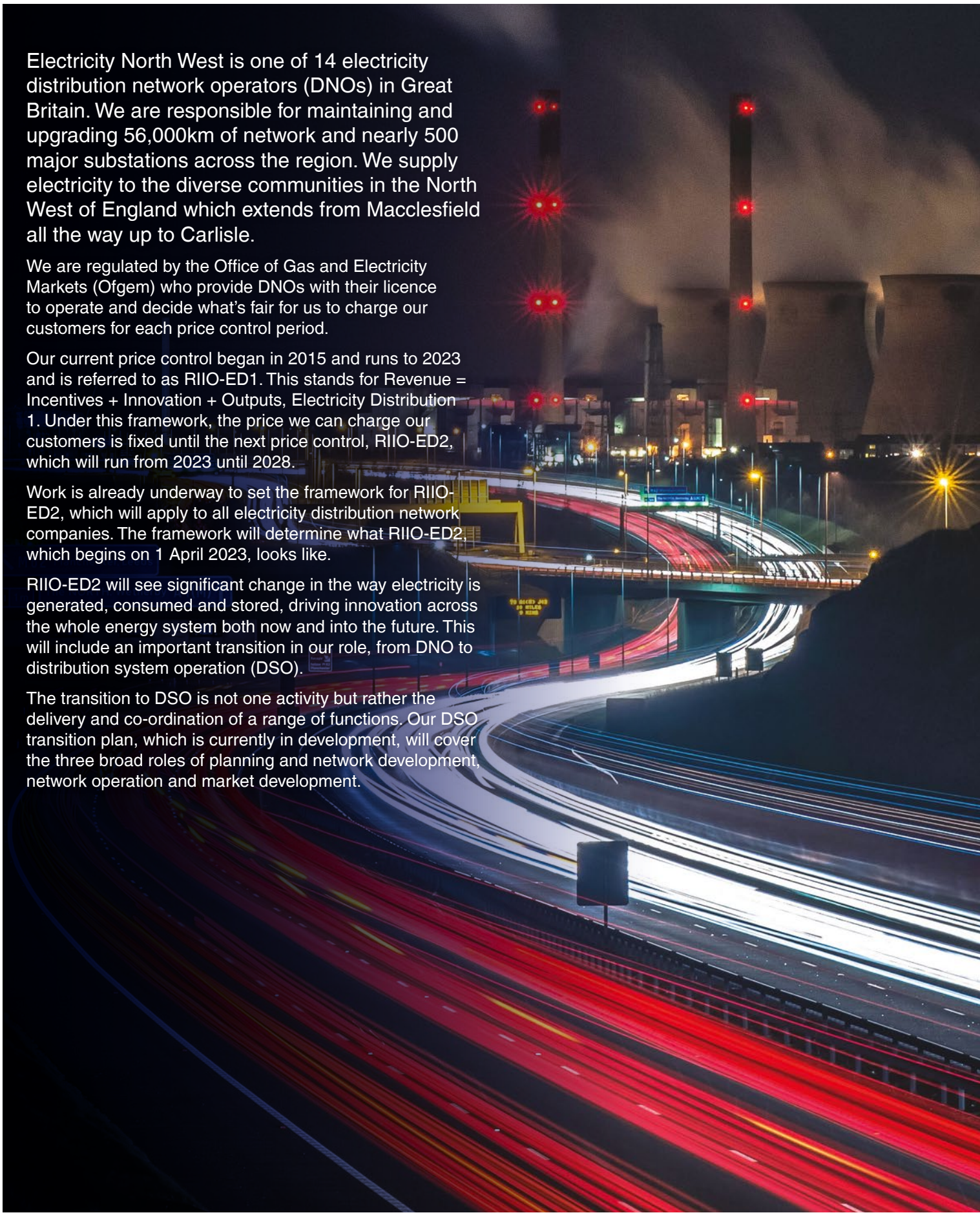
Network Headroom Report

August 2021

electricity north west

Bringing energy to your door



Electricity North West is one of 14 electricity distribution network operators (DNOs) in Great Britain. We are responsible for maintaining and upgrading 56,000km of network and nearly 500 major substations across the region. We supply electricity to the diverse communities in the North West of England which extends from Macclesfield all the way up to Carlisle.

We are regulated by the Office of Gas and Electricity Markets (Ofgem) who provide DNOs with their licence to operate and decide what's fair for us to charge our customers for each price control period.

Our current price control began in 2015 and runs to 2023 and is referred to as RIIO-ED1. This stands for Revenue = Incentives + Innovation + Outputs, Electricity Distribution 1. Under this framework, the price we can charge our customers is fixed until the next price control, RIIO-ED2, which will run from 2023 until 2028.

