations but is also driven by the thermal efficiency or insulation of every home or building. The UK is known to have the worst building stock in Europe for thermal insulation<sup>63</sup>, which directly affects energy consumption and costs, triggering the need for network reinforcement and resulting in higher bills for customers. These dimensions have a significant impact on those in fuel poverty and vulnerable circumstances, making it unlikely for these customers to switch to low carbon heating without any additional support. We recognise this as a key barrier for the decarbonisation and electrification of heat.

A critical element of our strategy is ensuring that no one is left behind in the energy transition, particularly those in vulnerable circumstances and fuel poverty. While it may not be our traditional role to deliver energy efficiency measures directly, we

<sup>63</sup> <https://www.regen.co.uk/wp-content/uploads/Regen-Heat-Paper-WEB2-Single-Page.pdf>

commit to undertaking an industry coordination role for the provision of relevant energy efficiency information to our customers to support the reduction of energy bills and demand. We will be proactive in our approach to coordination but recognise that customers may also seek energy efficiency advice directly from us. Therefore, we will make it clear that our General Enquiries team can provide help and advice both online or via phone and signpost to this service on all relevant customer touchpoints.

From our engagement, we understand that our stakeholders have a clear view: UK Power Networks has a definite role to play in the transition to electric heating and provision of energy efficiency measures but perhaps as a coordinator rather than a leader. Our stakeholders proposed that UK Power Networks should work with organisations to support those in fuel poverty or vulnerable circumstances (see our consumer vulnerability strategy). For example, working with local councils and housing associations to deliver low carbon advice, in particular heat and energy efficiency to those most at risk or in vulnerable circumstances. Our engagement saw very strong support for DNOs to take a collaborative/coordination role with energy efficiency. At the launch of our Heat Street project with the Association for Decentralised Energy (ADE), 80% of consumers at the event agreed with this perspective.

*“UK Power Networks must work with local councils and housing associations to deliver low carbon and particularly heat and energy efficiency to those most at risk”. **Net Zero Webinar, Heat breakout room.***

*“UK Power Networks has a role in supporting organisations to do good fuel poverty work. Service providers should provide solutions - networks should coordinate, provide information, but not do stuff in the household”. **Heat Focus Group.***

We have also drawn upon external research to develop a deep understanding of the impact of transition to electric heating for those in vulnerable circumstances. We understand that people who rely on electricity for heating are more likely to be in fuel poverty as evidenced by the SEN Looking beyond heat pumps project<sup>64</sup> and Ofgem<sup>65</sup>. Disparity in fuel costs for gas and electricity, due to levies based on traditional carbon intensity of the grid, is another factor that makes the heat pumps (despite a superior efficiency ~300%) less attractive and more expensive. This is particularly true for homes with poor energy efficiency, and therefore carries a risk of sliding more consumers into fuel poverty<sup>66</sup>.

As such, our Whole Heat approach encompasses coordination with gas networks, local authorities, trusted community partners and the wider supply chain to mitigate any unintended consequences of the decarbonisation of heat. We will build on our work from RIIO-ED1 collaborating with key stakeholders including local authorities, trade associations and gas networks to develop and define frameworks to facilitate the decarbonisation of heat and energy efficiency uptake measures.

We worked with The Association for Decentralised Energy (ADE) to develop our Heat Street project<sup>67</sup> that identified the most suitable energy efficiency measures & electric heating solutions for different localised ‘zones’. The data generated by the project (as shown in Figure 16) enabled over 60 local authorities to focus resources on those vulnerable circumstances, for example, Hammersmith & Fulham council used it to target their Green Homes Grant support to over 2000 residents. We also worked with Wales & West Utilities on HyCompact project<sup>68</sup>, where we engaged with 1,000 customers from a variety of socio-economic demographics to explore their attitudes and barrier to the uptake of low carbon hybrid heating solutions; almost 60% of respondents indicated little to no understanding of heat pumps and even fewer understood other low carbon technologies.

#### **Sidebar: Identifying pathways for the uptake of energy efficiency and low carbon heating – Heat Street**

Heat Street is a first of its kind research project to help communities map out their Net Zero carbon future at street level. The project took a data-driven and stakeholder informed view into the future to support local authorities and community energy groups forecast and plan for future deployment of energy efficiency and low carbon heating solutions in localised zones.

The project, supported by the Association of Decentralised Energy’s policy paper on Zoning, was developed in direct response to the uncertainty in pathways for the decarbonisation of heat and uptake of energy efficiency. We conducted socio-economic and technical analysis, supported by stakeholder engagement, to explore granular options for decarbonisation of heat and the likely impact on consumers, local authorities, policy makers and energy networks. We have delivered geospatial maps and granular data to help our stakeholders, mainly local authorities, understand where and how they can best target the uptake of energy efficiency and low carbon heating particularly for those in

<sup>64</sup>[https://www.smarternetworks.org/project/nia\\_ssen\\_0039/documents](https://www.smarternetworks.org/project/nia_ssen_0039/documents)

<sup>65</sup>[https://www.ofgem.gov.uk/sites/default/files/docs/insights\\_paper\\_on\\_households\\_with\\_electric\\_and\\_other\\_non-gas\\_heating\\_1.pdf](https://www.ofgem.gov.uk/sites/default/files/docs/insights_paper_on_households_with_electric_and_other_non-gas_heating_1.pdf)

<sup>66</sup> <https://www.sustainabilityfirst.org.uk/other-publications/what-is-fair>

<sup>67</sup> <https://innovation.ukpowernetworks.co.uk/projects/heat-street-local-system-planning/>

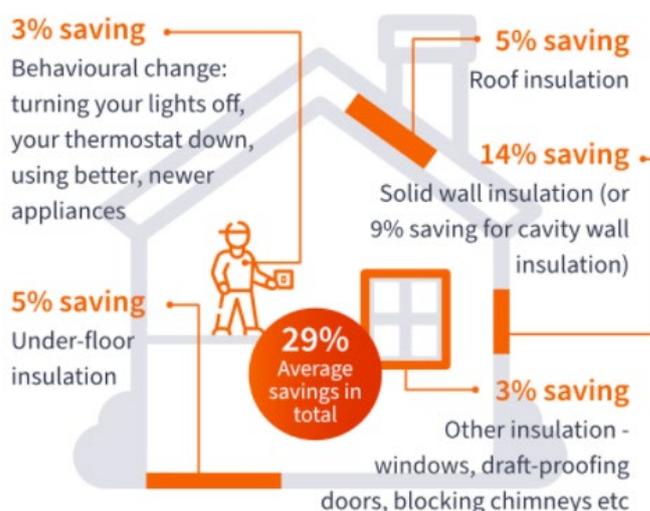
<sup>68</sup> <https://innovation.ukpowernetworks.co.uk/projects/hycompact/>

Based on these actions and learnings, we are committing to the proactive provision of energy efficiency information to all our gas-connected customers located within zones earmarked to electrify as per our Heat Street project analysis. This excludes off-gas grid areas and heat network zones that are expected to predominantly serve the new build stock; the advisory and information provision service for customers in off-gas grid areas is covered by our other commitment within the Whole Heat section, while policy and regulations have encouraged improved thermal efficiency in new builds by default.

To ascertain an efficient and measurable delivery of this commitment, we used our Heat Street project granular forecasts to identify electric and hybrid heat pump dominant (>50%) zones. The data confirmed that approximately 1,938 out of a possible 10,657 LSOAs (Local Super Output Areas) are predominantly earmarked for the uptake of electric or hybrid heat pumps. Considering that our service to off-gas grid zones is covered by the other commitment, all off-gas grid LSOAs were taken out of the equation leaving behind a total of 1.4m customers who will be proactively reached for the provision of energy efficiency information within RIIO-ED2.

Though the commitment is based on accurate forecasts as of today, we acknowledge that the make-up of these zones may change as policy pathways continue to develop and mature; however, the impact of such a change in forecast is negligible on our commitment. We believe energy efficiency is key to the reduction of energy consumption and consumer bills regardless of the energy source. As such, this initiative delivers value for the whole energy system by reducing energy requirements across the value chain from production/generation to customer meters.

Figure 16: Heat Street results demonstrating potential savings through energy efficiency



Building upon such insights, in RIIO-ED2 we want to continue supporting our customers by providing relevant LCT information and playing a greater role in coordinating support for customers in vulnerable circumstances during the transition to electric heating. This would include a wide range of 'value added services' tailored to the needs of customers including income maximisation, energy efficiency advice and befriending (further information can be found in our vulnerability strategy). This will help our customers to decarbonise their heating as well as providing valuable opportunities to reduce heat operating costs and reduce load on the network.

Consequently, in RIIO-ED2 we are planning two actions to complement our ambition:

Table 19: Our actions to provide relevant LCT information and play a greater coordinating role in energy efficiency

| Quantified benefits to our customers:  |
|--|
| <p><b>Quantified benefits to our customers of energy efficiency advice (present value over 5 years):</b></p> <ol style="list-style-type: none"> <li>1) £949k Societal benefits - CO2 reduction benefit through the uptake of energy efficiency measures</li> <li>2) £4.8m Customer financial benefits – Bill savings for the customer by implementing energy efficiency measures</li> <li>3) £1.7m Customer financial benefits – Bill savings for the customer by changing their behaviour due to energy efficiency advice provided</li> </ol> |

| <b>Conclusions from our research:</b>  |  |   |   |
|--|--|---|---|
| 4) Average heat operating costs reduction for all customers by 7% through the uptake of energy efficiency  |  |   |   |
| 5) Carbon emission reduction of 1.25 million tonnes per year for all customers adopting energy efficiency measures.                                      |  |   |   |
| 6) Energy efficiency upgrades will also help reduce the share of households in fuel poverty paying over £1500 for heating bills per annum from 17% to 9% |  |   |   |
| #  | Our planned actions  | What our stakeholders said  | How this benefits our customers   |
| 1  | Proactively provide energy efficiency information to 1.4m on-gas grid customers located within zones predominantly earmarked to electrify (as per Heat Street innovation project analysis)   | <p>“DNOs should proactively identify these customers and support partners who are better equipped to deliver those measures” <b>Heat Focus Group.</b></p> <p>Stakeholders think that we should play a coordination role in the roll out of energy efficiency measures. <b>Key insight I-FNZ10</b></p> <p>Further key insight links: I-FNZ12, I-FNZ1, I-FNZ2, I-FNZ7, I-FNZ8 and I-FNZ12</p> | <ol style="list-style-type: none"> <li>1) Reduce the impact of heat load on the network</li> <li>2) Reduced heat operating costs for customers</li> <li>3) Carbon emissions reduction</li> <li>4) Improve wellbeing and health of customers by ensuring homes are kept warm</li> </ol>  |
| 2  | Ensuring we leave no one in these communities behind, by using funds from the UK Power Networks Foundation, where necessary to proactively support vulnerable customers in the transition (as explained in our Vulnerability Strategy) | <p>Both customers and stakeholders are concerned that the transition to Net Zero could leave some customers behind with stakeholders stressing our responsibility (joint with other stakeholders) to protect and support such customers. <b>Key insight I-FNZ2.</b></p> <p>Further key insight links: I-FNZ1, I-FNZ7, I-FNZ8, I-FNZ10 and I-FNZ12</p>                                       | <ol style="list-style-type: none"> <li>1) Reduce the impact of heat load on the network</li> <li>2) Reduced heat operating costs for customers</li> <li>3) Carbon emissions reduction</li> <li>4) Closing the fuel poverty gap</li> <li>5) Improve wellbeing and health of customers by ensuring homes are kept warm</li> </ol> |

***We will ensure that 71% of off-gas grid homes in our regions have the suitable capacity to decarbonise their heating and transport by the end of RIIO-ED2.***

Within our distribution network areas there are specific communities, such as off-gas grid customers, where we have a high degree of confidence over the decarbonisation pathway due to the lack of alternatives. Across our regions we have identified 341,000 customers as those being off-gas grid, defined as not connected to mains gas and burn oil or solid fuel for their heating. To accelerate the drive to Net Zero, sufficient capacity must exist or be created in the network to support the uptake of heat pumps and other potential LCTs, such as EVs, for these customers who we anticipate will be early adopters of heat pumps.

The CCC “Further Ambition” scenario highlights these customers as potential early adopters of heat pumps in the 2020s. To support these customers, we are committing to deliver a coordinated network capacity release programme that will make 71% of the homes in off-gas grid communities ready for electrification to transition off fossil fuel heating. We will take a whole systems approach and do this in collaboration with the relevant gas networks, to ensure that electrification for each of these communities is the optimal decarbonisation pathway.

Customers have a clear expectation that we should support the development of low carbon heating. 95% of stakeholders at our Local Authorities Forum identified off-gas grid customers and new builds as the most likely early adopters of low carbon heating. This is further evidenced by our Business Options Testing (BOT) engagement that promoted proactive action by UK Power Networks to increase awareness and support households to switch to electric heating. In particular, our stakeholders see off-gas grid properties as one of the key adopters of electric heat over the 2020s due to the lack of alternative decarbonisation pathways.

***“UK Power Networks should be able to clearly identify areas of homes with off-street parking and heat pump capacity. These should be proactively upgraded”. EV Focus Group Participant.***

Our decision to strategically invest in off-gas grid areas has not been made in isolation. Through our Whole Heat approach, we engaged extensively with gas distribution networks (GDNs) and specifically worked with SGN and Cadent to develop a cohesive, consistent, and scalable framework to determine the least disruptive and most cost-effective energy pathway to decarbonise off-gas grid communities. Our aim was to take an inclusive whole systems approach in the best interest of the customers to produce a scalable blueprint to determine the most feasible pathway for different sized off-gas grid communities across our regions. The framework, developed by independent consultants, was based on ENA's Whole Systems cost benefit analysis (CBA) tool, and supported by inputs and assumptions agreed by all parties. The outcome of this exercise validated that electrification is the most cost-effective pathway for vast majority of off-gas grid customers. This is due to the distance from the gas grid and the investment required to extend the network, which results in an unfavourable cost benefit analysis (CBA) for customers. Details of this framework can be found in the relevant Engineering Justification Paper; [ED2-EJP-NP-102](#).

However, we did not stop there, we reached out to our partner Mobile Network Operators to understand if there were opportunities to collaborate on capacity and comms infrastructure as it has been well documented these same rural communities suffer from slow internet access or no access at all. This is where we learned about Ofcom's Shared Rural Network<sup>69</sup> (SRN) programme where the UK's four mobile network operators (MNOs) – EE, O2, Three and Vodafone will:

- Provide coverage to an additional 280,000 premises and for people in cars on an additional 16,000km of the UK's roads.
- Improve geographic coverage to 79% of Areas of Natural Beauty, up from 51%, and 74% of National Parks from 41%, benefitting millions of visitors every year.

By upgrading their existing networks and working together on shared infrastructure and new sites, the MNOs and Government will transform mobile coverage in rural areas. Individually, each operator will reach 90% geographic coverage, which will result in 84% of the UK having 4G coverage from all four operators, increasing choice and boosting productivity in rural areas.

The SRN is a sustainable approach to the challenge of delivering rural mobile coverage. The programme will transform 4G coverage without duplicating infrastructure, minimising the impact on the countryside.

Additionally, we have engaged with Openreach to understand any programmes they have in these off-gas grid areas and became aware of their plans to boost rural FTTP (Fibre to the premises) broadband to 6.2m<sup>70</sup> rural premises by 2026 facilitated by the BT Group announcing investment of £15bn in order to cover 25 million premises by December 2026. This target equates to connecting over 75,000 premises a week. This all-forms part of the governments 'Project Gigabit' which is a national mission to deliver lightning-fast, reliable broadband for everyone in the UK, achieving 80% by 2026.

