Northern Ireland Electricity Networks

Greater Access to the Distribution Network in Northern Ireland

Call for Evidence

Northern Ireland Electricity Networks

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Executive Summary

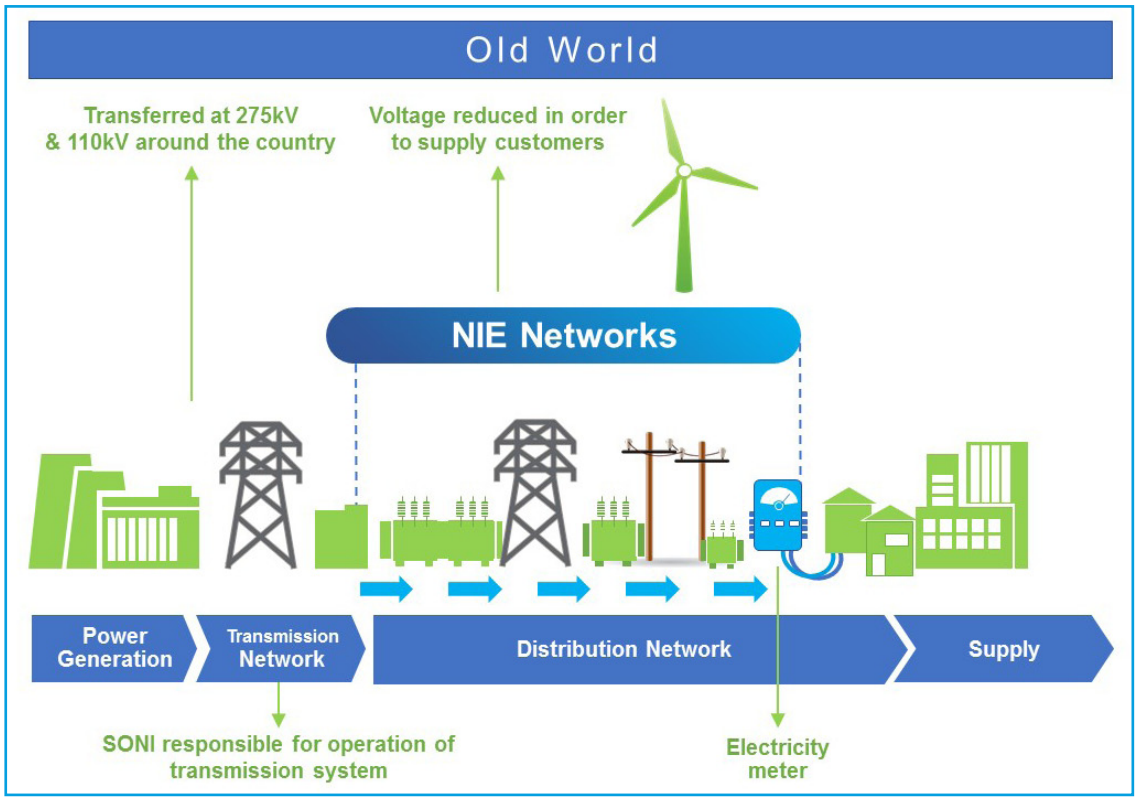
1.1 Scene Setting

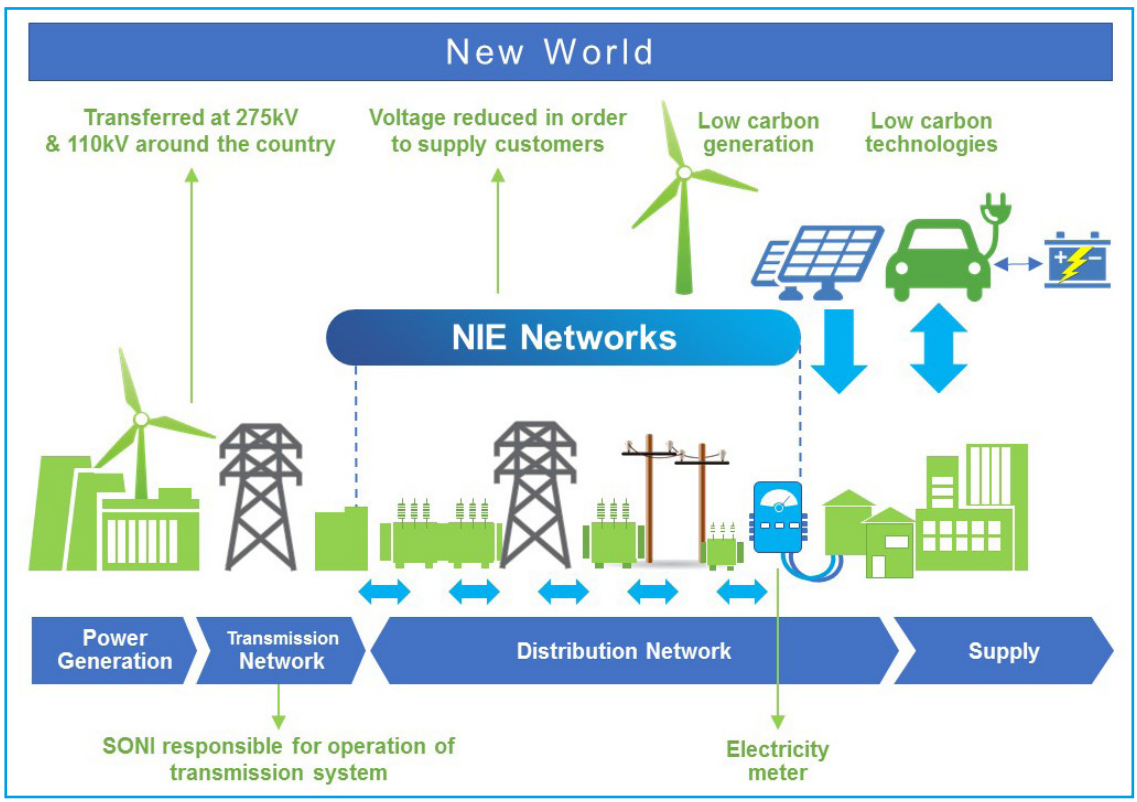
Climate change legislation, such as the EU's Renewable Energy Directive and subsequent Clean Energy Package, and the consequential decarbonisation of the energy sector, is forecast to create significant growth in technologies in turn requiring major changes in how the electricity industry manages and operates the network. Examples of such changes, many of which are already having an impact

- Renewable generation continues to grow;
- Electric vehicle and heat pump uptake is accelerating;
- More and more consumers now have the ability to produce their own electricity;
- New technology is giving consumers more control over how they use electricity;
- Energy storage technology is rapidly improving and its use growing accordingly.

As a result, the demands on the electricity network are changing. The network, which was designed to efficiently facilitate the flow of electrical energy towards the customer, is now experiencing significant energy flows in the opposite direction. Distribution Network Operators (DNOs) have already begun to take a more active role in the design and operation of the distribution network, performing new roles and functions. Technology has enabled this change away from a traditionally passive role of transporting electricity in one direction, i.e. from the transmission network to the end user, to that of playing a much more active role in network control and management.

Executive Summary

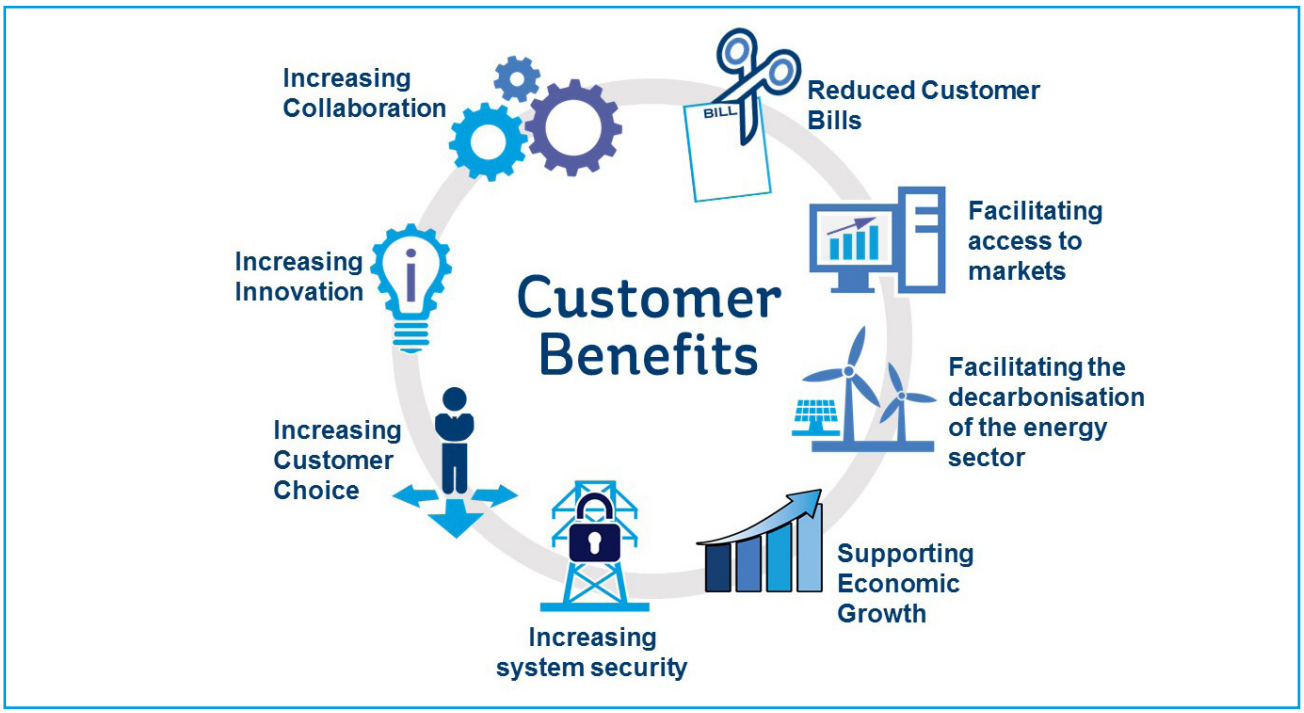




Northern Ireland Electricity Networks

#1

Executive Summary



This is the future direction of travel for operating a distribution network[1], and one that all network operators including NIE Networks must embrace. If managed effectively the shift will deliver significant benefits to all customers as defined in Section 4 placing downward pressure on electricity bills and creating new opportunities, both for the more intelligent management of the network through more active customer participation and for the network to act as a platform for the greater deployment of smart energy technologies as an alternative to conventional higher cost investment.