Work is already underway to set the framework for RIIO-ED2, which will apply to all electricity distribution network companies. The framework will determine what RIIO-ED2, which begins on 1 April 2023, looks like.

RIIO-ED2 will see significant change in the way electricity is generated, consumed and stored, driving innovation across the whole energy system both now and into the future. This will include an important transition in our role, from DNO to distribution system operation (DSO).

The transition to DSO is not one activity but rather the delivery and co-ordination of a range of functions. Our DSO transition plan, which is currently in development, will cover the three broad roles of planning and network development, network operation and market development.

Contents

1 Welcome

Welcome to our first Network Headroom Report (NHR). It sets out two main things: the areas of our network most suitable for new connections, and areas of our network where flexible services will be able to provide benefits. It covers the period 2021-2050.

As the region's distribution network operator (DNO), we are playing an important role in helping our communities to 'build back better' in the aftermath of the pandemic, supporting government plans for a green recovery, while continuing to work even harder to support the communities we serve.

We have developed our business plan for the next regulatory price period (RIIO-ED2) to satisfy our customers' needs and Ofgem requirements. Based on their inputs, we have set three strategic goals:

- Excellent customer service ensuring that we cater for the needs of vulnerable consumers
- Sustainability
- Delivering a reliable and affordable network.

To enable us to meet these headline commitments over the short, medium and long term, we need to have clear plans in place for continually changing and developing our network. Increased dependence on electricity for low carbon transport and heat means that our network must be smart and flexible to continue meeting these needs efficiently.

Sharing more planning and operational data in line with Ofgem's Data Best Practice guidance is one of our priorities as it is considered crucial to the transformation to a low carbon, affordable, flexible and digital energy system. We are delivering benefits for our customers and stakeholders by equipping them with additional information. Innovative and whole system solutions enabled by the data we share will unlock additional value from our system by allowing others to develop their capabilities. In particular, by improving the identification and sharing of future network constraints, we shall identify parts of our network where there is existing capacity and highlight where there are opportunities for flexibility services to help us plan and operate a more dynamic network.

The purpose of the NHR is to help industry participants by providing insights into future network headroom for new demand and generation. This will enable connections to locate in the most advantageous areas, identify when and where issues occur and develop targeted mitigations through the flexible service market we are stimulating. We are building on our other network reports, going beyond the present situation to highlight future impact of the electrical requirements we forecast in our Distribution Future Energy Scenarios (DFES) and the range of uncertainty in medium and longer-term network capacity.

We welcome your feedback to help shape our publication of network headroom in May 2022 that will be an important part of our Network Development Plan reporting which will further show how we are optimising network investments.

Steve Cox
Engineering and technical director

In this section we introduce our NHR in the context of how we determine and use the available capacity results we are presenting. We also explain how the NHR fits with our other reports, some of which share source information used in the assessments underlying our NHR and others which use NHR results as their input. The contents of each section of this NHR are also described to help readers locate relevant information quickly.

2.1 Planning our future network

As DNO for the North West of England, we are responsible for the affordable development of a safe and reliable system which must continue to meet our customers' needs as they transition to a net zero carbon future.

We have a dual role to play in this transition. We have committed to lead by example, demonstrating to our customers the actions that are needed and sharing our learning to help them on their net zero journeys. This commitment builds on our progress since 2019. For our next phase, 2022-28, we will set science-based targets and reduce the emissions from our buildings, transport and supply chain. In August 2021 we joined a growing movement with 3,000 other leading businesses, who are similarly committed to urgent action on climate change, as part of the United Nations' Race to Zero campaign.

We are committed to ensuring that our plans are based on the needs of our customers and stakeholders. We work closely with our strategic partners across the region, supporting the development of bespoke plans and projects to help meet their local targets, including net zero carbon by 2037 in the case of Cumbria, and 2038 for Greater Manchester.

Our network must evolve to meet the challenge as our customers' requirements change to meet their net zero ambitions.

