electricity north west

Bringing energy to your door

Grid digitalisation & data strategy

Automation of the network and data facilitation

February 2021

Contents

1 About Electricity North West

Electricity North West Limited 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 license to operate and decide what's fair for us to charge our customers for each price control period.

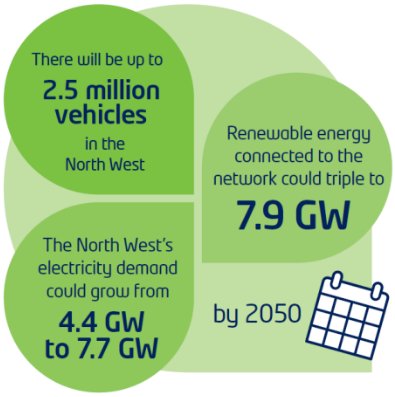
Our current price control began in 2015 and runs to 2023. It's referred to as RIIO-ED1. In full, that stands for Revenue = Incentives + Innovation + Outputs, Electricity Distribution 1. Under this framework, the price we can charge our customers is fixed until the next price control, RIIO-ED2, which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

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

The period of time which the RIIO-ED2 price control covers 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

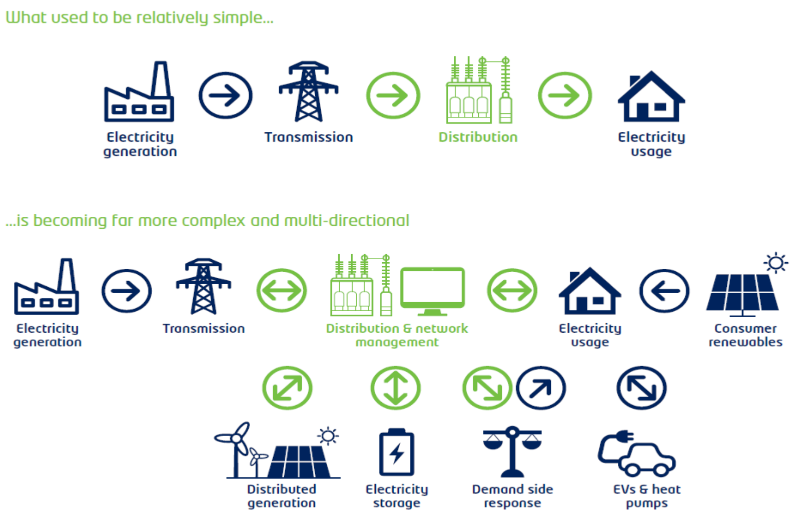
2 Smart grid vision

The UK became the first major economy in the world to pass laws to end its contribution to global warming by 2050. This is expressed as a target to bring its greenhouse gas emissions to net zero by 2050. In the North West, local authorities are working towards achieving this target sooner; Lancashire has set a target of 2030, Cumbria 2037 and for Greater Manchester the target is 2038.



The electricity supply industry has a significant part to play in achieving net zero and we are committed to playing a leading role in what will be a transformation of the industry. Net zero will lead to unparalleled changes in the way that our customers want to use our network. It is anticipated that demand for electricity will double as customers turn to electricity to power their cars and heat their homes; at the same time customers will want to generate their own electricity and distribute it through our network at unprecedented levels.

This will require a fundamental change in the way that we operate our network and in the way that we interact with our customers. Historically, our network was relatively simple, transporting electricity in one direction from generators to our customers. Going forward the situation will be more complex with multi-directional power flows that will vary greatly over the period of a day.



In short, our existing passive distribution network will transform into a smart grid that provides sensing and control throughout and facilitates two-way communications with our customers.

The transition to a smart grid will deliver the following benefits:

- Increased integration of low carbon technologies
- More efficient distribution of electricity – incurring lower losses
- Reduced peak demand
- Improved supply resilience – faster supply restoration
- Reduced cost – lower electricity bills.