The first step is to define the required evolution of the network. Whilst the high level principle of the evolution is well understood within the industry, there is a wide range of activity that could fall within its definition, and understanding and mapping out what that role will entail is a vital prerequisite to delivering the evolution that will ultimately have a real and tangible impact for customers and for NIE Networks, as a business.

NIE Networks are not alone on this journey and the Energy Networks Association (ENA)[2] through the Open Networks Project has begun to consider what this evolution will entail, an evolution they call the transition from a DNO to a Distribution System Operator (DSO). The Open Networks Project has developed a working definition of a DSO.

[1]33kV, 11kV, 6.6kV and 0.4kV Networks

[2]Energy Networks Association (ENA) is the voice of the networks, representing the transmission and distribution network operators for gas and electricity in the UK and Ireland.

Executive Summary

"A Distribution System Operator (DSO) securely operates and develops an active distribution system comprising networks, demand, generation and other flexible distributed energy resources (DERs)[3]. As a neutral facilitator of an open and accessible market it will enable competitive access to markets and the optimal use of DERs on distribution networks to deliver security, sustainability and affordability in the support of whole system optimisation. A DSO enables customers to be both producers and consumers; enabling customer access, customer choice and great customer service."

DSO

A DSO enables customers to be both producers and consumers, enabling customer access to networks and markets, customer choice and great customer service.

The ENA has also produced an animation explaining the drivers and benefits that the Open Networks Project will deliver: https://www.youtube.com/watch?v=8GxeWsppmBI

1.2 Why do we Call for Evidence

Whilst NIE Networks are collaborating with the ENA and other UK DNOs to understand what this evolution should entail, it is acknowledged that the electricity system and the market in Northern Ireland (NI) are different from Great Britain (GB). Consequently this Call for Evidence (CfE) seeks to obtain a NI perspective on what fundamental changes are required to be made to the DNO functions and to the future operation of the electricity network to deliver benefits to customers.

1.3 DSO Functions

To open up the network enabling customer benefits, seven key future DSO functions are shown in Table 1. These functions do not represent all the business functions of NIE Networks but rather those functions that will be subject to significant change or require development to enable NIE Networks to evolve to a DSO. These functions broadly align with the functions identified in the Open Networks Project but have been altered where appropriate to reflect NI specifics.

[3]Examples: Distributed Generation, Energy Storage , Demand Side Response

Executive Summary

DSO Function	Description
Market Facilitator	Enabling DERs to participate in TSO markets whilst respecting distribution network integrity and maintaining a neutral market position.
Service Provider	Utilisation of network assets to provide services to help the TSO to balance the system.
Congestion Management	Enabling smart solutions and market based solutions to be deployed as alternatives to conventional reinforcement.
Connections	Providing customers with options in how they connect to the network and utilising innovation to connect customers in a heavily congested network.
Data Provision	Provision of detailed data between the TSO and DSO to enable more efficient system development and operation.
Network Management	Development of new tools and operational procedures to improve operational processes and efficiencies.
Charging	Charging reform to provide opportunities and appropriate incentives to both demand and generator network users.

Table 1

The DSO evolution is not only about developing technical solutions for the functions outlined in section 3 but to provide greater access and choice for customers that want to participate in the developing system services market, in a fair manner for all customer types in order to help reduce energy bills. In fact the way customers use energy is changing with some households, businesses and communities wanting the ability to produce their own clean energy and to access new markets and technologies.

However, this DSO evolution will not result in unfettered access to the distribution network for all customers. To deliver improved access will require greater flexibility in how the DSO manages and operates the distribution network necessitating flexibility from existing and future customers' demand and generation capability.

Introduction

2.1 Scene Setting

Climate change legislation such as the EU's Renewable Energy Directive and the subsequent Clean Energy Package is driving the decarbonisation of the energy sector requiring significant changes in the electricity industry, for example:

Renewable generation continues to grow

In Northern Ireland ambitious Renewable Energy Sources for Electricity (RES-E) targets of 40% by 2020, supported by the Northern Ireland Renewables Obligation (NIRO) mechanism has seen very large volumes of Distributed Generation (DG) connecting to the distribution system. With over 1.5GW of renewable generation connected and a further 249MW committed to connect (Figure 1), the Northern Ireland distribution system with a minimum demand of 0.5GW is heavily saturated with distributed generation. Up to March 2018, 35.2% of total annual electricity consumption in Northern Ireland was generated from renewable sources located in Northern Ireland and it is anticipated that the RES-E target will be achieved ahead of the 2020 deadline.

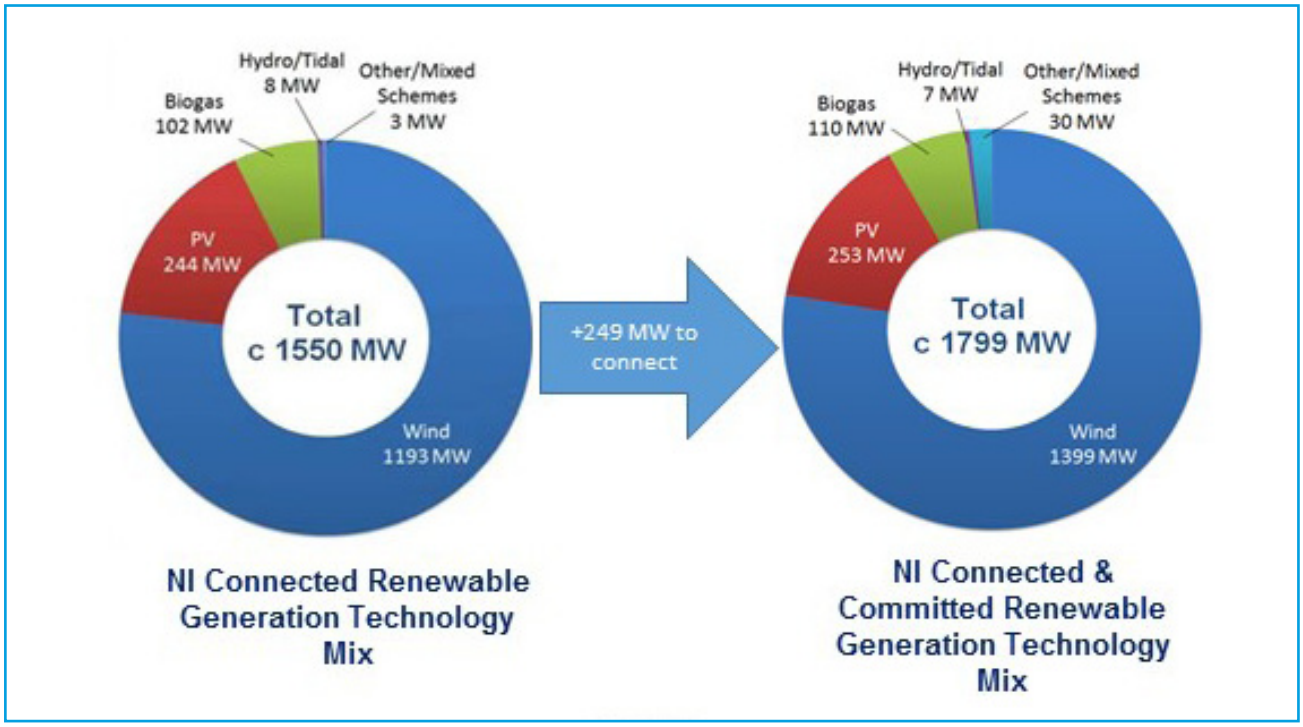


Figure 1

Northern Ireland Electricity Networks

#2

Introduction

Electric vehicle and heat pump uptake is accelerating

It is anticipated that demand levels will significantly increase on the distribution system through the electrification of heat and transport; most notably from the connection of heat pumps and electric vehicles. Whilst the connection of Low Carbon Technologies (LCT) are currently modest, it is expected that over the next decade there will be a large increase in the number connecting, as demonstrated by government announcements, e.g. no new diesel or petrol vehicles to be sold in the UK after 2040. An independent economic forecast commissioned by NIE Networks in 2016 provided an estimate of c110,000 electric vehicles and c53,000 heat pumps connecting to the distribution network by 2030. 2018 data now shows actual EV take-up to be above the original forecast.

It is also expected that demand will increase from other sources connecting to the network such as the connection of data centres.

Other changes include:

- More and more consumers now have the ability to produce their own electricity;
- New technology is giving consumers more control over how they use electricity;
- Energy storage technology is rapidly improving and its use growing accordingly.

As a result, the demands on the electricity network are changing. The flow of electrical energy is now bidirectional. The rapid growth in distributed generation is leading to bottlenecks and capacity constraints, a problem which changing patterns of consumer behaviour exacerbates. The traditional solution would be to upgrade the network by means of conventional reinforcement, i.e. bigger transformers and more cables. But this can be expensive. If assets are used in a more active and intelligent manner the DSO may be able to defer their replacement.