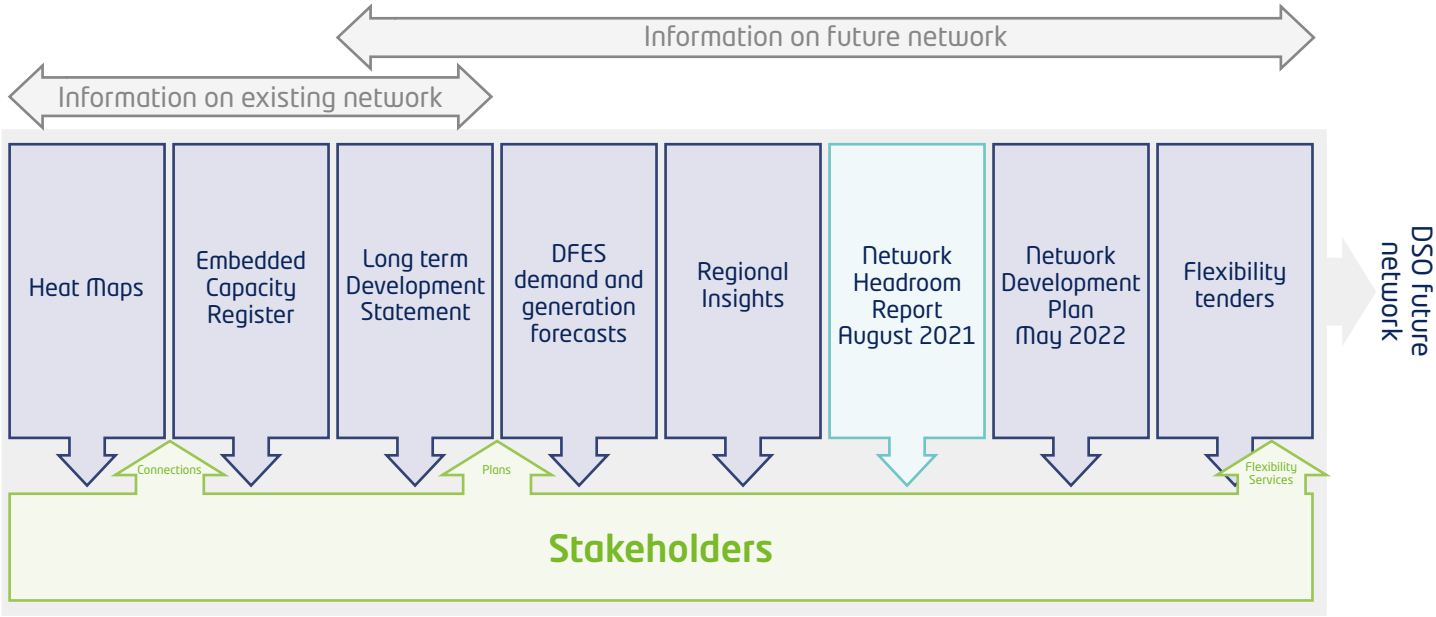
One of the changes we are seeing as part of the transition to net zero carbon is the connection of local embedded generation and flexibility, which are vital if we are to reduce carbon emissions. We are also accommodating more low and zero carbon technologies (LZCTs) including electric vehicle (EV) charge points to decarbonise transport and more heat pumps to decarbonise heating in the UK. We develop a range of Distribution Future Energy Scenarios (DFES) to capture the uncertainty of the magnitude and how quickly these changes may occur.

Our forecasts for the uptake of LZCTs are an important input to the assessments that inform our well justified investments including those in our RIIO-ED2 business plan submitted to Ofgem in July 2021. Alternative views of credible futures allow us to prepare for a range of eventualities. Analysis of demand and generation forecasts informs our understanding of where our network will have sufficient capacity and how this varies for each scenario. Where we identify potential network constraints, we consider mitigation options based on their location, magnitude and nature and timing dependencies. Interventions could range from purchasing flexible demand and generation services to investing in new assets to ensure that the necessary capacity is available up to 2030 and beyond. Procurement of flexibility services is a smart and efficient method for managing our network and we are supporting development of the flexibility market in numerous ways including increasing the visibility of our needs by reporting network headroom in this report. Flexibility providers will have more notice of potential constraints, giving them more time to participate.

Options to address the issues identified in our network assessments are compared using standard DNO approaches based on a common evaluation methodology (CEM) cost-benefit analysis (CBA) tool. Our Network Development Plan report scheduled for next year will provide further transparency on our investment plan, comprising economically optimal network interventions.

2.2 Complementary network reporting

SUITE OF COMPLEMENTARY DOCUMENTS



This NHR is consistent with our suite of documents which provide data for a range of time periods to support our customers and stakeholders with their development plans. Our Heatmap Tool provides information about the ability to accommodate additional connections on the present network, considerate of the connections accepted on to our distribution network but not yet realised. It is complemented by the Embedded Capacity Register which lists generation and storage resources (≥1MW) that are connected, or accepted to connect, along with information on flexibility services and network reinforcements associated with connections. Our Long Term Development Statement (LTDS) provides more detailed ratings of network components and forecast loadings for five years into the future.

Our DFES provides forecasts of future LZCT and electricity requirements in our region up to 2050. This NHR applies DFES forecasts to indicate the future ability of our existing network to accommodate predicted demands and generator connections under all DFES scenarios up to 2050. The assessments which underlie the headroom values follow our normal network evaluation practices and the results are summarised for the networks served by each bulk supply point (BSP - typically 132/33kV) and primary substation (typically 33/11kV) providing greater granularity over the first ten years.