Our customers have a large part to play in achieving net zero and our delivery of a smart grid. We will work together with our customers in an open and transparent manner and aim to provide improved digital services and open access to network and market information. We will fully implement the recommendations of the UK's Energy Data Taskforce (EDTF), led by industry regulator Ofgem:

- Digitalisation of the energy system
- Maximising the value of data
- Visibility of data
- Coordination of asset registration
- Visibility of infrastructure and assets.

3 About this strategy

This document is part of a suite of current documents which explain how we are preparing our network for the net zero carbon future and how we will support the government's commitment to achieve net zero emissions by 2050.

- Leading the North West to zero carbon – outlines our ambition to meet the region's carbon emissions target and sets out the range of initiatives and investments which will ensure we take a significant step on the road to achieving rapid decarbonisation
- DSO strategy – sets out the next steps on our DSO and net zero carbon journey
- Analysis of DSO functions – analysis of our DSO-related activities against the 19 high level DSO functions defined by Ofgem
- Distribution future electricity scenarios (DFES) – used to create our forecasts for future capacity requirements
- Decarbonisation pathways – energy blueprints developed with Cadent, the region's main gas network operator for Greater Manchester, Lancashire and Cumbria.

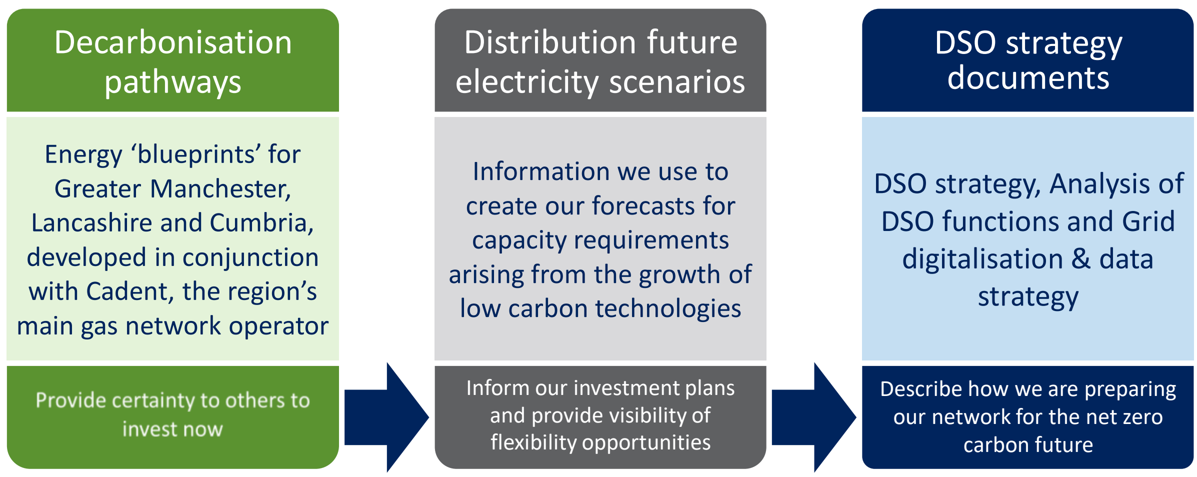
In July 2020 we consulted on our DSO strategy, Analysis of DSO functions document and our Grid digitalisation & data strategy; this document has been updated following the feedback we received during the consultation.

In this document we focus on our plans to install additional monitoring and control equipment across our network that will provide the enhanced visibility of network conditions in real time and provide the granularity of remote control required for a smart grid. We also provide details on the additional data that this enhanced monitoring equipment provides and how this data will be made available to customers and other stakeholders.

This strategy builds on the learning from many innovation projects that we now plan to roll-out as business as usual solutions, to address our smart grid challenges. Our new network management system underpins our development of a smart grid and incorporates technology developed through our innovation projects.

