Northern Ireland Gas Capacity Statement

2020/21 – 2029/30

Purpose of this Document

The aim of the Northern Ireland Capacity Statement (NIGCS) is to provide an assessment of the ability of the Northern Ireland transmission network to meet forecast demands on the network over a ten-year period.

The system is assessed by using network modelling on days of different demands over a number of different scenarios.

The modelling results for each of the scenarios and demand days are presented and discussed.

The paper is intended primarily for the gas and electricity power sectors. However, it is expected that there is a wider interest in terms of the security of gas supplies to Northern Ireland.

The paper provides an assessment of the ability of the transmission network to flow gas over a number of potential future scenarios.

Disclaimer:
The TSOs have followed accepted industry practice in the collection and analysis of data available. However, prior to taking business decisions, interested parties are advised to seek separate and independent opinion in relation to the matters covered by the present NIGCS and should not rely solely upon data and information contained therein. Information in this document does not purport to contain all the information that a prospective investor or participant in the Northern Ireland gas market may need.

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Acronyms and Glossary

Table 1: Acronyms and Glossary

AGI	Above-ground installation
BETTA	British Electricity Trading and Transmission Arrangements
BGTP	Belfast Gas Transmission Pipeline
CRU	Commission for Regulation of Utilities
CV	Calorific Value
EPH	Energetický a Průmyslový Holding
FE	Firmus Energy (distribution) Limited
GB	Great Britain
GMO	Gas Market Operator
GNI	Gas Networks Ireland
GNI(UK)	Gas Networks Ireland (UK)
GWh	Gigawatt hour
GY	Gas Year
I/C	Industrial and Commercial
IC2	Interconnector 2
IP	Interconnection Point
KWh	Kilowatt hour
m3	Cubic metres
MEL	Mutual Energy Limited
MJ	Mega Joules
mscm	Million standard cubic meters
mscm/y	Million standard cubic meters per year
mscmd	Million standard cubic meters per day
MW	Megawatt
MWe	Megawatts of Electrical Power
NI	Northern Ireland
NIAUR	Northern Ireland Authority for Utility Regulation
NIGCS	Northern Ireland Gas Capacity Statement
NGNTS	National Grid's National Transmission System
NWP	North-West Pipeline
PCI	Project of Common Interest
PNGL	Phoenix Natural Gas Limited
PTL	Premier Transmission Limited
RoI	Republic of Ireland
SEM	Single Electricity Market
SGNNG	SGN Natural Gas
SNIP	Scotland to Northern Ireland Pipeline
SNP	South-North Pipeline
SONI	System Operator Northern Ireland
SWSOS	South West Scotland Onshore System
TA	Transportation Agreement
TSOs	Transmission System Operators
UK	United Kingdom

Chapter 1 Executive Summary

The Northern Ireland Gas Capacity Statement (NIGCS) provides an assessment of the ability of the Northern Ireland (NI) gas transmission system to deliver demand to a wide range of customers over a number of potential forecast and additional demand scenarios within the next ten years up to 2029/30. The NI Transmission System Operators[1] (TSO's) liaised with current power sector shippers and Distribution Network Operators to compile the forecast demands. The TSO's carried out the assessment using hydraulic modelling software to test the network's ability from 2020/21 to 2029/30 to meet the forecast demands for the following seasons/scenarios:

- Summer Minimum
- Average Spring
- Average Winter Peak
- Severe Winter Peak

For each year and for each of these four seasons, the 'Base Case' scenario consisting of the existing gas transmission infrastructure was tested to two target minimum system pressures, as follows;

- 12 barg, in line with the NI Network Gas Transmission Code, and;
- 39 barg, which the TSO's normally maintain pressures in excess of, as per the System Operator Agreement approved by the Northern Ireland Authority for Utility Regulation.

In addition, sensitivity analysis was undertaken to examine the impact of the following:

- Reserved Capacity at Stranraer and Haynestown
- Carrickfergus Control Mode of Operation
- A new Future Power Station

Key Messages

- Adequate capacity exists across the 10 year study horizon to meet future customer demand **to 12 barg** in all study scenarios.
- In the Severe Winter Peak – Firm and Interruptible scenarios, with NI and Stranraer demands ranging from 8.59 – 9.51 mscmd, the current Moffat IP Entry Point capacity of 8.08 mscmd[2] is exceeded in all years, meaning the South North IP Entry Point is required in all cases.
- To maintain 39 barg system pressures will require:
  - diurnal inlet pressures at Twynholm above the guaranteed 56 barg and up to 74 barg, which is not guaranteed, and/or;
  - greater use of the South North IP Entry Point, potentially displacing flow which would otherwise be supplied through the Moffat IP Entry Point.
- The TSO's have balancing gas contracts at both entry points of the NI network to provide an operational tool (to a limited volume) to help balance the network.

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[1] GNI (UK), Belfast Gas Transmission Ltd, Premier Transmission Ltd, West Transmission Ltd.

[2] The current Moffat IP Entry Point capacity of 8.08 mscmd is in accordance with the terms of the Transportation Agreement between GNI (UK) and PTL.

If use of the balancing gas contracts does not alleviate the situation where inlet pressures at Twynholm are lower than that required to physically transport the energy demand at a suitable operating pressure the TSO's may need to declare a 'System Constraint' in line with section 10 of the NI Network Gas Transmission Code to reduce the amount of IP Capacity at the Interconnection Point and/or Exit Capacity at one or more Exit Points, noting that;

  - shipper registration at the South North IP Entry Point is required so that the market has the ability to respond to any shortfall in supply capacity from the Moffat IP Entry Point to maintain balance in overall entry and exit nominations, and;
  - if consumption reduction became necessary, this would be achieved via issuing Flow Orders to instruct Shippers to reduce Exit Nominations, with Power Stations being the primary focus for larger such events before progressing to other interruptible customers. It is noted that Power stations have secondary sources of fuel as such these actions should not impact the end consumer.

- Capacity in the NI Network is reduced by the reserved capacity for use by customers at Stranraer in Scotland (0.931 GWh/d) and Haynestown in the Republic of Ireland (6.6 GWh/d) from Gas Year 2020/21 onwards. Both can be facilitated and have minimal impact on minimum system pressures over the study horizon (~0.1 barg).
- The TSO's are presently working on introducing a new mode of operation at Carrickfergus station (an interface point between TSO's respective networks) which potentially will reduce the number of balancing actions and deliver pressure benefits across the NI network, with the potential for both to result in savings for NI consumers.
- There is capacity (again, to 12 barg minimum system operating pressure) for a new 383 MWe open-cycle gas-fired (OCGT) power station near Kilroot, which would require up to 23 GWh/d to supply on a full load basis. However, under onerous potential demand scenarios (i.e. Severe Winter Peak Firm and Interruptible load), there are scenarios in which, to maintain 39 barg minimum system pressure, greater than 56 barg minimum diurnal Twynholm inlet pressure is necessary (even with maximising the use of the South North IP Entry Point), and scearnios in which maximising utilsation of the Moffat IP Entry Point requires up to 74.7 barg.

Gas and Electrical Power Sector Interactions

- The analysis shows that across the ten-year period, total annual demand projections fluctuate most significantly in line with variations in power sector forecasts. Currently installed gas fired power generation is forecasting a decline in annual demand however maximum peak day demand forecast remain relatively consistent.
- When a new OCGT is considered at Kilroot, maximum peak day power sector demand will increase however the annual power sector demand may not increase

in proportion to the increase in the installed gas fired electrical generation capacity, owing to differing load factors.

- The North South Electrical Interconnector may affect NI power sector gas demand due to its impact on electrical interconnection capacity between NI and the RoI.
- Increased renewable integration's impact on the SEM is also driving increased variability in the running regime of gas fired electrical generation coupled with lower load factors. This too may lead to higher maximum peak day gas demand coupled with lower annual run hours.
- Greater analysis of the implications for the NI gas network of progressive integration of intermittent renewable electrical energy sources to meet consumer demand would be beneficial. This will ensure that the NI gas network is fully ready to meet higher maximum peak day gas demand, as gas will be expected to supply a greater percentage of the total electrical system demand over shorter periods to fully complement wind and solar integration.

NI Energy Strategy

The NI Energy Strategy should provide greater clarity on the future direction of how consumers will use energy with a key focus on decarbonisation, including demand factors such as heat, energy efficiency, transport and supply factors such as biomethane and hydrogen, etc.

- Strong growth across the distribution sector is expected to continue across the study horizon as gas continues to displace more carbon intensive oil-fired heating systems.
- The roadmap for compressed natural gas as a less carbon intensive alternative to diesel for heavy goods vehicles is also required to allow appropriate load forecasting.

The TSOs remain fully committed to engage with all key stakeholders in the establishment and delivery of future NI energy strategy, in which the gas network will play a critical role in delivering efficient outcomes on a whole energy system basis.

Chapter 2 Introduction

Overview

2.1 The aim of the Northern Ireland Gas Capacity Statement (NIGCS) is to provide an assessment of the ability of the Northern Ireland transmission network to meet forecast demands on the network over a ten-year period based on certain scenarios and assumptions.

2.2 The Northern Ireland (NI) Transmission System Operators (TSOs) are obliged via the NI Network Gas Transmission Code and their respective Gas Conveyance Licences to produce a capacity report based upon network analysis of relevant supply and demand scenarios.

2.3 The NI TSO's are;

- GNI (UK) Limited.
- Mutual Energy (MEL), on behalf of its relevant subsidiaries, as follows:
    - Premier Transmission Ltd. (PTL);
    - Belfast Gas Transmission Limited (BGTL); and
    - West Transmission Limited (WTL)[3]

Report Structure

2.4 This document is set out as follows:

Section 1: Provides the executive summary of the paper.

Section 2: Summarises the aim of this NIGCS and provides an overview over the report structure.

Section 3: Provides an overview of the existing Northern Ireland transmission network and future infrastructure projects that are currently being considered.

Section 4: Provides information on historic and forecast gas demand for NI.

Section 5: Sets out the scenarios that have been modelled in this year's NIGCS.

Section 6: Sets out the modelling results.

Section 7: Provides commentary on the results.

Appendix 1: Northern Ireland Demand Forecasts

Appendix 2: Summary of System Modelling Assumptions

Appendix 3: Detailed Modelling Results

Appendix 4: Maps

[3] WTL is not a TSO (Transmission System Operator) as defined by the European Commission but it is referred to as a TSO in this document for simplicity.