We shared data sets on our planned interventions under this commitment with the SRN and Openreach teams, who then layered their plans across the same communities to understand possible synergies in our programmes. We will develop plans where possible over RIIO-ED2 to deliver the lowest impact and the greatest value to our rural communities through shared engagement programmes and reducing disruption by co-ordinating any shared excavation works.

The CCC, in their Technical Net Zero report, have also advised that future-proofing investments by oversizing network infrastructure is a 'very low-regrets' option<sup>71</sup>. This is consistent with our cost benefit analysis and engagement feedback. Therefore, we believe that such a strategic investment ahead of need to ready our network across many of our off-gas grid communities means that we are best positioned to facilitate a Net Zero future for our customers.

***"You need to assess the impact of not providing infrastructure ahead of time. What are the costs to society if we don't do the right thing in time"- Net Zero Council Advisor***

As most of off-gas grid communities are mainly located in rural areas supplied by radial electricity networks, with a relatively higher presence of single-phase feeders and pole mounted transformers (PMTs), reinforcement will be required in the first instance. This will include the upgrades to three phase supply and bigger sized transformers for LV networks, and upstream reinforcement required for HV sites. Flexibility services are not a practical alternative in these areas during the initial stages of the transition.

Our 'ahead of need' capacity release programme aims to deliver 71% of 341,000 off-gas grid homes (242,000 homes) the capacity to decarbonise their heating and transport by the end of RIIO-ED2, using the 'touch the network once' approach to

<sup>69</sup> Home - Shared Rural Network ([srn.org.uk](http://srn.org.uk))

<sup>70</sup> BT Raises FTTP Broadband Target to 25 Million UK Premises - ISPreview UK

<sup>71</sup> <https://www.theccc.org.uk/wp-content/uploads/2019/05/Net-Zero-Technical-report-CCC.pdf>

ensure that we deliver maximum customer and environmental benefits within the scope of Whole Heat. This means sufficient network capacity will be made available for all these homes to become early adopters of LCTs, by installing heat pumps and EV charge points for their new vehicles, without triggering the need for any future reinforcement.

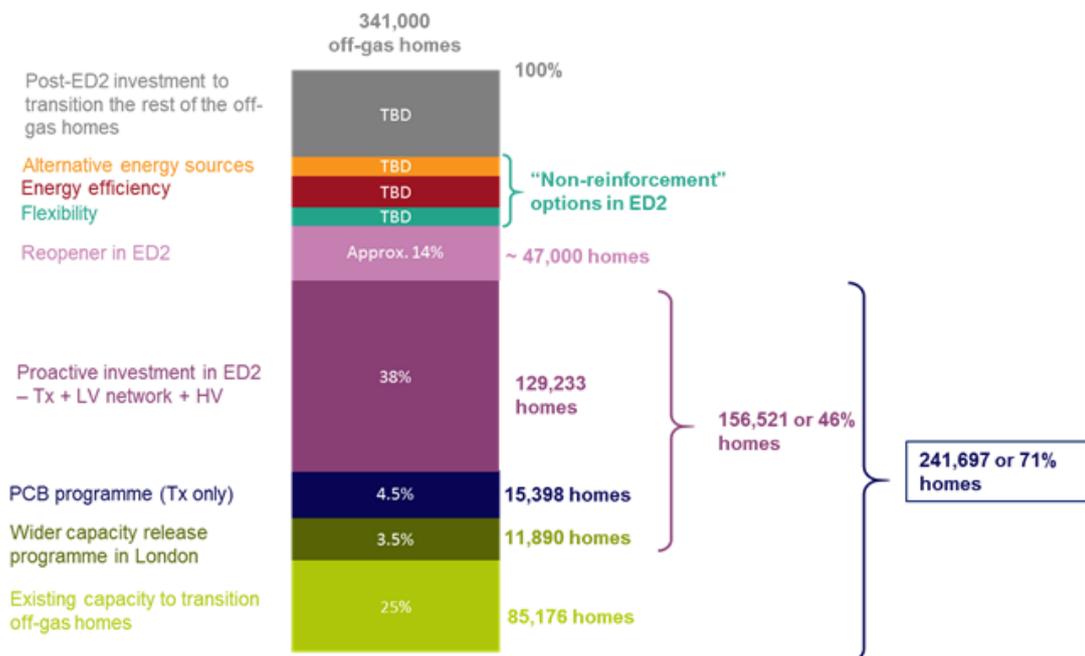
A proactive and coordinated approach will deliver best value for these communities, over a typical piece-meal process, by introducing efficiency in the delivery of work, minimising disruption and delivering carbon reduction benefits by avoiding delays in the uptake of LCTs, whilst managing the deliverability of capacity for decarbonising heat out to 2050. To ensure best value for transitioning customers, we intend to go beyond organisational and traditional sectoral boundaries to optimise the delivery of our coordinated off-gas grid programme. In addition to the framework development with GDNs, we have continued to engage with the telecoms sector to identify synergies and opportunities with their fibre roll-out programme for a more cost efficient and less disruptive customer experience.

Moreover our capacity release programme will be delivered in conjunction with support and education for our communities and customers during the transition, particularly those that may be in vulnerable circumstances. This will include a dedicated engagement function that works with trusted and local community partners to liaise with residents to provide information on energy efficiency, technology and funding options, as well as coordinating energy efficiency market driven products to deliver additional value to our customers on their journey to decarbonisation.

In RIIO-ED2 we propose to achieve 71% of the homes, through a combination of leveraging other asset driven programmes such as replacement of polychlorinated biphenyl (PCB) loaded transformers and LV monitoring, utilising the capacity already available in those networks and deliver strategic reinforcement through ex-ante funding as these are highly certain to be electrified. The next 14% homes are earmarked for uncertainty mechanisms such as the Net Zero reopener triggered by a policy change which precludes the extension of gas networks (such as the fuel poor network extension scheme) and the banning of new oil boilers.

Figure 17 demonstrates our efficient, yet ambitious investment approach incorporating the principles of Whole System Planning for our Whole Heat intervention to decarbonise off-gas grid communities. We have conducted thorough research and analysis, engaging with not only with external stakeholders to formulate a pragmatic plan, but have also identified synergies and overlaps with internal asset replacement programmes to drive efficiencies and deliver maximum value for money for our customers and stakeholders.

Figure 17: Investment approach to make homes ready for electrification in off-gas grid areas



For more detail on this investment case see Annexe B- ED2-EJP-NP-102

In RIIO-ED1, we are working with trusted local community partners and Local Area Energy Planning (LAEP) experts in the village of Barcombe in East Sussex to develop a blueprint to electrify off-gas grid communities using a coordinated

approach. Our innovation project CommuniHeat<sup>72</sup> is exploring the most appropriate, cost-effective, and future-proof solution by investigating a LAEP approach, which includes engagement with community residents, local authorities, local supply chain, and energy vectors to develop a practical guide that could be used to decarbonise other off-gas grid communities across the country. Additionally, through our innovative project “Heat Street” we also developed a ‘zoning’ framework to identify the most cost-effective and least disruptive energy efficiency measures and low carbon heating solutions for our customers, considering their local dynamics and demographics.

#### Sidebar: Developing a net zero transition blueprint for off-gas grid communities – CommuniHeat

Our innovation project CommuniHeat takes a whole system approach to develop a universal blueprint that facilitates rural off-gas grid transition off oil and fossil fuels to low carbon electric heating. We worked in collaboration with trusted local community partners and Local Area Energy Planning (LAEP) experts in the village of Barcombe in East Sussex to engage and educate over 600 homeowners and businesses, undertake research by gathering real metered data and develop digital twins to analyse the impact of this transition.

Our coordinated whole system approach delivers added value by incorporating and understanding the impact of wider changes within the community beyond the decarbonisation of heat. Aligned with our approach to touch the network only once, to minimise disruption for our customers, we also considered the impact of other vectors such as the electrification of transport and renewable distributed energy on the electricity network.

We expect CommuniHeat to deliver a practical guide on how all off-gas grid communities across GB can achieve this transition cost-effectively and with minimal disruption by coordinating with community residents, local authorities, local supply chain and other energy. At the end of the project, we aim to proactively share our learnings and the developed framework with other communities, local authorities and networks.

The table below expands on each of these actions to provide more detail on what our stakeholders said, and the benefits they will deliver to our customers.

**Table 20: Our actions to support the decarbonisation of our off-gas grid customers**

| Quantified benefits to our customers:  |   |   |   |
|--|---|---|---|
| <b>Quantified benefits to our customers of capacity release (present value over 25 years):</b>   |   |   |   |
| 1) £59.4m Network avoided costs - Deferred reinforcement due to taking a proactive approach  |   |   |   |
| 2) £85.8m Societal benefits - CO2 reduction from the electrification of off-gas grid customers   |   |   |   |
| 3) £2.8m Customer financial benefits - Bill savings for customers by transitioning from oil to electricity for heating   |   |   |   |
| <b>Quantified benefits to our customers of energy efficiency measures (present value over 10 years):</b>   |   |   |   |
| 4) £1.8m Societal benefits - CO2 reduction benefit through the uptake of energy efficiency measures in off-gas grid areas  |   |   |   |
| 5) £6.2m Customer financial benefits- Bill savings for the customer by implementing energy efficiency measures ahead of their transition to low carbon heating   |   |   |   |
| 6) £2.3m Customer financial benefits – Bill savings for the customer by changing their behaviour due to energy efficiency advice provided  |   |   |   |
| <b>Conclusions from our research:</b>  |   |   |   |
| 7) Heating operating costs reduction for all customers by 9% through the uptake of heat pumps, and a further 7% reduction through improving thermal insulation their homes   |   |   |   |
| 8) Carbon emission reduction of 3.1 million tonnes per year for 242,000 off-gas grid homes by switching to low carbon heating and a further reduction of 271,000 tonnes a year by the uptake of energy efficiency measures |   |   |   |
| #  | Our planned actions   | What our stakeholders said  | How this benefits our customers   |
| 1  | We will deliver coordinated network capacity release programmes to support off-gas grid communities. Activities will include: | Stakeholders think that we should ensure sufficient network capacity ahead of need, and coordinate network reinforcement so that we | 1) 242,000 homes can be ready for electrification of heat and transport to support their transition from fossil fuels by 2028 |

<sup>72</sup> <https://communiheat.org/>

|   |  |   |  |
|---|--|---|--|
|   | <ul style="list-style-type: none"> <li>Upgrading HV overhead lines to 3 phase</li> <li>Upgrading LV networks to larger capacity</li> <li>Upgrading transformer capacity</li> <li>Coordinate with the existing PCB transformer replacement programmes to minimise disruptions</li> <li>Future proofing the above upgrades to ensure we touch the network once</li> <li>Including LV monitoring on all replacement transformers</li> </ul> | <p>only “dig the road once”. <b>Key insight I-FNZ15</b></p> <p>Further key insight links: I-FNZ1, I-FNZ2, I-FNZ5, I-FNZ7, I-FNZ8 and I-FNZ18</p>  | <ol style="list-style-type: none"> <li>2) Reduced heating operating costs</li> <li>3) Reduced environmental impact of heating, delivering benefits of facilitating a faster transition</li> <li>4) Reduced network reinforcement costs through efficiencies of touching the network once</li> <li>5) Minimised disruption to customers by avoiding repeated interventions at the same locations</li> </ol> |
| 2 | Identify which off-gas communities to target by using external data sets such as fuel poverty statistics, insights from our local planning project Heat Street and local climate plans from local authorities.   | <p>Both customers and stakeholders are concerned that the transition to Net Zero could leave some customers behind, with stakeholders stressing our responsibility (joint with other stakeholders) to protect and support such customers. <b>Key insight I-FNZ2</b></p> <p>Further key insight links: I-FNZ1, I-FNZ5, I-FNZ7, I-FNZ8, I-FNZ15 and I-FNZ18</p>   | <ol style="list-style-type: none"> <li>1) Better understanding of electric heating and the opportunities.</li> <li>2) More efficient business plan through reduced uncertainty.</li> <li>3) Ensure capacity is built in the right locations</li> </ol>   |
| 3 | Coordinate the delivery of energy efficiency measures by working in partnership with trusted intermediaries to support customers to insulate and improve building fabric ahead of any off-gas grid transition programmes.  | <p>“If you have a co-ordinating overview of Energy Efficiency, you will know whether it is worth incentivising energy efficiency in any given location based on its value to the system” <b>Net Zero Council</b></p> <p>Stakeholders think that we should play a coordination role in the roll out of energy efficiency measures. <b>Key insight I-FNZ10</b></p> <p>Further key insight links: I-FNZ1, I-FNZ5, I-FNZ7, I-FNZ8 and I-FNZ18</p> | <ol style="list-style-type: none"> <li>1) Reduce the impact of heat load on the network</li> <li>2) Reduced heat operating costs for customers</li> <li>3) Reduced environmental impact of heating, delivering benefits of facilitating a faster transition</li> <li>4) Improve wellbeing and health of customers by ensuring homes are kept warm</li> </ol>   |
| 4 | Coordinating with community energy groups, leveraging our experience and resultant framework delivered by CommuniHeat innovation project, to raise awareness and educate customers in off-gas grid areas   | <p>Customers’ lack of awareness / knowledge and concerns about the difficulty and expense of installing low carbon heating solutions remain significant barriers to their adoption. <b>Key insight I-FNZ5</b></p> <p>Further key insight links: I-FNZ1, I-FNZ2, I-FNZ7, I-FNZ8 and I-FNZ18</p>  | <ol style="list-style-type: none"> <li>1) Improved working knowledge and environmental awareness of the impact of their current heating systems</li> <li>2) Improved support for consumers in vulnerable circumstances.</li> </ol>   |

## Whole System planning

The complex nature of the energy system and the unprecedented level of uncertainty about future network capacity requirements makes our role<sup>73</sup> challenging. However, building on our significant track record of whole systems planning and delivery during RIIO-ED1, we believe that we have a robust plan, for tackling these challenges. Distribution and electricity needs are regional in nature, whole systems thinking will also need to be regional to deliver value to our communities. Most of the carbon abatement in the CCCs pathways require local action and behaviour change, thus local level planning is going to be key.

Figure 18: Key whole systems interactions



To assist with understanding and forecasting the future uptake and evolution of LCT adoption and to inform our least regrets approach to network investment, we developed Distribution Future Energy Scenarios (DFES) based on the scenario framework published by National Grid in their latest Future Energy Scenarios. In December 2020, we published our most recent DFES that outlines four potential future energy worlds for energy consumption across our licence area. These worlds range from **Steady Progression** where general progress is made towards decarbonisation but does not meet Net Zero by 2050, to **Leading the Way** with a much higher level of societal change utilising both hydrogen and electric LCTs. Our strategy is all about putting our networks on a path to Net Zero which helps consumers unlock the value of changing their behaviours and in which the cost on the bill is as low as possible. We believe that **Consumer Transformation** is the most aligned pathway to achieving this outcome and therefore we have based our business plan on enabling the transformation change implicit in Consumer Transformation.

For our DFES publication, we undertook a significant programme of regional stakeholder engagement to understand how our scenarios aligned to their own plans and ambitions for their regions. For further details on our forecasting please refer to the Distributed Future Energy Scenarios section of the core Business Plan.

