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Planning for the future
TECHNICAL WORKSHOPS

Report prepared for NIE Networks

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Northern Ireland Electricity Networks

Report contents

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Key insights: an executive summary

Background

Northern Ireland Electricity Networks (NIE Networks) commissioned Perceptive Insight, an independent market research agency, to facilitate a programme of research with key technical stakeholders. Given the presence of technical areas in the business plan which require specific feedback, experts from a diverse range of industry and academia were invited to contribute to the process of shaping those area. To uncover these insights, three workshops were held via online videoconferencing. Table 1.1 provides an outline of the workshops, the date they took place and the number of stakeholders in attendance.

Table 1.1 Details of the NIE Networks workshops

Workshop	Date	Number of attendees
Technical workshop 1	2 November 2021	19
Technical workshop 2	25 November 2021	16
Technical workshop 3	13 January 2022	14

The three workshop discussions centred around a number of key technical issues, which NIE Networks will make decisions on as part of their business plan for the price control period, RP7. A summary of the main issues put forward by the stakeholder panellists during these sessions along with the main take aways are outlined below:

Technical workshop #1

Open Networks and Flexibility

Open Networks is an initiative developed by ENA to address emerging challenges associated with decentralisation, decarbonisation and digitalisation of energy resources with meeting Net Zero targets. The main objective is to allow gas and electricity networks to adapt into smart and flexible networks capable of meeting the demands. 'Being flexible with how and when we consume and produce energy means that we can be sure the power generated and delivered to us always matches the amount we use.'

- Open Networks adopts a technology neutral approach, whereby products are open to any potential customers. Heat provisions could be accommodated within the market, however, currently, there are no specific heat provision products in the Flexibility Services across GB;
- The 'Day 2' issue should be considered further, which relates to the installed network assets being unused due to the projected EVs and heat pumps not in use;
- Combining heat and power may enable congestion to be managed on the network;
- NIE Networks should ensure that there is value to the consumers from the upgrades given the costs are embedded in electricity bills; nodal pricing and smarter controls may be required to facilitate value generation, particularly for low-income households;

- The needs of rural dwellers should be considered going forward given that many are outside the gas distribution area; alternative heating solutions should be considered;
- With increased electrification there will be significant peak loads on the grid, which will have to be solved; dynamic tariffs and the introduction of smart meters may help to reduce the peak loads;
- Regional differences in regulatory models exist; RIIO model is adopted in GB, which facilitated establishment of the local flexibility markets, whereas NI adopts the RAB;
- There is a need for strategic investment to achieve the ambitious Net Zero targets;
- Although policy to connect renewable alternatives in NI does exists, there is lack of appropriate regulatory and market framework reinforcing these connections. This disconnection between policy and practical solutions prevents the system from becoming sufficiently flexible to cope with the demand and supply.

Innovation

- There are concerns that the electricity grid will not cope with the additional loads during peak times as a result of additional EVs and heat pumps; innovative technologies should be explored, trialled, and implemented to ensure the network's resilience going forward;
- NIE Networks should engage with the private sector more broadly to initiate collaborations, generate exposure, and increase the value of various technologies in decarbonisation transition;
- Hydrogen-based solutions will play in important role within the whole systems and cross-factor components of the transition; NIE Networks will enable and accommodate them where possible;
- With regards to EVs, there are concerns that the transition is concerningly slow at present; NIE Networks is working with various departments to ensure policies are in place to accelerate green development and growth.

Visibility and Open data

- There is a need for incentives in conjunction with grid upgrades to stimulate an early uptake of EVs, heat pumps, thermal storage, and other technologies;
- Currently, there are challenges around data retrieval from remote locations, its transmission and analysis;
- Network monitoring will facilitate forecasting and identification of areas of high LCT penetration;
- Smart metering and LV monitoring are viewed as complementary technologies as they generate distinct sets of data. In the absence of smart metering programme in NI, LV monitoring is necessary to provide an overview of the networks;
- It would be beneficial to have access to high volume of real-time data;
- Locationally concentrated data provided by NIE Networks could be linked with other datasets available and variables utilised on, for example, house type, fuel poverty rates and the number vehicles.

Market Operability

- Existing demand response products outside of GB are more advanced and are considered as suitable for the NI context, with a specific focus on the system itself and the capacity for renewables; smart metering technology and digitalisation are required initially to derive the highest value from the developed products;

- Capacity value of reduced demand at peak times should be considered given that reductions in customer demand for electricity at peak times simultaneously reduce the requirements for additional generation in the capacity market.

People & Skills

- Skill requirements going forward will centre around technology, cybersecurity, and innovation and additional efforts are required to promote the utility sector to potential employees;
- Women remain underrepresented within the utilities sector, and additional work should be undertaken to encourage female involvement.

Technical workshop #2

Network security and resilience

- Perceptions of any decreasing security of supply could have considerable implications in weakening the confidence among the general population to manage the electricity infrastructure effectively;
- To detect priority areas for tree cutting, helicopters and aircrafts are deployed; drones are useful and less costly than helicopters, however, there are issues associate with their use.

Resilience and reliance

- It is expected that consumers will become increasingly dependent on electricity, especially with the adoption of EVs and heat pumps. Consideration needs to be given to situations, such as during major weather events, when power outage occurs, whereby consumers reliant on electricity would be impacted severely. Similarly, consideration should be given to emergency response during power outages, with increasing numbers of electric powered vehicles.
- There is a risk of a cyber-attack which would interfere with infrastructure for long periods of time;
- Implementation of appropriate technologies to control heating systems would facilitate their management for customers experiencing difficulties with electricity supply.

Futureproofing the network

- NIE Networks is considering additional investment approaches associated with asset replacement to help improve network resilience;
- There is a broad agreement that increasing minimum sizing during asset replacement is required;
- Whilst moving to a higher capacity cable would incur small incremental cost, it would yield longer term benefits, even if increased loading does not materalise through reduced losses.

N-2 and network security

- A double circuit outage, or N-2, is a low probability, high impact event. When questioned about how such as situation could be controlled it was suggested that a standby battery storage facility, strategic spares or a connection point available for power generation should be considered where asset upgrade to transmission level is not possible;
- It was hypothesised that the optimum cost solution could be based on the VoLL (Value of Lost Load) and probability factors, and perhaps the flexible approach could help deliver the additional resilience and reliability;
- Lower BSP resupply figures for NI could be driven by a few sites or BSPs impacting the relatively well-performing majority. Under such circumstances, the focus should be on fixing the underperforming assets to achieve higher resupply standards;

- Given that the VoLL is an inferred monetary indicator of electricity consumers' willingness to pay to avoid additional periods without power, NIE Networks highlighted that VoLL in NI is reflected in customers' bills;
- The discrepancies in resupply values between NI and GB could be as a result of differences in methodological and analytical methods, diverse industries, provinces having different VoLL, and finally, the economy itself; there is a need for methodological compatibility as well as a CBA to reflect the most accurate analysis;
- Load prediction is an important value used by TSOs and DNOs; with the expected EVs, it would be difficult to predict given that all the factors currently used may become irrelevant.

33kV Reinforcement

- Adopting an early investment would avoid having a stranded asset for two years; one of the biggest restrictions concerning generation or battery storage is around network capacity, therefore infrastructure on both the import and export side is needed;
- There is an uncertainty with demand growth and if it grows more than forecasted, it results in a heavily overloaded asset; the challenge is in delivering the infrastructure more expeditiously to safeguard against the risks of higher than predicted demand growth, any unforeseen planning and legal delays which could also occur;
- Different triggers could be created associated with statutory approvals ahead of time to prevent delays, thereby allowing for build to take place quickly if demand does appear;
- The assumption of an LV network design is diversity, whereby network usage would be 50% at any given time (reference provided in the main text). This was exemplified by a car being charged every other day as opposed to every night, meaning that only 50% of households living in a particular area would be relying on the electricity network for charging EVs;
- Decreasing prices of PV panels could be more appealing to people with EVs and business premises, and therefore there could be increased levels of reverse power flow;
- Proactive investments in the reinforcement of the 33kV network for small scale generation is advisable;
- Given that the 33kV investment costs for LV connected generation is not charged to the connecting customer, the NIE Networks will require an allowance within the price control to account for this;
- Proactively creating capacity would be advantageous for achieving low carbon targets.

Tree cutting and vegetation management

- Vegetation management is determined by network voltage, meaning that for each voltage there are varying inspection frequencies and routine tree cutting;
- Having a wind speed map of NI would facilitate focused efforts;
- It was suggested utilising LiDAR and 3D laser imaging for tree cutting quality control to monitor and ensure that work is completed.

Technical workshop #3

Network performance & equipment

- Reclosing equipment and services reduce the impact of LV underground cable faults on customers;
- Sophisticated monitoring could offer additional functionality such as neutral condition assessment or detection of highly criticised neutral faults;
- There is an overlap between some of the LV monitoring functions and what could be achieved by implementing a full-scale rollout of smart meters; smart meter rollout in GB is

supplier led, and therefore distinct from the NI counterpart; one specific issue identified with the GB rollout relates to the lack of access to meter point level data due to privacy laws;
- Smart meters do not have the capacity for capturing waveform on high frequency data required for fault location or fault prediction;
- There could be significant value in combining smart meter data with LV monitor data; it is unlikely for smart meters to supersede LV monitors' functional capacity;
- Certain events on the network could be resolved with market solutions rather than it being a network condition issue that requires DNOs action; currently GB does not have sufficient smart meter or other market product penetration to be able to achieve this;
- Monitoring implies a reactive investment after the event, meaning that an investment would only be triggered when the data indicating a fault on the network was registered by the monitor; this could lead to performance issues, which the households living in these locations would experience;
- From a strategic perspective, LV monitors in GB are not being installed after the fault, they are installed in advance, based on modelling and understanding of the network;
- Half of the located faults are permanent and other half transient; once a fault location is sent, it typically becomes a permanent issue within one year;

Availability, Reliability & Performance

- Network performance based on the CML measure has improved since the introduction of RP6 in 2017;
- Once customer expectations are raised, the standards would have to be upheld, and it is difficult to assess what the public would be comfortable with; there may be differences in consumers' expectations based on their location, meaning that rural and urban dwellers may have distinct views and experiences;
- There are issues experienced by the customers who are behind meter generation at the end of the line; such customers in addition to being limited on their maximum apparent power, or kVA, also experience power quality issues;
- Customers' expectations in relation to network performance may change in the future; given the predicted uptake of EVs, their dependency will increase, and this should be factored in going forward;
- The electrification is deemed to create peaks and surges, hence NIE Networks should further focus on other business opportunities and expectations other than meeting their CML targets;
- Ultimately, NIE Networks carries the responsibility in terms of security of supply, even though certain elements may be outside of their remit;
- In response to power outages, businesses should consider options such as standby power generation, battery storage and UPS devices.

Sustainability

- NIE Networks' ambition is to deliver a sustainable energy system for all;
- NIE Networks' sustainable strategy is aligned with the United Nations Sustainable Development Goals (UN SDGs);
- To ensure the sustainability goals are sufficiently ambitious, network losses element should be included in the internal plans;
- Fleet: consideration of substitutes for vehicles in case of power cuts;
- Decarbonisation is paramount and adoption of any methods that would allow for an accelerated achievement of the goals is advisable.

Net Zero Targets

- NIE Networks' target is Net Zero by 2050 or sooner; other DNOs anticipate achieving this goal by the end 2028, and SPN carbon emissions reduction of 80% by 2030;
- The most certainty is around the 'minimum of 50% by 2030' target, whereas beyond this, it is difficult to evaluate the feasibility of targets given the global uncertainty around available technologies between 2030 and 2050 to facilitate further decarbonisation;
- There is uncertainty surrounding the contributions of offsetting projects deployed to remove carbon out of the air, with some of the existing initiatives seemingly not being fully effective; NIE Networks should perhaps consider reducing their reliance on offsetting where possible;
- A multi-step approach to understand the journey to Net Zero whilst embracing what other elements can be adopted and interim reviews would support timely decarbonisation;
- Achieving the targets may become more difficult as time goes on due to the current rises in manufacturing and other costs, therefore, the sooner appropriate actions are taken, the better the chance of achieving the overall goal;
- There are opportunities for hydrogen production and for its implementation on the network to support the decarbonisation agenda. However, hydrogen production would be a role for industry as opposed to being undertaken by NIE Networks;
- Commercial collaborations and/or academic partnerships are essential in achieving the Net Zero goals.

Introduction & approach

Introduction

Northern Ireland Electricity Networks (NIE Networks) commissioned Perceptive Insight, an independent market research agency, to undertake a programme of research designed to explore stakeholders' views and perceptions of the technical requirements contained in the RP7 business plan. Given that the upcoming RP7's requirements are expected to go beyond the issues of price controls, it was imperative to gather qualitative data from stakeholders with technical expertise to provide a meaningful input into the more complex aspects of the business plan. This report presents the findings from three technical workshops, which took place in November 2021 and January 2022.

Approach

Due to Covid-19 restrictions it was not possible to hold the stakeholder engagement workshops in-person, rather the workshops were held using video conferencing technology.

Structure of the workshops

Given the depth of discussion required and the number of topics to be covered it was decided to host a series three technical workshops. A number of key experts across different disciplines were identified and invited to all three workshops, along with key NIE Networks personnel.

The workshops were conducted to allow for the input gathered from the respondents to help shape the technical considerations within NIE Networks' RP7 business plan. In particular, the workshops provided input into the following, non-exhaustive list of considerations:

- NIE Networks' Low Carbon Technology forecasts;
- NIE Networks' key RP7 technical models e.g. LCT tools, ADST;
- Open data requirements – what data should NIE Networks publish;
- Input into NIE Networks' proposed innovation projects and strategy;
- The future role of distribution flexibility;
- Network resilience; and
- Impact of climate change.

The technical workshops took place on the following dates:

- 2nd November 2021
- 25th November 2021
- 13th January 2022

From the outset, NIE Networks intended that the workshop membership should achieve the following objectives:

- Bring a diverse range of views, experience, and expertise to inform thinking and to challenge discussion to help shape the business approach;

- Provide meaningful input into discussions with respect to the more technical aspects of the business plan – the group were required to be sufficiently technically equipped to understand some of the issues brought forward by NIE Networks;
- Represent technical experts across a diverse range of industry and academia, including the four DSO customer groups (system service providers, active and passive participants, passive consumer).

Recruitment of stakeholders

Perceptive Insight worked in partnership with NIE Networks' project team to identify the technical experts to be invited to the workshops. In addition, three industry innovators (one for each workshop), with experience of the wider UK market, were invited to present an overview of current developments in their specific markets. Table 2 summarises those organisations that participated.

Table 2: Organisations participating in the technical workshops

Participants	Presenters
NIHE	Energy Networks Association*
Electric Vehicle Association NI	Kelvateck*
Ulster University	Threepwood Consulting*
Queen's University, Belfast	
Renewable NI	
FERA	
SONI	
firmus energy	
Energia	
NI Water	
Phoenix Natural Gas	

Format of the workshops

NIE Networks' key role throughout the workshops was primarily to inform the technical panel of the approach taken to date, to outline their plans in relation to the technical components of the RP7, and to provide clarification on any of the issues raised by the stakeholders. The technical panel's role therefore was to engage in a discussion on the topics in question, share insights based upon their area of expertise and highlight the possible challenges associated with the plans developed to date.

Perceptive Insight's role within the workshops was to independently facilitate this dialogue, capture the data and follow up with a report highlighting the key findings. Each workshop was recorded and transcribed. The technical workshops ranged in length from 2hr to 2hrs 30mins.

In the sections that follow, each technical workshop is reported individually. For each subject area, we provide a summary of the presentations made by the guest presenters and NIE Networks' representatives, followed by an outline of the subsequent discussions that took place.

Technical workshop #1

Who took part?

The first technical workshop was attended by representatives from the following organisations:

- Energy Networks Association, who made the initial presentation;
- Energia;
- Electric Vehicle Association Northern Ireland;
- firmus energy;
- Northern Ireland Housing Executive;
- NI Water
- Phoenix Natural Gas;
- Queen's University Belfast;
- Ulster University;
- Renewable NI, and
- SONI.

A total of 19 people attended this workshop including four representatives from NIE Networks.

Technical areas covered

The first workshop focussed on the following technical areas:

- Open Networks and Flexibility;
- Transition from DNO to DSO;
- Innovation;
- Visibility;
- Open data;
- Market operability; and
- People and skills.

In the following paragraphs we summarise the key points that were presented to the technical panel and record their views on the proposed plans for RP7.

Open Networks and Flexibility

Overview of the guest presentation

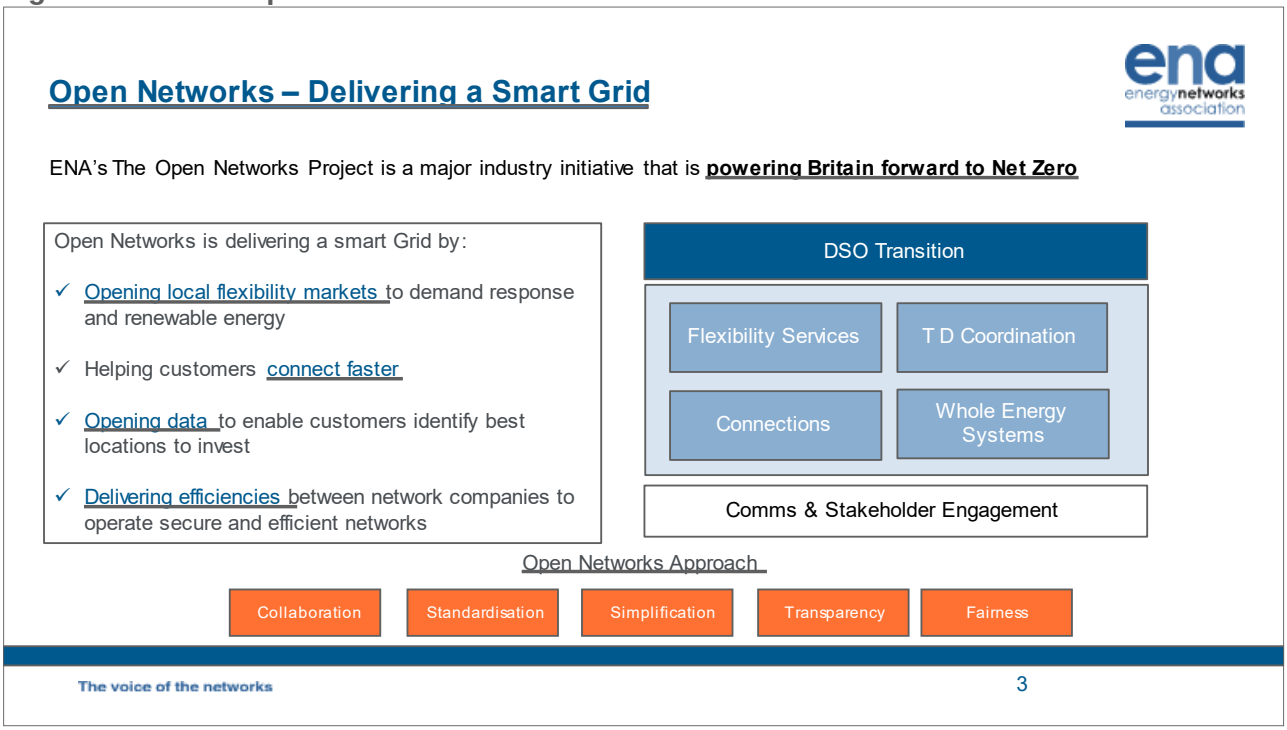
Representatives from the Energy Networks Association delivered a presentation which explained the work that the Energy Networks Association, the trading body for electricity and gas networks in the UK and Ireland, are undertaking on behalf of their members.

Open Networks

Open Networks is an initiative developed by the ENA in 2017 to address emerging challenges associated with decentralisation, decarbonisation, and digitalisation of energy resources, and more recently, with meeting the Net Zero targets. Thus, the main objective of Open Networks is to allow the gas and electricity networks to adapt into smart and flexible networks capable of meeting the demands. Open Network's approach of smart grid delivery is presented in Figure 1.1. Furthermore, five elements central to the overall approach were identified as:

- Collaboration;
- Standardisation of processes across GB;
- Simplification of existing processes;
- Transparency, and
- Fairness.

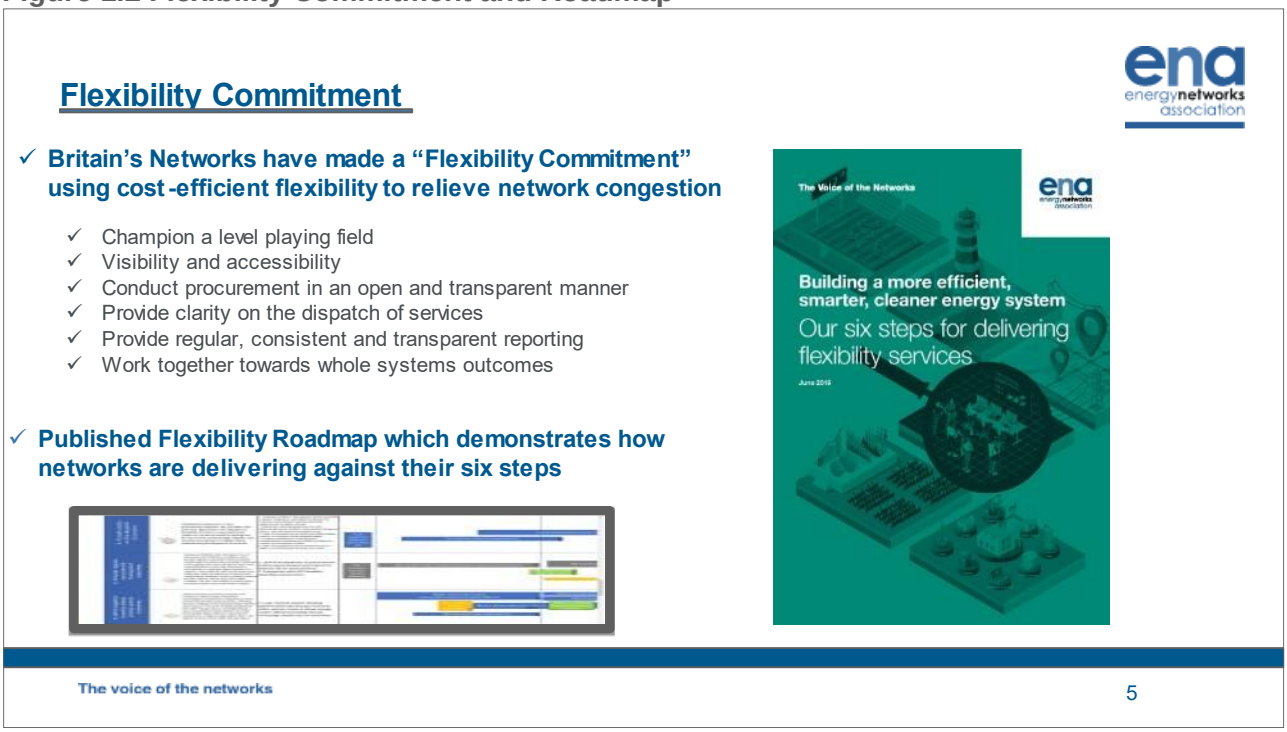
Figure 1.1 ENA's Open Network initiative



Flexibility

In terms of Flexibility, the guest speaker highlighted that through the Open Networks initiative the focus is on facilitating development and growth of the local markets which remain underdeveloped, although considerable progress has been made to date. Importantly, she remarked that GB's commitment to Flexibility began a few years ago, whereby all the networks agreed to openly test the market for these types of services. The principles underlying the Flexibility First approach were thereafter discussed along with the networks' progress against these priority areas (Figure 1.2).

