NORTHERN POWERGRID

DSO v1.1

Distribution System Operator
Development plan

October 2019

Contents

Foreword

A year of exceptional weather and extreme climate events has brought the need to mitigate and adapt for climate change and the urgency of making a transition to a low-carbon economy into sharp focus. With climate emergencies declared by many of our local authorities and a national net Zero Carbon by 2050 commitment made, we need to be considering more radical changes to eliminate net carbon emissions and create a clean and sustainable society for our children and grandchildren. We simply have to take action now to decarbonise our economy. Our electricity, transport, heating and homes also have to adapt to climate change that is already locked in.

Dramatically decarbonising the electricity system, while electrifying everything from cars to heating, is part of the solution to achieve substantial progress towards net-zero emissions by 2050. Our vision is a smart, flexible and clean energy system, where your electric vehicle is powered by a neighbour's solar panels and you get a discount on your bill for providing power back to the grid. We envision a world where your office heating intelligently manages its energy consumption to get the best price and help to balance power supply and demand; where batteries kick in automatically to keep critical infrastructure and your home running in a power cut.

In this world, everyone benefits from reliable affordable power, no energy is wasted and the system works to utilise every kWh of renewable energy that can be produced. We are determined to help make it a reality. As a distribution network operator, we already play a central role in enabling a low-carbon energy system, connecting people to wind and solar power across our region.

We have embarked on a transition to expand our capabilities and become a local optimiser of the energy system. The new role we are taking on is that of a Distribution System Operator (DSO). This entails us being a trusted and neutral platform able to optimise the whole energy system and underpin the rapid transition to carbon-free electricity, transport and heat; a system with the customer at its heart. We know from extensive public engagement over the last year that a broad range of stakeholders support our plan. It can deliver value to all of our customers and to the country. We wish to continue this dialogue around the updated proposals contained in this plan.

As a DSO, we take responsibility for the integrity of the regional system and the operation of energy markets, including new markets for local flexibility. We aim to enable customers to become active participants in the energy system, maximising the financial value of their energy resources and eliminating the need for new infrastructure, which would otherwise be needed to ensure a reliable system, cutting costs and helping the environment. We believe that making sure the system works to minimise the need for carbon-emitting generation ensuring every low-carbon kilowatt-hour of electricity is captured and used effectively needs to be central to our future work. We will also deliver a socially inclusive energy transition that benefits every one of the eight million people we serve.

We are already driving innovation. Our Customer-Led Distribution System programme is exploring the future potential for our network to operate a more flexible energy system and avoid unnecessary investment in our infrastructure or new generation. We are now rolling out the initial phase of customer flexibility, using commercial solutions to resolve network issues.

Our Smart Grid Enablers programme is preparing our network for the rapid growth of electric vehicles and we have set out the steps we are taking to be ready for the electrification of transport. We want customers to get the lowest cost energy for their vehicles through smart charging when the network is less utilised and to be able to sell power back when they are not in use. Providing power through vehicle-to-grid services could even protect households from power cuts.

We are investing in flood defences, new technology, cyber and physical security to make our network more resilient and adapt to unavoidable climate change and other threats. We are conscious how much of our daily lives is dependent on a power supply.

Social equality is very important to us when considering the future of the energy system. We want all of our customers to benefit from a smart system that is more efficient, reliable and cost-effective, allowing us to keep prices down. We are delivering projects such as microgrids to ensure the resilience of our rural communities and battery response solutions that allow vulnerable customers to remain on supply if there is a network fault. Our social inclusivity approach will ensure that as a DSO we always provide the best service and we will be asking people for their views later this year.

As we continue to develop our role as our regions' distribution system operator, it is critical we do so openly and transparently in dialogue with our customers and wider stakeholders. We have worked with a wide range of customers and stakeholders to develop our transition to DSO. Through dialogue, building on our 'DSO v1.0 next steps and emerging thinking', published last year, this DSO v1.1 document updates our guiding principles, explains our plan and why our vision for the future is right for our region. It is an incremental build in our thinking and provides more definition to our transition plan.

We are looking forward to continuing to work with the communities we serve as we continue to deliver the implementation and refine our future plans. This work directly informs our next long term business plan that we will start sharing in 2020, ahead of formal submission in 2021. The energy regulator will use this to determine our regulatory settlement for 2023-28.

Thank you for your continued interest, engagement and feedback.

Patrick Erwin
Policy & Markets Director

Executive summary

The need for change is more urgent than ever

The Government's commitment to achieve net-zero emissions by 2050 and the climate change emergencies declared in many of our local authorities are a radical step change in our collective ambition for decarbonisation. The pace of change in the UK energy system must now accelerate dramatically to match. Delivering net-zero means providing entirely carbon-free electricity for homes and businesses. It also means a profound increase in electricity demand to be able to decarbonise transport and heating – an extraordinary scale of transformation.

We are already responding. There is unprecedented change in the UK's energy system. Electricity production is fast shifting from large fossil-fuel power stations to renewable sources – predominantly intermittent power that ebbs and flows with the sun and wind. The whole system is becoming less centralised as smaller scale local generation has grown, up from 1GW to 4GW on our network alone in a decade. The way consumers use electricity is also shifting. In the next 10 years, we will see millions of homes and businesses embrace electric vehicles, adopt heat pumps and use battery storage as the UK decarbonises.

The growth of new technologies is essential to meet our climate goals. It will pose new stresses for energy networks and create new opportunities to transform how we manage them. It is incumbent that we act now to enable the optimal energy system for rapid decarbonisation. We must proceed with the utmost urgency.

Networks have a critical role to play

Electricity distribution networks are critical enablers for decarbonisation. We are already adapting to enable a smart, flexible, carbon-free energy system while continuing to deliver a safe, reliable and affordable service to our eight million customers. We are increasingly responsible for connecting customers directly to wind and solar power while actively ensuring the safety and reliability of our networks to keep power flowing to the communities we serve.

We are capable of becoming neutral, trusted platforms for optimising the whole energy system. We see a near-future where we are responsible for efficiently balancing our network, reducing the need for additional costly infrastructure or excess generation capacity, and providing universal services for customers, suppliers and other providers that benefit everyone.

This is why we are transitioning to a Distribution System Operator (DSO) model. We believe we are best placed to actively manage the network in real time and balance supply and demand locally. We can combine solutions for network flexibility and customer flexibility to maximise the value of all the existing energy assets that make up the local grid and reduce the need for high-carbon back-up power generation. We can deliver a network that efficiently manages widespread renewable power, so that every kilowatt-hour of low-carbon electricity is used productively and never has to be constrained.

We are already delivering the changes required to expand our capabilities, and this document is our plan to reach the full potential of our vision of DSO. It includes our long term plan to 2030, detailing how we propose to continue acquiring the competencies and develop the services we will need. It sets out our role and the actions we will take as an active participant to support the immediate and rapid decarbonisation of the energy system. It explains how we will help our customers extract maximum value from their assets through access to a range of markets. It also states how we will ensure clear accountability to deliver a resilient and cost-effective service throughout our network.

Collaboration is central to achieving this vision. This document shows how we are collaborating with other network operators and working to support the Government's Smart Systems and Flexibility Plan[1]. We are building this smart, local and cost-effective network around the needs of our customers, in collaboration with them, the wider industry, regulator and Government. This must be a joint effort.

We welcome Ofgem's summer 2019 DSO position paper. Using this as a base we are now exploring with industry and Ofgem what this will mean for the period to 2020 in terms of our role and how we can develop services for our customers. This will enable us to bring forward comprehensive business plans as part of the ED2 price control review.

[1] 'Upgrading Our Energy System – Smart Systems and Flexibility Plan', Ofgem, BEIS, 2017

Distribution network operators are best placed to deliver the optimal outcome

We believe we are best placed to ensure a fair and inclusive transition to a DSO model:

- Our eight million customers have diverse needs and we have a long term track record understanding how to prioritise and meet those needs while delivering a safe, stable and reliable network.
- Every customer in our region benefits from clear accountability for the transportation of their power because we own the assets we operate and are exposed to the risks that come with operating them.
- We are well capitalised and our equity shareholders are accountable for any failure, not the taxpayer.
- Our scale means we can champion our customers' needs at a national level while also engaging with the most local community energy groups.
- We are able to facilitate decarbonisation while putting customers at the heart of the transition with our local presence.

The implementation of our DSO plan is already well underway, exemplified by the initial phase of customer flexibility that we are rolling out. We are also introducing changes to provide clear direction for our people, enhance internal checks and balances and provide visibility to build the trust of our stakeholders. We are working with them to give confidence that we are delivering the right changes and that the adoption of new commercial services is delivered appropriately.

We believe that this will have a positive impact on the transition to DSO, including the development of competitive local markets for flexibility. These will provide greater resilience for our customers and new revenue streams in a way that benefits the whole energy system.

Our plan to deliver DSO

'DSO v1.0' was an articulation of our proposal. It provided a basis for customer consultation and allowed us to confirm our approach is the right one. This updated version responds to the feedback we have received, refines our guiding principles, confirms our commitments and sets our plan to transition to a DSO. DSO v1.1 is an incremental update to DSO v1.0. Our thinking on what DSO is and how we are approaching it has not changed materially.

We also demonstrate the progress we have made on our pathways, including:

- commenced market testing for customer flexibility services;
- made specific commitments to roll out customer flexibility processes that are business as usual, neutral and transparent;
- understanding of the interaction between wholesale energy and network services markets through our Customer-Led Distribution System innovation project;
- getting ready for the increased uptake of electric vehicles;
- practical proposals on consumer vulnerability, on which we will consult further;
- building our data capability as per the Energy Data Taskforce recommendations; and
- developing our Distribution Future Energy Scenarios to invite stakeholder input and scrutiny.

Establishing a level playing field for customer flexibility

Flexibility is central to our vision. We want flexibility to be an option for all of our customers, so they can financially benefit from offering it to the system. We envisage a world where a market for flexibility is embedded in every part of the network, allowing customer demand to be despatched with confidence to balance renewable power. This system would quickly find the lowest cost, low-carbon solution, maximising the value for customers while eliminating the need for high-carbon back-up generation.

This flexibility will play into a deep and liquid market, serving the energy and network services markets. When the cost of managing part of our network though flexibility exceeds the cost of alternative options, then our customers should still be able to offer their services to the energy market or the transmission system.

We won't get there overnight. The first phase of our customer flexibility plan is moving us in the right direction. We are committed to helping build a flexibility market that works for all users of the network and for the whole energy system, providing confidence to the market that every decision is made on the basis of sound judgement. As part of this commitment, we contributed to the formation of the Energy Networks Association's 'Six steps for delivering flexibility services'[2].

[2] Available from: www.energynetworks.org/assets/files/ENA%20Flexibility%20Commitment%20Our%20Six%20Steps%20for%20Delivering%20Flexibility%20Services.pdf

We pledge to deliver against each of these six commitments, as we continue the roll-out of our customer flexibility strategy through a number of different means.

- We will update and publish, by the end of 2019, our investment appraisal processes to embed customer flexibility into business as usual and explain how these are delivered by our teams.
- We will provide further transparency by designing a reporting framework that gives maximum visibility on the processes described above. We will start publishing these reports in the first quarter of 2020.
- To champion a level playing field, we will implement measures to make sure all potential service providers have an equal chance of participation in flexibility markets.
- We will continue to work collaboratively with our network partners, industry, Government, regulators and other stakeholders to deliver best practice.

Value for money for our customers is paramount and we will only deploy customer flexibility where it demonstrates this. In December 2018, we launched an Expression of Interest for flexibility at nine locations across our network, where our analysis indicated that flexibility may help defer network reinforcement. Through further network assessment[3] we determined reinforcement is no longer required during the current price control period. To ensure maximum value for our customers, we will not be progressing flexibility procurement for that use case in these locations.

Instead, we aim to deploy flexibility services to aid our two other use cases of planned maintenance and emergency support. We will tender for services at a number of locations in 2019 for services in 2020.

Implementing innovative network solutions

A smarter network is an essential precursor to a flexible energy system. Innovation is essential to manage new patterns of energy use, electric vehicles and heating. Our £83 million Smart Grid Enablers project is the UK's most comprehensive network upgrade programme. It is transforming our ability to monitor, control and communicate with more than 860 substations. It will give us the ability to respond to real-time information about power flows on our network and enable us to roll out smart grid solutions that could generate up to £350 million of benefits by 2031.

Our Active Network Management (ANM) solution is providing scalable capability to connect more generation at least cost, as an alternative to conventional reinforcement. We have 433MW of contracted flexibility in our four existing ANM zones and Driffield went live this year. We intend to roll out further ANM zones where there is high customer interest in connecting to the network, limited capacity and high reinforcement costs.

Extracting maximum value from electric vehicles

We want to unlock the full potential of electric vehicles (EVs) and their charging infrastructure to increase local flexibility. EVs are set to become dominant over the next 20–30 years, with up to 1m on the road in our region by 2028. This will increase energy demand and pose new challenges for networks, yet it could also provide flexible load and storage to reduce network costs.

We believe our network has the capacity to deliver the electrification of transport and are working with our stakeholders to ensure it benefits all our customers. Innovation trials of smart charging and vehicle-to grid technology are exploring how EVs could be a source of customer flexibility. Our EV report, 'Maximising the value of electric vehicles'[4] sets out what we are doing to accommodate EV's. Working with our partners, we want to demonstrate how they can be part of the solution to decarbonise society and benefit everyone.

Exploring the future for the whole energy system

This plan outlines future steps to build on our trials and initiatives over the next decade. We intend to develop innovative customer, commercial and technical solutions to deliver the functions and capabilities of a DSO.

We want to see a world where every low-carbon kilowatt hour of electricity is used productively. In future, no renewable and distributed generation should be stopped from entering the energy system. It should be able to be stored or diverted where it is needed in the network, delivering an efficient system and one where high-carbon power sources are no longer needed at peak times.

The most cost-effective, resilient and sustainable solutions will come from optimising the whole energy system, not just our own network, and take into account heat and transport. Our innovation programme is exploring solutions that can achieve these goals and work for our customers.

[3] Further information available in our Distribution Future Energy Scenarios, to be published by December 2019
[4] Available from: https://www.northernpowergrid.com/asset/0/document/5043.pdf

We are collaborating with Northern Gas Networks on InTEGReL, the UK's first incubator for integrated energy system technology. The project is exploring how heating systems can be used to help balance power demand and how gas storage could support the electricity system. Our Customer-Led Distribution System project has also identified £87bn of value in distributed energy resources (DERs) and the arrangements that would enable our customers to benefit from this.

Substantial enhancements in our ability to utilise data from our customers and network will help us and others to deliver new and improved services. A key part of our DSO role will be to provide data and information to the market. As a neutral facilitation service, we will enable competitive market providers to deliver improved services to customers. We support the recommendations of the Energy Data Taskforce and are collaborating with partners such as the Open Data Institute to take practical steps to make the vision a reality.

However, while the current regulatory and legal framework supports us to procure flexibility, it does not clarify our wider role and responsibilities to provide the scale of information and system coordination needed to manage a future network, accommodating millions of new energy resources such as EVs. We will continue to work with stakeholders, Government and regulators to support new policy and data initiatives.

Customers are at the heart of our transition

Our proposals are based on the insight of our customers. We have actively consulted customers and other stakeholders and will continue to involve them in influencing our plans. Our local presence, knowledge of our customers' needs and long term experience delivering services helps ensure that we provide the infrastructure and services that are right for them.

In response to our stakeholders' feedback on DSO v1.0, we have refined our guiding principles for DSO to address their needs.

Our transition to DSO:
- has decarbonisation and sustainability at its heart;
- is led by our customers' needs;
- provides a compelling value proposition for customers and stakeholders, that is ethical and promotes efficiency, fairness and inclusivity;
- operates according to processes that are neutral and transparent;
- keeps a strong focus on security and resilience;
- requires a right-sized regulated business that can support and enable deep and liquid competitive local markets for flexibility; and
- requires ongoing changes to duties that will optimise the system as the volume of distributed energy resources increase.

Achieving a socially inclusive transition which benefits all our customers

Ensuring an inclusive transition for everyone in our region is of the utmost important to us. We want all of our customers to benefit from a system that is cleaner, more efficient, reliable and cost-effective. We have developed an approach for a socially inclusive transition to DSO and will be asking people for their views later this year. Our unswerving commitment to supporting our most vulnerable customers means we will always ensure that we provide the best service as we transition to a DSO.

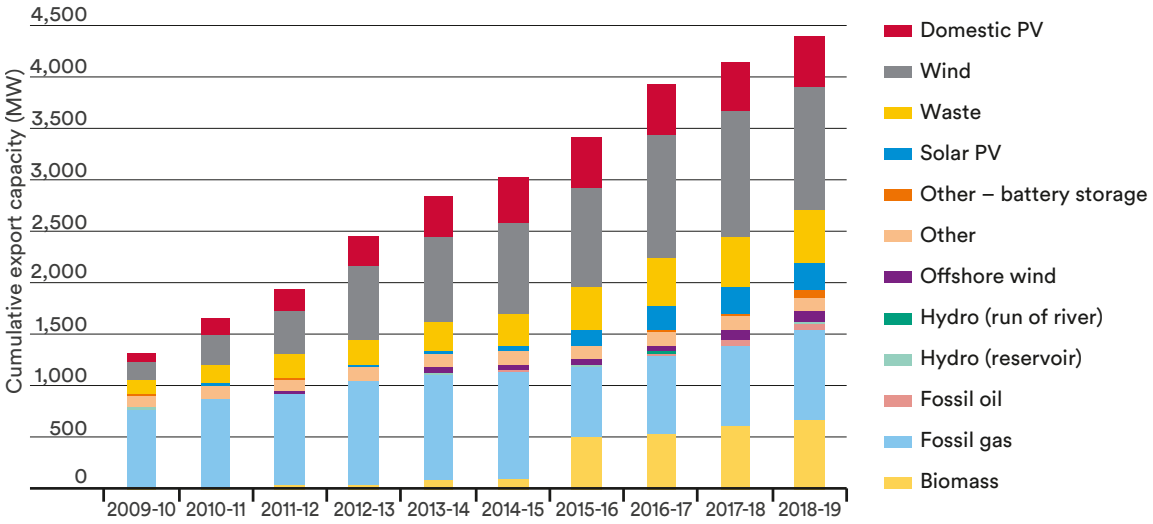
We will continue to engage with all of our customers and our second annual Stakeholder Summit will be held on 29 November 2019.

