NORTHERN POWERGRID

NETWORK DEVELOPMENT PLAN METHODOLOGY 2022

DOCUMENT CONTROL

Approvals

Role	Approver	Date
Author	Victoria Gosling	09/03/2022
Reviewer	Jack Scoffham Dr Mary Black (DFES review)	10/03/2022
Manager Approval	Simon Jesson	10/03/2022

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1 Executive Summary

Introduction

In response to the Clean Energy for all Europeans Package[1], Ofgem has introduced a new standard licence condition (SLC25B) which requires the publication of a Network Development Plan (NDP). This new licence condition requires Distribution Network Operators (DNOs) to inform stakeholders of our future network developments across our distribution network for a 1 to 10 year window.

Enabling Net Zero

2021 was a pivotal year for tackling climate change, with new policies and strategies announced that support the UK's goals of decarbonising by 2050. The UK government announced a new national target to reduce carbon emissions by 78 per cent by 2035,[2] and new strategies for hydrogen and heat and buildings to turn up the dial on the transition to zero carbon.[3,4] As a DNO, we must be ready to support this transition towards net zero, while ensuring we continue to deliver safe and reliable power, and offer ultimate value for money to all of the communities we serve.

As actions to support net zero grow at local, national and political levels, we are seeing transformational changes in the whole energy system, including:

- an expected tipping point for mass EV adoption, supported by the 2030 ban on new petrol and diesel cars, falling battery costs and expanding charging networks;
- a government-incentivised push for electric heating, with the Heat and Buildings Strategy setting out grants for heat pumps and ambitions to phase out fossil fuel heating by 2035;[2] and
- ever-increasing levels of distributed generation, with Low Carbon Technologies (LCTs) such as domestic rooftop solar photovoltaics (PV) being installed on new and existing properties, and existing solar PV being coupled with domestic storage batteries as prices of both technologies continue to fall.[5,6]

It is our purpose to enable the net zero ambitions of those in our region, whether through customer flexibility, network flexibility or adding additional capacity through reinforcement.

Scenarios & RIIO-ED2 Business Plan

We have developed a range of forecasting scenarios when considering our future pathway to net zero by 2050. Based on these scenarios, we have identified a Planning Scenario (which we consider as our "best view" scenario), which forms the basis of our planned interventions for the RIIO-ED2 (2023-28) period. The details of our planned interventions are as set out in our 2023-28 Business Plan, which we have just submitted to Ofgem.

[1] https://ec.europa.eu/energy/topics/energy-strategy/clean-energy-all-europeans_en
[2] https://www.gov.uk/government/news/uk-enshrines-new-target-in-law-to-slash-emissions-by-78-by-2035
[3] https://www.gov.uk/government/news/uk-government-launches-plan-for-a-world-leading-hydrogen-economy
[4] https://www.gov.uk/government/publications/heat-and-buildings-strategy
[5] https://www.solarpowerportal.co.uk/news/solar_pv_costs_fall_82_over_the_last_decade_says_irena
[6] https://ourworldindata.org/battery-price-decline

Network Development Plan – Three Documents

The Network Development Plan (**NDP**) comprises of this Network Development Plan Methodology Document and two reporting documents - the Network Development Report (**NDR**) and the Network Headroom Report (**NHR**).

The **NDP** itself is underpinned by the interventions that we have identified as being necessary, based on our Planning Scenario. In the NDP, we aim to set out the details of our planned network interventions over the coming years, so as to provide our stakeholders with information on our plans for new infrastructure and flexibility services, as well as providing details of demand and generation network headroom across our distribution network for the medium to longer-term.

The **NDR** will serve to provide the stakeholder with important additional information relating to key projects set for delivery in terms of new infrastructure to be installed and upcoming flexible services to be employed. This data will range from 1 to 10 years.

The **NHR** provides stakeholders with information relating to the magnitude of possible future demand and generation capacity headroom across a range of future scenarios. The NHR covers every year between the years 2021 to 2030 (inclusive) and every 5 years thereafter until 2050.

We are consulting with our stakeholders on the content of our NDP and invite feedback to be provided. We will also be holding a Webinar. We will also be holding a Webinar. Details of the Webinar are on our website, on the Network Data Section.

2 About Northern Powergrid

Northern Powergrid is responsible for the electricity distribution network that powers every day life for 8 million customers across 3.9 million homes and businesses in the North East, Yorkshire and northern Lincolnshire.

Northern Powergrid operates a network that spans around 25,000 square kilometres and consists of 96,000 kilometres of overhead power lines and underground cables and more than 63,000 substations, including:

— 122 large substations (42 grid supply points and 80 supply points).

— 552 primary substations.

— 63,134 distribution substations.

Northern Powergrid has a key role in society powering peoples' lives and enabling economic growth in the communities it serves. Every day it invests around £1 million on safely managing, maintaining and improving its network.

Northern Powergrid is taking action today to be ready for the demands of tomorrow. It is ensuring it has a diverse and skilled workforce ready to manage future energy systems that interact with growing levels of smart and LCTs. Ground-breaking innovation projects are exploring new technologies and supporting the company's transition to a Distribution System Operation (DSO) function and move towards more sustainable energy in line with net zero emissions targets.