DNOs have already begun to take a more active role on the distribution network, performing new roles and functions. Technology has enabled this change away from a traditionally passive role of transporting electricity in one direction from the transmission network to the end user, to that of playing a much more active role in network control and management.

Northern Ireland Electricity Networks

#2

Introduction

This is the future direction of travel for operating a distribution network, and one that all network operators including NIE Networks must embrace. If managed effectively the shift will deliver benefits to all customer types, placing downward pressure on electricity bills and creating new opportunities, both for the more intelligent management of the network and for the network to act as a platform for the greater deployment of smart energy technologies.

The first step is to define the required evolution. Whilst the high level principle of the evolution is well understood within the industry, there is a wide range of activity that could fall within its definition, and understanding and mapping out what that role will entail is a vital prerequisite to delivering the evolution that will ultimately have a real and tangible benefit to customers and will impact on NIE Networks, as a business.

NIE Networks are not alone on this journey, and the ENA through the Open Networks Project has begun to consider what this evolution will entail, an evolution they call the transition from a DNO to a DSO. The Open Networks Project will:

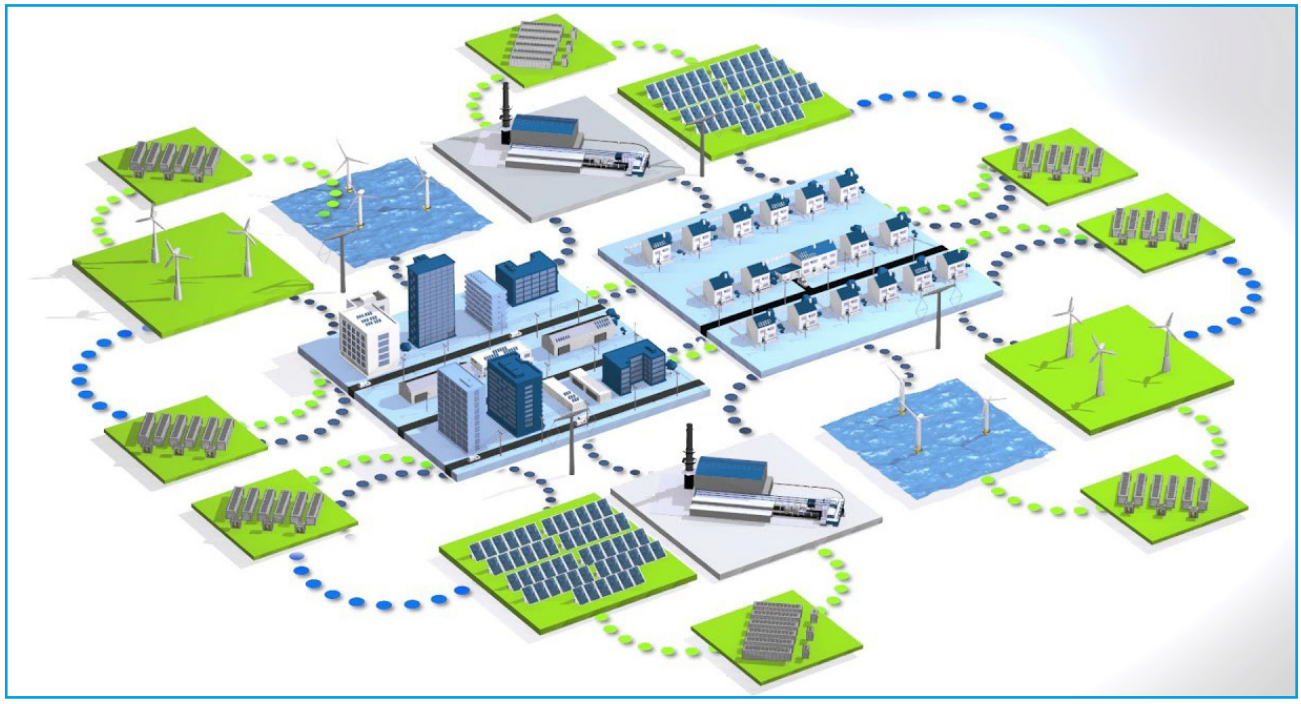
- Consider the possibility of giving houses, businesses and networks the ability to take advantage of new technologies to take control of their energy and lower their costs.
- Help underpin business growth, attract investment and deliver real economic benefits to the UK.
- Take a whole new energy system approach to designing solutions by consulting with a wide range of stakeholders.
- Develop improved transmission-distribution processes around connections, planning, shared TSO/DSO services and operation.
- Assess the gaps between the experience customers currently receive and what they would like, and identify any further changes to close the gaps within the context of a 'level playing field' and common transmission and distribution approach.
- Develop a more detailed view of the required transition from DNO to DSO including the impacts on existing organisational capability.
- Consider the charging requirements of enduring electricity transmission/distribution systems.

Northern Ireland Electricity Networks

#2

Introduction

The Open Networks Project has developed a working definition of a DSO:



"A Distribution System Operator (DSO) securely operates and develops an active distribution system comprising networks, demand, generation and other flexible distributed energy resources (DERs). As a neutral facilitator of an open and accessible market it will enable competitive access to markets and the optimal use of DERs on distribution networks to deliver security, sustainability and affordability in the support of whole system optimisation. A DSO enables customers to be both producers and consumers; enabling customer access, customer choice and great customer service."

The ENA has also produced an animation explaining the drivers and benefits that the Open Networks project will deliver: https://www.youtube.com/watch?v=8GxeWsppmBI

Q1 – In the Northern Ireland context do you agree with the DSO definition? If not please state how you believe the DSO should be defined.

Introduction

2.2 Why do we Call for Evidence?

Whilst NIE Networks are collaborating with the ENA to understand what this evolution should entail, it is acknowledged that the electricity system and the market in Northern Ireland (NI) are different from Great Britain (GB). Consequently, this CfE seeks to obtain a NI perspective on what fundamental changes are required for NIE Networks to introduce as the DNO licence holder and for the wider electricity network to deliver benefits to customers.

The responses to this CfE will be analysed by NIE Networks and UR and will be used in the development of a subsequent consultation document setting out a proposal for the necessary changes to NIE Networks' roles and responsibilities and the wider electricity network.

2.3 Next Steps

NIE Networks will hold a workshop on this CfE and wish to invite all interested parties to attend. This workshop will be held at The Crowne Plaza Hotel, Belfast on September 14th from 10.00am - 2.30pm. Interested parties should register at: Carl.Hashim@nienetworks.co.uk

NIE Networks invite interested parties to respond to this CfE. Whilst NIE Networks welcome all comments they particularly welcome comments on the questions that are embedded within this document. Responses should be sent electronically to Carl.Hashim@nienetworks.co.uk by 28th September 2018.

Please note that NIE Networks intend to publish all responses to this paper online at www.nienetworks.co.uk. Respondents who wish their response to remain confidential should highlight this when submitting the response.

DSO Functions

To open up the network enabling customer benefits, seven key future DSO functions are shown in Table 2. These functions do not represent all the business functions of NIE Networks but rather those functions that will be subject to significant change or require development to enable NIE Networks to evolve to a DSO. These functions broadly align with the functions identified in the ENA Open Networks Project but have been altered where appropriate to reflect NI specifics.

Each DSO function will now be considered in detail

DSO Function	Description
Market Facilitator	Enabling DERs to participate in TSO markets whilst respecting distribution network integrity and maintaining a neutral market position.
Service Provider	Utilisation of network assets to provide services to help the TSO to balance the system.
Congestion Management	Enabling smart solutions and market based solutions to be deployed as alternatives to conventional reinforcement.
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Table 2

Q2 - Are there any additional functions which you feel should be included in the evolution to a DSO? If so please provide a detailed description of the function(s).

DSO Functions

3.1 Market Facilitator

This DSO function is concerned with how the distribution system can facilitate DERs participating in markets which are operated by third parties, usually by the Transmission System Operator (TSO). For the avoidance of doubt these markets are referring to balancing services markets which in the Northern Ireland context are known as System Services.

There are 14 system services that are available in Northern Ireland. These services can be delivered by DERs through the dropping of demand, increasing of generation or providing reactive power in response to system events or on receipt of a dispatch signal.