Figure 1.2 Flexibility Commitment and Roadmap



To demonstrate the uptake of Flexibility services, the guest presenter highlighted that GB has one of the largest Flexibility markets around the globe, quoting 2.9GW of local flexibility services planned for tender in 2021, with 1.6GW contracted in the second half of 2021.

In terms of the Open Networks' project, it was noted the work focuses on helping to standardise, simplify and provide transparency on all steps across the flexibility lifecycle. This means that Open Networks is actively involved in the following processes:

- Identification of the network needs;
- Increasing visibility of the needs to the market;
- Procurement processes; and
- Operations, dispatch, and settlement of the services.

To achieve the set goals, it was demonstrated in the presentation that the learn-by-doing approach is a preferred method across Flexibility projects. More specifically, innovation has played a critical role in helping to establish local markets, allowing for testing of early concepts, and trialling a range of methods. The innovative projects included:

- Flexible Power by Western Power Distribution;
- Piclo;
- Local Energy Oxfordshire, and
- Cornwall Local Energy Market.

During the final remarks, the Energy Networks Association presenter acknowledged that despite considerable progress across the Flexibility markets, further actions and effort are needed to promote the availability of such services. In addition, she noted that an increase in the market size is likely, however DNOs do not procure all the Flexibility put out for tender. In terms of the next steps required, building market confidence and liquidity by offering standardised, simplified, and

transparent processes are necessary. To achieve this however, further stakeholder engagement and market coordination are essential.

Discussion

Based upon the presented information, the discussion was subsequently opened to the technical panel. One of the stakeholders firstly put forward a question pertaining to the usage of heat provision in Flexibility markets.

Response: The guest presenter explained that Open Networks adopts a technology neutral approach, and noted that the Flexibility products which are being procured in GB are open to all potential customers who require the service.

They further elaborated that currently there are no specific heat provision products. However, they emphasised that if this is a measurable through the baseline service, it can be accommodated within the market. They also indicated that at present heat provisions are not a requirement within Flexibility markets and there is no stipulations with regards to fuel types or technologies that need to be incorporated within the service provision.

Comments: The stakeholder highlighted the issues surrounding the Irish grid, and more specifically, pertaining to wind power. He remarked that there is abundance of energy at present and there will be even more available in the future and suggested that perhaps this could be utilised to displace fossil fuels at certain times. He observed that, across much housing stock, very inefficient kerosene is used for hot water heating, and there is no simple solution to direct the surplus wind power to direct to water heating. The following are the points the stakeholder expanded on:

- The ‘Day 2’ issue after wires are installed (suggested thick wires to last at least 60 years): this relates to the fact that upon the grid upgrade, it will remain empty due to the projected electric vehicles (EVs) and heat pumps not in use at that time. However, electric heating might be used as a solution to expend surplus power efficiently. Combining heat and power may enable congestion to be managed on the network. The NIHE is a landlord for approximately 85,000 homes in NI and plays a role in promoting energy upgrades to all 780,000 dwelling in the region. It has been noted that the NIHE-owned homes are usually smaller in size, are insulated and have a hot water cylinder, therefore a relatively small heat input or a fraction of heat provided by electricity can be beneficial to the occupiers. Solutions such as electric flow boilers could contribute to damp prevention, additional space heating provision, and provide a less costly alternative to hot water heating.

Intermittently using immersion heaters in existing homes that also have fossil oil boilers outside of the main dwelling, where in summer the hot water oil boiler efficiency is usually low.

- The costs of upgrades and impacts on the end-users: this refers to ensuring that there is value to the consumers from the upgrades, given that the costs are passed onto them. The concern is that low-income households may observe increases in electricity bills whilst not benefitting from the upgrades. ‘Nodal pricing’ and smarter controls are perhaps required to facilitate this value generation in the low-income areas in the west of NI where wind energy concentration is the highest.

- The NIHE is required to consider the needs of rural dwellers and thus is considering alternative heating solutions for homes outside of the gas distribution area. In that regard, air source heat pumps and/or boiler hybrids could avoid imposing significant peak loads on the grid or excessive costs associated with cold weather, by activating the boiler, assuming there is oil present. However, the price of zero carbon heating oil is at present too high and there is preference within the NIHE to incorporate 100% electric heating systems. In relation to this, an issue of systems testing was also raised, and more specifically which bodies/organisations could take on this challenge. Given that the NIHE does not have direct responsibility for the electricity system costs the overall expense would be dispersed among the households. With regards to commercial entities, it was highlighted that these could have difficulties in patenting water-based thermal storage systems, and thus not willing to cover the costs of testing.

If a big hot water tank could hold enough heat, or if a home were pre-heated, to avoid activating the heat pump in peak demand periods and to interact with low power prices.

- The issue of dynamic pricing: it was suggested that giving certain consumers access to 'Agile' tariffs would facilitate development and refinement of the solutions and smart technologies that reduce peak loads (for example, for households with a heat pump and PV panels or wind turbine that are more productive in the afternoons). A question was posed in relation to possibility of re-introducing of the Powershift tariff under the assumption that the demand profile data were returned, and live monitoring guaranteed within pilot installations. Alternatively, individuals could have access to half-hourly meters and market-based tariffs? This would require standard remote instruction sets developed to rapidly switch demands on or off in response to grid conditions and pricing.

Response: The guest presenter offered a response to the stakeholders' comments relating to the dual use of the upgraded infrastructure. He explained that at present, most of the Flexibility products were deployed to manage existing constraints. He added that he was not aware of existing projects or trials that were specifically designed to offset any fuel type or carbon intensive fuels, however he recognised that this is a pertinent issue. He added that within Open Networks there is an All Energy System workstream that focuses on the interplay between gas and electricity, and which becomes increasingly more relevant.

The other element that the guest speaker commented on was the capacity trading aspect. He indicated that at present there are two trails operating in the UK which are looking at things from a localised perspective. Going forward, there are certain aspirations among ENA to develop the products further and not to replicate projects, which would be somewhat redundant.

A representative from NIE Networks subsequently added that in the context of the upcoming RP7, it is key to ensure a robust forecast of the uptake of both EVs and heat pumps. This information at a localised level would facilitate detailed planning of the specific areas of infrastructure upgrades as and when required.

Comments: A stakeholder commented about the differences in regulatory models between NI and GB. He indicated that the regions operate under different assumptions of generating revenue and

that this is the first hurdle that NI faces in trying to deliver smarter solutions which don't involve growing the RAB.[1]

Response: The guest presenter elaborated on the points raised on the existing regional differences of revenue models for networks. She acknowledged an alternative model to RAB is currently adopted in GB, and that the RIIO model is more of a context model, which facilitated establishment of the local Flexibility markets.[2] She added that there is a need for strategic investment given the ambitious Net Zero targets in place. From the networks' perspective, she emphasised the need for infrastructure investment to support the uptake of EVs, heat pumps as well as other technologies. As part of the RIIO framework in GB, the electricity networks are going into the next price control period ED3, which will focus heavily on the policy for strategic investment. The presenter also highlighted that networks' visibility is crucial in forecasting and planning the necessary upgrades to the infrastructure which are lengthy processes. In her final remarks, she pointed out that regulatory framework is critical in ensuring the networks have the capacity to support the levels of technological uptake that is required going forward.

Another guest speaker also pointed out that currently there are no clear incentives or policies directly linked with Flexibility services and that Ofgem is preparing to incorporate in their next RIIO period.

Comments: In response to these comments, the stakeholder emphasised that in NI there is policy to connect renewable alternatives, however there is a lack of appropriate regulatory change, and more specifically, the regulatory and market framework which would allow the system to become sufficiently flexible to cope with the demand and supply. He pointed out that in NI in 2020, 15% of available wind energy was lost.

Transition from DNO to DSO

NIE Networks' presentation

This next subsection centres around NIE Networks' transition from the Distribution Network Operator to Distribution System Operator. The NIE Networks' representative began with noting that NIE Networks' RP7 is a critical period to ensure that all customers are enabled to play a role in the decarbonisation of the energy system. External drivers impacting decarbonisation were identified as:

- 2050 UK Net Zero targets;
- 2030 UK ban on sale of internal combustion engine vehicles, and
- 2030 NI renewable energy target (presumed ≥ 70%).

NIE Networks has responded to these challenges by undertaking a consultation exercise around greater access to the Distribution Network, the transition to DSO and what functions are associated with this role. In addition, in the strategy document, Networks for Net Zero, NIE Networks has highlighted what DSO functions are taken forward, and outlined internal sustainability as well as external decarbonisation progression.

[1] RAB – Regulatory Asset Based
[2] RIIO – Revenue = Incentives + Innovation + Outputs

A DSO vision and roadmap developed specifically for NI includes four key components:

- Visibility – concerned with data monitoring of the network to observe real-time activities;
- Controllability – concerned with network operation and automation;
- Market Operability – enabling access to a range of different markets including Flexibility and other third party markets, and
- Customer & Commercial – ensures that all customers are able to benefit from the energy transition.

These four elements are underpinned by three functions that NIE Networks have highlighted as being needed in order to facilitate the transition. Firstly, necessary systems and data are required, secondly, people with specific skills, and thirdly, innovation to expedite across all the four DSO areas.

Innovation

With regards to innovation, the representative from NIE Networks emphasised its importance in facilitating the DSO transition. He noted that it enables development of solutions, their trialling, implementation, and ultimately integration, to support customers and stakeholders in deploying low carbon technologies and renewables at the least possible cost.

The projects financed by the Regulator focused on being a fast follower, whereby well-established solutions from GB and elsewhere in the world were adapted and implemented to suit the NI context. Currently, these are progressing well with the intent of their application into business as usual at the beginning of RP7 period. The ultimate goal is to be able to identify constraints of the network caused by renewables or low carbon technologies and have a range of options to address and solve them.

This portfolio of projects for the current RP6 period included:

- FLEX – to deploy and trial Flexibility products;
- SAM – monitoring real-time ratings of overhead lines and transformers;
- STATCOM – managing voltages on the system;
- DRVC – demand reduction through voltage control;
- FESS, and
- LV ANM.

In addition to internally run initiatives, NIE Networks supports external projects such as GIRONA and RULET by providing expertise and network modelling resources. It has been acknowledged that collaboration with other external stakeholders to progress with the transition is essential. It was highlighted that in relation to innovation strategy for RP7, NIE Networks has the following intentions:

- To broaden the scope of what is currently being implemented;
- To continue with the fast follower concept whilst allowing for project expansion;
- To expand the range of Technology Readiness Levels projects, and
- To collaborate externally.

Discussion

A number of key questions were put forward to the technical panel for discussion. These included:

- **Are we taking the right approach to innovation during RP7? (TRL spread, whole system opportunities, project quantity/value exceeding RP6)**
- **Do you think a more flexible approach to innovation is required, and what criteria should be applied? (Defined projects, innovation pot, project criteria)**
- **What are your view on the innovation projects we should undertake? (Priority areas, specific projects/technologies, collaborations)**

Comments: One of the stakeholders opened the discussion by indicating there is a need for extensive investment on the demand side. He added that certain groups of consumers may experience difficulties in accessing market-based or agile tariffs to trial them. Further, it was suggested that there may be issues in terms of innovation where some of the most effective technologies are available in the public domain; such as hot water tanks where there is scope for using this option to limit peak demands throughout the winter period. In that regard, the concern is that the electricity grid will not be able to cope with the additional connected heat pumps and EVs during peak times and, thus, other options should be explored, trialled, and tested.

Another concept brought forward was to explore deployment of switching protocols to enable consumers to test certain components of energy transition themselves. For example, energy enthusiasts could test getting accustomed to switching things on and off depending on the grid condition. The stakeholder emphasised the need to engage with the private sector more broadly to initiate collaborations, generate exposure and increase the value of various technologies in decarbonisation transition. He concluded by bringing attention to direct resistance heating, which he indicated can shift three times as much load in comparison to heat pumps and could be of interest to NIE Networks.

Stakeholder question: Is hydrogen something that you will be looking at production of or development in the future?

Response: With regards to hydrogen, the NIE Networks representative noted that, in his view, direct production is not on any networks' agenda, however he also indicated that hydrogen-based technologies play a role within the whole systems and cross-factor components of the transition. He emphasised that there is a place for hydrogen solutions and that NIE Networks will attempt to enable and accommodate them where possible.

Thereafter, another representative from NIE Networks expressed his interest in getting an academic perspective on the proposed structure for RP7. He specifically asked a stakeholder for his input given the extensive work in research and innovation undertaken in this space.

Comments: The stakeholder agreed with the direction NIE Networks has taken in relation to the wider TRL spread, additional funds for innovation and also the introduction of Flexibility as it is not possible to predict what is going to be a key priority in 5 to 10 years. He thereafter expanded on his viewpoints with regards to where the focus should be placed on going forward:

- Growth in nodes – there is a possibility that the tipping point for the uptake may occur sooner than projections suggest, thus NIE Networks should prepare for this in advance;

- Grid reliability – this is a concern as all the energy usage focuses on electricity grid; grid reliability could be tested via certain projects;
- Carbon reductions – lifecycle analysis of potential projects to ensure no adverse effects occur is advisable.

Another stakeholder subsequently presented his perspective, and began by noting that transition is concerningly slow. He quoted the figures for electric vehicles in Northern Ireland (which was 6,500) and emphasised that in the second quarter of 2021 alone there were 990 plug-in cars added. He raised his concern over the lack of smart meters to date and stated that the consumers are seemingly ahead of the Government and the DNOs. Thereafter he commented that NIE Networks seems to be far behind and is continuously reacting rather planning ahead and, that given the projections for 350,000 EVs by 2030, the progress is not expeditious enough. In fact, there is only one CCS charger in about 40-mile radius in the Belfast area. A quote from NIE Networks to the Infrastructure Committee in December of 2020 was read out to demonstrate that this remains an issue to this day:

The stakeholder also provided insights into current quotes for rapid charger connections of £80,000

> *"We have a number of enquiries for potential operators, but they have not followed through. A lot of this is to do with the cost of connection."*

which is between 2.5 and 6 times the price of GB. At this stage it was also pointed out that as bodies await the Energy Strategy little practical progress is made. The stakeholder asked about any possibilities to engage with the Government to accelerate the policies and release the investment in order to facilitate the transition.

Response: A NIE Networks representative subsequently addressed the stakeholders' comments. It was initially stated that NIE Networks has been very active on the policies front. The belief is that a number of policy decisions can and are being made in advance of the Energy Strategy being finalised. One particular area of regulatory constraint is in relation to connection charging policy, which is not compatible with the GB and ROI equivalents. Moreover, there are concerns with regards to prices which may be the barrier to development whereby companies would have to invest considerably more money for the same project undertaken in NI as opposed to, for example, south of Scotland. It has been acknowledged that these types of policies lead to NI being the region lagging behind the rest of the UK and ROI.

Comments: A stakeholder shared his views with regards to priority areas for innovation. He began by pointing out that it would be useful to gather insights from other programmes in NI. For example, by understating how hydrogen generation is paired with waste water plants and then utilised in building capacity would be beneficial going forward.

Lastly, a stakeholder contributed to the discussion from an embedded generation perspective, which is concerned with providing reactive car capability to meet requirements at transmission nodes. He was interested in any current live projects or possible ideas for projects assessing the provision of reactive power required for those transmission nodes by locating that source of reactive power which would relieve requirements for embedded generators. He indicated that the market for reactive power is worth considering and exploring to help manage voltage on the network. On this point, a NIE Networks representative indicated that this may be considered in terms of future innovation projects given that the current Flexibility trials are concerned with active power provision.

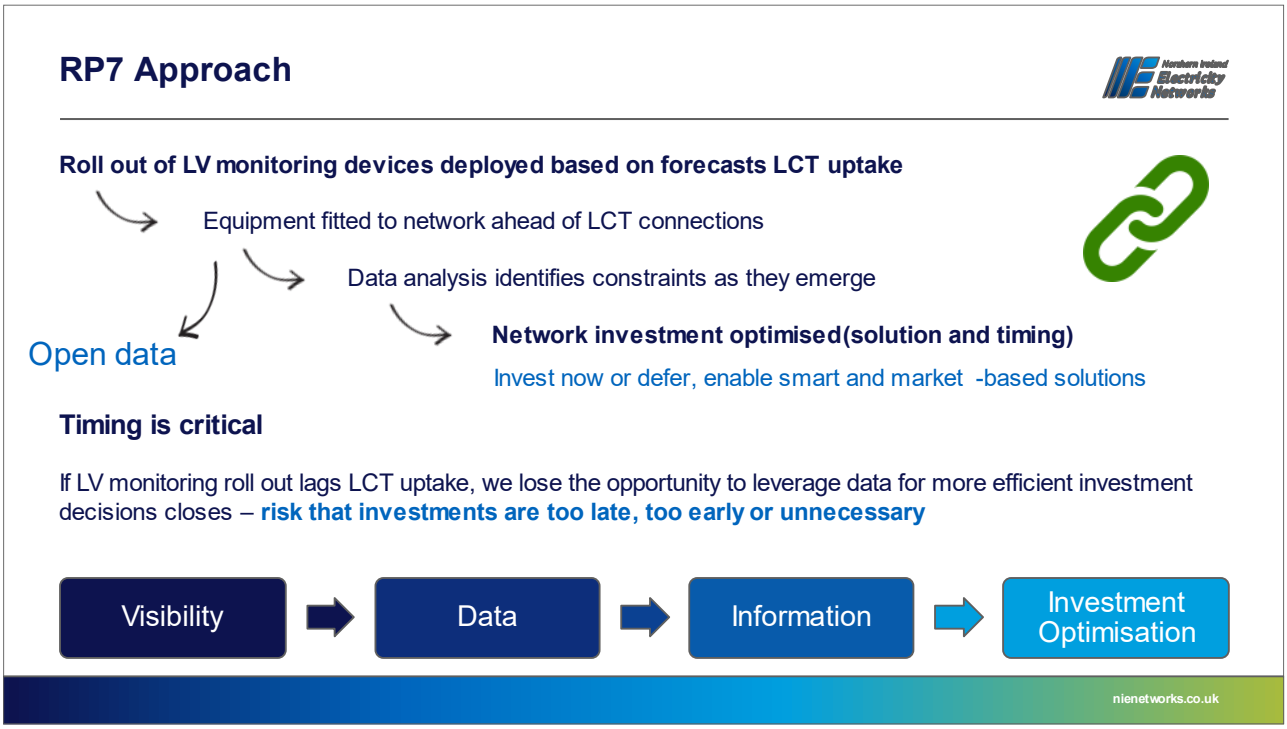
Visibility

NIE Networks' presentation

Another key area included in the DSO vision that NIE Networks wanted to gather insights on was in relation to Visibility. This component is concerned with additional monitoring across all voltage levels on the network to facilitate effective investment allocation. A recently published Energy Data Taskforce report highlighted that Visibility is crucial in achieving modern and digitalised energy systems. More specifically, it was noted that Visibility allows NIE Networks to observe the impacts of low carbon technologies and renewables which can be subsequently used to plan network investments. Currently, it was reported that NIE Networks has excellent visibility on the high voltage networks, substations, and overhead lines circuits, down to 11kV, and this is continuously enhanced in terms of directional power flows and high-resolution power monitoring. In contrast, real-time visibility on the low voltage (LV) networks is limited, which will be essential going forward as the vast majority of domestic low carbon technologies are going to be connected to that low voltage network.

In the context of RP7, steps are proposed to address this issue by deploying monitors on the LV network at ground mounted (GM) substations. Figure 1.3 summarises NIE Networks' approach to enhance LV network visibility.

Figure 1.3 NIE Networks' approach to enhancing visibility at low voltage networks



A few additional points were made on the intended improvements to visibility, including:

- Rollout of LV monitors to be undertaken at 50% of ground mounted secondary substations during RP7 period (approx. 4000 sites);
- Full visibility of the ground mounted substations guaranteed in the next 10-15 years;
- Prioritisation of substations and early identification of clusters where heat pumps and EVs are emerging;

- Potential for smart metering, which would serve as an additional data source (LV monitors provide real-time data, whereas smart meters collect data over time. Absence of smart meters in NI reinforces the need for LV monitoring.

Following from the presentation, a number of questions were posed to the panel:

- **Do you think we should be investing in enhanced network monitoring, particularly LV?**
- **Do you agree that timing is important, that rapid deployment is necessary to leverage benefits?**
- **Is targeting 50% of GM substations during RP7 an appropriate level of ambition?**

Discussion

Comment: The discussion began with one of the stakeholders highlighting the need for incentives in conjunction with grid upgrades to stimulate an early uptake of EVs, heat pumps, thermal storage, or other technologies.

Response: In his response, the NIE Networks' representative agreed that data availability might be a key enabler. It was speculated that making the general public aware of the implemented grid upgrades would inform them of additional capacity available on the grid to meet the needs for LCTs, which in turn could stimulate their uptake.

Comment: Another point raised by one of the stakeholders was in relation to the communications network, and in particular the end of line monitoring. In that regard, he indicated that, currently, retrieving data from underground components and their transmission to data centres for analysis are challenging, and was interested in finding out what solutions to this NIE Networks are considering.