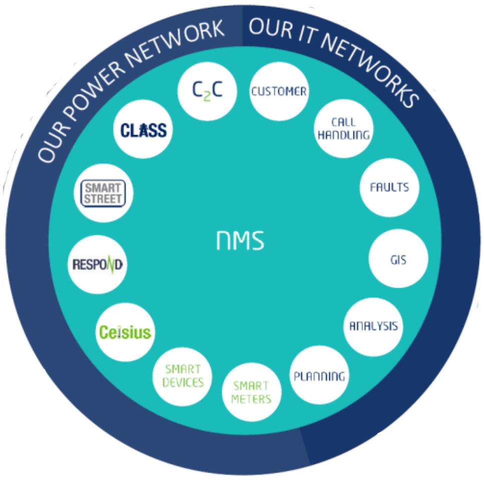
Throughout this document the estimated cost of any proposals is provided as follows:

£ less than £1m   ££ between £1m and £10m   £££ more than £10m



4 Network control

Progress



In order to manage increasingly uncertain energy flows on the network, it is essential that key network parameters such as voltage and power flow magnitude and direction at critical points in the network are measured in real time. Consequently, key enablers for a smart grid include numerous additional network energy and voltage measurement points, advanced communications technology and enhanced automatic control capabilities.

We have made a significant investment to replace our old control room management system with a state-of-the-art network management system. The new network management system provides increased visibility of network operation coupled with dynamic control to optimise the configuration of the network at any given time. It has incorporated, and improved, automatic supply restoration algorithms from the old control room management system, delivering improved security of supply. Its outage management system provides efficient management of field teams and up-to-the-minute customer information.

Central to the development of our network management system is the need for an accurate representation of the network. We have completed a comprehensive cleanse of our asset information and established a single geospatial asset management system. This has, in effect, created a single model of the network that only requires maintenance in one system, and can then be extracted for other systems, such as power flow modelling tools. This has delivered efficiency and accuracy in our data management processes.

Another element of the implementation of our network management system is the conversion of all communications at our major substations from analogue to digital data; this data is exchanged over our core data network that is independent of third party communications providers.

Furthermore, to improve the communication efficiency and interoperability between our network management system and the network points of data acquisition, we have adopted an open standard communication protocol at all our major substations.

Next steps

Innovation is an integral part of our success. Through a series of innovation projects, we have demonstrated how we can deliver value for our customers. Going forward it is our intention to apply our learning from these projects and develop it into business as usual processes. Specifically, we will embed the learning from projects like CLASS, Smart Street and Capacity to Customers (C_2C) into the network management system to deliver our smart grid.

As the number of smart meters installed at customer premises increases, the network management system will assimilate consumption data (aggregated or discrete) to provide its control system with greater insight of the energy flow on the network to make better optimisation decisions. Smart meter power outage and restoration functionality will assist fault location and restoration performance.

An active network management facility will be incorporated into the network management system to integrate the dispatch of flexible generation and demand to optimise network operation, as well as minimise reinforcement expenditure. This will allow flexibility service providers maximum access to the market and deliver network capacity at an efficient cost.

To deliver the smart grid benefits that we expect, the network management system will collect and store significantly more data on the demands placed upon the network and the performance of the network in meeting those new demands. In line with the recommendations of the Energy Data Task Force, it is our intention to make as much of this data as possible available to customers in an open and industry-standard format. This, we hope, will help our customers to make informed decisions, enabling them to improve their energy use or generation which will benefit themselves and other users of the network.

5 Customers

Progress

We offer a range of flexible connections to the network enabling customers to participate in the flexibility service market or to lower the cost of connection. Many existing flexible connections have old standard control and communications arrangements. All new flexible connections will incorporate four-quadrant (real/reactive power, import/export) metering, open standard protocol technology and an appropriate digital communication path. The same arrangements will also be offered to existing flexible connection customers to allow them to fully contribute to our smart grid future.

We currently offer a range of information sets to provide insight into connection and market opportunities:

- The embedded capacity register – provides information to electricity network stakeholders on generation and storage resources (≥1MW) that are connected, or accepted to connect, to our distribution network, and is updated on a monthly basis. The register also includes information about flexibility services provided by connected resources, including flexible demand and details about network reinforcements
- Long term development statement – details demand and capacity at network substations
- Distribution future energy scenarios (DFES) – provides demand and generation scenario forecasts that reflect our stakeholders' energy needs
- Network capacity heat maps – geospatial network maps detailing capacity availability.