Chapter 3 Transmission Network Overview

Scottish Onshore System and Subsea System

3.1 The NI gas transmission system for commercial and regulatory purposes begins at Moffat in Scotland, at the point which connects the GNI(UK) gas network to the National Grid National Transmission System (NGNTS) in GB (Great Britain). This connection allows for the importation of GB gas to the Gas Networks Ireland Transmission System and to the Northern Ireland Transmission System. From the connection with the National Grid system at Moffat, the GNI(UK) owned Scottish Onshore System (SWSOS) consists of a compressor station at Beattock, which is connected to Brighouse Bay by two pipelines all capable of operating at 85 barg.

3.2 A second compressor station at Brighouse Bay compresses the gas into the two sub-sea interconnectors to the Republic of Ireland which can operate at pressures in excess of 140 barg if required. This pressurised gas feeds Gormanston station which is the starting point of the South North pipeline.

3.3 Before reaching the Brighouse Bay compressor station, an offtake station at Twynholm supplies gas to Northern Ireland via the Scotland to Northern Ireland Pipeline (SNIP). The SNIP pipeline has a Maximum Operating Pressure (MOP) of 75 barg. While there is no compressor station dedicated to the SNIP alone, PTL has the contractual ability to request and pay for elevated Twynholm inlet pressures above the contractual guaranteed supply pressure to Twynholm inlet of 56 barg.

3.4 A map GNI (UK), GNI and MEL infrastructure in Northern Ireland, Scotland and the Republic of Ireland is shown in Figure 3-1.

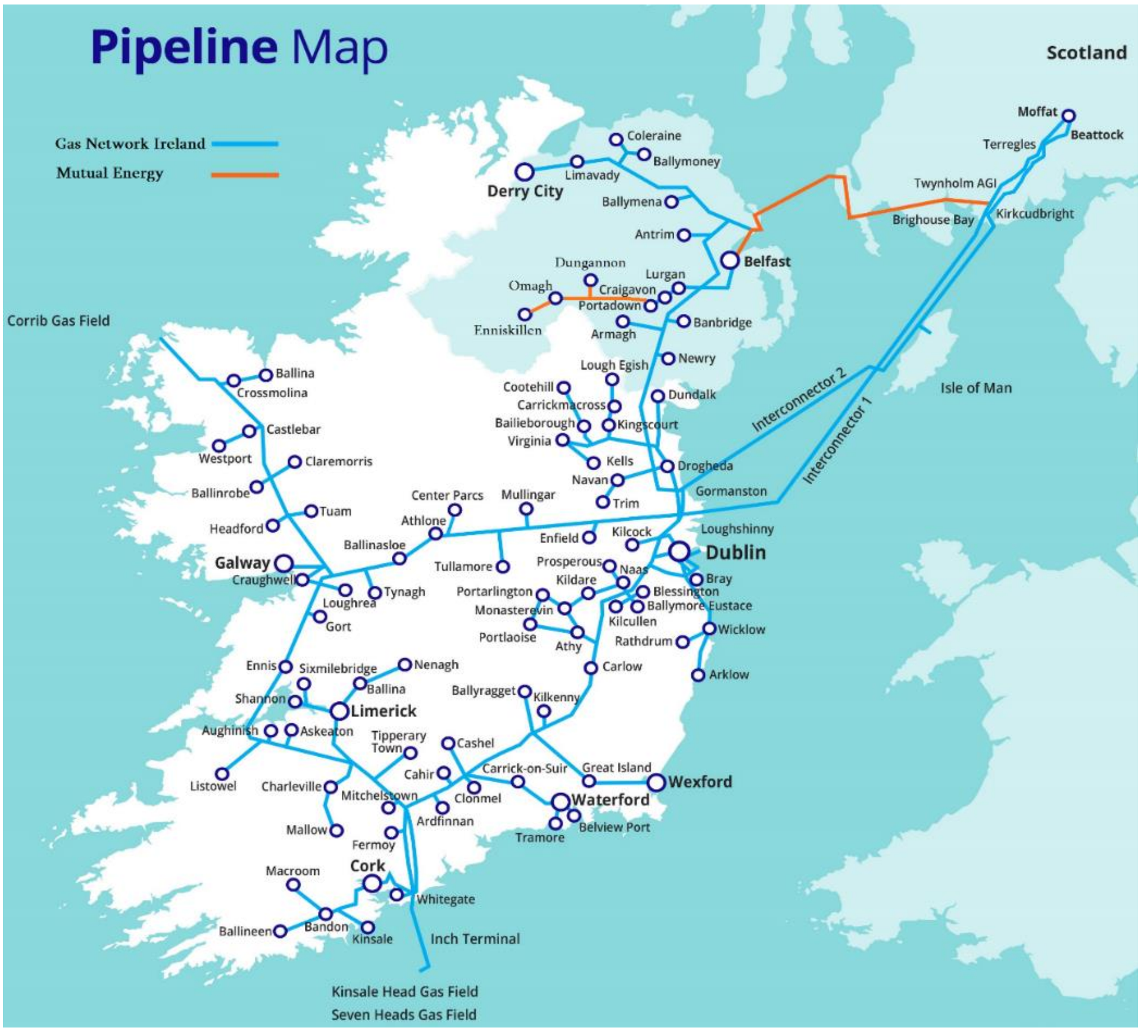

Figure 3-1: Northern Ireland Transmission Network Map (GNI (UK)/MEL infrastructure in Scotland and GNI infrastructure in the Republic of Ireland is also shown).

Northern Ireland Transmission System

3.5 The Scotland to Northern Ireland Pipeline (SNIP) (600 mm nominal diameter), completed in 1996, connects to the SWSOS at Twynholm in Scotland and has a MOP of 75 barg. The pipeline is 135 km long, runs towards the coast near Stranraer and crosses the Irish Sea to terminate at Ballylumford Power Station, Islandmagee. The SNIP is owned and operated by Premier Transmission Limited (PTL).

3.6 The Belfast Gas Transmission Pipeline (BGTP) comprises a further 35 km of 600 mm pipeline with a MOP of 75 barg and runs from Ballylumford via Carrickfergus to Belfast, where it supplies the Phoenix Natural Gas (PNGL) distribution network. The BGTP is owned and operated by Belfast Gas Transmission Limited (BGTL).

3.7 The North-West Pipeline (NWP) (450 mm nominal diameter) connects to the BGTP at Carrickfergus and extends a further 112 km from there to Coolkeeragh power station. The NWP is owned and operated by GNI (UK). The Firmus Energy distribution network connects several towns to the NWP.

3.8 The South-North Pipeline (SNP) (450 mm nominal diameter), built in 2006, connects to the NWP at Ballyalbanagh, Co. Antrim and extends 156 km to Gormanston, Co. Meath in the Republic of Ireland. The SNP supplies, through the Firmus Energy distribution network, the towns in the corridor from Newry to Belfast. The pipeline facilitates supplies into the Northern Ireland transmission system via IC2 (Interconnector 2)[4] by booking capacity and placing nominations at the South North IP Entry Point and through the ROI transmission system.

3.9 In 2015, following an open competitive process, conveyance licences were awarded for the 'Gas to the West' (GTTW) network extension, to Mutual Energy (through its subsidiary West Transmission Limited) for the transmission element and to SGN Natural Gas (SGNNG) for the distribution element.

3.10 The construction of the circa. 200 km of gas pipelines (78 km being transmission pipeline) as part of the Gas to the West Project commenced in October 2017. It is estimated that this project would connect up to 40,000 new business and domestic consumers to natural gas in the West and North-West.

3.11 The Strabane connection became live in 2017. The main 'high pressure' transmission extension and the three 7 barg intermediate pressure system 'legs' were all completed and commissioned by 2019.

Haynestown and Stranraer

3.12 Two offtakes from the NI system exist to supply customers outside of Northern Ireland which are to have reserved capacity in the NI Network (i.e. capacity not available to NI Shippers) from Gas Year 2020/21 onwards, as described below;

- an offtake on the SNIP at Stranraer in Scotland, already in commercial operation but which from Q4 2020 is expected to have arrangements such that it shall have reserved capacity of 0.931 GWh/d (equating to 0.084 mscmd) at Moffat and at the Stranraer Exit Point, and;
- an offtake on the SNP near Haynestown in the Republic of Ireland (to supply an new offtake to the ROI System), which is expected from Q4 2020 to have arrangements such that it shall have reserved capacity of 6.6 GWh/d (equating to 0.597 mscmd) at Gormanston and at the ROI System Exit Point.

These two offtakes are accounted for in the NIGCS.

3.13 Figure 3-2 shows a map of the Northern Ireland Transmission Network from Moffat in Scotland to Gormanston in the ROI.

[4] IC2 is a 195km sub-sea pipeline that runs from Brighouse Bay compressor station in southwest Scotland to Gormanston, Co. Meath, Ireland.

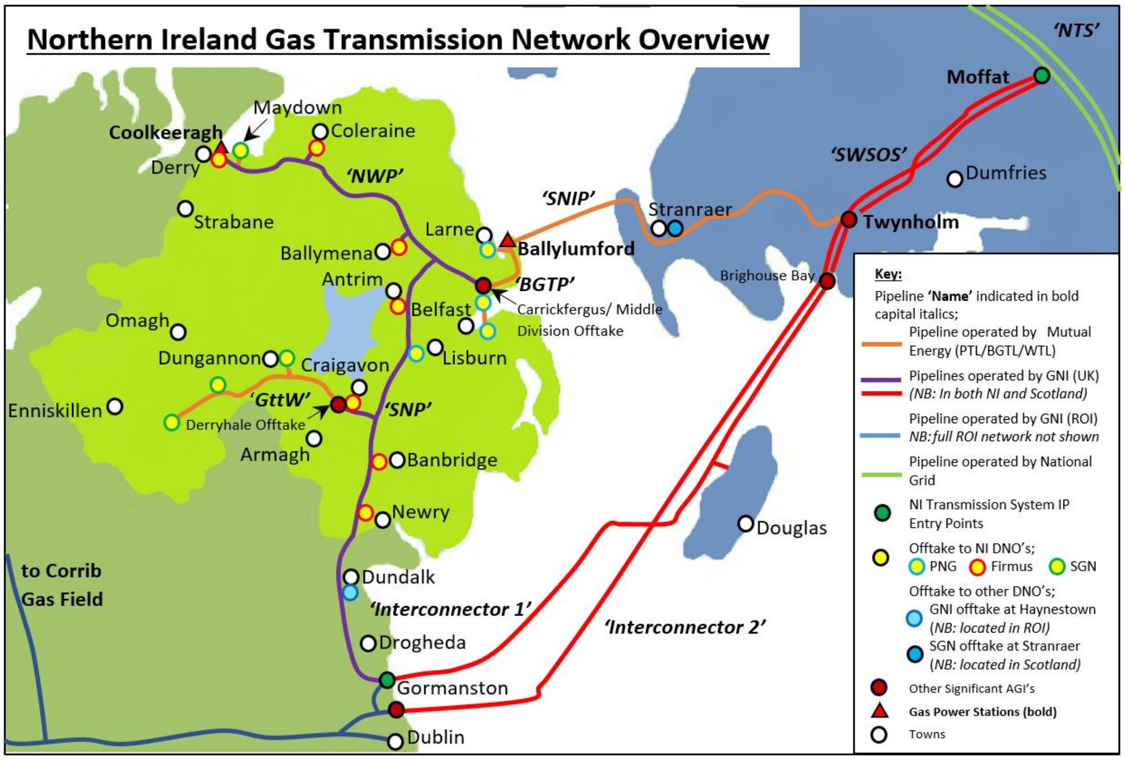

Figure 3-2: NI Transmission Network Map

Northern Ireland Distribution System

3.14 Northern Ireland has three existing gas distribution network companies: Phoenix Natural Gas Limited (PNGL), Firmus Energy (Distribution) Limited (FE) and SGN Natural Gas Limited (SGNNG) respectively. Figure 3-3 below illustrates an overview of their respective Gas Supply Areas.