Response: The NIE Networks' representative recognised this as an issue and indicated that NIE Networks is actively exploring opportunities for solutions. At present, there is an ongoing project designed to assist with the development of a blueprint for the future telecoms network.

Comment: Subsequently, the discussion turned to appropriateness of targeting 50% of the substations for LV monitoring. The stakeholder commented on the importance of targeting 50% of suitable substations as some areas may not require monitoring or the same level of monitoring as others.

Response: In response, the representative confirmed that through NIE Networks' forecasting facility, likely areas of high LCT penetration could be identified, and consequently monitors could be installed at those locations. The data derived from the monitors would be used to trigger timely investment, and the monitors themselves could be transferred to and utilised at different locations.

Comment: Further to this, another stakeholder agreed that there is a need for enhanced network monitoring and added that a partnership with other bodies to promote LCTs would be beneficial in gaining knowledge and understanding of peak demands and how to address concerns around this. A further comment from the panel was offered by a stakeholder who asserted that the appropriateness of the 50% target is contingent upon the cost-benefit analysis to be undertaken for the Regulator.

Response: The representative from NIE Networks then elaborated that this is the early view and subject to change, however it is broadly in line with GB in terms of the percentages. He added that

GB is certainly more advanced in terms of their rollout of smart meters and in that RIIO ED2 precedes RP7 by year, meaning that the region has a more complete dataset. This in turn, as the representative highlighted, could potentially necessitate a higher percentage visibility in NI, albeit based upon an appropriate analysis and business case.

Comment: The guest presenter pointed out that, at present, the figures are not mandated by any entity, but rather reflect a commitment to enhance visibility. He also agreed with the previous opinions raised in relation to adequacy of the 50% target as well as with the notion that some areas may require more or less monitoring than others. Speaking from a GB perspective, the presenter added that consumers are keen to access the data, resulting in the DNO taking initiatives to connect EVs in certain locations. One of the stakeholders then posed a question on how the relevant bodies arrived at the 50% figure and if there was an argument for 100%.

Response: The NIE Networks' representative responded that he was not able to provide detail around that, however he indicated that NIE Networks is analysing the maximum demand data derived from static monitors from a number of locations. Thus, NIE Networks is able to identify areas within that threshold and those where the uptake of LCTs is low, which may indicate that intervention is not required in these locations.

Upon this discussion, a representative from NIE Networks requested a brief exchange among the panel on the timing component. Specifically, he was interested in panel's opinions on NIE Networks' perspective, that is, if the monitors are installed prior to the congestion, this might facilitate more efficient decision making on investments. On this, one stakeholder speculated to what degree smart metering could be an alternative to the proposed monitoring given that the former technology produces granular data on appliances' time of use.

Response: The NIE Networks' representative elaborated that in the absence of a smart metering programme in NI, the LV monitoring is the way forward. In addition, the two components should be complementary of each other, with the substation derived data and domestic property data facilitating comparisons of losses and/or efficiencies. Until there is 100% coverage of smart meters, LV monitors are necessary to provide an overall picture.

Open data

NIE Networks' presentation

Regarding open data, the NIE Networks representative indicated that various network data can be made readily available. Another representative from NIE Networks explained that the DSO dashboard developed by the UK Power Networks provides grid information at a node level for a number of locations across the UK. The dashboard displays frequencies, voltages, active and reactive power flows as well as generation outputs and composition. Figure 1.4 provides a summary of open data presentation, including the questions directed to the panel.

Figure 1.4 Key open data assertions

Discussion

Comments: A stakeholder opened the discussion by drawing attention to the fact that the Housing Executive is considering district heating with electric heat pumps in their stock. In order to decarbonise district heating, there is a need to access all available data. For example, GIS can plot data in relation aquifers, wind energy, and rivers to harvest energy. The stakeholder concluded by indicating that there is a lot of value in transparency.

Another stakeholder recognised that high volumes of data are valuable. He noted that the data released could be used for monitoring constraint areas to facilitate the development of investment plans for local generations or other demand side response. With the use of data, new and existing areas requiring attention could be identified.

A third stakeholder contributed to the discussion by noting that from the generation development perspective, the power flow data would be of use as it forecasts demands. He suggested that this type of information would be relatively easy to supply and useful for generation development as it would enhance medium term plans. Hence, he was interested in what data could be provided by NIE Networks.

Response: The NIE Networks representative acknowledged the need for static and GIS data for development plans going forward, however this was not available at present. He indicated that what currently is provided through the DSO dashboard is the real-time or close to real-time data.

Comment: One of the stakeholders agreed that it would be beneficial to have access to high volume of real-time data. Another stakeholder added that as the new LCTs are emerging, there is an increased need for data from which power flows and power markets could be identified. To that, a further stakeholder added that locationally concentrated data provided by NIE Networks could be linked with other datasets available and variables utilised on, for example, house type, fuel poverty rates and the number vehicles.

On the closing of this segment, the guest presenter commented on the lessons from a GB perspective, and more specifically, on the conflicting viewpoints on data sharing. He elaborated that the shareholders are encouraged to share data where possible, however there may be some concerns over its sensitivity, meaning that the disclosed data may influence other organisations' operations.

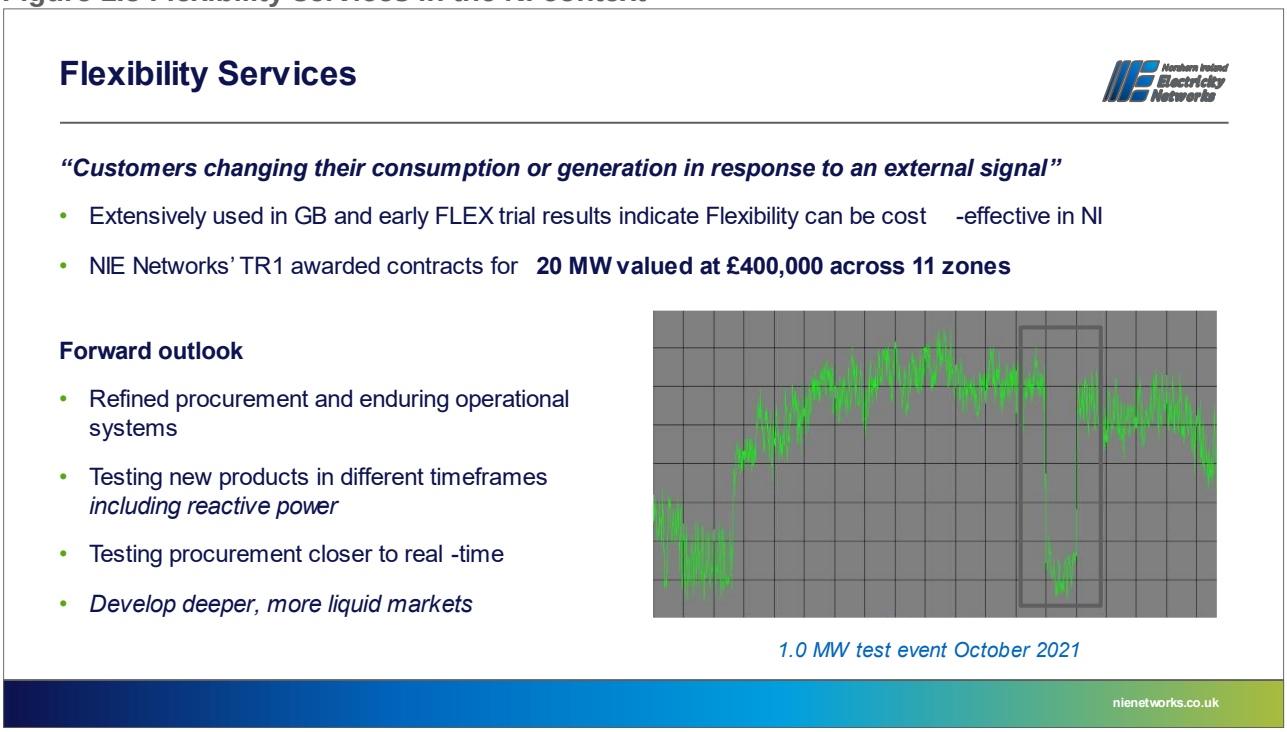
Market Operability

NIE Networks' presentation

The following session centred around market operability, and specifically on Flexibility services in NI. The comprehensive presentation on Flexibility services (Figure 1.5) outlined the work undertaken in NI to date as well as presented a vision for future Flexibility markets. A number of pertinent comments were made throughout in addition to the key points highlighted in Figure 1.6. These included:

- Early results from trials in NI suggest that Flexibility can be successful in the region; services are designed to manage congestion on the networks in place of unnecessary investments in the infrastructure, meaning that constraints on transformers could be alleviated by procurement of demand reduction services from connected customers;
- Possible disruptions and outages are minimised and additional opportunities for customers to invest in LCTs are generated;
- GB created a roadmap in the transition to DSO but is it accurate and applicable to NI given the regional differences?;
- Flexibility addresses scarcity on the network; it is not a particular type of power or in any particular direction, but rather it is procured where the need emerges;
- Explicit flexibility – an approach adopted by NIE Networks where a contract with a customer or aggregator acting on their behalf is signed reinforcing a formal relationship; the price signals that come through smart meters are associated with an implicit approach; NIE Networks relies on the customers to respond to price signals.

Figure 1.5 Flexibility services in the NI context



Based on the presented details on Flexibility services in NI, the following questions were put forward to the panel:

- **To what extent should we procure ahead of need to stimulate markets? Should we be procuring Flexibility services substantially ahead of time so that whenever that constraint does materialise the market is then already developed and available?**
- **What criteria should be used to select projects to bring to Flex markets? Should we be formally adopting the ENA's commitments around Flexibility?**
- **What additional aspects of Flexibility should we be trialling?**

Discussion

Comment: The discussion began with one of the stakeholders highlighting existing demand response products outside of GB, which he noted are more advanced and suitable for the NI context. Importantly, the parallels with the markets in California and New York were pointed out, with a specific focus on the system itself and the capacity for renewables. However, smart metering technology and digitalisation are required initially to derive the highest value from the developed products.

In addition, the stakeholder indicated that the capacity value of reduced demand at peak should be considered given that reductions in customer demand for electricity at peak times simultaneously reduce the requirements for additional generation in the capacity market. It was then noted that it is difficult to quantify the monetary value as NI properties' energy efficiency levels are substandard.

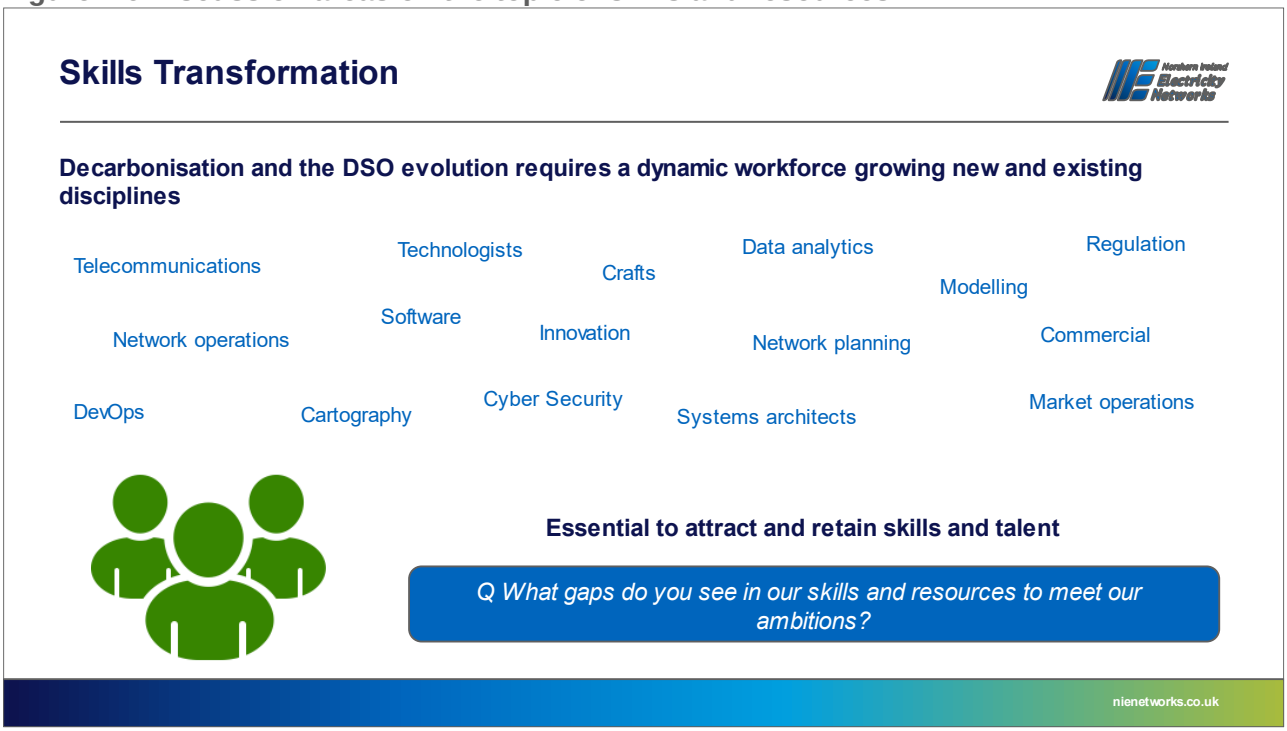
Another stakeholder agreed that peak demand reductions are essential. He then commented on the importance of incentives for people to reinforce investments in the systems given that interest rates for borrowing money among utilities are lower. More specifically, he suggested that providing more capital whilst factoring in that the interest in investment will subside over time, will ensure progress in the required direction.

People & Skills

NIE Networks' presentation

The final segment of the discussion centred around the skills and resources required to fulfil the transition to DSO and general decarbonisation agendas. Figure 1.6 summarises the brief and presents the question posed to the panel.

Figure 1.6 Discussion areas on the topic of skills and resources



Discussion

Comments: One of the stakeholders indicated he was concerned with the lack of apprentices on the practical side of work, which he attributed to the jobs essentially not appealing to the younger generation. Indeed, he noted that there are difficulties within the sector in obtaining the workforce required. Thus, it was suggested that to overcome these issues, an approach should be made to educational providers to promote all the utilities and reinforce uptake of the essential jobs. This theme of skills deficit was echoed by other panellists, who also highlighted the issue of cost associated with upskilling. It was then speculated that offering free of charge training or providing easily accessible resources could increase peoples' enthusiasm.

Throughout the discussion additional points were articulated, including:

- Skill requirements going forward will centre around technology, cybersecurity, and innovation. Hence, encouraging students to take up technological and data analytics modules might address some of the gaps;
- There is a broad range of skillsets in all types of employment and jobs across all utilities should be promoted as an inspirational future;
- Women remain underrepresented within the utilities sector, and additional work should be undertaken to encourage female involvement;
- Early career advice on what employment opportunities utilities offer could stimulate interest in and the uptake of jobs in this sector.

Technical workshop #2

Who took part?

The technical workshop, which focussed on on network reliance and resilience, was attended by representatives from the following organisations:

- Threepwood Consulting, who made the initial presentation;
- Queen's University Belfast;
- Northern Ireland Housing Executive;
- Phoenix Natural Gas;
- Renewable NI;
- SONI;
- Energia Supplier;
- Power NI;
- Energia;
- Energy Trading Ireland

A total of 16 people attended this workshop including eight representatives from NIE Networks.

Technical areas covered

The technical areas covered in this workshop included the following:

- Network security and resilience;
- Reliance and reliability;
- Future proofing the network;
- N-2 network security;
- 33kV reinforcement; and
- Tree cutting and vegetation management.

Network security and resilience

Overview of the guest presentation

The guest presenter, from Threepwood Consulting, firstly discussed network security and resilience in the context of GB.

P2 & EREP 130

The guest presenter introduced the following:

- P2: a DCODE document that all DNOs in UK are mandated to comply with as a minimum. It is a prescriptive document that sets deterministic requirements for the network.

He stated that in 2015/16 Imperial College London reviewed P2 and recommended some relaxations to the network security levels. An ENA P2 Working Group undertook further analysis in 2020 which considered the societal, economic, and environmental impacts of reductions in security of supply at the GB level. The P2 working group findings concluded that security of supply levels for Bulk Supply Points and Primary Substations should remain unchanged and that further work was needed to consider if any parts of the local HV feeder network may be suitable for relaxations in security of supply levels. He also introduced past work with NIE Networks to benchmark how NIE Networks' security compares to GB security. It was found that three quarters of market towns studied in GB have a 33kV backfeed capacity of 50% or more. The recommendation therefore would be for NIE Networks to achieve comparable figures.

- EREP 130: a guide for applying P2 standard.

The guest presenter highlighted that, in 2020 EREP 130 was revised and upgraded to a DCODE document, which resulted in EREP 130 being mandatory for applying planning standards across GB DNOs. He added that this was perhaps due to the demand side response and electricity storage being considered as future of network security.

Power Outage Impacts

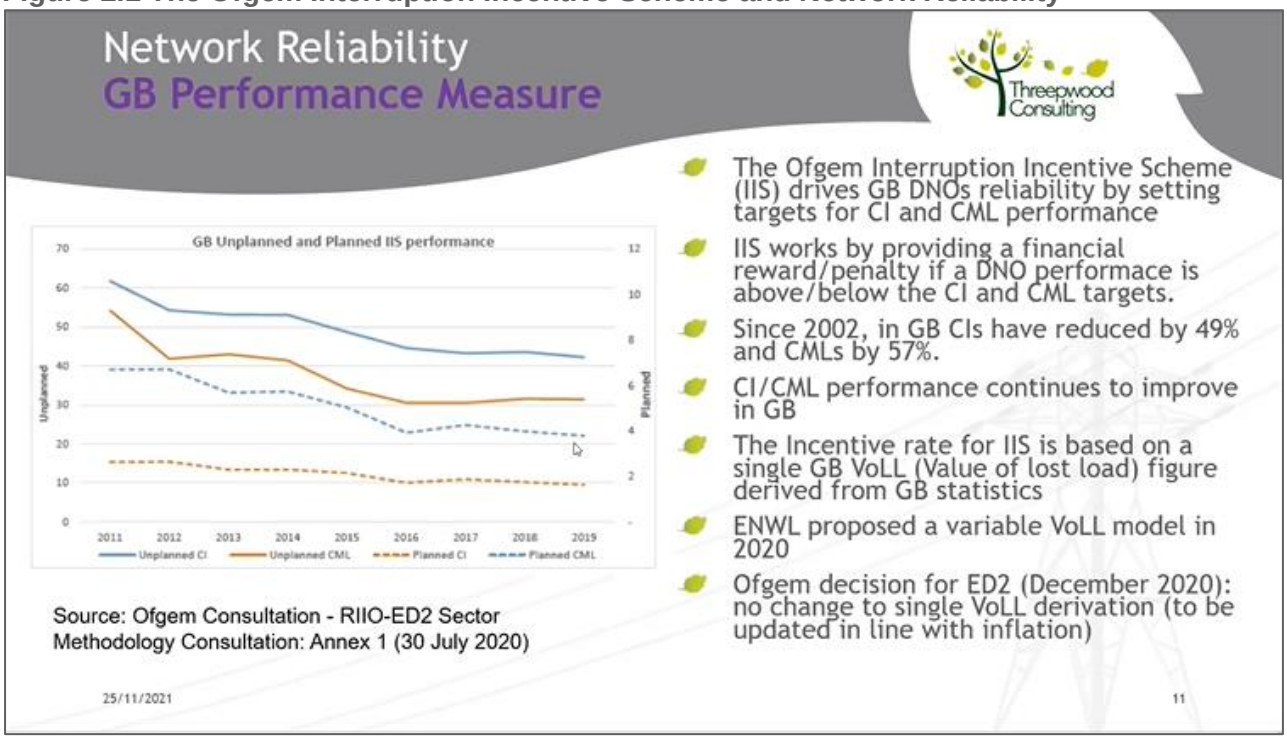
The presenter reported power outages as a serious concern to governments and also highlighted that the UK is becoming increasingly reliant on electricity. He mentioned that perceptions of decreasing security of supply could have considerable implications in weakening the confidence among the general population in the government's ability to manage the electricity infrastructure effectively. He highlighted that while diesel generation was a traditional way to get supplies back, the environmental impact is considered to be unsustainable.

> *Diesel generators are still a big part of networks' resilience but that they shouldn't be a mainstay, they're a last resort*

Network reliability

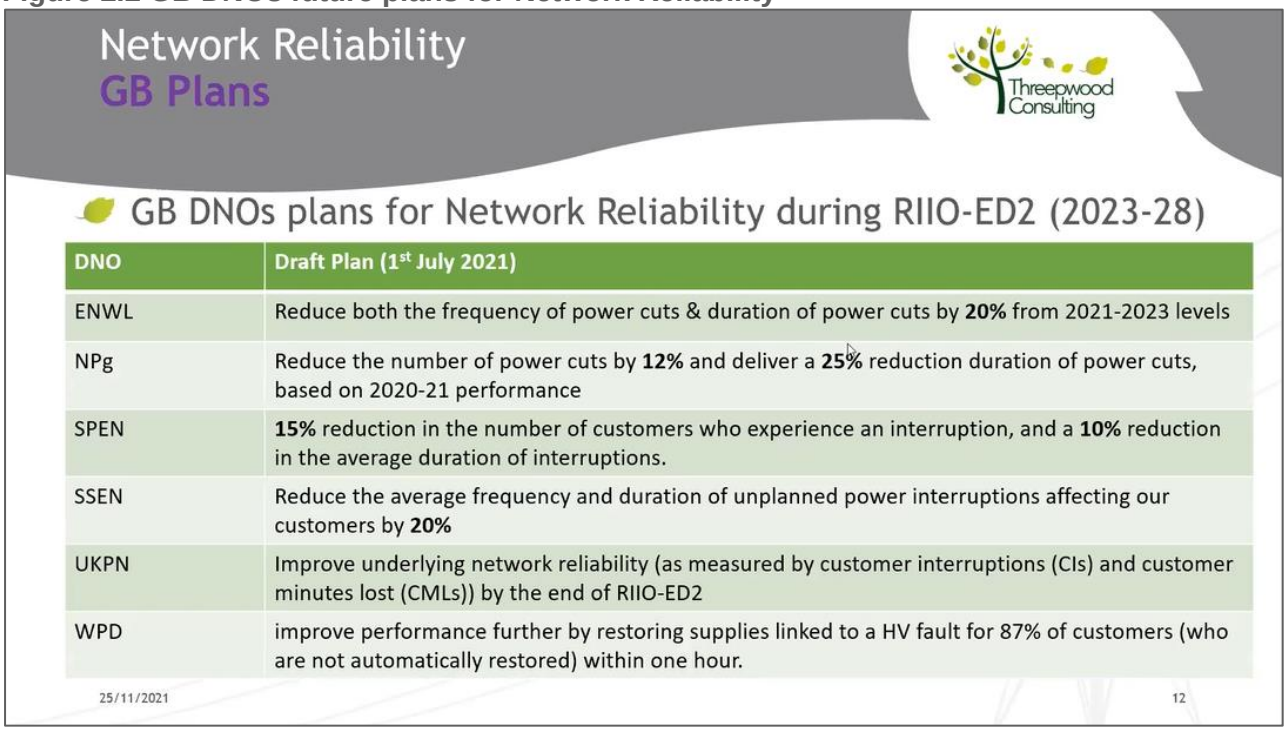
The guest speaker introduced CI (Customer Interruptions) and CML (Customer Minutes Lost) as the metrics in GB to measure network reliability. The Ofgem Interruption Incentive Scheme is anticipated to continue to 2028 using the reward / penalty mechanism, subject to inflation. Figure 2.1 provides a summary of the reliability incentive scheme.