Unlocking customer value

The traditional 'fit and forget' Distribution Network Operator model is no longer appropriate for managing a system with growing amounts of local and intermittent generation, changing patterns of consumption and more complex resultant flows of electricity.

Local generation, including wind and solar farms, biogas plants, combined heat and power systems and rooftop solar panels on thousands of homes, now accounts for more than 4GW of the capacity on our network (see Figure 1) – up from just over 1GW a decade ago.

Figure 1: Generation connected to our network



It is not just customers' choice of generation that is changing. Our customers are also making the transition to electric vehicles, and the broader societal trends of digitalisation and more sustainable use of resources all require a response.

Northern Powergrid, in common with our peers, is adapting to these challenges by transitioning to a DSO model, increasingly actively managing the network in real time and optimising its performance through interaction with its customers. There are a number of unanswered questions on what DSO entails and how it may therefore be delivered. We explore this further in Part 2 of this document where we set out our longer-term plans. But it is recognised that the procurement of customer flexibility is a key implementation step and we go on to describe what we are already doing in that respect in Part 1 of this plan.

About this document

This document

At Northern Powergrid, we are helping to shape the transition from a DNO to a DSO to ensure it delivers value for all our customers. In this document we are setting out our direction, refined by stakeholder comment, to provide visibility of our actions and provide opportunity for further input.

Part 1 explains our ongoing actions for those areas where we are confident of the direction required – most importantly, the first phase of our customer flexibility plan roll-out that is already widely recognised as core to our DSO transition.

In Part 2, we are setting out our direction of travel on what needs doing out to 2030. We have choices to make in our business plans for the 2023-28 period and these will be informed by regulatory guidance and further stakeholder input.

This document is built from stakeholder feedback

This is the second version of our DSO plan, dated September 2019. It builds on 'DSO v1.0' which was released as a consultation, in December 2018[5]. Stakeholder expectations, technology and commercial development keep moving fast within and outside of Northern Powergrid. Our ongoing dialogue about DSO with customers, policy makers, regional stakeholders and colleagues is helping us to deliver the transition. This ongoing dialogue will contribute to the production of a strongly evidenced plan for the RIIO-ED2 price control that provides our customer with what they need.

To produce this iteration of the DSO plan, we have engaged widely since December 2018 and this has informed our revisions, refinements and progress. We participated in industry conferences and meetings, and held our own events:

- A stakeholder summit in November 2018 where we invited comments on our DSO green paper prior to publication of DSO v1.0;
- A DSO-focused event in January 2019 to gather feedback on our consultation[6];
- Six stakeholder-led, single topic roundtables in May 2019 – energy system data, innovation, retail market interface with DSO, climate change: the impact on regions and organisations, the challenges and interdependencies of decarbonising heat, and clean air zones and low emission vehicles;
- One-to-one meetings with stakeholders.

Have your say

Please tell us what you think about how we define distribution system operation and functions associated with it, as well as our ambition to deliver these.

We would also welcome views on the set of activities and direction of travel that we are setting out to become a DSO.

We have a set of specific engagements coming up, which we describe later on, in the stakeholder engagement section, but any views on our plans are welcomed at any time.

Send your comments to:
yourpowergrid@northernpowergrid.com

[5] Our DSO v1.0 emerging thinking and next steps, December 2018, is available from: www.northernpowergrid.com/asset/0/document/4682.pdf
[6] A summary of the event and the feedback that we received is available from: www.northernpowergrid.com/asset/0/document/4777.pdf

Action taken following feedback on DSO v1.0:

You said	We did
We agree[7] with the guiding principles but should you add to them to reflect the need for impartiality and transparency?	We have updated our guiding principles in this document (refer to page 38)
How can you be ready in time for the electrification of transport?	We have issued an EV document to explain the steps we are taking to enable this change
How do active network management and customer flexibility services interact?	We explain in this document (refer to page 25)
How does the governance process operate for Northern Powergrid's innovation portfolio?	We held a roundtable on the topic in May 2019
Can we contribute more feedback on social inclusivity?	In autumn 2019, we are consulting on our first draft for a strategy securing an inclusive energy system transition (refer to pages 40–43)
Could DNOs act as a trusted (and neutral) catalyst to optimise the whole energy system? This role is vacant for now.	We agree and are developing the case for the regulator so the right framework is in place by the start of the next price control
Can you provide long term visibility on your potential flexibility needs?	In December 2019, we will publish and consult on our Distribution Future Energy Scenarios to 2050
How do we ensure neutrality? And who is the arbiter/guardian of this?	We are making specific commitments with regards to visibility and neutrality (refer to page 17)

[7] At our January 2019 DSO event, a voting poll of the audience identified that 84% agreed.

Developing DSO v1.1: at a glance

DSO v1.1 is an incremental update to DSO v1.0

Our thinking on what DSO is and how we are approaching it has not changed materially. We have updated the previous document based on stakeholder feedback, brought it up to date and increased the detail in a number of places. The most material changes are identified here.

Area	Content	Changes in DSO v1.1	Page
Part 1: Developing DSO – our next steps			
Our customer flexibility plan	New	— Specific commitments for neutral and transparent roll-out of customer flexibility	17
	New	— How we are delivering against the ENA's six steps for delivering flexibility services	17
	Update	— Progress and next steps for our customer flexibility plan roll-out	18-19
Key enablers for decarbonisation	Update	— Description of our key enablers work	20-23
	Update	— Describing our active network management roll-out and how this relates to our use of customer flexibility services	24-25
Extracting maximum value from electric vehicles	Update	— Getting ready for the increased uptake of electric vehicles	26
Innovation: exploring the future	New	— Delivering understanding of the interaction between wholesale energy and network services markets – initial findings from our Customer-Led Distribution System project	34
PART 2 – Where next			
Guiding principles	Update	— Addition of principles on neutrality/ transparency and resilience	38
Making sense of distribution system operation	New	— A new proposition on seven themes for a socially inclusive transition to DSO	41-43
Adapting the regulatory framework	Update	— Identifying how our transition to DSO needs to work with the regulatory rule book around price controls	44
Our plan: at a glance	Update	— Showing work already done	46-47
	Update	— Outlined more future activities	46-47
Our stakeholder engagement			
	Update	— Latest customer research and outlook for next 12 months engagement	48-51
Annex – key themes			
	New	— Greater definition of future activities with additions including whole system approaches and data	54

Key priorities – what lies ahead

Engagement

Communicating — Engage with our stakeholders to understand what the DSO transition means for them and to guide its direction – stakeholder summit November 2019.

Planning scenarios — Build our view of customer activity driving new load requirements and discuss with regional and national stakeholders through our Distribution Future Energy Scenarios to support our future investment plan.

Defining DSO — Engage with Ofgem and industry to better define the DSO role and guide plans that place energy system optimisation to meet net zero decarbonisation targets at the heart of the next regulatory price control review.

Enabling actions

Developing markets — Complete market testing for first phase of customer flexibility roll-out with new services in place from summer 2020.

Earning trust — Deliver new commitments for providing transparent and neutral facilitation of customer flexibility alongside network investment by Q1 2020.

Investing — Continue to deliver the smart grid enablers investment in new control and communications capability.

Progressing our thinking

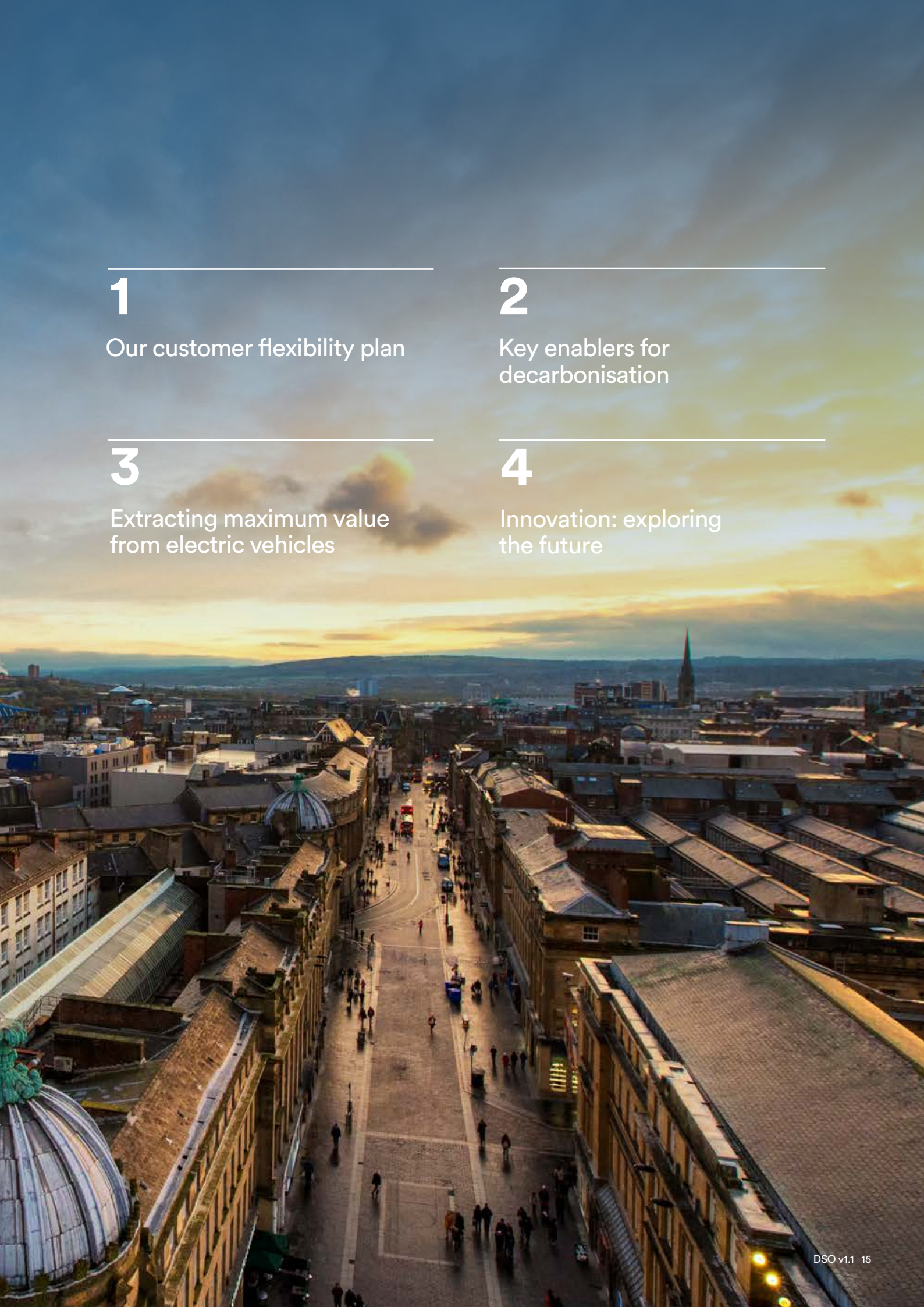
Innovating — Innovation projects develop new capabilities to support decarbonisation and resilience at least cost.

Ensuring an inclusive transition — Consult in Q4 2019 on our seven themes for a socially inclusive DSO transition.

Part 1: Developing DSO – our next steps

The implementation of our DSO plan is well underway, exemplified by the initial phase of customer flexibility that is being rolled out alongside the existing technology and systems upgrade programmes.

In this part of the document, we introduce these next steps we are taking now to deliver on some key DSO functions. Following careful engagement, we know our stakeholders agree that these tasks will deliver value to our customers and make sense for any likely future scenario.



1

Our customer flexibility plan

2

Key enablers for decarbonisation

3

Extracting maximum value from electric vehicles

4

Innovation: exploring the future

Part 1: Developing DSO – our next steps

1. Our customer flexibility plan

Introduction

We believe that a key part of becoming a DSO is the active participation in developing a market for flexibility, giving all our customers the opportunity to take an active part in the energy system by using their energy resources to support the network when we need it. We hope to futureproof our network through the utilisation of both generation and demand to help balance the system. This includes both commercial and domestic users being able to shift the way they may have normally used energy in order to avoid more expensive solutions being deployed.

Building trust and reinforcing the cultural change

The incentives and mandate exist in the current price control period for us, as a DNO, to continue to make the transition to DSO. No significant changes are required to deliver on the current actions necessary to optimise the network through the use of customer flexibility alongside network solutions. The debate required for the forthcoming ED2 price control review is about what new system optimisation duties are required. We explore this further in Part 2 of this document; this is emerging thinking and it would be useful to understand stakeholder views on these points.

The RIIO regulatory regime incentivises us (and other DNOs) to find lower-cost ways of meeting the required outputs, and to the extent they do – they share the benefits with the customers. These incentives have proved very effective in the past – and there is every reason to expect them to apply to the use of flexible market solutions as an alternative to traditional network reinforcement. If any company is slow to capture these opportunities, their performance is compared directly with their competitors in the sector and their price control settlement factors in the greater efficiency demonstrated by others.

At the working level we are seeking to reinforce these company-level incentives with changes to our structure and processes. We are introducing changes to provide clear direction for our people and provide visibility that builds the trust of our stakeholders that we are delivering the changes required.

We are committed to helping build a flexibility market that works for all users of the network, providing confidence to the market that every decision is made on the basis of sound judgement. In line with this commitment, we contributed to the formation of the Energy Networks Association's (ENA) 'Six steps for delivering flexibility services'[8]. These steps outline our drive for consistency across network businesses to build an efficient flexibility marketplace. We expect these steps will provide confidence to our stakeholders that the adoption of new commercial services is being correctly considered. This confidence should have a positive impact on the development of competitive local markets for flexibility. **We outline how we plan to implement them in Figure 2.**

Customer flexibility — a significant change built on trust

— The blend of RIIO regulation and incentives that we comply with;
— Our track record in introducing positive changes (including competition in connections);
— Our company culture which promotes a strong ethos;
— The introduction of a clear definition of roles within our teams; and
— The reporting and visibility of our actions.

An even playing field: network vs customer flexibility solutions

[8] Available from: www.energynetworks.org/assets/files/ENA%20Flexibility%20Commitment%20Our%20Six%20Steps%20for%20Delivering%20Flexibility%20Services.pdf

Figure 2: Our implementation of the ENA's six steps for delivering flexibility services

Champion a level playing field	As a minimum, we pledge to deliver against each of these six commitments as we continue the roll-out of our customer flexibility plan. Building on the high-level commitments we made in DSO v1.0, we are delivering as follows: — **Update and publish, by the end of 2019, our investment appraisal processes to embed customer flexibility into business as usual and bring clarity of roles within our teams.** This process will include segregation of key decisions that could be perceived as a conflict of interest. This process will reinforce a culture of transparency and inform our stakeholders on how we allow fair competition between network and commercial market solutions to address network needs. We will be inviting an independent third party to review these processes. — **We are designing new metrics to give maximum visibility on the investment appraisal processes.** This will not only include the outcomes of our investment decisions but also the working we use to arrive at those decisions. We will start publishing these reports in the first quarter of 2020. This will provide network users with the confidence that the investment processes are being operated in good faith. — **Working collaboratively with other industry partners and policy makers we are seeking whole energy system approaches that drive convergence in approach to the introduction of flexibility services.** An example of this approach is the Open Networks programme where DNOs are working together to share best practice and deploy consistency across all aspects of the development of flexibility services. — **We will widen the scope of network data that we publish.** We will shift from a bilateral dialogue with local authorities, local enterprise partnerships and other organisations representative of all major energy sectors, including heat and transport, to a data-sharing platform, with a view to facilitate access and stimulate debate, so that the most accurate information is captured in our network requirements. — **We will aim for all potential service providers to have an equal chance** of participation in customer flexibility markets.
Ensure visibility and accessibility	
Conduct procurement in an open and transparent manner	
Provide clarity on the dispatch of services	
Provide regular, consistent and transparent reporting	
Work together towards whole energy system outcomes	

Part 1: Developing DSO – our next steps

1. Our customer flexibility plan

Progress update on the Expression of Interest we launched in December 2018

In December 2018, we launched an Expressions of Interest for flexibility at nine locations across our network (refer to figure 3). These were identified as a result of an initial load forecast, assessing future maximum demands against capacity at extra-high voltage (EHV) substations. Breaches were taken as an early indication that there could be a role for flexibility services to address future network constraints as an alternative to load-related network reinforcement. We received a positive response to our Expressions of Interest.

Parallel to the assessment of the Expression of Interest response, we have undertaken the next step of our needs assessment, related to the Engineering Requirement P2/6 (security of supply), and this showed that no intervention (in terms of customer or network solutions) during the ED1 period is necessary for this use-case.

The outcome of this further assessment will be fully shared as part of the Distribution Future Energy Scenarios (DFES) report that we expect to publish by the end of 2019. We will actively be seeking feedback on the underlying assumptions and if you wish to be informed of the publication and engage with us on it, email us on flexibility@northernpowergrid.com

Received a response from 22 assets across nine locations

Resulting in 16MW against the advertised 12MW

At 7 out of the 9 locations published, the level of interest was at or above our requirement

72% of interest was through demand side response, 22% storage and 5% diesel generation

Our approach

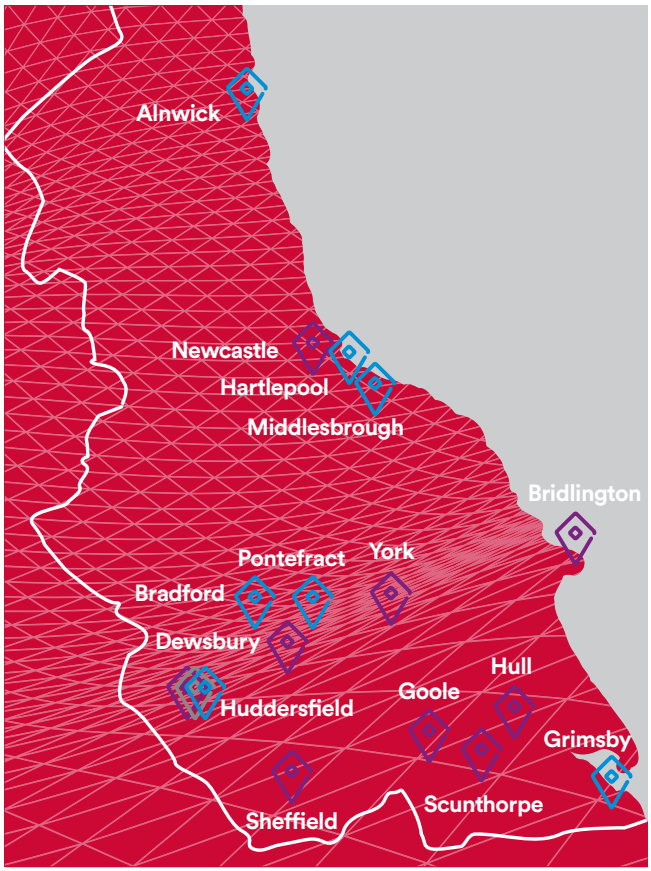
- Our approach prioritises keeping downward pressure on customer bills.
- Our immediate priority is deploying flexibility to avoid power cuts.
- There are no current investment or flexibility needs for forecast EHV capacity constraints.