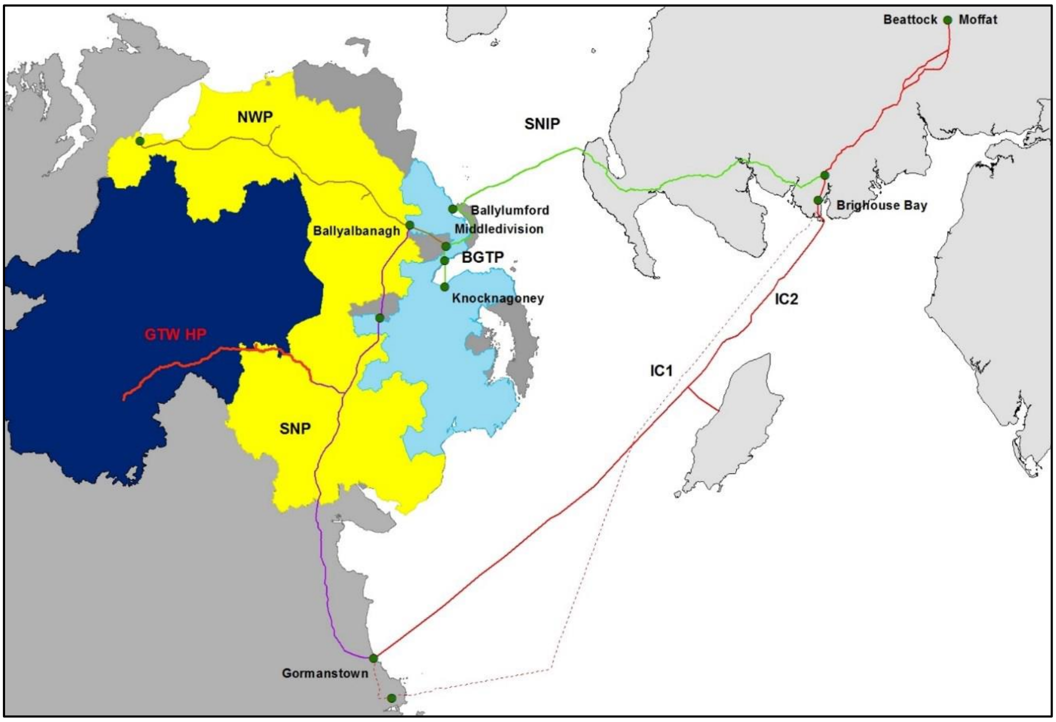

Figure 3-3: NI Distribution Gas Supplies area overview, PNGL area in light blue, FE areas in yellow and SGN area in navy.

3.15 PNGL own and operate the distribution network in the Greater Belfast (including Larne and 'East Down') area. They were awarded their conveyance licence in September 1996 and presently have over 225,773 connections[5]. A map of the PNGL licensed area is shown in Figure A4-1 in Appendix 4: Maps.

3.16 FE own and operate the distribution network in the area commonly referred to as the 'Ten Towns'. FE was awarded their conveyance licence in March 2005 and have over 51,572 connections[5]. The licenced area covers a greater geographical area including Antrim, Armagh, Ballyclare, Ballymena, Ballymoney, Banbridge, Bushmills, Coleraine, Craigavon, Cullybackey, Derry~Londonderry, Limavady, Lurgan, Moira, Newry, Portadown, Portstewart, Tandragee and Warrenpoint. A map of their licence area is shown in Figure A4-2 in Appendix 4: Maps.

3.17 SGNNG own and operate the distribution network in the main conurbations in the west of Northern Ireland including Strabane (operational since January 2017), Omagh, Enniskillen, Derrylin, Dungannon, Coalisland, Cookstown and Magherafelt which were commissioned in 2019. SGNNG was awarded their conveyance licence in February 2015 and have over 774 connections[5]. A map of their licence area is shown in Figure A4-3 in Appendix 4: Maps.

3.18 SGN operate a Distribution network supplying the town of Stranraer in Scotland which is supplied by the SNIP. While GNI operate a distribution network supplying Haynestown in the Republic of Ireland which is to be supplied by the South North pipeline.

3.19 Hence, the SGN Stranraer load and the future GNI Haynestown connection are to be considered within the scope of this document in assessing the capacity of the NI transmission network to supply their demand.

Potential Additional Gas-Fired Power Generation

3.20 Belfast Power Ltd. had planning permission approved in April 2019 for the construction of a 480 MWe capacity Combined Cycle Gas Turbine (CCGT) power station located in Belfast Harbour Estate, supplied by an offtake to the Belfast Gas Transmission Pipeline near Kinnegar Barracks. It is noted that the project was not awarded a capacity contract in the SEM Capacity Market 2023/2024 T-4 Capacity Auction[6]. The project does however retain a grid connection offer from System Operator Northern Ireland (SONI)[7].

3.21 EPUK Investments (EPUKI) acquired AES' Northern Ireland assets (namely Kilroot and Ballylumford power stations) in June 2019 and is exploring options for flexible and renewable power generation, including new gas-fired generation, across the existing sites. The SEM Capacity Market 2023/2024 T-4 Capacity

[5] Northern Ireland Authority for Utility Regulation Quarterly Transparency Report, Quarter 2 April to June 2020
[6] https://www.sem-o.com/documents/general-publications/T-4-2023-2024-Final-Capacity-Auction-Results-Report.pdf
[7] http://www.eirgridgroup.com/site-files/library/EirGrid/EirGrid-Group-All-Island-Generation-Capacity-Statement-2019-2028.pdf

Auction results have confirmed the award of 338.09 MWe of new (Gas Turbine) Awarded Capacity to EP Kilroot[6], which after accounting for de-rating factors applied[8], implies an Installed Capacity requirement of 383 MWe. Engagement between the project developer and the relevant stakeholders is ongoing as to the project's final detailed configuration. The operational commencement date is due 1st October 2023 and the technology type is flexible gas-fired Open Cycle Gas Turbine OCGT technology.

Potential Additional Gas Connections

3.22 Islandmagee Energy Limited ("IMEL"), a subsidiary of InfraStrata plc hold the development rights to an Underground Gas Storage project located in Islandmagee, County Antrim. The project (number 5.1.3) was not included in the European Commission's fourth list of Projects of Common Interest (PCI[9]).

3.23 The project to upgrade the SNIP pipeline to accommodate physical reverse flow between Ballylumford and Twynholm (PCI number 5.1.2), was not included in the European Commission's fourth PCI list[9].

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[8] https://www.sem-o.com/documents/general-publications/Initial-Auction-Information-Pack_IAIP2122T-2.pdf, page 6

[9] https://ec.europa.eu/energy/sites/ener/files/c_2019_7772_1_annex.pdf

Chapter 4 Northern Ireland Gas Demand

Historic NI Annual Demand

4.1 The historic NI gas demand is summarised by sector in Table 1 and shown graphically in Figure 5 below. The distribution category includes the gas demand of Phoenix Natural Gas, Firmus Energy, SGN Natural Gas and SGN at Stranraer, while the power sector includes the Ballylumford and Coolkeeragh power stations.

4.2 A gas year begins on 1st October and ends 30th September each year. All tables in this document show data for a given gas year.

Table 4-1: Historic NI Annual Demand

	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20
ENERGY (GWh/y)										
Power	11,562	9,137	7,986	8,390	9,646	10,011	10,082	8,925	8,894	8,801
Distribution	4,834	5,008	5,603	5,377	5,935	5,732	5,870	6,568	6,589	7,388
Total NI	**16,396**	**14,145**	**13,589**	**13,767**	**15,581**	**15,743**	**15,952**	**15,493**	**15,483**	**16,189**
VOLUME (mscm/y)										
Power	1,047	827	723	759	873	911	964	816	816	803
Distribution	438	453	507	487	537	522	531	600	604	672
Total NI	**1,484**	**1,280**	**1,230**	**1,246**	**1,410**	**1,433**	**1,495**	**1,416**	**1,420**	**1,475**