Figure 2.1 The Ofgem Interruption Incentive Scheme and Network Reliability



Supplementary to Figure 2.1, Figure 2.2 below is a snapshot of what the GB DNOs are committed to accomplishing between 2023 and 2028. Specifically, all aspire to improve their reliability by 12-20%.

Figure 2.2 GB DNOs future plans for Network Reliability



DNO	Draft Plan (1st July 2021)
ENWL	Reduce both the frequency of power cuts & duration of power cuts by **20%** from 2021-2023 levels
NPg	Reduce the number of power cuts by **12%** and deliver a **25%** reduction duration of power cuts, based on 2020-21 performance
SPEN	**15%** reduction in the number of customers who experience an interruption, and a **10%** reduction in the average duration of interruptions.
SSEN	Reduce the average frequency and duration of unplanned power interruptions affecting our customers by **20%**
UKPN	Improve underlying network reliability (as measured by customer interruptions (CIs) and customer minutes lost (CMLs)) by the end of RIIO-ED2
WPD	improve performance further by restoring supplies linked to a HV fault for 87% of customers (who are not automatically restored) within one hour.

Network reliance

Overhead line networks are more susceptible to faults, therefore keeping them clear of vegetation is a considerable undertaking. While historically workers were directed to conduct line patrols to

assess the trees, this proved to be labour intensive and time consuming. Thus, DNOs in GB committed to trialling LiDAR, a remote sensing method which provides more accurate clearance data and understanding of affection rate per span (volume of trees) along with detecting growth rate and tree type. To detect priority areas for tree cutting, helicopters and aircrafts are deployed.

The guest presenter also outlined network automation as a primary area for increasing resilience. This would include the following:

- Improvements to telecommunications resilience;
- Increasing the number of remote controlled and automation points on the HV network;
- Further roll-out and development of intelligent automatic network reconfiguration tools to allow the rapid reconfiguration of a network during faults.

Discussion

Comments: One of the stakeholders opened the discussions by commenting that since the introduction of EREP 130, demand side response and electricity storage contribute to security and he questioned if electricity storage connections would have to be a firm connection, which is a more expensive option. The guest presenter responded that a firm connection is not required, however there is an option for a facility generator to enter into a contract with the DNO if interested.

Another stakeholder raised a point about whether drones could replace aircrafts in implementing LiDAR for tree cutting. In his response, the guest presenter indicated that drones are useful and less costly than helicopters, however, the civil aviation authority would not allow a drone to appear in a given area unexpectedly. They are certainly useful for a local area when a line of sight from one point is guaranteed. Otherwise, the drone's pilot would be required to relocate continuously whereas a helicopter can cover that area in a shorter timeframe. The stakeholder also questioned how many power cuts and blackouts are caused by poor weather conditions, such as high winds, and whether weather forecasting could be used to predict these occurrences. The presenter agreed this is of great importance and highlighted that the Met Office conducted a study that centred around creating a risk methodology for networks. Moreover, a metric is expected to be adopted in GB to measure DNO's capabilities in adapting to climate change and to identify the areas that require improvements.

Resilience and reliance

In this segment, a representative from NIE Networks took the opportunity to define network reliability as the probability of assets failing and customers experiencing power outages, and reliance as the time and network's ability to restore the supply. He highlighted that electrification of heat over the next two decades is anticipated to be significant in NI. In relation to this, he posed two questions to the stakeholders for discussion, namely:

- **How will the decarbonisation of heat and transport impact customer reliance on electricity going forward? and**
- **Are the current levels of reliance and resilience on the electricity network satisfactory for the future world we are going into?**

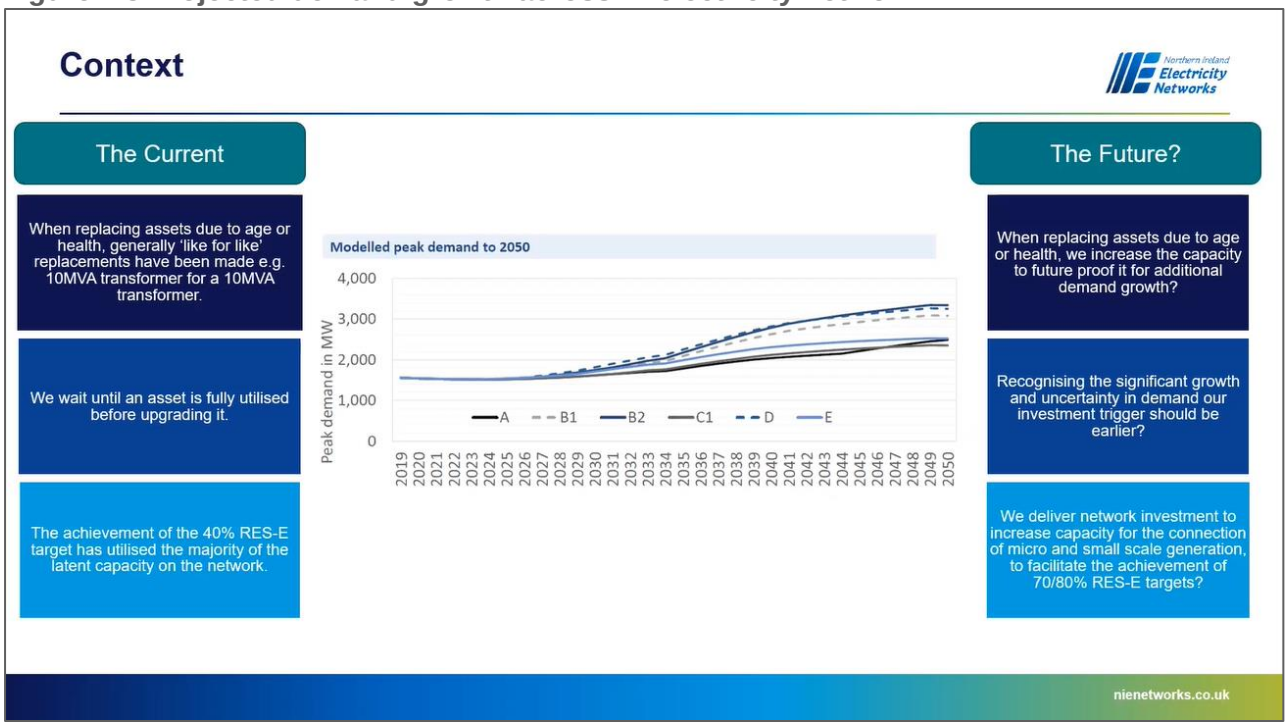
Discussion

Comments: One of the stakeholder remarked that in the case of a storm or other situation where consumers are disconnected from electricity for multiple days, this has significant impacts on households, and particularly those who are entirely dependent on electricity for energy to heat and power homes as well as for transportation. From a supplier perspective, another stakeholder agreed that this is important to consider going forward. Additionally, he commented on the possible risks of a cyber-attack, which could interfere with infrastructure for a long period of time.

Comments: A stakeholder suggested that additional data channels to control oil fired boilers would facilitate management of heating systems for customers when difficulties with electricity supply arise. Moreover, arrangements for an oil 'pay as you go' system would ensure a sufficient amount of oil in the tank available at any given time which could be activated when needed. Hybrid heat pumps were also suggested as a solution to issues with power supply, possibly using sources of energy such as wind, which could be enabled when market prices are low. He emphasised however, that system readiness and integration of smart technologies requires a much wider consideration of the heating sector.

Subsequently, a NIE Networks representative proceeded by highlighting NIE Networks' forecasts of LCTs uptake and explained that the demand for electricity will increase in line with electrification of heat and transport. He posed a number of pertinent questions to the panel, which are presented in Figure 2.3.

Figure 2.3 Projected demand growth across NI electricity network



Futureproofing the network

NIE Networks' presentation

Following on from the initial discussion on networks' resilience and reliance, a representative from NIE Networks delved into the area of future proofing the network. In his presentation, he pointed out that going into to RP7 starting in 2024, NIE Networks is considering additional investment approaches associated with asset replacement to help improve network resilience.

He described that the current RP6 consolidates two main approaches, namely:

- Condition based approach: replacing, retrofitting, refurbishing the assets on the transmission and distribution network; and
- Risk based approach: flood protection works at primary and secondary substations

While this work is anticipated to continue into RP7, he indicated that plans for additional approaches to improve network resilience are being considered. By implementing enhanced minimum specifications for equipment placed on the network, NIE Networks could ensure that assets are future-proofed with a minimum extra cost to the customer.

Primary Driver – Correct Size of Asset

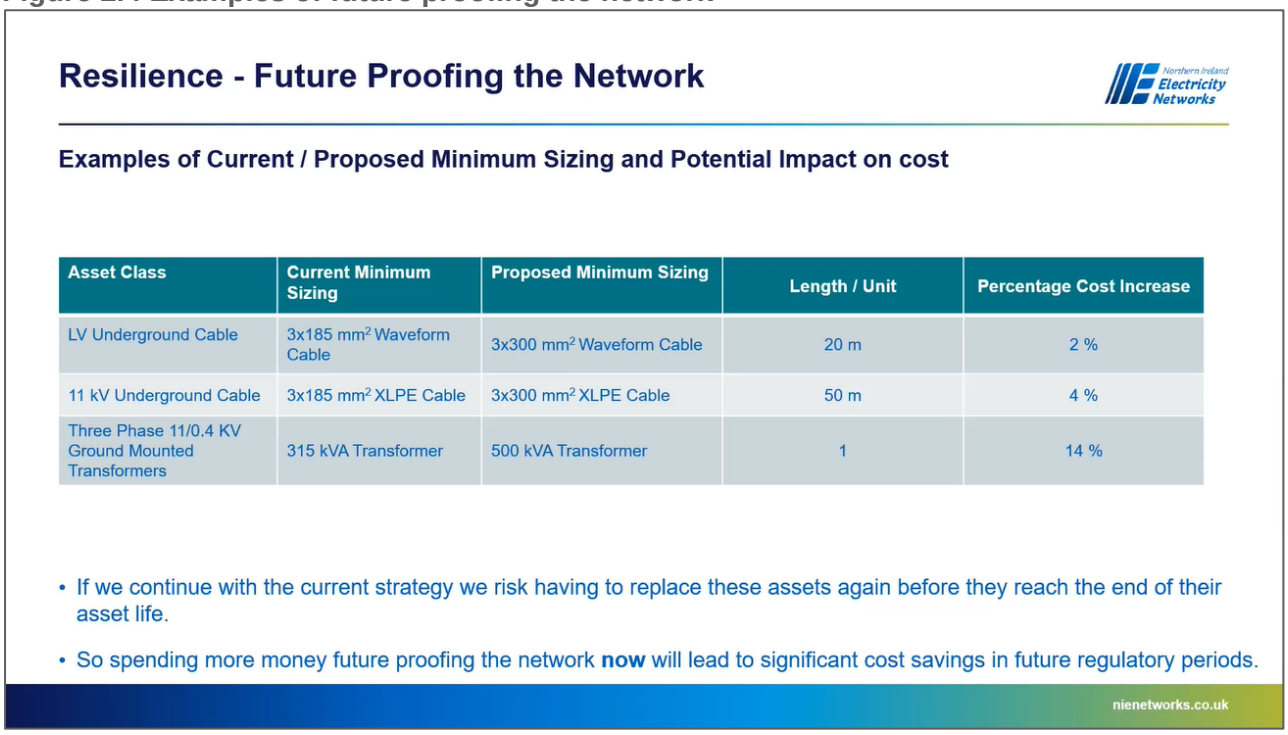
The NIE Networks representative stated that as the reliance on the electricity network increases, network resilience for both Demand and Generation customers will need to increase in parallel. He further highlighted that, currently, assets are replaced on a like for like basis, which is contingent upon their age and condition. However, RP7 will attempt to futureproof the network by ensuring that assets are suitably sized to cater for future load growth beyond the short-term. This would have the following impacts:

- Increased network resilience;
- Reduction of asset replacement due their exceeding electrical ratings before the end of their anticipated lifespan;
- Enhanced electrical performance;
- Reduction in network losses;
- Reduction in planned interruptions in supply to customers;
- Reduction in associated carbon footprint of groundwork; and
- Small costs increases.

The representative from NIE Networks also discussed current and proposed plans for futureproofing the network as presented in Figure 2.4 which he concluded by posing the following questions to the panel:

- **Do NIE Networks proceed with increased minimum sizing during asset replacement?**
- **Is it better to wait until we have certainty that demand is there or not?**

Figure 2.4 Examples of future proofing the network



Resilience - Future Proofing the Network

Northern Ireland Electricity Networks

Examples of Current / Proposed Minimum Sizing and Potential Impact on cost

Asset Class	Current Minimum Sizing	Proposed Minimum Sizing	Length / Unit	Percentage Cost Increase
LV Underground Cable	3x185 mm² Waveform Cable	3x300 mm² Waveform Cable	20 m	2 %
11 kV Underground Cable	3x185 mm² XLPE Cable	3x300 mm² XLPE Cable	50 m	4 %
Three Phase 11/0.4 KV Ground Mounted Transformers	315 kVA Transformer	500 kVA Transformer	1	14 %

- If we continue with the current strategy we risk having to replace these assets again before they reach the end of their asset life.
- So spending more money future proofing the network **now** will lead to significant cost savings in future regulatory periods.

nienetworks.co.uk

Discussion

For the most part, stakeholders agreed with increasing minimum sizing during asset replacement. One stakeholder was interested in understanding the long-term impacts associated with the additional megawatt hours of charging on the network given that this would have considerable consequences in relation to the operations of SONI. Therefore, maintaining a close working relationship between NIE Networks and SONI is crucial in preventing any unintended consequences.

A second stakeholder questioned whether NIE Networks is incentivised to reduce network losses. This was addressed by a NIE Networks representative who stated that the Cost Benefit Analysis (CBA) is undertaken in the best interest for the consumer, rather than NIE Networks. Another question from the panel was posed in relation to the 66kV voltage and if it has been considered where assets are smaller and more accurately sized for certain load situations. The NIE Networks representative noted that while a 66kV has not been actively considered, there is currently a 6.6kV network around Belfast, which is being considered for an 11kV upgrade during RP7. The guest presenter further commented that WPD implement Three Phase services within homes in preparation for the uptake of EVs and heat pumps, thereby futureproofing by initially adding a bigger cable.

Other stakeholders agreed and pointed out that whilst moving to a higher capacity cable would incur small incremental cost, it would yield longer term benefits, even if increased loading does not materialise through reduced losses. A stakeholder further highlighted a general case for integrated energy planning.

Another consideration could be the embodied energy needed to make cables. If you double the voltage, if you're using less cable, you're using less copper, there's less embodied energy in that.

N-2 and network security

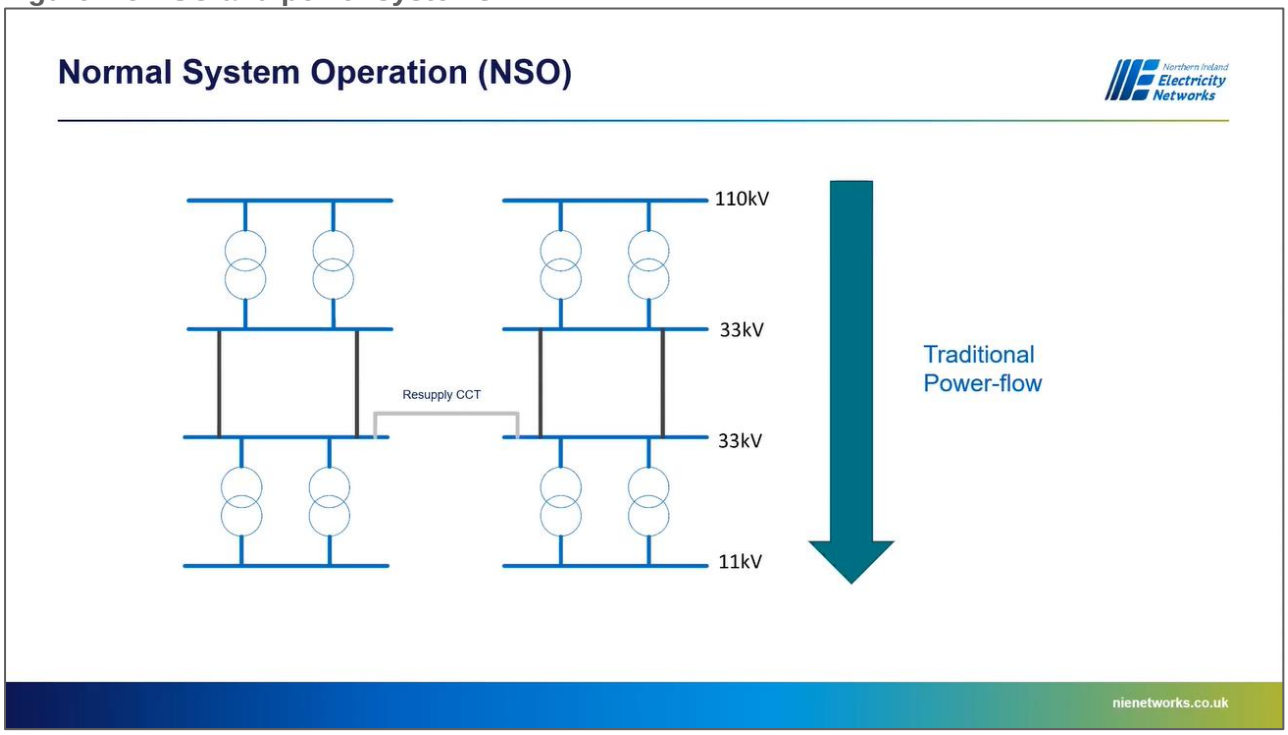
NIE Networks' presentation

A representative from NIE Networks subsequently presented on the subject of N-2 network security. He began by explaining how the power system operates traditionally using the diagram in Figure 2.5.

He pointed out that substations require two transformers in a circuit, each carrying 50% of the load, which consequently allows for removal of one, if and when required. The representative highlighted that when one transformer is out for maintenance or replacement, downstream customers remain unaffected due to redundancy measures in place, however, the overall security of supply is weakened. This leads to a single point of failure in the bulk supply point substation, a scenario called a single circuit outage or N-1. Thereafter, the NIE Networks representative discussed a scenario whereby failure in the remaining transformer occurs, and which would lead to all downstream customers losing power supply. This is called a double circuit outage, or N-2. While there is a minimum requirement to restore 33% of electricity within 3 hours, and the remaining power to be resupplied from other networks, in some instances it may not be possible to supply the full load causing major disruptions to the customers. This, he emphasised is a low probability event, however the adverse impacts are significant. Relative to the covered subject, the following question was posed to the panel:

- **Do you think the consequences from this high impact but low probability event are acceptable?**

Figure 2.5 NSO and power systems



Discussion

One of the stakeholders inquired about how such a situation would be controlled, to which a representative of NIE Networks replied by introducing flexible assets to offer system support.

Another stakeholder suggested undertaking a Cost Benefit Analysis with probabilities of transformer failures while considering the following:

- Do you need a spare transformer?
- Do you have a plan to change a transformer now and how long would that take?
- Is it worth investing in a third transformer as a live standby on site?

Concerning resilience and redundancy, the stakeholder also suggested having a standby battery storage facility or, alternatively, a connection point available for power generation since it appears to be costly to upgrade assets to transmission level to cover faults that happen very rarely. He also questioned the validity of standalone lines upgrades in the absence of transformers upgrades. The NIE Networks' representative reverted by acknowledging standby generation and strategic spares as possible solutions.

