NIE Briefing on Grid Capacity in Northern Ireland In the Context of Enabling Economic Growth

Submitted to the ETI Committee

2 April 2015

2 April 2015
Revision: 1

1. INTRODUCTION

1.1. Against a backdrop of ensuring that, in a reduced tax environment, any barriers to economic growth in Northern Ireland are addressed, the ETI Committee has asked NIE to provide a "briefing on the shortcomings of the electricity grid in Northern Ireland". This document is intended to inform the forthcoming oral hearing on 14 April.

This briefing document sets out NIE's response.

1.2. The purpose of this document is to:

- Help inform the debate
- Provide clarity regarding grid capacity and how the need for reinforcement is being addressed
- Provide pointers to help agenda setting for policy makers
- Outline specific actions that NIE is taking and intends to take

1.3. The Committee additionally advised NIE that the oral hearing would also address issues around renewable energy and the grid. We are therefore also providing a document prepared for the Minister's forum meeting on 30 March, which addressed these same issues.

1.4. The same grid has to cater for both the connection of renewables, and the connection of new or increased loads. While there is interplay between these two demands, in other respects the considerations are somewhat different.

1.5. Section 2 briefly describes the Northern Ireland electricity networks;

Sections 3 and 4 outline the regulatory framework and allowances;

Sections 5 to 7 outline the drivers for load related investments and how these are targeted;

Section 8 considers the capacity to cater for economic growth and proposes potential steps that can be taken to expand provision.

2. THE NORTHERN IRELAND GRID

2.1. The “Grid” in Northern Ireland in fact consists of two distinct networks – the transmission network and the distribution network.

2.2. The transmission network consists of 275,000 volt (275kV) lines and 110,000 volt (110kV) lines, some 1500km in total, plus associated substations. Using a transport analogy, the transmission system can be thought of as the “motorway”, moving bulk energy around the system.

The transmission network is owned, constructed and maintained by NIE. It is however operated by SONI as the independent Transmission System Operator (TSO). Since April 2014 SONI has also been responsible for transmission investment planning. This role was transferred from NIE to meet the requirements of the IME3 Directive.

2.3. The distribution network consists of 33,000 volt (33kV), 11,000 volt (11kV) 6,600 volt (6.6kV) and low voltage (400 volt / 230 volt) lines, some 45,000 km in total, plus associated substations. Continuing the analogy, the distribution network is akin to A and B roads.

NIE owns, plans, operates, constructs and maintains the distribution network.

2.4. There are circa 840,000 electricity customers in Northern Ireland. Currently there are no demand customers which connect directly to the transmission system. All such customers are therefore connected to the distribution network.

3. REGULATORY FRAMEWORK

3.1. As the Distribution Network Owner (DNO), NIE has a statutory duty to design and operate the electricity network in accordance with the Electricity Safety, Quality and Continuity Regulations (ESQCR). These regulations govern matters such as safety clearances to live equipment and maximum and minimum system voltage levels.

3.2. As the holder of a Distribution Licence in NI, NIE has Licence obligations to maintain network performance. The network performance requirements are set out in the Distribution Code (commonly referred to as the “D Code”) and detailed in the System Security and Planning Standards. Both the D Code and the Planning Standards are the subject of regulatory approval. The documents, quite technical in nature, are available on the NIE website.

3.3. NIE’s revenues, to cover both operating costs and capital investments, are set by the Utility Regulator (UR). The current price control period, referred to as RP5, is for 5 ½ years, and runs to September 2017.

4. REGULATORY ALLOWANCES FOR NETWORK CAPITAL SPEND

4.1. The current RP5 price control makes provision for a range of capital investments in the networks. These include provision for asset replacement, reinforcement to cater for renewables, and reinforcement to cater for growing load.

4.2. The allowance for distribution load related investment was £23m for the RP5 period. NIE is required to, and will, manage its related statutory and licence obligations within this overall allowance.

4.3. Transmission load related allowances are treated differently, due to the uncertainty of the larger transmission projects in terms of the detailed work requirement and the potential for significant variation in the projected project cost. These schemes are therefore covered by a mechanism whereby each major transmission scheme has to be individually justified and a separate capital allowance sought from the Utility Regulator.

SONI as TSO, in its system planning role, justifies the need for the scheme and carries out initial preconstruction work including achieving planning permission. NIE subsequently applies to UR for construction approval and then builds out the scheme.

4.4. Asset replacement is extremely important. The bulk of the transmission and distribution network was developed in the 1950s and 1960s, and many components now need to be replaced with their modern equivalents. This is essential for safety and operational reasons, but also to protect power quality and continuity which is crucial for indigenous and incoming industry.

Over the course of the RP5 price control, NIE will spend a total of £217m on replacing transmission and distribution assets.

4.5. Regulators in setting regulatory allowances also focus closely on ensuring that companies are efficient, hence delivering value for money for customers.

NIE is demonstrably an efficient company. Its obligations under RP5 will be delivered against allowances which are set on the basis of NIE being the 5th most efficient of the 15 UK DNOs.

5. DRIVERS FOR LOAD RELATED INVESTMENT

5.1. The key drivers of load related investment are as follows:

- Load Growth – at the macro level, province wide growth in demand is relatively low (+0.4% in 2014). However, at the local network level, load growth at individual primary substation sites varies considerably. While some sites show negative growth a significant number of sites show a relatively high level of demand growth.
- Customer Connections – NIE's 'Statement of Charges' limits chargeability for connections to the work involved at the voltage level to which the customer is to be connected, and one voltage level above. Therefore "deep reinforcement", for example at 33kV, required to connect LV, customers has to be funded through NIE's allowance.
- Opportunistic Investment - NIE reviews and reprioritises load related investment plans where opportunities present themselves for efficient and cost saving reinforcement of the network. Examples are working in conjunction with Public Realms schemes, and with NIE's own asset replacement schemes.