Each region, and even districts within regions will have their own challenges. Our Whole Systems approach is a process that will look to address whatever issue needs to be addressed, for example:

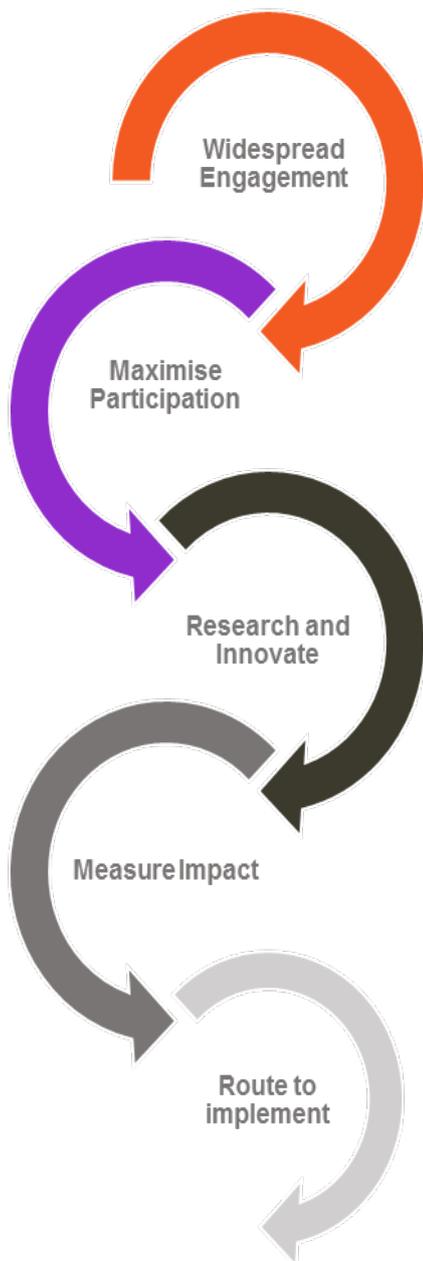
- In London we may see a greater focus on transport with off-street charging, or district heating or roadworks
- The South-East might see more projects looking at distributed generation, or off-gas homes converting to electric heating and rural EV charging

<sup>73</sup> This planning role will be delivered by the DSO (role 1).

- The East might see similar to above with perhaps some projects looking at pockets of industrial hydrogen usage

### Our Whole systems approach

Our whole systems thinking drives us to take a whole system approach:



#### Widespread engagement to **identify** challenges and opportunities

- Continuous interaction with our Whole Systems Thinking stakeholders (see Fig 6)
- Pro-active outreach to local and regional authorities on local area energy plans
- Responsive to cross sector requests for information and open to collaboration with other actors
- Open information and data sharing and transparent on our plans and interventions
- Record, assess, prioritise and communicate any likely market failures identified

#### Understand and unlock obstacles to maximise customer **participation**

- Demonstrate a credible willingness to invest to make things happen, where necessary
- **If no market failure**, determine how demand or supply might be stimulated in response to demand and supply forecasts
  - Develop high quality information and advice to develop awareness and inform choice
  - Provide top class customer support and user-friendly digital tools to support and automate connections and other services
  - Exhaust all available flexibility options and any pre-existing smart solutions
  - Strategically invest in network capacity release and electrification programmes within baseline allowances
  - Trigger uncertainty mechanisms or seek inclusion of projects in the strategic investment reopener process
- **If apparent market failure**, investigate options and discuss widely with our Whole Systems Thinking Stakeholders
  - Identify and progress collaboration opportunities for research and testing of potential options
  - Establish the appropriate lead for these activities and step in where there is an absence of leadership

#### Research and innovation to **test** potential options for addressing market failure

- Verify the existence of the market failure, ascertain its extent, and reprioritise
- Establish the origin of the market failure to tackle root causes such as:
  - Technical obstacles preventing installation or use
  - Behavioural issues or lack of consumer acceptance
  - Operational deficiencies and ineffectiveness
  - Poor value for money whether real or perceived
- Adopt a lean and iterative approach to developing and testing solutions to the root causes identified

#### **Measure impacts**, costs and benefits, customer and social value of options

- Undertake a social return on investment (SROI) applying commonly accepted metrics and proxies
- Conduct a whole system cost benefit analysis (CBA) whilst challenging costs and seeking efficiencies

#### Develop **routes to implementation** for proven options

- Seek public authority support and advocate for inclusion of solutions in local authority energy plans (LAEPs)
- Explore opportunities for innovation funding to implement proof of concepts and pilot projects
- Include appropriate projects in the strategic investment reopener process if necessary

Our approach identifies multiple potential solutions and then quantifies those which deliver the lowest whole systems cost to the consumer before final investment approval. Our process for investment decisions also involves integrated planning together with the ESO to determine the optimum implementation solution across the transmission and distribution systems and so deliver the lowest whole system cost solution for the customer.

Close and effective engagement with customers and stakeholders is essential for success. Our joint stakeholder engagement with ESO on the Regional Development Programme for the South Coast is an excellent example of whole systems collaboration to deliver lower costs for the consumer (see Sidebar). From this successful endeavour, we have developed a structured engagement process to use a model for further RDPs during RIIO-ED2.

#### **Sidebar: Whole Systems Regional Development Programme (RDP) for the South East**

The idea of the RDPs is to use an adaptive testing or “design by doing” approach that supports the effective management of the electricity network on a Whole System basis and supports the continued evolution of DSO capabilities. This is achieved through a joint Transmission & Distribution (T&D) process, which proactively identifies key areas of development and collaboration, resulting in coordinated and efficient joint actions and consequent reduction of whole electricity system costs.

The RDP process can also act as the necessary vehicle to push the boundaries of current system design and thinking by strengthening the coordination of transmission and distribution. This enhanced coordination covers a wide range of network and system operation activities such as data, processes, and solutions.

As the first DNO to kick off the RDP process in August 2016, we were able to deliver value to consumers by:

- Unlocking more than 1GW of capacity on the transmission network to connect DERs without the need for £1bn infrastructure spending between Brighton and South London
- Improved customer experience through early visibility of the assessment process, faster and cheaper connections, and new revenue streams for Distributed Generation

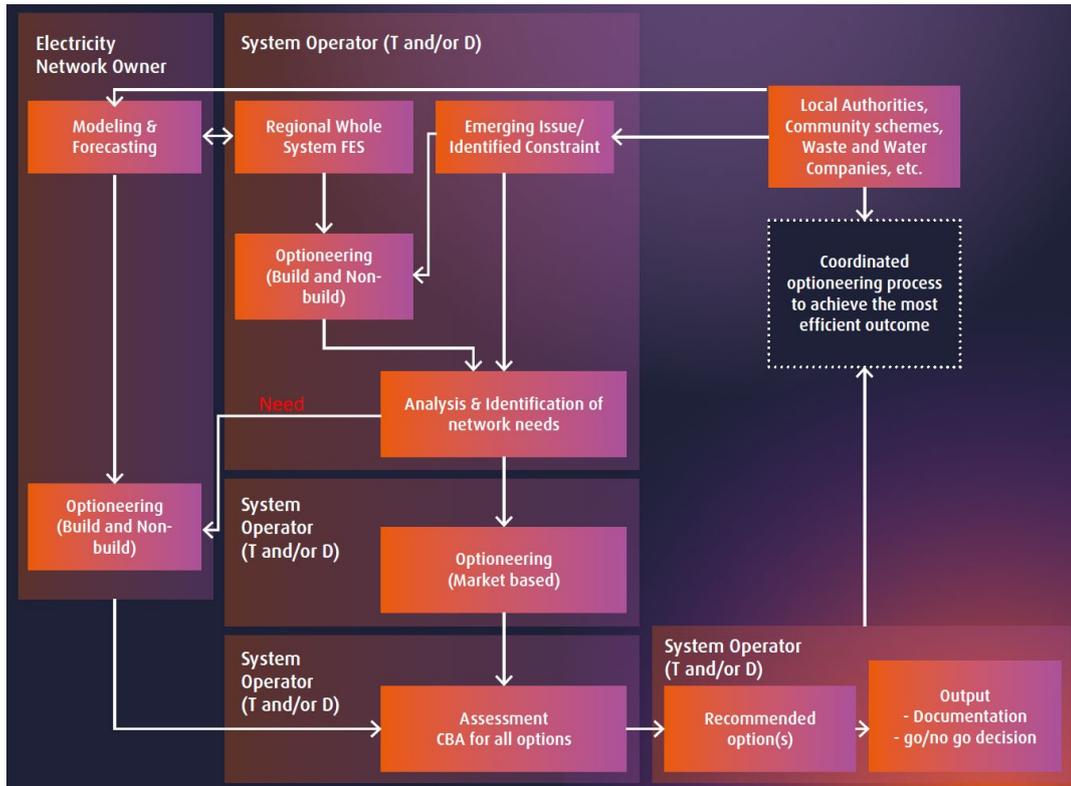
As a result, we are building up on the learnings from our work in RIIO-ED1 to facilitate the expansion of the RDPs in ED2 in order to deliver more efficient network and system management, lower overall system costs and value for money for consumers.

Our Whole System approach for T&D enhanced coordination also includes reactive power services, as we have successfully demonstrated via Power Potential, our joint procurement trial with the ESO. In a similar manner to RDPs, we are designing our systems and processes in collaboration with the ESO to increase system flexibility by using more DERs and provide coordinated and optimised network support at both transmission and distribution level.

This enhanced coordination can reduce conflicts of services for both active and reactive power, while ensuring safe and intact operation of the distribution network without additional costs. Our Power Potential trials have shown that the efficient roll-out of regional reactive power markets could save up to £94m up to 2050 and unlock 3.7GW of additional capacity in the South East transmission region.

At high level, the following schematic of the process shows key interrelations and collaborations that we will follow as part of our approach for new Whole System opportunities using Whole Electricity as the example. This will be extended to include relevant stakeholders in non-energy sectors, including in Whole Transport and Whole Heat, as relevant to specific opportunities.

Figure 19: Process schematic of key interrelations and collaborations in our Whole Systems approach used for electricity



We expand on our approach below:

### Identifying Challenges and Possible Solutions

Through our engagement, we have arrived at a Whole System strategy that encompasses initiatives across the electricity system, wider energy vectors, and which includes sectors beyond energy where electricity supply is a key enabler of Net Zero progress. However, this relies on being able to identify opportunities through continued collaboration with other stakeholders. It is only through working together that we will be able to meet Whole System challenges and foster innovation for longer-term benefit.

We have engaged stakeholders and customers to gain understanding and visibility of a wide range of challenges that exist at system boundaries, and therefore may be ready for a Whole System solution. We also identified a key Insight from our engagement that stakeholders expect us to play a central role in enabling the transition to Smarter Networks and they recognised this will require collaboration with a wide range of stakeholders<sup>74</sup>. Therefore, through RIIO-ED2, we will build on the engagement and interaction we have had with stakeholders to ensure that we continue to identify challenges, share information and search for solutions together. Where this involves maintaining contact with other regulated companies, we have established a way of working through the ENA’s Whole System work. We have led Whole System workstreams within the ENA that relate to Whole System investment planning, developing CBAs, and data exchange programmes. Through the ENA, we have access to electricity and gas sectors, bringing together DNOs/DSOs, GDNs, TOs and the ESO to identify collaborative investment planning processes, data exchanges and cost assessment tools. This joint and coordinated whole energy approach can deliver benefits, while securing the energy network at optimal value for money to consumers. An example of this joint working is our common “Whole System Charter” with SGN (we are working with Cadent to develop similar charters) which drives closer collaborative working over RIIO2 through:

- Developing and sharing a set of market indicators that improve GDN/DNO ability to forecast gas and power demand.
- Holding a joint annual review to share planning assumptions prior to publication of our respective statements.
- Develop a joint scenario planning process to be used for the RIIO-3 Price Control.
- Sharing our annual investment plans for those assets with whole system implications and conducting whole system assessments on these.

<sup>74</sup> Line of Sight – Whole System: I-DSO/WS2

- Developing a large load connection process across the GDN / DNO boundary to help customers secure the energy connection best suited to their needs.
- Developing and implement an operational planning, information sharing protocol.
- Developing a trial mechanism in RIIO-2 for sharing real time operational data for assets of common interest.
- Exchanging early information between the GDN and DNO on scale, location and likely duration of any substantial gas or power network outage to allow system impact planning to minimise customer disruption.

We will also need to work with a wider range of stakeholders across other sectors. This has been strongly supported by stakeholder feedback that we should go beyond our traditional remit and engage more closely with new stakeholders less familiar with electricity networks. This includes Local Authorities and councils, as well as operators within the transport sector. Furthermore, another organisation may be aware of a problem they face, but unaware of the potential value of collaborating with us to deliver a Whole System solution because they do not know enough about our capabilities and vice versa. Part of identifying potential solutions must therefore be to make ourselves known to organisations with whom we may not have previously collaborated. Through RIIO-ED2, we need to keep expanding our view of which stakeholder groups we can work with to identify further Whole System solutions that we can support.

To do this, we are stepping up our game, being more proactive, and that starts now. We are engaging with a range of organisations including Local Authorities, public transport providers such as Transport for London and rail operators, port operators and vehicle fleet operators, as well as EV chargepoint companies and motorway services operators. Another example of where we have already adopted a proactive approach is our work with National Grid to extend our joint planning process. This combined process will make us more visible and provide access to other sectors.

At this stage in the process, we will set up specific decision gates that must be met to progress an opportunity. This includes an assessment of whether or not the market can deliver an equally suitable solution, and whether or not the activity is incremental to the existing price control. We will do this through making a Whole System assessment an embedded part of our business decision making process that must accompany any activity that goes through the planning process. Where the market could not deliver the solution, and where the activity is incremental to the existing price control, we will progress the activity through our process, as it represents a problem that requires a Whole System solution. Where these conditions are not met, we will conduct a further review and only progress the activity through our process if we can evidence the need and reasons for why a Whole System solution is unsuitable.

Our stakeholders highlighted that data sharing and information provision is key, since it improves transparency, objectivity and neutrality in the decision-making process as well as supporting innovation. UK Power Networks embraces this growing interest in open data and digitalisation, and therefore is developing the appropriate tools and synergies to enable openness of data and the growth of market solutions, please refer to our DSO and Digitalisation strategies for detail on how we achieve this.

Building greater intelligence of emerging customer and system needs to invest at the right time and right place, that is why we will combine our market intelligence with an in-depth understanding of our network and the wider system, and its constraints, including the potential for smart, flexible or energy efficiency solutions, so that we can prepare and respond flexibly and efficiently to ensure we are not a barrier to decarbonisation in our regions.

Our market intelligence will draw on different types of market data including:

- **Customer attitudes.** We will use market research, ongoing engagement, and third-party sources to understand shifts in customer attitudes that could impact LCT uptake and input into our product and service development both for the DNO and DSO businesses. We are trialling AI platforms that can ingest publicly available structured and unstructured data and from external organisations to measure how sentiment on specific topics such as EVs or Heat pumps is changing to enable us to understand the external environment in a more quantitative way to inform our strategy.
- **Data from LCT industry suppliers, manufacturers and other third parties.** We will work in partnership with, and use data and forecasting provided by, suppliers and manufacturers serving the LCT sector such as EV dealers and Heat Pump manufacturers and charge point installers, to gain an insight into expected demand. We will seek to supplement this with data from other companies that could provide an insight into expected consumer demand at a regional level, such as credit card companies, internet search engines or electricity suppliers offering smart tariffs. Digital enables us a wealth of opportunities to interact and share data compliantly with other organisations at scale using Application Programming Interfaces (APIs). Our intent is to maximise this potential to ensure we are ready for whatever our customers need from our networks. This strategically aligns with the Smart Systems Package - published 20 July 2020 calling for coordinated asset registration for PV, EV, batteries and heat pumps. In addition, the requirement under building regs to notify DNOs of connecting LCTs.
- **Intelligence from our ongoing engagement programme.** This will be crucial for us to understand at a macro level upcoming demand from their investment plans that we will need to be ready for. It will also identify micro level

issues about our products and services that will need to be refined or potentially created to address operational issues on the ground impacting safety, customer satisfaction, reliability, and efficiency.