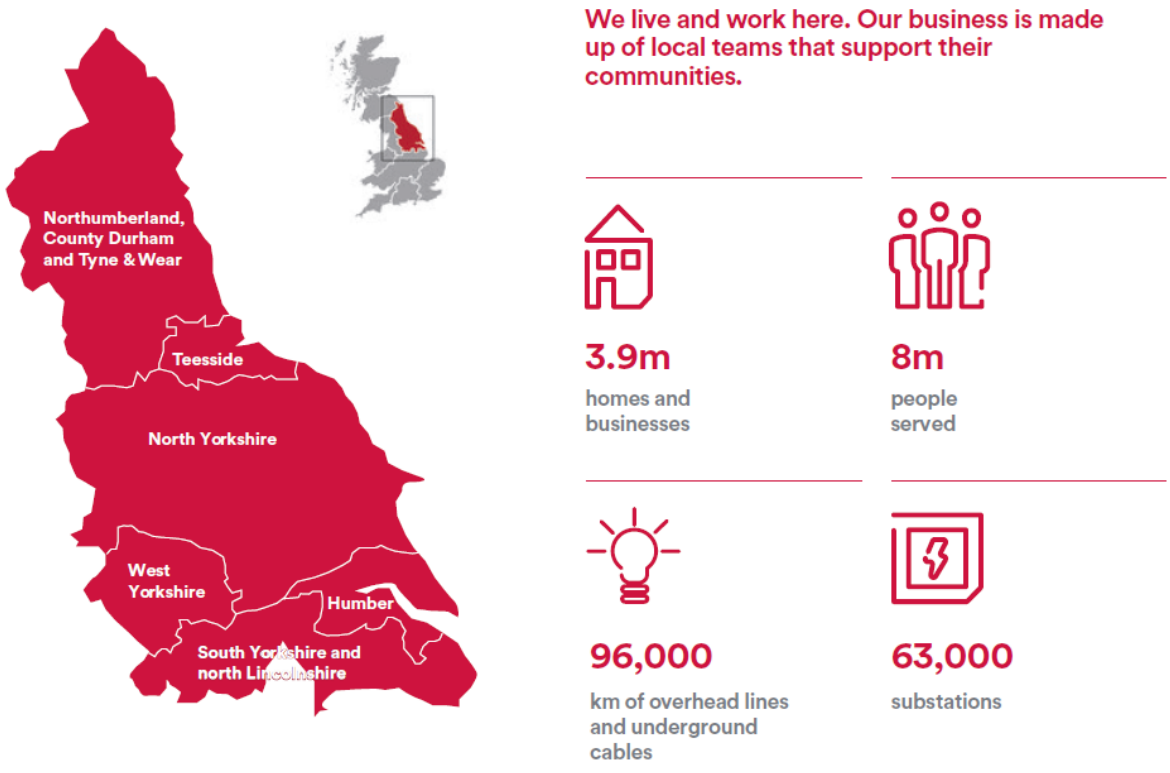

Figure 1 – Northern Powergrid network region and our business

3 Introduction

3.1 Why have we published a NDP?

In response to the Clean Energy for all Europeans Package[7], Ofgem has introduced a new standard licence condition (SLC25B) which requires the publication of the NDP. This new licence condition requires DNOs to inform stakeholders of our future network developments across our distribution network for a 1 to 10 year window.

This document is our 2022 NDP Methodology document. The objective of the NDP is to inform stakeholders of our plans for interventions, flexibility service requirements, and forecast demand and generation headroom across our distribution network for a range of scenarios, for the medium to longer term. The impact of power generation, and decarbonisation of transport and heat are all considered in this NDP forecast. To maximise access for our stakeholders to support the regional collaboration, we have worked with Open Networks and Explain Research to present our information.

The full **NDP** includes:

1. Network Development Report (**NDR**) (downloadable datasets);
2. Network Headroom Report (**NHR**);
    a. Demand Headroom Report (downloadable datasets);
    b. Generation Headroom Report (downloadable datasets); and
3. Network Development Plan Methodology (this document).

The NHR (demand and generation) will be updated annually and the NDR will be updated biannually.

3.2 Who is it for and what are the benefits

We are publishing the NDP to share the data we have so far with our stakeholders for you to tell us if it supports your requirements.

The NDP report comprises of this Methodology Document and two reporting documents, the Network Development Report (**NDR**) and the Network Headroom Report (**NHR**).

The **NDP** will serve to provide the reader with valuable additional information on key projects set for delivery in terms of new infrastructure to be installed and upcoming flexible services to be employed and locations where we need these services in the coming years. Its aim is to provide information to stakeholders on major developments for the years 1-10 so they can plan and forecast accordingly.

The main objective of the **NHR** (demand and generation) is to indicate where it is anticipated that there will be available network capacity to accommodate future connections and where flexibility services may be required in the longer-term.

[7] https://ec.europa.eu/energy/topics/energy-strategy/clean-energy-all-europeans_en

All our stakeholders can give feedback on the NDP, but we expect it will be of most interest to:

— local and combined authorities and Local Enterprise Partnership (LEP) planners and energy teams;

— low carbon initiative coordinators;

— economic regeneration and recovery teams;

— developers of large scale generation and demand projects;

— LCT developers and installers, across all disciplines from EVs to heat pumps; and

— housebuilders and developers.

3.3 Where does the NDP fit with existing network reporting documents?

DNOs already report on distribution network capacity to empower customers and stakeholders, some of whom need information on immediate connection applications, some who may be looking for opportunities to locate developments to provide network services and others looking at long-term plans for our region.

Different network reports, as shown below, have different purposes and therefore have a range of timeframes and content.