Figure 3: Our recent customer flexibility activity

2018 expression of interest – traditional reinforcement

2019 market test – planned maintenance

2019 market test – emergency support



Looking forward

As we have a principle of ensuring that customer flexibility is deployed only where it demonstrates value for money for the customer, we are looking at deploying services to aid our two other use cases of planned maintenance and emergency support.

We have earmarked essential planned maintenance projects taking place on the network, scheduled to take place next year, that may be suitable for flexibility. This put more options at our disposal to manage the network more efficiently at times of higher than usual system risk.

We have also assessed where on the network we believe that we could benefit from the use of flexibility to aid the use of emergency support. This will help us restore the network under very rare events of fault conditions.

We aim to tender for flexibility services at up to 10 locations across our network for both of these use cases in 2019 for the utilisation of services in 2020 (refer to figure 3).

Figure 4 describes the three use cases currently identified by industry for contracted customer flexibility.

Figure 4: Cases for use of customer flexibility

Traditional reinforcement	To defer spending on traditional reinforcement.
Planned maintenance	To manage the risk of power cuts during long duration construction periods.
Emergency support	To provide emergency support during unplanned power cuts.

Lessons learnt

From our existing work to date, a number of key themes have emerged from stakeholders that we are looking to implement in our next round of tenders:

1 **Have clearer timelines for future tenders – we aim to release our invitation to tender in 2019 for the utilisation of services in 2020. In this pack, there will be clear instructions regarding what is expected of potential flexibility providers and the timing of key deadlines.**

2 **Provide greater visibility for the methodology of how tenders are priced against other options – as transparency is a key theme throughout our transition to DSO, visibility over decision making will increase around how we choose particular solutions to solve particular network needs.**

3 **Provide a longer-term view of our flexibility requirement – we understand that visibility over how the network may change over future years is important to flexibility providers to give them certainty that the need for services at a particular point in the network will continue in the future.**

Part 1: Developing DSO – our next steps

2. Key enablers for decarbonisation

No regrets key enablers

The design of the energy industry that will be in place in 2030 is still not decided and is the subject of industry research and consultation, including that led by the Open Networks programme, describing a selection of five options, i.e. 'worlds'[9].

Despite the uncertainty surrounding the distribution of roles and responsibility, we are making progress towards the end vision of a smart, flexible energy system. We will continue to engage with the Open Networks product on key enablers[10], and with Ofgem's proposed definition (see text box), to pick the investments that are, for now, not committing to any one direction. These are typically those actions which can allow us to implement low cost flexibility solutions for our customers and enhanced co-ordination for the operation of the distribution and transmission systems.

A clear policy direction from Ofgem and the Government, which ends uncertainty around the distribution system operation functions, will enable further investment in key enablers in our plans for the ED2 period.

> **'The hardware, software and all associated data and interoperability standards that are required to unlock DSO functionalities, support markets, and delivery of consumer benefits through competition'**
>
> **Ofgem definition of key enablers**
> **DSO Position paper, July 2019**

New customer energy practices enabled by smart grids

Our objective is to maximise sustainability by making the most of our existing extensive asset base to enable customers to connect, at least cost, more generation and increase or change their pattern of energy use – in particular with electric vehicles and electrical heating. In summary, our actions include:

- Our £83m Smart Grid Enablers programme was a key pillar of our ED1 business plan (2015-23) and remains a key enabler for our transition to the role of DSO.
- We have 433MW of contracted flexibility in our four existing Active Network Management (ANM) zones, with Driffield having gone live in 2019.
- We have reviewed our network design policies to incorporate new technologies, release capacity and incorporate learning from our innovation projects.
- Our major substation voltage reduction initiative has released over 1.65GW of capacity on local networks[11].

Although the national smart meter roll-out programme is running behind, we are well set to use the data it has started to provide to deliver benefits for our customers through improved services and network planning. We connected to the national central smart meter system (operated by the Data Communications Company) in November 2017, our initial systems and processes are in place, and we have submitted our Data Privacy Plan to Ofgem requesting permission to use consumption data to lead to better informed investment decision making and operational management of the network.

[9] www.energynetworks.org/electricity/futures/open-networks-project/future-worlds/future-worlds-consultation.html
[10] Open Networks 2019, Workstream 3, Product 3
[11] For more information on our 'Voltage reduction at primary' initiative, refer to our 'Environment report 2018'

Our Smart Grid Enablers programme is preparing our network for rapid growth of electric vehicles, domestic heat pumps and renewable power

It is the UK's most comprehensive network upgrade programme, creating the backbone of a smart grid, supporting the North's ambitions to put low-carbon technology at the centre of its economy, and enabling solutions that could generate up to £350 million of benefits by 2031[12]. Its design was heavily informed by our major innovation project, Customer-Led Network Revolution.

Our programme is upgrading the control units in our substations to make the network compatible with modern digital communications, along with establishing the communication network from our control centres to those units. This investment will give us greater ability to control and analyse how our network is operating in real time to respond to the uptake in low-carbon technologies. Ultimately, the programme introduces network flexibility, by allowing us to operate it with smarter, more efficient and cost-effective practices and technologies (explained in table 1).

Table 1: Smart Grid practices and technologies

Primary network	Local network
✓ Self-healing networks	✓ Time-of-use demand data
✓ Real-time capacity management	✓ Remote monitoring of LV circuit power flow
✓ Two-way power flow monitoring	✓ Automated control of voltage
✓ Advanced substation control devices	✓ Fault prediction and smart 'fuses'
✓ Wideband flexible communications (IP-based)	✓ Wideband communications
	✓ Harvesting network data from existing HV devices

We are able to report good progress in the roll-out of our programme (as shown in table 2), and are on track to reach our objectives by the end of the price control period.

[12] This commitment was part of our ED1 business plan and more details are available from: www.yourpowergridplan.com/index.cfm#!smarter_powergrid

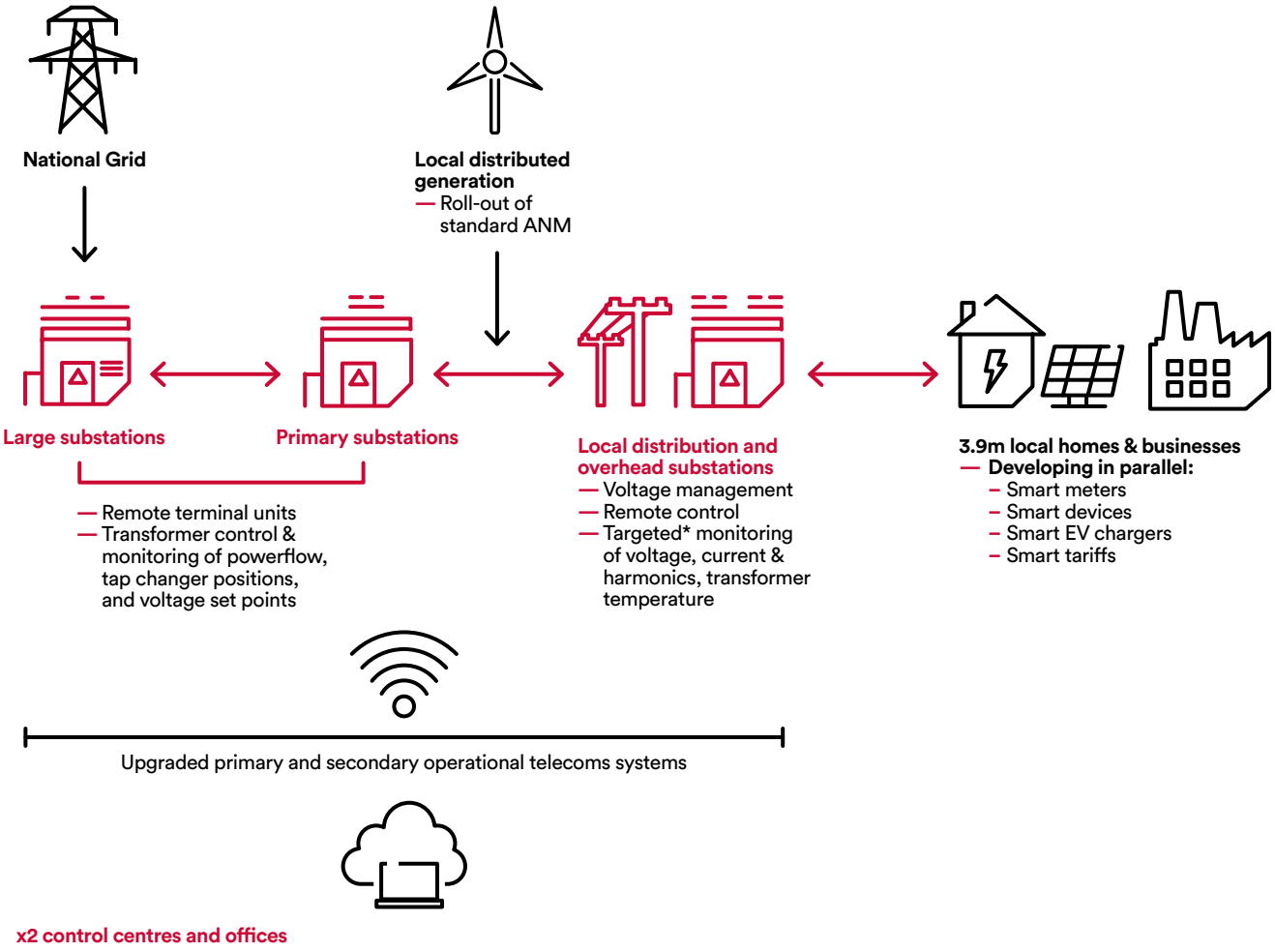
Part 1: Developing DSO – our next steps

2. Key enablers for decarbonisation

Table 2: Roll-out of Northern Powergrid's Smart Grid Enablers

Asset area	Investment description	Budget	Status as of Q3 2019
Voltage control and monitoring	✓ Replacement of all 132kV and EHV transformer automatic voltage control relays ✓ Installation of control equipment at HV regulators ✓ Functionality for creating network flexibility and improving network visibility	£34m	Widespread delivery across region and in year 3 of 6
Primary substation Remote Terminal Units (RTUs)	✓ Upgrading or replacement of all remote terminal units with programmable & IP based units. Conversion to modern digital communication protocol ✓ Creates a platform for local substation control and ability to communicate more information	£18m	Widespread delivery across region and in year 4 of 7
Primary telecoms system	✓ Upgrading core infrastructure and replacement of wide area network to all primary substations ✓ Provides IP based network with additional bandwidth & resilience	£10m	Core infrastructure upgrades in year 2 of 2 Delivery of proof of concept followed by 2 year rollout 2020-21
Distribution monitoring	✓ Rollout of low voltage monitoring to local substations ✓ Harvesting of data from existing HV remotely controlled assets ✓ Additional visibility of network operation and provision of LV platform for advanced network management	£3m	Widespread delivery across region focusing on highly utilised networks and low-carbon technology connection hotspots
Secondary telecoms system	✓ Replacement of existing radio system to over 9,500 sites for remote control of assets ✓ Provides scalable IP based network for grid edge control & monitoring	£14m	Procuring new system with proof of concept & rollout from 2020 to 2023
Control and operational systems	✓ Rollout of standard ANM systems, changes to existing network control system and distribution system analysis ✓ New databases for monitoring data and platform for data analytics	£5m	Various projects in progress
Total		**£83m**	

Figure 5: Smart Grid Enablers programme snapshot



Enhanced functionality:

— Greater visibility of network and asset operating conditions
— Enhanced network control systems and distribution analysis system to make informed decisions (such as deploying customer DSR)
— Improved data analytics (such as ability to predict faults leading to less disruption to supplies and detect EV connection hotspots)
— Secure and resilient operational communications links to receive data and issue commands
— New access to information about our customers' energy use

Customer benefits:

The ability to efficiently connect an increasing amount of low-carbon technologies whilst experiencing improved network resilience

* We are targeting LV monitoring at:
— Highly utilised & high loss networks
— Commercial centres
— LCT growth hotspots

Part 1: Developing DSO – our next steps

2. Key enablers for decarbonisation

Active network management (ANM) creates capacity for more large-scale generation

ANM is an important part of our future plans. We are installing technology on our network that provides real-time information on the levels of electricity demand and generation that is coming on to the network, providing intelligence on how close the distribution network is to its capacity limits. If the network begins to approach its limits, our ANM system limits the amount of generation to within safe working limits. To enable this, we agree contracts with our generation customers that allow us to limit their generation when required; in return we are able to offer them connections that are cheaper and faster, as we avoid the need to invest in reinforcing our network through traditional means, which would involve installing new cables and substations.

Our ANM scheme in Driffield is on a 66kV section of our network that is considered to be operating at full capacity in relation to embedded generation connections. However, through ANM, we are able to actively manage exports from generation customers in order to provide them with cost-effective connections to the distribution network. This scheme is ground-breaking for us, as it is our first replicable scheme, meaning that we now have a standardised solution that we can roll out anywhere this situation occurs on our network. It went live in Q1 2019 after we completed the installation of control equipment at our control centre in Leeds, factory and site acceptance testing, and whole scheme commissioning[13].

We are looking to roll out further ANM zones as our customers require them. Locations in North Lincolnshire and Yorkshire are under consideration.

A note about the long term future:

Generation curtailment is not optimal in a future where we will be seeking to maximise use of low-carbon energy resources. Ideally, no kWh is stopped from entering the energy system, but is instead stored or diverted to a place in the network where it is needed and may be used to displace higher carbon power sources.

[13] We gave a technical webinar for customers to explain how to apply for an ANM connection in the Driffield area which can be viewed on our youtube channel from: www.youtube.com/watch?v=b5ldDaCSy2E&list=PL94rWuj3fAYKORoDp_3W-B-BqleOHIsXg&index=5

Distinguishing between customer flexibility and 'flexible connections'

'Flexible connections' and contracted customer flexibility are quite different solutions, even if they appear similar because they both can act as alternatives to traditional network reinforcement. 'Flexible connections' are essentially constrained connections where the generation (typically) is curtailed to operate within the physical limitations of the network. Active network management is one form of 'flexible connection' benefitting multiple customers in an area. Customer flexibility can also be used to avoid reinforcement but there are other use cases.

Table 3: Comparing customer flexibility and flexible connections

	Contracted customer flexibility	'Flexible connections'
What is it?	Provision of a third party service as alternative to other system management solutions	A form of connection
Who is it purchased by?	The network operator	The connectee – it is a cheaper form of connection cost
How long is it in place for?	Variable (depends on contract)	— Contractually: permanent until removed — From an energy system perspective: ideally temporary, as curtailment is a waste of low-carbon resource
What triggers the customer response?	Network control processes following a network event and/or automated system despatch (fixed time periods agreed at time of contract execution or network incidents (e.g. faults))	Settings of the control equipment agreed between network operator and the customer at the time of connection
What does it manage?	Customer demand turn-up/turn down and generation turn-up/turn down	Generation export
What initiates it?	The anticipation of a network issue based on a short term forecast of network requirements or the need to build resilience (where flexibility is used as an insurance type product in the instance of a network fault)	A new generation connection request which would cause network limits to be exceeded if connected for unconstrained operation

In theory, a case for complementarity between a new generation connection and contracted flexibility on the basis of network reinforcement does exist. For example, if a generation connection request appears at a point on the network which cannot be accommodated, there will be a need to consider what is the best system outcome and what is deliverable – i.e. implementing ANM or offering neighbouring customer flexibility contracts? The use case for flexibility here would be a turn-up service required to offset the output of the generator during times when there is a breach to the network design capability. The deployment of storage may improve the practicality of the latter, depending, of course, on the amount of electricity produced by the generator during the time period that network constraint exists, as well as other factors.

Finally, the interaction of control systems for flexible connections with those for contracted flexibility is essential. This is so that the actions of embedded customer flexibility are not counteracted by the actions of generators in the ANM scheme, leading to the system operator not seeing any benefit from their customer flexibility procurement scheme, yet still paying for the service. We are working with the industry to address this point.

Part 1: Developing DSO – our next steps

3. Extracting maximum value from electric vehicles

Electric vehicles (EVs) are set to become the dominant form of personal motorised transport over the next 20–30 years, driven by technology advancement, electrification policies, and economics. The growth in EVs has started with adoption doubling annually and our scenarios suggest that there could be up to 1m electric vehicles on the road by 2028 (x65 the number today). We are working to enable the electrification of transport more generally (not just electric vehicles) to ensure it is for the benefit of all of our customers.

In 2017, the UK Government announced its plans to reduce emissions from transport in its Road to Zero Strategy[14]. Most importantly, it outlined the ambition to ban new petrol and diesel car sales by 2040 and specific actions for improving air quality and decarbonising the transport sector.

We acknowledge that the issues surrounding air quality and decarbonisation of transport can be tackled by avoiding travel altogether or by strategically promoting walking, cycling, the use of public transport, and carpooling. However, there is no doubt now that EVs will be a significant part of the transport future in the UK.

The actions we are taking to enable the electric transport future are being informed by our local stakeholders where our events and direct engagement with over 20 local authorities are guiding our work. Nationally, we are also working with the industry through the ENA, Government and Ofgem.