Headroom results signpost parts of the distribution system most likely to be suited to new connections in the future. They also highlight the parts of the network where reinforcement may be required to allow the forecast level of future connections and where we are more likely to require flexibility services or encourage energy efficiencies. We have previously provided a long-term view of our network's capability to accommodate forecast demand and generation in our Regional Insights documents, with the latest being published in February 2021.

The NHR presented here is part of our commitment to share more information to empower our stakeholders. It has been designed for the following audiences and is important to them because:

- Electricity North West: part of our internal network assessment and planning processes
- Customers: insight into network opportunities for future connections
- Local authorities and organisations: understanding of future network capabilities and support for regional developments
- Ofgem: appreciation of how our network may cope with the range of credible forecasts to identify available capacity and needs.

We will continue to improve and develop our publications, taking into account wider industry work, which is further shaping network capacity and investment reporting. We will publish our first Network Development Plan in 2022 and will look to develop its content following the outcome of Ofgem's ongoing review of the LTDS. Planned enhancements are likely to include increased accessibility, wider network coverage and improvements to the accuracy of the results as we develop more detailed approaches to provide stakeholders with greater benefits.

2.3 Document structure

This document comprises three further main sections:

- Section 3 introduces the NHR and defines the net zero carbon scenarios employed to signpost stakeholders and customers to network availability and capacity requirements. It also outlines the methodology we use to evaluate future network capabilities
- Section 4 looks to the future of the NHR and how this will integrate with future publications of the NDP from May 2022
- Section 5 is where we ask you as our customers and stakeholders to feedback on how best we can provide information that will increase its value to you.

The NHR is accompanied by a data workbook including tables of demand and generation headroom for our whole region for all DFES scenarios.

This section describes the scope of our NHR and the detailed content. Importantly, we also explain the methodology, assumptions and source information to ensure a thorough understanding of the sensitivities of the results we are sharing to permit their extrapolation.

The NHR aims to provide a simple quantification of available capacity across our network based on a range of uncertain future load and generation growth.

In accordance with a new standard licence condition (SLC25B), in May 2022 we will publish our Network Development Plan (NDP) with one part being our NHR. We are publishing this NHR on its own this time to trial processes, demonstrate capabilities and refine it further in advance of its inclusion with the NDP next year.

The scope and format of our NHR has been collectively developed and agreed by all DNOs coordinated through the Energy Networks Association (ENA) Open Networks project namely Work Stream 1B (WS1B). The task of developing a standardised network capacity report was already progressing in 2020 when a new licence condition was introduced requiring DNOs to publish their Network Development Plans incorporating visibility of parts of the distribution system most suited to new connections and where reinforcement of the distribution system may be required. The prior work on network headroom reporting gave us an opportunity to publish our NHR as a trial to check processes, demonstrate capabilities and inform the development of the NDP template in co-ordination with other works to help provide clarity and visibility to customers. It is intended that future publication of the NHR will be as part of our NDP reporting.

3.1 NHR scope

Our stakeholders are already gaining benefits from the information we share on our existing network but have told us that they also need information on future network headroom to accommodate their long-term developments. Some are looking to understand what is needed to meet net zero in our region while others are looking at the implications for major infrastructure developments which take longer to plan and construct. For this reason, our NHR goes to 2050 in alignment with the range of our DFES and covers all scenarios to illustrate the level of uncertainty across our forecasts of alternative credible pathways.

The scope and format of the NHR matches the source and application of the future headroom results it includes. For example, year-on-year values are made available out to 2030 where we have more certainty in our forecasts because we have visibility of our connections pipeline and the government has already set some of the policies that will affect LZCT uptake. Results beyond the first ten years up to 2050 are given every five years to avoid a cumbersome dataset which is not reflective of the inexact nature of headroom during this date range.

Headroom for demand and generation is given recognising the needs of different types of customers and because of the vital role that they are playing in decarbonisation. BSP and primary substation headroom values match our DFES which in turn align with where we currently have comprehensive system loading measurements that are a critical starting point for our forecasts. We are planning more widespread monitoring of our low voltage networks and we expect that this will be reflected in forecasts and more accurate LV network headroom reporting in the future.

The NHR provides an indication of the capability of our network to accommodate new demand and generation connections and is by its long-term nature is subject to change.

SCOPE OF NETWORK HEADROOM REPORT

Date range	To 2050
Reporting granularity	Every year for the first ten years and then every five years
Forecast scenarios	All DFES scenarios
Reported headroom	Demand and generation
Network coverage	All distribution voltages down to the low voltage side of primary substations (typically 11kV)
Evaluation methodology	Thermal and fault level calculations
Format	Excel spreadsheet

3.2 Scenarios

NHR headroom values are derived from our 2020 DFES forecasts and presented in such a way that comparisons of headroom between scenarios and across each scenario from 2021 out to 2050 can be made. All scenarios are modelled using regional data, extensive local engagement and connection pipelines in our unique bottom-up methodology developed as part of our ATLAS project, which makes them representative of the North West and all of its local areas.