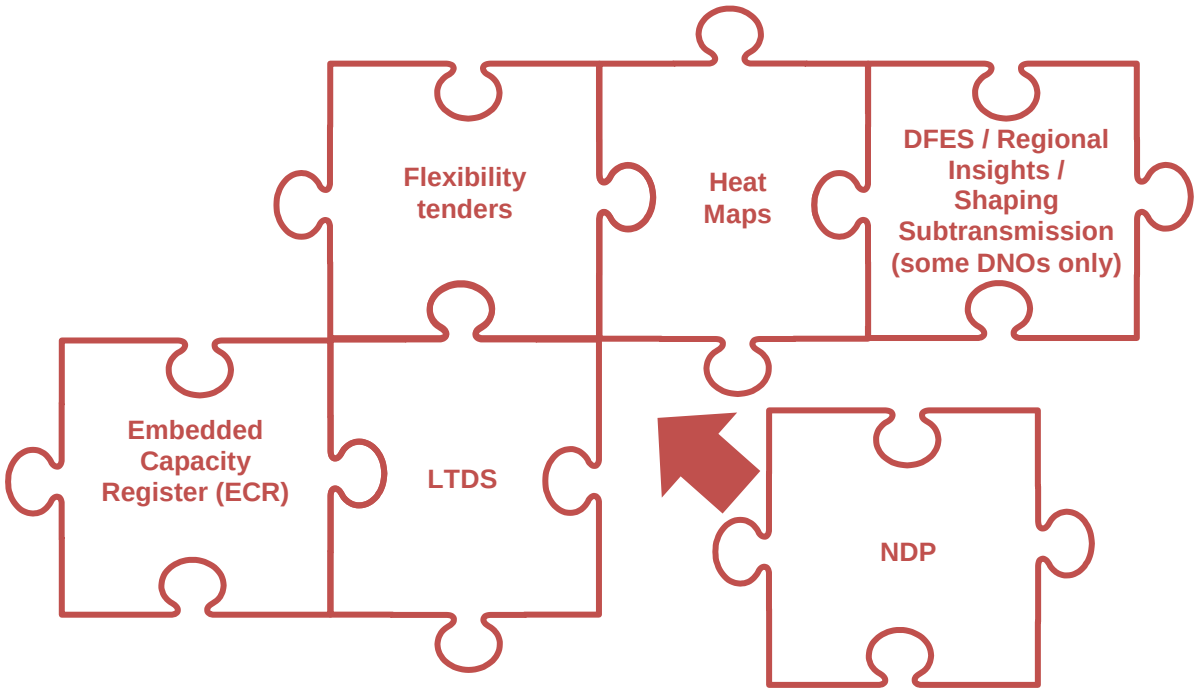

Figure 2 – Distribution network data and capacity reports

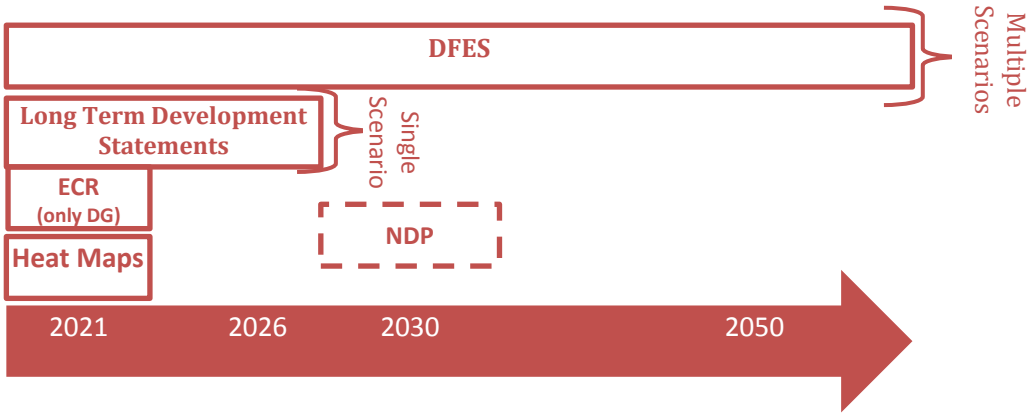

Figure 3 – Timeline of existing network capacity, demand and generation reports

The NDP will follow on from the LTDS covering a 1 to 10 year period for multiple forecasting scenarios, where the LTDS covers the capacity in the short-term for a single scenario. The NDP aims to provide value to customers by aligning against existing and evolving reports. The NDP objective is to address the capacity and network developments in the medium-term to longer-term.

3.4 Scope of the NDP

The requirements of the NDP have been set out by the Energy Network Association (ENA) Open Networks Workstream 1B, Product 5 Form of Statement (FoS).[8] The scope is summarised in the following table.

Date range	Every year to be covered individually between 1-10 years.
	After the 10th year, this requirement moves to every five years up to 2050 or aligning with the final year of the DFES forecast.
Scenarios	DFES scenarios, plus a 'best view' scenario.
Network capacities and assessment methodology	Demand and generation headroom (available capacity) in MW per reported year per scenario.
	Headroom calculations are considerate of financially approved network developments in delivery or planned for delivery, including asset-based enhancements and the use of flexibility services. This may include updates in network developments in the timeframe 0-5 years which were not included in the latest LTDS (November). If included, this must be stated in the accompanying notes and updated in the next LTDS (end May).
	Headroom calculations are considerate of thermal loading and fault level constraints as a minimum.
Coverage	Capacity information to be provided for substations where the greatest voltage is greater than 20kV, normally BSP and primary substations down to and including the primary secondary voltage, typically HV (20kV, 11kV or 6.6kV).
Format and publication	The format of the Network Headroom Report part of the NDP is tabular in nature, presented in Microsoft Excel or similar spreadsheet format. Interactivity can be added to the workbook to improve visualisation of the data. Guidance shall be included to explain the scope of the data workbook, define each data element and give user instructions. A contents and version control page is included to ensure that users are able to easily access data, accurately reference the report and view approvals. It also states the

[8] https://www.energynetworks.org/assets/images/Resource%20library/ON21-WS1B-P5%20Network%20Development%20Plan%20Form%20of%20Statement%20(19%20Aug%202021).pdf

	dates and versions of critical data sources including the LTDS and DFES.
	Licensees shall endeavour to refresh the Network Headroom Report with the latest Licensee's data annually, including the years in between publishing the whole NDP (which shall be published by 1st May every two years).
Information sources	Parameters for the existing network underlying the headroom calculations shall be based on the latest LTDS and incorporate a view of financially approved and planned interventions.
	Existing and future network demand and generation shall be based on the licensee's latest LTDS and DFES forecasts for demand and generation at the substation.
	It is expected that the flexibility services incorporated in the NHR shall be in accordance with DNO Flexibility Procurement Statements and Reports or if not included in those reports, they must be stated in the accompanying notes. Publication of Flexibility Procurement Statements and Reports is a new Standard Licence Condition 31E, and reporting detail is yet to be finalised, but will likely include the location and magnitude of contracted and prospective flexibility services.

Table 1 – Summary of NDP scope

3.5 How to provide feedback?

During March and April 2022, we are consulting with our stakeholders on the content of our NDP and invite feedback to be provided. We will also be holding a Webinar. Details of the Webinar are on our website, on the Network Data Section.

4 The Planning Scenario (Best View) Network Development Plan Methodology

We have developed a range of forecasting scenarios when considering our future pathway to net zero by 2050. Based on these scenarios, we have identified a Planning Scenario (our "Best View"), which has formed the basis of our network development plans for the 2023-28 period (as set out in our RIIO-ED2 Business Plan). The Planning Scenario is our interpretation of the "Best View" scenario.

Our business end-to-end planning process plays an integral part to inform our Planning Scenario (our "Best View") development plan. We must ensure that thermal capacity is available to support load growth on our network, and in addition to thermal capacity, we must also ensure that our network operates within statutory voltage limits, that the fault level duties are within the ratings of the network assets, that power quality is within national standards and that we ensure that network losses are as low as reasonably possible.

The methodology we use to determine the required network investment is:

1. Forecasting;
2. Network impact assessment (identifying the network constraints);
3. Optioneering; and
4. Preferred solution.