NIE Networks' presentation

Network Security Benchmarking

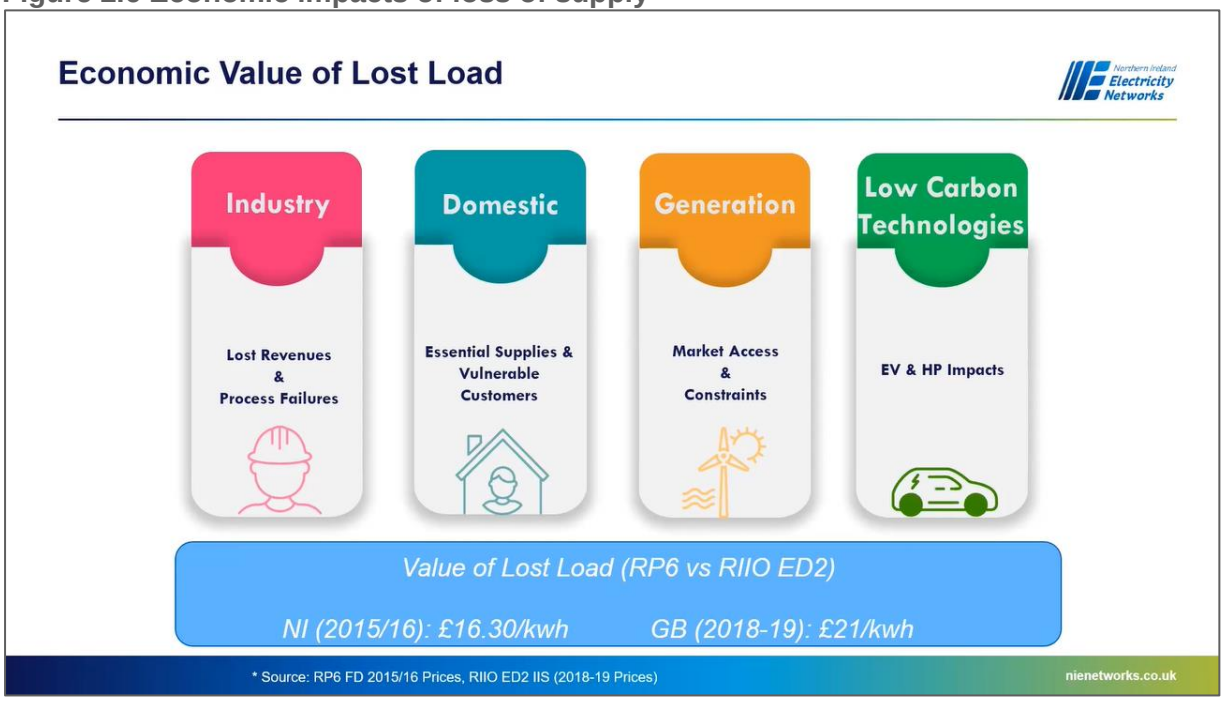
A representative of NIE Networks proceeded to explain that in relation to GB, NI is currently 25% lower on average resupply capacity for the market town type Bulk Supply Point (BSP). Based on wider security investment methodologies, the guest presenter brought forward the following recommendations:

- Use the Value of Lost Load to inform Network Security driven reinforcement / re-supply capability; and
- Increase the 33% P2 level to 50% re-supply capability for all BSP substations.

Value of Lost Load

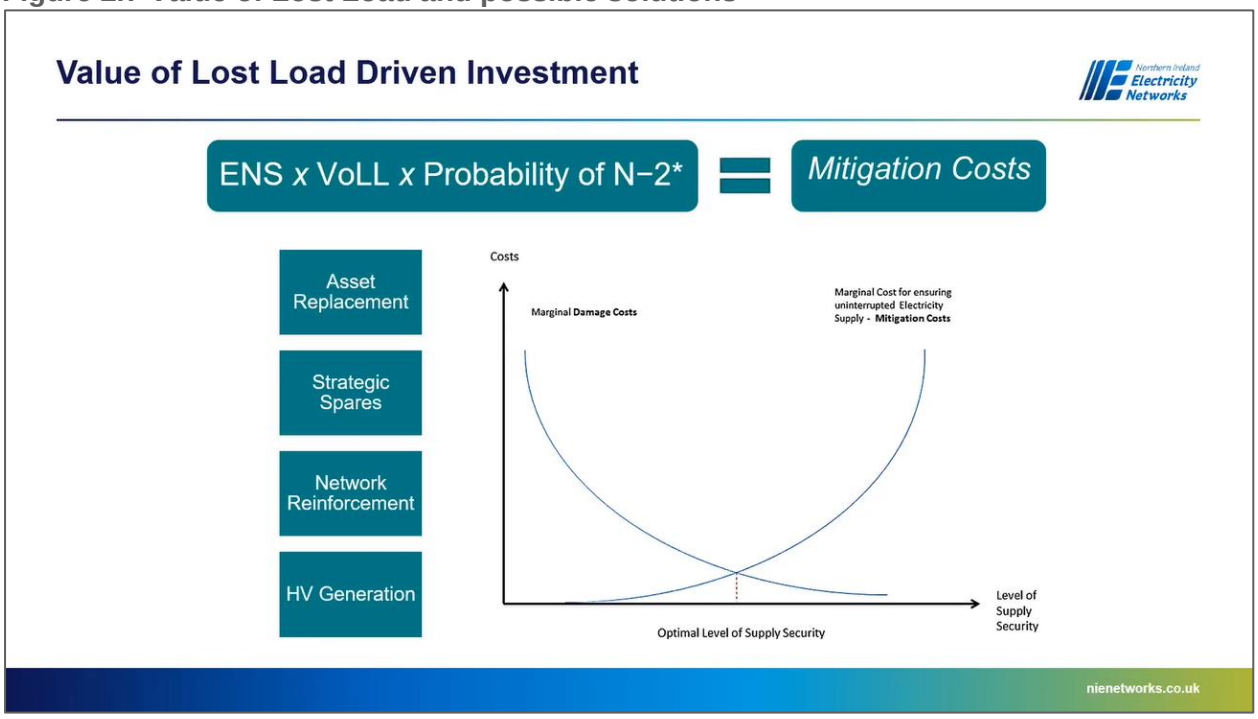
The economic impacts of loss of supply were subsequently outlined. As part of the RIIO ED2 process, the value of £21/kwh (2018/19 prices), is about 25% higher in GB than in NI (Figure 2.6).

Figure 2.6 Economic impacts of loss of supply



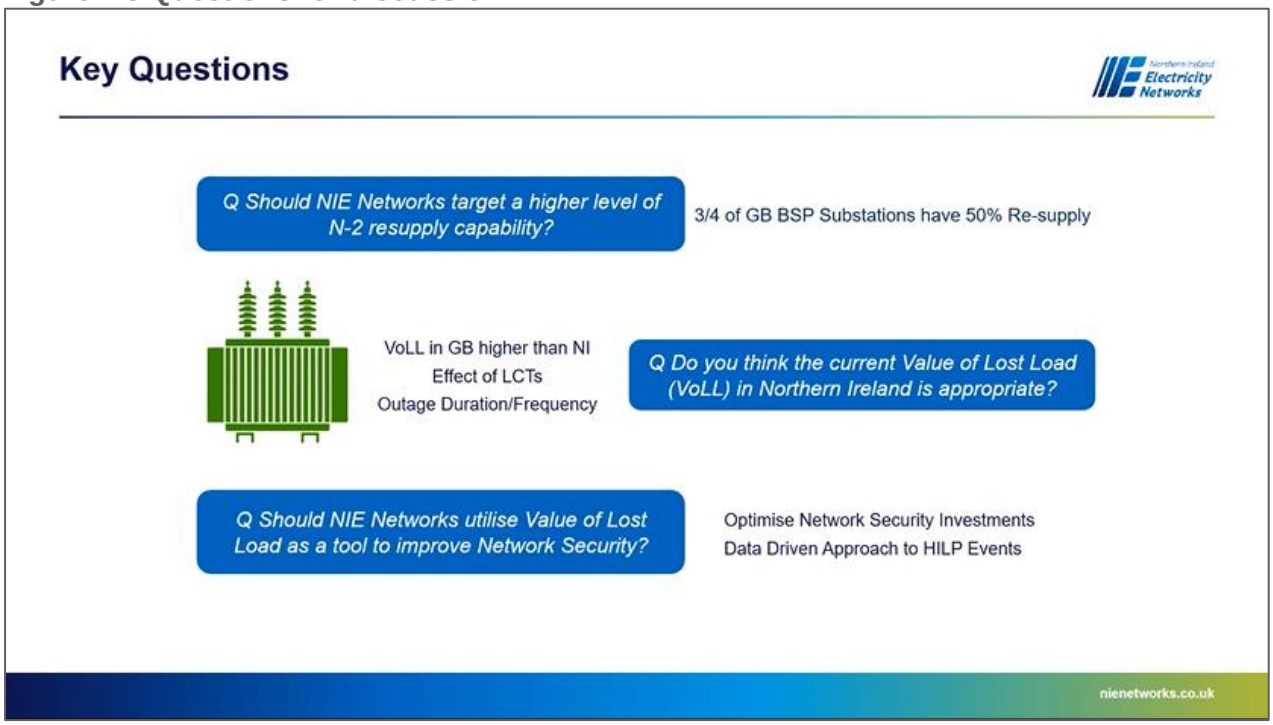
The NIE Networks' representative delved further in order explain the value of lost load (Figure 2.7). Multiplying Energy Not Served (ENS) with Value of Lost Load (VoLL) and Probability of N-2 calculates the mitigation cost, which is an optimum amount of capital that can be spent to ensure disruption from N-2 events are avoided. This could be appropriated to the options listed or other alternatives.

Figure 2.7 Value of Lost Load and possible solutions



The discussion that followed was guided by the questions presented in Figure 2.8:

Figure 2.8 Questions for discussion



Discussion

Most of the stakeholders agreed with the issues raised throughout the presentation. One of the stakeholders indeed recognised that having standby circuits could balance the costs, such as capex, with reliability due to their multiple functionalities. More specifically, these could perform routinely scheduled tasks as well as serve as a backup or standby to each other. He further noted that in terms of redundancy, aggregating different loads with demand side management or connection generation facility, could reinforce the network and its reliability. Thus, it was hypothesised that the optimum cost solution could be based on the VoLL and probability factors, and perhaps the flexible approach could help deliver that additional resilience and reliability.

Another stakeholder remarked that the lower BSP resupply figures for NI could be due to a few sites or BSPs impacting the relatively well-performing majority. Under such circumstances, the focus should be on fixing the underperforming assets to achieve the standards. A representative from NIE Networks confirmed this and added that the few BSPs with lesser resupply capability should be caught by the CBA to be addressed. The representative then posed further questions for discussion:

- **Do you think the current value of lost load in Northern Ireland is appropriate? (where the VoLL is 25% less than GB)**
- **Do you think this will increase with uptake of LCTs such as EVs and heat pumps?**
- **Do you think this is affected by the duration or frequency of outages?**

One of the stakeholders argued that the VoLL is largely driven by welfare or human rights considerations and questioned why it would be lower in NI as compared to GB. Given that the VoLL is an inferred monetary indicator of electricity consumers' willingness to pay to avoid additional periods without power, the NIE Networks' representative highlighted that VoLL in NI is reflected in customers' bills. He also commented on NIE Networks' commitment to commission economics experts to address this issue and to identify NI's position against the GB benchmark.

Another stakeholder indicated that given the differences in peoples' understanding of VoLL, the discrepancies in resupply values between NI and GB could be as a result of differences in methodological and analytical methods, diverse industries, provinces having different VoLL, and finally, the economy itself. The NIE Networks' representative agreed and emphasised the need for methodological compatibility as well as a CBA to reflect the most accurate analysis.

Whenever you have probabilities for really rare events, there's going to be a bigger margin of error because you've got less to go on in your analysis to determine that.

One of the stakeholders highlighted that load prediction is an important value used by TSOs and DNOs. However, with the expected EVs, it would be difficult to predict given that all the factors currently used may become irrelevant. One of the other stakeholders commented that SONI and NIE Networks have different figures for VoLL. In that regard, the representative clarified that NIE Networks' value is derived from loss of supply due to a fault (economic costs of not being supplied), whereas SONI's is based on the loss of supply of a major generating set (market costs). The stakeholder commented that NIE Networks' value is somewhat more relevant since it is a network-related issue.

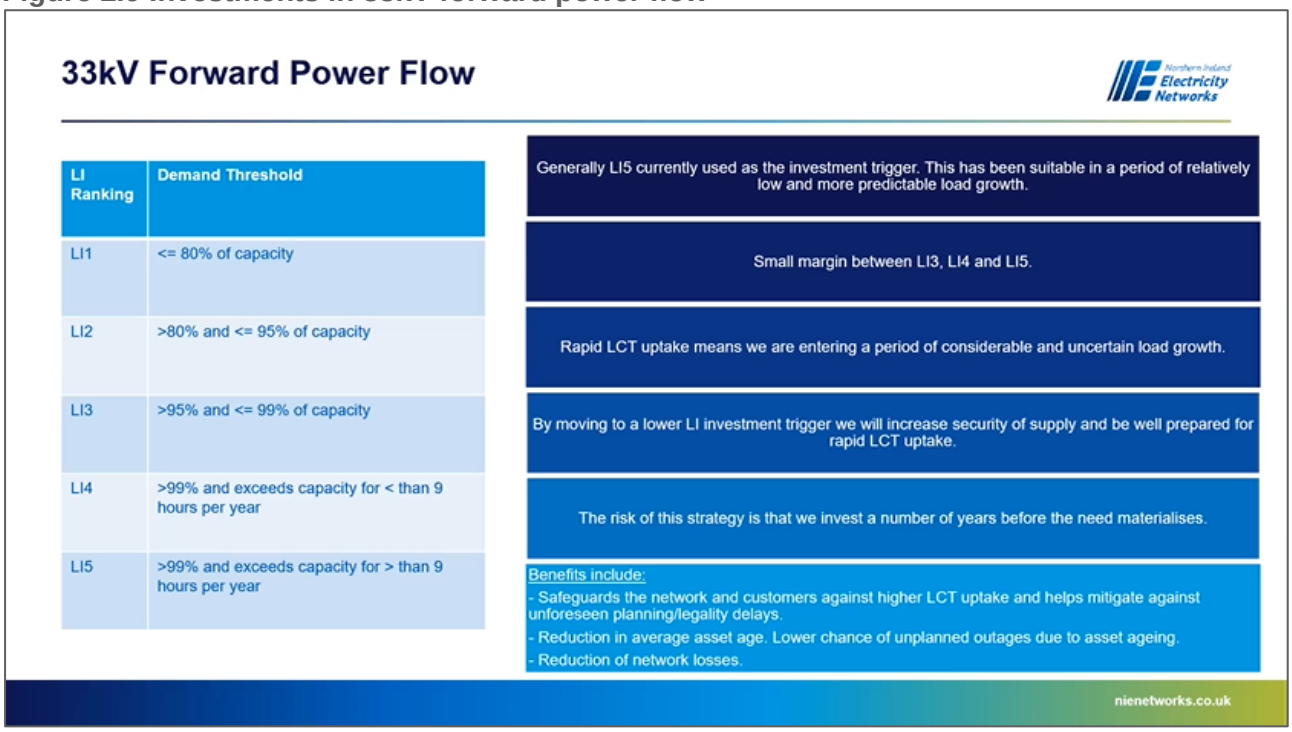
Overall, most stakeholders seemed to agree with NIE Networks using VoLL as a tool to improve network security.

33kV Reinforcement

NIE Networks' presentation

Moving on to another segment of the presentation, a representative from NIE Networks introduced the topic of investments in forward and reverse power flow. Figure 2.9 summarises the investment decisions for the 33kV network for power flow. The load indices metric used (left side of the slide) ranks 200 primary substations, whereby LI1 refers to not heavily loaded and LI5 overloaded asset.

Figure 2.9 Investments in 33kV forward power flow



Discussion

The NIE Networks representative posed the following questions for discussion:

- **Do you agree we should change LI5 reinforcement trigger, to safeguard against rapid demand increases due to LCTs and unforeseen delays to the delivery of the infrastructure?**
- **If we change our LI reinforcement trigger, when should we trigger reinforcement?**
    - **LI3 (>95%)**
    - **LI4 (>99%)**

One of the stakeholders suggested that adopting an early investment strategy would avoid having a stranded asset for two years. One of the biggest restrictions concerning generation or battery storage is around network capacity, therefore infrastructure on both the import and export side is needed.

Another stakeholder added that other factors could trigger an investment and suggested giving consideration to the following:

- Where are developments going to happen?
- Which suburban areas will buy the EVs / heat pumps first?
- Which areas will have oil heating?

Based on these speculations, it was suggested there is a need for an integrated approach across the physical GIS area planning. The representative replied that NIE Networks is procuring a tool which would identify, to street level, when people are likely to procure EVs. This technology, however, is still prone to inaccuracies given that it relies on forecasting.

A stakeholder suggested that the threshold for investment could be tied to the rate of demand growth. However, the NIE Networks' representative pointed out that while this is a fair point, there is an uncertainty with demand growth and, if it grows more than forecasted, it results in a heavily overloaded asset. Therefore, the challenge is in delivering the infrastructure more expeditiously to safeguard against the risks of higher than predicted demand growth, any unforeseen planning and legal delays which could also occur. Another stakeholder responded by stating that a different trigger could be created associated with statutory approvals ahead of time to prevent delays, thereby allowing for build to take place quickly if demand does appear.

Suggest you have a different trigger to get the statutory approvals way ahead of time. You get a budget for that, so that you have the approvals sitting, so you can kind of build it relatively quickly if the demand does appear.

The stakeholder further highlighted the issue of people arriving home and connecting their EVs at peak times and wondered if there any observable changes to this pattern. The representative from NIE Networks remarked that it is unlikely that a change would occur unless customers receive incentives for behavioural adaptations. The guest presenter commented on GB trends and stated that there are detectable spikes in the uptake of EVs on the island. He added that the assumption of an LV network design is diversity, whereby network usage would be 50% at any given time. This was exemplified by a car being charged every other day as opposed to every night, meaning that only 50% of households living in a particular area would be relying on the electricity network for charging EVs.[3] The stakeholder then pointed out that it is the time of day that is the issue, whereby electric heating and heat pump loads during winter reach their peak at teatime, which would ultimately destroy the wires.

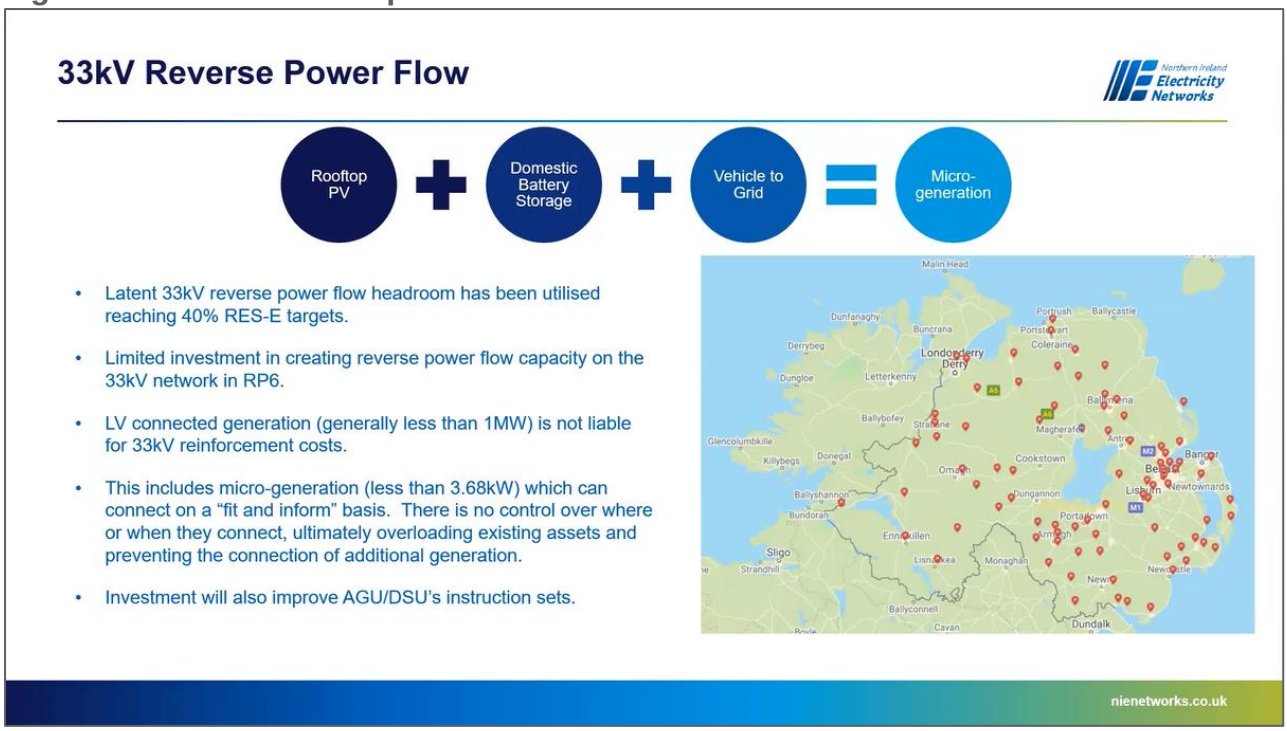
Another stakeholder emphasised the importance of considering old housing estates which were designed to a 2kV After Diversity Maximum Demand (ADMD) and had a limited number of substations and possibly tapered LV feeders. With 7kV EVs being now connected, immediate actions would have to be taken. With regards to the timing of when to trigger an investment, he noted that this is contingent upon radial circuit, and more specifically, on the possibility of the fuse reaching its limits or on the resupply and the 11kV.

[3] UK Power Networks London, Western Power Distribution, Scottish & Southern Electricity Networks were referenced to be operating under these assumptions of diversity.

NIE Networks' presentation

The representative from NIE Networks continued to present on the subject of 33kV reverse power flow, which considers the other side of the equation and is concerned with creating capacity for reverse power flow. Figure 2.10 illustrates NIE Networks' primary substation areas (red dots on the map) with little or no capacity for the connection of additional electricity generation. In terms of the costs, this is not chargeable to the new connecting customers, but rather to all existing consumers.

Figure 2.10 33kV reverse power flow



Discussion

The NIE Networks' representative posed the following questions for discussion:

- **Should we proactively create additional generation headroom in areas with limited reverse power flow capacity?**
- **Should we develop 'Generation Indices' to target where we invest in the network to accommodate generation?**

One stakeholder began by commenting on the decreasing prices of PV panels, which could be more appealing to people with EVs and business premises. In that case, there would be continued increased levels of reverse power flow.

A second stakeholder indicated that since there is no capacity headroom in the 33kV networks for small scale generation, a different approach is required. For example, proactive investments in the reinforcement on the 33kV network for small scale generation is advisable. He also added that one of the challenges appears to be in the lack of mechanism for recovering the costs associated with such investments, meaning that once connected to LV network, there are additional costs for the use of the 33kV connection. Thus, there might be a need for an accompanying change in the charging methodology.

Proactively creating capacity would be a good thing to support low carbon targets.