- Distributed Generation – the connection of significant amounts of distribution connected generators has led to the need for investment in network reinforcement to release further generation capacity. The investment is required primarily to alleviate thermal overload and voltage rise on the electricity network. This work is required not only to facilitate renewable connections, but also to ensure the networks remain safe, and supply quality to existing customers remains within standards.

6. TARGETING INVESTMENT FOR LOAD GROWTH

6.1. NIE carries out a continuous process of monitoring system demand at individual nodes such as primary substations. This allows comparison with the system capacity at each node to determine the level of utilisation and that compliance is maintained with both statutory and licence obligations.

6.2. This analysis work is undertaken at individual nodes throughout the year when reviewing available capacity for assessing new connection applications, and when planning for system outages to facilitate system maintenance or asset replacement.

6.3. A formal annual process is also carried out at the end of the winter period which reviews the peak demand for that year against system capacity at each primary node across the province. NIE uses this process to monitor the utilisation level at each site.

6.4. The annual information is compared against previous years to allow NIE to build an historic demand trend at each primary node which is extrapolated forward to forecast potential load growth at each site.

6.5. This forecast trend is further substantiated by using other internal and external sources such as; volumes and location of connections applications, DoE Area Plans, and development plans from large customers and bodies such as Invest NI, Titanic Quarter and Belfast Harbour Commissioners.

6.6. This process allows NIE to compare future peak loads against system capacities to identify potential future ‘hotspots’ that may require reinforcement.

6.7. When assessing reinforcement options NIE endeavours to identify the optimum solution to maximise long term customer satisfaction whilst complying with statutory and licence obligations.

In considering options NIE is required to undertake a cost benefit analysis appraisal which will identify the “least cost technically acceptable” (LCTA) solution, the potential for developer/customer contributions (in line with NIE’s Statement of Charges) and taking account of proposed scheme life, critical variables and probabilities.

6.8. This overall process ensures efficient targeting of investment in a timely manner and permits the development of a longer term coordinated investment plan.

7. EXAMPLES OF LOAD RELATED INVESTMENTS PLANNED FOR RP5

7.1. The following are examples of network reinforcement projects programmed to be undertaken during the RP5 period. These projects are either complete or at various stages of development:

- Killyman Central / Moy Park - 33kV line upgrade
- Granville Central substation - 33kV line upgrade
- Maghera / Draperstown - 2 new 33kV circuits
- Cookstown – 1 new 33kV circuit
- New primary substation at Roslea (Newtownbutler)
- New primary substation at Tullyvannon
- Castlederg – 2nd 33/11kV transformer
- Limavady Town – 33kV line up-grade
- c12 primary 33/11kV transformer up-grades
- c17 individual network schemes at 11kV
- c100 individual network schemes at LV
- c35 distribution transformers

8. CAPACITY TO CATER FOR ECONOMIC GROWTH

8.1. As described above, NIE carefully targets investment so that *underlying* load growth is catered for. In cases however where *point* loads increase, for example due to a new factory being built, or an existing customer installing a new production line, there can be a local capacity issue which requires reinforcement. This issue tends to be exacerbated where customers are located in more remote rural areas.

8.2. One might question why this is the case, and take the view that the network should be generally capable of dealing with increased point loads, regardless of location and without the delay involved in reinforcement. The issue with this is that such point load increases and their locations are not predictable.

8.3. There would therefore have to be investment across large parts of the network in *anticipation* of possible future point load growth. This would however mean the potential for stranded investment and a consequent and unnecessary increase in overall tariffs to the general body of customers.

8.4. That being said, the investments to cater for underlying growth do in themselves create some “headroom” in the network that can be used by new customers or those increasing their load. This is because reinforcements are carried out using network components that have standardised ratings which may be in excess of the immediate reinforcement requirement. Recent examples include:

- Dungannon customer – increase from 4.6 to 6MVA – no charge

- Omagh customer – increase 1.7 to 2.1MVA – no charge
- Omagh customer – increase 1.5 to 2.5MVA – no charge
- New customers at Dungannon Business Park: 1.2MVA. 1MVA and 85MVA – no charge
- Co Tyrone customer – increase 3.2 to 3.5MVA- no charge
- Cookstown – 1 new 33kV circuit (£1.5m)
- New primary substation at Roslea (Newtownbutler) (£870k)
- New primary substation at Tullyvannon (£700k)

8.5. There has in the past been some limited use of anticipatory investment – for example Invest NI has provided monies so that electrical capacity can be made available at industrial parks. This approach is particularly applicable to new loads and hence new factories or inward investments. There is of course still a risk of stranded investment, should investors decide on a different location for some other reason.

8.6. The approach described above could be extended through higher levels of investment – for example creating a "power park" in a selected area, which could then cater for significant levels of potential future loads. This type of approach could potentially involve transmission as well as distribution investment. SONI as TSO would be likely to have a view in this regard.

8.7. There is no doubt that these types of anticipatory investments could assist with economic development – however there would be significant costs involved which, if not funded through tariffs and hence by the general body of customers, would have to be funded through some other source. Clearly these are central policy questions that would have to be considered by DETI, UR and others.

8.8. NIE can contribute to this debate by helping stakeholders to consider what might be possible from a network perspective. To do this in a comprehensive way would also require the input of SONI.

We would suggest that an initial useful step would be to convene a workshop at which illustrative scenarios, and their scale of costs, could be explored.