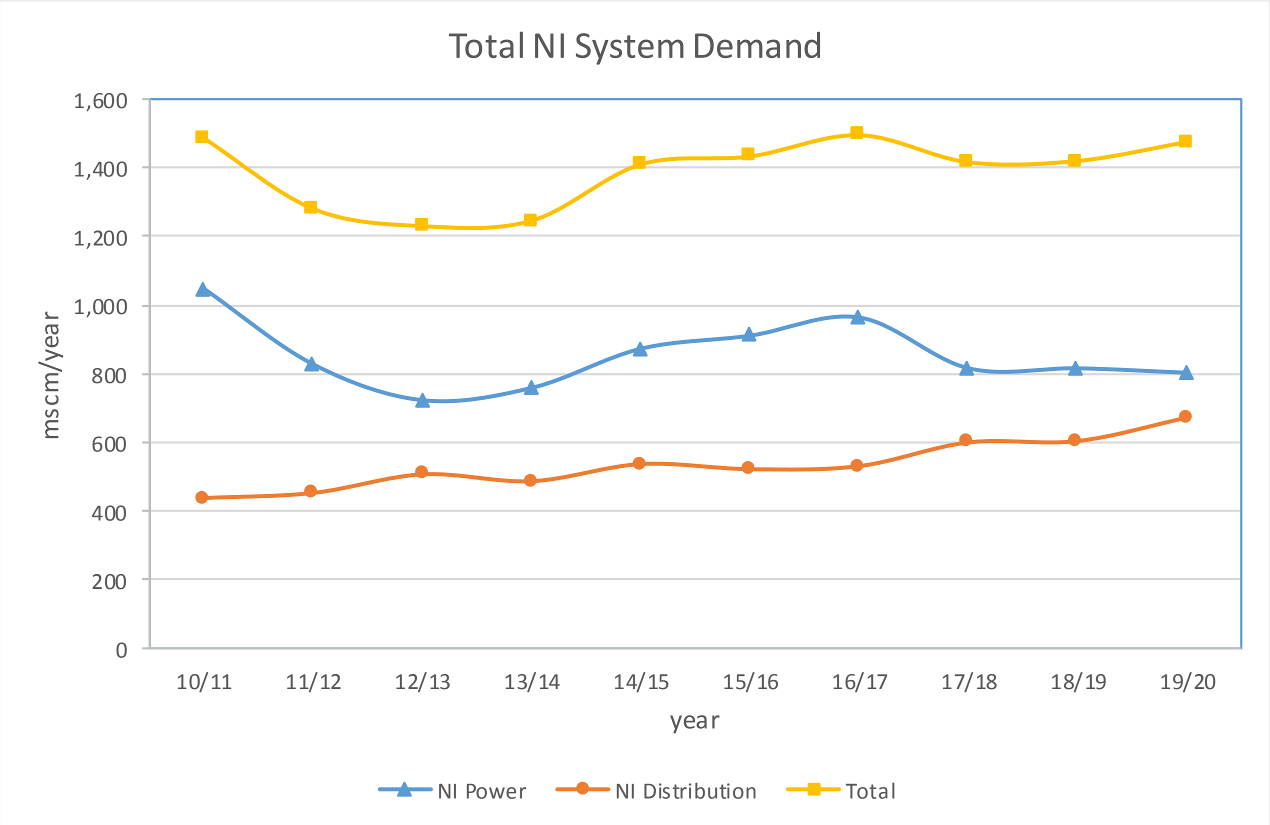

Figure 4-1: NI Historic Demand (mscm/y)

4.3 The figures provided in Table 4-1 were provided from the Gas Market Operator (GMO) for all NI DNOs (including Stranraer demand) and power stations customers on the NI transmission system.

4.4 In the period 2009/10 to 2018/19, the highest annual gas demand was recorded in 2016/17. Despite a decline in power sector gas demand, distribution demand has steadily grown across the period. The total system demand forecast for 19/20 is within 2% of the 10/11 levels.

NI Intra-Year Gas Demand

4.5 Figure 4-2 and Figure 4-3 show the within year NI gas demand. It is noteworthy that demand does not show a pronounced seasonal variation. The demand profile in is quite irregular. With a large proportion of the demand coming from the power sector, this variation is likely linked at least in part to the flexibility of gas generators being utilised to complement variable renewable energy sources such as wind and solar.

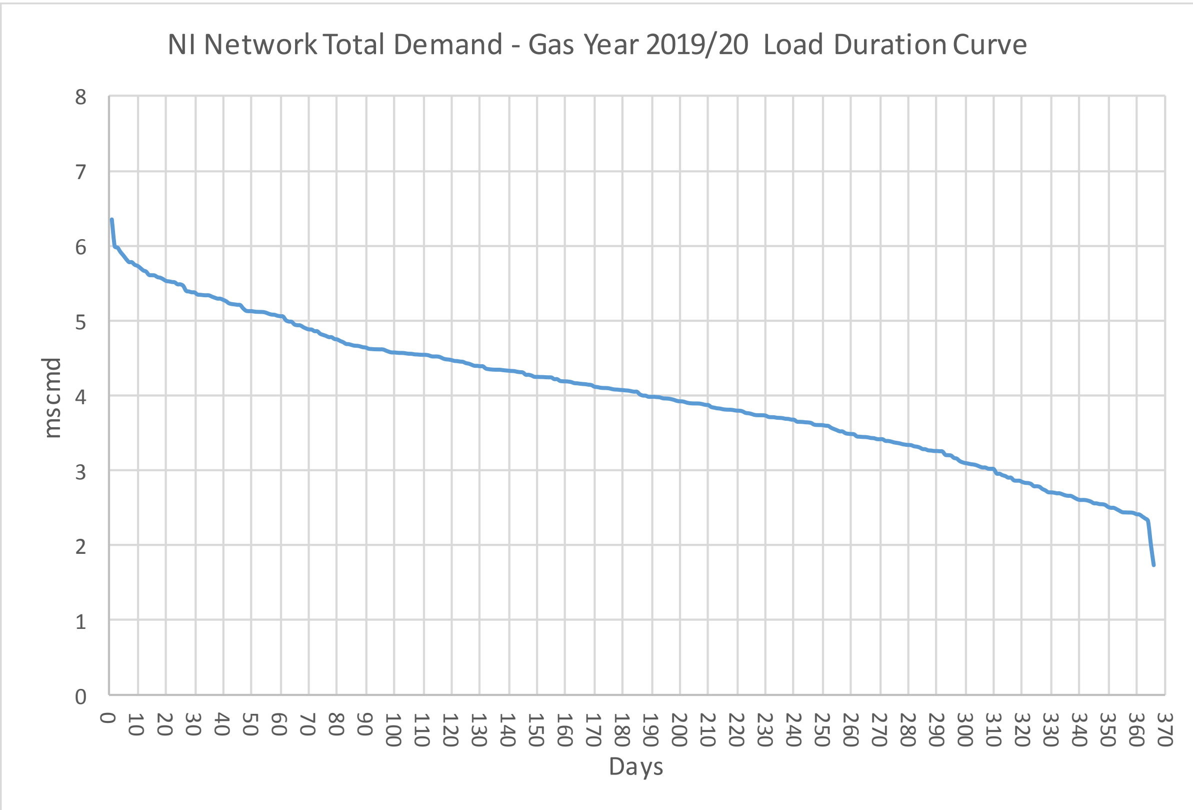

Figure 4-2: NI Network Total Demand Load Duration Curve for 2019/20.

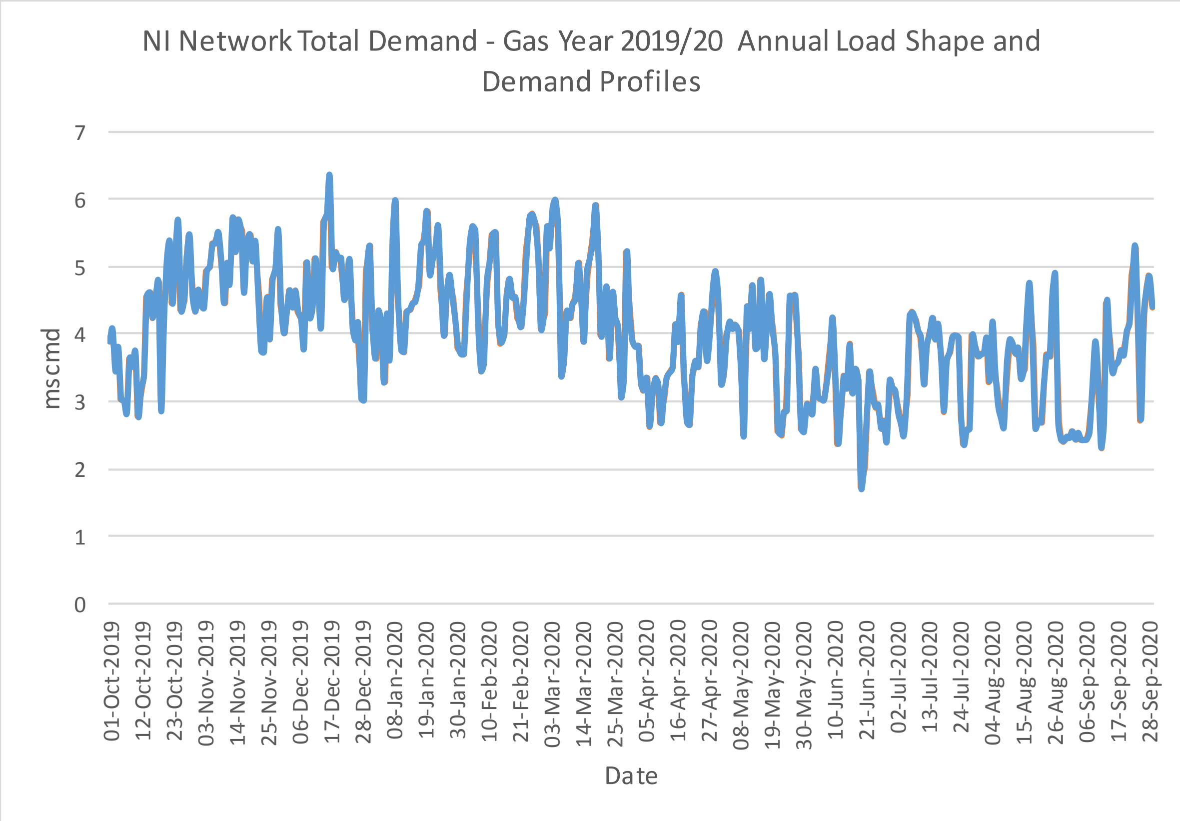

Figure 4-3: NI Network Total Demand showing daily variations up to 15/09/2020

Power Sector

4.6 The Single Electricity Market (SEM) is the wholesale electricity market for the island of Ireland. The market arrangements are designed to integrate the all-island electricity market with European electricity markets, enabling the free flow of energy across borders[10]. The SEM allows for increased competition from power generation in the Republic of Ireland, which impacts NI power sector gas consumption.

4.7 The move by SONI to 65% renewable penetration (i.e. System Non-Synchronous Penetration Limit), driven by government policy to meet challenging carbon reduction targets, has also reduced the annual volume of gas needed for power generation. Gas fired dispatch tends to fluctuate with the variation of renewable generation levels on the electrical power grid, such as wind and solar generation. However, it must be noted that this does not change the peak day demand on the gas network on days when cold calm weather and low wind conditions prevail.

4.8 Changes in annual gas volumes for power generation is influenced by substantial swings in commodities – specifically coal, gas and carbon.

4.9 One (of three) of EPH Ballylumford's B Station units closed in January 2016 and the remaining two units were initially reduced in capacity, before closing in November and December 2018. Three units at its C Station remain operational

[10] www.EirGrid.com/customer-and-industry/i-sem

with a nominal 593 MW (electrical) capability. Likewise, ESB Coolkeeragh's plant remains operational with a potential 408 MW (electrical) output.