Tree cutting and vegetation management

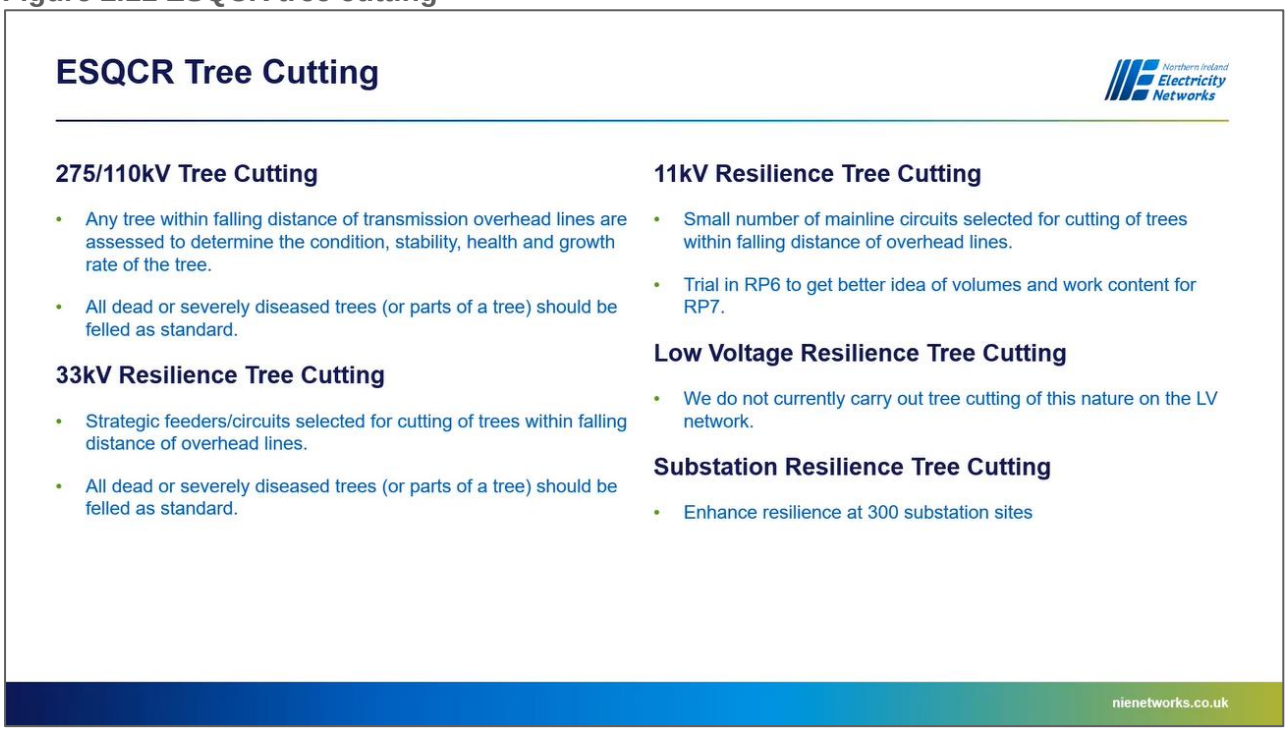
NIE Networks' presentation

The lead asset engineer at NIE Networks' discussed the frequency and extent of tree cutting in RP6 and the proposed approaches for vegetation management during RP7. He remarked that vegetation management is determined by network voltage, meaning that for each voltage there are varying inspection frequencies and routine tree cutting. He explained the process of vegetation management and outlined the factors that are associated with this. He continued by identifying the aim of this process, which includes:

- Minimising tree related faults around the overhead line network;
- Maintaining the integrity of the overhead lines;
- Providing safety from the dangers of electricity to the public and NIE Networks personnel; and
- Improving customer satisfaction by minimising transient tree-related faults.

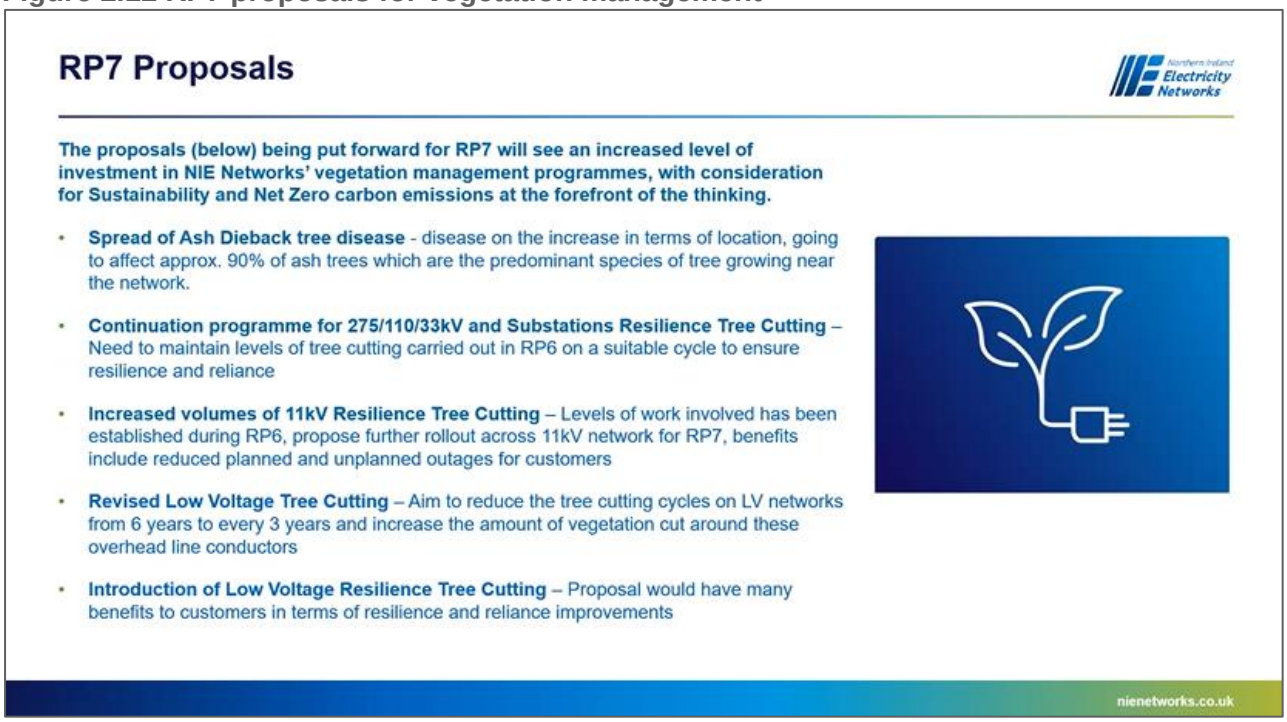
He also discussed the ESQCR legislative requirement, which is a risk-based methodology designed to identify the most suitable locations to carry out resilience tree cutting. The condition assessment carried out for ESQCR, as presented in Figure 2.11, factors in the speed of growth of the trees.

Figure 2.11 ESQCR tree cutting



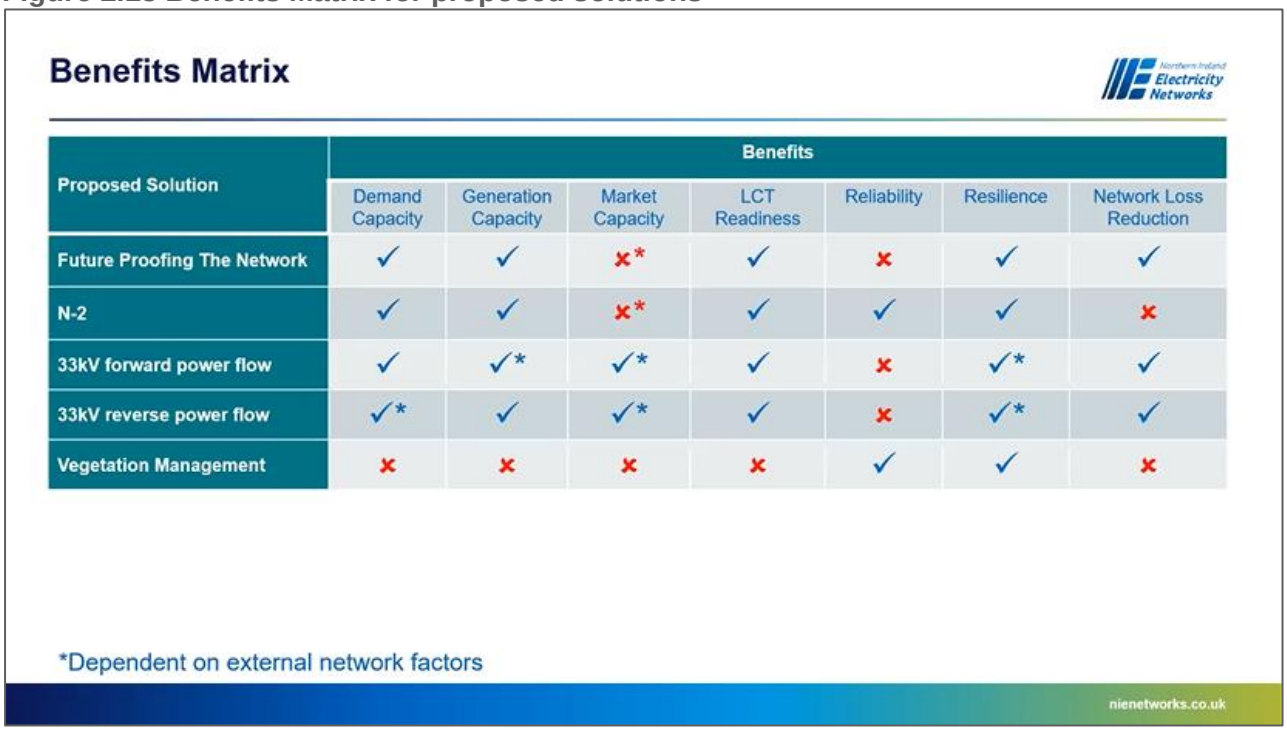
Having outlined the current approaches to vegetation management adopted by NIE Networks, the representative turned to outlining the proposals for RP7, summarised in Figure 2.12.

Figure 2.12 RP7 proposals for vegetation management



In concluding remarks, NIE Networks' representative presented the completed Benefits Matrix for all the proposed solutions throughout the technical workshop (Figure 2.13). In relation to vegetation management specifically, despite not having much impact on demand generation or market capacity, he emphasised that there are considerable benefits associated with the networks' reliability and resilience.

Figure 2.13 Benefits Matrix for proposed solutions



Proposed Solution	Benefits						
	Demand Capacity	Generation Capacity	Market Capacity	LCT Readiness	Reliability	Resilience	Network Loss Reduction
Future Proofing The Network	✓	✓	✗*	✓	✗	✓	✓
N-2	✓	✓	✗*	✓	✓	✓	✗
33kV forward power flow	✓	✓*	✓*	✓	✗	✓*	✓
33kV reverse power flow	✓*	✓	✓*	✓	✗	✓*	✓
Vegetation Management	✗	✗	✗	✗	✓	✓	✗

Discussion

The following questions were posed to the stakeholders for discussion. Do you agree NIE Networks should:

- **Increase 11kV resilience tree cutting?**
- **Commence low voltage resilience tree cutting?**
- **Enhance existing substation resilience tree cutting?**

The key issues highlighted by the panel included:

- Having a wind speed map of Northern Ireland would facilitate focused efforts;
- If external contractors are used for tree cutting, monitoring, ensuring quality work, and pay are important considerations to be factored in;
- Using LiDAR and 3D laser imaging for tree cutting quality control to ensure that work is completed;
- Understanding what percentage of lines are located near roads; where possible, helicopters could be substituted by road vehicles for monitoring purposes; and
- More focus in the LV space for tree cutting.

Technical workshop #3

Who took part?

The focused workshop on future connections was attended by representatives from the following organisations:

- Kelvatek, who made the initial presentation;
- Energy Trading Ireland;
- firmus energy;
- Queen's University Belfast;
- Ulster University;
- SONI;
- NI Environmental Link;

A total of 14 people attended this workshop including eight representatives from NIE Networks.

Technical areas covered

The technical areas covered in this workshop included the following:

- Network performance;
- Availability, reliability and performance;
- Sustainability; and
- Net Zero targets.

Network performance

Overview of the guest presentation

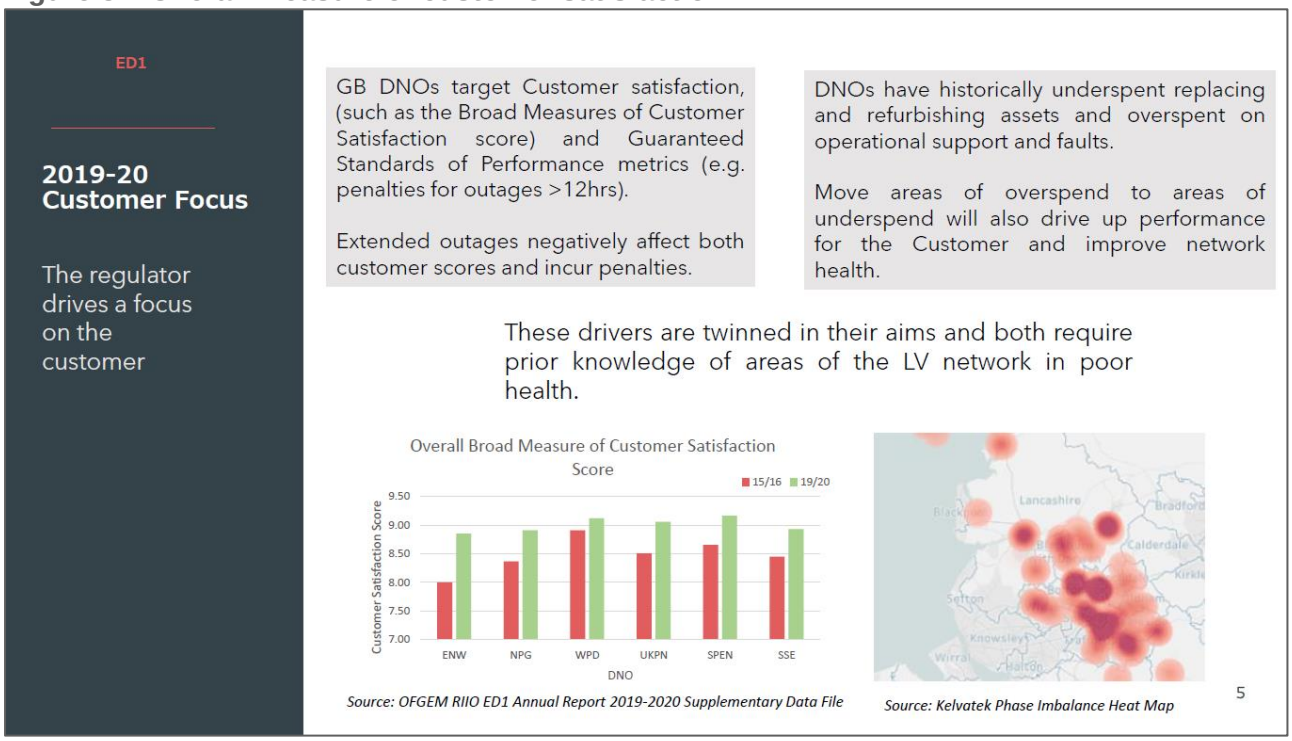
The guest presenters from Kelvatek jointly provided an overview of the work being undertaken currently by the company and discussed a number of issues with regards to network performance.

GB DNO Performance

Kelvatek partners with all British Distribution Network Operators (GB DNOs) and NIE Networks to provide the energy industries with reclosing equipment and services to reduce the impact of LV underground cable faults on customers. Specifically, the ways the DNOs can and are reducing the number of network interruptions to their customers were highlighted. Further, the Ofgem's Interruption Incentives Scheme (ISS) was explained, whereby the incentives and penalties are used to influence GB DNOs to reduce customer interruptions (CI) and customer minutes lost (CML), and which provides the DNOs with a revenue for improving network performance. Given the interest in reducing CIs and CMLs, Kelvatek offers a range of devices that support the DNOs in achieving their reductions targets.

In addition to providing equipment, Kelvatek supervises and analyses the impacts and effectiveness of the policies the DNOs are guided by. This in turn means that the company is able to advise and help the DNOs to improve their performance and customer satisfaction, as presented in Figure 3.1.

Figure 3.1 Overall measure of customer satisfaction



Reclosing devices

The reclosing devices supplied by Kelvatek provide the DNOs with specification information during an interruption allowing it to alter the first fuse operation and therefore provide a precise fault type and location. This practice allows DNOs to undertake a rapid intervention and fault repair leading to reduced risk of numerous interruptions and gives them an advantage as the technology reduces the time of restoring and repairing the interruptions. The devices also play a major role in the sustainability context as they provide real-time and accurate details on the networks' performance.

Drivers for ED2

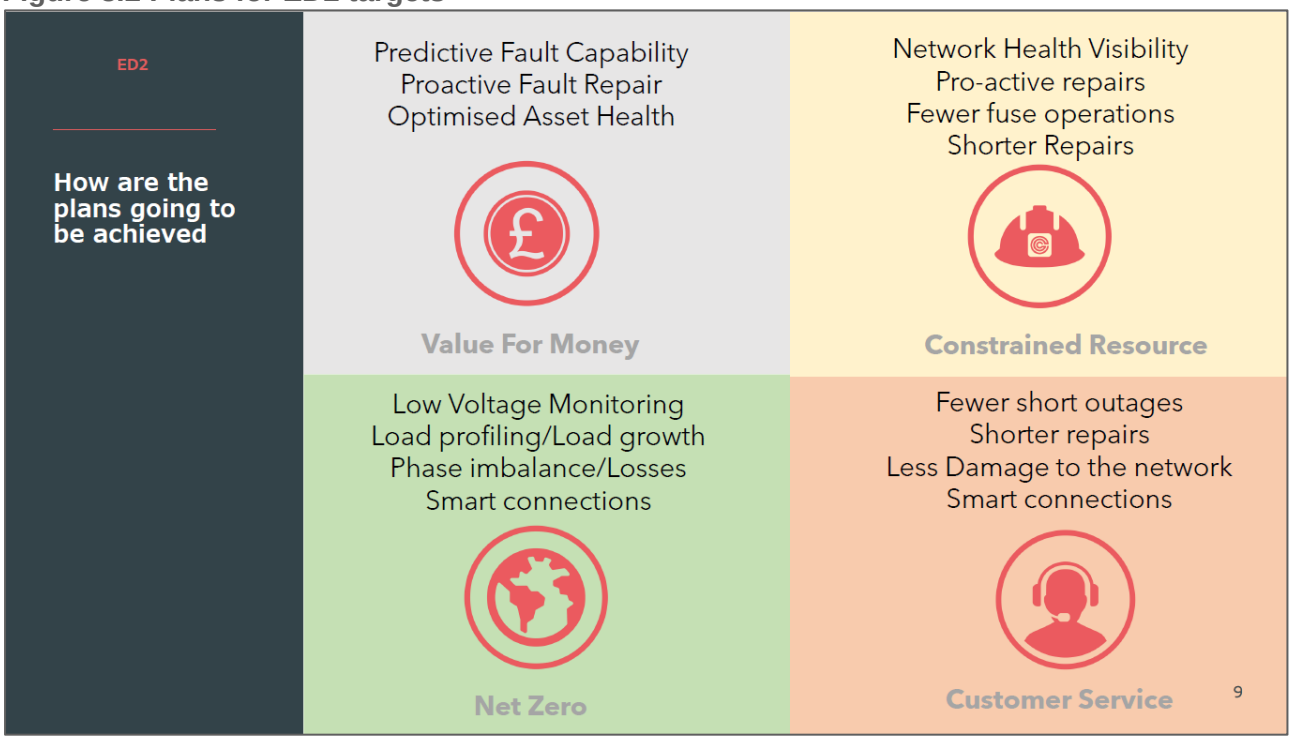
In the next part of the presentation, insights into the CI/CML performance improvements that DNOs are targeting through the next price control period, ED2, were outlined. In that regard, four recurring themes were identified and discussed in further detail.

Figure 3.2 provides a summary of the DNOs plans for meeting individual targets. In relation to the specific components, the following comments were made:

- **Value for money:** An improvement is needed on the LV network in particular through methods such as interpretation of predictive faults, with a proactive fault repair focus, which would allow the DNOs to identify faults and to trigger a prompt repair; optimised asset health ensures that budget for repairs is being assigned to the right areas at the right times.
- **Constrained resource:** DNOs have committed to reduce their operational budgets through better planning, resourcing, and leveraging digitalisation strategies; this can be supported through adapting the quality measurements the devices take on the network, acknowledgement of the issue and deployment of an appropriate intervention.

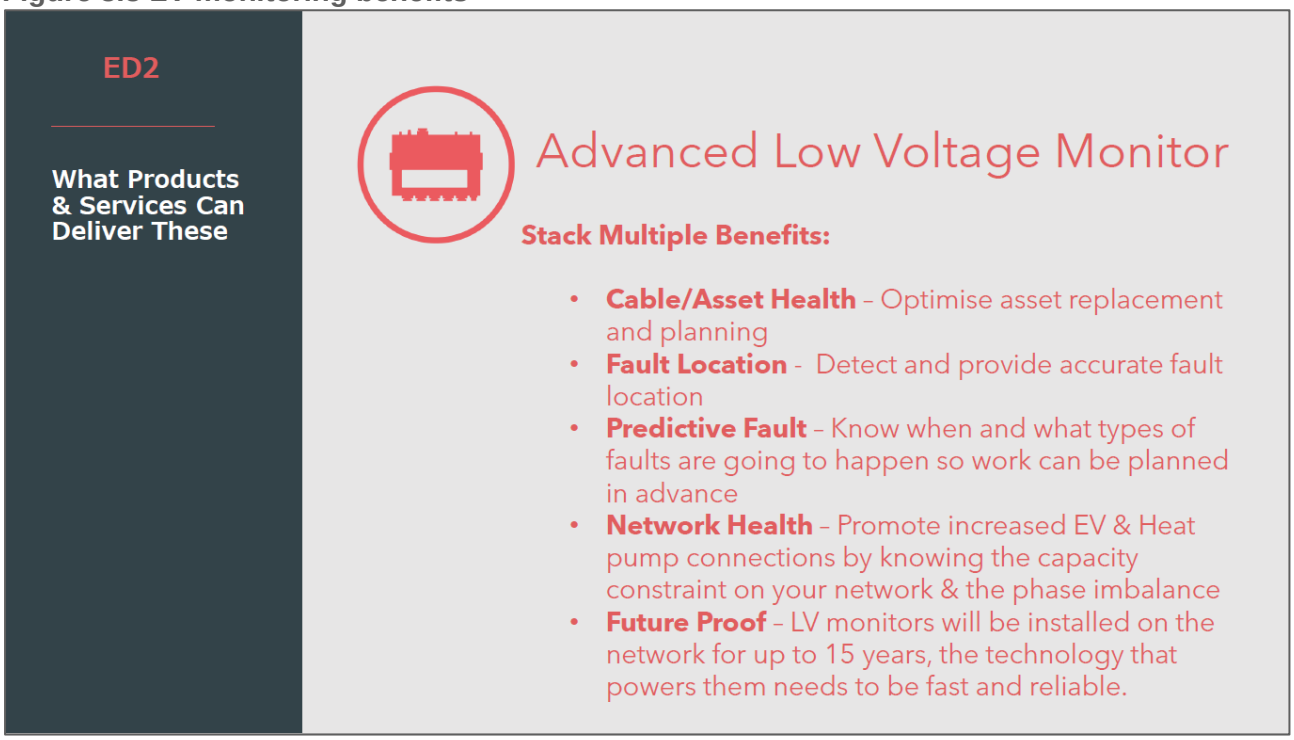
- **Net Zero:** The Low Voltage monitoring is crucial for network visibility; it will give the DNOs the ability to view load profiling and load growth, it will allow for predictions to be made and provide the DNOs with more visibility of where the investment is essential within the network to meet the Net Zero targets.
- **Customer service:** DNOs aim to deliver a reliable and resilient service through approaches such as fewer and shorter power outages and providing customers with more channels to interact with the DNOs, digital or otherwise.