This would be timely: NIE has already commenced work on its network investment plan for the next regulatory period, RP6, which will run from October 2017. Inherent in this process is formal engagement with domestic, commercial, institutional and industrial consumers and representative bodies, so that plans have been fully informed by customer priorities. The UR, CCNI and DETI are all involved in this process.

There is clearly therefore a window of opportunity now to develop thinking and policy on anticipatory network investment, and the costs and benefits of this, so that provision can be made, if necessary, in NIE's RP6 plans.

8.9. The cost of connecting to the electricity network is also a key consideration for customers.

Prior to the RP5 price control, NIE operated to a regime whereby 40% of the cost of connecting domestic customers was subsidised by the general body of customers. There was no such subsidy for non domestic

customers. This subsidy has now been removed, and all customers now pay the full cost of connection. NIE's connection charges are in accordance with its Statement of Charges, which is approved by UR.

8.10. The UR has published its plans to introduce contestability in connections in Northern Ireland. NIE welcomes this, and is working with the UR and stakeholders on the process to plan and put in place contestability.

8.11. In relation to the connection of renewable generation, there are many factors playing into current concerns. These are fully addressed in NIE's briefing document to the Minister for the meeting on 30 March, referred to at 1.3.

NIE Briefing on Connecting Renewable Generation to the Electricity Network

Submitted to DETI

27 March 2015

27th March 2015
Revision: 2

1. INTRODUCTION

1.1. While there has been very significant progress in Northern Ireland on the connection of renewable generation, in pursuit of the Assembly's target for renewables; many developers are frustrated by what they see as slow progress and rising costs to connect.

1.2. This briefing document sets out, in summary form, NIE's perspective on achievements to date, the technical issues that are now emerging, and what needs to be done to move things forward.

1.3. The purpose of this document is to:

- Help inform the debate
- Demonstrate what has been achieved
- Provide pointers to help agenda setting for policy makers
- Outline specific actions that NIE is taking and intends to take.

1.4. Section 2 sets out a summary of progress to date, the key issues, and what needs to be done to move forward. More detail supporting NIE's views can be found in the subsequent sections.

2. SUMMARY

Progress to date

2.1. Very good progress has been made on connecting renewables so far in Northern Ireland. NIE has in fact connected more renewable generation per customer than any other Distribution Network Operator (DNO) in the UK.

2.2. The 40% target requires circa 1600MW of renewable generation capacity to be connected. Over 1260MW of this is either already connected or in progress. Other connections in the queue are likely to bring the total towards and beyond 1600MW figure.

2.3. Transmission system reinforcements designed to enable up to 27% penetration versus the 40% target are advancing to plan.

2.4. Further connection of renewables beyond the 27% level will require a very sizable investment in the transmission system. Also significant investment will be required in the distribution system to enable further penetration of small scale generation.

2.5. Significant issues however have emerged on the distribution network, which is now "saturated" across much of Northern Ireland, particularly in the north and west. Many developers are frustrated by what they see as slow progress, rising costs to connect and inability to connect at some locations.

2.6. Apart from the investment required, there will be difficult technical challenges to overcome since the levels of renewable penetration in Northern Ireland are already at the limits of what such systems normally have to deal with.

What needs done to move things forward

2.7. NIE will continue to pursue its "Project 40" initiative, together with all the relevant stakeholders.

2.8. In relation to distribution system saturation, NIE is in discussions with UR regarding a new tranche of investment to release capacity to connect small scale generation to the distribution system.

2.9. To move beyond this, we will also be proposing deeper technical analysis, supported by piloting to define what might be technically feasible for small scale generation. This work will also define costs and consideration will need to be given to how such investments can be funded.

2.10. Additional piloting will be needed on the distribution system to address operational issues being reflected up to the transmission system. NIE will work with SONI to define what is required, and will bring proposals to UR for consideration.

2.11. Further investment in the transmission system to enable moving beyond the 27% figure needs to be defined. SONI as Transmission System Operator has this responsibility, with inputs from NIE. The costs are likely to be very significant. NIE will work closely with SONI and UR to define options.

2.12. The North-South interconnector project must also be realised. While SONI is responsible for bringing the project to consented stage, NIE (together with ESB Networks for the RoI portion) has responsibility for building the project. NIE is currently working with ESB Networks, UR and CER to define a strategy to minimise the build phase.

2.13. The forthcoming review of the Strategic Energy Framework (SEF) should include review of the 40% target and its timing, including knock-on effects and investment required on the transmission and distribution systems. The review should also consider the interplay of large scale and small scale generation – for example the displacement of large scale generation by new small scale generation coming onto the system. NIE will participate fully in this process.

2.14. There is already a very substantial amount of renewable generation in the pipeline and we recommend a review of the current approach to incentivisation.

NIE reiterates its full commitment to working though the various issues with all stakeholders.

3. BACKGROUND

3.1. NIE has been working closely with stakeholders to enable grid connections for renewables, in line with meeting the Government's 2020 target of 40% of electrical consumption from renewables. The 40% target equates to some 1600MW of installed electrical capacity. The ultimate figure will depend on the mix of generation types.

3.2. Renewables Generators fall into three broad categories: [1] Large Scale Generation (LSG); [2] Small Scale Generation (SSG); and [3] Micro Generation (MG). Importantly, each category connects at different voltage levels and presents very different challenges in terms of grid connection.

3.3. The transmission network in Northern Ireland consists of 275,000 volt (275kV) lines and 110,000 volt (110kV) lines, some 1500km in total, plus associated substations. Using a transport analogy, the transmission system can be thought of as the "motorway", moving bulk energy around the system.