It is widely understood that the evolution of the EV charging infrastructure will drive increased demand in electrical energy and higher peak loads in the electricity systems, perhaps adding to the network costs. And yet, the benefits associated with utilising flexible load and the storage inherent in EVs may reduce the network costs by entirely offsetting their increase. We are continuously updating our localised, scenario-based forecasting to inform our network infrastructure planning.

We believe the roll-out of EVs and their charging infrastructure can be, and should be, for the benefit of all electricity customers. As we transition to the role of DSO, we are seeking to unlock the full potential of distributed energy resources, including EVs.

Innovation trials of new commercial and technical solutions are being used to see how smart charging and vehicle-to grid (V2G) technology could be a source of customer flexibility that may help us to manage the system. Early innovation trials have already proved useful – we have updated our network planning standards to reflect observations from the network impact of customers' charging behaviours. Now, the focus is on collaboratively developing and demonstrating how EVs can be part of the solution for the overall energy system of tomorrow –providing a benefit to electricity customers, as opposed to being the problem.

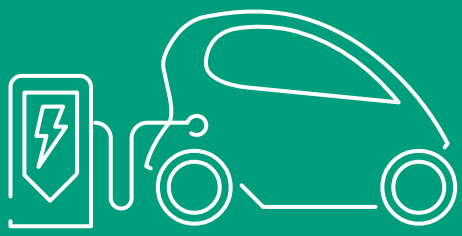
Our EV document[15] sets out what we are doing to accommodate the charging of EVs. It acts as a reference guide to inform stakeholders on what we are doing now, what we have planned, and what we believe are the wider energy system development actions needed in the future.

[14] HM Government, 2018. Road to Zero. Next steps towards cleaner road transport and delivering our Industrial Strategy. See also: Department for Environment, Food and Rural Affairs & Department for Transport, 2017. Clean Air Zone Framework.
[15] Available from: https://www.northernpowergrid.com/asset/0/document/5043.pdf

Current EV uptake in our region

At the end of 2018 Q4, there were 186,402 plug-in vehicles[16] registered in the UK. Out of these, 2% were registered in the North East and 6% in Yorkshire and the Humber.

There currently are more than 3,000 charging points installed in our region.



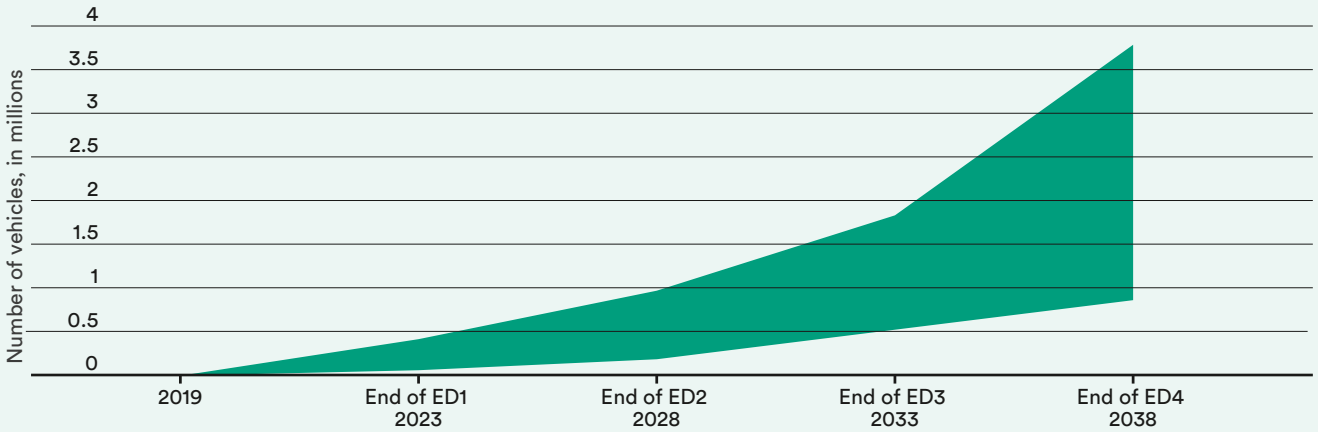
186,402

plug-in vehicles in the UK[17]

8%

of UK plug-in vehicles are in our region

Figure 6: EV growth projections in the Northern Powergrid area



[16]Electric and hybrid cars, light goods vehicles and quadricycles.

[17]Department for Transport statistics, 2018. Vehicle Licensing Statistics. Table VEH0131. Plug-in cars, LGVs and quadricycles licensed at the end of quarter by upper and lower tier local authority, United Kingdom from 2011 Q4.Note: Although this data gives a good indication of the number of plug-in vehicles using our network, some deviation is to be expected as North East and Yorkshire and the Humber regions, as defined by Office for National Statistics, do not correspond to the exact borders of our DNO licence areas.

Part 1: Developing DSO – our next steps

3. Extracting maximum value from electric vehicles

Many of our innovation projects are designed to support this change and ensure our network is fit for the future.

e4Future

With Nissan and National Grid, we are running a 'world-first' £9.8 million trial using 1,000 vehicle-to-grid (V2G) chargers. It will test how EV batteries can support the grid when plugged in for charging and will evaluate a commercial offer for EV fleet customers. The e4Future project was announced by BEIS as part of a drive to fully integrate EVs, increase UK renewable energy generation and alleviate pressure on the grid.

Silent power

We are working with two dynamic UK SMEs, Hyperdrive Innovation and Offgrid Energy, to develop a new electric response vehicle with an onboard energy storage system (ESS) to power homes while their electricity supply is being restored. The project offers a quieter, cleaner alternative to the diesel-powered generators currently used. It can absorb power as well as generate, critical for a world where consumers with solar power are becoming active participants in the power and flexibility markets.

Electrifying our fleet

We announced three key initiatives to give our 2,500 employees the chance to engage with EV technology. We are installing charging points at 11 of our sites, including a number of V2G chargers. We aim to encourage employees to go electric and we are starting to electrify our own fleet. We will observe how our employees interact with EVs and the impact on the network.

Gamification

Our Activating Community Engagement trial explored how a mobile game could incentivise households to reduce consumption at peak times. The lessons of GenGame are now being used in a follow-up GenDrive project, which will explore how mobile games can incentivise EV drivers to use their vehicles to support the UK energy grid.

We are committed to helping local authorities deploy their plans for low emission transportation successfully and have spoken to over 20 of them about their EV plans to date. Our teams work closely with officers to optimise the options at the time of a connection enquiry.

We carried out an EV workshop in October 2018 to share best practice, and collect feedback; also hosting a roundtable around the theme of 'Clean air zones and low emission vehicles: challenges, opportunities and future thinking' in May 2019. These events informed our EV readiness document. Recognising the high demand of this type of event, we are planning to hold another transport event before the end of 2019.

Despite having mapped out these specific next steps for EVs we recognise that there remain a number of uncertainties for the decarbonisation of transport and we are interested in stakeholders' views on what more we can do.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Part 1: Developing DSO – our next steps

4. Innovation: exploring the future

Our innovation portfolio is central to our transition to becoming a Distribution System Operator. It is leading our thinking on the open questions that define what a DSO is and how it will benefit our customers. As well as scoping the future, our innovation portfolio is providing information which is bringing us closer to being able to make the transition to DSO by allowing us to develop the methods we'll need to manage a smarter powergrid in real time. It also helps us to understand the wide range of skills essential to the transition and develop processes to coordinate many different functions within our organisation. The question for stakeholders is whether there are gaps in our thinking or our project portfolio that we need to be filling.

Our innovation strategy

Our innovation programme plays a vital role in how we respond to external changes, new demands and emerging risks. Its impact can be seen right across our business, improving services and reducing costs for customers[18]. **We focus on four core innovation streams:** Throughout those four streams, we will sharpen our focus on consumer vulnerability to help understand risks that may be exacerbated, opportunities that may occur, and solutions that the DSO is best placed to offer. Later on in the document, we share our proposed strategy for a socially inclusive transition to DSO, as an example of purposes that our innovation portfolio of projects will help support.

Overall, in the period to 2023 we are investing over £10m in innovation projects related to the transition to DSO. We have significantly expanded our innovation portfolio since the start of the ED1 period. In 2018-19 we invested all of our £3.8m Network Innovation Allowance (NIA) across a portfolio of 26 projects.

Affordability remains central to our drive in innovation as we look for ways to get more value from our investments, and ways to be more considerate of customers made vulnerable by fuel poverty in our operations.

Asset stewardship transformation to address the performance, reliability, optimisation and carbon impact of individual network assets.

Digital and automation to allow us and our stakeholders to gain in financial and time efficiency thanks to a better use of data, systems, and machine intelligence.

DSO techniques to build a technical and commercial toolkit that will help us deliver on the DSO functions that are either new to us or expanded from our current role as a network operator[19].

[18] For more information about our Innovation strategy, and the recent progress made, refer to our Environment and Innovation report 2017-18.
[19] As defined by Ofgem in the Open Letter Consultation on the RIIO-ED2 Price Control and by Product 5 of Workstream 3 of Open Networks.

Key innovation projects benefitting our DSO transition

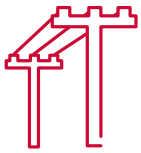
‘Distributed solar storage study’: building our battery storage understanding

We have teamed up with Moixa and Energise Barnsley in a ground-breaking trial to demonstrate how home energy storage and solar PV can save customers money and reduce network constraints. We have installed 40 smart batteries in homes with and without solar panels near Barnsley and linked them in a virtual power plant. On sunny days when generation is high and local demand is low, the batteries will be able to store energy rather than export it onto the electricity network. We expect this solution to reduce residents’ energy bills, enable more solar power to be installed without upgrading the local network, and save millions in the cost of running the UK’s electricity system. The final project report is due in Q4 of 2019[20].

‘Microresilience’: using DER to maintain power to critical infrastructure

Our microresilience project will show how batteries and local generation can maintain electricity supplies to isolated communities and critical infrastructure in the event of a power cut. We are trialling solutions at four sites with different needs:

Two lifeboat stations, which are at greatest risk of losing power in storms when their services are needed most.



A remote village supplied by a single 60km overhead line, which is vulnerable to high winds.

Newcastle Swing Bridge, which requires a dedicated power source when it is open.

The project will trial systems which can switch seamlessly from the national grid to a microgrid without any interruption in supply. We have now completed the specification document, describing the use case for each site, setting us up for the design phase. Completion is expected in late 2020.

[20] Reports will be posted on: www.northernpowergrid.com/innovation/projects/distributed-storage-solar-study-nia-npg-011

Part 1: Developing DSO – our next steps

Key innovation projects benefitting our DSO transition

'Activating Community Energy': gaming as a way to engage customers in flexibility

We ran the world's first trial to show how a mobile game could be used to incentivise households to reduce their consumption at times of peak demand. More than 2,000 customers took part in GenGame, competing for cash prizes by turning off washing machines, televisions, lights and other home devices. The three-year project demonstrated that players could be encouraged to cut their electricity consumption by an average 11%[21].

Domestic customers are an important potential source of flexibility. Homes account for 95% of our customers and 35% of the electricity we distribute, and domestic energy use will grow as electric vehicles and heat pumps are adopted more widely. The Activating Community Engagement (ACE) project generated important insights into how to recruit customers to provide flexibility, how to maintain their engagement and how to use gaming technology to maximise results. It also helped us understand important demographic issues such as which types of customers are most likely to take part and which can deliver the most flexibility.

Domestic demand side response (DSR) could compete in the new flexibility markets that are being developed, but it would require an aggregator to achieve the necessary scale. By testing a technology that enables domestic DSR, ACE is helping an emerging market diversify its offering. Community energy groups have told us they need support to kick-start this market and level the playing field on providing flexibility services. A market in domestic DSR will ultimately benefit our customers, by giving them more choice, and the energy system, by providing more competition for flexibility tenders.

'Integrated Transport Electricity and Gas Research Laboratory': delivering whole system solutions

InTEGReL is a whole energy system demonstrator built as a collaboration between Northern Gas Networks, Northern Powergrid and Newcastle University to explore and test new energy technologies, strategies and processes which bring transport, electricity and gas together. It is the UK's first incubator for cutting edge whole energy systems technology, allowing forward-thinking businesses to test their ideas in real-world conditions, and at a large scale.

InTEGReL will tackle the UK's energy challenges head on, with teams of academics and engineers working to deliver breakthroughs in the decarbonisation of heat, energy storage and transport.

We are building an integrated test network to explore how to make these systems work together and how to optimise the outputs across them with the following assets:

Power and heat storage (electro-chemical and thermal batteries).

Vehicle-to-grid chargers.

An electrolysis plant, H2 storage and a fuel cell to allow transfer between energy vectors.

The objective is to identify the most affordable and practical solutions to moving customers onto low carbon, low cost energy.

[21] More information on the findings from ACE: www.northernpowergrid.com/ innovation/projects/activating-community-engagement-nia-npg-005

Key innovation projects benefitting our DSO transition

‘Resilient Homes’: bringing stored electricity to customers in vulnerable situations

Power cuts cause problems for all of us, but they can seriously affect the health and wellbeing of particularly vulnerable customers. Even a short power cut can have a significant impact on customers who are on the Priority Services Register (PSR) or who rely on electrically powered medical equipment. This is compounded by the worry caused to these customers, and their carers, about how to cope in the event of a power outage.

With the help of National Energy Action, Northern Powergrid aims to deliver a modern solution using in-home batteries to maintain power in the event of a temporary break in supply.

Subject to a confirmed feasibility study, we plan to install batteries into the homes of 30 customers relying on electricity to power critical medical equipment so we can assess the batteries’ viability and effectiveness.

‘Foresight’: using data intelligence to avoid power cuts

The transition to DSO includes making use of intelligence from data to develop increasingly active networks that deliver high levels of reliability and availability for customers. Identifying and preventing potential power cuts before they happen will help us deliver on this customer-focused ambition. We can do so by improving our understanding of our network’s status through data analysis. Foresight is a three-year project that will enable us to spot the tell-tale signals on the network before a fault happens. It will improve our understanding of indicative pre-fault behaviour of low-voltage cable networks and our ability to develop management options for it.

A greater understanding of fault types will support a radical change in our approach to replacement works and will improve network reliability, efficiency and maintenance programmes, which will benefit our customers and result in less physical disruption on the network and roads. If we can fix faults in advance, we will keep the power flowing to all of our customers and not only play our part in resource conservation by saving materials, but also minimise the need to dig up roads, which causes traffic disruption for local businesses and householders. Northern Powergrid currently has a policy that sees 250 metre sections replaced after four faults. With Foresight completed, the company will be able to minimise the time taken on cable replacement programmes by only replacing short faulty sections.

Part 1: Developing DSO – our next steps

Key innovation projects benefitting our DSO transition

'Customer-Led Distribution System' (CLDS): exploring the impact of markets on our services

About the project

This project approaches the future of the distribution system with a bottom-up customer-led approach. It extends the DSO debate from vertical services (between distributed energy resources (DERs) and the system) to horizontal local energy markets (between DERs). It investigates the radical changes needed in the system, its players and markets to facilitate and propel the growth of DERs in a subsidy-free environment, with a focus on local energy markets and specifically on the interactions between markets for energy, markets for network services, network operation and network planning.

Local energy markets match demand and generation locally by providing incentives to customers with flexible load to follow and buy locally produced renewable energy. They are not yet here. Owners and electricity customers will obtain significantly more value from their assets by participating in local energy markets compared to providing services to the distribution network.

Initial project outputs

The value to customers with flexible DERs of local energy markets is potentially very significant...

Modelling led by the University of Bath has shown that the benefits to DERs from participating in local energy markets are between 20 and 63 times greater than the benefits from participating in the network services market, dependent on the network conditions (e.g. whether the networks are dominated by domestic or commercial load and whether they are lightly or heavily loaded).

The introduction of real-time local energy markets which deliver value to both the seller (such as a PV owner) and to the buyer with flexible load (such as an EV user) could accelerate the growth of DERs. The benefits to DER and users from local energy markets are estimated to be in the order of £90bn during the period 2030 to 2050.

Local market arrangements should be put in place and designed with the objective of maximising the value of DERs for their owners and users and for the energy system as a whole. These arrangements should be appropriate for the local DER mix and penetration levels, their times of operation, and the characteristics of local demand.

...and tapping into this value would require new arrangements.

To release these benefits, the structure of electricity distribution systems and their markets would need to be transformed to support a customer-focused decentralised and decarbonised energy system that delivers the optimal value for all key stakeholders.

The project has set out evolutionary states for industrial structures to deliver potential future market design.