This will be overlaid onto an in-depth understanding of our network and the wider system, which we will gain from:

- **Deploying LV monitoring.** We will collect real time data through mobile monitoring of the transformers that make up our LV networks where we are forecasting constraints over RIIO-ED2. See our LV monitoring strategy for more detail.
- **Use of smart metering data.** We will work with energy suppliers to supplement our LV monitors with smart meter data that is aggregated to protect consumer privacy, but still useful to be able to understand emerging system needs
- **Use of advanced analytics.** We will target visibility of 100% of our networks by using AI and predictive analytics to “fill in the gaps” where we don’t have monitoring or smart meters. This will support us with a form of risk index to target our investment decision making.

### Testing Preferred Solutions

Within the electricity sector many of our potential solutions are traditionally tried and tested already but trying to overcome barriers to deployment of low carbon technology in other sectors is often more novel. In the latter areas the solutions often lie at the interface points between our network operation and the business operations of partner organisations, so it is also not always clear who should take the lead or which solutions are likely to be effective. There are often uncertainties around customer reactions and future demand and dependencies on Government incentive packages, which are also a moving picture.

This creates a need for collaborative research and Whole System discussions with partners to formulate and manage the research and analyse the outcomes. In some cases, pilot and demonstration projects will be needed to test solutions at some sort of scale and thereby identify the best Whole Systems pathways and projects for the future.

The shape of these projects will depend on the areas of uncertainty which need to be tested and resolved. This may relate to customer acceptance of new technology, its practical installation and cost or its operational effectiveness or ways to promote optimum usage off peak, for example. Some examples of our current innovation projects illustrate the range:

- Our HyCompact project with WWU looks to assess the practicality and customer acceptance of new hybrid heating technology, ways of anticipating the balance of demand between gas and electricity for hybrid heat and the cost implications, including increased electricity network demand
- Our Optimise Prime project is studying patterns of recharging use for commercial fleet electric vehicles at employee homes and at depots, looking at how this could be optimised and at the implications for our networks, including the practicalities of procuring flexibility services to meet recharging demand in the most efficient way.
- Our Charge Collective project is designed to test the size of the market failure preventing commercial investment in on-street residential EV charging stations in three test urban environments. Given the social and environmental benefits of increased on-street charging supply, the project will help identify the costs and benefits of socialising a part of the up-front network investment costs, where these are a barrier to charging infrastructure deployment.

Our approach to Charge Collective is set out in detail in our case study appendices (D).

### How we measure the impact

After identifying an opportunity and a potential solution, we will need to conduct a comprehensive assessment. For Whole System solutions, this is a particular challenge because:

- The initiative in question is likely to involve collaboration with a third party, and therefore a common approach to impact assessment is required
- Identifying benefits to customers may be challenging, particularly where the benefits are wider societal benefits that are hard to assign to customers in direct financial terms
- Costs falling to one organisation may not be in the same proportion to the benefits felt to that organisation and its customers
- Markets in new Net Zero technologies are highly dynamic and may be influenced by our actions. Up-front costs for consumers from capacity enhancement may be mitigated by faster price reductions once demand achieves critical mass

- Wider Government incentives for take-up of particular technologies (e.g., hybrid heating systems, on-street EV charging in residential streets) could make a game-changing difference to underlying demand

The Charge Collective project mentioned in the previous section highlights these complexities. The socialisation of network enhancement costs will allow on-street chargepoints to be built in hard-to-reach urban residential environments where the market would not deliver. Essentially there are two options to addressing this, which involve either tackling the issue via the price control process or through a new government-led support mechanism. We believe there is merit in exploring the former option as this is likely to be quicker to implement and can ensure that a more coordinated, cost efficient process, is adopted. This would ensure that:

- Residents gain access to chargepoints earlier and with greater convenience
- Residents will tend to pay less for on-street charging
- There is a social equity dimension considering that consumers with driveways (who tend to be wealthier) already benefit from their EV chargepoint connection costs being socialised
- There is an obvious environmental gain as consumers switch to EVs earlier
- Earlier achievement of critical mass for EVs will accelerate the fall in EV and especially EV battery prices, benefitting everyone
- Costs can be mitigated through auctioning of the right to build chargepoints in particular locations. This drives down the cost, such that the socialised element is the minimum necessary to meet the market failure.

In response to these challenges, we need to improve how we work with other regulated companies on Whole System topics. We have already led the development of a methodology for regional investment planning processes within the electricity sector (ONP WS1B P1). This methodology provides a structured approach when considering a range of potential investment and operability options across transmission and distribution to resolve network constraints and their impact.

As part of this process, we should consider the proportionality of the expected benefit versus the cost of running the process and implementing the identified solutions. This assessment process should also ensure that the identified solutions can be delivered in time to address the relevant network constraints (i.e., before the network constraints materialise and pose a risk to the network). In this context, the use of CBA tools is an important method for quantifying the value of activities that use a Whole System approach. We have used CBA tools traditionally for planning and appraisal. They are useful in understanding and comparing activities and being able to identify cost-effective approaches that justify investment. CBAs have a continuing role to play in the context of Whole System activities, but there are some new complications that need to be addressed:

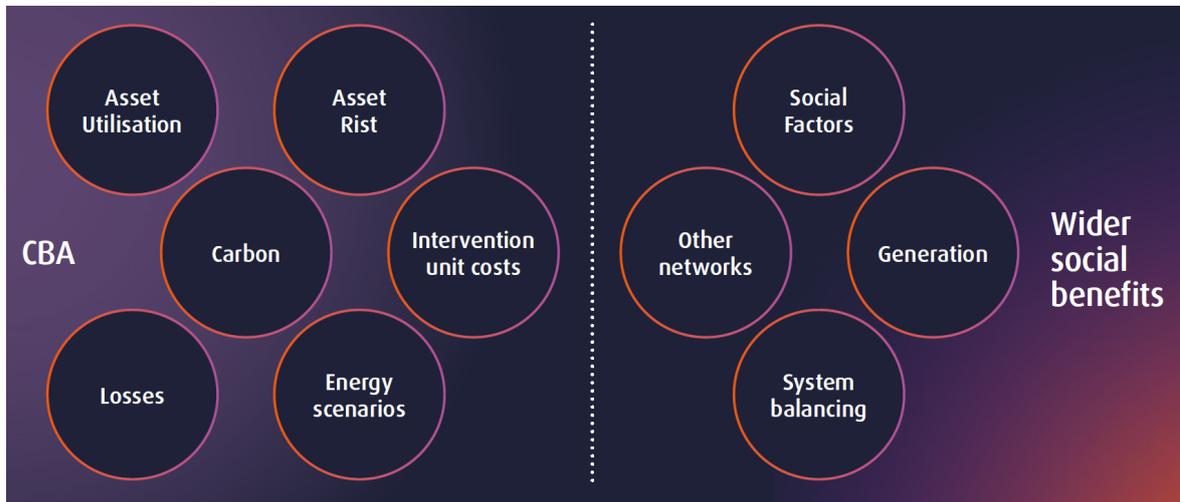
- The type of costs and benefits is likely to be more diverse. In particular, the benefits of a Whole System project could be wider societal benefit that is harder to quantify. **The CBA therefore needs to be able to handle and quantify this range of inputs**, ideally in a way that allows for direct comparison.
- Costs will be incurred across a range of different organisations, including other regulated companies but also associations and companies in other sectors. Similarly, benefits will be felt across a wider range of customers and in a range of direct and indirect forms. **The CBA therefore needs to be able to handle this variety of stakeholders, collaborators, customers and consumers.**
- As well as capturing these costs and benefits, the **CBA needs to be robust in allocating costs and benefits between the parties involved. This will necessitate licensees sharing more information on their cost drivers with one another to understand how they can work together to reduce total costs.**

By partnering with other DNOs and through engagement with Ofgem we have established new CBA guidance to ensure that there is a consistent approach to including social benefits as part of the options analysis. A common methodology has also been agreed by DNOs with regards to how a DNO's central forecast translates into peak demand across its network and the process by which optioneering is undertaken when determining an investment plan to meet this. We have also co-developed a Whole System CBA (ONP WS4 P1) through our work with ENA to ensure that the features described above are incorporated, as well as ensuring that existing requirements for investment analysis are also maintained. This includes:

- Featuring multiple activities and scenarios simultaneously, as well as a tipping point analysis that shows how far the inputs need to move before it changes the ranking of different activities and scenarios
- Accommodating multiple stakeholders within the inputs and outputs
- Separation of costs and benefits into:
  - **Stakeholder impacts:** This includes annual capex and opex per stakeholder
  - **Societal impacts:** This includes impacts related to safety, environmental, transport, disruption, heat, and other user-defined categories. Under each is a range of parameters that can be amended (e.g., to adjust carbon intensities of emissions)

- **Customer impacts:** This includes fuel costs by different sources, distribution and transmission costs for power and gas, and system operation costs
- A distributional analysis that shows how costs and benefits are divided between the different stakeholders, and therefore provides a basis for reallocating any responsibilities between stakeholders where necessary
- Outputs that include both NPV and carbon measures that break down into the participating parties.

Figure 20: The distinction between what is captured in Ofgem's core CBA and what constitutes wider societal benefits



This tool can be used to cover a wide range of direct benefits but may not be able to capture the full range of indirect social benefits, as shown in the diagram above. Where the CBA tool is limited, or projects are more complex and therefore require additional analysis, we will use further tools as needed. These include:

- **Social Return on Investment (SROI) tool:** This standard industry tool is based on a CBA approach but supports scenarios where there are societal impacts that need to be better understood and potentially reallocated between stakeholders. The SROI tool aims to capture more details of the indirect benefits, such as additional social value to customers or society through the modelling of suitable proxies. Without such additional tools it may not be possible to capture total level of benefits of a project that justify the level of costs that are incurred by a particular party, for the sole reason that they are not direct benefits to those customers. This tool will return both an NPV calculation that measures a direct financial impact and a decarbonisation measure that can be used to capture the contribution of the activity to achieving Net Zero. Following the example set in consumer vulnerability, we will set common proxies for whole system SROI calculations to ensure consistency and transparency across the electricity industry.
- **Wider stakeholder tools:** With the ENA, we have also co-developed processes for investment planning optioneering in cases where local authorities and regional bodies are involved (ONP WS4 P4). These regional stakeholders are developing ambitious environmental, and decarbonisation plans that require challenging and strategic investment in infrastructure. Hence, by developing a coordinated Whole System investment optioneering process, we are certain that a more efficient outcome can be provided with the options identified and the local authorities can meet their ambitious plans.

The combination of these tools, as well as others, will allow us to explore all available options to achieve Net Zero, while capturing consumer impacts and helping deliver a secure energy network at optimal value for money to consumers. In this way, the energy industry will be able to articulate in a consistent way the benefits that Whole System solutions can deliver.

#### Developing Routes to Implementation

Once we have identified an opportunity and analysed the long-term impacts and value using the tools and processes mentioned above, we will decide whether or not to proceed with the project. Each opportunity will be different and require some degree of bespoke arrangements to determine whether or not to progress, and if so how. Nevertheless, we will look to follow an approach that includes:

- **A review of the level of costs and benefits, and where they sit:** We will compare initiatives based on the outputs of the assessment tools mentioned above. However, we must be cognisant of the need to provide value for money to our customers through any investments that we make. Therefore, we will look at the distinction between direct benefits and

wider social benefits. This is of most importance to projects where the level of overall benefit is high, but the specific benefit to the customers of an organisation is less than the costs that the organisation would have to bear. In such a scenario, a project with the potential to deliver benefits might not be progressed because there is not enough value for one particular organisation. To manage such situations, we propose the following approach:

1. Establish a fair allocation of costs and benefits between the parties through use of the CBA tools, and based on this identify situations where this would result in one party receiving insufficient benefits to justify its costs.
2. Where parties are regulated by Ofgem, make use of the Coordinated Adjustment Mechanism (CAM) reopener, . This allows us to transfer outputs and allowances where we work with other regulated companies.
3. Operate a two-way process in which we test our plans from a whole systems perspective, welcoming other network users to propose whole system solutions for us to consider, and respond to other system users, where we may be able to offer an alternative whole systems solution.
4. Look into alternative bespoke arrangements where the CAM is not a possibility. If we believe there is an opportunity to realise significant benefits for society, but those benefits do not directly apply to our customers, we will aim to reduce the marginal costs to consumers using existing price control mechanisms such as the totex Incentive Mechanism (TIM)- for example In off-gas grid areas where we aim to deliver suitable capacity to decarbonise their heating and transport, we would work with telecoms to install fibre at the same time- thus each party delivering the output at a lower cost through shared digging- this is where the existing sharing factors mechanisms could trigger lower marginal costs to customers. In such situations, we will judge each case on its individual merits and propose a tailored approach.
5. Where an opportunity involves unregulated parties, where the benefits and associated cash flows are not transparent, we will focus our innovation programme to develop suitable mechanisms to transfer value between the actors as covered in our Innovation section of the core business plan. For example an alternative we will investigate through our Innovation Whole Systems theme is a means or mechanism where funding can be re-directed directly to the DNO via the RIIO framework without impacting the consumer energy bill.

We will also look at the outputs of our tools to compare different projects to understand the relative levels of costs and benefits, as well as the potential sensitivities that the outputs have to changes in the input data.

- **A review of specific operational requirements:** We will assess our ability to resource and manage the particular project, as well as the ability of any stakeholders we work with to deliver this project. This means that we will review operational and project risks including:
  - The comparable level of dependence on external parties and the level of coordination needed to ensure a successful project delivery.
  - The timeframe of the project, and any resourcing constraints that may exist over the period.
  - The comparable level of risk within the project that would need to be managed to deliver the benefits.

To illustrate where our process has already delivered results, we have included an example in the Whole Electricity section.

### Integrating Community Energy

Community energy groups play an important role in developing and delivering local area energy projects within their community. They complement other regional bodies like local authorities and wider public sector organisations in delivering climate action.

We see 'community energy' comprising community-led projects or initiatives which focus on reducing energy use; using energy more efficiently; generating energy; purchasing energy and providing local energy advice services to communities.

Our approach to supporting community energy is to continue to work through Community Energy England and regional umbrella groups such as Community Energy London and Community Energy South to identify the groups and individuals in our area who want to deliver change in their local communities. Through a detailed segmentation analysis, we will make sure we understand their specific needs to tailor our services appropriately.

We will support community energy groups through our local area planning team. This will enable us to offer complementary services with other local energy participants like local authorities. Through structured ongoing engagement we will provide our expertise and knowledge to help community groups develop deliverable local energy action plans. It will also enable us to surface issues, identify opportunities and prioritise actions to help them realise those plans.

Our four pillars to supporting community energy groups:

- **Engage and learn** – through our open data portal and our dedicated community energy web pages we will share information on heat and transport decarbonisation, energy efficiency, data modelling and scenarios. We will help groups use this data at specialist webinars, surgeries, and masterclasses.