3.4. The distribution network consists of 33,000 volt (33kV), 11,000 volt (11kV) and low voltage (400 volt / 230 volt) lines, some 45,000 km in total, plus associated substations. Continuing the analogy, the distribution network is akin to A and B roads.

3.5. LSG will contribute the major part of the 2020 target with installations typically in the size range 5MW to 40MW. LSG mainly takes the form of wind farms but solar farms are likely to play a more significant part going forward. LSG connects to the transmission network (at 110kV) and the distribution network (typically at 33kV). LSG output is typically under the direct operational control of SONI, with aspects of control being the responsibility of NIE.

3.6. SSG takes the form of single wind turbines, anaerobic digesters or small solar installations in the size range 20kW to 500kW. Popular sizes are 250kW for single turbines and 500kW for anaerobic digesters, aligning with current incentive (ROCs) bands. SSG connects to the distribution network; normally to LV and 11kV lines fed from 33kV/11kV primary substations. SSG output is not controlled.

3.7. MG takes the form of much smaller sizes in the range of 4kW to 12kW. Typical examples are photovoltaic (PV) panels on domestic rooftops. MG normally connects directly to customer premises at 230V single phase or 400V three phase. Whereas applications for LSG and SSG are assessed in some detail to determine their impact on the NIE distribution network, most MG is connected on a 'fit and inform' basis, in a category referred to as 'G83 connections'. This means that NIE has very limited control over the rise in G83 connections.

4. PROGRESS TO DATE

4.1. While recognising that many developers have been frustrated at delays and costs associated with their connections, in overall terms very significant progress has been made in Northern Ireland.

4.2. At this point, some 20% of consumption from renewables is being achieved with c760MW of generation connected and a further c500MW 'committed'

to connect. Of the c760 MW connected, some 76MW relates to small scale generation and 47MW to micro generation.

4.3. When compared to the rest of GB, NIE has connected the highest level of renewables to date, relative to customer numbers, of all the Distribution Network Operators (DNOs), at a rate of c780W per customer as of July 2014. (This rate for NIE has now increased to 910W per customer). The table below illustrates this.

DNO	Customers (million)	Generation connected to date (kW)	Generation Connected (kW)/ Customer	RANK
NP	3.9	410,242	0.11	6
UKPN	8.1	622,000	0.08	7
ENW	2.4	1,024,000	0.43	3
SP	3.5	2,700,000	0.77	2
SSE	3.7	1,200,000	0.32	4
NIE	0.84	652,000	0.78	1

Table comparing levels of renewables connected per customer[1]

4.4. Further, this considerable achievement has been achieved against a background of unique technical challenges due to the nature of the electrical networks in NI. These challenges are outlined below.

5. OVERALL NETWORK CHALLENGES

5.1. All DNOs are facing the central issue that, historically, networks were designed to bring electricity from large, centrally located power stations, in one direction through the networks, ultimately to customers' premises. That model is changing rapidly, with the advent of large amounts of smaller scale generators scattered across the networks, multi-directional power flows, and emerging approaches such as energy storage, Aggregated Generation Units (AGUs) and Demand Side Units (DSUs).

5.2. NIE faces these same issues; however they are magnified in Northern Ireland for two reasons.

5.3. The first reason is the very high existing and projected level of penetration of renewables in NI, as already highlighted, coupled with the nature and capacity of the distribution network.

5.4. While the NIE network serves 'demand' customers well; it is inherently less receptive to dispersed in-feeds of renewables generation than is the case with most GB DNOs. During rural electrification in the 1950s and 1960s, NI (rightly) adopted a modest approach to serving low rural load densities – for

[1] ENA Networks report- 'Connections to the Distribution Network- briefing Note' Figures as of July 2014

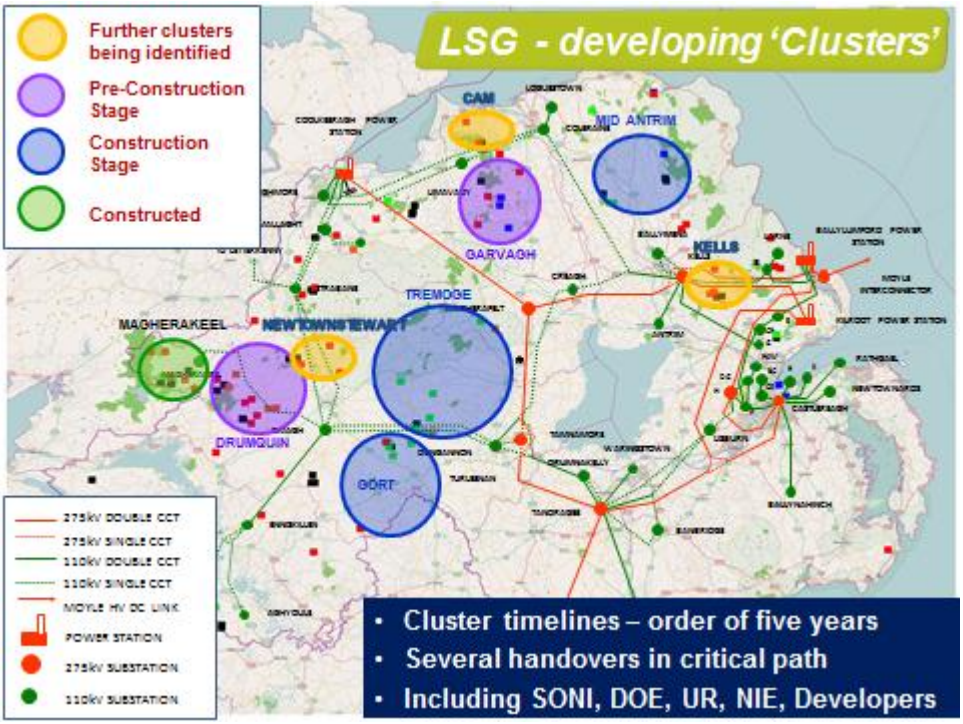
example through lighter overhead line construction and greater use of single phase versus three phase lines. NIE has 3.5 times[2] the total distribution overhead line per connected customer compared to the GB average because of the dispersed population.