Figure 2 illustrates the timeframes for the delivery of these services which range from delivering the full response within 2s of a low frequency event, Fast Frequency Response (FFR), to delivering slow ramping services

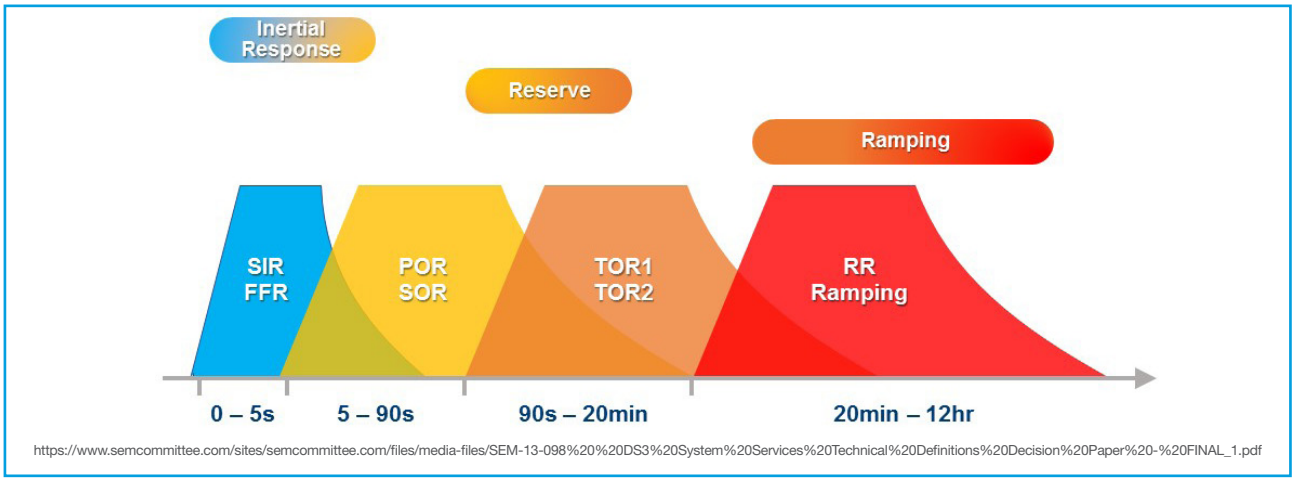

Figure 2

However, as the majority of these services will ultimately be provided by customers connected to the distribution network, the coherent response of these customers can cause violations on the distribution network which if not properly managed will have a detrimental impact on the quality of supply experienced by other connected customers. Violations can be in the form of:

- Thermal Overloads
- Voltage Rise
- Voltage Step
- Protection Issues
- Reactive Power Issues

To avoid the aforementioned violations NIE Networks has developed processes to manage DERs participating in balancing markets, allowing access at times when the network allows and restricting access at times when there is no capacity. These processes are different depending on whether the participant is providing active or reactive power services.

DSO Functions

Active Power

Currently the TSO is responsible for the contracting and dispatching of DERs, usually via an aggregator[4], for participation in balancing markets. To protect against the violations described above, NIE Networks issue "instruction sets" to DERs seeking to participate in active power balancing markets. The instruction set provides customers an operational window in which they can reduce demand, shown below in figure 3. These are developed through a manual, time intensive desktop process. It is the responsibility of the customer to ensure that they do not offer or provide system services outside of their designated instruction set. This keeps the load reduction within a window where the distribution network is capable of supporting all connected generation and allows customers to participate in the market without compromising the performance experienced by other customers connected to the local network. Although the instruction sets limit the timeframe when a customer can participate in balancing markets, they provide access for customers in constrained areas of the network where otherwise that customer's participation would have a detrimental impact on the performance of the network.

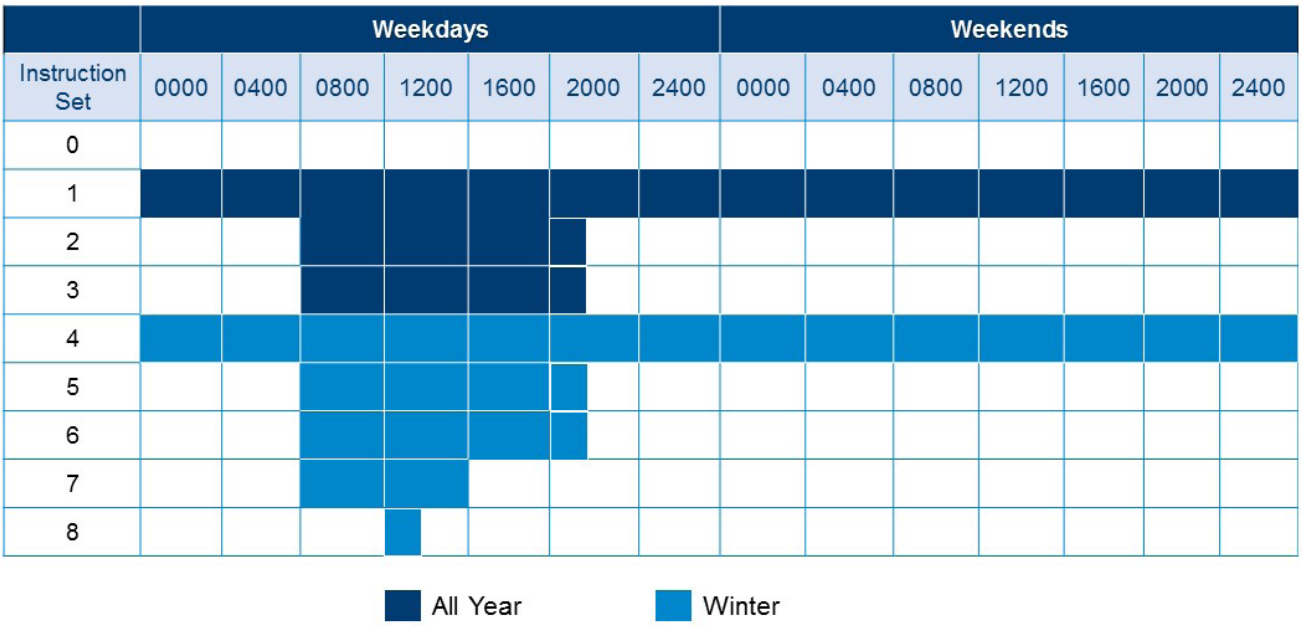

Figure 3

Q3 - NIE Networks currently use static annual instruction sets. Do you think NIE Networks should develop more dynamic instruction sets based on real time power flows, voltages and network topology, potentially providing system service participants with greater access to the network for the provision of system services and protecting the network from sudden changes?

[4]Aggregators are third party intermediaries specialising in coordinating or aggregating DERs response from individual consumers to better meet industry requirements.

DSO Functions

Reactive Power

Reactive power on the distribution network has the potential to significantly influence voltage and voltage stability. Consequently, unlike active power, reactive power is directly controlled by the system operator with the license obligation for controlling voltage. This ensures that voltage remains within acceptable limits, system stability is maintained and remedial action is taken swiftly to resolve any issues. The instruction set process cannot be employed for reactive power system services as it does not provide co-ordinated reactive power management, does not prevent dynamic instability and does not allow fast remedial action to be taken if required.

To address this NIE Networks is developing a Nodal controller solution. The Nodal Controller if successful will coordinate the reactive power from DERs to deliver the required reactive power at a TSO/DSO interface whilst respecting the voltage and thermal capabilities of the network. Figure 4 displays a high level architecture of the Nodal Controller.

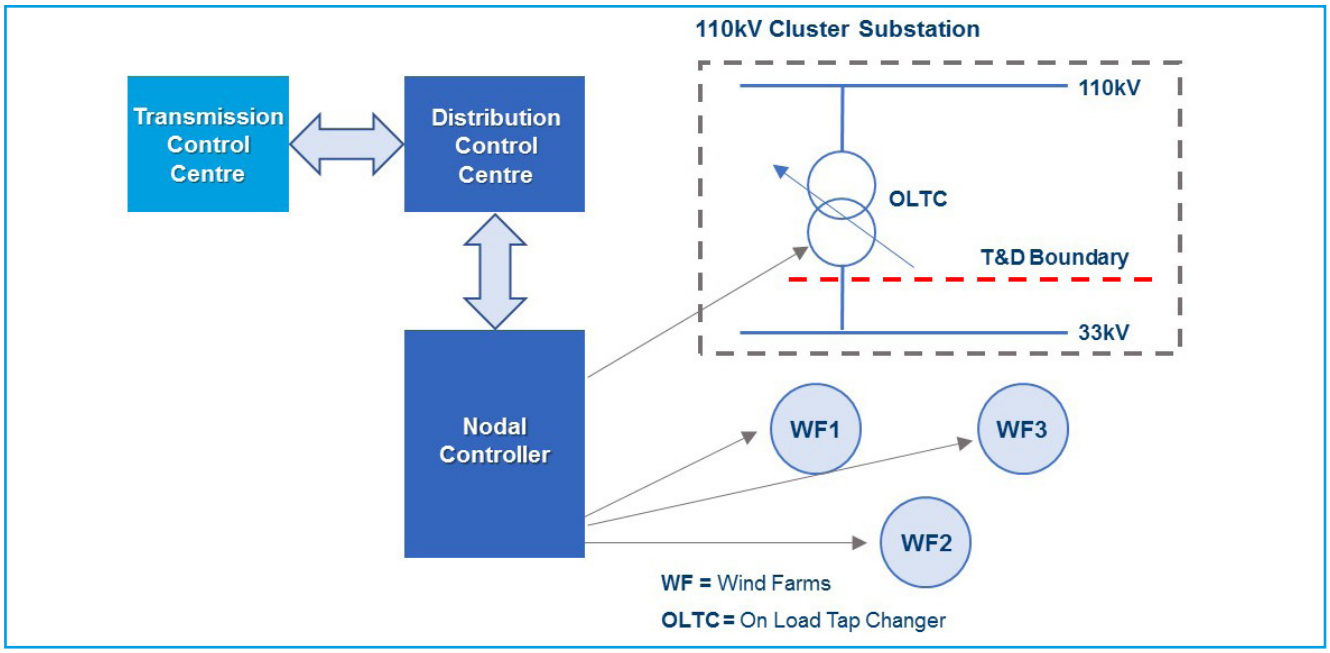

Figure 4

Q4 - Do you agree that NIE Networks should develop a technical solution to enable customers to participate in reactive power system services?

DSO Functions

3.2 Service Provider

NIE Networks has a history of providing services to the TSO, when required during critical events, often referred to as High Impact Low Probability (HILP) events, to support the security of the system. This includes:

- Load Shedding
- 3% Voltage Reduction

However, there is the potential for the electricity network to offer other solutions, through the flexing of its existing assets, to further support the TSO in system balancing. These services, if developed and managed correctly could be utilised by the TSO on a more frequent basis for Low Impact High Probability (LIHP) events to help reduce energy bills. Examples of such services are shown in Table 3.