Next steps

We are collaborating with other network operators, through the ENA's Open Networks Project and Data Working Group, to ensure that our information is provided in a common industry standard. Furthermore, the Data Working Group is investigating the feasibility of producing a digital system map that would provide a range of technical information from across the energy industry (gas and electricity), available in a single location and in an open and interoperable format. £

We and the other network companies are also collaborating with Electralink on the development of a one-stop-shop for all electricity data to be made available in an open and interoperable format through the Flexr project. £

Notwithstanding this collaborative work, we are looking to enhance our own current information portfolio. Of note is the development of our DFES information to include a forecast of reactive power requirements. £

As we head towards net zero, both the distribution networks and the transmission system will interact on a level not seen before. It is vital that there is a much richer data exchange between £

distribution and transmission companies to ensure efficient system coordination. To precipitate this, we have raised a modification proposal (GC0139) to the Grid Code that requires an enhanced level of data exchange, consistent with the need for whole system planning across distribution and transmission networks.

To ensure an accurate and efficient data exchange, associated with GC0139 and with other stakeholders, we are developing our capability to provide network models and information generally according to the IEC Common Information Model (CIM) standard. This will streamline data exchange with National Grid and, in line with EDTF recommendations, CIM information will be made publicly available.

During our consultation in July 2020, our stakeholders requested that we share more data surrounding cost and affordability. We already share a range of information regarding our standard connections costs through our Common Charging Methodology, as well as information about Use of System Charges. We will take this request onboard and look at other ways we can share this type of data. We are also working towards developing/procuring a system which will link with our network models to provide automated, self-service budget estimates for new connections.

There are opportunities for us to utilise data and data analyses to predict/manage asset maintenance, improve demand forecasting, actively predict and manage capacity issues arising from low carbon technologies, and formulate demand response solutions.

6 The networks

6.1 Smart substations

Although traditional substation designs have delivered a high-quality supply of electricity to our customers over many years, they do not meet the requirements for a smart grid. They provide a limited number of measurements which are communicated slowly utilising old technology.

Future smart substations and field equipment will be connected using modern higher bandwidth communications technology. All field sensors and protection devices will support internet protocol (IP) communication using open standards. This delivers many advantages, e.g. many more measured values can easily be collected and transmitted to the control centre for decision-making, and measurement and control devices can be remotely interrogated and configured. The adoption of international standards also opens the supplier market for equipment and encourages a wider supplier base to adopt these standards and compete effectively in the market.

Progress

To enable our existing substations to talk with our new network management system, we have converted the communications links at all our large substations from analogue to digital technology, adopting an open standard communications protocol.

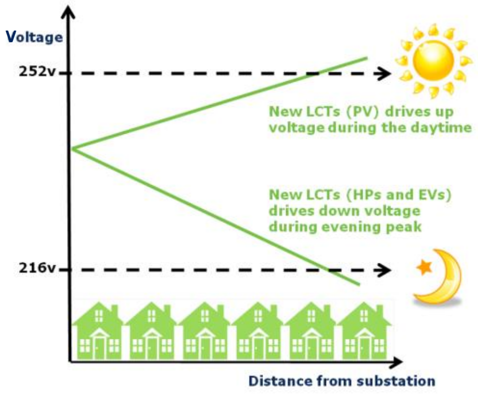
Next steps

We will continually review our standard substation designs to incorporate the latest developments in technology, which will enable us to gather more measurement and control data. Additional and improved data will drive increasingly complex control algorithms to deliver an efficient and smart grid.

We anticipate that our new substation designs will facilitate remote configuration of primary substation equipment and network protection devices, allowing us to change the network’s operating state in response to changing conditions.

6.2 Low voltage network (230V and 400V)

Arguably, the low voltage network will experience the most significant change in use as our customers use increasing numbers of low carbon technologies. Network power flows, losses, voltage and harmonic levels will all be impacted. Traditional low voltage network design methods would require significant levels of network reinforcement to cater for this change in use.