5.5. The second reason arises from the location of large scale renewable generation. While other technologies are starting to emerge, wind has historically been the key contributor. The best locations for wind energy in NI are mostly in the west; however the population (load) centres are concentrated in the east. As a result, the 'backbone' transmission network requires strengthening to cope with the transport of wind energy from west to east.

6. LARGE SCALE CHALLENGES

6.1. To address this "west-east" challenge, NIE developed a strategy in conjunction with the Utility Regulator and the industry which deals with transmission reinforcement in the form of the 'Medium Term Plan (MTP)' to enable around 27% (vs the 40% target) to be achieved. This plan reinforces the transmission overhead line and substation system in a series of customer funded investments totalling £60m running to 2017.

6.2. A related initiative is the use of "cluster" substations to connect large scale generators, as illustrated below. With this approach the transmission network is extended to the epicentres of groups of large scale wind farms.



6.3. This approach and the associated charging method benefits, firstly, in enabling core network infrastructure to be ready ahead of connection.

[2] Ofgem, '2008/09 Electricity Distribution Quality of Service Report', 18 December 2009, Table A2.6 GB average total km overhead line 21,823 km; GB average customers 2,049,496: GB average overhead line/customer= 0.011km/customer * Figures based on average of 13 DNO's as LPN has no overhead line network. NIE total km overhead line 29,886; NIE total customers 840,000: NIE average overhead line/customer= 0.0355

6.4. The ‘cluster’ approach also reduces overhead line lengths and hence minimises environmental impacts, in line with NIE’s responsibility to develop an efficient infrastructure. It will be the primary method of connection for achieving 2020 targets, with these targets in the main being met through connection of large scale renewables. Note that further significant reinforcement will be required to enable the transmission network to deal with renewables levels in excess of 27%. This is explored later in section 12.

6.5. Importantly, while transmission reinforcement helps connection of LSG, it does not immediately address issues around SSG or MG which attach to the distribution network.

6.6. This has led to increased difficulties in trying to attain wayleaves for renewable projects. This has two effects – it has the potential to delay larger projects due to protracted negotiations and/or DETI referrals and it also increases costs due to landowners demanding significant one-off payments to let this infrastructure be built through their land.

7. SMALL SCALE AND MICROGENERATION CHALLENGES

7.1. Unfortunately, circumstances relating to connection of SSG to the distribution network present challenges less readily resolved, albeit NIE is working hard with industry stakeholders to address this situation as below.

7.2. The ‘sparse’ nature of NI’s population, particularly in the west, has by necessity led to a distribution network of greater length per connected customer and of lighter construction than is the case, in the main, with GB network operators (DNOs). The network length factor is illustrated in the following table.

7.3. The high levels of incentive for SSG and MG renewables, introduced in 2010 and unique to Northern Ireland, have led to unprecedented levels of applications.

7.4. Furthermore, the dispersed rural population densities mean the local ‘load sink’ for generation is often much smaller by comparison with similar UK DNO networks, resulting in generation output in NI being ‘pushed’ further up the network where it then impacts on the 33kV network leading, for example, to reverse power flow through substation transformers.

7.5. These features of the NIE network significantly limit the potential to connect small scale generation, albeit NIE has connected some 120MW of SSG and MG with a further 110MW+ committed in the work pipe, which will bring the total above 230MW.

7.6. This quantum of SSG and MG represents a very large amount of ‘non-controlled’ generation connecting to NIE’s distribution network and proportionately higher than being connected in the case of GB DNOs, leading to serious congestion with network reinforcement now being required for many connections.

DNO Owner	DNO	Total Length of OHL (kms)	Customers	Customers/ km of OHL	RANK
NP	NEDL	14,913	1,568,612	105	9
UKPN	YEDL	13,586	2,247,727	165	12
	EDFE	34,583	3,496,181	101	7
	EDFS	12,763	2,229,279	175	13
ENW	ENW	13,053	2,356,612	181	14
SP	SPD	21,118	1,991,331	94	6
	SPM	21,444	1,482,550	69	4
SSE	SSEH	31,551	729,290	23	1
	SSES	27,470	2,905,434	106	10
WPD	CNE	22,750	2,591,542	114	11
	CNW	23,856	2,435,566	102	8
	WPDS	18,164	1,520,440	84	5
	WPDW	28,459	1,088,889	38	3
	NIE	29,886	840,000	28	2

Table comparing number of customers per km of overhead line[3]

7.7. As a result, the cost of connections chargeable to developers for reinforcement of the 11kV network has risen markedly over the past two years to the point of making many projects uneconomic. This increase in costs arises because with more generators connecting to each 11kV circuit in congested locations, the circuit needs strengthened at significant cost, with these strengthening costs chargeable to developers.

7.8. In addition, the cumulative impact of connections to the 11kV network has led to power being 'pushed up' to the higher voltage levels, resulting in capacity limits being reached at many 33kV/11kV primary substations and leading, unfortunately, to a situation where NIE is unable to make offers to connect in these locations, unless a technical remedy can be found, and the necessary funding put in place.

7.9. Work to remedy these 33kV constraints is not currently chargeable to developers. NIE approached the UR in 2013 in respect of lower order investments at 33kV/11kV primary substations that might release further headroom. As a result, £2.3m of funding was agreed and this enabled a further approximately 100 projects to proceed, equating to around 30MW.