Next steps for the project

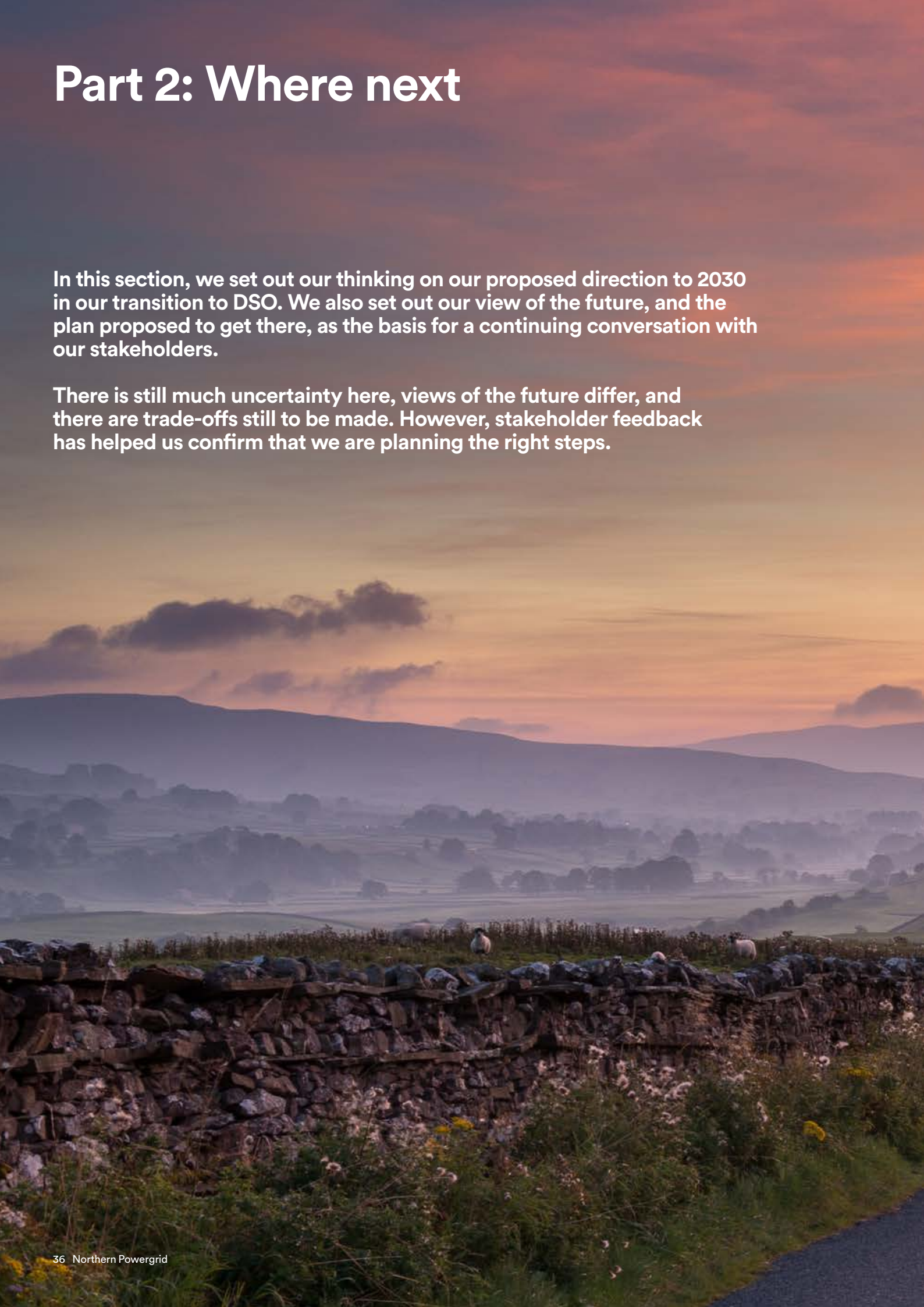
The development of local energy markets may develop alongside more connection of renewables to the transmission system from technologies such as offshore wind and nuclear generation. Investment strategies and DSO service propositions are required that are key enablers for the different energy market transition pathways. In this next stage of the project we are considering these key enablers to support our customers.

The project is assessing the value available from local whole systems optimisation, and how this may be delivered for customers.

Part 2: Where next

In this section, we set out our thinking on our proposed direction to 2030 in our transition to DSO. We also set out our view of the future, and the plan proposed to get there, as the basis for a continuing conversation with our stakeholders.

There is still much uncertainty here, views of the future differ, and there are trade-offs still to be made. However, stakeholder feedback has helped us confirm that we are planning the right steps.



1

Guiding principles

2

Making sense of distribution system operation

3

A clearer regulatory guidance to plan ahead of the next price control

4

Our plan overview

Part 2: Where next

1. Guiding principles

Firstly, it is appropriate for us to share the guiding principles that are informing our more specific draft proposals.

In our planning and in the proposed execution of our next steps, we are guided by the belief that our transition to DSO:

— is led by our customers' needs;
— provides a compelling value proposition for customers and stakeholders, that promotes sustainability and ethical values by being efficient, fair and inclusive, and better for the environment;
— operates according to processes that are neutral and transparent;
— keeps a strong focus on security and resilience;
— requires a right-sized regulated business that can support and enable deep and liquid competitive local markets for flexibility; and
— requires ongoing changes to duties that will optimise the system as the volume of distributed energy resources increase.

2. Making sense of distribution system operation

The distribution system operator operates at a regional level, in collaboration with the national Electricity System Operator (ESO) – whose role includes balancing the national electricity grid on a second-by-second basis – and is accountable for the frequency of the interconnected system. The shift away from large generation means that the ESO has to look to new control paradigms, whilst in parallel, at a local level, we are developing our services to connect increasing quantities of generation and load.

The current situation is one of joint procurement of network services between DSOs and ESO (i.e. World B in the ENA Future Worlds work). We are keen to contribute to exploring which model achieves the best outcome going forward. Our vision for the future is one of distributed control, with networks being interconnected, but not interdependent, and for a system that can self-heal and fragment using network control, flexibility from distributed energy resources and distribution connected storage. In such a world, responsibility for system operation is shared with DSOs managing regional issues and the ESO managing the overall system and long term planning.

We believe that the DNO is best placed for delivering most of the distribution system operation as synergies between network and system operation exist in many places, and because clear accountability should be of paramount priority.

Figure 7: What DSO means for our customers

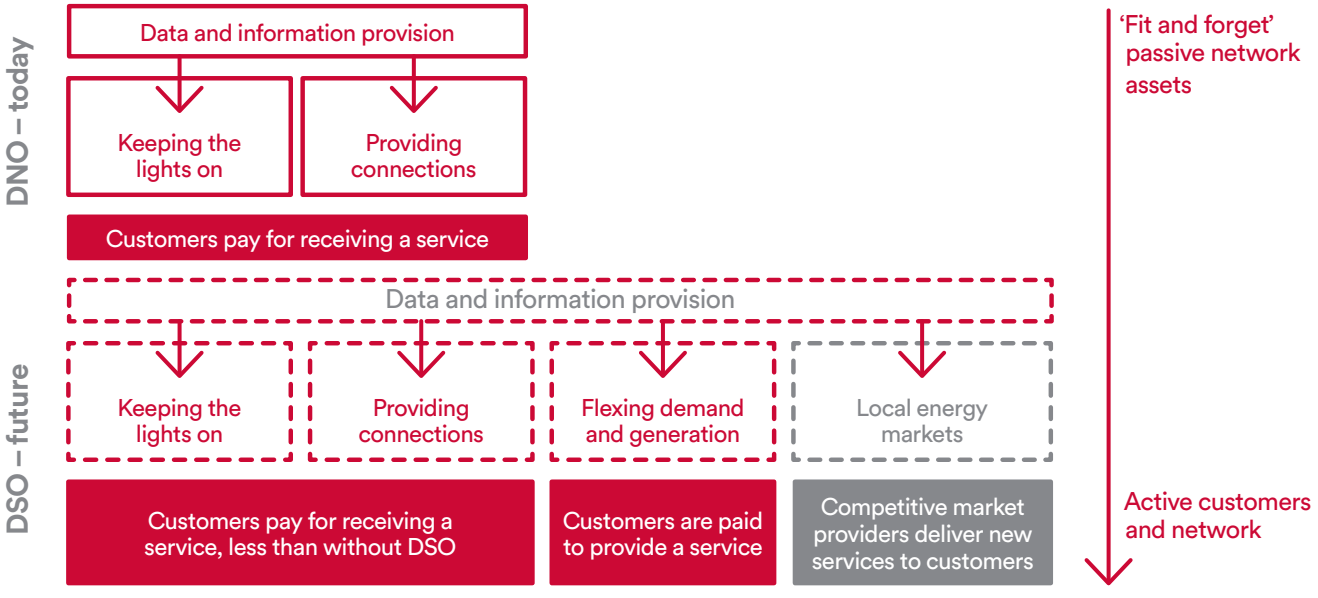
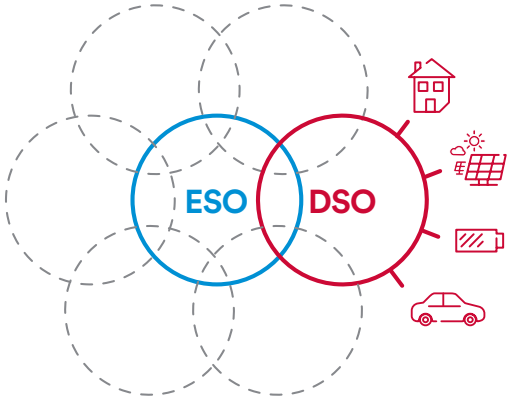


Figure 8: DSO interfaces – other DSOs and the ESO



How this all comes together for the customer

Figures 7 and 8 explain our vision of a DSO in simple terms.

— New local energy markets will provide the energy customer with services that go beyond supplying units of electricity: energy management, light and heat will be the traded commodities instead. We expect these local energy markets to be provided by competitive market actors, competing to provide services that customers with increasingly more flexible energy resources (like electric vehicles) value. As DSO, we expect to support these markets by providing network data that can be used by third parties to provide these services.

— As DSO, we anticipate rewarding and enabling customers to play a much more active role in supporting the network by flexing demand or generation. These are network services provided to the DSO to help manage the system and deliver our core services to all customers cost-effectively. Prices, smart technology and new commercial services will encourage and enable customers to be flexible in their energy demand, using electricity when it is in abundance (when the wind is blowing, or the sun is shining) and reducing consumption at times of high demand. For example, a domestic customer could be rewarded for allowing their washing machine to start later in the day. A commercial customer could be paid for allowing their fleet of electric cars to discharge their batteries onto the network to help with a local surge of electricity demand. A generator of electricity may be constrained temporarily, according to criteria agreed at the time of their connection.

— From our primary duty to keep the lights on, it is also our ambition that, as we get more out of our existing network infrastructure, customers will receive a more efficient service through the introduction of new technology to monitor, control and communicate with our substations. For example, we will be able to dynamically alter network voltages, providing headroom for more generation or reducing demand to help balance the system. By monitoring the actual load on key equipment we will be able to save money by taking a much more accurate approach to investment in upgrades.

Part 2: Where next

3. Making sense of DSO

Local Government acts as a catalyst for energy system change

The transition to a smarter, more cost-effective, low-carbon energy system offers huge opportunities for the country's economy and to improve people's lives. Decisions about energy policy and investment are now increasingly taken at a regional level which allows them to respond better to local needs.

Local Government is gaining more direct power over energy through national processes such as devolution deals, the Northern Powerhouse and energy hubs led by Local Enterprise Partnerships (LEPs). Central Government is also pushing ahead with its Industrial Strategy by securing local growth plans (such as for Greater Grimsby[22]) to address regional differences on economic growth, transport connectivity and education. Suitable energy infrastructure is a key success factor for these regional initiatives. Across our region, 22 out of 30 local authorities are considering building or extending a district heating network with the support of Government funding. In 2018, BEIS awarded LEPs with funding to develop their energy strategies. We have since held meetings and contributed to the development of the energy strategies of seven LEPs in our region.

Health
29% of households in our region have a long term health problem or disability.

Old age
By 2030, most local authorities in our regions are projected to have a higher proportion of elderly people than the national average, particularly in rural areas.

Poverty
16% of households across our regions live in extreme poverty, including 20% in the North East, twice as much as the national average.

Fuel poverty
13% of the population of Yorkshire and the North East are in fuel poverty, compared to 11% nationally.

Ensuring an inclusive transition for all people in our region

Our aim is to provide the best possible support and assistance to our vulnerable customers, informed by a detailed understanding of their needs.

Our consumer vulnerability strategy is central to what we do as an electricity network operator and our principal aim remains clear – to provide the best service to our vulnerable customers. Our engagement tells us that we are doing the right thing, so our focus remains on embedding our services, giving our colleagues the confidence and tools to deliver an excellent tailored service and setting stretch targets for continued improvement.

[22] In July 2018, Government announced a Town Deal for Greater Grimsby

Table 4: Our consumer vulnerability strategy

Defined customer group	Our role
— Customers who need extra support when accessing and receiving our services or as a result of a power loss or interruption.	— To provide support tailored to their needs during a power cut and when accessing our wider services, for example connection.
— Customers experiencing vulnerabilities which Northern Powergrid has a legitimate role in addressing, reducing or supporting.	— To develop innovative ways to support our customers and communities experiencing affordability and wider societal issues with an aim of reducing vulnerability in the future.
— Customers who are less able to represent themselves or their interests in energy matters.	— To give our customers a voice – acting as an advocate when discussing industry policy and to share best practice.

Each year we report on our performance to Ofgem through the Stakeholder Engagement and Consumer Vulnerability (SECV) submission[23]. It is now important that during business planning for the ED2 period and for DSO we look to the 2030 horizon.

How we adapt our approach to customer vulnerability in the future will, of course, be driven by the new functions that we will take on as we transition to DSO, but it will also be led by the new energy system that the DSO provides the infrastructure for, and by the new socio-economic context of the period. So as we look to a 2030 horizon, we need to remain aware of 'the bigger picture', beyond our current remit and beyond familiar issues.

Defining vulnerability is difficult, but some consensus emerges at the high level: a group of experts recently offered the following definition which we are comfortable with:

'Vulnerabilities can arise when aspects of the energy market combine with someone's personal circumstances or characteristics to create situations where (compared with a typical consumer) they are less able to represent their interests or more likely to suffer detriment.'

We wanted the proposal for our strategy for a socially inclusive transition to DSO to be practical and move from high-level commitments to specific actions. Guided by our Social Issues Expert Group, our proposal is informed by a literature review that helped us define seven key themes. It describes specific steps that could be taken to bring the seven themes to life, and make our transition to DSO an inclusive one.

We will be consulting in winter 2019 on our proposal, with a view to refine its seven themes, and add even more definition to potential deliverables.

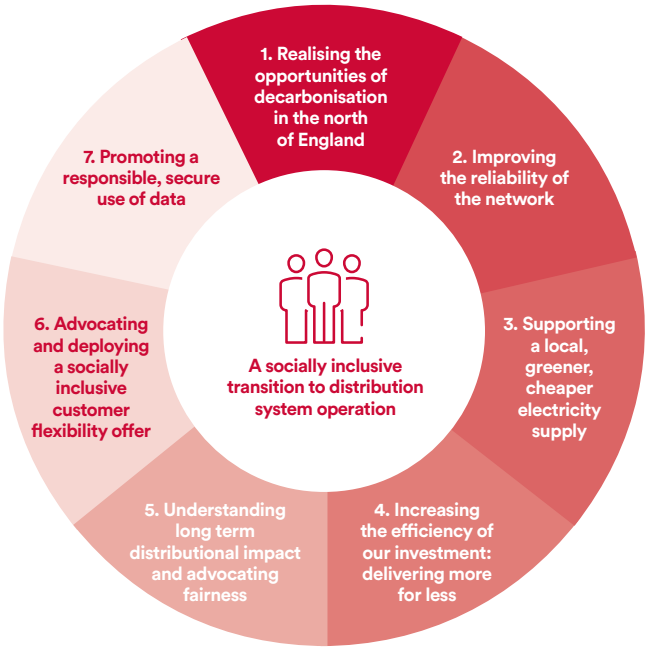
[23] The 3 parts of our SECV submission are available from our website's library: www.northernpowergrid.com/document-library/stakeholder-engagement.

Part 2: Where next

3. Making sense of DSO

Our proposed seven themes for a socially inclusive transition to DSO

Figure 9: Our proposed approach for a socially inclusive transition to DSO



1. Realising the opportunities of decarbonisation in the north of England

There is substantial potential for the Northern Powerhouse to become the new heartland for a low-carbon energy economy. By 2030, it is estimated that up to 46,000 jobs could be created in the power sector alone[24]. Historically, industrial change has been poorly managed which has resulted in regional inequalities across the UK. New vulnerabilities are emerging as a result of decarbonisation but we believe that a well managed 'just transition' could build on the economic strengths of the North of England and deliver the high skill, high wage, low-carbon economy of the future.

Practical action: We will refine our workforce renewal strategy to incorporate the needs of the region as well as our challenges in order to support regional employment and economic growth. For instance we will look to target our recruitment in areas of potential job loss to support those communities going through transition.

We will also invest in upskilling our staff in new areas such as smart grids and data, to bring them along with the transition.

2. Improving the reliability of the network

By adding new tools to our tool kit, DSO will improve the reliability and resilience of our network for the benefit of all our customers. But in addition, this could be of particular benefit to the most vulnerable, because the value of lost load (i.e. power) is higher for them[25]. We have recognised this and, when prioritising network investment to improve resilience and reduce faults, we take social and demographic factors into account. But we think that more could be done to target our work towards vulnerable customers.

Practical action: We will continue to use our Social Mapping Tool to help us understand more about vulnerable communities and ensure that they are represented in our programmes and projects.

Our innovation portfolio will explore how emerging technology can allow us to deliver a better service to vulnerable customers, following the example of our Resilient Homes innovation project[26], piloting in Newcastle, and studying how batteries can power customers' medical equipment if their electricity supply is disrupted.

3. Supporting a local, greener, cheaper electricity supply

The energy system is changing to allow for more participation of local actors in renewable energy generation, supply, aggregation, storage and energy efficiency services. This will benefit our customers by providing a better environment, contributing towards alleviating fuel poverty and giving the customer an opportunity to participate in local energy initiatives. There is plenty of evidence to support that locally-led energy initiatives, also referred to as community energy, bring benefits to people and communities beyond financial ones, and develop, strengthen, and inform[27].

Practical action: We will continue to promote our Community Partnering Fund[28] which supports community energy projects alongside those looking to address fuel poverty, energy efficiency, electrical safety, priority services register and science, technology, engineering and maths (STEM) education.

[24] 'A just transition: Realising the opportunities of decarbonisation in the north of England', IPPR North, March 2019
[25] As demonstrated by ENW's 'Value of Lost Load' project. More on: www.enwl.co.uk/zero-carbon/smaller-projects/network-innovation-allowance/enwl010---value-of-lost-load-to-customers/
[26] More information about this project is provided in the Innovation section of this document.
[27] 'State of the sector report 2018', Community Energy England, June 2018; and 'Community Energy research', Northern Powergrid, January 2016
[28] The latest round opened in September 2019 for application. More on: www.northernpowergrid.com/news/community-projects-throughout-north-of-england-set-to-benefit-from-100-000-fund

We are also revisiting our strategy to support Community Energy because we recognise its potential for profit redistribution, for income generation for buildings and for new jobs creation.

We will continue to advocate for local supply, or collective self-supply[29], which could bring financial benefits to both buyers and sellers thus helping to potentially alleviate fuel poverty in communities.

4. Increasing the efficiency of our investment: delivering more for less

We can deliver a better service at lower cost by building a smart grid which takes advantage of network and customer flexibility, and extracts the most value from existing network and customer assets (such as batteries). This will keep prices down for all our customers and thus help alleviate fuel poverty.