Forecasting (DFES scenarios)

The Distribution Future Energy Scenarios (DFES) plays a key role in our network planning and underpins our "Best View" development plan. Our DFES models the range of credible energy futures for our region. The scenarios are projections, rather than predictions, and the insight we gain from this regional real-world modelling helps us to plan and deliver services, informs investment in our network, and ultimately enables us to facilitate the region's growth and decarbonisation ambitions.

In 2021, we submitted our RIIO-ED2 2023-28 Business Plan that will underpin a transformational change in our business and the wider energy sector. As part of the RIIO-ED2 Business Plan, we produced our own Planning Scenario. The Planning Scenario is one of the scenarios considered in our DFES. The Planning Scenario is our interpretation of our "Best View" scenario.

The data in the DFES enables us to:

— facilitate our region's net zero ambitions;

— understand the projected uptake of LCTs and the increase in distributed generation capacity;

— explore how we can proactively manage our network to alleviate any constraints created by energy demand or generation;

— model the impact of these changes on the electricity distribution network and indicate locations; and

— determine the need for intervention or investment to deliver a reliable low carbon network.

We have developed a range of scenarios to forecast possible decarbonisation pathways to net zero. These scenarios range from a predominance of electrification in the heat and transport sectors to other outcomes where alternatives to electricity such as hydrogen can be expected to play a greater role.

We have considered five scenarios which underpin our DFES. These are shown below.

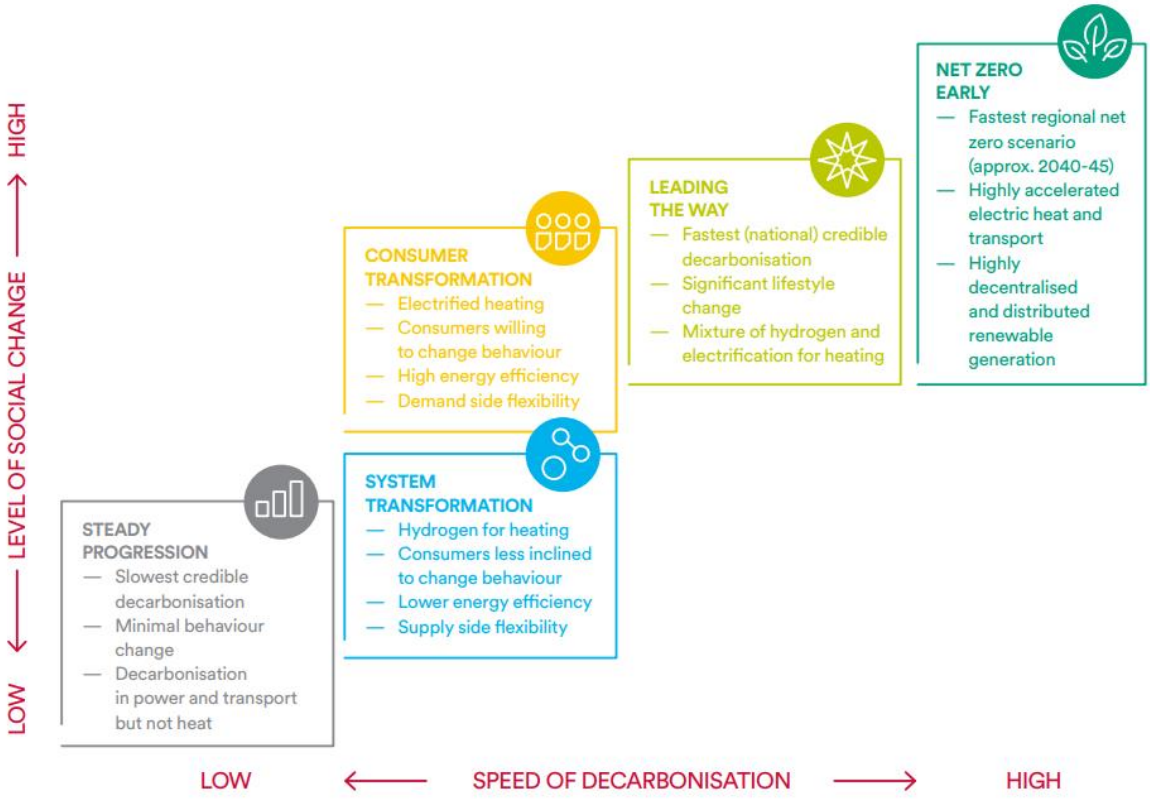

Figure 4 – DFES scenarios

Figure 4 above outlines the five scenario worlds behind our network headroom reporting. More detail of each of the energy scenarios, assumptions and building blocks can be found in the DFES 2020 Report for the National Grid based scenarios in and the DFES 2021 Report for the best view scenario.[9,10]

All the Great Britain DNOs have agreed through the ENA Open Networks Project to produce a "Best View", a scenario that sets out the most favourable pathway to net zero for their respective regions. The way we came up with our best view has been previously published in our ED2 2023-28 Business Plan, in DFES 2021 and in the Open Networks Project reports; and for ease of reading is repeated again here in Annex 1.

[9] https://www.northernpowergrid.com/asset/0/document/5836.pdf

[10] https://ed2plan.northernpowergrid.com/sites/default/files/document-library/Scenarios_and_investment_planning.pdf