7.10. NIE also brought forward a proposal as part of the Competition Commission (CC; now the Competition and Markets Authority) RP5 price control referral process, to make further monies available to address 33kV constraints. The CC determined that further investment in this area was 'not in the public interest'.

7.11. The NIE distribution network is effectively now at saturation point, particularly in the west. NIE had previously issued offers to applicants with connection conditional on further investments being agreed with the UR. However, following a formal dispute process, the UR concluded that NIE should not issue offers conditional on such investment approval.

[3] Ofgem, '2008/09 Electricity Distribution Quality of Service Report', 18 December 2009, Table A2.6

7.12. NIE and the UR outlined the situation in an 'agreed statement' published on 15 August 2014. This statement explained the reasons for capacity constraints and outlined the work NIE was undertaking to explore alternative connection methods. Developers were provided with a choice of either withdrawing from the application process, with a refund of the application fee, or remaining in the process and retaining their queue position until such time as any alternative method of connection was confirmed or otherwise.

7.13. Following on from this position statement, NIE withdrew some c80 conditional offers and, since that point last year, has been unable to offer connection to a further c300 applicants. In most cases where offers were withdrawn or not made, as above, most applicants have chosen to remain in the process and await the outcome of work being progressed by NIE and other key stakeholders as part of NIE's "Project 40" initiative.

7.14. The Project 40 initiative and work to remedy the challenges facing SSG is described in more detail later in the paper.

7.15. It is vital that expectations as to what a Managed Connections approach could deliver, are kept in check. This is for several reasons.

7.16. Firstly, the technical research that NIE has conducted to date does not point to any similar schemes of scale that have been implemented elsewhere. It is also likely that any such scheme would still not be applicable in all cases; there would still therefore be disappointed developers.

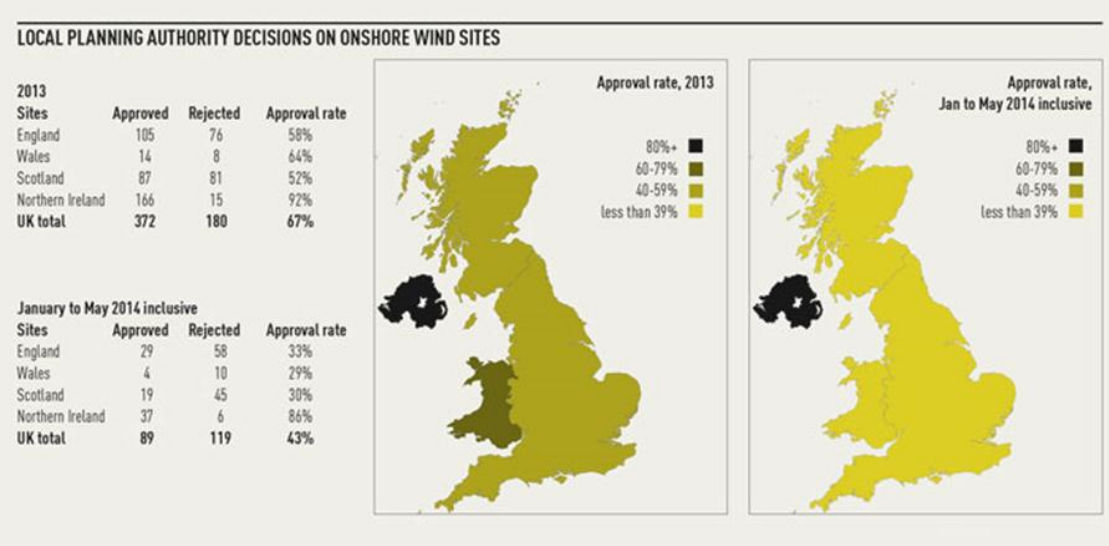
7.17. Secondly, even if a suitable technical approach can be found, there is likely to be a significant funding requirement. SSG customers will either have to pay more to connect or NI customers are going to have to subsidise this deep reinforcement through tariffs.

7.18. In the event of NI customers funding the necessary reinforcement, there would have to be a clear view taken of value for money. This is essentially an energy policy matter. To address this fully, comparison would have to be made with the cost of connecting an equivalent amount of large scale generation, and whether that represented better value. A complete analysis would also look at the extent to which new SSG can displace existing LSG, which has already been connected, enabled by customer funded transmission reinforcement.

8. THE GENERATION QUEUE

8.1. The generation queue comprises applicants awaiting quotation, those with offers who have not yet accepted, and those who have accepted an offer. Before an application is accepted by NIE the applicant must have secured planning permission.

8.2. This approach ensures that capacity is not reserved without commitment from developers and has served the industry well. Management of the queue is a critical part of renewables delivery. However planning approval rates are relatively very high in Northern Ireland hence enabling a high flow of applications to NIE.



Comparison of planning application approvals for onshore wind sites in UK[4]

8.3. The LSG queue is of an order of 450MW with c300MW due to connect by March 2017 in line with the current incentives period. The SSG queue is of an order of 140MW with c100MW expected to connect before March 2017 when the current ROCs incentives cease.

8.4. Importantly, not included in the above, there are in excess of c300 SSG connections in a form of 'suspense' awaiting the outcome of work to establish if alternative connections methods might be deployed i.e. in the form of 'managed connections', and assuming that funding would be made available. A summary of the queue status (including connected values) for LSG and SSG is presented below.