Service	Frequency Response		Voltage Control
Delivery Method	Operation of circuit breaker[5] to reduce voltage and therefore reduce demand (Fast Frequency Response)	Operation of tap changers to reduce/increase substation voltage and therefore reduce/increase demand (Slower Response)	Stagger transformer tap positions to support reactive power management

Table 3

The Potential for the distribution network to offer services to the TSO has been trialled by Electricity North West (ENWL) through their Customer Load Active System Services (CLASS) project. Using the same technologies as described in Table 3 the CLASS project is being used to support the TSO by providing Voltage and Frequency services. Importantly, the CLASS project has demonstrated that these services can be provided without compromising the customer's quality of supply[6].

Q5 - NIE Networks has existing assets on the network which potentially have the capability of providing additional services to the TSO. Should NIE Networks be allowed to provide cost effective solutions to the TSO in balancing the network to help reduce bills for all customer types?

[5]This operation will be managed to ensure that all customers remain on supply throughout the event.
[6]https://www.enwl.co.uk/innovation/class/

DSO Functions

3.3 Congestion Management

As demand and generation customers connect to the electricity network the capacity of the network for further connections diminishes until no further capacity remains, at which point network reinforcement is triggered, at additional cost, enabling additional demand and/or generation to connect. There are various forms of constraints on the network including:

- Thermal
- Voltage
- Fault Level
- Power Quality

NIE Networks is responsible for planning investment on the distribution system to ensure that future demand and generation growth can be accommodated without compromising the quality and security of supply to existing customers. Since demand is expected to increase significantly due to the electrification of heat (Heat Pumps, etc.) and transport (Electric Vehicles, etc.) it is vital that NIE Networks has the appropriate processes in place for managing this.

There are two investment philosophies that can be adopted, namely: conventional reinforcement and smart incremental reinforcement.

DSO Functions

Conventional Reinforcement

To manage congestion on the electricity network DNOs have traditionally reinforced the network using conventional solutions. These solutions consist of, for example, building new substations or circuits, increasing the size of transformers and increasing the cross sectional area of overhead lines and cables. Whilst these solutions tend to be capital intensive they have long asset lives, provide high levels of security of supply and release significant headroom, as demonstrated in Figure 5 below.

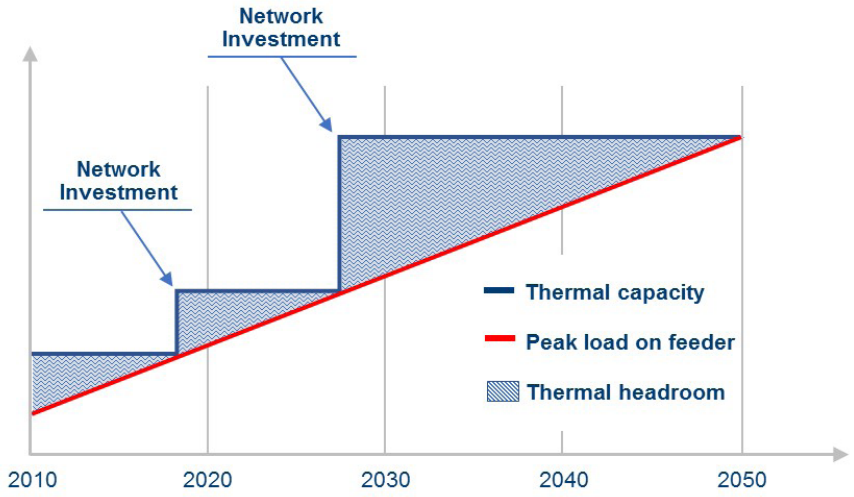

Figure 5

Smart Incremental

Smart solutions refer to new technological and/or commercial solutions that, in most cases, have not yet been fully developed or widely deployed. Even technologies which are well understood, and have been trialled are considered to be smart in this framework, since they have not yet been widely deployed. These solutions can be operating on the network-side, generation-side or customer-side of the distribution system. Examples of smart solutions include dynamic network reconfiguration, dynamic thermal ratings and enhanced automatic voltage control. Smart solutions also consider market based solutions whereby NIE Networks could issue a Request for Tender (RfT) to solve congestion problems in specific locations. This may be in the form of, for example, energy storage, Demand Side Response (DSR), Vehicle to Grid (V2G) technology and may enable the development of Peer to Peer (P2P) energy trading. The main benefit of smart solutions is that they can be used to defer capital expenditure on the network and therefore deliver financial benefits to the general customer base.

A smart incremental investment strategy will not solely deploy smart solutions. Instead conventional solutions will still be widely used but where appropriate and where financial benefit can be derived smart solutions will be deployed.

DSO Functions

Figure 6 displays a forecast of the difference in discounted Total Expenditure (TOTEX) between a smart incremental investment strategy and a conventional, or Business as Usual (BaU) strategy for future regulatory periods. From Figure 6 it can be seen that there are significant financial benefits which can be passed on to customers over subsequent regulatory periods by selecting the smart incremental strategy compared to the conventional strategy.

Although the savings are notable, smart solutions do not provide the same level of security of supply that conventional reinforcement provides. For example a solution which requires customers to offer DSR does not offer the same level of security as installing larger transformers.

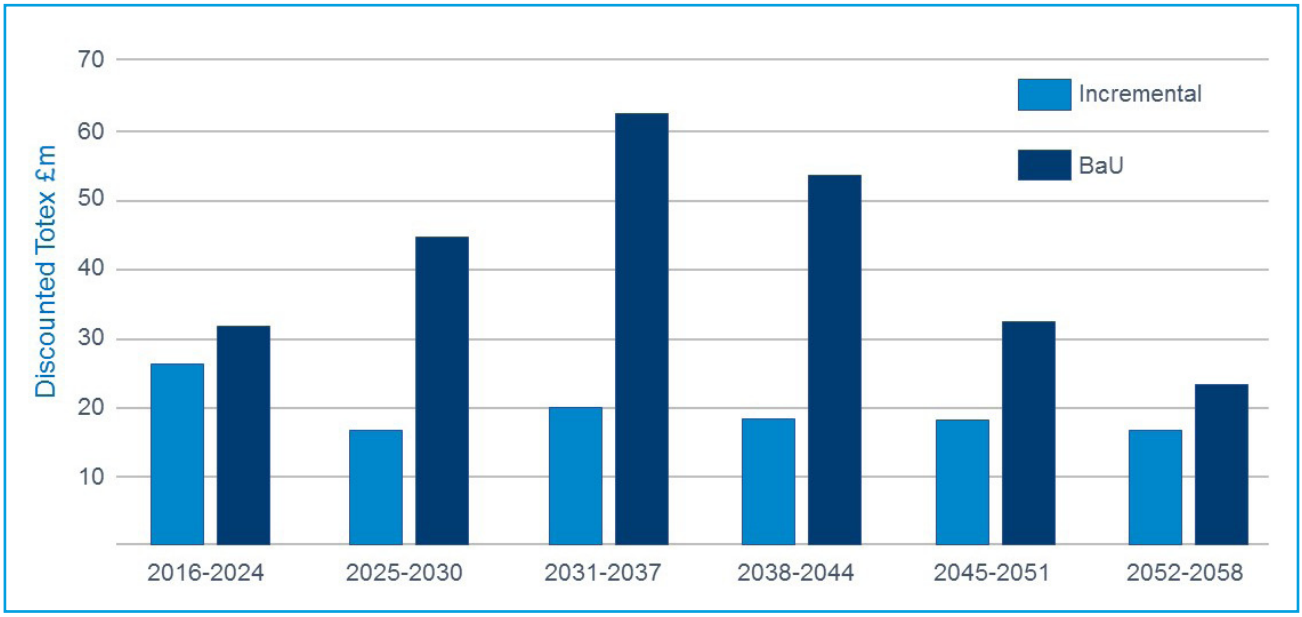

Figure 6

Q6 - Should NIE Networks continue to invest conventionally to maintain a high level of network resilience and security but at a higher cost or should they adopt and integrate smart solutions to reduce network costs and deliver the network security through a more dynamic approach to operating the network?

DSO Functions

3.4 Connections

With c1.8GW of generation committed to connect to the NIE Networks' transmission and distribution system, there is limited unused capacity for future generation to connect in the absence of investment. As we are already close to Government targets for energy consumption from renewable sources, it is now becoming more difficult to justify further proactive network investment for renewable generation. Consequently, NIE Networks and SONI invited stakeholders to explore how further generation could be connected in the future for example by adopting more innovative approaches rather than traditional network investment. This invitation was carried out by the issuing of a joint CfE[7] on 12 October 2017.

The stakeholders' response to this CfE provided NIE Networks and SONI with a very helpful insight on stakeholder views across a broad range of related matters including the technical, commercial, process and information sharing arrangements that they believe would be central to moving forward with further connection of generation in Northern Ireland. This insight allowed NIE Networks and SONI to issue a joint consultation[8] on 31 January 2018 with options on a way forward. Such options were:

- Potential Prioritisation of DS3 System Services
- Hybrid Working Group
- The formation of a Connection Innovation Working Group to look at both the commercial and technical matter relating to:
  - Zero Firm Access Quantity (FAQ) offers with no Associated Transmission Reinforcement (ATR)
  - Active Network Management Connections

[7]http://www.nienetworks.co.uk/documents/final-cfe-soni_nie-networks.aspx
[8]http://www.nienetworks.co.uk/getattachment/Connections/Generation-connections/Generation-Consultation/NI-Gen-Connections-Consultation.pdf.aspx

DSO Functions

The Next Steps paper was published on 29th June 2018 and outlines its terms of reference for the Connection Innovation Working Group which will be made up of NIE Networks, SONI, Stakeholders, UR and Department for the Economy (DfE).