Practical action: We are committed to running an efficient network, optimising capacity use, which results in reduced capital investment and helps us to keep our prices down. We are taking action through our innovation strategy (such as the voltage reduction initiative to reduce customer electricity bills), and by deploying smart grid enablers (refer to page 21).

5. Understanding long term distributional impact and advocating fairness

We recognise that new market models, or the uptake of low-carbon technology by the wealthiest first, can have perverse, unintended consequences. We advocate for a fair charging system, where distributional impacts of charges are well understood.

Practical action: We will remain alert to the customer bill impact of developments in the energy system that are beyond our control such as network charging reform on the energy bill. We will help our stakeholders understand what is at stake in the charging reforms by sharing material that explains the impacts in simple terms.

We also remain alert to developments on the customer protection front, as new unregulated markets develop.

6. Deploying a socially aware customer flexibility offer

Some customers will have less flexibility to offer than others, whether by choice or necessity. In some cases, domestic demand side response may not be an option, may require additional facilitation, or may even be detrimental to customers. Issues such as overpayment due to time of use tariffs, harmful self-disconnection or limited access to technology are other examples of issues for which we will seek to minimise the risks.

Practical action: Intelligence on the social make-up of an area where we are considering deploying a domestic flexibility offer will be a key factor in our go/no-go decision criteria, and the design of the offer. We continue to advocate for customer protection and hence consider endorsing schemes such as FlexAssure[30], the Association for Decentralised Energy voluntary code of conduct for commercial aggregators.

7. Using data to target our efforts

A smarter world brings the potential to deliver for consumers in vulnerable situations and we are seeking to grab these opportunities whilst protecting our customers privacy and safety. For instance, data may be used to empower customers by enabling them to understand their energy use, bills, budget and to feel confident in their decision making abilities. Also, new in-home technology such as home energy management or distance health monitoring has potential that deserves to be investigated through innovation.

Practical action: We will expect to make information freely available on how customer data we hold is accessed, used and shared, especially data collected at the end consumer point from (from a meter or a device).

We will investigate the opportunity introduced by new in-homes technology (smart devices, and smart meters) to offer more targeted and accurate support to households in need.

[29] Example of previous action in the field include an expert-led event and feedback report, available from: www.northernpowergrid.com/your-powergrid/article/reporting-back-from-our-local-supply-event

[30] More about the scheme on : https://www.flexassure.org/

Part 2: Where next

4. Adapting the regulatory framework

We are implementing our transition to DSO. The mandate and incentives for us to do so already exist in the current RIIO-ED1 regulatory price control period. This is supported by the Smart Systems and Flexibility Plan[31] and recommendations of the Energy Data Taskforce[32].

The industry is actively developing a detailed understanding of what the potential of DSO is and how it could transform services for customers. Collectively, we will continue to refine the definition of DSO through time, as detail is added, in order to confirm the optimal approach. Network operators need clarity to build a business plan for the next price control period – RIIO-ED2 – that delivers the optimal system for a net-zero society and creates best value for customers.

The process we are going through is the managed introduction of disruptive change. The current implementation phase is about network optimisation – seeking the optimal solution for customers from customer flexibility, network flexibility and asset investment options. Discussions at the next regulatory price control review in 2019 to 2022, for the five-year period starting in 2023, must address the extent to which DSOs should take on more of a system optimisation role.

In determining the optimal future world for RIIO-ED2 business planning, there are questions that we along with Ofgem, industry and wider stakeholders need to address in order to clarify the role of the DSO and other connected parties. The answers to these fundamental questions could lead to different outcomes in determining the best industry design and the timing of the move to a new system co-ordination model.

- What is the DSO's role in resource optimisation and accelerating decarbonisation?
  - Should network companies and/or system operators actively accelerate decarbonisation or should they be passive facilitators of this transition?
  - Should they be required to act neutrally in respect of the carbon impact of their engagement with customers (connections and procuring network services), in their investment decisions, and in operation of the network, the system, or markets?
- How should DSOs take the most cost out of the whole system through the use of new technology, new uses of existing technology, and new commercial arrangements?
- How should DSOs improve resilience? How may we deliver on this core customer expectation?
- How should DSOs deliver more sustainable outcomes by delivering additional value streams for customers from their assets? How should we optimise use of the connected assets 'behind the meter' (DERs such as PV, storage, EVs) to deliver value for customers? Is this a higher priority than optimising the transmission and distribution system?
- Who is best placed to provide universal services (such as data provision) to competitive service providers[33]?

To address these vital questions, we are already:

- engaging in dialogue with our customers and stakeholders;
- collaborating with the industry – principally through the ENA Open Networks programme[34];
- discussing with Ofgem and the Department for Business, Energy and Industrial Strategy (BEIS) to update the Smart Systems and Flexibility Plan through time; and
- innovating with our own projects and others engaged in the energy system and sharing the best practice learnings so all regions can benefit.

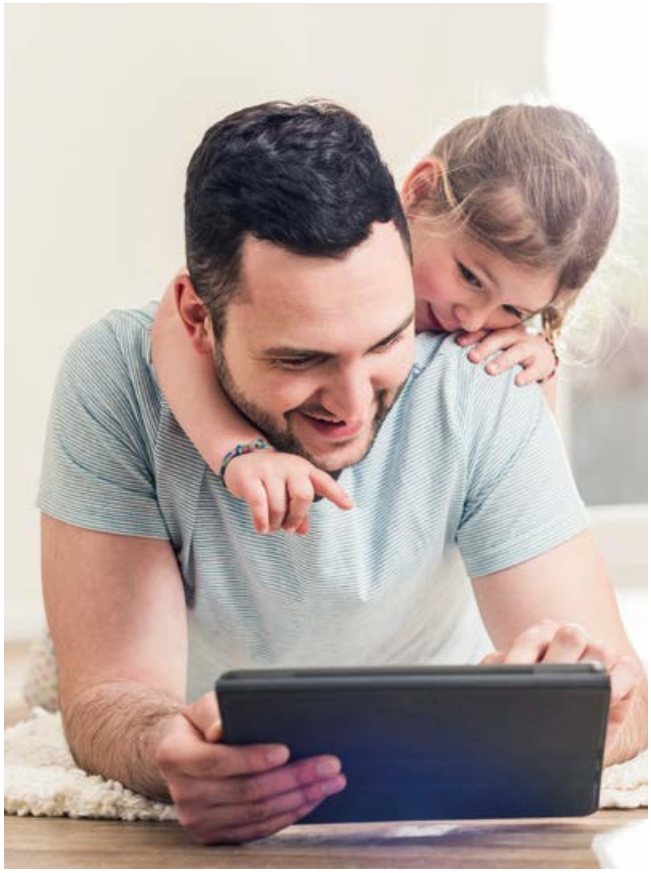
For its part, the regulator will need to provide extra clarity on the functions of distribution system operation that it will license network operators to deliver. We welcome the July 2019 DSO position paper[35], as it establishes a baseline for further detailed discussion. Through industry interaction and dialogue with Ofgem we expect to develop business plan guidance with which we may then build a RIIO-ED2 plan that delivers value for customers through DNOs taking on many of the DSO functions.

[31] 'Upgrading Our Energy System – Smart Systems and Flexibility Plan', Ofgem, BEIS, 2017
[32] https://es.catapult.org.uk/news/energy-data-taskforce-report/
[33] Providing data and information about the network to all customers and market players is set to allow for a competitive energy market to flourish in our region. We already share a lot of data (such as network congestion in heat maps) but this would be done with a heightened level of governance and accessibility, while recognising required compliance with the ethical and legal requirements of sharing data, such as the General Data Protection Regulation.
[34] For more information about the Open Networks programme of work, visit: www.energynetworks.org/electricity/futures/open-networks-project/
[35] Accessible from: www.ofgem.gov.uk/publications-and-updates/ofgem-position-paper-distribution-system-operation-our-approach-and-regulatory-priorities

5. Our key themes

We have built our plan around three categories that reflect the drivers for change of the energy systems for which we need to cater:

Customer and Commercial Development, Technical Development, and Data and Systems Development. To aid navigation and comparison for stakeholders the plan structure also echoes that used by the Open Networks programme.



In Customer and Commercial Development:

We deliver on the visible, tangible aspects of DSO that support our customers' needs: the uptake of local, renewable generation, and of storage; and the change to consumption patterns caused by the decarbonisation of heat and transport, by energy efficiency and by raising awareness of sustainability. Co-ordinated actions with customers and the sector will support the development of a deep and liquid flexibility market. Delivering on our customers' needs will require understanding their behaviour, bringing them on board with our new services, and standardising our approach with industry.

For Technical Development:

We focus on the network implications of our transition. In the context of a changing energy environment, we seek to improve network and system reliability and resilience in a cost-efficient way. We plan to deal with an uncertain future thanks to our long term forecasting, and through the introduction of more flexibility in our use of network assets.

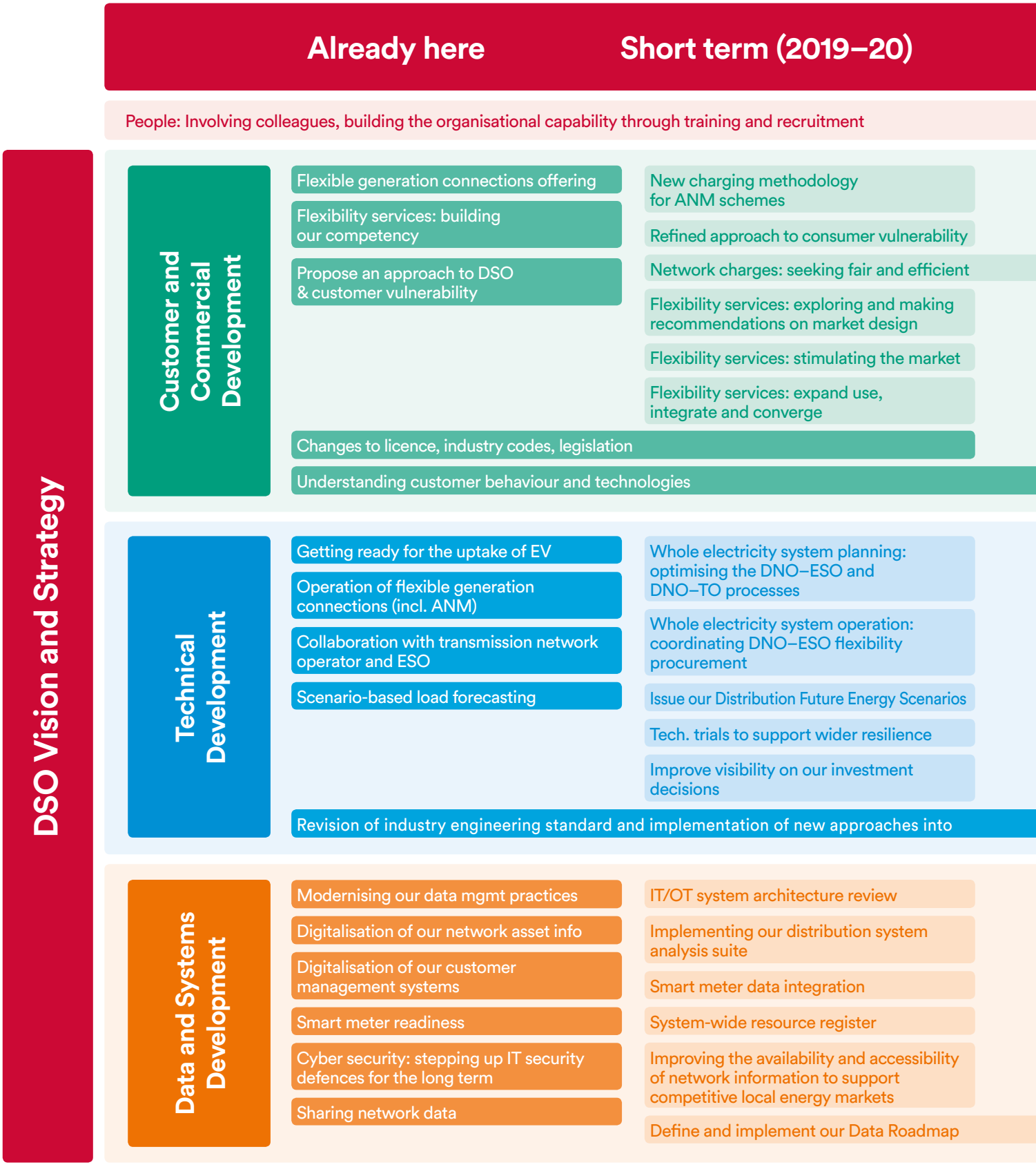
In the Data and Systems Development category:

We build the foundations that will enable a number of the other changes. Digitalisation is transforming all sectors of the economy, including utilities. Smart technology allows us to manage our network much more efficiently, responding to real-time information about power flow, monitoring the condition of our assets remotely, and automating many processes. It also gives us new possibilities to interact with customers and service providers. We propose harnessing these possibilities by investing in IT building blocks.

Our choice of the time periods for this draft thinking has been determined by natural planning horizons as well as regulatory price control periods. We start by setting out the actions we have taken in the past year, followed by those that we are working towards as high priority (2019/20). The medium term takes us to the end of the current ED1 price control period in 2023 and we then have a longer-term set of actions that take us to 2030 (i.e. just beyond the end of the ED2 price control period that ends in 2028).

Part 2: Where next

Our plan: at a glance



Medium term (2021–23)

Long term (2024–30)

Operating as regional DSO

DSO commercial operations becoming core business capability

charges for a changed system

Flexibility services: incorporate the learnings of innovation to deploy with domestic and small businesses

Realising smart meter benefits: understanding how smart meters affect customer behaviour

Realising smart meter benefits: understanding how to make use of smart meters to expand our customer flexibility procurement

Align our methodology to forecast future load across business functions

Forecasting customer flexibility needs in operational timescale

Active management of the energy system

Network flexibility solutions deployed

Integrated planning and forecasting across both transmission and distribution (incl. IDNOs)

Contestable services provision explored

Provision of flexible services to ESO and other DSOs

Improved network flexibility, tracking and optioneering capability

Whole energy system planning and net-zero target

Smart Grid Enabler deployed

Northern Powergrid

Building a data platform

DNO control systems interacting with liquid flexibility market

Building our organisational capability on data

Real-time, secure exchange of data with third parties

Upgrading of our network management system to deal with flexibility

Industry data sharing to manage the roll-out of EV and other LCTs

Our stakeholder engagement

Working with our customers and stakeholders to prepare for a successful transition into a DSO is one of our key priorities for 2019-20.

Our objectives
As we proceed with our transition to a DSO, our aim is to maintain an active dialogue with our diverse customers and stakeholders. They have told us that they want to be actively involved and we would like them to feel involved as partners, supporting the development of a network and energy system that meets current and future needs. We aspire for them to share their priorities, guide our decisions and help us ensure that customers are at the heart of our approach to DSO.

We have a responsibility to communicate with our customers and stakeholders in an accessible and straightforward way so that they understand this complex agenda and its importance. This will allow them to engage with our plans and influence them.

Listening and having an open dialogue
We work to ensure that the style of our stakeholder events is open and informative and we are in listening mode. We pose open, challenging questions and take care not to ask participants to make superficial votes on closed, specific parts of a complex, interlinked agenda. We take comments and questions on board and consider them in our plans.

1

Our thinking is generated from stakeholder insight

2

The conversation continues – our plan for future engagement

3

How to contribute to the conversation

Our stakeholder engagement

1. Our thinking is generated from stakeholder insight

A wide-reaching conversation

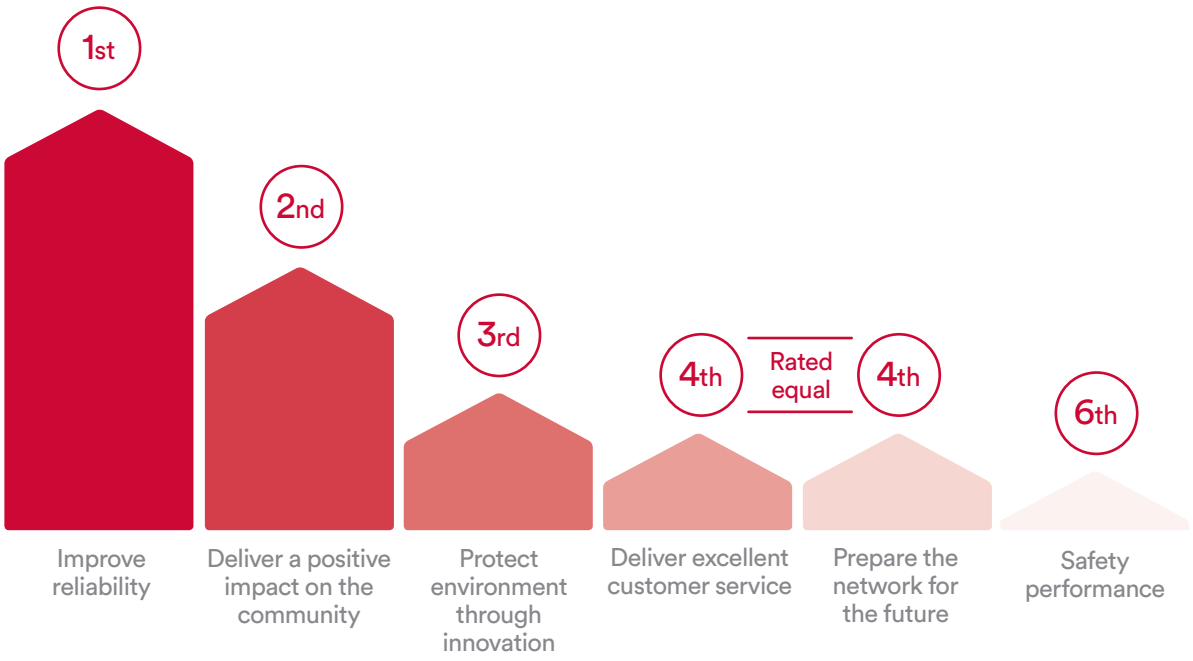
Starting in 2017, we have sought ideas from all corners of industry and from our diverse customer base to help set our direction for the transition into a DSO. We have held events tailored for different audiences and increased our reach through webcasting.