- **Collaborate and innovate** – building on our successful track record of projects such as Energywise, Energy Garden and more recently Communiheat we will work with community energy groups to access funding to co-design innovation trials that benefit local communities. These projects provide funding opportunities for community groups and a chance to develop technical and commercial know-how.
- **Connect and flex** – we will provide a dedicated team to support groups connect their energy projects by offering bespoke surgeries and advice throughout the process. In addition, we will help groups unlock enduring value in their projects by searching out relevant flexibility opportunities.
- **Community support** – we recognise that one of the key challenges for community energy groups is access to funding. These groups will continue to have the opportunity to receive funds to support our social delivery programmes through our UK Power Networks foundation and our targeted support for fuel poor customers (see Commitment VS7, VS8).

Whether as a partner, through direct community energy funding or by supporting local umbrella organisations we will deliver ongoing structured engagement to surface the issues, opportunities, and priorities to support and encourage communities in the South East, East and London to deliver local energy projects that make a real difference for the communities they serve.

### Our RIIO-ED2 Whole system planning interventions

As a society, we are on a steep Net Zero learning curve and many of the changes required to achieve Net Zero are continuing to emerge. This will evolve as technologies mature, policy stances become clearer, and local energy plans develop. Our plan is developed to be flexible enough to be able to go at the pace of our fastest customers.

We have four interventions related to system planning:

|   |  |
|---|--|
| <p>We will engage with all 127 regional and local planning authorities on their climate plans each year of RIIO-ED2, offering a three-tiered support service utilising a framework to assess, develop action plans and deliver investments where a prescribed level of certainty is achieved in period.</p> | <p>By 2024, we will provide core planning datasets via an on-line self-service energy planning tool to support the planning process for our local authorities, helping them make the best choices for their communities.</p> |
| <p>We will provide proactive services to our DER through expanding our digital outage planning and automatic restoration tools, to minimise disruption and maximise their system access throughout RIIO-ED2.</p>  | <p>We will embed a requirement to have explicitly considered whole system solutions as part of our investment planning and investment governance by the start of RIIO-ED2</p>  |

***We will engage with all 127 regional and local planning authorities on their climate plans each year of RIIO-ED2, offering a three-tiered support service utilising a framework to assess, develop action plans and deliver investments where a prescribed level of certainty is achieved in period.***

We will not be passive bystanders in the transition to a Net Zero society: we will use our knowledge and convening power to support local authorities to meet their Net Zero ambition. Local Authorities have shared with us their own stretching targets for achieving Net Zero and have emphasised the importance of our role in helping them to achieve this goal. We will offer support on local authorities' climate plans within our distribution area and provide a framework to invest when a prescribed level of confidence has been achieved. This approach strategically aligns with the Transport Decarbonisation Package<sup>75</sup> - published 14 July, where new powers, duties, and funds for local authorities in areas of transport and charge point infrastructure have been signalled.

Our customers believe we should be ambitious in facilitating Net Zero at a regional level and should work with local communities and other utilities to tackle barriers to entry. We will use our convening power to play a coordinating role with

<sup>75</sup> Transport decarbonisation plan, Department for Transport, July 2021

different ecosystem players to comprehensively understand and facilitate future local area energy plans and where future demand is likely to exceed flexibility. We will utilise our experience, data, and understanding of the Net Zero transition to help local authorities turn ambition into action. This will also give us greater visibility of where and when network capacity will need to be released, helping us to plan this work promptly and efficiently. We have made provision for a full time Community Energy role within our local area energy planning team, who will support local community energy groups in developing their proposals into outcomes, through being a bridge between these communities, our connections teams and ultimately the planning functions in our DSO.

We believe this proactive and collaborative approach will help to deliver a higher confidence level for Local Area Energy Plans, as well as to coordinate delivery of decarbonisation leading to significant savings compared to an orchestrated approach.

**“We should bring customers and stakeholders together by playing a coordinating role in local area energy planning.” Net Zero Council Meeting 2.**

This intervention builds upon the experience that we have gathered working in close collaboration with local authorities in RIIO-ED1, and the feedback we have received that this is both valuable and necessary to realise local Net Zero ambitions e.g., GLA for Isle of Dogs and Cambridgeshire County Council. This intervention forms a critical part of our “Whole Systems approach” by working with local authorities and partners to facilitate economic growth and decarbonisation.

RIIO-ED2 has a big focus on delivering Net Zero at the lowest cost to all customers. Local planning is critical to delivering Net Zero efficiently as the unique needs of the local area and local energy system need to be considered when making decisions. Ofgem has set the expectation that local plans can be used to justify spend, making specific reference to both the Local Heat and Energy Efficiency Strategies approach being used in Scotland and the Energy Systems Catapult LAEP Method.

The LAEP methodology is extremely comprehensive. However, it is clear the approach requires significant effort and detailed modelling that may be challenging for the authorities to complete in the near term, given the feedback we have received on resourcing constraints at the local level. We are committed to supporting local decarbonisation activities, however investment to facilitate these must be robustly justified.

To address the issues above we have worked with a number of regional planning bodies to co-develop a framework which will:

- Ensure a collaborative engagement approach between UK Power Networks and the 127 regional and local planning authorities and other regional planning bodies e.g., County Councils across our area.
- Enable network investment to be committed at reduced risk where a consistent minimum level of confidence is achieved before progressing.
- Support decarbonisation whilst not being too resource intensive.
- Foster knowledge sharing across all regional planning authorities to accelerate progress.

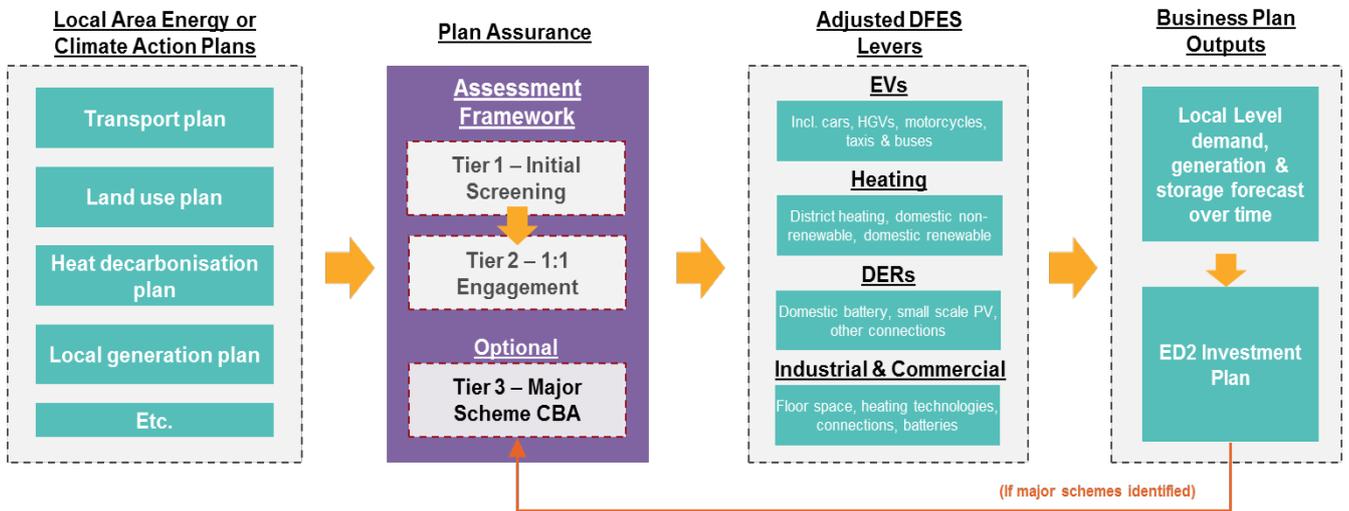
The framework consists of a 3-tiered approach that can be run regularly (e.g., at least annually for each LA) to enable ongoing review of evolving plans:

1. **Tier 1** Initial Screening is based on a data capture process that our local area energy planning team would support the local authorities to complete based on their work done to date. The form will use the agreed criteria and minimum requirements to identify the plans maturity and will drive further engagement. The guidance will also support local authorities in understanding the information needed to make investment decisions.
2. **Tier 2** is a more detailed 1:1 engagement enabling understanding of the area’s unique plans. The basis of this assessment will be more quantitative in nature and focus on the robustness of, and confidence in, specific plans. The aim is to output an agreed volume and timing adjustment to UK Power Networks’ Distributed Future Energy Scenarios that can be used for investment planning.
3. **A Tier 3** assessment aligned to the existing CBA approach is then used for strategic investments. As the potential for regret spend is greater with large schemes, further collaborative analysis may be required to ensure confidence before committing spend.

We do however recognise that the range of powers that local authorities may change through the RIIO-ED2 period. We can see from the Transport and Decarbonisation Strategy a growing focus on providing local authorities with the tools to drive

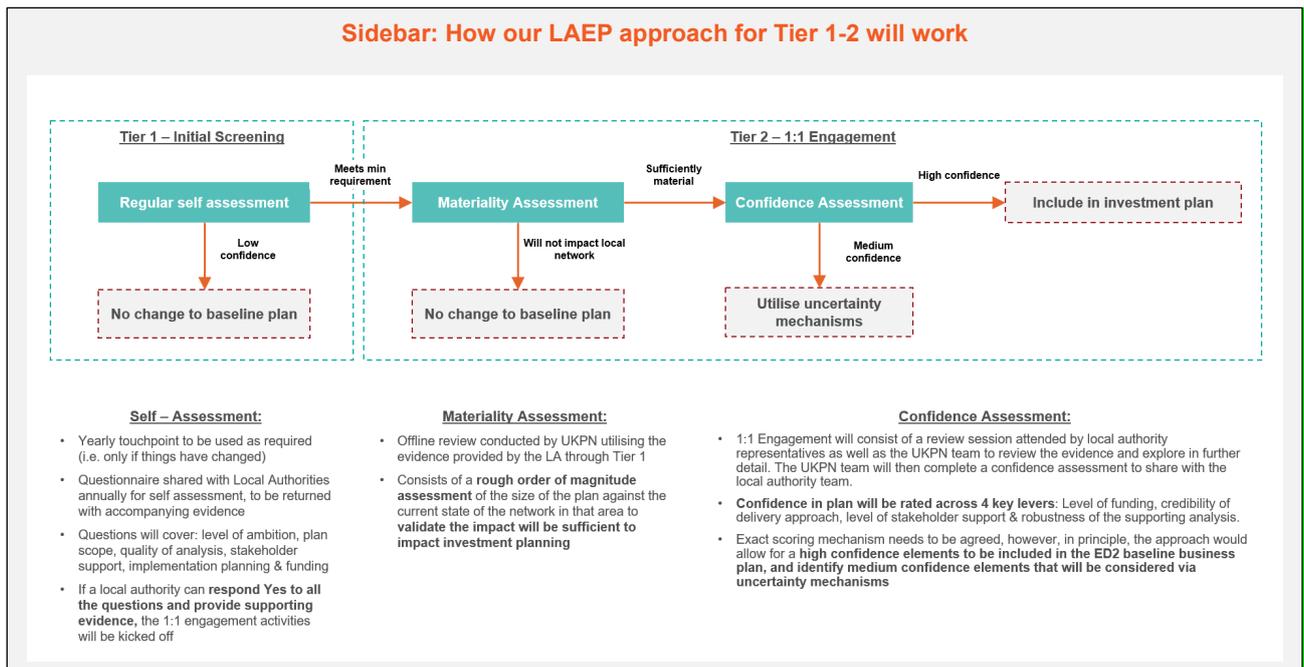
decarbonisation in their region. We will therefore regularly review our framework to make sure it remains proportionate, transparent, and appropriate. Our three-tiered approach, coupled with our dedicated resources and digital support tools will enable UK Power Networks to take a tailored approach to needs in our regions, responding directly to stakeholder feedback increasing the capacity and capability of our Local authorities around energy planning.

Figure 21: End to end three tier framework



We are currently trialling this approach with a regional planning body to test the practicality of the approach from both its perspective and ours. Our initial findings from the trial are:

- The level of agency that the regional planning body has over the deployment of LCT technologies varies significantly. This means that elements of their plan may proceed at different rates through the framework.
- Even if the regional plan is not fully developed, more insight in the plan development timetable is valuable for DNOs as it indicates when their input into the plan would be most valuable. The benefit of this is that it would minimise future rework.
- From a regional body perspective an understanding of the DNO evidence requirements early in the process allows them to tailor their process to produce this information proactively rather than having to generate it reactively with associated delays.



To support our approach in RIIO-ED2, we will establish a local area planning team that will work with local authorities to develop their energy plans and develop cost-benefit analyses for infrastructure. This team will enhance Local Authority capacity and capability in support of low carbon transition (This includes Innovation capabilities as part of our social contract) The table below expands on each of these actions to provide more detail on what our stakeholders said, and the benefits they will deliver to our customers.

**Table 21: Our actions for Local Area Energy Planning**

| <b>Quantified benefits to our customer:</b>  |  |   |  |
|--|--|---|--|
| <b>Quantified benefits to our customer of our three-tiered support service (present value over 5 years):</b> |  |   |  |
| £8.6m Societal benefits - Costs avoided by local authorities for local planning resources                    |  |   |  |
| £326k Societal benefits – Value of upskilling local authority staff and other resources                      |  |   |  |
| #  | <b>Our planned actions</b>   | <b>What our stakeholders said</b>   | <b>How this benefits our customers</b>   |
| 1  | <p>We will engage with all 127 regional and local planning authorities on their climate plans and establish a local area planning team of 20 full time employees: They will be responsible for working with Local authorities to assess their energy plans and develop CBAs and have dedicated resource focused on Community energy progression.</p> <p>This will follow a three-tier approach:</p> <ol style="list-style-type: none"> <li>Tier 1: We will work with all 127 regional and local planning authorities to assess their plans and readiness against the framework</li> <li>Tier 2: For the Local Authorities passing the above assessment (40-50), we will deep-dive into their climate action plans to agree optimum infrastructure requirements</li> <li>Tier 3: For Local Authorities who have defined projects requiring bespoke strategic investments (10), we will work with them to co-develop suitable CBAs to unlock infrastructure investments</li> </ol> | <p>Stakeholders think we should be ambitious in supporting Local Authorities and local area energy planning. <b>Key insight I-FNZ13.</b></p> <p>Customers and stakeholders believe it is important for the future energy system to take account of the wider whole system impact. Stakeholders They expect planning activities to be coordinated and cost benefit analysis to have a wider scope to consider the impact on the system. There is also support for our role in enabling Local Area Energy Plans. <b>Key insight I-DSO/WS8</b></p> <p>Further key insight links: I-FNZ1, I-FNZ5, I-FNZ7 and I-FNZ8</p> | <ol style="list-style-type: none"> <li>Customers will benefit from a coordinated approach for their communities to decarbonise.</li> <li>Enable pro-active engagement with all local authorities whilst minimising unnecessary effort on both sides.</li> <li>Provide transparency on the process and the criteria at each stage to justify network investment.</li> <li>Prioritise effort in areas where investment decisions are most needed to reduce delays; whilst providing clear guidance on the minimum requirements agreed across all parties to share knowledge and support the development of all local plans.</li> </ol> |

**By 2024, we will provide core planning datasets via an on-line self-service energy planning tool to support the planning process for our local authorities, helping them make the best choices for their communities.**

Today, our customers don't have the information they need to fully understand and participate in Net Zero activities. As we are all on this decarbonisation journey together it is important that nobody is left behind. Because of this we are committed to proactively developing material to help our customers close "the knowledge gap" and understand the benefits of LCTs, and to partner with trusted third parties to help educate our customers.