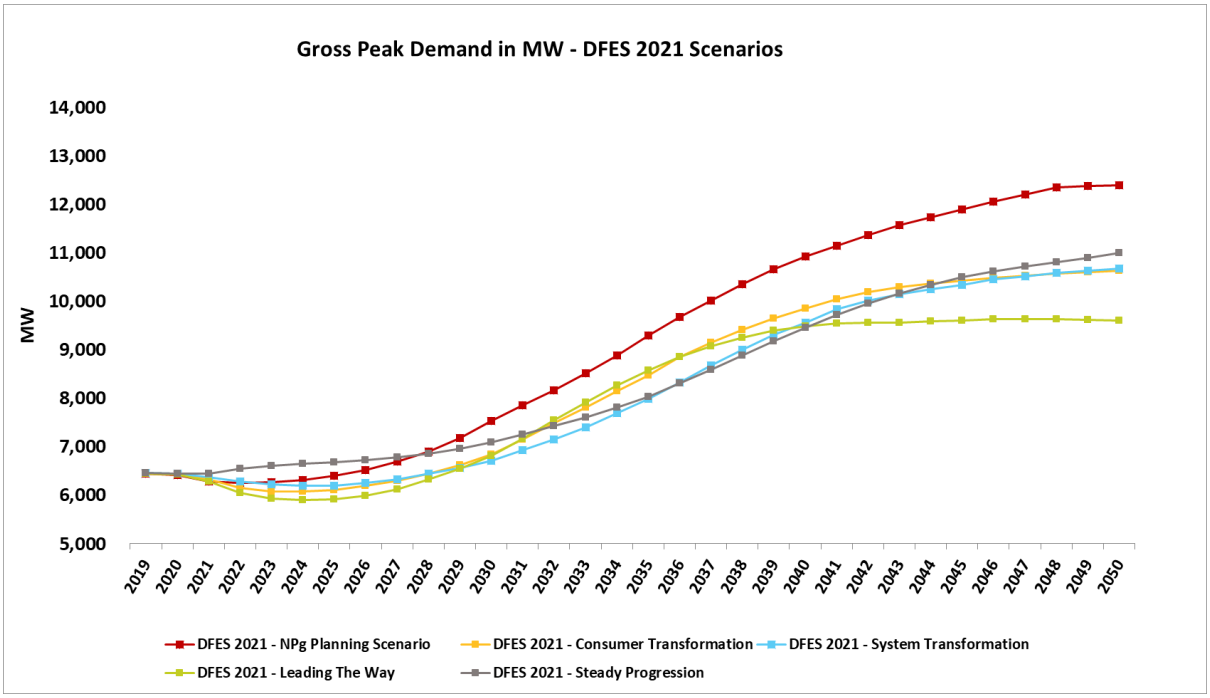

Figure 5 – Demand Scenarios

Figure 5 above shows the future projections for gross peak demand in the Northern Powergrid region, which is a key parameter of interest for network intervention studies. In the four National Grid ESO FES-aligned scenarios, the System Transformation, Leading the Way, and Consumer Transformation scenarios all indicate initial slight reductions in peak demand in the short term - largely due to expected improvements in energy efficiency.

However by 2028 all the scenarios are forecasting an increase in peak demand compared to the current position due to electric load growth from new LCTs such as Electric Vehicles (EVs) and heat pumps.

Much of the higher gross peak demand projection in the Planning Scenario in later years is due to a higher assumption on electric HGVs compared to the four National Grid ESO FES-aligned scenarios which in 2021 were assuming HGVs were largely hydrogen fuelled.

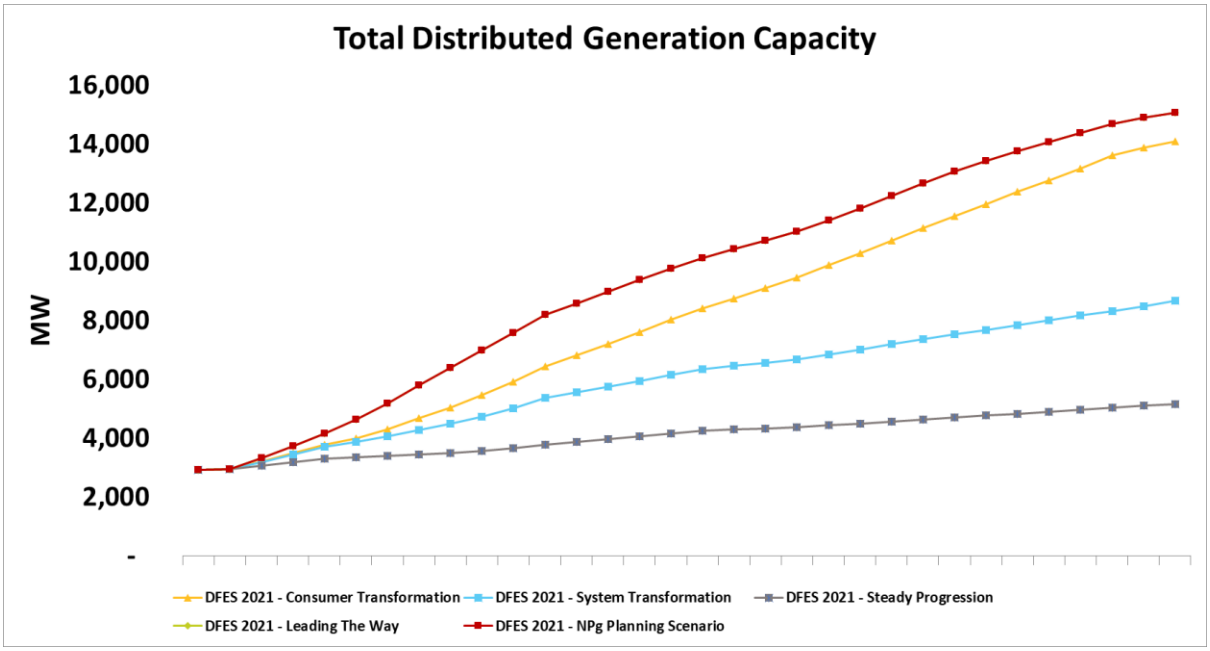

Figure 6 – Generation Scenarios

Figure 6 shows the future projections for embedded generation capacity on the distribution network, which is another parameter of interest for network intervention studies. In the four National Grid ESO FES-aligned scenarios, the Leading the Way Scenario (hidden behind the Planning Scenario on the chart) shows the highest increase in generation capacity required to power the demands for electric heat and transport. Consumer Transformation moves towards high generation requirements too but along a slower trajectory.

The lower generation requirement in System Transformation and Steady progressions is linked to the lower electrification framework in both those scenarios.

Our Planning Scenario is in line with the Leading the Way scenario on generation requirements reflecting that it is a scenario with high expectations for EVs and Heat Pumps.

Our Planning Scenario is our interpretation of the "Best View" scenario. The Planning Scenario is based on our regional interpretation of the range of national scenarios currently available (National Grid ESO FES and the Climate Change Commission (CCC) scenarios in the Sixth Carbon Budget). It has also taken government policy and stakeholder feedback into consideration, as well as regional characteristics.

We are always mindful that the future is uncertain, and we do not yet know which LCTs will become the mainstream over the next 30 years and beyond. As a network operator, we are committed to embracing this uncertainty to ensure no matter what scenario materialises, we can deliver safe, reliable and low carbon power.