If stakeholders reading this CfE have any queries regarding the above information, they should email these to ConnectionDesign@NIENetworks.co.uk.

As Microgeneration is connected mainly on a 'fit and inform' basis, it has not been included in the consultation on "Connecting Further Generation in NI". For this reason a number of questions have been outlined below:

Microgeneration

Under Engineering Recommendation G83/1 a single generator with an energy source of 16A/phase or less can connect to the low voltage network if the DNO is advised of the intention to use the source in parallel with the network before, or at the time of commissioning. In this case the customer is not required to apply and receive a connection offer prior to connection to the network. In the case of projects where the proposal is to install multiple generators with energy sources of 16A/phase or less in a number of customer installations in a 'close geographic region', the installer is required to discuss the project with NIE Networks at the earliest opportunity. NIE Networks will then assess the impact that these connections may have on the network and specify conditions for connection. The process currently used by NIE Networks is displayed in Figure 7.

DSO Functions

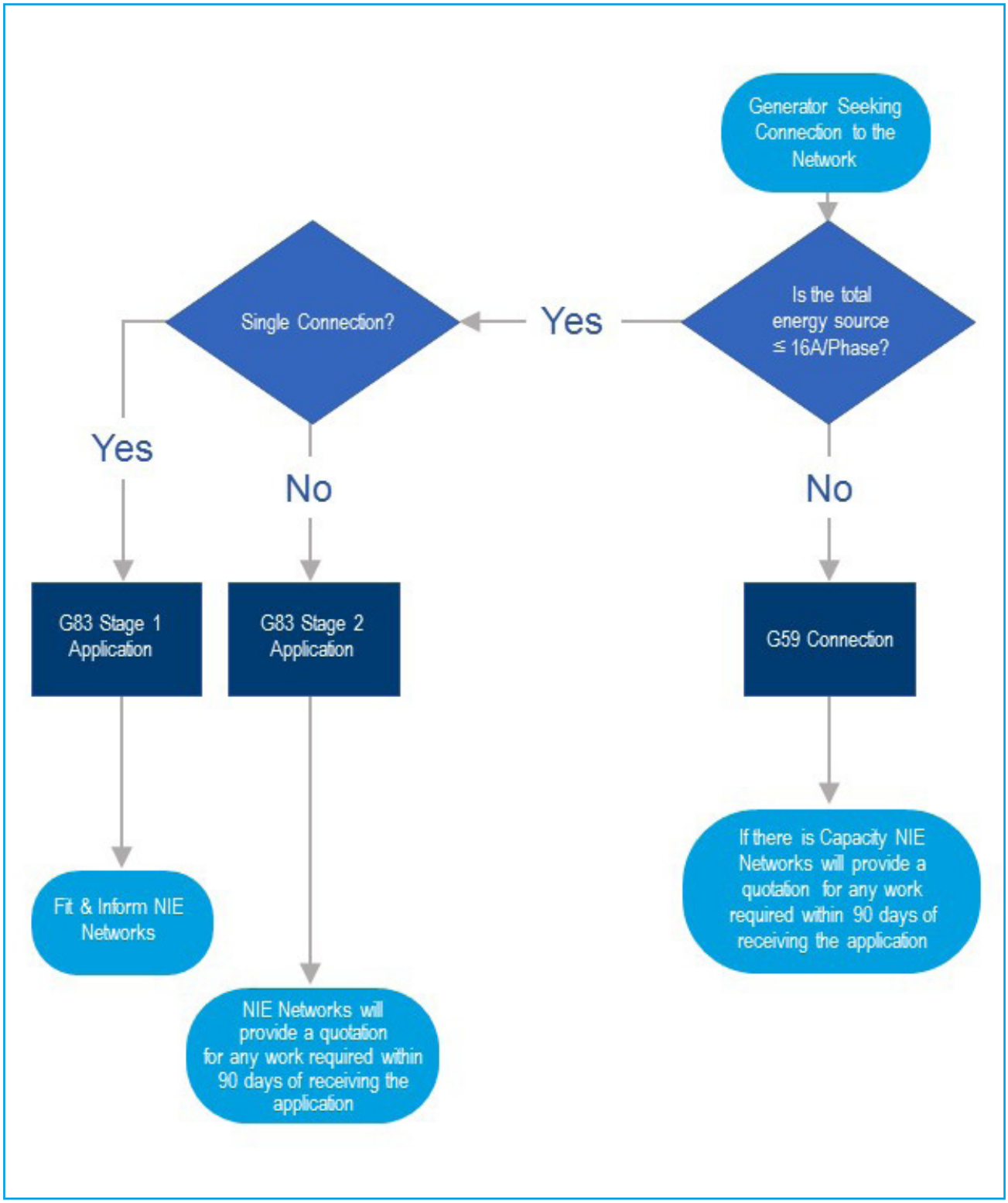

Figure 7

DSO Functions

Figure 8a illustrates a typical Engineering Recommendation G83/1/NI connection, whereby customers can fit the generator and inform NIE Networks of the intention to use the source in parallel with the network before, or at the time of commissioning.

Figure 8b, illustrates an installation where the source of energy behind a single inverter is >16A/phase. Even though the inverter is rated at 16A/phase this installation is currently regarded as an Engineering Recommendation G59/1/NI connection, necessitating that the customer must apply for a connection offer from NIE Networks and will be subject to any associated network costs and generation queues. This is based on the ESQCR (Electricity Safety, Quality and Continuity Regulation) Part 6, 23.

Figure 8c, illustrates an installation where two inverters are connected at a customer's premise. Whilst each inverter is rated at 16A/phase this installation is currently regarded as an Engineering Recommendation G59/1/NI connection, meaning that the customer must apply for a connection offer from NIE Networks and will be subject to any associated network costs and generation queues.

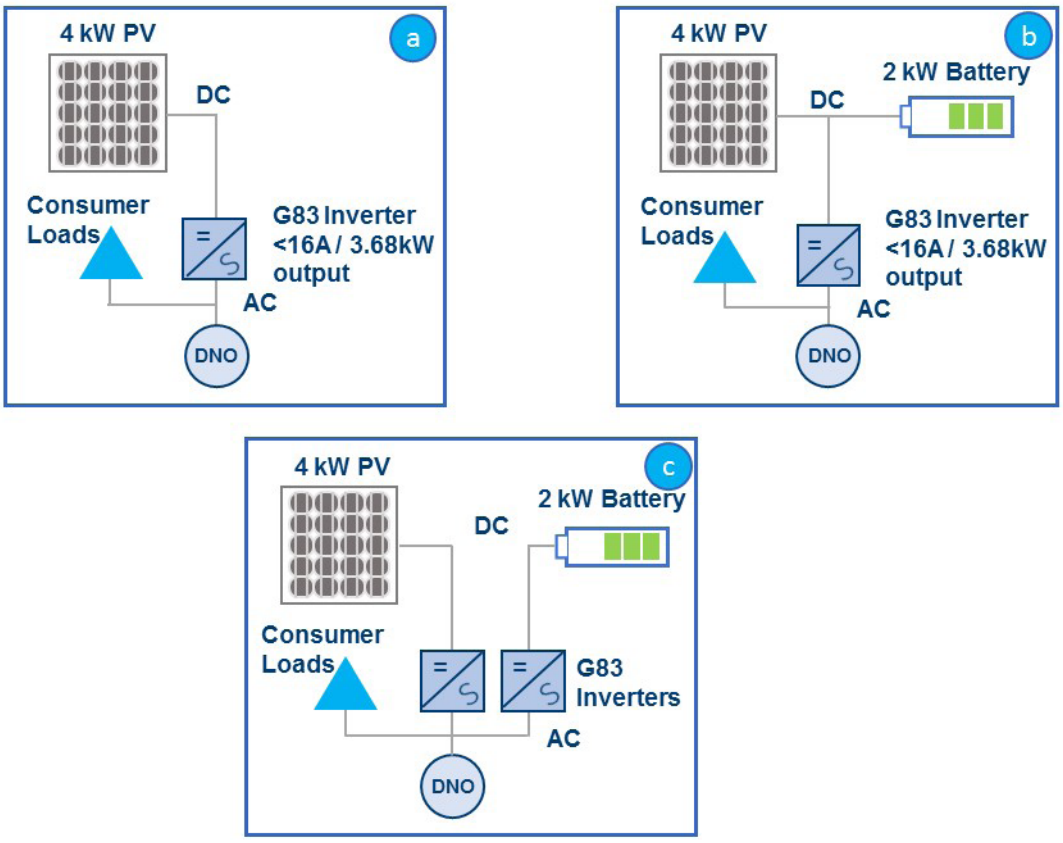

Figure 8

DSO Functions

Q7 - Do you believe that installations similar to that illustrated in Figure 8b, where a total energy source>16A/phase connects behind a single inverter rated at 16A/phase, should be allowed to connect under an Engineering Recommendation G83/1 arrangement on a 'fit and inform' basis? If so, please set out in detail.

Q8 - Do you believe that installations similar to that illustrated in Figure 8c, if fitted with a G100[9] export limiting device should be allowed to connect on an Engineering Recommendation G59 "fast track" process? In this case customers would still be required to contact NIE Networks to receive permission to connect; however, due to the reduced likelihood of considerable grid impact NIE Networks would be able to expedite any network assessment and revert to the customer, informing them that they can or cannot connect to the network in reduced timescales.