Understanding of the range of potential impacts on our network can be obtained from the demand and generation headroom results corresponding to our five scenarios: Steady Progression, System Transformation, Consumer Transformation, Leading the Way and Central Outlook.

Our DFES publication details the uptake of LZCTs and how these are predicted to vary between each scenario. Four of the five scenarios show the possible different paths to net zero and are defined in terms of the speed of the electrification of transport and heating along with renewable distributed generation (DG) uptake which is anticipated to connect across our network. In very simplistic terms the uptake of LZCTs are predicted on a primary by primary basis across the year range 2020 – 2050 and as the number of heat pumps and EVs increases so does the anticipated demand at each BSP and primary substation. Other potential changes in our customers' use of electricity factored into our DFES include energy efficiencies, economic development and shifts in the time of use driven by time-varying tariffs.

ELECTRICITY NORTH WEST 2020 DFES SCENARIOS

Steady Progression (SP)
Slow decarbonisation
Not meeting net zero targets
Limited efficiencies

System Transformation (ST)
Hydrogen helps to meet net zero beyond 2040
Limited efficiencies

Central Outlook (CO)
Average assumptions across the other scenarios

Consumer Transformation (CT)
Electrification of transport and heating help to meet net zero
High uptake of renewable DG
High efficiencies

Leading the Way (LW)
Net zero before 2050
Early electrification of transport and heating

3.3 Introducing our workbook

The NHR is accompanied by a data workbook of detailed headroom results for all scenarios including tables.

A positive value in the capacity headroom tables indicates that there is generally expected to be sufficient network capacity for the forecast demand or generation, either due to existing capacity or planned load transfer or planned reinforcement with high confidence of progression in the area.

EXAMPLE STRUCTURE OF THE NETWORK HEADROOM REPORT EXCEL WORKBOOK COMPRISING TWO DEMAND AND GENERATION HEADROOM TABS

Demand headroom

Select Primary	Albion St		Primary Demand Headroom (MVA)													
Grid Coordinates	Easting	Northing	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050
	367434	426087														
Grid Coordinates	Firm		10.12	10.29	10.02	9.79	9.56	9.37	8.99	8.70	8.50	8.10	6.47	4.95	4.34	4.27
	Non Firm		14.72	14.89	14.62	14.39	14.16	13.97	13.59	13.30	13.10	12.70	11.07	9.55	8.94	8.87
Steady Progression	Firm		10.06	10.24	10.08	9.91	9.75	9.63	9.32	9.09	8.94	8.59	7.35	6.23	5.15	4.81
	Non Firm		14.66	14.84	14.68	14.51	14.35	14.23	13.92	13.69	13.54	13.19	11.95	10.83	9.75	9.41
System Transformation	Firm		10.12	10.32	10.09	9.90	9.71	9.57	9.26	9.04	8.90	8.58	7.29	6.40	6.11	6.36
	Non Firm		14.72	14.92	14.69	14.50	14.31	14.17	13.86	13.64	13.50	13.18	11.89	11.00	10.71	10.96
Consumer Transformation	Firm		10.11	10.30	10.06	9.87	9.70	9.59	9.33	9.16	9.11	8.90	7.85	1.98	-3.84	-8.27
	Non Firm		14.71	14.90	14.66	14.47	14.30	14.19	13.93	13.76	13.71	13.50	12.45	6.58	0.76	-3.67
Leading the Way	Firm		10.19	10.45	10.28	10.14	10.04	9.97	9.76	9.63	9.60	9.14	2.83	-2.78	-7.74	-7.59
	Non Firm		14.79	15.05	14.88	14.74	14.64	14.57	14.36	14.23	14.20	13.74	7.43	1.82	-3.14	-2.99

Generation headroom

Select Primary	Blackburn		Generation Headroom - Battery Storage (MW)													
Grid Coordinates	Easting	Northing	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050
	370584	429294														
Grid Coordinates			14.58	14.91	14.65	14.43	14.19	13.96	13.83	13.55	13.42	13.33	12.60	11.46	10.51	9.73
Steady Progression			14.51	14.83	14.76	14.65	14.51	14.38	14.31	14.08	13.97	13.87	13.41	13.12	12.90	12.95
System Transformation			14.58	14.93	14.70	14.50	14.27	14.08	13.98	13.74	13.64	13.58	13.02	12.65	12.58	12.79
Consumer Transformation			14.58	14.94	14.72	14.53	14.33	14.14	14.05	13.82	13.73	13.70	13.21	10.71	8.20	6.16
Leading the Way			14.61	15.00	14.81	14.65	14.46	14.27	14.18	13.94	13.83	13.73	10.78	7.55	5.08	5.62