Figure 3.2 Plans for ED2 targets



Supplementary to this, Figure 3.3 provides a description of the benefits associated with advanced LV monitoring, including fault location, asset and network health, and futureproofing.

Figure 3.3 LV monitoring benefits



Discussion

The NIE Networks' representative began the discussion by posing the following questions:

- **What are GB DNOs deploying to facilitate increased monitoring on the LV network where visibility is limited?**
- **Are the devices rolled out in GB restricted to monitoring only? Or do the devices also allow for more sophisticated functionality, such as automation and reclosure?**

One of the guest presenters explained how rapidly over the past year things have changed. Indeed, he indicated that devices offering a wider range of benefits or possibly different devices dealing with specific circumstances are now of interest to their customers. He then referred to WPD, which he noted only consider installing LV monitors when the data derived from smart metering may indicate an issue. This means that smart metering data will be predominately used to manage problems, however a modest rollout of LV monitors is also incorporated in their plan.

Further to this, the presenter highlighted that more sophisticated monitoring could offer additional functionality, such as neutral condition assessment or detection of highly criticised neutral faults. He emphasised that incorporating powerful monitoring systems can facilitate network management and prompt responses to emerging issues, which cannot be achieved by capturing a simple load profile alone.

One of the stakeholders commented on the overlap between some of the functions discussed in the presentation and what could be achieved by implementing a full-scale rollout of smart meters. He questioned the presenter on the extent of device redundancy assuming that the original smart meter rollout target of 80% by 2022 in GB is met. In his response, the guest presenter explained that the smart meter rollout in GB is supplier led, and therefore distinct from the NI counterpart. One specific issue identified with the GB rollout relates to the lack of access to meter point level data due to

privacy laws. The DNOs are required to provide justification of circumstances which would allow the meter point level data to be released.

Furthermore, the presenter drew attention to the fact that smart meters do not have the capacity for capturing waveform on high frequency data, which is required for fault location or fault prediction. This was exemplified by demonstrating how cable health and its degradation could be tracked with the use of specialist devices but not by smart metering. He also stated that the Kelvatek devices capture a broad range of signals and data at a higher frequency, and therefore aid fault location.

The guest presenter added that there could be significant value in combining smart meter data with LV monitor data. However, he also noted that it is unlikely for smart meters to supersede LV monitors' functional capacity.

To this, the stakeholder reiterated that certain events on the network could be resolved with market solutions rather than it being a network condition issue that requires DNOs action. The issue is however that currently GB does not have sufficient smart meter or other market product penetration to be able to achieve this.

The guest presenter responded that this depends on the problem that requires a solution and highlighted that GB DNOs attempt to address emerging issues and manage constraints at the network level. The added difficulty relates to a situation whereby the networks control smart metering rollout and he hypothesised that in NI, NIE Networks would take on this role. He thereafter emphasised that NI could adopt more sophisticated methods in its approach to rollout by allowing networks companies access to smart meter data. Moreover, as the presenter pointed out, the supplier-led GB rollout has been mainly criticised for its business case which centred around energy consumption reductions. This means that the widespread use of time of use tariffs, which facilitate peak management on the networks, cannot and is not being achieved with smart metering. In relation to this, a representative from NIE Networks recognised that in NI, the evolution of the Flex project and generation of market incentives could assist with resolving issues on the network. Currently, the Flex trial is directed at the industrial and commercial customers, whereas the smart meter rollout would become an enabler for development of the domestic Flexibility market, which in turn would support households with electric vehicles.

The discussion around smart meters continued and the presenter from Kelvatek emphasised the importance of having an accurate representation of networks' assets. He elaborated that sophisticated monitors installed at substations allow the DNOs to identify possible issues with the assets that might adversely impact how the network operates and lead to faults. Further, the output from these devices is easier to understand (as opposed to smart meters) and thus, more actionable.

One of the stakeholders began by noting that monitoring implies a reactive investment after the event, meaning that an investment would only be triggered when the data indicating a fault on the network was registered by the monitor. This ultimately, could lead to performance issues, which the households living in these locations would experience. In addition to stating his opinion, another stakeholder enquired about three separate issues and requested a GB perspective on each, namely:

- The role of modelling in the networks, and more specifically, what are the predictions for the uptake of EVs and heat pumps and how this can be used in advance of the need;
- Issues around reclosing; and
- Safety concerns on the networks.

The guest presenter, in relation to the issue of reclosing, indicated that overall aim of the approach applied across GB is getting access to a fault on the network before a recloser is triggered multiple times. It was further explained that indeed the reactive approach is currently adopted, whereby the installed reclosing devices capture data after the first or second fuse operation during a transient fault. From a strategic perspective, LV monitors in GB are not being installed after the fault, they are installed in advance, based on modelling and understanding of the network. Also emphasised was the role of modelling going forward. More specifically, it was noted that historical records of fault activities on the network combined with data from other sources can assist in identification of suitable locations for the installation of the LV monitors to pick up fault in the future. It was pointed out that the models are not static. By installing LV monitors, more data is available and more precise predictions can be made in terms of load growth, EV uptake etc, whereby the values are not inferred, but rather, real data is collected and used.

One of the stakeholders commented on the changes in the fault characteristics over time and remarked on the considerable advances in that space. Specifically, he indicated that unless the characteristic of the fault changes, the likelihood of such faults to be found is minimal due to its transient nature.

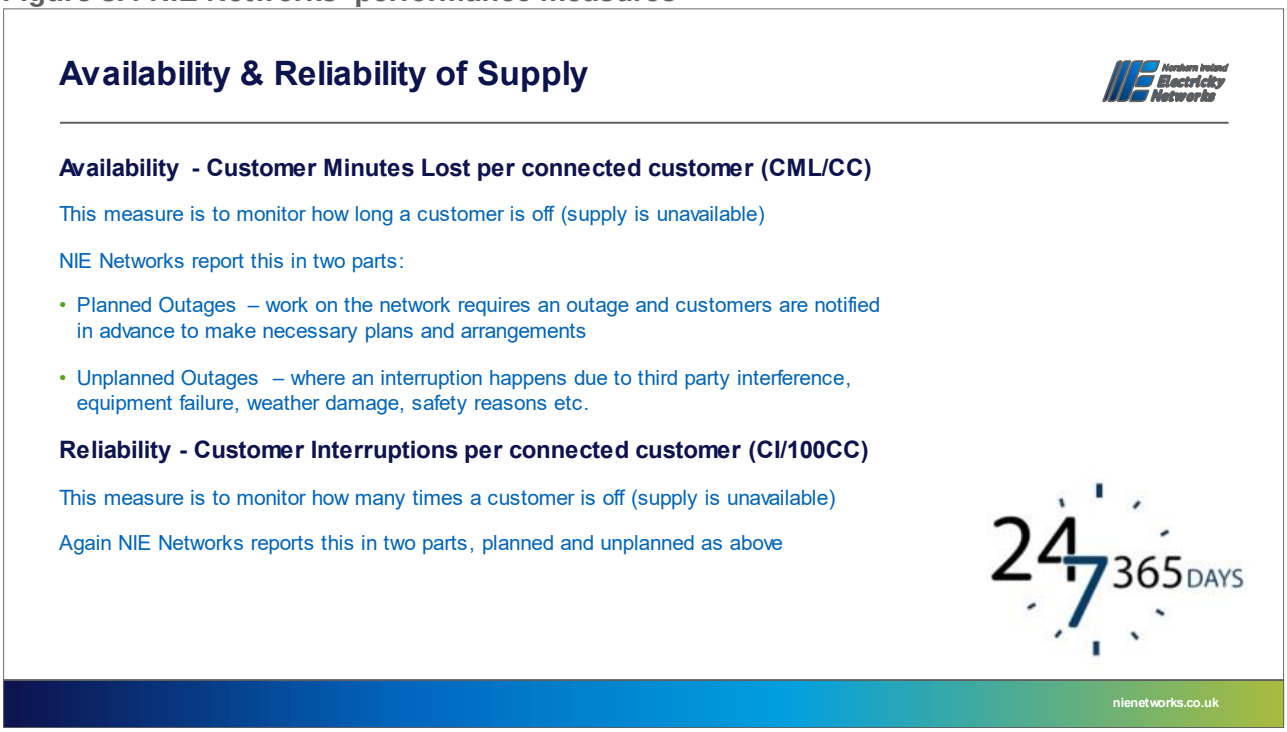
One of the guest presenters highlighted that half of the located faults are permanent and the other half transient. Further, he emphasised that once a fault location is sent, it typically becomes a permanent issue within one year. He therefore suggested that by installing monitoring devices, DNOs avoid additional operational costs, repeat visits to the same location, and continuous fuse replacements, which, in turn, ensures that planned repairs are proactive processes.

Availability, Reliability & Performance

NIE Networks' presentation

Moving onto the next part of the workshop, a representative from NIE Networks began his presentation with the introduction of availability and reliability as network performance measures, whilst highlighting the distinctiveness of planned versus unplanned power outages. Figure 3.4 provides a summary of the approaches.

Figure 3.4 NIE Networks' performance measures



Thereafter, the representative discussed the historical data in relation to Customer Minutes Lost (CML) and how the network's performance, based on this measure, has improved since the introduction of RP6 in 2017. The introduction of different actions aimed at influencing the processes and efficiency of addressing emerging faults has resulted in positive impacts on CMLs. Similar historical trajectory was observed in relation to Customer Interruptions (CI) which reflects the number of faults on the network.

The NIE Networks representative proceeded to discuss the factors that influence network performance, with a specific focus on the planned and unplanned power outages. Whereas the former are the disruptions initiated by the network, the latter interruptions occur outside of the network's control. The processes involved in the two types of outages are briefly described in Figure 3.5, however the following details were showed in relation both.

Planned outages

The expanded network investment programme proposed in RP7 and increased customer connections for housing and/or low carbon technologies will require an increased number of planned network outages. Therefore, going forward, the following actions will be needed to improve the network performance. NIE Networks proposed to reduce the impact of outages through:

- Improving working practices;
- Adapting new technologies such as live line working practices;
- Automated network switching, resulting in reduced numbers of affected customers; and
- Temporary provisions for LV generation as an alternative supply (associated with certain limitations).

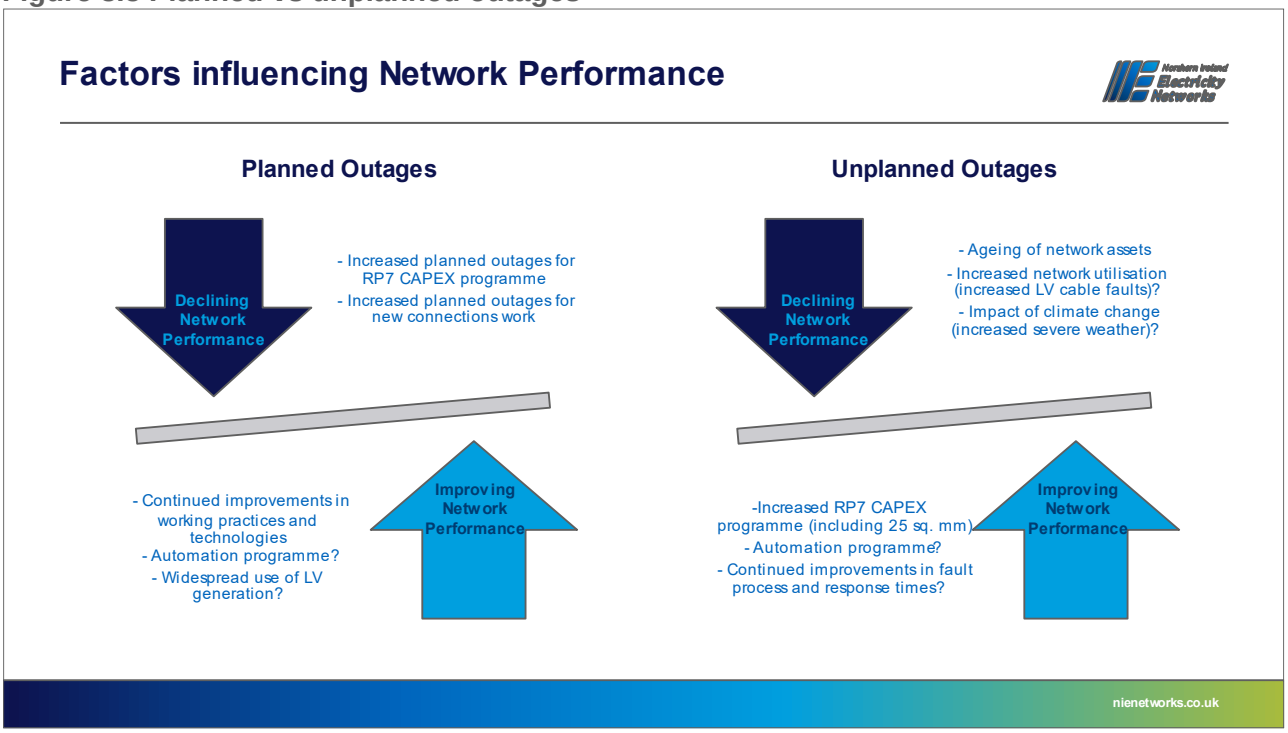
Unplanned outages

In the context of unplanned outages, NIE Networks experiences pressures to ensure that network assets continue to be operational, whilst factoring that the elements of the network deteriorate over

time and reach end of life. Further to this, a direct consequence of degrading equipment is an increased likelihood of faults on the network and supply interruptions. To minimise the unplanned outages going forward, NIE Networks aims to:

- Replace outdated assets to reduce the risk of faults;
- Reconfigure and operate the network remotely through the automated network switching points; and
- Continue to improve response time (this action cannot simply reflect RP6 by doing more of the same).

Figure 3.5 Planned vs unplanned outages



Discussion

In summary, RP7 plans regarding improvements to CML performance, response time, reliability of the network, along with approaches to decreasing the frequency and duration of outages were highlighted. The key questions posed included:

- **What is the level of acceptance of current performance for both duration and frequency of outages?**
- **In future should the focus be placed on duration or frequency of outages (planned vs unplanned)?**
- **What should be prioritised in terms of funding?**
- **What criteria should be used to measure success?**

In addition, the following questions were posed by NIE Networks:

- **Are current levels of network performance appropriate going forward?**
- **Taking into account electrification of heat and transport, what should be the levels of network performance during RP7 and beyond?**

One of the stakeholder expressed the view that once customer expectations are raised, the standards would have to be upheld, and that it is difficult to assess what the public would be comfortable with. Furthermore, the stakeholder highlighted that there may be differences in consumers' expectations based on their location, meaning that rural and urban dwellers may have distinct views and experiences. Thereafter, the stakeholder drew attention to the issue of measurement of reliability and was interested in knowing whether it is through minutes lost or energy lost. He elaborated that given the increased uptake of EVs and heat pumps, households are likely to consume more electrical energy, and suggested that the interruptions may have more significant impacts going forward than they did before. Thus, this area should be considered further.

The stakeholder also commented on the network automation aspect, whereby he highlighted that additional monitoring on the network would provide considerable benefits, particularly with regards to the volumes of incoming data. However, to be able to process the data, the network should ensure that:

- The communication is effective, so no data is lost; and
- Adequate personnel are in place to manage the system.

The guest presenter added that the operational cost savings and performance improvements can be achieved through a proactive repair strategy. Minimising repeat visits, improved precision of and timely responses to interventions would increase network performance and simultaneously reduce CI/CML for the customers.

Another stakeholder addressed the issues experienced by the customers who are behind meter generation at the end of the line. He indicated that such customers, in addition to being limited on their maximum apparent power, or kVA, also experience power quality issues. This effectively affects the revenue streams emerging from the grid connection. Ultimately, when the quality is not adequate for the users of the distribution network, there are financial implications for the network. Further, the stakeholder recognised that the overall network performance is satisfactory, and that rural areas are more prone to interruptions, which is to be expected during major weather events particularly. Thus, he concluded that setting unattainable standards is essentially meaningless when the overall network performance is reasonable.

Another issue, highlighted by the same stakeholder, was in relation to demand side management. Specifically, he made a comment that for some customers financial impacts of being off demand are high and further compounded by the challenge of restarting equipment after an outage. While interruptions are certainly disruptive, the stakeholder recognised that compensation is not likely to be offered. On the other hand, this provides an opportunity for demand side aggregators, whereby options around battery storage, UPS and a range of initiatives can be discussed where operational continuity is essential to businesses.

In response, the representative from NIE Networks highlighted that it is important to consider how customers' expectations in relation to network performance may change in the future. Currently, it

certainly may be satisfactory, however given the predicted uptake of EVs, customer expectations going forward may increase, which should be factored in going forward.

The stakeholder remarked on the issue of 100% supply guarantee and rising consumer expectations, and how NIE Networks would be obliged to deliver on the commitments made to the customers. On the other hand, he agreed on the point of rising demand, and therefore requirements for supply in proportion to the rise in the uptake of EVs. The electrification is deemed to create peaks and surges, hence NIE Networks should further focus on other business opportunities and expectations other than meeting their CML targets.

One of the stakeholders also agreed that currently, network reliability and performance is efficient. He highlighted that once the demand for EVs and heat pumps increases, this may possibly result in more frequent voltage complaints, faults, and issues with supply. In relation to this, the stakeholder commented on NIE Networks' response times to these emerging issues and explained that if they are not responded to proactively, the public's perception of the organisation could decrease fairly quickly.

Two points were emphasised in terms of how NIE Networks should prepare to overcome possible obstacles regarding supply, demand, and performance:

- By having plans in place well in advance; and
- By having reinforcements and knowledge of where these will be needed.

A representative from NIE Networks commented on the feedback from customers and their expectations of network performance and highlighted that the general intolerance, particularly among businesses, is towards transient faults.

Subsequently, one of the stakeholders elaborated that the uncertainties around power supply and possible interruptions are the reasons why big corporations did not embrace the demand side. He highlighted that on occasions where electricity supply fails during production, organisations may face enormous monetary losses. Further, he also noted that some aspects are not within NIE Networks' control and business should also have contingency plans in place to deal with such incidents.

The guest presenter suggested that because of these issues, high-value customers would benefit from having access to monitoring, which would inform them of developing issues. A planned outage could therefore be scheduled to overcome the negative consequences associated with unplanned events, which is a less costly solution to NIE Networks. Indeed, providing higher quality of services is associated with lower overall costs, despite the pervasive misconception that the opposite is true.

The final comments on the subject of network reliability and its performance included:

- Ultimately, NIE Networks does carry the responsibility in terms of security of supply, even though certain elements may be outside of their remit;
- In response to power outages, businesses can consider options such as standby power generation, battery storage and UPS devices;
- Industrial customers have the capacity to implement solutions such as UPS, whereas the wider consumer base would benefit from improved reinforcement of the network and rerouting power systems given the costs associated with alternative power sources (NIE Networks);

- Although reliability and network performance have historically been satisfactory, with the increases in EVs and heat pumps uptake, there is a possibility that this will decrease.

The representative from NIE Networks summarised the discussion by highlighting the need for modelling to identify where the hotspots are likely to occur, and subsequently target the monitoring based on the data. Alongside the modelling, the network will be able to target long term investment or introduce smart solutions such as flexibility or LV network, which given the exponential demand growth would also facilitate a proactive approach to NIE Networks operations.

Sustainability

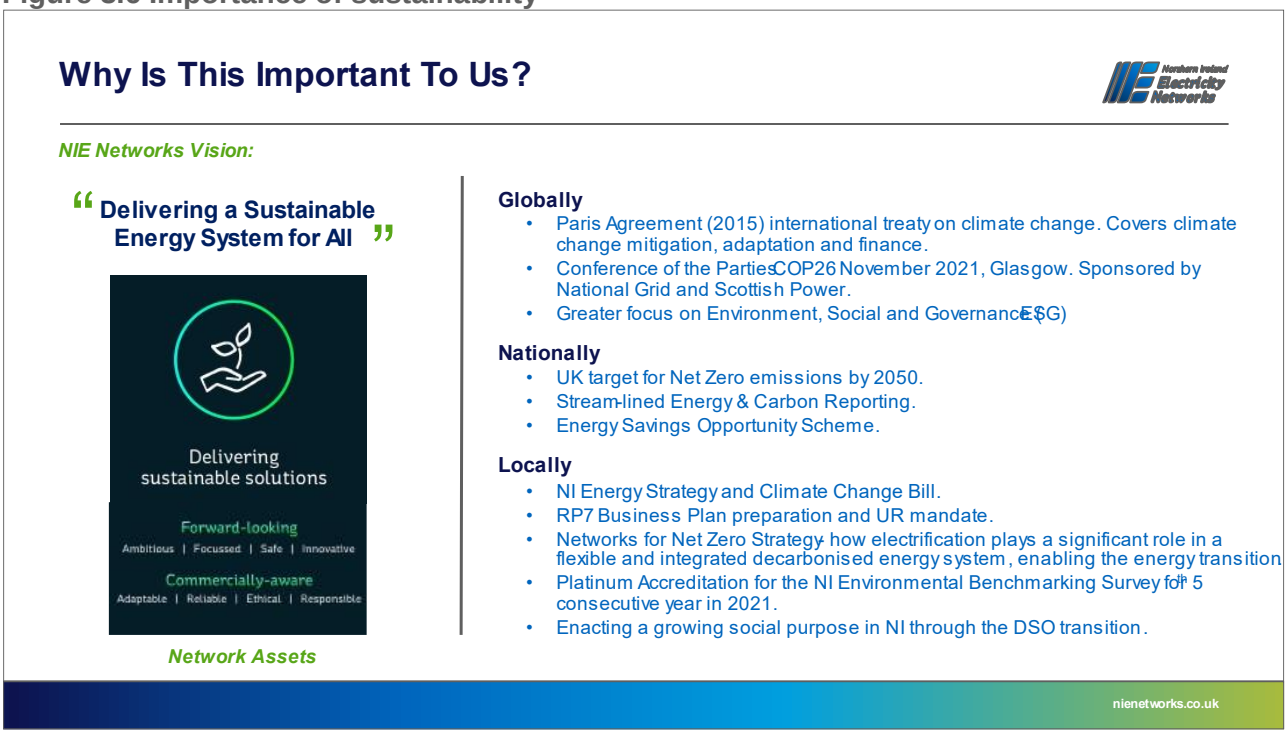
NIE Networks' presentation

The final part of the workshop centred around sustainability. One of the representatives from NIE Networks presented a detailed plan of NIE Networks' internal commitments in tackling climate change, which included:

- To act in an environmentally responsible manner;
- To address climate change and its impacts on society; and
- To minimise pollution.