	Connected		Committed		Offer Issued		Applied		On Hold		Total
	MW	Sites	MW	Sites	MW	Sites	MW	Sites	MW	Sites	MW
LSG	640	35	395	23	61	3	212	15			1,308
SSG	77	330	107	474			30	142	49	312	263
MG	47	8,800									47
Total	764	9,165	502	497	61	3	242	157	49	312	1,618

8.5. The amount of work in the queue including the level of committed generation, i.e. offers accepted but projects not yet connected, is of a very high order, with NIE second only to Scottish Power in ranking within GB DNOs on a per customer basis.

8.6. It should be noted that, of the circa 1600MW of renewable generation capacity required to meet the 40% target, over 1260MW of this is either already connected or in progress. Other connections in the queue are likely to bring the total towards and beyond 1600MW figure.

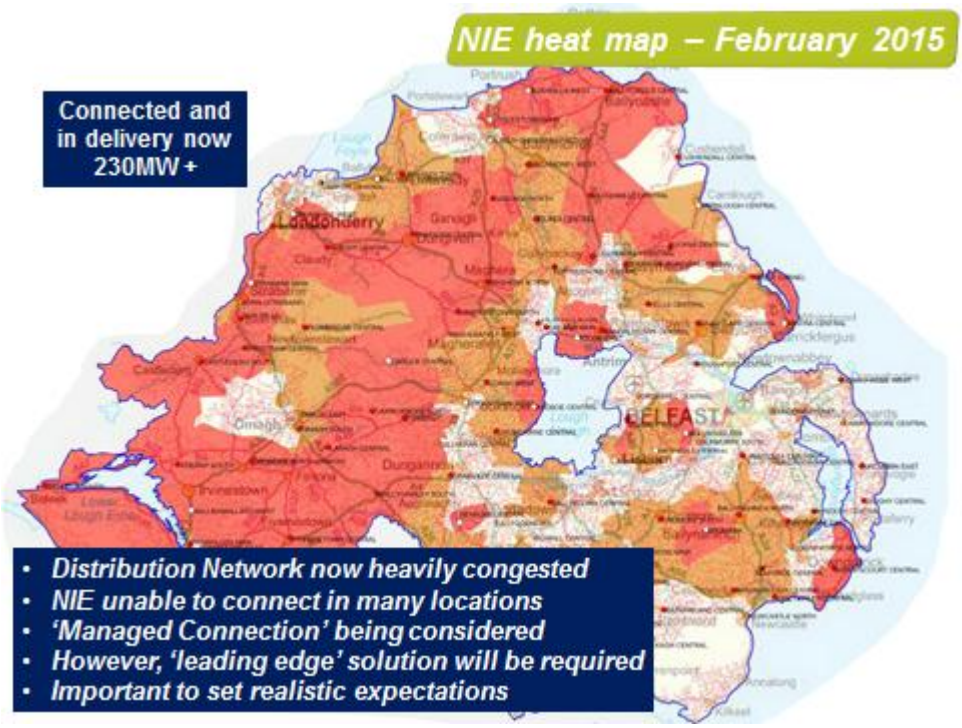
[4] http://utilityweek.co.uk/news/planning-gets-political/1017952#.VQFmddlFDIU

9. INFORMATION SHARING

9.1. NIE has progressively enhanced information available to developers on the NIE website to assist them in understanding how to progress with a connection application and to provide status information for example in relation to progress with clusters and congestion of the distribution network.

9.2. To assist SSG in particular; a 'heat map' of the distribution network is provided and updated on a regular basis. This presents an overview of distribution network congestion in relation to SSG.

9.3. To further assist developers a network mapping application is now available on the NIE web site. This allows developers to gain a better understanding of where their proposed generator might link into the NIE network and assists them in arriving at a view of whether a connection may be viable or otherwise before proceeding with a formal application to NIE.



9.4. NIE has received very positive feedback on these 'web based' applications and will, through engagement, continue to develop the information available on the web site to further assist developers.

9.5. NIE regularly meets with and provides information updates to individual developers, larger developers and interested parties through various forums including the Renewables Grid Liaison Group (RGLG), CAFRE and DARD events, council meetings and NIRIG events. This is in addition to stakeholder engagement through the Project 40 subgroups.

10. PROJECT 40 – SUPPORTING RENEWABLE CONNECTIONS

10.1. Given the many challenges being faced; Project 40 was established by NIE in May 2014 as an initiative to support enabling of large scale, small scale and microgeneration renewables connections in line with the Northern Ireland Strategic Energy Framework (SEF) 2020 targets for energy consumption from renewables in Northern Ireland.

10.2. Project 40 was tasked with assessing UK best practice and considering a range of technical and commercial options to optimise network access and the delivery of renewable generation to the NIE network.

10.3. As part of Project 40, NIE has engaged with a number of GB DNOs as well as attending various forums including the Energy Networks Association (ENA) which are considering similar challenges to those faced by NIE in the connection of renewables. NIE will engage more widely with GB DNOs as Project 40 progresses.

10.4. A number of working sub-groups has been established comprising technical, commercial, financial and legal representation from NIE, together with representation from SONI, developers, the Utility Regulator (UR), the Northern Ireland Renewables Industry Group (NIRIG), the Ulster Farmers' Union (UFU), the Department of Enterprise Trade and Investment (DETI), the Department of Agriculture and Rural Development (DARD), the College of Agriculture Food and Rural Enterprise (CAFRE) and other stakeholders where appropriate.

10.5. The focus of the working sub-groups is to collaboratively develop technical and commercial solutions and initiatives to improve access for generation applying to connect to the NI network, and where appropriate to expedite connection delivery.