3.4 Methodology

Thermal headroom

For our NHR, the ability of our network to accommodate the predicted requirements at each BSP and primary substation is determined based on our existing network described in our LTDS published each year. To arrive at a figure for the available headroom at each substation, the peak demand and generation forecasts from our DFES per substation are assessed against the firm or non-firm capacity at that location. Although short-term future headroom results are informed by detailed analysis, longer-term values to 2050 are based on tabular comparisons because the conditions in some scenarios are so extreme that detailed power flow analysis cannot work. Although our NHR does not reflect the availability of transmission capacity, we work closely with the transmission owner to facilitate our customers' connections.

The results are expressed in the form of either firm or non-firm connections, where firm capacity allows for the connection of demand which is secure for a first circuit outage at any specific site. Demand which is connected under a non-firm arrangement can be disconnected or actively constrained under outage conditions. Negative values shown in red cells in the report indicate where capacity shortfalls exist and show us where future network interventions may be required in the upcoming RIIO-ED periods; this allows users to understand the influence of the various scenarios on available network headroom up to 2050. Negative values also show where interventions may be required to accommodate forecast requirements and should not be interpreted as a barrier to specific requirements. For example, a customer wanting to understand consequences for connecting an individual development can interpret our results on the basis that our underlying forecasts may include their connection.

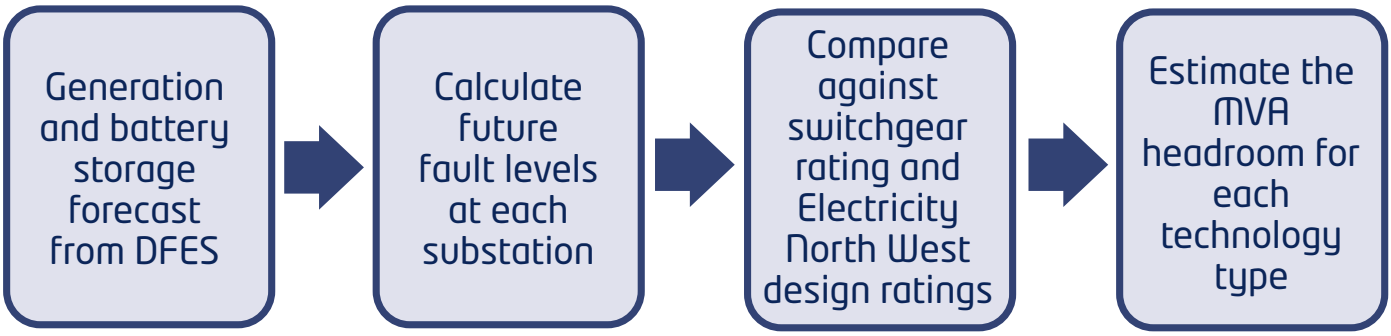
Connections to our network are always possible, however, there may be a requirement to apply interventions to overcome constraints.

Fault level headroom

As detailed in our DFES publication, the uptake of DG and battery storage is predicted to see continuous growth across all scenarios up to 2050. This will increase the fault level across the network. The impact on fault level varies depending on the technology of the generator (e.g. inverter-based source or synchronous generator) and how it is connected. It is important to manage increasing fault levels to ensure that we can continue to operate our network in a safe manner protecting both colleagues from danger and plant from potential disruptive failure.

Short circuit studies are a key factor in our assessments of our network's ability to accommodate forecast generation, with fault level studies used to assess our network's capability to accommodate forecast generation. Without knowledge of the exact nature and location of predicted generation, 'future fault levels' are simulated using assumed contributions for the different types of generation and calculated at each primary and BSP, to allow the consideration of the impact of the forecast generation on the existing fault level. These levels are then compared against the respective switchgear make and break ratings at each primary substation and BSP as well as Electricity North West design ratings to determine the fault level headroom availability. Spare capacity in MVA is subsequently calculated from the remaining fault level headroom together with the results of reverse power thermal assessments which consider the network when all DG is operating when our customers are consuming the least amount at the time of minimum demand.

HIGH LEVEL PROCESS FOR DETERMINING FAULT LEVEL HEADROOM



Generation headroom values are broken down by technology and are in accordance with the terms of our standard DG connection contract and disconnection/ constraint when our network configuration is abnormal.

Results are split into three categories, covering inverter, synchronous and battery-based technology. It can be seen in the results that there is more headroom for inverter-based generation in the future due to the assumed lower fault infeed associated with this technology, with less headroom available for synchronous generators due to them typically having a greater fault infeed.