Distribution

4.10 Demand from the Distribution sector has continued on a general upwards trend across the previous ten years as shown in Figure 4-1, reflecting increasing market penetration of natural gas as a fuel within the domestic and industrial/commercial sector.

Forecast NI Annual Demand

Overview

4.11 The power stations and Distribution companies (including SGN for Stranraer and, GNI for the future Haynestown connection) have provided their forecast annual gas demands for the next 10 years. Table 4-2 and Figure 4-4 demonstrates the forecast changes for total demand and also the individual sectors for the years considered. The following sections provide some further details on each of the sectors. It is noted that a prolonged impact of the current COVID-19 response is not assumed in the figures provided.

4.12 All volumes are based on typical gas Calorific Value (CV) values (which is a measure of the energy density of the fuel) seen historically at Moffat from National Grid's National Transmission System (NGNTS) (taken to be 39.8 MJ/m^3). It is noted that this figure is an average value and any changes to Moffat CV values will impact on the volumes of gas required.

Table 4-2: NI Forecast Annual Demand for 2020/21 to 2029/30 (mscm/y)

	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30
Power	730	767	782	780	615	605	605	605	605	605
Distribution	679	701	722	749	768	785	798	807	816	826
Haynestown	35	36	49	51	52	76	78	79	80	82
Stranraer	15	15	15	15	16	16	15	15	15	15
NI Total	1409	1468	1504	1529	1383	1390	1403	1412	1421	1431
Total	1459	1519	1567	1594	1451	1482	1496	1506	1516	1528

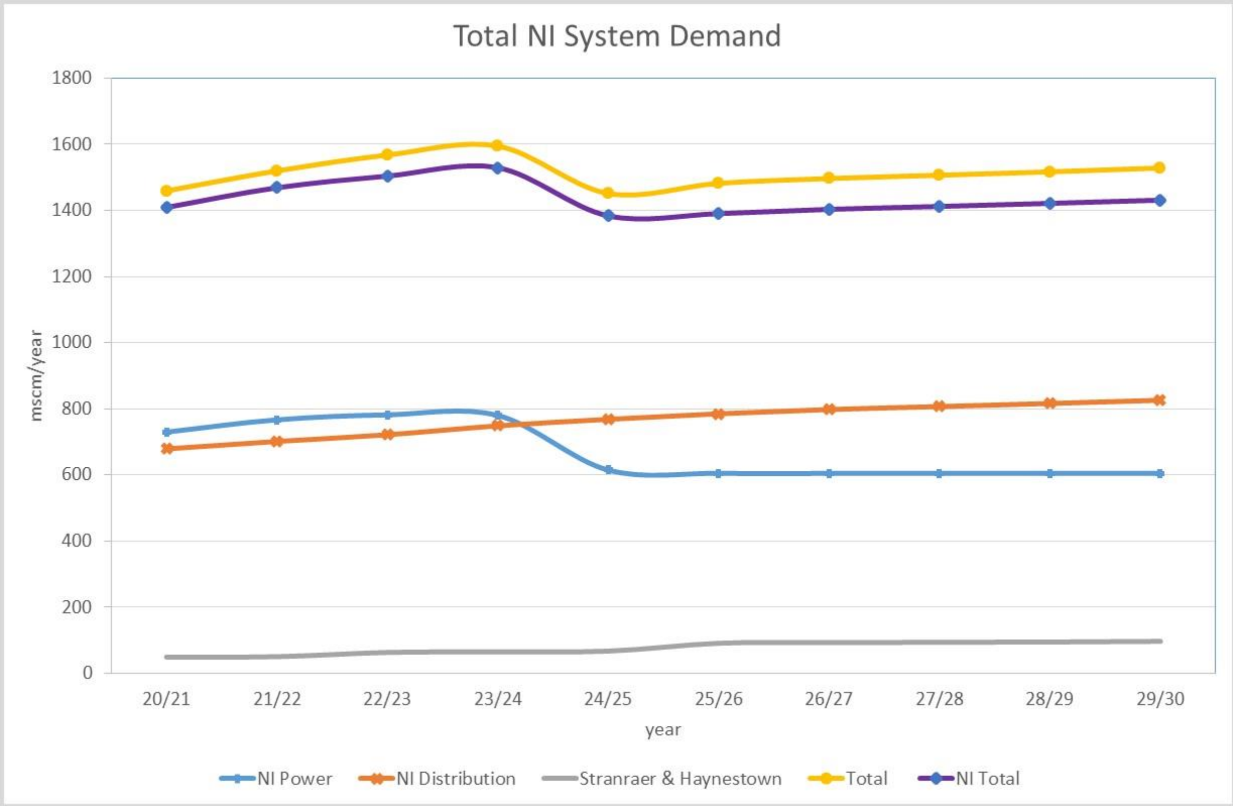

Figure 4-4: NI Forecast Annual Demand for 2020/21 to 2029/30 (mscm/y)

4.13 The overall ten-year forecast indicates a changing demand profile over the period, with the proportion of distribution demand increasing from 48% in 2020/21 to accounting for 58% of total NI demand by 2029/30. The forecast annual demands show 1.6% NI system growth between the start and end of the ten-year period being examined (excluding Haynestown and Stranraer). When Haynestown and Stranraer are included in the total figures, an increase of 4.7% in total demand is forecast, the majority of this growth coming from Haynestown as Stranraer demand is relatively static. The NI system demand at the end of the 10 year forecast is within 7% of that at the end of last year's ten-year forecasts.

Electrical Power Sector

4.14 Forecast figures were provided by the two current gas fired power stations, EPH Ballylumford and ESB Coolkeeragh. The total power generation forecasts provided in Figure 4-4 above are the aggregated demand for these two generators only (i.e. no new plant has been assumed).

4.15 As there are a number of competing factors and assumptions, there is a level of uncertainty in the forecast annual demand figures for the power stations. This reflects the difficulties the power stations face in predicting a 10-year profile. The forecasts are based upon the power stations' best estimates and latest assumptions, but the changing nature of the competing factors (such as from generation in the RoI, the increasing penetration of renewables, impacts on commodities prices, plant retirement etc.) should be taken into account when assessing the future demand forecasts.

4.16 Power sector demand growth of 7% is forecast between 2020/21 and 2022/23 (to 780 mscm/y), followed by a 22% decline from that peak level across the period to 2029/30. In total then, a 17% decline in power sector demand is forecast by 2029/30 in comparison to 2020/21 forecast consumption. The ten-year aggregated power generation forecast volumes are approximately 12% lower than those forecast in last year's statement. The load of any new gas fired power stations has not been included in the forecasts above, which contributes to the decline. It is noted that the SEM 2023/2024 T-4 Capacity Auction results have confirmed the award of 338.09 MWe of new (Gas Turbine) Awarded Capacity to EP Kilroot , which after accounting for de-rating factors applied, implies an Installed Capacity requirement of 383 MWe. This proposed new power station load has been examined in the sensitivity analysis and it has been shown that there is capacity for this new 383 MWe OCGT near Kilroot to 12 barg.

4.17 As previously mentioned, the closure of Ballylumford B Station (units B4 and B5, providing 250 MW (electrical)) in 2018 has reduced the gas fired power generation demand currently operational in Northern Ireland.

4.18 44% of Northern Ireland electricity consumption was generated by renewable sources in the 12 months to June 2019, which surpassed Northern Ireland's renewable target of 40% by 2020[11]. With the increasing amounts of renewable electrical generation, OCGTs may see increased prevalence with associated impacts on peak day gas demands. The power generator's forecasts will have been based on a number of factors, not least the SONI/EirGrid All-Island Generation Capacity Statement 2020-2029[12]. This document assumes that EPH Kilroot oil/coal fired units ST1 and ST2, providing 476 MWe capacity will not be available after 2023. SONI and EirGrid are also working towards the delivery of the second North South Interconnector, and despite planning permission having been recently granted in Northern Ireland[13], its delivery is not likely before 2024[14]. Upon completion of the second North South Interconnector, the all-island electricity system will have access to the generation capacity from both jurisdictions to meet the combined load. The all island system can then be considered to be capable of operating electrically as one. Any synchronous generation deficit owing to oil/coal plant closure or any continuation of limited interconnection will potentially be met with new gas fired power generation.

4.19 The generators forecasts were based on an assessment of likely future operating requirements of the plant in light of SEM market conditions, accounting for fuel price forwards and continued renewables penetration (based on average wind profiles over the last number of years). The competitiveness of gas-fired power generation, and so their merit order within the market, will be influenced by energy policy looking to drive de-carbonisation of electrical generation, which although a devolved matter with the Department for the Economy having

[11] http://www.soni.ltd.uk/newsroom/press-releases/renewable-energy-record/
[12] www.eirgridgroup.com/site-files/library/EirGrid/All-Island-Generation-Capacity-Statement-2020-2029.pdf
[13] https://www.planningni.gov.uk/index/news/dfi_planning_news/news_releases_2015_onwards/news-interconnector-decision-140920.htm

responsibility for such in Northern Ireland, is heavily influenced by UK Government policy as well as at an all-island level, due to participation in SEM. Other critical assumptions are based upon the projected transmission constraints determined by the SONI to guarantee electrical system stability, projected electricity demand and plant outage requirements (as required for maintenance activities).

Distribution

4.20 Forecast figures were provided by the three gas Distribution Network Operator's (DNO) in Northern Ireland (PNGL, FE and SGNNG), as well as SGN for Stranraer and GNI for the future Haynestown connection. The distribution forecasts provided in Figure 4-4 show the total NI and the overall total aggregated demand forecasts. Forecasts provided for the purposes of the NI Gas Capacity Statement were based on the distribution companies' own modelling forecasts which incorporated the expected growth rates within the domestic and I/C (Industrial and Commercial) sectors over the 10 years modelled.

4.21 The total NI distribution demand forecasts increases gradually year on year (ranging from 1.1–3.8% growth per annum). When Haynestown and Stranraer are included (although Stranraer total distribution load growth is effectively static), growth ranges from 1.1-4.9% per annum. Significantly, this represents an increase of approximately 22% over the 10 year forecast period, from an initial forecast demand of 729 mscm/y in 2020/21 rising to 923 mscm/y in 2029/30. The forecast at the end of the ten-year period in 2029/30 is 14% higher than at the end of last year's ten-year forecasts for the total distribution demand (i.e. last year 812 mscm/ywas estimated by 2028/29). The year-on-year increase reflects the distribution companies' expected growth rates within the domestic and I/C sectors. This is due to the increasing NI distribution network, including extensions under the Gas to East Down and Gas to the West projects and increasing penetration within the already established network areas.