*"The more tailored the advice and support that UK Power Networks is able to provide, and more personalised to homeowners the more engaging it was e.g., specific for my area, life stage, reasons for investing in the technology, which way your roof is facing etc., type of charging point required"* **Phase 2b Engagement Report.**

Broadly, we know that our customers are keen to engage in the Net Zero transition. However, they have varying levels of understanding of the detail behind the technology, markets and policies that will drive the transition. Our engagement found that our customers were genuinely shocked with the scale of the change required and that they had no idea about some of

the things that would have to change i.e., heating. This is backed up by the March 2020 edition of BEIS’s Public Attitude tracker that found that only 35% of people had awareness of Net Zero<sup>76</sup>. We understand it is our responsibility to help educate our customers about the benefits of LCTs and how they can easily adopt these technologies.

*“Both business customers and customers in vulnerable circumstance want to see more personalised, bespoke advice and information on the energy transition and how to switch to low carbon energy and think there is a role for us to play here. Customers can see us filling the role of a central source of information and support, particularly when it comes to energy grants and incentives” Phase 2b Engagement Report.*

It’s clear from our customers and stakeholders that they need additional services to meet their needs. To address this, we are going to significantly improve the proactive information we provide to our customers by developing tailored information services. We commit to providing customers with the information that they need to seamlessly transition their energy usage and make better-informed decisions, building customer confidence in LCTs, promoting greater participation in flexibility markets and increased revenue opportunities.

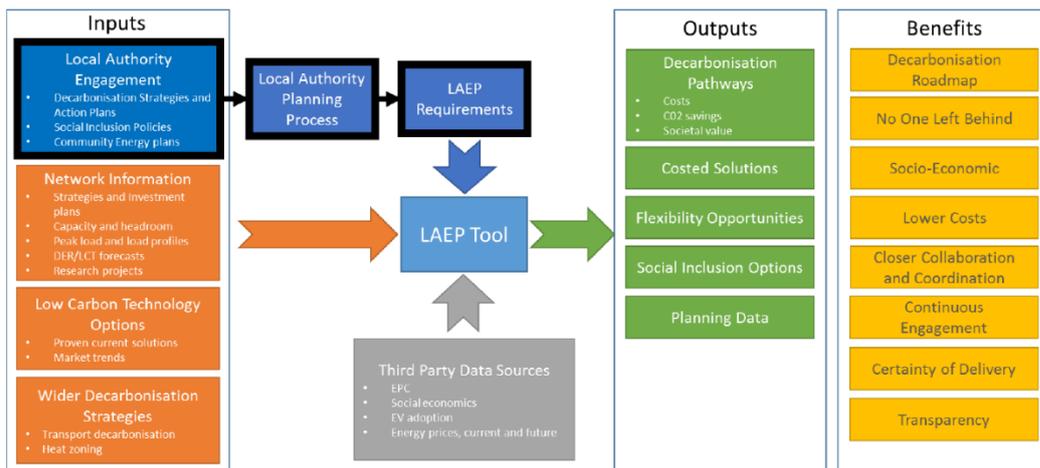
We will develop a Local area energy planning self-service tool, where Local authorities can layer local input such as decarbonisation strategies and action plans, local market trends, social inclusion policies, transport plans etc. upon our network infrastructure data to develop optimum options for their communities. This will help level up the gaps between local authorities in our area and reduce costs all round. We will collaborate with our regional gas networks to offer up various options for our local authorities to model scenarios across electricity and gas vectors. The local area energy planning team in the section above will be able to support the various levels of resource and skill levels in the use of this tool, to ensure the local authorities have all the support they need to progress across the three tiers.

Figure 22: An overview of our proposed LAEP digital planning tool

## An overview of our proposed LAEP digital planning tool

### Objective

Enable Local Authorities to plan and implement whole systems solutions that deliver on their decarbonisation strategies and action plans by helping them to identify solutions that are cost effective, energy efficient, have social value and are inclusive.



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We’ve already started on this journey in RIIO-ED1 providing tailored EV ‘Ask the Expert’ sessions, dedicated EV and FNZ web portals, and tailored customer offerings. Our proposed RIIO-ED2 business plan builds on this.

*“I can understand it is good for the environment, so do a lot of people, but there needs to be comprehensible information out there that shows savings and benefit to the environment” Business, EPN, 50-249 employees.*

<sup>76</sup> BEIS public attitudes tracker, March 2020

In RIIO-ED2, we are planning the following actions to deliver on these interventions in direct response to our engagement feedback:

*Table 22: Our actions to develop high quality information*

| <b>Quantified benefits to our customers:</b>   |   |  |  |
|--|---|--|--|
| <b>Quantified benefits to our customer of our energy planning tool (present value over 5 years):</b>   |   |  |  |
| 1) £12.8m Societal benefits - Avoided costs for LAs from improvement in efficiency and optimisation of expenditure on local area energy planning |   |  |  |
| <b>#</b>   | <b>Our planned actions</b>  | <b>What our stakeholders said</b>  | <b>How this benefits our customers</b>   |
| 1  | Deliver online self-serve planning tools for local authorities to conduct energy planning by 2024   | Stakeholders think we should be ambitious in supporting Local Authorities and local area energy planning. <b>Key insight I-FNZ13.</b><br><br>Further key insight links: I-FNZ1, I-FNZ5, I-FNZ7, I-FNZ8, I-FNZ9, I-FNZ11, and I-DSO/WS6   | 1) Providing an improved experience and support for Local authorities, supporting those without the skills and resources to self-serve, and providing efficient multiple access to central data that we have already developed - lower costs all round |
| 2  | Providing detailed information of local infrastructure and coordinating with other organisations (such as installers) on the requirements for smooth compliant installations of LCTs. | Connections customers for, or installers of, low carbon technologies want a fast and simple connections process that is tailored to low carbon technologies and provides accessible information regarding existing capacity. <b>Key insight I-FNZ11.</b><br><br><i>“Customers want information provision built into their normal processes. The more we can provide, the better – proactively shared.”</i><br><b>EV Focus group.</b><br><br>Further key insight links: I-FNZ1, I-FNZ5, I-FNZ7, I-FNZ8, I-FNZ11 and I-DSO/WS6 | 2) Providing an improved experience for customers and reducing the need for revisits.  |

***We will provide proactive services to our DER through expanding our digital outage planning and automatic restoration tools, to minimise disruption and maximise their system access throughout RIIO-ED2.***

The energy sector is changing around us. “Fit and forget” is no longer an option as renewable generators are increasingly selecting distribution networks as their network of choice. We understand new types of interaction and participation for these system actors will be needed. Operators of DER have changing needs as the energy system becomes more reliant on them.

***“If UK Power Networks know about regular maintenance or planned outages then this information should be made public.”***  
**DG focus group.**

Additionally, our engagement showed us that our customers want us to enhance our network outage management and communication, as well as provide visibility of network outage information (More specifically: Historic outages, planned outages, unplanned outages, and efficiency of the network).

To make sure we optimise access for these providers, we have taken learning from our engagement in RIIO-ED1, we will scale innovative solutions such as our outage planning tool, Network Vision, to encompass 80% of all DER capacity over 1MW. This will minimise disruption to DER by ensuring they have equal input and influence on the planned outage schedule. Furthermore, we will build new functionality into our Distribution Energy Resource Management System (DERMS) system to reduce the impact of abnormal network running arrangements, thus maximising DER network access over RIIO-ED1.

Table 23: Our action to reduce disruption to DER

| # | Our planned actions  | What our stakeholders said  | How this benefits our customers  |
|---|--|---|--|
| 1 | 100% of our DER with capacity over 1MW to be covered by Outage planning and automatic restoration services and proactive provision of information including historic data. | <p>“If UK Power Networks know about regular maintenance or planned outages then this information should be made public.” <b>DG focus group</b></p> <p>Stakeholders support ambitious options on outage planning, including the use of digital tools and provision of comprehensive information to reduce outage impact. <b>Key insight I-DSO/WS7</b></p> <p>Further key insight links: I-FNZ1, I-FNZ8, I-FNZ11 and I-FNZ16.</p> | <ol style="list-style-type: none"> <li>1) Outage planning process will be streamlined because of this automated process.</li> <li>2) Reduction in DER interruptions.</li> <li>3) Better visibility for customers participating in energy markets.</li> <li>4) Improved DER experience during power outages.</li> </ol> |

**We will embed a requirement to have explicitly considered whole system solutions as part of our investment planning and investment governance by the start of RIIO-ED2.**

All investments currently have a robust governance process called the “Portfolio Board”; this board is chaired by our Director of Asset Management. We will revise our end-to-end process to ensure each major investment includes a whole systems assessment. We acknowledge each investment opportunity will be different and require some degree of bespoke arrangements to determine whether to progress, and if so how. Nevertheless, as part of our whole systems assessment we will look to follow an approach that includes, a review of the level of costs and benefits, and where they sit.

We must be cognisant of the need to provide value for money to our customers through any investments that we make. Therefore, we will look at the distinction between direct benefits and wider social benefits. This is of most importance to projects where the level of overall benefit is high, but the specific benefit to the customers of an organisation is less than the costs that the organisation would have to bear. In such a scenario, a project with the potential to deliver benefits might not be progressed because there is not enough value for one particular organisation. To manage such situations, we propose to:

- Establish a fair allocation of costs and benefits between the parties through use of the CBA tools, and identify situations where this would result in one party receiving insufficient benefits to justify its costs.
- When appropriate, make use of Ofgem’s Coordinated Adjustment Mechanism (CAM) reopener - this allows us to transfer outputs and allowances between regulated companies.
- Where use of the CAM is not possible, we will investigate alternative collaborative approaches.
- Operate a two-way process in which we: test our plans from a whole systems perspective, welcoming other network users to propose whole system solutions for us to consider; and respond to other system users where we may be able to offer an alternative whole systems solution.

We will also look at the outputs of our tools to compare different projects to understand the relative levels of costs and benefits, as well as the potential sensitivities that the outputs must changes in the input data.

Table 24: Our actions for embedding whole systems into our processes

| # | Our planned actions   | What our stakeholders said  | How this benefits our customers   |
|---|---|---|---|
| 1 | 100% of investment scheme papers will have an explicit assessment of whole systems and will be reviewed as part of the current investment governance, this will be implemented before RIIO-ED2 and reported in our annual DSO report. | <p>Stakeholders see a role for UK Power Networks in enabling the transition to Smarter Networks. They anticipate this will require collaboration with a wide range of stakeholders. <b>Key insight I-DSO/WS2</b></p> <p>Further key insight links: I-DSO/WS8.</p> | Increased breadth of stakeholder scope and number of options considered results in lower costs and wider benefits to consumers. |

Figure 23: An overview of all our Energy Efficiency interventions

## Eight Million Energy Efficiency Interactions

We have committed to providing increased energy efficiency support to customers during RIIO-ED2. Across the five years, we'll offer advice and information via eight million customer interactions. Here's how we'll do it.....

**242,000**

We will coordinate the delivery of energy efficiency measures in partnership with trusted intermediaries ahead of off-gas grid transition programmes

**1,400,000**

We will proactively provide LCT and Energy efficiency advice to customers located in zones earmarked for electric heating by 2028

We will develop an energy efficiency flexibility product, running tenders every 6 months, starting in 2023.

**2,400,000**

We will supply energy efficiency advice with every low carbon technology enquiry over the RIIO-ED2 period

**4,000,000**

We will provide fuel poverty support advice to 800,000 customers during each year of the five years of RIIO-ED2

## Holding us to account to be a facilitator to decarbonisation within our regions

### Context

UK Power Networks is crystal clear that it will be a failure on our part if in RIIO-ED2 people are not able to connect low carbon technologies quickly and easily. Furthermore, to retain the confidence of our customers for the Net Zero transition, we also need to ensure that we do this at the lowest possible cost.

The key challenge to this however is that the nature, scale, pace, and timing of the transformation of the United Kingdom's energy system remains the subject of significant uncertainty. As a network company, we therefore need to be demand driven and able to adapt quickly as circumstances change and the needs of our customers become clearer.

We are aware that other companies have asked for significant ex-ante increases in totex investment rather than utilising uncertainty mechanisms citing the risk of being a potential barrier to low carbon transition. We do not believe this position is in the best interests of current and future customers given the uncertainty described above. Our view is that a well-justified and robust investment approach is independent of whether allowances are requested up front (ex-ante) or through in-period adjustments enacted through uncertainty mechanisms provided these are designed correctly. This is a point that we have explored extensively with our Customer Engagement Group (CEG). Put simply, even if you asked for all the expenditure allowances ex-ante, you would still need to plan the network efficiently based on confidence in demand (utilisation) to ensure investments are well justified and consumers are protected from unnecessary price increases. This is exactly the approach that a commercial business operating in a competitive market would undertake to ensure an efficient deployment of capital.

In this new section that we have introduced based on stakeholder feedback of our Draft Business Plan, we describe our strategy to facilitate LCT uptake at a practical level whilst protecting current and future customers. We then describe the critical success factors that we have considered to ensure that we are a facilitator and not a blocker for decarbonisation within our regions. Principally these include providing capacity at the right time and right place, ensuring local intelligence is factored into our forecasts and investment plans through strong ongoing engagement, taking a balanced approach to investment that protects current and future customers, having a responsive regulatory framework that releases allowances on a timely basis and finally ensuring that we have the resources (labour and materials) to flexibly respond to demand.

However, no business plan can claim to have all the answers worked out for a transformational change for which there is no precedent globally. Measurement against key targets is our way of ensuring we remain on track for the Net Zero transition. Therefore, we outline the metrics that we intend to measure and publicly report our progress to all interested customers, stakeholders, Ofgem and government (both national and local).

### Our critical success factors

Our approach to ensure we are not a blocker to decarbonisation is built upon for key actions:

- Building greater intelligence of emerging customer and system needs to invest at the right time and right place
- Working with Local Authorities and Stakeholders to enhance our forecasting and investment plans
- Taking a balanced approach to Net Zero investment that protects current and future customers
- Having a responsive regulatory framework that releases allowances in a timely way
- Ensuring we have the resources (labour and materials) to flexibly respond to demand

### Monitoring the implementation of our strategy

We believe that we have a robust strategy that addresses the risks to us being a potential blocker to decarbonisation. However, we know that is not enough. It is clear that the companies that succeed will be those that can adapt quickly and efficiently as circumstances change.

It will therefore be necessary for us to constantly monitor the performance of our strategy and adjust to “course-correct” as appropriate. This feedback loop will be fundamental to ensuring that we are on track and that we stay on track - that we are meeting customer expectations now and that we can plan effectively to continue to do so in the future.