In the same way as with the thermal headroom, negative values and red cells in the NHR demonstrate where fault level headroom capacity shortfalls exist for the forecast level of future DG. We will be targeting these for future reinforcement in the upcoming RIIO-ED periods so that stakeholders can use them to understand the influence of our DFES scenarios for DG penetration on available network capacity up to 2050.

4 Future

From May 2022, DNOs are required to prepare and publish a Network Development Plan in accordance with a new standard licence condition (SLC25B) implementing elements of the Electricity Directive (EU) 2019/944 which is part of the Clean Energy for all Europeans Package.

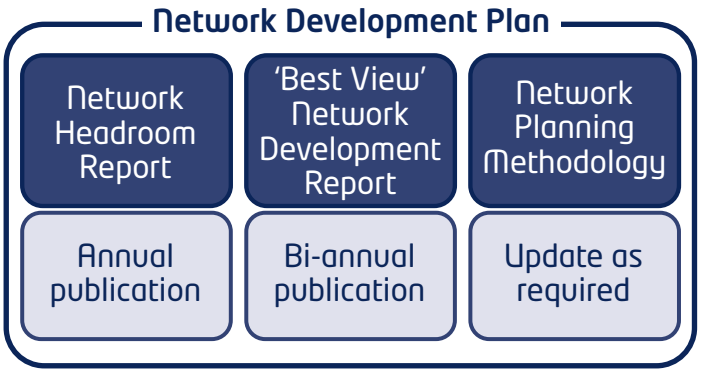
The objective of the NDP is to provide stakeholders with transparency on distribution network constraints and needs for flexibility. Its focus is to present a best view of planned asset-based and flexible network developments over the five to ten-year period.

The scope of the NDP includes:

- Parts of the distribution system most suited to new connections
- Where reinforcement of the distribution system may be required
- Sufficient information for secure and efficient operation, coordination development and interoperability of interconnected systems
- A reasonable number of future scenarios
- Non-frequency ancillary flexibility service requirements.

Through the ENA Open Networks project Work Stream 1B (WS1B), DNOs have been collectively developing a Form of Statement (FoS) for the NDP to ensure alignment and consistent implementation so that stakeholder access and value is increased by understanding the scope and format of NDPs from any DNO. Stakeholder feedback is being sought on the draft FoS comprising three parts to cover all requirements of the new licence condition.

THREE PARTS OF THE NETWORK DEVELOPMENT PLAN



The Network Headroom Report part of the NDP FoS builds on WS1B's definition of standardised network capacity reporting in 2020 and on which this NHR is based. While all parts are defined to comply with the requirements of the licence condition, their form is also aligned with other reporting to avoid overlaps and fill gaps. For example, although the NDP must cover five to ten years in the future, it is proposed that the Network Headroom Report goes to 2050, matching the range of the DFES forecasts to show uncertain longer-term network impacts.

This publication of the NHR is not only sharing network capacity data with our stakeholders, but is also an opportunity to trial processes, demonstrate capabilities and further inform the development of the NDP FoS in co-ordination with other works to help provide clarity and visibility to customers.

It is proposed that the 'Best View' Network Development Report part of the NDP is published every other year in accordance with the new licence condition, but that the NHR part is updated annually going beyond the mandated requirements, with the intention of providing greater benefits through the latest view of future network headroom based on the annual DFES forecasts. On this basis, the next NHR will be published as part of our first NDP in 2022, also including a report on our business as usual methodology used to plan our network development as summarised in the NDP. All DNOs are publishing NHR in 2021 and the collective feedback will be used to further refine the report to improve subsequent versions.

5 Your views

Our plan is to publish an updated Network Headroom Report annually for the benefit of our communities and customers as they transition to a low carbon future. Therefore, we welcome comments on how we could make it more useful to you. Your feedback on what network headroom and capacity information is helpful, how it is most usefully presented and how we could improve your access to make it more efficient would be appreciated.

As the NHR is set to be amalgamated into our NDP, the future success of the NDP requires us to work closely with our stakeholders as they have the most intimate understanding of potential regional developments and therefore the scope and timing of information necessary to support them. Together, we can provide mutual benefits; we can tailor our reporting to deliver more valuable network indicators to customers while ensuring that our network develops to match their needs in an efficient and timely manner incorporating flexibility services through a more established market informed through clear communication of network requirements.

We would like to get your input on the future of electricity in the North West to continue the conversation on our NDP, its improvement and its utility, in particular with regard to supporting carbon reduction and reaching net zero.

Feedback is essential to fully understand customers' requirements for network headroom data and to determine improvements and priorities for our NHR.