4.22 The DNO's forecasts are inclusive of shrinkage gas. No indication has been given that interruptible load factors or typical daily profiles will change. The current COVID-19 response has led to uncertainty in the 2019/2020 period, but it is assumed this will not be an enduring factor affecting long-term distribution planning.

4.23 Discussions with industry and the NIAUR in relation to biogas are at an early stage and therefore no consideration has been given as to its impact on the energy supply mix at present. Equally, no consideration appears to have yet been given to any potential demand for gas (through Compressed Natural Gas (CNG) as a fuel for transport. It is noted that Gas Networks Ireland as a part of its Vision 2050 strategy is targeting 20% renewable gas on its ROI network by 2030

4.24 It is also unclear to what extent Distribution Shippers, in general, have considered the potential for improved energy efficiency as impacting on demand volumes. One Shipper described how energy efficiency savings are likely to be offset against upward pressure for improved comfort levels.

4.25 The Northern Ireland Energy Strategy 2050[14], to be published by end of 2021, is expected to provide further clarity on issues affecting the future of gas supply and demand. Energy accounts for approximately two thirds of all greenhouse gas emissions in Northern Ireland and heat accounts for approximately half of Northern Ireland's total energy consumption[15], therefore decarbonisation of heat is likely to be a key aspect of the strategy. With approximately 45% of distribution sector consumption in the 12 months to June 2020 (per the previous four NIAUR Quarterly Transparency Reports[16]) being by domestic and small industrial and commercial consumers (which will predominantly be heating load), this will be of significant importance to Distribution Shippers future demands (with potential for gas penetration continuing to replace carbon intensive oil fired central heating systems, since the NI natural gas industry is still in the growth phase), but so too will other strategies affecting demand (for example, energy efficiency and transport, amongst others), as well as potential future gas supply developments (e.g. biogas and hydrogen, etc.).

Historic NI Peak Demand

4.26 The historic NI peak day demand (capacity) for each of the last ten gas years is summarised by sector in Table 4-3 below. The distribution category includes the historic gas demand of Phoenix Natural Gas, Firmus Energy, SGN Natural Gas and SGN Stranraer, while the power sector includes the Ballylumford and Coolkeeragh power stations.

Table 4-3: Historic Actual Peak Day NI Demand (mscmd)

Historic Actual Peak Day Demands (mscmd)				
Year	Peak Flow Power	Peak Flow Distribution	Potential Total NI Peak Flow	Actual Realised NI Peak Flow
2010/11	4.63	2.66	7.29	6.67
2011/12	4.68	2.56	7.24	5.96
2012/13	4.19	2.59	6.78	6.54
2013/14	4.24	2.64	6.88	5.81
2014/15	4.62	2.79	7.41	6.33
2015/16	4.26	3.29	7.55	6.74
2016/17	3.96	4.00	7.96	6.28
2017/18	3.86	4.02	7.88	6.45
2018/19	3.76	3.15	6.91	6.44
2019/20	3.65	3.39	7.04	6.38

4.27 The volumes provided in Table 4-3 are the metered flows recorded by the TSOs for gas exiting their respective networks.

[14] https://www.economy-ni.gov.uk/articles/northern-ireland-energy-strategy-2050
[15] https://www.economy-ni.gov.uk/sites/default/files/consultations/economy/energy-call-for-evidence-summary-report.pdf
[16] https://www.uregni.gov.uk/publications/transparency-reports-2020

4.28 The highest historic total peak day demand on the NI network occurred on 15th January 2016 at 6.74mscm/d. On this day, there was a combination of low temperatures impacting distribution demand and low wind, meaning relatively high dispatch of gas fired power generation in NI. In gas year 2019/20, the peak demand (of 6.38mscm/d) occurred on the 17th of December 2019.

4.29 On 1st March 2018, the highest ever Northern Ireland Distribution demand of 4.02 mscm/d was seen – this was despite what would be considered akin to 'average winter peak' conditions of only "17 Degree Days" being recorded on this day (1 degree day equalling each degree Celsius the average daily temperature is below a standard reference temperature of 15.5°C). It is possible this is explainable by other influencing factors, including public forewarning of the 'Beast from the East' extreme weather pattern and media coverage that National Grid issued a gas deficit warning, which may have helped spike domestic Non-Daily Metered (NDM) demand beyond what would be expected on a purely temperature driven basis.

4.30 The peak power flow recorded in gas year 2019/20 was the least recorded across the previous ten years. This is likely explainable by the closure of Ballylumford B Station which provided peaking plant for such demand scenarios, along with the increasing penetration of renewable energy.

Forecast NI Winter Peak Day Gas Demand

Overview

4.31 In order to assess the system on days of different demand patterns, four sample demand days are analysed for each scenario over the ten-year period modelled: 1-in-20 severe year winter peak day, average year winter peak day, average spring day and summer minimum day. The demand data used for the modelling, as per Shippers' responses to questionnaires issued by the TSO's, is presented in Appendix 1.

4.32 Since the network is designed to meet firm winter peak demand, there is particular interest in assessing the ability of the network to meet the demands on the two winter peak days:

- the severe winter peak day firm demand representing the demand expected in 1 out of 20 years, and;
- an average year peak day firm representing a winter peak day demand in an average year (i.e. not abnormally cold etc.).

4.33 The historic peak Distribution demand seen on 28th February / 1st March 2018, as discussed at 4.29, contributed to the positive engagement between the TSO's and DNO's in reviewing forecasting methodologies for the sector. Regression analysis of this demand was used in developing forecasts supplied for this document, so that volumes accounted for temperature by deriving the number of Degree Days, with forecasts based on assumed Degree Day temperature conditions going forward and accounting for estimated domestic and I&C volume growth and any known large I&C demand changes (either loss of load or new load). Average winter peak forecasts have been based on the average of the maximum number of Degree Days experienced in the last 5 year being 17 Degree Days, whilst 2010 historic low temperatures of -10.1 degrees Celsius (i.e. 25.6 Degree Days) is used for Severe Winter Peak forecasts.

1-in-20 Severe Winter Peak Day Demand (Firm and Interruptible)

4.34 The Demand forecasts for the 1-in-20 Severe Winter Peak Firm and Interruptible case are presented below in Table 4-4.

Table 4-4: 1-in-20 Severe Winter Peak Day Firm and Interruptible Forecast Demand for Base Case Scenario

Severe Winter Peak Day Forecast Demands (mscmd)			
Year	**Peak Flow Power**	**Peak Flow Distribution**	**Total NI Peak Flow**
2020/21	3.94	5.24	9.18
2021/22	3.94	5.41	9.35
2022/23	3.94	5.62	9.56
2023/24	3.94	5.80	9.74
2024/25	3.94	5.93	9.87
2025/26	3.94	6.14	10.08
2026/27	3.94	6.21	10.15
2027/28	3.94	6.26	10.20
2028/29	3.94	6.30	10.24
2029/30	3.94	6.37	10.31

4.35 The 1-in-20 severe winter peak demand (firm and interruptible) figures in Table 4-4 above represent the combined total of the individual 1-in-20 year peak demands for each of the power stations and distribution companies. “Power” is the aggregate of Ballylumford, and Coolkeeragh Power Station demands. “Distribution” is the aggregate of Phoenix, Firmus, SGN Natural Gas, Haynestown and Stranraer demands. These figures therefore represent a simultaneous peak demand for both sectors.

4.36 The total Severe Winter Peak forecast demand figures have been consistently higher than the actual winter peak demands that have been actually recorded (the highest peak daily demand to date was 6.74 mscmd on the 15th January 2016 and this was forecast to be 7.55 mscmd (as per average winter forecasts) in this year) because, to date, the peak demands for the power stations and distribution companies have not occurred simultaneously.

4.37 Total forecasts show a year-on-year (ranging from 0.39 – 2.25% per annum) increase in the 1-in-20 peak demand, with 12.3% growth across the period to a total forecast demand in excess of 10.31 mscmd. This is driven largely by the distribution sector as power sector forecasts are flat across the ten-year period.

4.38 The peak power sector demand is forecast to remain at 3.94 mscmd across the forecast period. However, it is noted that some assumptions made, such as those discussed previously in 4.18, is that 476 MWe capacity at coal-fired EPH Kilroot units will no longer be available after the gas year 2024/25 and will be replaced by a new gas-fired power station, which does not form part of these estimates. The value of the sensitivity analysis contained in the appendix of this document looking at the addition of a new gas-fired power station is reinforced by this observation.

4.39 Severe Winter (1-in-20 year) peak demand forecasts for the distribution sector show a year-on-year increase (ranging from 0.64–3.88% per annum), amounting to a 21.56% increase across the period for the sector. This trend reflects previous forecasts for the expected growth of the distribution sector and is especially prevalent as penetration by SGNNG in the Gas to the West and PNGL in Gas to East Down licence areas continues to grow. The future Haynestown connection is a new contributor to this growth. A sensitivity has been added to examine the impact of making the Haynestown & Stranraer unused reserved capacity available to NI Shippers. Initial projected peak day demands of 2.1 GWh/d (0.19 mscmd) growing to 4.4 GWh/d (0.4 mscmd) are forecast for Haynestown by the end of the 10-year forecast period. Stranraer peak daily demand is expected to grow from 0.885 GWh/d (0.0801 mscmd) to 0.92 GWh/d (0.0833 mscmd) over the same 10-year forecast period.

Average Winter Peak Day Demand (Firm and Interruptible)

4.40 Again, the average winter peak day demand figures (presented in Table 4-5) represent the combined total of the individual average winter peak demand forecasts for each of the power stations and distribution companies.

Table 4-5: Average Winter Peak Day Firm and Interruptible Forecast Demand for Base Case Scenario

Average Winter Peak Day Demands (mscmd)			
Year	**Peak Flow Power**	**Peak Flow Distribution**	**Total NI Peak Flow**
2020/21	3.37	4.21	7.58
2021/22	3.37	4.35	7.72
2022/23	3.37	4.55	7.92
2023/24	3.37	4.68	8.05
2024/25	2.78	4.83	7.61
2025/26	2.78	5.04	7.82
2026/27	2.78	5.18	7.96
2027/28	2.78	5.28	8.06
2028/29	2.78	5.38	8.16
2029/30	2.78	5.49	8.27

4.41 The TSO's are satisfied with the potential reliability of the average winter peak forecasts provided by the DNO's as demands to expect on an ongoing basis, since they would appear largely aligned to historic volumes, accounting for expected growth in the sector. A review of forecasts against actual demands will be continued on an annual basis to ensure the suitability of this report in accurately testing capacity of the system to meet forecast demands.