In order to ensure exceptional performance in customer service and satisfaction, we have determined targets from across our plan for several key performance indicators, and we will continually monitor our performance against these targets.

|   |   |
|---|---|
| <p><b>Key Performance Indicator</b>Targets measured over the RIIO-ED2 period<br/>Early warning effectiveness - Forecasting Effectiveness Metric<br/>We will measure accuracy of our LCT uptake forecasts on a yearly basis.</p> <p>Forecasting is a critical part of having early warning of LCT uptake to give sufficient time to respond to demand<br/>Measured quarterly (reported annually)</p>   | LCT uptake +/- 15% range on an annual basis   |
| <p>Early warning effectiveness - Overall Network Utilisation Metric</p> <p>We will measure actual and forecast network utilisation on a yearly basis (current year and ED2).</p> <p>This will show the utilisation of the 120k transformers that form our LV network.</p>   | Maintain utilisation per network within +/- 10% of target agreed with Ofgem by the end of ED2                                   |
| <p>Service experience – C-SAT scores for our Low Carbon Technology Customers (measured through the industry Broad Measure of Customer Service scores for connections)<br/>Measured weekly.</p>  | 93% satisfaction or #1 DNO Group average over RIIO-ED2  |
| <p>Service experience - Major connections customers' C-SAT scores that are connecting LCTs (measures the segments not covered through the regulated industry survey)<br/>Measured weekly</p>  | 90%+ satisfaction or #1 DNO Group average over RIIO-ED2   |
| <p>Stakeholder experience – measuring satisfaction of all of our engagement mechanisms ranging from “ask the expert,” surgeries and forums for LCT customers<br/>Measured after each event</p>  | 90% satisfaction of our engagement from LCT customers (e.g. EV charge point providers) average over RIIO-ED2                    |
| <p>Service experience – measuring complaints of LCT connection customers<br/>Measured at the point of each complaint.</p>   | Measure to be confirmed as we need to assess our baseline of complaints for LCT customers and then put a target to reduce this. |
| <p>Regional planning service experience - LA engagement scores for our Local Area Energy Planning service given the criticality of LAs to drive local decarbonisation planning and delivery.<br/>Measured quarterly.</p>  | 90% satisfaction with our service average over RIIO-ED2   |
| <p>Connection timescales – how effectively are we delivering on customer expectations for delivery timescales?</p> <p>Specific question in our CSAT survey that asks customer “How well has the DNO met your timescales for connection of your service? Please rate from 0-10”</p> <p>All connection customers will be included in this measure.<br/>We will report scores by customer segment (domestic, business, connection type) to give a view of the overall market satisfaction.<br/>Measured weekly</p> | 90% overall satisfaction with delivery timescales average over RIIO-ED2   |

We will embed these measures in our management incentive frameworks to ensure that our executive and overall company remuneration policy is linked to the key priorities of our customers. We describe this in further detail in Section 5: Social Contract.

In summary we are confident, but not complacent about our strategy to ensure we are not a blocker to decarbonisation in our regions. We are already working on implementation plans for our proposals and developing solutions to ensure we can hit the ground running in RIIO-ED2. We also realise that you can have a well thought through strategy that could become irrelevant if you are not on top of the changes in your external environment. That's why our ongoing engagement with customers and stakeholders, coupled with monitoring of key metrics are pivotal to provide the feedback loop to keep iterating and improving our business strategy.

## Do what we say on Whole systems

We are committed to being open and transparent about our progress as we deliver on our priorities in RIIO-ED2 both through our own actions and collaboratively with stakeholders and partners. Collaboration is vital if we are to achieve the stretching emission targets before us. Transparency is an essential component in fostering trust with our customers and partners so that we can work productively together.

Table 25 defines clear targets against which our performance will be measured.

There are a number of additional methods in which we can be held to account against these targets including through:

- Our annual reporting process where we will provide detailed formal progress reports against interventions and targets as well as other comprehensive reporting as required by Ofgem.
- Examination and assessment of our ongoing plans by expert advisory bodies including the CEG and CC.
- Regular meetings with Ofgem, BEIS, and other policy makers.
- Our ongoing broad customer and stakeholder engagement process where we are keen to understand needs and concerns as our plans progress and as the policy and technology landscape evolves so that we can best meet these needs.
- Close collaboration with stakeholders and partners to jointly develop energy and investment plans to meet their needs and targets.
- Regular publication of Open Data on our website relating to network investment plans, network capacity, curtailment, and other parameters.

In addition, as part of the new Whole Electricity System Licence condition (LC7A) introduced in May 2021, we will be publishing an annual register of whole system actions that we have coordinated with transmission and distribution network licensees<sup>77</sup>. Our approach to comply with this license conditions is:

- Engaging through the ENA Open Networks Project with stakeholders and with Ofgem to develop the form and typical content of the annual statement required to meet the License Condition for first publication by May 2022.
- In RIIO-ED1 launch and grow the register in preparation for RIIO-ED2.
- During RIIO-ED2 consider how the scope of this Whole Systems register can be expanded beyond just the transmission and distribution networks.

<sup>77</sup> Ofgem - Whole Electricity System Licence Condition 7a "Whole Electricity System Obligations"  
<https://epr.ofgem.gov.uk/Content/Documents/Electricity%20Distribution%20Consolidated%20Standard%20Licence%20Conditions%20%20-%20Current%20Version.pdf>

Table 25: Our Whole Systems strategy targets

| # | Whole Electricity interventions  | Actions We will take to deliver our interventions  | How you can hold us to account? (KPIs)  |
|---|--|--|---|
| 1 | We will expand the geographic area of our South East RDP in RIIO-ED2 and deliver a regional development programme in East Anglia by 2024, as agreed with the ESO, unlocking value identified in the ESO CBA through this approach.   | We will continue expanding the geographic area of our South East of England RDP during RIIO-ED2  | We will continue expanding the geographic area of our South East of England RDP during RIIO-ED2.<br><br>We will deliver a Regional Development Programme in East Anglia by 2024.  |
| 2 | We will work with the ESO to expand the Power Potential trial to be a business as usual offering across our EPN and SPN regions by 2028. This will be a world-first large scale rollout of a whole system reactive power management solution.                                    | We will work with the ESO to expand the Power Potential offering across our EPN and SPN by the end of RIIO-ED2   | By 2028 our DER in EPN and SPN are providing reactive power service to the ESO  |
| 3 | Over RIIO-ED2 we will deliver 1.2GW of distributed energy resources (DER) capacity at no more than £8m, using smart interventions and new innovations, reporting progress in our annual business plan.   | Release 1.2GW (associated with the highest scenario of grid scale solar and battery uptake) of additional capacity through a combination of DSO-led solutions and market-based curtailment trading over RIIO-ED2 for no more the £8m   | Release 1.2GW (associated with the highest scenario of grid scale solar and battery uptake) of additional capacity through a combination of DSO-led solutions and market-based curtailment trading over RIIO-ED2 for no more the £8m. |
| 4 | We will make our connections process faster and easier for our residential customers connecting low carbon technologies. We aim to instantaneously process 80% of general enquiries (GE) supply upgrades via self-service offerings, delivering a 9/10 experience over RIIO-ED2. | Deliver new instantaneous self-service offerings for GE supply upgrades (target 80% volumes)<br><br>(End of RIIO-ED1 target is 40% volumes)  | 80% of LCT service and supply upgrades to be self-service by the end of RIIO-ED2  |
|   |  | Offering new customer support tools for connecting customers such as our depot EV capacity calculation tool for fleet operators, resulting in customers asking for the most efficient connection capacity from the outset. For further details on this action please refer to the connection's strategy appendix | Launch and manage a Fleet connections tool, to support fleet managers to select the best solution- embed Optimise Prime solution into BAU   |
| 5 | For each year of RIIO-ED2, we will develop high quality marketing information which can be used by third party intermediaries, to encourage an increase in customer use of low carbon technologies, unlocking greater participation in flexibility markets                       | Annually we will produce useful information, which explains to customers (delivered through third parties) the benefits of LCT information and how it benefits them<br><br>We will work in partnership through intermediaries to deliver and market this information   | Customers and intermediaries score us 9/10 for usefulness of this information on average over RIIO-ED2.   |
| 6 | We will develop an energy efficiency flexibility product, running tenders every 6 months, starting in 2023.  | Run 6 monthly energy efficiency tenders from 2023 as part of our flexibility programme<br><br>Develop explicit CBA assessment at investment planning stage.  | 6 monthly EE tenders run from 2023  |
|   | <b>Whole Transport interventions</b>   | <b>Actions We will take to deliver our interventions</b>   | <b>How you can hold us to account? (KPIs)</b>   |

|                                 |   |  |   |
|---------------------------------|---|--|---|
| 7                               | We will assess and if required upgrade supplies for 728,000 homes free of charge to accommodate connecting LCT's by coordinating with installers.   | Promote home fuse upgrades and service alterations through better coordination with industry.  | Counting assessments, fuse, service alteration of unlooping's offered in RIIO-ED2                                       |
| 8                               | We will create an additional 248MW of LV network capacity to unlock LCT related demand across our networks.   | Proactive load related network / flexibility investment to facilitate capacity required for residential LCT volumes in the period and where accelerated uptake is forecast including upgrading single to three phase CCT programmes, smallest pole mounted transformers of 50kVA and small-bore LV cable upgrades. | 248 MW LV Capacity delivered for LCT related load over the period   |
| 9                               | We will reduce street-works costs and transport disruptions in London by collaborating with other statutory bodies on at least 40 collaboration projects in RIIO-ED2  | To complete at least 10 collaborative street-works projects in RIIO-ED2  | 40 collaborative projects across the period<br><br>We will report against this target in our annual business plan       |
| 10                              | We will use well-defined uncertainty mechanisms to prepare for a possible accelerated LCT uptake by ensuring capacity is released in a timely manner and facilitating an additional 847MW of LV capacity for LCT uptake and support an additional 1.1m homes connecting an LCT. | Facilitate accelerated LCT uptake by ensuring an extra 847MW of LV capacity is released in a timely manner.  | Deliver 100% of the capacity volume triggered across the period under uncertainty mechanisms                            |
|                                 |   | We will also ensure an additional 1.1m homes are ready for LCT adoption.   | 100% of triggered volumes delivered   |
| 11                              | We will run a process to identify and address market failures with respect to the provision of on-street charging, unlocking over 2,400 public charge points in areas of market failure.  | Engage 127 regional and local planning authorities and identify 2% of areas where public charging market failure exist.  | Engage 127 regional and local planning authorities and identify 2% of areas where public charging market failure exist. |
|                                 |   | Run tenders in 2% of total areas, supporting in areas of market failure only.  | Run tenders in 2% of total areas, supporting in areas of market failure only  |
|                                 |   | Unlock market to deliver 2,400 public chargers across the period   | Unlock market to deliver 3-5k public chargers   |
| 12                              | We will run a process to identify and deliver an additional 7-8MW of capacity in areas located near 14 motorway and trunk road service stations, by running a call to market in 2024 and 2025, ensuring a maximum of 30 miles between charging across our regions.              | Using our Green Recovery approach, we will run two call to market rounds, to request applications, and assess and select MSA sites that provide most value to customers.   | Run 2 rounds in RIIO ED2- Y2 and Y3   |
|                                 |   | Deliver network capacity/extension programmes of 7-8MW at the closest point of our network to estimated 14 MSA sites selected.   | Deliver all Ofgem approved sites with 7-8MW each  |
|                                 |   | Future-proof MSA connections by laying 33kV cables to 11kV supplies.   | 100% of MSA cable routes installed- rated for 33kV for future proofing  |
| <b>Whole Heat interventions</b> |   | <b>Actions We will take to deliver our interventions</b>   | <b>How you can hold us to account? (KPIs)</b>   |
| 13                              | By 2028 we will proactively provide LCT and energy efficiency information to 1.4m of our customers located within zones earmarked for electrified heating.  | Proactively provide energy efficiency information to all our customers located within zones earmarked to electrify (as per Heat Street innovation project analysis)  | 100% of areas identified for electrification reached with energy efficiency advice                                      |
|                                 |   | Ensuring we leave no one in these communities behind, by using funds from the UK Power Networks Foundation, where necessary to   | See targets in the Consumer Vulnerability strategy  |

|    |  |  |  |
|----|--|--|--|
|    |  | proactively support vulnerable customers in the transition (as explained in our Vulnerability Strategy)  |  |
| 14 | We will ensure that 71% of off-gas grid homes in our regions have the suitable capacity to decarbonise their heating and transport by the end of RIIO-ED2.   | We will deliver coordinated network capacity release programmes to support off-gas grid communities. Activities will include: <ul style="list-style-type: none"> <li>• Upgrading HV overhead lines to 3 phase</li> <li>• Upgrading LV networks to larger capacity</li> <li>• Upgrading transformer capacity</li> <li>• Coordinate with the existing PCB transformer replacement programmes to minimise disruptions</li> <li>• Future proofing the above upgrades to ensure we touch the network once</li> </ul>  | 71% of the 341,000 off-gas grid homes have suitable capacity to decarbonise by the end of RIIO-ED2   |
|    |  | Identify which off-gas communities to target by using external data sets such as fuel poverty statistics, insights from our local planning project Heat Street and local climate plans from local authorities.   |  |
|    |  | Coordinate the delivery of energy efficiency measures by working in partnership with trusted intermediaries to support customers to insulate and improve building fabric ahead of any off-gas grid transition programmes.  | 341,000 off-gas grid homes provided with energy efficiency information and advice<br><br>106,000 homes implementing energy efficiency measures as a result of our advice.  |
|    |  | Coordinating with community energy groups, leveraging our experience and resultant framework delivered by CommuniHeat innovation project, to raise awareness and educate customers in off-gas grid areas   | 341,000 customers reached and engaged around potential decarbonisation pathways  |
|    | <b>Whole System Planning interventions</b>   | <b>Actions we will take to deliver our interventions</b>   | <b>How you can hold us to account? (KPIs)</b>  |
| 15 | We will engage with all 127 regional and local planning authorities on their climate plans, offering a three-tiered support service utilising a framework to assess, develop action plans and deliver investments where a prescribed level of certainty is achieved in period. | We will engage with all 127 regional and local planning authorities on their climate plans and establish a local area planning team of 7 full time employees (plus an option for an additional 5 under uncertainty mechanisms should the workload exceed defined triggers): they will be responsible for working with Local authorities to assess their energy plans and develop CBAs.<br><br>This will follow a three-tier approach:<br>1. Tier 1: We will work with all 127 regional and local planning authorities to assess their plans and readiness against the framework<br>2. Tier 2: For the Local Authorities passing the above assessment (40-50), we will deep-dive into their climate action plans to agree optimum infrastructure requirements with them<br>3. Tier 3: For Local Authorities who have defined projects requiring bespoke strategic investments, we will work with them to co-develop suitable CBAs to unlock infrastructure investments (10) | Volume of staff fully allocated to this activity will be reported in our annual business plan<br><br>Volume of assessments conducted in RIIO-ED2<br><br>Volume of LAs supported in developing climate actions plans<br><br>Volume of LAs trigger investments |
| 16 | By 2024, we will provide core planning datasets via an on-line self-service  | Deliver online self-serve planning tools for local authorities to conduct energy planning by 2024  | Annual volume of DFES and SFS data shared with LAs   |

|    |  |   |   |
|----|--|---|---|
|    | energy planning tool to support the planning process for our local authorities, helping them make the best choices for their communities.  | Providing detailed information of local infrastructure and coordinating with other organisations (such as installers) on the requirements for smooth compliant installations of LCTs.   | Volume of customers that were issued tailored information annually- we will report on this in our annual business plan                  |
| 17 | We will provide proactive services to our DER by expanding our digital outage planning and automatic restoration tools, to minimise disruption and maximise their system access. | 100% of our DER with capacity over 1MW to be covered by Outage planning and automatic restoration services and proactive provision of information including historic data.  | DER score us 9/10 for usability of these tools on average over RIIO-ED2. 80% of all DER over 1MW registered on the outage planning tool |
| 18 | We will embed a requirement to have explicitly considered whole system solutions as part of our investment planning and investment governance                                    | 100% of investment scheme papers will have an explicit assessment of whole systems and will be reviewed as part of the current investment governance, this will be implemented before RIIO-ED2 and reported in our annual DSO report. | 100% of investments have a whole system assessment  |

### Building on our customer and stakeholder engagement

Our core RIIO-ED2 engagement programme comprised of five phases and drew insights from over 16,000 customer interactions including large demographically representative surveys covering residential and business customers across our regions. To deepen our understanding of these, 83 focus groups and 160 in-depth interviews were held to draw qualitative insight including with hard to reach groups. This programme of engagement provided insight on the priorities of our customers and stakeholders and the outcomes they expect.