The Planning Scenario offers the most value in the short-term and while it is plotted to 2050, its one to 10-year horizon provides a higher degree of certainty which helps us as an organisation to plan for network impact assessment and investment decisions.

The DFES report and interactive tools can be found on our website:

https://www.northernpowergrid.com/network-data.

Network Impact Assessment

The methodology for performing our Network Impact Assessment is as set out below.

On our EHV and 132kV network, the identification of constraints is informed from our planning scenario outputs, which themselves are derived from our load forecast model, such that we compare current and future demand on the network against the stated capacities of our network assets.

Our load growth model provides future demand profiles which we use in conjunction with equipment ratings to determine the nature and magnitude of network constraints.

Where the current or future demand is shown to be exceeding the declared firm capacity of that section of the network during the 2023-28 period, then this identifies that a constraint exists. After identifying network constraints from our load growth analysis, we then validate the outputs from the analysis.

Using this data we then assess future forecast loading (from our Planning Scenario and across the range of potential decarbonisation pathways), to confirm those sites where the capacity is exceeding capability and where we need to ensure compliance with the relevant planning requirements and standards.

On the 132kV and EHV network the firm capacity of a substation (or a wider substation group) is typically defined as the network's ability to supply demand immediately following the occurrence of a first circuit outage (FCO) – this is the capacity that is immediately available without requiring manual intervention. This capacity can be provided by the intrinsic network assets, network flexibility, distributed generation security contribution and/or any DNO-contracted flexibility. Where we have identified that a constraint exists, the firm capacity is reviewed in further detail to identify whether any adjustments can be made.

Following this, where the constraint is confirmed, then optioneering of potential solutions is performed.

Optioneering

Once the network validation has confirmed the details of the constraints, identification of appropriate options to resolve the constraints are then performed.

As our preferred investment strategy we have committed to a flexibility first approach to overcome network constraints. This approach to network development helps us reduce the cost of new infrastructure investment, run existing networks more efficiently and creates a smarter, more flexible system for all.

The types of interventions we consider to address network constraints are shown below, where we pursue a "flexibility first" process:

- Flexibility services: where customer can agree to actively manage their demand / generation to support avoiding constraints;

- Smart network technology: where we employ sensors and network communication devices to maximise the information available in our existing assets;

- Network reconfiguration: where we temporarily or permanently reconfigure the network topology to disperse the excess demand into the wider network;

- Deploy enhanced network asset ratings: where we look to increase the thermal capability of existing assets (i.e. transformers);

- Network reinforcements: where we replace the existing assets with new assets or by installing additional assets, which will provide more capacity on our network; and

- Synergies with other work programmes: align investments to fully maximise the benefit gained through multiple work programmes.

We use industry standard tools such as the ENA Common Evaluation Methodology (CEM) and OFGEM Cost Benefit Analysis (CBA) to consider the whole life cost of each option – and therefore ensuring we choose the most suitable solution to meet the long term needs of our customers.

Preferred Solution

Once all options have been identified, at each individual EHV site we assess the costs, benefits and net present value (NPV) of each option to determine the solution that is most economic and efficient in providing the required capacity at the required time to support the planning scenario load growth. This could be a blend of customer and network flexibility and innovative solutions as well as conventional reinforcement.

4.1 Network Development Report (NDR)

Our Network Development Report (NDR) is provided on our website in the Network Data Section. The NDR provides information on key projects set for delivery (planned and committed) in terms of new infrastructure to be installed, upcoming flexible services to be employed, and locations where flexibility services will be needed over the coming years. The range covers the next 1 to 10 years.

The types of network interventions set out in the NDR include the following:

- DNO contracted flexibility service requirements;

- Smart network technology;

- Network reinforcements (load related and condition based related) we have committed to during the RIIO ED1 price control;

- Network reinforcements (load related, condition based related and fault level related) planned for RIIO ED2 price control (depending upon development activity the solutions are subject to change); and

- Network reinforcements as a result of New Connections (new customer demand and generation connections), if applicable.

We also provide details in the NDR of our planned condition based interventions – this refers to where asset replacement is required due to condition and performance.

Where we are replacing transformers, this will increase the network capacity. The amount of capacity released around these assets will be assessed during the implementation stage of the project.

For each development proposal included in this NDR, the following information is provided:

Network Infrastructure	Flexibility Services
- Location of intervention - Outline of the planned works - Reason for carrying out works - Impact on the distribution system capability - Equipment ratings (for transformers, the existing and new rating) - Expected start and completion data, and - Equipment ratings	- Location of intervention - Year of intervention

We have provided a look up table within the NDR to enable stakeholders to easily identify the location (postcode and x and y coordinates) of each of our Supply Point substations and Primary substations.

Postcodes and coordinates for each of our Supply Point substations (typically 132/33kV or 132/66kV) and Primary substations (typically 33/11kV or 33/6.6kV) have been provided in the datasets within the NDR.

It is worth noting that changes to the expected completion date can occur for the following reasons, including:

- Delays in securing consents and wayleaves to install equipment on private land;
- Changes to system outage dates;
- Changes to customer requirements and/or timescales; and
- Changes to plant and materials supplier lead times.

In providing this information, it is important to recognise that these activities are the most up to date information that we have available, but that these may change in future years due to a range of factors – including customers changing their accepted connections (e.g. cancelling or increasing the capacity), annual load forecasting updates indicating different dates of constraints occurring, future new customer connections resulting in increased network capacity, revised asset condition assessments indicating intervention may not be necessary, flexibility procurement not providing sufficient capacity, etc.

Flexibility Services

We currently have an open call for flexibility services to provide early visibility of where we may purchase flexibility in the future so that customers can understand the opportunities for them to develop new income streams. The call is open to any interested customer in the region who has the ability to modify their energy consumption and/or production of energy in real time. We have confirmed that we would like to hear from all interested parties, large or small, whether already connected to the network or considering a new connection.

We have signposted customers who may be able to provide flexibility services to Northern Powergrid, to contact us via our website (https://www.flexiblepower.co.uk/locations/northern-powergrid/where-we-are-procuring). We will then follow up to discuss the opportunities, technical capabilities, and the technical requirements to become a flexibility service provider. Updates will also be provided about future tender opportunities as soon as they are launched.