In December 2018, we published our emerging thinking which triggered a new round of conversations. Broadly speaking, our stakeholders have told us to keep moving in the direction we had set. Additional feedback on specific points helped us revise some aspects of our plans, as discussed in the introduction of this document.

We have carried out research with our customers and stakeholders to understand what investment they value most from Northern Powergrid[36]. We are planning further research to expand on this topic, at a more granular level, to understand whether we should be accelerating some initiatives. But the initial, summary conclusions for now are shown in Figure 10. The takeaways are:

- From #1: Reliability continues to be number 1, consistent with findings from previous years.
- From #2: This indicates support for our commitment to a plan for an inclusive energy system transition.
- From #4: Preparing for the future is important, but needs to be balanced with the other priorities – investment needs to be fully justified.

Figure 10: Our customers' and stakeholders' views on our business priorities



[36] By Impact Utilities, from December 2018 to January 2019 on a sample of 1,700 customers and stakeholders.

2. The conversation continues – our plan for future engagement

Engagement to support specific parts of our DSO plan

Feedback from the Open Networks project has informed our engagement strategy: it asked for a mixture of high-level reviews of progress and more technical sessions that focus on just one aspect of DSO. So, since December 2018, we have held focused conversations on key themes, including energy system data, innovation, retail market interface with DSO, climate change: the impact on regions and organisations, the challenges and interdependencies of decarbonising heat, and clean air zones and low emission vehicles.

We are now proposing specific engagement on our load forecasting process, and on our consumer vulnerability approach. Putting customers at the heart of the transition is a theme that will run through all these conversations.

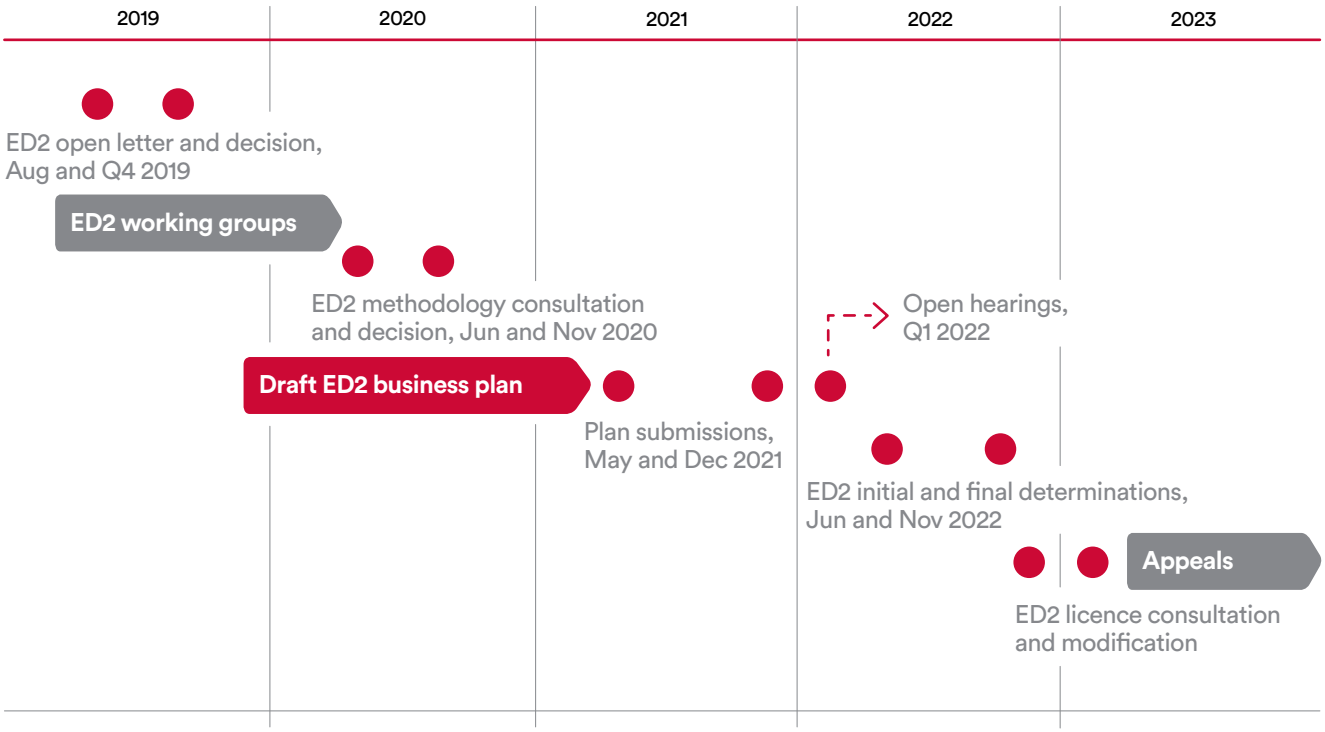
Customer Engagement Group

This new group, set up in Autumn 2019, will scrutinise and challenge our business plans for the RIIO-ED2 period which will include our plans for providing DSO services. The group will help ensure that Northern Powergrid's business plan for the 2023-28 regulatory period has properly addressed the needs of the eight million people across the communities it serves and that it facilitates a significant shift towards a low-carbon economy.

Planning for the long term starts now

The draft milestones towards our final business plan for RIIO-ED2 and a revised network operation licence are known (Figure 11). Prompt decisions are required so that we produce plans to deliver on a clear system optimisation mandate and have the opportunity to continue to meaningfully engage with our stakeholders and strengthen these plans in accordance with feedback received.

Figure 11: Draft milestones towards the start of RIIO-ED2



Our stakeholder engagement

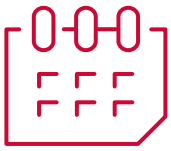
3. How to contribute to the conversation

We would appreciate your views on our vision and plans. We are planning to discuss some of the themes in this document at a number of stakeholder events in Q4 2019 and Q1 2020.

This feedback will then inform a revised plan that we expect to incorporate in our emerging thinking for our ED2 plan.

The email to use: **yourpowergrid@northernpowergrid.com**

The webpage to visit: **www.northernpowergrid.com/DSO**



Attend one of our upcoming events: **www.northernpowergrid.com/customer-events-and-surgeries**

Register for our newsletter by emailing us, so we can keep you informed of opportunities to hear about progress updates and give us your feedback.


NORTHERN
POWERGRID

Annex: Key themes

1

Customer and Commercial Development

2

Technical Development

3

Data and Systems Development

Annex: Key themes

1. Customer and Commercial Development

Already here

Customer and Commercial Development

Flexible generation connections

— We offer flexible connections to the growing numbers of customers who want to connect new generation to our network. These allow customers to connect faster and at less cost than using firm connections. In return, customers allow us to limit generation from their asset if this is necessary to maintain a stable network.

— Our approach to and types of flexible connection were updated at the end of 2018 to facilitate further the connection of distributed generation and to allow for alignment with Open Networks outputs[37].

Flexibility services: building our competency

Building on the learning from our Customer-Led Network Revolution project, we are developing our ability to use customer flexibility services in several ways:

— Customer flexibility procurement: The launch of our Customer Flexibility Plan is our first step towards integrating customer flexibility into our business as an alternative to network solutions. It sets out where our network is expected to require intervention and invites customers to express interest in providing flexible capacity that enables us to compare alongside network interventions[38].

— Storage: We have developed our understanding of the storage market by using a 2.5MW (5MWh) battery in Darlington to provide frequency response services to National Grid. KiWi Power have commercially operated the project since September 2017, and we are evolving its use in compliance with new regulatory requirements being introduced on the topic[39].

[37] These are captured in the publicly available Code of Practice document : www.northernpowergrid.com/asset/1/document/1678.pdf

[38] We provide a progress update in Part 1 section 1.

[39] Ofgem has recently developed new licence conditions in the Electricity Distribution Licence to clarify that distribution network operators and Independent distribution network operators cannot operate storage without Ofgem's consent. More on: https://www.ofgem.gov.uk/publications-and-updates/enabling-competitive-deployment-storage-flexibleenergy-system-statutory-consultation-changes-electricity-distribution-licence

Already here

Customer and Commercial Development

Propose an approach to DSO and customer vulnerability

— We have worked with our Social Issues Expert Group and drawn on work produced by industry experts to improve our understanding of how a smart, flexible energy system may provide most benefit and avoid disadvantage to customers in vulnerable situations.

— As a result, we have drafted a proposal of our strategy for a socially inclusive transition to DSO that goes beyond statements of intent. It outlines seven key themes and describes practical steps that could be taken to ensure they become a reality. This well-documented framework can guide our development of DSO in-house and contribute to industry-wide work (refer to page 42-43).

Changes to licence, industry codes, legislation

— The definition of the DSO role will develop through time. In the near term, the blend of regulation and incentives is well set to support the transition but there is a debate required for the ED2 price control review on the role of DSO and the incentives required to support system optimisation. Regulation and industry codes will need to adapt.

— Recent examples include: the new licence condition on storage, the DUoS charging using HH settlement[40], BSC modification 'Multiple Suppliers through Meter Splitting'[41], Smart Energy code modification to allow network operators to control smart EV chargers[42], and the energy code review[43].

Understanding customer behaviour and technologies

— Customers are driving the transition to a smart, flexible energy system by using new technologies to change the way they use and produce energy. We are building our understanding of how these trends may evolve and affect our network by observing how customers are using energy now and considering how this may change in a range of future scenarios. We do this by looking at new monitoring data we are obtaining from our network, developing our understanding of customer behaviour through our innovation projects and our interaction with other DNOs through national forums including learning from other innovation projects.

— Our Customer-Led Network Revolution (CLNR)[44] and Activating Community Energy (ACE)[45] projects were important in understanding how to introduce more capacity at least cost. They also show that people's energy practices reflect their circumstances and lifestyles in ways that cannot be predicted by simple economic analysis. A few projects in our innovation portfolio continue to investigate this (such as DS3), as do projects led by other DNOs (such as My Electric Avenue and Electric Nation).

[40] More about DCP268 on: www.dcusa.co.uk/SitePages/Activities/Change-Proposal-Register.aspx
[41] More about P379 on: www.elexon.co.uk/mod-proposal/p379/
[42] More about SECMP0046 on: https://smartenergycodecompany.co.uk/modifications/
[43] More on: www.ofgem.gov.uk/publications-and-updates/energy-codes-review
[44] www.networkrevolution.co.uk/conclusions/
[45] www.northernpowergrid.com/ACE

Annex: Key themes

1. Customer and Commercial Development

Short term – 2019-20

Customer and Commercial Development

New charging methodology for ANM schemes

— We will adopt the new guidance for charging ANM schemes in line with the new code modification[46].

Refined approach to customer vulnerability

— We will share our proposed seven-theme framework with industry experts and consult with them in order to test and refine it within six months.

Network charges: seeking fair and efficient charges for a changed system

— We consider that a holistic review of network charging is required which considers connection charges, ongoing usage charges as well as flexibility contracting.

— We are actively contributing to Ofgem's network charging reform[47] that is seeking to align policies and methodologies with the smart, flexible uses of energy and introduce appropriate cost signals for efficient use of network capacity.

Flexibility services: exploring and making recommendations on market design

— A new market in customer flexibility is emerging and commercial providers are already recruiting new customers even though the market design and industry structure are at an early stage: we are still defining what is traded, how and where, and the roles of the parties involved.

— Our Customer-Led Distribution System (CLDS)[48] project is exploring how to accommodate large volumes of new technologies, such as local generation and electric vehicles, at least cost, while at the same time enabling customers to earn income by selling energy or services to balance the network. It will make recommendations on the market design and industry structure, and contribute to our roadmap for transition.

[46] More about DCP348 on: www.dcusa.co.uk/SitePages/Activities/Change-Proposal-Register.aspx
[47] Targeted charging review' and 'Charging futures'
[48] For more information: www.northernpowergrid.com/innovation/projects/customer-led-distribution-system-nia-npg-19

Short term – 2019-20

Customer and Commercial Development

Flexibility services: stimulating the market

— We consider that we have a role to play in stimulating what is still an emerging market. We will raise awareness of this and explain to our customers how they could become a service provider and the benefits of doing so.

— We will continue to scan for opportunities across each of the three primary use cases. At the current time, we see the most value for our customers in implementing customer flexibility to help manage emergency support and construction maintenance. We will be tendering for these services in Q4 2019 for the utilisation of services in 2020.

Flexibility services: expand use, integrate and converge

— We will be looking to deploy services in the short term for emergency support and construction maintenance in the first instance. If our 2019 customer flexibility tenders are successful, we will start utilising contracted services from 2020 to deliver value for money for our customers. Next, we will look to expand our contracted flexibility offer to other use cases, as described in page 18 of this document, including to cases where new load connection appears at a point on the network which cannot be accommodated as it stands.

— We are developing our end-to-end capabilities required for its operation. This includes the commercial offerings, contracts, despatch, verification, and settlement functions.

— Building on our experience, customer feedback, and industry-wide learning, we will drive convergence of procurement methods across DNOs in order to develop consistent and best practice experience for customers.

— We will explore various platforms on which flexibility can be traded and which may provide the required back-office functions.

— We will provide a level playing field for all technologies and business models providing solutions to capacity constraints. Customer technologies will compete on their merits.

Annex: Key themes

1. Customer and Commercial Development

Medium term – 2021-23

Customer and Commercial Development

Realising smart meter benefits: understanding how smart meters affect customer behaviour

— Widespread roll-out of smart meters and the associated introduction of half hourly settlement and time of use tariffs will allow new offerings to emerge as choices for customers[49].

— We will monitor the impact of these tariffs on customer behaviour, specifically changes to customer demand profiles and energy consumption. This in turn will require us to reassess some of our network planning and design assumptions. Initial indications from innovation projects and early trials with customers are that these changes in demand profiles can help to prevent network constraints from arising.

Realising smart meter benefits: understanding how to make use of smart meters and EVs to expand our customer flexibility procurement

— Our objective is to provide customers with opportunities to make the best use of their assets like solar panels, electric vehicles and battery storage to either reduce their energy bills or earn revenue by contributing flexibility to aid the wider system and the other customers connected to it.

— As described above, smart meters enable half hourly settlement and time of use tariffs. This technology and the associated commercial offerings, in turn, make it possible for us to pass on flexibility signals to a wider range of customers compared to now. Engagement with energy suppliers will be required to understand how network cost signals will be experienced by and made visible to customers.

Align our methodology to forecast future load across business functions

As part of the technical development of our roadmap, we have adopted a new methodology for 'scenario-based load forecasting' to inform our network planning. The action here is to drive consistency, and consider aligning the key assumptions used in the forecast methodology, relating to load growth, with those used in our cost recovery calculations (network charges) and our investment plans for customer-driven activity (i.e. driven by new connections).

[49] Changing actor dynamics and emerging value propositions in the UK electricity retail market', January 2019, University of Exeter, EPSRC, and Imperial College London consultants.

Long term – 2024-30

Customer and Commercial Development

Operating a regional DSO

— We expect that the increase in flexible DERs will introduce both the business case and capability for integrating more customer flexibility into our operations.

— Utilising our own regional energy forecast, we expect to procure a full suite of balancing services, and coordinate fully with other system operators in GB (ESO, DSOs).

DSO commercial operations becoming core business capability

— The regulation and incentives will change in order to drive the most value from the DSO role in terms of system optimisation supporting increased connection and use of DERs. By this time, we expect to be able to access services on behalf of others or provide services to others, where doing so is necessary to maximize whole system efficiency and protects competition.

Flexibility services: incorporate the learnings of innovation to deploy it with domestic and small businesses

— As we develop customer flexibility into business as usual for the industrial and commercial and other commercial customers, we will roll out best practice both from our own experience and other DNOs into the procurement of flexibility from domestic customers.

— This will include optimising against the expected impact the electrification of transport and heating will have on our network.

Annex: Key themes

2. Technical Development

Already here

Technical Development

Getting ready for the uptake of electric vehicles

— Electric vehicles (EVs) are set to become the dominant form of personal motorised transport over the next 20–30 years, driven by technology advancement, electrification policies, and economics.

— We have set out our position on what we are doing now, what we have planned, and what we believe are the wider energy system development actions needed in the future and have produced an EV readiness paper now published[50].

Operation of flexible generation connections (incl. ANM)

— Over the last decades, we have been controlling distributed generation export through simple single generator inter-trip schemes, operated through control arrangements, and involving no financial transactions.

Table 5: Flexible connections that we offer

	Single power generating facility		Multiple power generating facilities
Constraint to be managed	**Export limitation**	**Event initiated (HV and above)**	**Event initiated (HV and above)**
Thermal	✓	✓	✓
Voltage	✓	✓	✓
Tapchanger	✓	✓	✓
Fault level	x	✓	x
System connectivity	x	✓	x
Infrequently operated generating plant	x	✓	x

— In the last few years, we have also used ANM schemes to mitigate constraints whilst connecting generation on our network at three locations: Seals Sands, Blyth and East Roos.

— In March 2019 we went live at Driffield in Yorkshire with a standard area based ANM scheme that can be rolled out to other network zones as the need arises[51]: for those with high customer interest in a connection, limited capacity, and high reinforcement costs. Full network wide ANM enablement will be considered in future when it can be proven to be efficiently deployed.

[50] www.northernpowergrid.com/document-library/

[51] More information is available from a recorded webinar on: www.youtube.com/watch?v=b5ldDaCSy2E&list=PL94rWuj3fAYKORoDp_3W-B-BqleOHIsXg&index=5

Already here

Technical Development

Collaboration with Transmission Owner (TO) and with the Electricity System Operator

— Over many years, we have collaborated with the Transmission Owner (and now also the Electricity System Operator) to ensure that the needs of both distribution and transmission systems are taken into account when we connect new generation and adopt new solutions based on dynamic constraint management and customer flexibility is important.

— Recently, some processes have been revisited, or are undergoing trial.
  – We are helping to define the new relationship between DNOs and the SO by taking part in a High Volts case study, as part of the ENA Open Networks programme (2019 Workstream 1b 2019, Product 1).
  – We are also contributing to a new trial Statement of Work process known as the 'Appendix G trial' which seeks to reduce the time new generation customers have to wait for their application to be processed. We expect the trial will lead to a change in the Connection and Use of System Code in early 2020[52].