Rather than developing options for how to deliver on those expectation in isolation, we established a Net Zero and Whole Systems Council and DSO and Whole Systems Panel to co-create solutions for our business plan. Composed of respected and representative organisations with expertise across the energy landscape, these groups challenged our direction and level of ambition. To ensure our plans reflected a whole systems approach, we engaged with wider groups of stakeholders through webinars, bilateral calls and focus groups, focusing on those at system boundaries across energy, heat and transport. By reflecting on stakeholder feedback with our Net Zero and Whole Systems Council and DSO and Whole Systems Panel, we iteratively developed a robust set of business plan options to satisfy our customers' that were taken forward into quantitative and qualitative options testing.

To ensure that our business plan is robustly evidenced, the engagement and research insights were run through a triangulation exercise that assessed the strengths and weaknesses of our proposed business plan against the evidence available and made reasoned and justifiable decisions to inform our Business Plan. We then undertook Acceptability testing to provide us with an understanding of customer views towards the proposed business plan and ultimately how acceptable it is in their eyes. In asking customers to consider the acceptability of our plan in relation to our environmental proposals, we summarised and packaged up our commitments using the terminology “reducing the carbon emissions from customer homes and UK Power Networks’ own network”, explaining our proposals to facilitate the Net Zero energy transition together with those to reduce our own environmental impact.

Following submission of our Initial Business Plan and feedback received that our plan should recognise local and regional climate plans, we undertook extensive engagement with all County Councils and Local Authorities in our network areas. We provided an overview of the key messages and overall costs from our Initial Business Plan to test support for these at a regional and local level. We held 3 webinars and 14 interactive sessions, one for each county in our network areas, and invited Local Authorities in those counties to attend. During these sessions we:

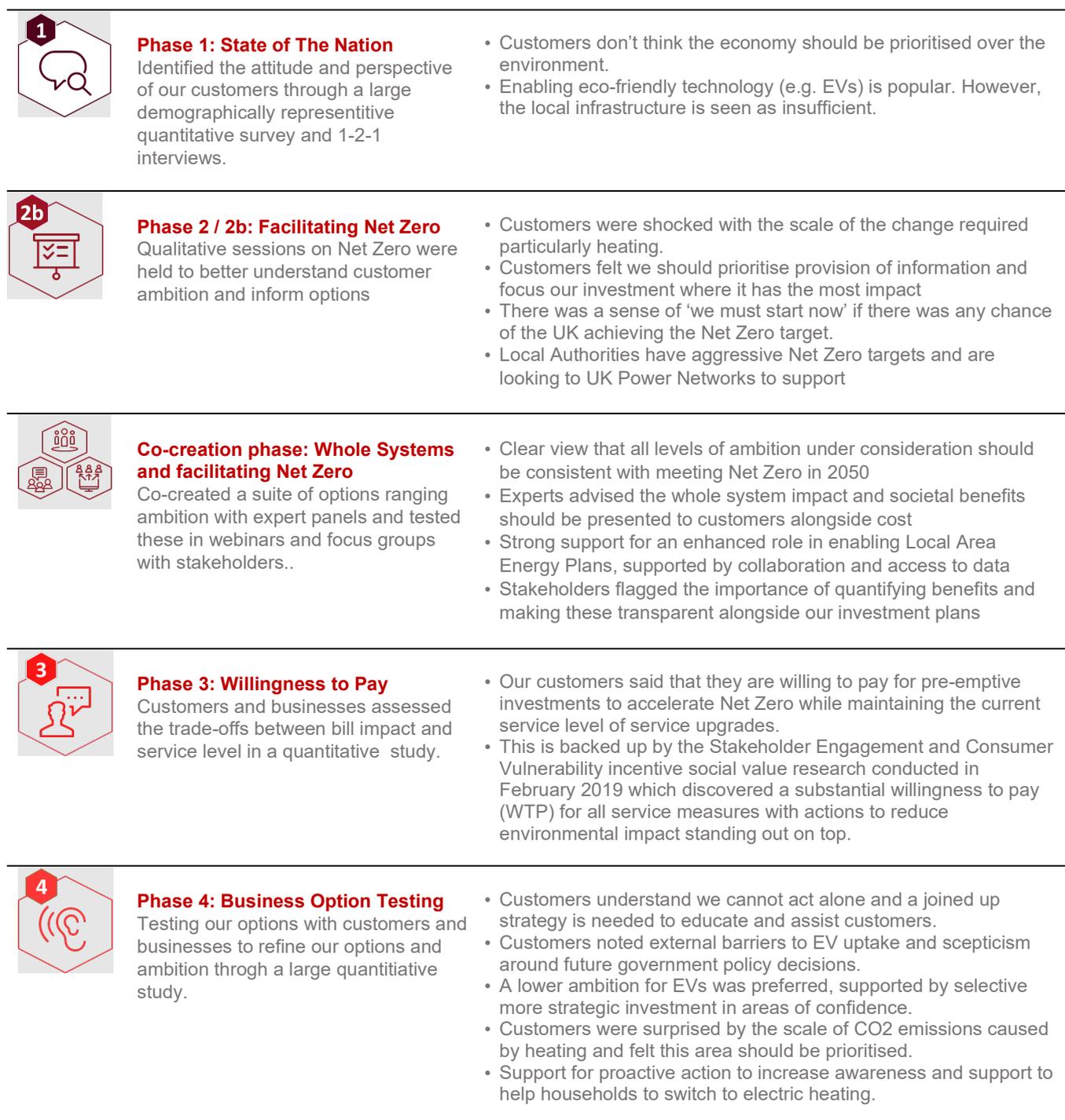
- Shared our forecasts of the take up of low carbon technologies in their areas that have been included in our plan.
- Highlighted our investment approach and the areas where we expect to invest to increase network capacity.
- Presented our understanding of their net zero ambition and introduced our proposed climate action plan assessment framework to support the delivery of it.

- Presented key strategic net zero and vulnerable customer investments that we have included in our plan.

After each session, we sent out a questionnaire designed to quantify the level of support for our key initiatives covered and gather further feedback.

For full details of engagement that informed the development of our RIIO-ED2 business plan, please refer to our “Line of Sight – Whole Systems” Annexe A and RIIO-ED2 Engagement chapters.

Figure 23: Overview of our Stakeholder Engagement Approach





### Phase 5: Acceptability testing

Test customer support for the RIIO-ED2 business plan through a large quantitative study.

- Acceptability of our plan in relation to our environmental proposals was greater than 80% in all three of our regions.
- Customers thought it was important we are doing work to play our part, especially given our role in readying the network.
- There was appreciation of the balance between internally focused initiatives and those focused on the public within the plan.
- From a business perspective in particular, more guidance and impartial advice would be appreciated from UK Power Networks

## Testing our Initial Business Plan with stakeholders

The valuable input received from our engagement with County Councils and Local Authority confirmed that our Climate Plan Assessment Framework is a proportionate and transparent approach for assessing regional and local climate action plans. We further adjusted our Whole Systems strategy, plans and commitments to align our proposals and ensure we unlock investment for local area plans for development and growth. Insights from this engagement and our engagement with our Net Zero and Whole Systems Council, customer representatives and consumer groups included:

- Broad support for our Whole Systems commitments but the need to consider local needs and future government policy were stressed.
- Unequivocal demand for a local area energy planning team and digital tool and a strong desire to participate in co-design, development and testing of the tool.
- General consensus that energy efficiency measures are equally important as electrification of heating for off-gas grid customers.
- Insistence that collaboration with local authorities is critical for public charging and consideration for the Access and Forward Looking Charges Review is necessary.
- Direction that en-route charging capacity on the strategic road network should focus on areas where social and economic growth is planned.

We have subsequently received 10 letters of endorsement from County Councils and Local Authorities further endorsing our business plan and framework.

## Our commitment to continued engagement throughout RIIO-ED2

To deliver our ambition of achieving Net Zero at the lowest cost to customers in an increasingly complex energy sector, a whole system approach is required. By collaborating with our peers and working in partnership with a broad range of organisations across system boundaries, we will account for interdependencies across the whole system and inform decarbonisation pathways. Our coordinated approach will enable us to make better business decisions and deliver on customer and stakeholder needs in an optimal way.

We will gain insight from our customers and stakeholders annually throughout RIIO-ED2 to understand how we can support them in facilitating their transition to a Net Zero future, including consideration of the trade-offs involved. As our customers' and stakeholders' priorities and preferences evolve, so will our engagement approach.

As outlined on our RIIO-ED2 Business Plan, we will employ two mechanisms to support this engagement:

- **An annual State of the Nation survey** - our industry will be going through a significant transformation over the period and this will impact everyone. This annual survey is aimed at understanding the views and priorities of citizens across our three regions that can be tracked over time.
- **Citizen Assembly** - many of the issues we are grappling with our complex and multi-faceted. We will use assemblies to bring out diverse perspectives on complex and contested problems. By investing time in this form of deliberative research it will enable participants to understand, change and develop their opinions. The UK's Climate Assembly and the Scottish Government's Just Transition Commission have demonstrated how this can be done

Applying the engagement approach set out in our core business plan across the four building blocks that make up our whole system strategy for facilitating Net Zero will allow us to maintain a whole system perspective as we continue along the decarbonisation journey.

Figure 24: Our engagement approach



There are significant whole systems benefits for the customer to be gained from close collaboration across whole system planning; whole electricity; whole transport; and whole heat. Common to these Building Blocks is the need to continue working with traditional stakeholder such as network companies, Ofgem, government bodies, generators, retailers, aggregators, consumers and consumer groups.

Critically, decarbonisation pathways must reflect the needs and ambitions of local communities. We will need to collaborate and to co-develop the plans that will enable us to achieve Net Zero together. Reflecting on this, our plan commits to expanding our capabilities so that we can work more closely with local bodies to establish and deliver local area energy plans.

Across whole electricity, we will build on strong relationships with the ESO, TSO and other DNOs both bilaterally and through joint forums such as the ENA and Open Networks Project. The electricity network plays a pivotal role in all decarbonisation scenarios and as the future network is developed, regular engagement with these bodies at strategic and operational levels will allow us to optimise developments across transmission and distribution systems. In turn, this will reduce the cost of investment required while ensuring operational security as the electricity we transfer becomes less carbon intensive.

As we become more integrated with the heat and transport sectors during RIIO-ED2, our links with organisations across these sectors will become more deeply embedded in our core business functions from connections through to customer services and DSO. This will include continued engagement with CPOs, heat network stakeholders, equipment manufacturers and installers at an operational level to facilitate the integration and operation of these technologies on our network in the simplest way possible. As these emerging technologies evolve, we will continue to co-design energy solutions in partnership with innovators, government, industry, academic, thought leaders and technology providers to learn from others, establish best practice and accelerate adoption.

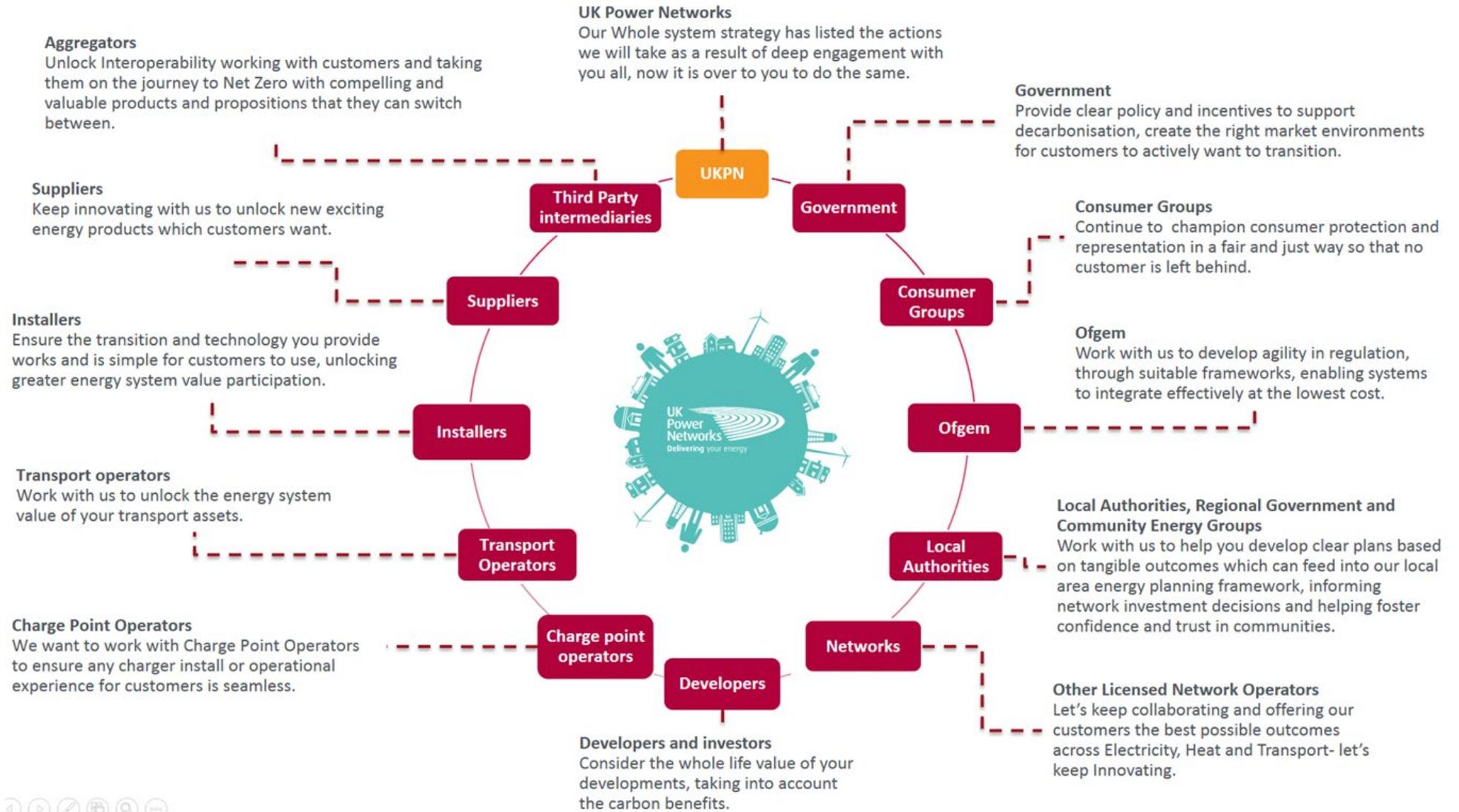
We will also continue to develop our engagement across new intersecting segments such as telecoms, water and other transport systems such as rail, this engagement will be covered under our Innovation engagement plans, which to date has been the springboard to wider system value in systems such as transport, electricity and heat.

### The call to action

We commit to being a proactive enabler and facilitator of Net Zero and our strategy sets out our interventions to achieve this at the lowest Whole system cost. However, we know that we can't do this alone. To achieve the ambitious decarbonisation goals of our customers, we will need to work together with a community of partners from across industries to make ambitious and coordinated plans to ensure the path forward is as efficient as possible. These plans will need to deliver the infrastructure, markets and services that enable widespread decarbonisation, while ensuring that no one is left behind in the energy transition.

We now welcome other actors across the whole energy system to respond to our call to action by joining forces with us as we deliver on our interventions and collectively implement the changes required to facilitate Net Zero.

Figure 25: Our Call to Action for Whole Systems actors



## **Annexe A: Line of Sight – Enabling Whole Systems Solutions- Redacted**

## **Annexe B: Whole Systems end-to-end case studies- Redacted**