We will be issuing a flexibility tender during Q2 2022, to seek to procure flexibility services in areas of our region with known constraints. We will be continuing these procurement activities in future years.

The downloadable datasets in the NDR lists the sites where we anticipate we will need flexibility services over the coming years.

4.2 Network Headroom Report (NHR)

The Network Headroom Report has been produced to provide our stakeholders with an insight into the available network capacities available for new connections in terms of generation and demand headroom, which is reported for each of our DFES forecast scenarios.

The headroom calculations include the network capacity that is increased by our network developments in delivery (financially approved) or planned for delivery, including asset-based enhancements and the use of flexible services. The headroom calculations are considerate of thermal loading and fault level constraints.

Our headroom results have been provided for Supply Point substations (typically 132/33kV or 132/66kV) and Primary substations (typically 20kV, 11kV or 6.6kV).

4.3 Baseline data for generation and demand forecasting

Generation data is forecasted using a combination of accepted generation in the short-term (weighted by predicted likelihood of proceeding) and future energy scenarios indicating the size and scale of generation likely to connect in our region in the longer-term – these future scenarios align with those predicted by National Grid as part of their Future Energy Scenarios (FES) process.

Our planning scenario (our “Best View” scenario) includes an assumption that even without intervention a high adoption of Time of Use Tariffs (ToUT) by residential and industrial energy will lower Gross Peak Demand because customer price-driven flexibility through ToUT will help distribute power away from times of peak demand. For example, EV smart charging technology with a ToUT will determine the best time to charge assets such as EVs, to both avoid constraining the network at

times of high demand and enable customers to take advantage of cheaper electricity prices at times of low demand.

The impact of network interventions are included in all of the forecast headroom scenarios, including all interventions types (DNO contracted flexibility services, smart network technology and load related network reinforcements).

4.4 How do we calculate the forecast demand headroom?

The forecast network demand thermal headroom is provided in MWs for every substation in our region (covering 132kV to 6.6kV substations).

The forecast headroom is calculated for each of our future projected scenarios (defined in the DFES) using the gross peak demand. Planned and committed network interventions have been included in the forecast headroom predictions. Where the headroom value goes negative, this means that there is zero headroom available. Network constraints at the GSPs have not been included within this demand headroom report and further analysis would be required. The range covers every year between the years 2021 to 2030 (inclusive) and every 5 years thereafter until 2050.

4.5 How do we calculate the forecast generation headroom?

The forecast network generation thermal headroom is provided in MWs for every substation in our region (covering 132kV to 6.6kV substations) and is provided for each of our future projected scenarios (defined in the DFES). The headroom values are firm capacity values which means the generation at the customers site will not be disconnected during an unplanned network outage (due to a fault) on the wider network.

The headroom is calculated by comparing the gap between our future projected generation values, substation potential reverse power flow capability and upstream network constraints. Where there are known fault level constraints the network generation headroom is defined as zero headroom available. Planned and committed network interventions have been included in the forecast headroom predictions. The range covers every year between the years 2021 to 2030 (inclusive) and every 5 years thereafter until 2050.

Considerations

- Network constraints at the Grid Supply Points (GSPs) have not been included within this headroom report and further analysis would be required.

- The headroom results do not account for the capacity released where we have Active Network Managements schemes. We have a generation ANM scheme which has been developed and deployed within the Driffield (Yorkshire licence area). The Driffield ANM scheme manages the export from a number of generators to ensure that the power flows within the Driffield 66kV network and the local 132kV network remain within their design limits.

- The headroom capacity forecasts are subject to change in response to our customer generation and demand requirements, and hence the inherent uncertainty associated with ongoing transitions towards net zero.

- This report is focused on the higher voltage primary network and the large scale interventions. However, in addition to these a large amount of work will also be taking place on the low voltage networks in order to enable our customers to run their EVs and heat pumps at residential level. It is the needs at LV that are driving the requirement for more capacity at HV. This data is not reported in the NDP.

- It should be noted that during the production of this NDP, the NHR was published in August 2021 as a precursor to this NDP to allow our stakeholders to provide feedback, and is based on the DFES 2020 data. Since August 2021 we have updated the DFES and therefore the NDR plans will be slightly out of sync with the NHR. However we do not expect this to be a significant misalignment. The publication of the full NDP in 2024 will align data across the three separate reports as three documents will be published at the same time.

- Although every effort has been made to ensure the accuracy of the data provided in this NDP, Northern Powergrid does not accept any liability for the accuracy of the information contained herein, and in particular neither Northern Powergrid nor its directors or its employees shall be under any liability for any misstatement or opinion on which the recipient of this statement relies or seeks to rely.

In conclusion, our Network Development Report shows that we expect load growth under all scenarios due to electrification of heat and transport and that this will accelerate into the 2030's. We expect intervention at 22 EHV sites over the next seven years to 2028. But we expect up to 71 EHV sites will require intervention during 2028-33. Hence we will be increasingly focusing on flexibility services and LV monitoring to help manage the growing capacity requirement.

5 References

The Network Development Plan Methodology aims to be a standalone document, however to further support our stakeholders with their developments there are a range of supporting data and tools that Northern Powergrid publish.

- Long Term Development Statement
- Embedded Capacity Register (ECR)
- Contracted Capacity Register (CCR)
- Demand Availability Heat Map
- Generation Availability Heat Map
- Distribution Energy Scenarios 2021 (DFES)
- DFES Visualisation Tool
- DFES Downloadable Files
- Flexibility Service Locations - where we are procuring

6 Acronyms

CCC	Climate Change Commission
CEP	Clean Energy Package
DFES	Distribution Future Energy Scenarios
DNO	Distribution Network Operator
DSO	Distribution System Operation
ECR	Embedded Capacity Register
EHV	Extra High Voltage
ENA	Energy Networks Association
EREC	Engineering Recommendation
ESO	Electricity System Operator
EVs	Electric Vehicles
FoS	Form of Statement
FES	Future Energy Scenarios
HV	High Voltage
LCTs	Low Carbon Technologies
LTDS	Long Term Development Statement
LV	Low Voltage
NHR	Network Headroom Report
NDP	Network Development Plan
NDR	Network Development Report
NPV	Net Present Value

7 Annex 1 – How we derive our "Best View" scenario for planning

We adopted our Planning Scenario as our Best View Scenario in 2021. Our Planning Scenario was developed during 2021 and has informed the investment decisions we have set out in our business plan for 2023-28. Because our Planning Scenario has been produced to support real investment decisions we are making in the short term, we carefully considered existing policies, inputs from our stakeholders and the local characteristics of our region.