4.42 Total forecasts are variable across the period with year-on-year forecasts of between 1.89% to 4.35% growth. The average winter peak forecasts show 9.1% growth in demand across the period to a total of 8.27 mscmd. This is driven by the distribution sector as average winter day power sector forecasts are forecast to fall quite significantly across the period (excluding any potentially new generation). Note, this is exceeding the contractual capacity limit of the Moffat IP Entry Point of 8.08 mscmd.

4.43 As mentioned, power sector demand is forecast to significantly decline across the period by as much as 17%, with variation of up to 22% between the minimum and maximum demand years which is attributed to the demand increasing initially over the period before then decreasing. As previously mentioned however, this does not include the load of any new gas-fired power station, with further assumptions as to the likely closure of EPH Kilroot coal-fired plant and the likely completion date of the second North South electrical interconnector. These forecasts will also be heavily influenced by other critical assumptions, as previously discussed at items 4.14–4.19.

4.44 Average Winter peak demand forecasts for the distribution sector show a year-on-year increase (ranging from 1.9–4.6% per annum), amounting to a 30.4% increase across the period for the sector. This trend reflects previous forecasts for the expected growth of the distribution sector and is especially prevalent as penetration by SGNNG in the Gas to the West and PNGL in Gas to East Down licence areas continues to grow. The future Haynestown connection is a new contributor to this growth, with initial projected average peak day demands of 1.9 GWh/d (approximately 0.17mscmd) growing to 4.4 GWh/d (approximately 0.36 mscmd) by the end of the period. Stranraer shows average peak day demands of 0.884 GWh/d (0.08mscmd) growing to 0.917 GWh/d (0.083 mscmd) by the end of the period.

Chapter 5 Modelling Scenarios

Overview

5.1 A hydraulic model of the NI transmission system was constructed using hydraulic modelling software which allows the user to configure and analyse the demand and supply balance on the network for a number of scenarios.

5.2 The model was run for the ten Gas Years from 2020/21-2029/30 inclusive, to determine if the existing Northern Ireland transmission system has the capacity to meet forecasted and potential additional flow requirements.

5.3 The modelling considers the ability of the system to meet the daily demand within that day. The ability of the system to respond to within day demand changes was not considered at entry points to the NI network where a flat flow profile of incoming gas is assumed.

Modelling Assumptions

5.4 Gormanston station is the landfall station for IC2 where gas comes ashore in the Republic of Ireland from Scotland. This gas is pressurised at Brighouse Bay Compressor Station prior to flowing under the Irish Sea via IC2. There is no compressor station at Twynholm where gas feeds the SNIP, there is however a guaranteed contractual inlet pressure at Twynholm of 56 barg. It is noted that historically the inlet pressures have been typically higher than the contractual guaranteed supply pressure. The graph below at Figure 5-1 shows the minimum, maximum and average hourly pressure at Twynholm on each day in the 'winter' months (taken as October to March) of 2019/20.

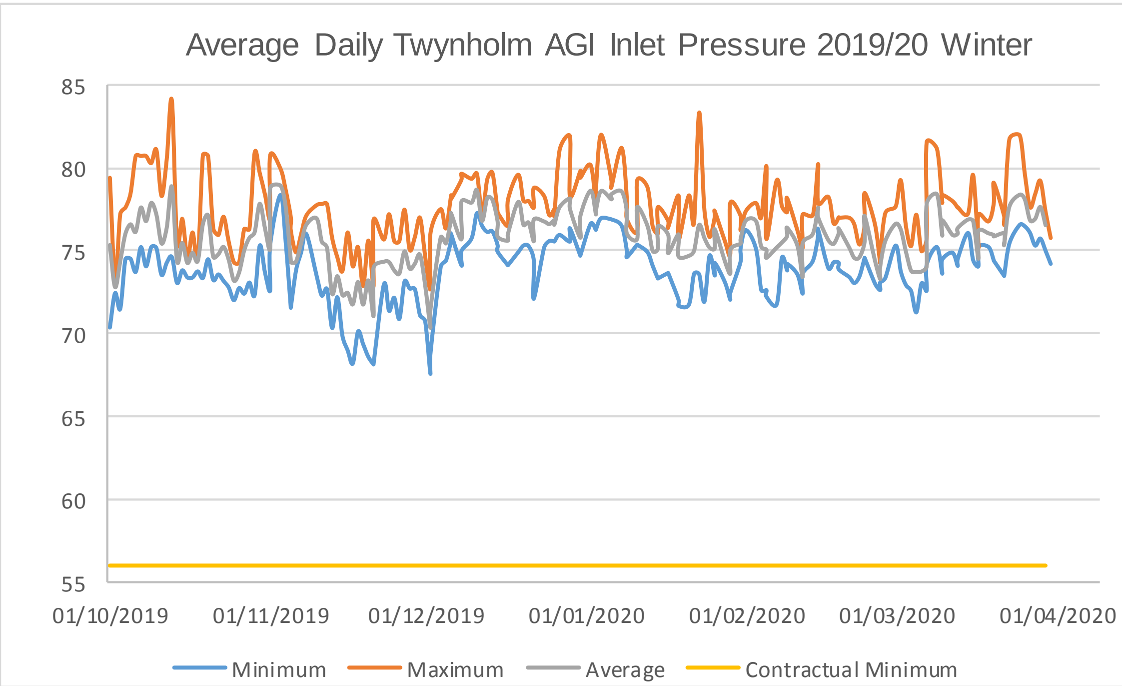

Figure 5-1: Min, Max & Average Daily Twynholm Inlet Pressure Winter 2019/20

5.5 The average minimum daily inlet pressure at Twynholm was 73.8 barg through the winter months of 2019/20.

5.6 Figure 5-2 illustrates a load duration curve of the same dataset looking at daily minimum pressure on each day which may allow better depiction and easier understanding of normal minimum pressure trends.

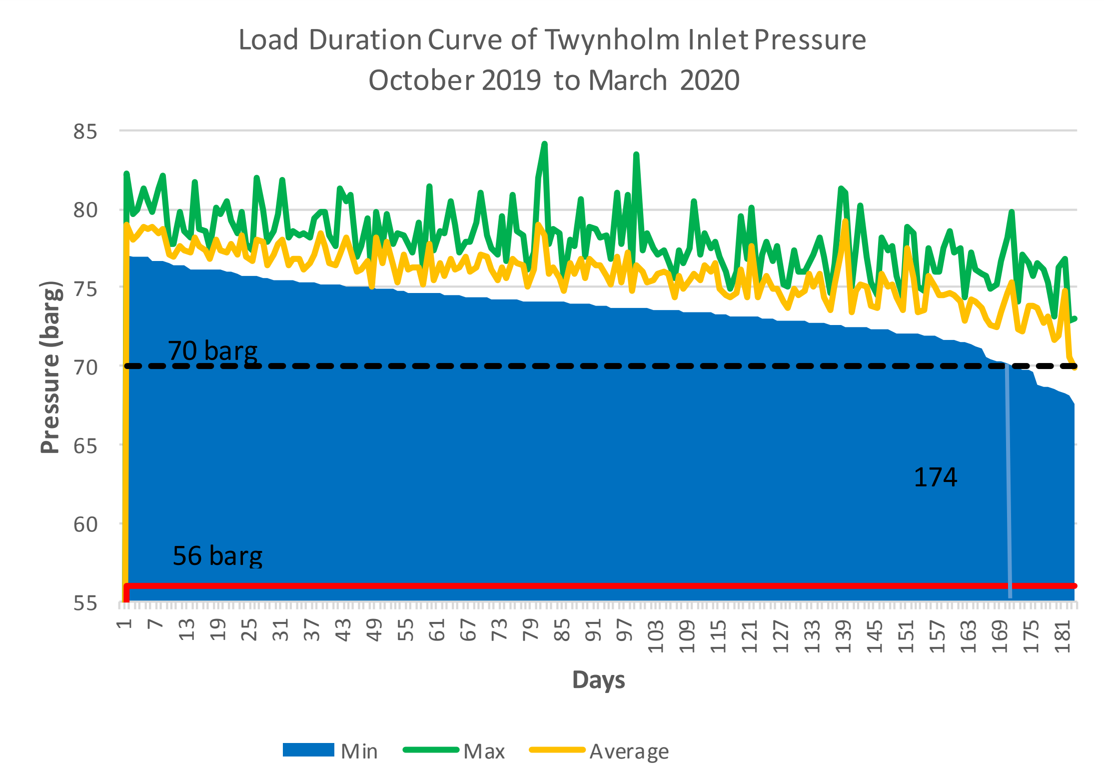

Figure 5-2: Load Duration Curve of Twynholm Inlet Pressure Winter 2019/20

5.7 The average daily minimum Twynholm inlet pressure across the period from October 2019 to March 2020 was 73.8 barg. There were 174 days in the dataset of 183 where minimum diurnal pressure was greater than 70 barg, hence the pressure was below 70 barg for only 9 days in the period. The minimum pressure experienced was 67.6 barg, well above the contractual guaranteed supply pressure of 56 barg.

5.8 The South North IP Entry Point remains fully available to support supply where required. Likewise, the Moffat IP Entry Point remains fully available to support supply with a capacity of up to 89.28 GWh/d, equating to 8.08 mscmd at the 56 barg guaranteed supply inlet pressure. The availability of higher Twynholm inlet pressures, which are not guaranteed, are of great importance to the ability to physically deliver gas through the Moffat IP Entry Point up to the capacity made commercially available (i.e. 8.08 mscmd). The predominant use of the Moffat IP Entry Point stems from the commercial practice of the NI Shippers and as such reflects the historical and current physical operation of the Northern Ireland transmission network. Therefore, to examine the physical ability of the network to supply commercial nominations at the Moffat IP Entry Point, the impact of operation at both guaranteed contractual pressure and such pressures as would be necessary to meet potential commercial nominations up to 8.08 mscmd are examined. This reflects the fact that 8.08 mscmd is only guaranteed at the contractual 56 barg inlet pressure. PTL do however have the contractual ability to request and pay for elevated Twynholm inlet pressures above the guaranteed supply pressure to Twynholm inlet of 56 barg.