Progress

Our Smart Street innovation project has demonstrated that these problems can be addressed in a smarter way using increased monitoring of the low voltage network in conjunction with active voltage optimisation and automatic network re-configuration. As part of the project we installed low voltage circuit breakers and switches, on-load tap changing transformers and monitoring devices that communicate with our network management system. The closed loop control system operates to ensure that there are no network voltage violations and reconfigures the network to optimise for power flow and losses.

Next steps

Following the success of this project we were awarded £18 million from Ofgem's Innovation Rollout Mechanism (IRM), enabling us to roll-out the technology into business as usual at 180 sites across the region. The rollout will be prioritised to address locations where we observe the highest levels of low carbon technology penetration. It is anticipated that the technology will be further deployed at many more locations over the next eight years. **£££**

To improve our modelling capability for use in planning and real-time control applications, we plan to develop a four-wire model of the low voltage network, based on core data held in our network management system and geospatial information system. We plan to develop and deploy this model. **££**

As smart meter data becomes available this will be incorporated into our network management system to further refine our understanding of how the network is operating in real-time. **££**

We will publish as much of this network data as possible, recognising the restrictions around publishing personal data under the General Data Protection Regulation (GDPR). Visibility of this data will, for example, help inform suitable locations for electric vehicle charge points or community-based solar generator installations.

It is envisaged that this data provision will support the development of community and local energy projects for the benefit of the community and our network. We have a dedicated team who work with community and local energy organisations to look at opportunities for the connection of renewable generation and electric vehicle charge points, and provide societal benefits to local communities. This team can also help to resolve network capacity issues for community and local energy projects or help in the creation and balancing of micro grids.

6.3 High voltage network (6.6kV and 11kV)

Progress

During the commissioning of our new network management system we converted substation communication links from analogue to digital technology using open standard communications protocols. We will install more of this technology at strategic points on the network and at distributed energy resource (DER) connection points. This will provide much greater volumes of network information to our network management system, resulting in improved fault response performance.

Next steps

Increasing monitoring, control and automation of the high voltage network is crucial to supporting the development of a smart grid. It will provide greater visibility of network operating parameters in real-time and enable customers to flexibly contribute to network efficiency and security. This information will provide a far greater insight into network operation in real-time and enable better customer information about network capacity and any restrictions that apply to that capacity at any given time.

The implementation of expanded data collection has been guided by the learning from our innovation projects – C_2C, Respond and Celsius. We will install monitoring and control points to enable us to transition these projects into business as usual, therefore significantly increasing the capacity available to new connection customers. Capacity availability data will be published for the benefit of prospective connection customers.

6.4 Extra high voltage network (33kV and 132kV)

As with the high voltage network, open standard communication protocol and associated technology has been installed at all our grid and bulk supply substations.

Next steps

Our new network management system will incorporate an active network management capability which will operate across all voltage levels to maximise available network capacity for customer use. Central to this capability will be the development of automated flexibility procurement systems that will contract for flexibility services in near real-time.

The extra high voltage network interfaces with the national transmission system. It will be a requirement of the active network management system to recognise constraints on both the extra high voltage network and the transmission system and manage boundary flows of energy to ensure both networks can operate within design limits. This will require real-time data exchanges between distribution and transmission network management systems. These data exchanges will be facilitated through secure digital links between control systems, typically using open standard protocols such as inter control centre protocol.

These digital links will be used to communicate critical network information such as available capacity, current power flow, network constraints and network status data. In addition, digital links between control systems may also be used to provide National Grid with a limited control capability to constrain or trip distribution connected generation/demand, or to facilitate a co-ordinated black start process.

For our active network management system to function properly and precisely predict the response to a control action, it will need to include an accurate representation of the current topology of the transmission system. It is anticipated that National Grid will provide this representation in a standard open source format (such as IEC CIM) on a daily basis. This information would then be incorporated into our network models within the active network management system. It is also likely that similar topology data transfers would be required between our systems and National Grid.