Our Planning Scenario was produced following the Climate Change Committee's 6th annual carbon budget which was published at the same time as the Government's Ten Point Plan. In developing the Planning Scenario, we have considered all existing and potential policies that will impact our network in both the short and long term.

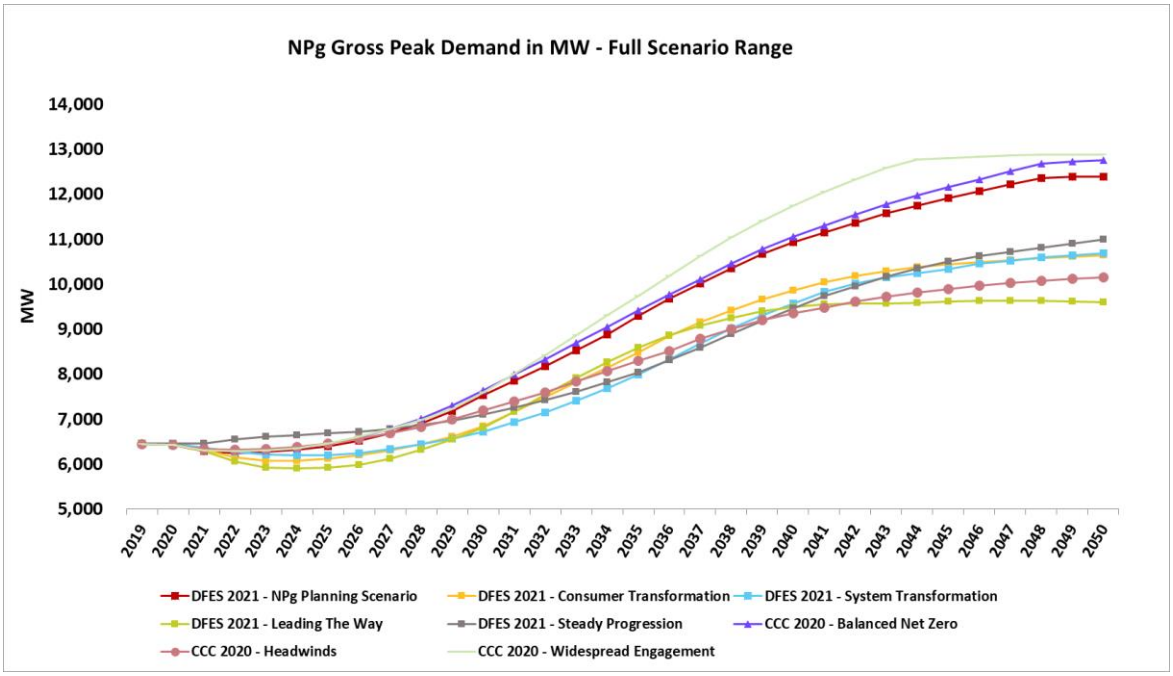

Figure 7 – Full range of scenarios including CCC

Figure 7 shows the full range of scenarios informing our best view, including the CCC scenarios.

Policy commitments such as the ban on sales of new Internal Combustion Engine (ICE) vehicles by 2030 and policy ambitions such as those announced in October's Buildings and Heat Strategy are included within our assumptions to form the Planning Scenario.

The assumptions on latest policy can be seen in the following table.

Key building block	Assumptions on latest policy
Electric vehicle uptake	• In line with the Government's Ten Point Plan, it assumes a ban on the sale of new ICE vehicles by 2030 and includes a ban on new hybrids by 2035

Heat pump uptake	• In line with the CCC's Balanced Pathway scenario, it meets the Government's Ten Point Plan targets of 600,000 heat pumps being installed annually in the UK by 2028 • It assumes a ban on the sale of new gas boilers for new homes from 2025
Energy efficiency	• Domestic thermal efficiency is assumed to be moderate. Appliance efficiency assumptions meet current EU targets for 2030 • I&C energy efficiency is aligned to EU energy efficiency targets
Renewable energy sources	• Solar PV assumptions based on high large scale solar uptake and high domestic PV take up, reaching 1013 MW by 2030 and 2146 MW by 2050 • Wind assumption supported by recent wind turbine sizes and behaviours reaching 748 MW by 2030 and 2015 MW by 2050

Stakeholder inputs

Our methodology for developing the Planning Scenario includes assumptions based upon our engagement with our stakeholders. This includes information gathered from our connections pipeline, surveys and 1-to-1 conversations we hold with our stakeholders.

Within all DFES 2021 scenarios, we have included 600 MW of recently accepted customer demand connections in our near-term forecasts. We have also considered 4 GW of accepted customer generation connections. This ensures that projects being undertaken by stakeholders, right now, are visible in our forecasts to provide the greatest clarity.

The accepted connections account for a wide range of customer activities, such as electric rail, park & ride EV charging, glass industry, warehousing growth, new units at industrial, manufacturing and business parks, and services like sewage treatment and waste. Also of note is that our Green Recovery scheme is now in progress, which creates the necessary capacity to support clean energy growth projects across our region, including regeneration and development at the Humber freeports, large scale solar and wind generation and rapid EV charging on motorways and trunk roads as identified in the Project Rapid report commissioned for the Department of Transport.

Stakeholder insights have also been gathered from surveys shared with key stakeholder groups as part of our DFES 2020 engagement campaigns, reaching out to groups including local authorities, LCT installers, car dealerships and large industry. These quantitative insights are supported by information gathered from 1-to-1 engagements our team has with stakeholders, whether that is speaking to local councils about their plans, or community groups such as the example of Hope Valley Climate Action.

Regional characteristics

Our region is unique, and we are careful to reflect locally specific characteristics in the assumptions for our Planning Scenario.

We have carefully monitored trends specific to our region to ensure our Planning Scenario is truly reflective of life in our local communities. For example, we have scaled up the uptake of large solar PV in our Planning Scenario to reflect the large pipeline of these projects expected in our region by 2030. We have also modified our assumptions from the FES building blocks for current heat pumps to reflect what is believed to be a higher number already in our region and used DVLA data to improve the certainty of our EV projections.