10.6. The significant areas in focus for LSG include: arrangements to expedite delivery timelines for cluster connections; developing (in conjunction with SONI) generation connection design policy to manage 'reactive' power; assessing the technical limitations of long cable connections and for SSG: developing alternative approaches connection alongside work on MG; to assess multiple micro solar applications. Project 40 is also addressing a number of outstanding commercial / charging protocols for LSG, SSG and MG.

10.7. In respect of the acute issues facing SSG; a number of potential approaches have been considered by the Project 40 SSG sub-group around alternative connection methods. Considerable work has already been completed by NIE and an initial view formed on a potential alternative connection method. This approach, sometimes referred to as a 'Managed Connection', (more information in Appendix A) has been shared with DETI, the UR and the industry including DARD and UFU within sub group workshops.

11. TIMELINES AND FUNDING

11.1. Whereas the GB DNOs have had access to a low carbon fund of some £500m to support research into more automated approaches to defer investment with this being linked to the connection of renewables; NIE has not had access to this or any similar fund. Proposals for funding in this area were put forward as part of NIE's RP5 price control were rejected by the CC.

11.2. NIE has however completed scoping a pilot study with a view to being positioned in the last quarter 2015 to decide on the technical viability or otherwise of a managed connection arrangement. Work will also continue with SONI in parallel over the next period to consider the impact of SSG from their viewpoint.

11.3. NIE is also working closely with the UR to finalise the Project 40 managed connection consultation document which will take account of important principles around managed connections and also possible changes in the approach to chargeability i.e. the extent to which developers might pay for costs of managed connection or other 33kV works. We plan to issue this consultation document early in Q2 2015.

11.4. Subject to suitable funding arrangements being agreed with the UR, NIE expects to be in position to roll out a managed connection, if this is ultimately proven workable, in the first quarter 2016.

11.5. Separately and in certain cases, a range of modest 33kV network investments at primary substations would increase the level of acceptable reverse power at specific locations, although the issue remains as to how these 33kV investment costs should be allocated. This work if undertaken would be complimentary to the introduction of managed connections or would stand on its own as a method of increasing headroom. It is estimated around 30MW could be realised from a further investment of c£2m.

11.6. NIE is currently in discussions with the UR around funding.

12. HIGH LEVEL FINANCIAL IMPACTS - RELATING TO TRANSMISSION REINFORCEMENT

12.1. Transmission network reinforcement to enable renewables has been ongoing in the form of the medium term plan, expected to complete by end 2017 at a cost of some £60m to the NI customer base.

12.2. Beyond this, more sizable investment, c£420m (NIE estimate of cost) will be required to move beyond 27%, towards the 40% target. These costs are for the North-South interconnector, and other significant transmission system reinforcements.

12.3. It should be noted that, in line with the EU IME3 Directive, NIE's transmission planning function was transferred to SONI in May 2014. The costs of moving from 27% to 40% are therefore now subject to SONI revision, with inputs from NIE.

Appendix A- The 'managed connection'

Where the total generation connected to a specific 33/11kV primary substation exceeds the available load at that substation at any point in time, reverse power flows back up through the primary substation to the upstream 33kV network. These power flows, referred to as 'reverse power' may result in specific network operational limits being exceeded at the more congested primary substations.

The situation may be remedied in different ways through a more automated approach or through more conventional investment or a combination of both.

As network load and aggregated generation output are variable, there is the potential to connect additional generation to the network to utilise the headroom that results at times when the aggregated generation output is lower than the reverse power capability of the specific substation.

However, when generation output approaches the acceptable level of reverse power, it would be necessary under this approach to be able to control the aggregated generation output to within these limits. This automation / control arrangement is referred to as 'reverse power control'.

The control function would at times require generators outputs being reduced to zero in a controlled manner to protect the network from any excursions outside these network imposed limits. This central control would be based on ensuring predefined limits for the transformers and associated equipment, or the upstream network, are not exceeded. The sequence of generator disconnection would be in a pre-defined order.

Managing connections based on reverse power control only, would still require reinforcement of the local 11kV network to maintain statutory voltages on the network, therefore connection charges to developers will, unfortunately, not reduce. NIE did consider additional local control (referred to as voltage control) of generators which might have removed the need for such reinforcement however this form of control, for SSG, was found to be unproven in the GB DNOs.

It should be noted that additional costs may also apply as specific control and communication arrangements are required to manage reverse power. This may be of particular significance to smaller installations as additional costs may affect the financial viability of smaller projects.

Also by introducing a form of control, the generator is likely to see some level of output reduction depending on the specific circumstances at a particular primary substation.

This is a highly complex issue that involves estimating the level of expected constraints and the developer factoring this into their business case.

The mix of generation is therefore critical to the assessment by the generator developers of the likelihood of constraint occurring. NIE has drafted a consultation document as part of the Project 40 SSG sub group designed to test the principles of a managed connection solution in line with the above and has invested considerable time and effort into shaping a pilot trial to test the viability, or otherwise, of this approach.

The managed connections approach would therefore require NIE to monitor power flows at 33kV/11kV primary substations and disconnect generators in

some pre-agreed order to avoid substation capacity and safety limits being breached. Combining this more automated solution with further conventional investment at primary substations would appear at this point to be the best way of exploiting remaining headroom on the distribution network.

In any event therefore; to remedy this situation and provide any further headroom for connections will require further investment in the distribution network, with this investment potentially taking the form of some combination of conventional reinforcement and network automation.

Also, because of the high levels of generation being connected to the distribution network and the potential for the managed connection approach to take SSG to an even greater level; NIE are now engaging closely with SONI to assess the impact of higher levels of SSG connect given that SSG is not controlled by SONI and therefore the impact of increased levels of SSG must be considered from a forecasting and operability view point and dealt with, in part, through increased curtailment of LSG.