Scenario-based load forecasting

— The challenge we face in formulating our smart grid development plan is that the growth and location of low-carbon technologies (LCTs) is highly uncertain, and many of the smart technologies we plan to use to manage their impact on our network are still in their relative infancy.

— Our objective is to ensure that LCTs can be speedily connected, while keeping costs for customers as low as possible, and maintaining high levels of network reliability.

— As a result, and directly based on an innovation project[53], we have adopted a new forecast modelling ability to more accurately predict LCT uptake and load growth in our secondary and primary substations and supply points.

— This forecasting tool is assisting us with our network planning and informing where we deploy low voltage monitoring to help manage potential LCT connection hotspots.

[52] More information on CMP298 on: www.nationalgrideso.com/codes/connection-and-use-system-code-cusc?mods
[53] Refer to the relevant NIA project

Annex: Key themes

2. Technical Development

Already here

Technical Development

Revision of industry engineering standard and implementation of new approaches into Northern Powergrid

— We are embedding innovation into our organisation by capturing new learning and requirements in engineering policy & standards, and developing new approaches to the ongoing training of colleagues as more technical solutions become available. This will be an ongoing process through to 2030 and is led by our Smart Grid Implementation team.
— We typically collaborate with other network operators through the ENA to agree new or revised engineering standards. Examples included the revised security standard P2 that levels the playing field for network & non-solutions, development of generation standards G98 and G99 to meet the new European Technical Codes, or G100 that allows the connection of emerging customer technology in the export limiting space. We will also contribute to the review led by BEIS of electrical engineering standards[54] and adopt recommendations in line with industry.

[54] As announced in July 2019. More information on: www.gov.uk/government/publications/electrical-engineering-standards-independent-review

Short term – 2019-20

Technical Development

Whole electricity system planning: optimising the DNO–ESO and DNO–TO processes

Along with industry, and driven by the Open Networks programme (2019 workstreams 1a and 2b), we are working on ways to optimise the processes across transmission and distribution boundaries, such as:

- operational planning,
- investment planning (i.e. evolving the regional Network Option Assessment process, develop an Engineering Report on whole system investment planning),
- forecasting.

Whole electricity system operation: coordinating DNO–ESO flexibility procurement

Working with the ESO through Open Networks, 2019 Workstream 1a Product 5, we will work to resolve potential conflict between ESO and DNO-triggered customer flexibility in order to minimise the risks to resilience and to whole system efficiency that the conflicts may create.

This is necessary to ensure that the procurer of the flexibility product benefits from the service being delivered as, in some cases, the benefit will be negated by operation of the ANM scheme. This will require information sharing across transmission and distribution in addition to IT/OT systems integration.

Issue our Distribution Future Energy Scenarios

- In autumn 2019, we will publish a selection of long term load forecasts, which sit upstream of our investment planning, and invite external scrutiny. The purpose is to build a 'best view' load scenario, supported by our stakeholders, feeding into our network planning processes (and eventually ED2 plan) and ensuring our network is 'future fit' as defined, for instance, by the regional economic development plans and by energy strategies of local stakeholders.
- The dialogue with our stakeholders will move from being bilateral to self-service, and inclusive. It will be data-led, built around a purposefully-built platform to explore, compare and contrast the variety of views held on the topic of the local energy future.

Technology trials to support wider resilience

We are looking for new ways to strengthen the resilience of our network through innovation projects that focus on helping electrically dependent customers (Resilient Homes), that examine the potential of microgrids (Microresilience), and that trial vehicle-to-grid technology and commercial models (e4Future).

Annex: Key themes

2. Technical Development

Short term – 2019-20

Technical Development

Improve visibility on our investment decisions

— In order to demonstrate that potential conflicts of interest between various parts of our organisations are being managed, we will publish more data to enable greater transparency on how customer solutions are being considered alongside network solutions to increase capacity.

— We already publish data, that our stakeholders find useful, describing capacity available on the system (as shown in table 6), but this commitment is to increase the available data as well as describing our processes that allow for improved understanding and scrutiny. Practically, we will:
- Revise our investment planning processes to make customer flexibility options explicit, create a level playing field, and clarify roles and responsibilities by Q4 2019.
- Publish a set of related quarterly metrics from Q1 2020 onwards.

Medium term – 2021-23

Technical Development

Forecasting customer flexibility needs in operational timescales

We will develop short term forecasting models for day-ahead network operation able to predict issues and assess the optimal solutions based on DER information, network information, and a series of other factors influencing the use of customer flexibility (weather forecast, time of day, etc.).

Network flexibility solutions deployed

We will continue delivering the commitments in our ED1 business plan to introduce more network flexibility solutions. Network flexibility solutions are those that increase the amount of headroom on our network, enabling us to connect more customers and to service increasing requirements from existing customers.

We are approaching this by introducing new solutions into our engineering policy and standards as learning arises from innovation projects that can be deployed in a cost-effective way. We are also using the smart grid enabling technology we are deploying, for example using voltage management technology to prevent voltage rising to excessive levels at times of high solar PV generation and using increased network visibility from LV monitoring to inform customer quotations.

Contestable services provision explored

In parallel with the above, we will look into new solutions to generate more value from existing assets for whole system use, such as the provision of frequency response and reactive power to the ESO.

As contestable services (activities the DNO can do for which a market alternative exists), these are also subject to consideration by Ofgem in its setting of a policy framework for DSO.

Improved network flexibility, tracking and optioneering capability

We expect that in the next few years, guided by Open Networks 2019 Workstream 1a, an industry-wide demand side response framework will be developed to:

- start standardising and ultimately coordinating flexibility procurement;
- give visibility on distributed energy resources contracts;
- resolve conflicts (ESO–DNO or DNO–DNO or DNO–other); and
- optimise the service across both transmission and distribution networks.

This framework will underpin our control room's future distributed energy resource management systems.

Annex: Key themes

2. Technical Development

Medium term – 2021-23

Technical Development

Smart Grid Enablers deployed

— We have launched an £83 million Smart Grid Enablers programme, which is transforming our ability to monitor, control and communicate with more than 860 major substations and 8,000 distribution substations. This will enable us to respond to real-time information about power flow on our network.

— By 2023, we will have a state-of-the-art command and control system, underpinned by a secure and resilient communications network, which will allow us to implement smart grid solutions that could generate up to £350 million of benefits by 2031.

Long term – 2024-30

Technical Development

Active management of the energy system

As a DSO, we will have technical capability to manage balancing services and despatch as well as constraint management. Deployment will depend on roles and responsibilities that are yet to be defined. We will share or co-ordinate access to data with the ESO to manage the whole system efficiently.

Integrated planning and forecasting across both Transmission, Distribution (incl. IDNOs)

We expect that the aforementioned work on whole electricity system planning will culminate in a licence condition change that we will be complying with in full in our ED2 business plan. Regional planning will be undertaken across transmission and distribution networks according to common methodologies. This will ensure whole electricity system efficient outcomes and improve customer connection processes in areas of constrained networks.

Provision of flexible products to the ESO and other DSOs

Technology will enable the release of flexible services for both the ESO and other DSOs to resolve network issues in all parts of the system. Enterprise-scale interfaces and messaging hubs are in place to facilitate such activities.

Whole energy system planning and Net Zero target

Our forecasting processes will support some form of conversation amongst all stakeholders in local energy planning, which:

- Will ensure that our business plan will support the realisation of Government's Net Zero target by 2050,
- May lead to identify where cross-vector approaches may deliver better outcomes for energy consumers and decarbonisation.

Annex: Key themes

3. Data and Systems Development

Already here

Modernising our data management practices

— Data management is an evolving area for us – we already share some raw data sets and reporting on our website, but the concept of open data challenges us to do it in a way that creates more value for more stakeholders. As set out in our DSO v1.0 thinking, the potential benefits for us are that we see data not only as a way to do our job better in managing an increasingly active network but also that we may support those parties delivering energy services to customers. Part of our vision for DSO is that if we publish more data, then parties delivering new products like innovative tariffs for electric vehicle charging, may provide a better service (for example, cheaper charging of vehicles when networks are less congested).

— In order to develop our capabilities on data and analytics, we have established partnerships with Peak Indicators, Newcastle University and Open Data Institute (ODI) in Leeds. ODI can help us deepen our skills and understanding of open data, and explore and realise the potential of data sharing. Our first project with them is sharing our Distributed Future Energy Scenarios.

— We continuously seek industry synergies and standardisation by taking into consideration the Government's Energy Data taskforce[55], and the Midata programme in the energy sector.

Digitalisation of our network asset information

— The eAM programme has consolidated a number of different data sets into a single asset register and geographical information system. Our records have been updated and repositioned against the new Ordnance Survey MasterMap backgrounds. We can now share information with other utilities and key stakeholders that operate similar record management systems. This lays the foundation to delivering on recommendation 5 of the Energy Data Taskforce: 'Visibility of infrastructure and asset: digital system map'.

Digitalisation of our customer management systems

— Since 2015, we have been progressively implementing Oracle Customer Relationship Management (CRM) across our key service lines. We now provide a fully- integrated service across all communication channels and hold a single record of customer information.

Data and Systems Development

[55] The taskforce was launched in November 2018 to deliver recommendations for how industry and the public sector can work together to reduce costs and facilitate competition, innovation and new business models in the energy sector, through improving data availability and transparency.

Already here

Smart meter readiness

— We connected to the national central smart meter system (operated by the Data Communications Company or DCC) in November 2017. This satisfies the Smart Energy Code (SEC) requirements to comply with licence conditions for handling smart metering data. The Gateway is the enabler for benefits realisation. In 2019 we will build the IT capability to use the data in our operational processes.
— We have been processing smart metering alert outage data operationally since the end of April 2018. During 2019 we have made progress on systems integration projects to establish secure network communications with our smart metering system. Work continues to define the most appropriate delivery approach for all projects initially scoped as a number of projects are dependent on access to smart metering data. We are working to minimise the impact of the lower than anticipated volume of SMETS2 meters, changes to roll-out forecasts and meter functionality, and service quality issues being experienced by the national infrastructure.
— We submitted an initial Data Privacy Plan in December 2018, and then a revised one in May 2019 to describe to the regulator our proposals and controls for accessing, aggregating and utilising half hourly electricity consumption data. We now expect feedback from Ofgem in 2019 to confirm the timescales for the next stage of the authorisation process.

Cyber security: stepping up IT security defences for the long term

— We are continuously working to improve our IT security defences and the ways in which we protect our customers information. We have established partnerships with class-leading advisory organisations and we work closely with UK agencies and regulators to maintain high standards of protection.
— Because our network is classed as critical national infrastructure, we have a duty to protect it, so our investment in cyber security investment is on-going and regularly reassessed.

Data and Systems Development

Annex: Key themes

3. Data and Systems Development

Already here

Sharing network data

In an effort to be transparent and helpful to our stakeholders, we share a large amount of data about the network, current and future. The data that is freely available online today is shown in table 6 below. Data we share with the national electricity system operator (ESO) on a regular basis, towards optimising a whole electricity system is captured in table 7. In addition, we provide data that supports the wholesale and retail markets.

Table 6: Data and information we currently share publicly

Power cuts[56]	Map and tabular view of planned and unplanned power cuts by postcode.	**Real-time**
Generation availability[57]	Map and tabular view of the network capability to connect large-scale developments to major substations.	**Monthly**
Demand availability[58]	Map and tabular view of the network capability to connect large-scale developments to major substations.	**Monthly**
Long term development statements[59]	A detailed view of our system capability to assist existing and future users. The data allows third parties to model our EHV and HV networks.	**Yearly**
Investment[60]	Map and tabular view of the investment that we are planning by postcode.	**Twice a year**
Contracted Capacity Register[61]	Tabular view of large scale generators which are connected to our network or are yet to be connected (accepted connection offer).	**Monthly**
Flexibility requirement[62]	A list of sites where we want to assess the availability of customer flexibility with a view to contract it.	**Yearly**
Safe Dig[63]	Customers who are carrying out underground construction can select and download asset data quickly.	

Data and Systems Development

[56] www.northernpowergrid.com/power-cuts
[57] www.northernpowergrid.com/generation-availability-map
[58] www.northernpowergrid.com/demand-availability-map
[59] www.northernpowergrid.com/long-term-development-statement
[60] www.northernpowergrid.com/investments-in-your-area
[61] www.northernpowergrid.com/contracted-capacity-register
[62] www.northernpowergrid.com/DSO
[63] www.northernpowergrid.com/services-directory/check-before-you-dig

Already here

Table 7: Data and information we currently share with National Grid ESO

Week 24	A large submission that includes technical data on our network so that National Grid can assess security and safety of the GB network and inform their future planning and investment decisions.	**Yearly**
Week 50	A summarised, update of the Week 24 report.	**Yearly**
Statement of work	An assessment of the impact of new generation on a Grid Supply Point.	**Ad hoc – when the cumulative generation reaches a given threshold at a Grid Supply Point.**

Data and Systems Development

Annex: Key themes

3. Data and Systems Development

Current – 2019-20

Data and Systems Development

IT/OT system architecture review

— Our vision for DSO gives new roles and responsibilities to our organisation, and this can be interpreted in IT terms as requirements for a revised system architecture. Our objective is to integrate the information technology and operational technology plans to maximise sustainability of investments and efficiency of operations.

— So as part of our assessment of the new capabilities required to deliver on various DSO functions, we are building an IT competency profile of DSO, to guide our strategic investment. The work is carried out through the Strategic Technology Forum, which brings together a wide range of stakeholders from across the business, including IT & OT.

Implementing our distribution system analysis suite

— Early 2020, we are releasing Auto-design, a new online, self-service tool to give budget estimates on LV connections in minutes, and for free. It also has the ability to guide customers to the most cost-effective and realistic connection option i.e. where suitable capacity is available on the distribution network. Weexpect that this will accelerate feasibility studies for LCT deployment undertaken by our customer, and that it has the ability to assist our LV design processes.

— We are also replacing existing power system analysis packages with the next generation of network analysis tools (from 132kV down to LV) that allow for greater flexibility in automated analysis (for example, constraint analysis for flexible customer connections), and new data-extract functionalities that will improve the interoperability of our processes and systems.

Smart meter data integration

— Defects in the live national infrastructure are compromising service performance, resulting in erroneous data (i.e. missing, duplicate and incorrectly formatted information). We are working with the other DNOs as part of the ENA's DCC IT Integration Group to resolve 33 defects directing impacting service performance for network operators.

— Notwithstanding this, we would like to go live on a number of new system integration applications that will allow us to make use of smart meter data such as our outage management, and in our design processes, and are monitoring the deployment of smart meters to rebase our assumptions with regards to timing.

Current – 2019-20

System-wide resource register

In addition to data that we already share (tables 6 and 7 above), and driven by the Open Networks programme, 2019 Workstream 2, Product 1, we are deploying registers in a format consistent across DNOs, which will share:

- connection & capacity data for resources >1MW,
- related network reinforcement data, and
- commercial services data.

Improving the availability and accessibility of network information to support competitive local energy markets

- Data provision will be a core DSO function, as it facilitates the emergence of new energy markets, and because it supports our commitment to transparency.
- There is a need for us to define the type of data we could provide to the marketplace, beyond what we already publish, and the format we should use, to assist others to deliver enhanced energy services in the competitive market. As a result, the data that could be shared is to be re-assessed and will grow in line with stakeholders' needs. We expect this to include a focus on interoperability of format for planning and forecasting, as well as load flow models; network headroom; asset data; and GIS data.

Define and implement our data roadmap

- We are revisiting and strengthening our internal policies around data management as part of an enterprise-wide initiative to meet new standards of governance, quality and privacy-compliance; and to deliver on the recommendations of the Energy Data taskforce.
- We are also working with stakeholders to clarify their expectations and meet them in a timely fashion.

Data and Systems Development

Annex: Key themes

3. Data and Systems Development

Medium term – 2021-23

Data and Systems Development

Building a data platform

We will be exploring emerging data management technologies to gain insights from data held in structured and unstructured formats, especially where data sets have been too large or complex to be accessed to date. Access to more data sets and IT processing power will support more sophisticated analysis. This includes network data (gathered from the new monitoring equipment) and any other type of data held in the business.

Building our organisational capability on data

Data analytics is a skill where we have limited capability, so we are working to build that skillset in house, supporting it with the right processes and tools. We are researching how other organisations organise themselves to manage data well, how they structure their teams the skills and resources, job titles, etc. We will use this information to inform our plans and approach.

Upgrading our network management system to deal with flexibility

- To support active network management, we will need to manage information flows and control systems. We will also need to grow the ability to undertake real-time power system analysis, respond to smart meter alarms, manage demand side response contracts (and associated trading platforms) and manage the active network management equipment.
- We may consider for instance expanding the existing control support function with capability for active power flow management and short-term forecasting.

Industry data sharing to manage the roll-out of EV and other LCTs

We are looking for opportunities to manage the high volumes of low-carbon technology, by emulating the spirit of open data and through collaboration across the industry. Examples include the idea of a single point of registration for EV charging points, as promoted by the ENA's LCT working group, or data sharing for small electricity and heat generation units.

Long term – 2024-30

DNO control systems interacting with deep and liquid flexibility markets

Starting off with the simple interaction today we envisage a future where our control room is equipped with an algorithm-driven despatch automation model that is able to recommend and execute in 'real' time optimal solutions based on DER information, network information, and a series of other factors influencing the use of customer flexibility (weather forecast, time of day, etc.).

Real-time, secure exchange of data with third parties

The information on DER across distribution and transmission will evolve from being available in static format to being dynamic and real-time:

- Store and transfer asset data, network data and DER data between our operating technology and information technology applications;
- Transfer real-time DER information between ESO and DSOs.

Data and Systems Development

Glossary

DER:
Distributed energy resource

DG:
Distributed generation

DNO:
Distribution network operator

DSO:
Distribution system operator

DSR:
Demand side response

EHV:
Extra high voltage

ESO:
Electricity system operator

EV:
Electric vehicle

HV:
High voltage

LV:
Low voltage

LCTs:
Low-carbon technologies

RIIO-ED1 or ED1:
The current price control which runs from 1 April 2015 to 31 March 2023

RIIO-ED2 or ED2:
The next price control which will run from 1 April 2023 to 31 March 2028

V2G:
Vehicle-to-grid

Notes

Notes