NIE Networks' ambition is to deliver a sustainable energy system for all. This approach is in alignment with the global, national, and local targets on climate change, decarbonisation, and electrification as outlined in Figure 3.6. The NIE Networks representative highlighted the importance of the global and national integrated approach for decarbonisation of the energy system enabling energy transition. She also emphasised the need for increased operational capability and resilience within NIE Networks in order to meet the increasing customer interests and needs in the area.

Figure 3.6 Importance of sustainability



NIE Networks' sustainable strategy is aligned with the United Nations Sustainable Development Goals (UN SDGs). The most important and appropriate to NIE Networks' goals are presented in Figure 3.7.

Figure 3.7 NIE Networks' list of sustainability goals

The representative from NIE Networks further discussed the specific Science Based Targets (SBTs) and Race to Zero Campaign, to highlight the pathways for carbon footprint reduction. These included:

Science Based Targets

- 50% reduction in carbon emissions by 2030;
- Global average temperatures limited to well below 2°C or 1.5°C; and
- Introduction of a unique science-based carbon reduction trajectory aligned with the latest climate science.

Race to Zero

- Mobilises a coalition of leading net zero initiatives; and
- Achievement of zero-carbon recovery worldwide

Sustainability Action Plan 2021-2024

The NIE Networks' representative presented key points on the implementation of their Sustainability Action Plan through RP6. The plan aims to increase the company's corporate social responsibility, productivity as well as waste reduction. It is aligned with the UN STGs and sets out four key areas:

- Climate Action;
- Supply Chain and Contracts Reform;
- Health and Wellbeing; and
- Diversity and Inclusion.

As the action plan is reviewed annually, the specific targets are also reassessed and adjusted on a yearly basis in accordance with the goals already met.

Discussion

Upon providing an overview of the goals, targets, and future plans, the NIE Networks representative posed the following question:

- **Should we invest more to deliver more ambitious targets?**

The guest presenter from Kelvatek opened the discussion by making a point on the losses on the network. More specifically, he indicated that 90% of SSE's business carbon footprint was accounted for by the losses within the network. Therefore, the internally set targets to mitigate climate change were in relation to improvements in these losses. In relation to the question from the NIE Networks representative, the guest presenter noted that to ensure the sustainability goals are sufficiently ambitious, the network losses element should be included in the plans, and asked if this is being considered by NIE Networks.

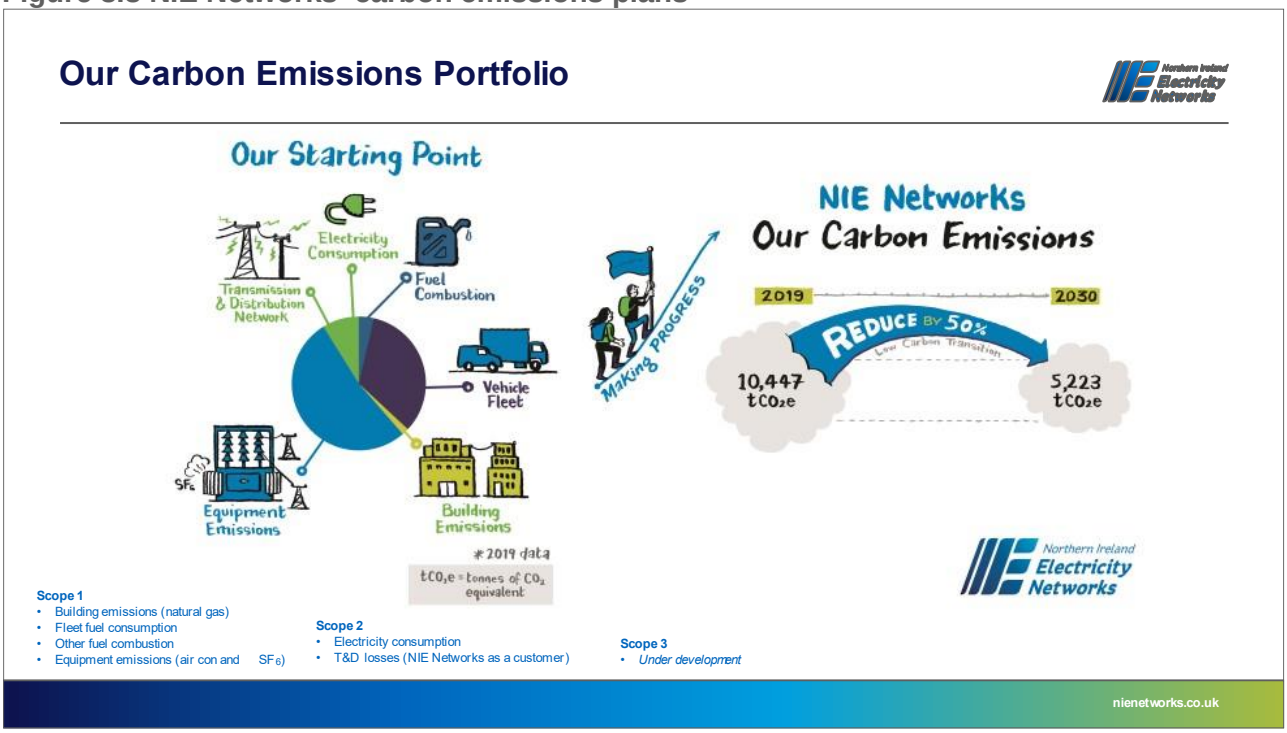
Two representatives from NIE Networks both indicated that the loss reduction is not currently being included in the strategy adopted by NIE Networks. One representative explained that in principle this was a plausible concept, however he was concerned about how this would be measured. He elaborated that with increased electrification and utilisation of network assets, network losses would also increase, which would be counteracted, to an extent, through decarbonisation and by implementing automation. He also added that, with expansion of renewable methods in the future, the network losses will decrease.

NIE Networks' presentation

Carbon emission portfolio

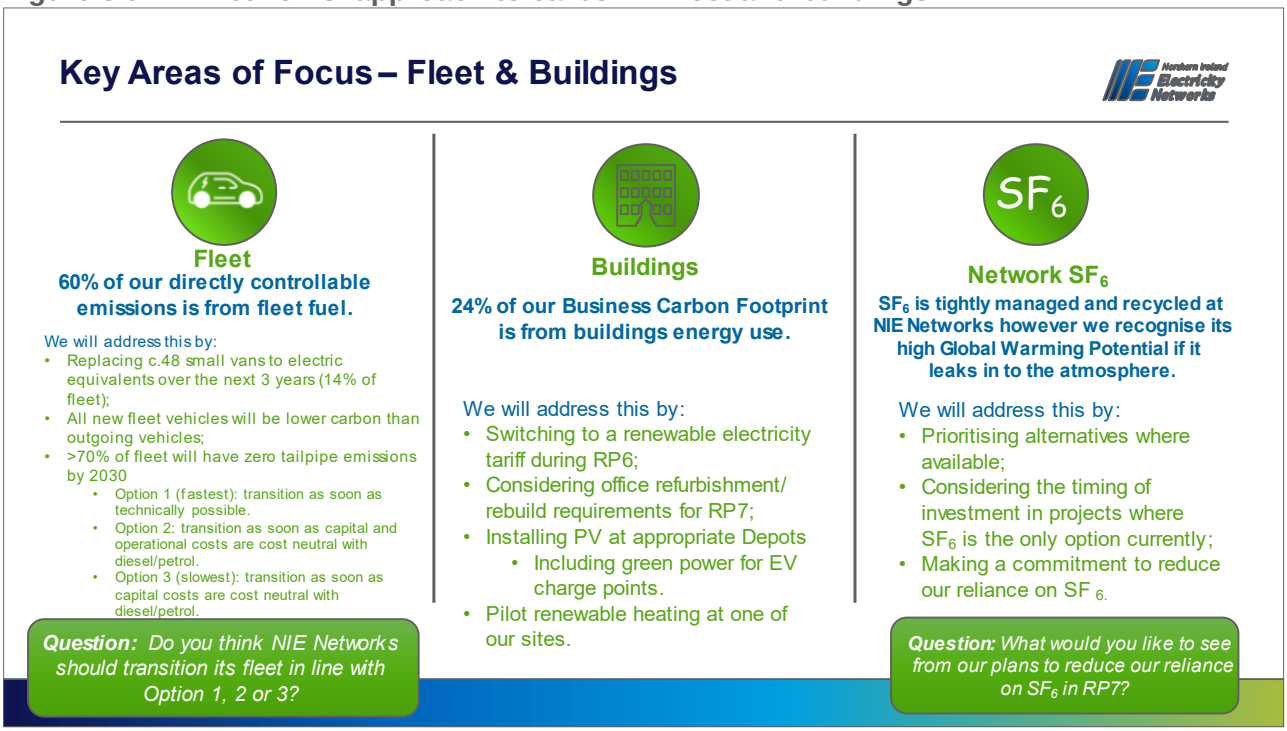
The representative discussed NIE Networks' aims to reduce the carbon emission and the associated targets to be achieved. The portfolio included key areas of carbon emissions reduction as presented in Figure 3.8.

Figure 3.8 NIE Networks' carbon emissions plans



Supplementary to this, Figure 3.9 shows how NIE Networks' targets, as specified in the carbon emissions portfolio, will be carried out. Indeed, the NIE Networks' representative summarised the three key areas of focus and highlighted a series of specific actions to be taken in relation to fleet, buildings, and reliance on sulphur hexafluoride (SF_6).

Figure 3.9 NIE Networks' approach to carbon in fleet and buildings



Discussion

In relation to the three individual components, the panellists were encouraged to provide feedback on what the most appropriate transition should entail.

Fleet

One of the stakeholders highlighted that NIE Networks should consider substitutes for vehicles in case of power cuts. He was concerned that, during power cuts, when NIE Networks would be required to respond to an emergency and restore power supply, they would possibly have uncharged vehicles, and thus would be delayed in taking action during an incident.

Another stakeholder described option one as being the most appropriate in facilitating rapid decarbonisation. He emphasised that decarbonisation is paramount and urged adopting the methods that would allow for an accelerated achievement of the goals. In addition, he indicated that this option would not only impact the emissions reductions, but also, NIE Networks would be leading by example in this space.

The guest presenter suggested that an amalgamation of the first two options would be the most suitable approach to adopt. He also recognised the importance of NIE Networks leading by example, and further indicated that the operational risks and customers' costs must be balanced.

The stakeholder added that price volatility in relation to fossil fuels will always be present within the system, regardless of the wholesale gas prices, which should be taken into account. Thereafter, he

agreed with the presenter's viewpoint on having a greater consideration for the losses on the network.

The guest presenter elaborated that the losses are not just on the transmission network but also on the distribution network, with one of the issues being phase balancing. For instance, in a three-phase supply where one is overloaded, the losses can be measured. He added that this is not so much an issue when energy is generated from renewable sources, however, when mixed fuels are utilised, this impacts the efficiency of the network. A stakeholder supplemented the guest presenter's response by noting that the transmission losses are approximately 2%, whereas those on the distribution network are 8%, thus highlighting that the losses on the latter are greater.

SF_6

Thereafter, the representative from NIE Networks drew the panel's attention to the issues of SF_6. She explained SF_6 is tightly managed and recycled at NIE Networks, however it recognises its high global warming potential if it leaks into the atmosphere. It was noted that, NIE Networks is proactive in their attempts to decrease reliance on SF_6, nonetheless, the representatives of the organisation posed the following questions:

- **What would you like to see in the networks plans to reduce reliance on SF_6 during RP7?**

The guest presenter commented that given this gas has major global warming potential, and is a higher threat than carbon dioxide, all GB DNOs are committed to reducing their reliance on the pollutant. However, they were unsure about the specific targets or commitments by other DNOs.

Subsequent to this, the representative highlighted the following actions NIE Networks is going to take to address this issue:

- Prioritise alternative options where available;
- Consider the timing of investment in projects where SF_6 is the only option;
- Anticipate fast-approaching technology which would facilitate the move away from SF_6;
- Make a commitment to reduce reliance on SF_6.

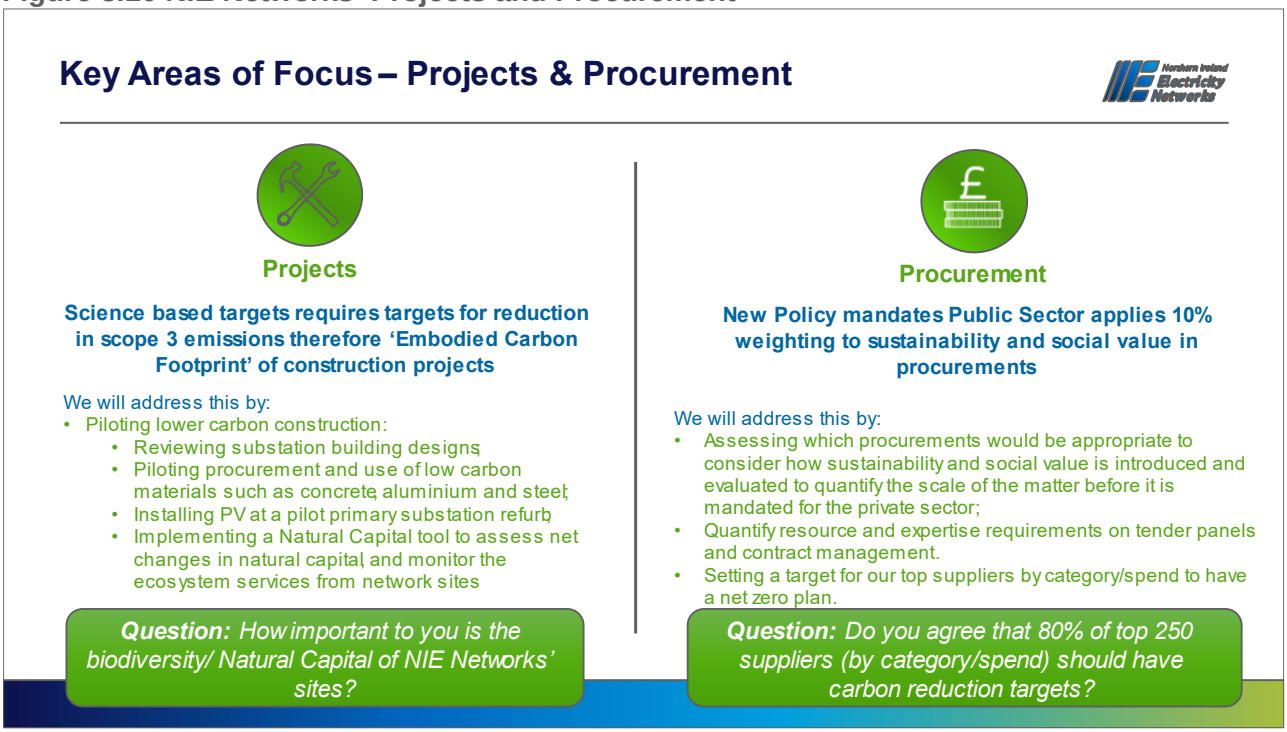
Other key areas

Moving on to another key areas of focus around sustainability, namely projects and procurement, the representative summarised NIE Networks' ambitions as outlined in Figure 3.10. In relation to the projects, she pointed out that Natural Capital investments and biodiversity enhancement are the approaches designed to offset scope 3 emissions through 'Embodied Carbon Footprint'. The NIE Networks' representative was therefore keen to obtain feedback from the panel on how to build a whole systems approach to achieve this, how to develop Natural Capital in the upcoming projects, and how important is biodiversity/ Natural Capital?

Comment: One of the stakeholders acknowledged that, from an environmentalist perspective, the use of ecosystem services and Natural Capital are very important approaches, and their organisation has engaged with various departments to promote. He provided an example whereby NI Water, the largest electricity user in the region, are using natural methods to purify water, and thereafter concluded that the details of project development are crucial.

In terms of procurement (Figure 3.10), the NIE Networks representative highlighted that the public sector is mandated to apply 10% weighting to sustainability and social value in their procedures. Ahead of this mandate being applied to the private sector, NIE Networks, in line with other GB DNOs, propose the 80% of top 250 suppliers (by category/spend) should have carbon reduction targets. The following discussion therefore was in relation to this element.

Figure 3.10 NIE Networks' Projects and Procurement



Comment: One of the stakeholders agreed that all businesses should have a carbon reduction target. He also acknowledged that his company has own internally specified goals in this space. Similarly, the guest presenter commented on the fact that Kelvatek also has carbon reduction objectives, although he debated if the 80% target was sufficiently high going forward.

In response, the NIE Networks' representative clarified that the figure of 80% is a guide provided by Ofgem and agreed it could be more ambitious at a later stage. Given that NIE Networks is at the beginning of this journey, the representative expressed that setting a minimum target in line with other GB DNOs, with the view of increasing this moving forward, is currently the best solution.

Net Zero targets

In the last component of her brief, the representative from NIE Networks drew attention to Net Zero targets. She reiterated that NIE Networks' target is Net Zero by 2050 or sooner, however other DNOs, particularly WPD as well as UK Power Network, anticipate achieving this goal by the end of 2028, and SPN carbon emissions reduction of 80% by 2030.

Discussion

Factoring in the ambitious plans proposed by other GB DNOs, which are all aligned with the Science Based Targets, the NIE Networks' representative asked the following:

- **Should NIE Networks be more ambitious?**
- **To reach Net Zero sooner should we use carbon compensation technologies?**
- **What do you think of the strategy? Are any focus areas missing?**

One of the stakeholders enquired about what NIE Networks viewed as achievable in terms of these goals.

The NIE Networks' representative responded that there is the most certainty around the 'minimum of 50% by 2030' target, whereas beyond this, it is difficult to evaluate the feasibility of the targets given the global uncertainty around available technologies between 2030 and 2050 to facilitate further decarbonisation. She added that the trajectory for reducing carbon emissions is in place, however, to support achievement of the targets sooner, carbon compensation technologies would have to be implemented going forward.

Another stakeholder commented that from the environmental perspective they would appreciate NIE Networks doing as much as possible and as quickly as possible in terms on achieving Net Zero. He highlighted the issues regarding offsetting, how effective it is and what value they generate. He elaborated that there is uncertainty surrounding the contributions of projects deployed to remove carbon out of the air, with some of the existing initiatives seemingly not being fully effective. Due to these concerns, he added that NIE Networks should perhaps consider reducing their reliance on offsetting where possible, however he acknowledged that this requires further, and more detailed discussions.

The guest presenter commented that a sensible approach would be to review the targets by 2030. A multi-step approach to understand the journey to Net Zero whilst embracing what other elements can be adopted and interim reviews would support timely decarbonisation.

A stakeholder emphasised that achieving the targets may become more difficult as time goes on due to the current rises in manufacturing and other costs, therefore, the sooner appropriate actions are taken, the better the chance of achieving the overall goal. He suggested that investing in cables, transformers, and other essential assets before the inflation should be considered a priority. In addition, there may be issues with supplies in the near future due to other network operators also procuring assets to meet their own 2030 or 2050 targets.

One of the stakeholders were interested in NIE Networks' attitudes towards hydrogen and hydrogen-based solutions. Specifically, he wanted to know if NIE Networks would be open to developing reliable systems with an outside company. He added that such partnership would be linked with electricity trading, and therefore, provide a business opportunity for creating revenue.

A representative from NIE Networks indicated that the hydrogen debate continues to be active in NI and further elaborated that this is in reference to the production as well as demand side. He recognised that there are opportunities for hydrogen production and for its implementation on the network to support the decarbonisation agenda, however this is something that would be assessed further going forward. Overall, NIE Networks' view is that hydrogen production would be a role for the industry as opposed to being undertaken by NIE Networks.

From a commercial perspective, the stakeholder thereafter asked if NIE Networks was required to develop the electric/hydrogen solutions or were they considering partnerships with other companies that already implement these alternatives. He added that over and above the Net Zero agenda, there are commercial opportunities that could be explored with NIE Networks.

Another representative from NIE Networks commented on NIE Networks' approach to implementing existing hydrogen/electric technologies which can offer flexibility services to DNO/DSO/TSO. More specifically, he noted that NIE Networks will create market incentives, and is currently trialling this through the Flex programme. Going forward, NIE Networks will release a specifications document open to any third party to compete for, and the contract will be awarded on the competitive basis. The representative recognised that there is a need for NIE Networks to be more collaborative in their innovations projects and in parallel with the hydrogen/electric industry and colleagues in the gas and water sectors, to ensure a successful development of the whole systems solution across the energy sector. Lastly, the representative was interested in knowing if NIE Networks should be requesting greater allowances for commercial collaborations and academic partnerships during RP7.

The stakeholder agreed that collaborations are key and would be keen to explore commercial opportunities with NIE Networks. He thereafter specified that NIE Networks is required to deliver on the core issue. Above and beyond that however there are business opportunities to create revenue from the already existing systems and products, and it is up to NIE Networks to decide how aggressive the organisation can be in exploring new business avenues, collaborations, and ultimately creating profit. Finally, he added that if NIE Networks has the desire to develop these collaborations and partnerships and drive revenue, there certainly are opportunities to be explored.