This combination of network topology data and real-time measurement data will facilitate automatic control of boundary flows to ensure both networks operate within limits. It is likely that similar digital links will be required at other boundary points such as connections with adjacent distribution companies and potentially embedded distribution companies in future. £

Many of the low carbon technologies that connect to our network introduce 'noise' to the electricity supply, known as harmonic distortion. To ensure that the network and customers' devices operate properly, it is important to limit the amount of harmonic distortion. This is one of the key design considerations when connecting low carbon technologies like windfarms. To facilitate the connection and operation of low carbon technologies, we are proposing to install equipment at strategic locations on the network to accurately measure harmonic distortion. ££

Our Grid Code modification proposal (GC0139), to enhance the planning data exchange between Electricity North West and National Grid Electricity System Operator (ESO), will provide both companies with greater insight into the operation of each other's networks under different demand scenarios. This will ensure that the whole system can be designed to cater for the full range of stresses placed upon it. Publishing this data in open formats will provide transparency of how the networks are operated and how flexible service providers can contribute to the efficient development of the networks.

Our consultation in July 2020 revealed that stakeholders would find the publication of the planning data exchanged between National Grid ESO and Electricity North West useful for:

- Providing the evidence base for local plans
- Better informed decisions to prioritise for businesses/communities
- Improved understanding of costs
- Better understanding of how the grid works
- A common format in which information is presented.

When applying to connect to our distribution network, a constraint on the transmission system sometimes impacts the ability to get connected in a timely manner. We have worked with National Grid ESO to develop a new, more transparent process of identifying transmission system constraints affecting a new connection. A modification to the Connection and Use of System Code will formalise this process. Once approved we will publish the capacity headroom of each of our transmission system grid supply points.

Feedback from our consultation indicates that stakeholders would prefer to see our network data published as part of a national publication, that includes all DNO data, as well as published separately on our website, to reach a wider audience. We will ensure that we apply this recommendation and present data on our own website and via national data portals.

7 Glossary

Term	Description
Active network management (AMN)	A smart system used by DNOs to manage generation and load on the network to facilitate the connection of low carbon technologies
Distribution Future Electricity Scenarios (DFES)	Forecasting plans for a range of scenarios for how low carbon technologies will be taken up and how the network could respond. The scenarios inform our investment plans and provide visibility of flexibility opportunities
Distribution network operator (DNO)	Company licensed to distribute electricity in Great Britain by the Office of Gas and Electricity Markets (Ofgem)
Distribution system operation (DSO)	The systems and processes needed to operate energy networks in the net zero carbon future
Energy Data Taskforce (EDTF)	Taskforce established by government to improve data availability and transparency to facilitate greater competition and innovation in the energy sector
Energy Networks Association (ENA)	Industry body which represents transmission and distribution network operators for gas and electricity in the UK and Ireland
Flexible services	The term used for paying a customer to reduce their electricity consumption or increase generation on request, due to a network constraint
Flexr project	A project led by Electralink and GB distribution network operators to provide and standardise data to enable a smarter, more flexible energy system
Key enablers	The technology, data and engineering competencies and capabilities needed to deliver DSO functions
Low carbon technologies	Technologies which produce little or no CO_2 emissions, such as electric vehicles, electric heat pumps, solar and wind generation
Net zero carbon	The achievement of balancing carbon dioxide emissions with carbon removal or eliminating carbon altogether
Network management system (NMS)	Software used to monitor, maintain and optimise electricity networks
Ofgem	Office of Gas and Electricity Markets – the government regulator for gas and electricity markets in Great Britain
Ofgem DSO functions	A list of 19 key distribution system operation functions published by Ofgem designed to enable the delivery of net zero carbon
Open Networks Project	A key industry initiative to deliver government policy that will transform the way our energy networks work and help deliver the 'smart grid'
RIIO-ED1	Current electricity industry price control period, 2015-2023
RIIO-ED2	Next electricity industry price control period, 2023-2028
Smart grid	An electricity network which allows devices to communicate between suppliers to consumers, allowing them to manage demand, protect the distribution network, save energy and reduce costs

Smart Grid Forum	Industry platform which engages on the significant challenges and opportunities posed by GB's move to a low carbon energy system