[9]http://www.nienetworks.co.uk/documents/useful-resources/21_007v1

DSO Functions

3.5 Data Provision

As the volume of DERs connecting to the distribution network increases the need to have greater data and visibility of the network becomes more important and is necessary to ensure the efficient development and operation of both the distribution and transmission system. Currently there is real time visibility through Supervisory Control and Data Acquisition (SCADA) down to 6.6kV circuit level; however, below these levels there is extremely limited real time data.

Three potential areas where the increased provision of data may be required between TSO and DSO and also the DSO and TSO to allow for the efficient development and operation of the electricity system include:

- Future data – data provided ahead of time
  - Near time forecasting of demand, generation and DERs on the distribution network
- Real Time data – data provided in real time
  - Real time data of DERs >100KW
- Past data – data provided after an event
  - Disturbance recorder data of system events

Q9 (a) – Do you agree that the DSO/TSO requires increased data to efficiently develop and operate the system to help reduce network operating costs and facilitate greater access to the network for existing and future customers?

Q9 (b) - Do you agree that to achieve this, increased levels of data need to be made available in the areas identified and be efficiently transferred between the TSO and the DSO?

Q9 (c) - Are there any other areas that you believe the DSO should have visibility of?

Q10 (a) - The provision of data and visibility of the network plays a significant factor in ensuring the efficient management and operation of the electricity network to help reduce energy costs. Do you believe that greater metering functionality is required in Northern Ireland to provide the DSO with increased data? If so, please set out in detail.

Q10 (b) – Do you believe customers should have increased access to network data? If so, please set out in detail.

DSO Functions

3.6 Network Management

When planning an outage, generation is sometimes required to be constrained when the system is abnormal. In general, generation is only connected and charged for a Normal System Operation (NSO) connection and therefore may have to be constrained under Abnormal System Operation (ANSO) feeding arrangements. Consequently, NIE Networks' control engineers will reduce the output from generators, if required, by sending SCADA signals or by instructing operational staff to disconnect generation from the system. When determining the level of constraints to apply, generally conservative assumptions are used, for example, when paralleling between two Bulk Supply Points (BSPs)[10] it is current practise to ensure that there is zero reverse power flow at both substations prior to carrying out the parallel. In reality it may be appropriate to allow a level of reverse power flow without causing any network violations.

Q11 - Should NIE Networks invest in technologies to enable generation constraints on the distribution network to be reduced?

3.7 Charging

Distribution Use of System (DUoS) tariffs are designed to recover the distribution network costs from the end users based on how they contribute to the network costs. As customers generate more of their own electricity locally but still want to remain connected to the distribution network for continuity of supply reasons and to avail of system services, the current DUoS tariffs will need to change from primarily a volumetric approach to a more capacity charging approach to benefit all customer types. The emergence of new technologies and the growth in DG is changing how and when the distribution network is used and will influence the effectiveness of NIE Networks' DUoS tariffs.

Factors which may impact on charging include:

- Reduced usage will increase network charges for all customer types unless capacity charging is introduced.
- The increasing connection of generation to the distribution network instead of the transmission network is changing the direction and volume of energy flows on the network.
- How and when customers want to use the network is changing as customers are connecting DG to reduce their network usage, while some want to store electricity and use it during peak times.
- The connection of new technologies such as heat pumps and electric vehicles have the potential to cause system peaks and network constraints.

[10] 110kV/33kV substation

DSO Functions

Set against this, the emergence of smart technologies and innovative business models offer opportunities to adjust supply and demand at times and places where there are network constraints. This can defer or reduce the network reinforcement which might be needed. NIE Networks' tariffs may need to change to facilitate these opportunities and provide the appropriate incentives to both demand and generator network users.

Current Charging Arrangements

Currently NIE Networks' DUoS charges are set to recover regulated Distribution Allowances using cost reflective principles. DUoS charges provide network users with signals about the costs they confer on the distribution network in terms of investment and operation. The price signals should incentivise network users to make decisions on how and when they use the network to achieve the most economically efficient outcome. If customers change their behaviours in response to the price signals, this will ultimately reduce future network costs for all users. NIE Networks' DUoS tariffs include some or all of the following price components set to recover specific costs:

- **Standing Charges (£/month or £/quarter)** – charges applied on a per user basis. These charges are designed to cover costs that do not vary with the extent to which the supply is taken up e.g. the cost of basic metering, meter reading, billing and the maintenance of service cables and terminations not recovered as part of the connection charge.

- **Unit Charges (p/kWh)** – charges applied in relation to energy transported across the distribution network to the end user. Unit charges are designed to cover the cost of network development, maintenance and operation not recovered through connection charges or capacity charges. The types of unit charges applied in NIE Networks' DUoS tariffs are:

  - Unrestricted rate – the same charge is applied to all units delivered to the end user.

  - Time of Day (TOD) rates – generally different charges are applied to predefined day and night time periods throughout the year.

  - Seasonal and Time of Day (STOD) rates – half hour metering is required to facilitate STOD unit charges. STOD tariffs are mandatory for all demand customers with a connected capacity greater than 70kVA. Small business users can opt for a STOD tariff. Higher unit charges are levied during winter days with peak rates levied during a 3 hour window (16:00-19:00 Monday to Friday) to reflect anticipated system peak demand.

Unit charges for different time or seasonal periods are designed to reflect the network costs associated with using the network in the predefined time periods.

DSO Functions

- **Capacity Charges (£/kVA)** – a charge for peak demand used in the current or previous tariff year is levied on demand customers with a connected capacity greater than 70kVA. Capacity charges are not levied on pure generator connections. Half hour metering is required to calculate a user's peak demand.

- **Reactive Charges (p/kVarh)** – a charge per kVArh of reactive power is levied on demand customers with a connected capacity greater than 70kVA to cover costs associated with providing supplies at lower power factors. This is related to the power factor expressed in customers' connection agreements. Reactive charges only apply during the winter peak period (1600 - 1900 hrs Monday - Friday). Reactive charges are not levied on pure generator connections.

The following table shows the price components used in the tariffs for the main user groups. The revenue recovered under the price components is expressed as a percentage of the total DUoS revenue recovered by NIE Networks over a tariff year (based on 2017/18 tariff forecast revenues).

User Category	Tariff Type	Customer Numbers	DUoS Revenue (expressed as a % of total)			
			Standing Charge	Unit Charge	Capacity Charge	Reactive Charge
Domestic	Unrestricted	767,746	12.2%	37.0%		
	TOD	33,268	0.5%	1.6%		
Small Business (MIC<70kVA)	Unrestricted	47,008	0.8%	10.2%		
	TOD	13,781	0.2%	4.7%		
	STOD	5,840	0.2%	3.0%		
Medium Business (MIC>70kVA)	STOD	5,050	0.2%	12.5%	7.5%	0.1%
Large Energy Users (MIC>1MW)	STOD	200	0.3%	3.5%	3.7%	0.1%
Unmetered	Unrestricted	-		1.3%		
Generators	STOD	836	0.0%	0.1%		
TOTAL		**873,748**	**14.6%**	**74.0%**	**11.2%**	**0.2%**

Table 4

Cost reflective DUoS price signals are set to incentivise customers to use the distribution network more efficiently. Customers can reduce their bills by responding to the price signals and ultimately reduce future network costs for all users. TOD and STOD unit charges encourage users to avoid times when the network is more heavily loaded. Similarly capacity charges encourage users to reduce their maximum import demands which can be achieved through peak lopping or load shifting.

DSO Functions

Reactive power charges are generally avoidable if users employ 'best practice' design in their electrical installation to maintain a power factor between 0.95 and unity. Power flowing with a power factor of less than 0.95 results in much higher losses in the distribution network, hence greater network capacity is required. A comparatively small improvement in power factor can reduce losses significantly as electrical losses are proportional to the square of the current. Reactive power charges contribute less than 1% to the annual DUoS income however the impact on an individual user's bill can be more significant.

NIE Networks publish 48 DUoS tariffs to recover distribution network costs from approximately 874,000 connected end users. The DUoS tariffs are assigned to end users based on:

- **Voltage of connection** – 33kV, 11kV or LV voltages.
- **Type of end user** – domestic, commercial, unmetered, generator.
- **Type of metering** – credit meter with single or multiple registers, keypad meter, half hour meters.
- **Size of end user** – there are 3 bands based on user Maximum Import Capacity (MIC): (i) MIC less than 70kVA, (ii) MIC between 70kVA and 1MW, and (iii) MIC greater than 1MW.

Potential Changes to Charging Arrangements

The Utility Regulator has recognised in their forward work plan that a charging review is required. In anticipation of this charging review some areas that could be considered include:

- **Options for tariff groups and new DUoS tariff** – DUoS tariffs are currently assigned to end users based on voltage, size of user etc, as outlined above. Network costs allocated to the tariff group are based on the "average" user in the tariff group. With the introduction of new technologies, the customers in a tariff group may have a range of network usage patterns.

  Different price structures and tariffs may be introduced to recognise common modes of behaviour, such as PV users, or user flexibility such as customers who participate in Demand Side Response. Different charges or rebates could also be considered to encourage generators to connect close to local load and flex their export to meet local demand. Matching generation to demand on the same part of the distribution network would reduce power flows and potentially future network reinforcement cost, however the benefits of such an arrangement is highly dependent on the reliability of customer demand.

DSO Functions

- Rebalancing DUoS charges – when network users install alternative energy sources their electricity consumption generally reduces. As a consequence a higher proportion of past network investment costs, will be claimed from the remaining network users through unit charges. Rebalancing network costs by reducing the proportion recovered from unit charges and increasing the proportion recovered from fixed charges, such as capacity or standing charges, could provide a fairer and more appropriate allocation of costs.