We have posed some questions to help gather your specific feedback. Please respond to the questions below by completing our online survey. Alternatively, please email us with your comments.

- Did you find our NHR informative?
- How could/will our NHR be used by your community or business?
- Are there any other parameters that you would like us to present in our NHR to increase its usefulness?
- Could we interpret our network headroom data in a different way to help you better understand the ability to accommodate future connections and use of flexibility services in our region?
- Do you have any other comments on our NHR?

With your agreement, we shall share your feedback on our report with the Open Networks project to help shape the NHR part of the NDP.

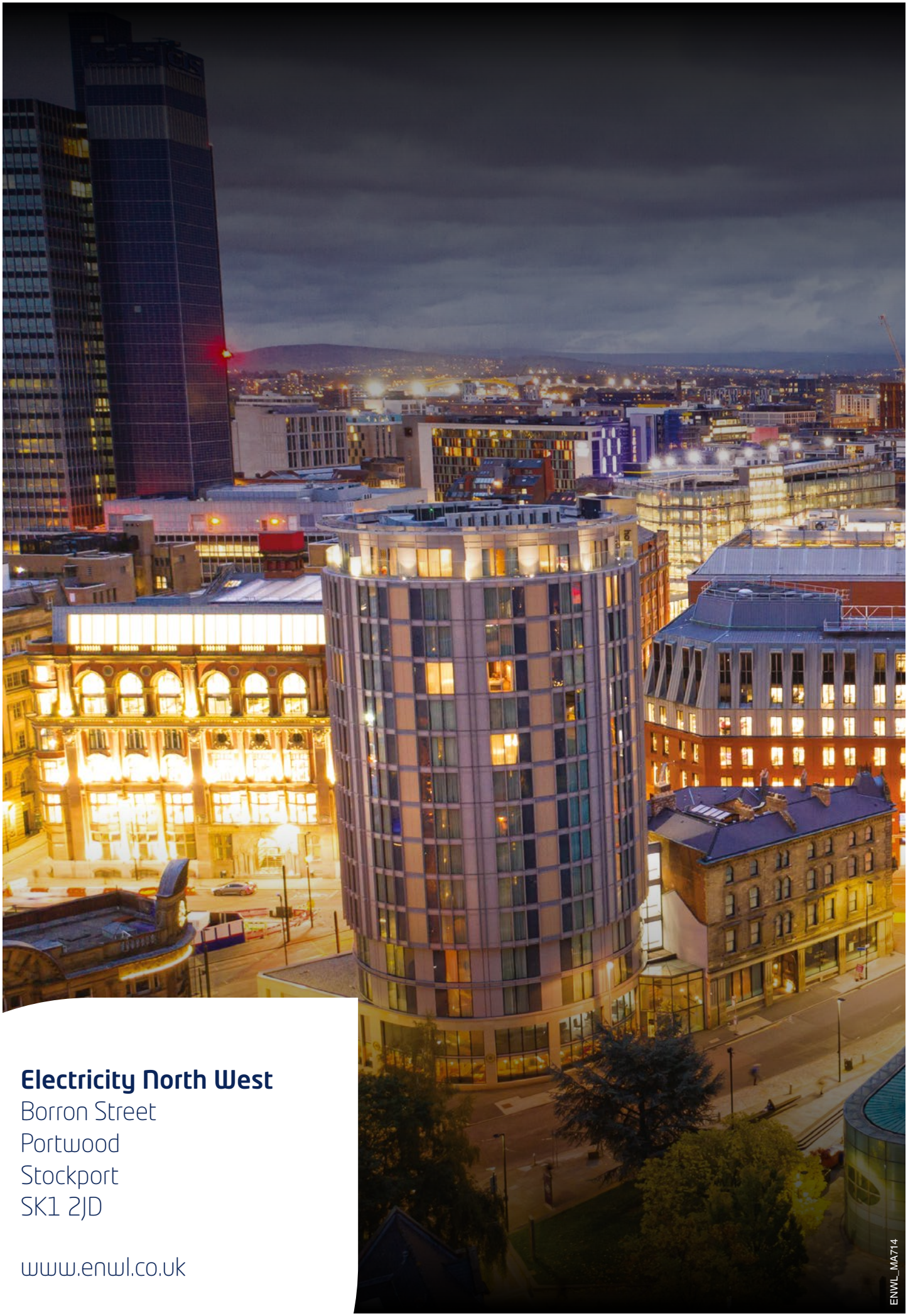
development.plans@enwl.co.uk

www.enwl.co.uk/dfes

www.enwl.co.uk/signup

Stay connected...

electricity north west
Bringing energy to your door



Electricity North West
Borron Street
Portwood
Stockport
SK1 2JD

www.enwl.co.uk