- **New Technologies and Time of Use Pricing** – suitable access and smart charging arrangements for new technologies such as electric vehicles, heat pumps and storage are required. If these technologies were to cluster at certain parts of the network they could drive network reinforcement. More time of use DUoS charges could provide cost signals to reduce the need to reinforce the network. While all customers with MICs greater than 70kVA have time of use prices, less than 30% of small business users and less than 5% of domestic customers are on time of use DUoS tariffs.

Moving forward, DUoS charging structures may need to include the newer types of costs, such as expenditure on smart grid assets and flexible services. Careful consideration is required on how these costs should be mapped to the tariff components as this will impact the proportion of costs recovered from each user group and individual network user.

Q12 - Do you believe the existing tariffs are fit for purpose, or do they need amendment to deliver benefit to all customer types?

Q13 – Do you believe the areas of potential change as outlined in this section, are correct? Are there other areas of change that should be considered? If so, please set out in detail.

Northern Ireland Electricity Networks

#4

What this means for Our Customers

The DSO evolution is not only about developing technical solutions for the functions outlined in section 3 but to provide greater access and choice for customers that want to participate in the developing system services market, in a fair manner for all customer types in order to help reduce energy bills. In fact the way customers use energy is changing with some households, businesses and communities wanting the ability to produce their own clean energy and to access new markets and technologies.

However, this DSO evolution will not result in unfettered access to the distribution network for all customers. To deliver improved access will require greater flexibility in how the DSO manages and operates the distribution network necessitating flexibility from existing and future customers' demand and generation capability.

We have collaborated with the ENA Open Networks Project to develop the following defined customer types for this new DSO world:

- System Service providers
- Active Participant
- Passive Participant
- Passive Consumer

We recognise that connected customers will evolve and may move between categories through the 'lifetime' of connection to the distribution network. It is also clear that not every customer will want to or is able to take advantage of the DSO functions and that the evolution to DSO must work for all customers whether they are acting in an active or passive manner.

To enable customers to understand which category they currently fall into and how they may wish to evolve over time to the Open Networks descriptions are outlined below:

System Service providers

Customers who opt to sell system support services to the TSO or DSO. These customers have generally invested in DER to participate in the energy market and provide support services or they are demand customers who are more aware of the energy market and can flex their demand as part of their business, i.e. demand side management. This group includes larger individual customers and also aggregators providing services through the management of a portfolio of smaller customers. The TSO or DSO would agree term contracts on a bilateral basis for the services it needs.

Active Participant

These customers have invested in DER, demand side management or low carbon products. This category will include customers actively participating in the energy market to derive income from generation and/or storage, demand customers reducing operating costs and larger customers who have invested in low carbon equipment for social responsibility reasons. They are very likely to be responding to time of use signals, including managing demand or export at times of peak demand. While these customers will have bilateral contracts with suppliers for energy services

they do not have contracts for services with TSOs or DSOs.

Typical customers in this category are storage, Distributed Generation and flexibility service operators, larger demand customers and community energy schemes; however this category also includes aggregators managing exports and demand side management on behalf of multiple smaller customers.

Passive Participant

This category includes smaller energy conscious customers (domestic or non domestic) who have invested in off-the shelf low carbon equipment to derive income from renewable energy schemes, to reduce their overall costs or for social responsibility reasons. Generation or demand is unlikely to be actively managed and is installed on a passive fit and forget basis. 'Off the shelf' low carbon equipment in this case includes solar panels, heat pumps or electric vehicles. These customers are likely to be exporting and importing and would seek to benefit from supplier's time of use tariffs.

Passive Consumer

Normally domestic or smaller non-domestic demand customers with little or no interest in the flexible energy market or low carbon products. These customers may have smart appliances and in due course could agree smart energy contracts with suppliers and aggregators (at which point the key relationship is between the DSO and the aggregator/ supplier, therefore the customer will fall out of these categories). This category includes customers in social housing with or without access to a community energy supply contract via their landlord. These customers are likely to be on standard supplier tariff.

Q14 - Do you agree with the customer groups and definitions set out in this section? If not, please set out in detail.

Q15 - Please detail which customer group(s) you either identify with or represent.

Q16 - What are your views on benefits of the DSO evolution across these consumer groups and how this can be maximised? Please set out in detail.

Responding

Although NIE Networks are keen to receive responses to all questions within the Call for Evidence, we appreciate that respondents' areas of interest may vary depending on their DSO Customer type. Respondents may answer either all questions or only those that are relevant to them. More general comments are also welcomed, for example:

Q17 - Do you believe that there are any policy inhibitors that may prevent or restrict NIE Networks evolving to a DSO? If so, please set out in detail.

Q18 - Do you have any other suggestions on how NIE Networks could give customers greater access to the distribution network? If so, please set out in detail.

Q19 - Do you believe greater access to the distribution network will bring other customer benefits? If so, please set out in detail.

Q20 - Do you believe there is any downside for customers in receiving greater access to the distribution network? If so, please set out in detail.

5.1 Request for Comment

Responses should be submitted electronically by populating some or all of the following fields and selecting the submit button. Alternatively, responses can be sent via email to Carl.Hashim@nienetworks.co.uk. Please note that NIE Networks intend to publish all responses to this paper online at www.nienetworks.co.uk. Respondents who wish their response to remain confidential should highlight this when submitting the response.

Responding

Name:

Organisation/Company:

Q1 - In the Northern Ireland context do you agree with the DSO definition? if not please state how you believe the DSO should be defined.

Q2 - Are there any additional functions which you feel should be included in the evolution to a DSO? If so, please provide a detailed description of the function(s).

Q3 - NIE Networks currently use static annual instruction sets. Do you think NIE Networks should develop more dynamic instruction sets based on real time power flows, voltages and network topology, potentially providing system service participants with greater access to the network for the provision of system services and protecting the network from sudden changes?

Q4 - Do you agree that NIE Networks should develop a technical solution to enable customers to participate in reactive power system services?

Q5 - NIE Networks has existing assets on the network which potentially have the capability of providing additional services to the TSO. Should NIE Networks be allowed to provide cost effective solutions to the TSO in balancing the network to help reduce bills for all customer types?

Q6 - Should NIE Networks continue to invest conventionally to maintain a high level of network resilience and security but at a higher cost or should they adopt and integrate smart incremental solutions to reduce network costs and deliver the network security through a more dynamic approach to operating the network?

Q7 - Do you believe that installations similar to that illustrated in Figure 8b, where a total energy source>16A/phase connects behind a single inverter rated at 16A/phase, should be allowed to connect under an Engineering Recommendation G83/1 arrangement on a 'fit and inform' basis? If so, please set out the detail.

Q8 - Do you believe that installations similar to that illustrated in Figure 8c, if fitted with a G100 export limiting device should be allowed to connect on an Engineering Recommendation G59 "fast track" process? In this case customers would still be required to contact NIE Networks to receive permission to connect; however, due to the reduced likelihood of considerable grid impact NIE Networks would be able to expedite any network assessment and revert to the customer, informing them that they can or cannot connect to the network in reduced timescales.

Q9 (a) – Do you agree that the DSO/TSO requires increased data to efficiently develop and operate the system help reduce network operating costs and facilitate greater access to the network for existing and future customers?

Q9 (b) - Do you agree that to achieve this, increased levels of data need to be made available in the areas identified and be efficiently transferred between the TSO and the DSO?

Q9 (c) - Are there any other areas that you believe the DSO should have visibility of?

Q10 (a) - The provision of data and visibility of the network plays a significant factor in ensuring the efficient management and operation of the electricity network to help reduce network energy costs. Do you believe that greater metering functionality is required in Northern Ireland to provide the DSO with increased data? If so, please set out in detail.

Q10 (b) – Do you believe customers should have increased access to network data? If so, please set out in detail.

Q11 - Should NIE Networks invest in technologies to enable generation constraints on the distribution network to be reduced?

Q12 - Do you believe the existing tariffs are fit for purpose, or do they need amendment to deliver benefit to all customer types?

Q13 – Do you believe the areas of potential change as outlined in section 3.5 are correct? Are there other areas of change that should be considered? If so, please set out the detail.

Q14 – Do you agree with the customer groups and definitions set out in this paper? If not, please set out in detail.

Q15 – Please detail which customer group(s) you either identify with or represent.

Q16 – What are your views on benefits of the DSO evolution across these consumer groups and how this can be maximised? Please set out in detail.

Q17 - Do you believe that there are any policy inhibitors that may prevent or restrict NIE Networks evolving to a DSO? If so, please set out in detail.

Q18 - Do you have any other suggestions on how NIE Networks could give customers greater access to the distribution network? If so, please set out in detail.

Q19 - Do you believe greater access to the distribution network will bring other customer benefits? If so, please set out in detail.

Q20 - Do you believe there is any downside for customers in receiving greater access to the distribution network? If so, please set out in detail.

General Comments:

Please select if you wish your response to remain anonymous. ☐

Submit

Next Steps

NIE Networks will hold a workshop on this CfE and wish to invite all interested parties to attend. This workshop will be held at The Crowne Plaza Hotel, Belfast on Sept 14th 2018 from 10am - 2.30pm. Interested parties should register at: Carl.Hashim@nienetworks.co.uk

The responses to this CfE will be analysed by NIE Networks and UR and will be used in the development of a subsequent consultation document setting out a proposal for evolving the operation of the distribution network to facilitate the future needs of a low carbon economy.

6.1 Proposed Time Table

Key Milestones	Proposed Dates
Call for Evidence Release	10/07/18
NIE Networks Workshop	14/09/18
Call for Evidence Close	02/10/18
Publication of Consultation Paper	Q4 2018

Northern Ireland Electricity Networks

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