5.9 A summary of key assumptions is set out in Table 5-1. Detailed modelling assumptions can be reviewed in Appendix 2.

Table 5-1: Summary of NIGCS 2020/21 Key Modelling Assumptions

Moffat IP Entry Point (Twynholm AGI)	
Minimum System Pressure at the Inlet to Twynholm AGI	56 barg
Control Mode	Volumetric Control with flows set flat at 1/24th total daily demand per hour
Pressure Drop across AGI	2.5 barg
Entry flow Profile	Flat
Twynholm AGI Design Capacity	8.64 mscmd
Commercially available Contractual Capacity (via Twynholm)	8.08 mscmd
Difference between Twynholm Design and Commercially available capacity	-0.56 mscmd
Capacity Commercially available to NI Shippers (i.e. Moffat IP Entry point less Stranraer reserved capacity)	7.996 mscmd
South North IP Entry Point (Gormanston AGI)	
Minimum System Pressure at the Inlet to Gormanston AGI	77.5 barg
Control Mode	Volumetric Control with flows set flat at 1/24th total daily demand per hour
Pressure Drop across AGI	2.5 barg
Entry flow Profile	Flat
Gormanston Ph2 AGI Design Capacity	6.0 mscmd
Commercially available Contractual Capacity (via Gormanston)	6.0 mscmd
Difference between Gormanston Design and Commercially available capacity	0 mscmd
Capacity Commercially available to NI Shippers (i.e. South North IP Entry Point less Haynestown reserved capacity)	5.4 mscmd
Carrickfergus AGI	
Control Mode	Free flow (flows determined by prevailing pressures).
Pressure Drop across AGI	2 barg
Pressure Requirements / Boundary Conditions	
Maximum Operating Pressure	75 barg
Minimum (contractual) Operating Pressure	12 barg[17]
Minimum (operational) Operating Pressure	39 barg[18]
Maximum Pipeline Velocities	20 m/s

[17] NI Network Gas Transmission Code; http://gmo-ni.com/assets/documents/NI-Network-Gas-Transmission-Code-Version-1.5-30th-April-2019.pdf
[18] NI TSO 'System Operator Agreement' approved by NIAUR

Network Conditions

5.10 Three scenarios of network conditions were modelled for this year's NIGCS. The 'Base Case' was aligned to contractual guaranteed pressures at Twynholm inlet and the NI transmission network (56 barg and 12 barg, respectively) and two forms of sensitivity analysis looking at maintaining 39 barg minimum target system pressure in the NI transmission network. It is noted that 39 barg is a target pressure and it is not expected that load shedding would occur to maintain this pressure tier.

5.11 A standing assumption of the modelling (since it has been the historic custom and practice) is that the Moffat IP Entry Point shall be the primary supply of capacity, in so far as is hydraulically possible under the given network conditions scenario, with flows through the South North IP Entry Point (Gormanston AGI) only being utilised for NI demand as necessary to balance supply and demand and/or to meet minimum pressure requirements. Haynestown demand will always be supplied via the South North IP Entry Point.

5.12 In all scenarios, a flat flow profile of NI demand being supplied through Twynholm is also assumed, which means the inlet pressure required to physically flow capacity into the SNIP will increase as the operating pressure of the SNIP increases. This is in order to maintain minimum pressure assumptions/requirements across the NI transmission network. The model, therefore, does allow Twynholm inlet pressure to increase as necessary to facilitate such flat flow profile, meaning the actual diurnal inlet pressure requirement is typically significantly more than 56 barg. In these scenarios, the constraint on being able to deliver such a flow profile should be considered as the availability of the maximum diurnal pressure requirement computed by the modelling.

5.13 Maintenance of higher NI transmission system pressure (e.g. 39 barg, the current operational pressure that the TSO's target to maintain in excess of), will require higher inlet pressures to sustain the same flow through Twynholm. The first variance in network conditions assumptions, therefore, examined the diurnal inlet pressures required to facilitate all NI load up to that made commercially available to NI Shippers (7.996 mscmd), plus Stranraer demand, being delivered through Twynholm, the relevant constraint here being the 75 barg MOP of the SNIP and the 77.5 barg maximum inlet pressure of Twynholm (i.e. 2.5 barg pressure drop across the station). Demand greater than 7.996 mscmd plus Stranraer demand would be met through the South North IP Entry Point.

5.14 At this higher NI transmission system pressure, the availability of only 56 barg at Twynholm at any point in a given day, would (on a flat flow basis) reduce the capacity which is physically possible to deliver into the NI network through the Moffat IP Entry Point. Therefore, a further iteration of modelling was undertaken to examine the extent to which greater flows through the South North IP Entry Point (Gormanston AGI) would be required to maintain the same minimum NI transmission system pressure.

5.15 The three network conditions scenarios modelled can therefore be summarised as per Table 5-2 below.

Table 5-2: Network Conditions Scenarios Modelled

Scenario	Minimum diurnal Twynholm inlet pressure	Minimum NI transmission system pressure
Base Case	56 barg	12 barg
NI transmission system pressure sensitivity	56 barg	39 barg
Twynholm inlet pressure sensitivity	Pressure as necessary to facilitate required flat flow (up to 7.996 mscmd + Stranraer Demand) through Twynholm	39 barg

Demand

5.16 Four typical demand scenarios were modelled; Severe Winter Peak, Average Winter Peak, Average Spring Day and Summer Minimum, and on both a Firm and Firm and Interruptible basis.

5.17 Three sensitivity studies are undertaken, the first examines the impact of making the unused reserved capacity at Stranraer and Haynestown available to NI shippers. The second looks at the impact that modelling Carrickfergus in volumetric control has on the system and the third examines the impact of additional power sector demands.

5.18 The load growth scenario was modelled as a sensitivity analysis to assess the impact on the network of such increased demands. The approach was to add the additional demand of the sensitivity scenario to the Base Case Severe Winter Peak Day Firm and Interruptible demands of various gas years.

5.19 The scenario examined the effect of adding 383 MWe of new OCGT power plant to the NI transmission sytem in GY 2023/24 and 2029/30, as the earliest feasible operational date and the peak of the forecast demands across the remainder of the forecast period, respectively.

5.20 Table 5-3 summarises the suite of network modelling completed for the NIGCS 2020/21.

(Note: 'F' – Firm, 'F & I' – Firm and Interruptible)

Table 5-3 Demand Scenarios Modelled

Scenario	Base Case	Base Case + Unused Reserved Capacity Sensitivity *	Carrickfergus Volumetric Control Sensitivity **	Base Case + Additional Power Station Demand Sensitivity ***
Severe Winter Peak Day (F&I)	√	√	√	√
Severe Winter Peak Day (F)	√	√	√	
Average Winter Peak Day (F&I)	√		√	
Average Winter Peak Day (F)	√		√	
Average Spring Day (F)	√		√	
Average Spring Day (F&I)	√		√	
Summer Minimum Day (F&I)	√		√	
Summer Minimum Day (F)	√		√	

* Gas Years 2020/21 and 2029/30

** Gas Years 2020/21

*** Gas Years 2023/24 and 2029/30 only for additional CCGT sensitivity, 2020/21.

Chapter 6 Modelling Results

Overview

6.1 Based on the demand figures supplied and the modelling assumptions outlined in Chapter 5, the detailed modelling results in Appendix 3 have been obtained. These are set out in the sections which follow;

Summer Minimum, Average Spring and Average Winter Peak Day Demand Scenarios

6.2 The Northern Ireland transmission network has sufficient capacity (through the Moffat IP Entry Point alone) to meet the Base Case Summer Minimum Day, Average Spring Day and Average Winter Peak Day demands on a Firm and also on a Firm and Interruptible basis for all years modelled, at 12 barg minimum system pressure requirement in line with the TSO's contractual requirements under the NI Network Gas Transmission Code. Any flow through the Gormanston IP Entry Point is supplied to meet Haynestown demand. The Average Winter Peak Firm and Interruptible load simulation for the 29/30 year suggested Twynholm inlet pressure requirements in the diurnal range from 56.1 to 60.2 barg.

6.3 With diurnal Twynholm inlet pressure set to the contractual 56 barg, maintaining 39 barg operating pressure across the NI transmission system with flows only via the Twynholm entry point is possible in Summer Minimum and Average Spring (firm and interruptible) demand scenarios – this has been modelled to demands of up to 4.943 mscmd. It is noted that maximum diurnal pressure of up to 59.3 barg would be required under such scenarios.

6.4 However, under Average Winter Peak Day demand scenarios as modelled, beginning in 20/21, it is not possible to sustain 39 barg operating pressure across the NI transmission system through the Moffat IP Entry Point alone, should minimum diurnal Twynholm inlet pressure fall to 56 barg. For example, in the 2029/30 Winter Peak Day Firm and Interruptible scenario, of 7.913 mscmd (i.e. NI and Stranraer demand and only, 0.36 msmcd coming via Gormanston for Haynestown supply), diurnal pressures ranging from 68 – 72.7 barg are required. In this scenario, should these pressure requirements not be available, up to 3.19 mscmd of flow (for NI demand, 3.36 mscmd total to include Haynestown demand) would be required through the South North IP Entry Point rather than the Moffat IP Entry Point in order to balance supply and demand and maintain 39 barg minimum system pressure.

Severe Winter Peak Day Demands - Firm

6.5 With NI and Stranraer demands ranging from 8.59 – 9.51 mscmd, the current Moffat IP Entry Point contractual capacity of 8.08 mscmd is exceeded in all years, meaning the South North IP Entry Point is required in all cases. When Haynestown demand is also included, total system demands range from 8.78 – 9.91 mscm/day. The severe winter peak day firm demand increases by 11.4% over the period. This is driven by the distribution sector (+19.0% growth in daily peak), with peak day power sector demand remaining flat across the period.

6.6 Minimum system pressures of 12 barg, assisted by flows through Gormanston AGI, are maintained in all cases with a minimum Twynholm inlet pressure of 56 barg and flowing up to the maximum assumed available through Twynholm AGI. Additional capacity required through the South North IP Entry Point ranges from 0.704 – 1.834 mscmd. Maximum diurnal Twynholm inlet pressures range from 60.7 – 61.3 barg. To maintain these same flow requirements but maintain 39 barg minimum system pressure, higher Twynholm inlet pressure is required as follows 2020/21; 67.3 – 72.7 barg diurnal range, 2029/30; 67.6 – 73.6 barg diurnal range.

6.7 With a minimum diurnal Twynholm inlet pressure of 56 barg, maintaining minimum system pressures of 39 barg requires flows to be increased through the South North IP Entry Point, ranging from 3.456 – 4.413 mscmd (0.190 – 0.400 mscmd would be required through Gormanston in any case to supply Haynestown). Maximum diurnal Twynholm inlet pressures ranging from 63.0 – 64.3 barg are still required in such circumstances.

Severe Winter Peak Day Demands - Firm & Interruptible

6.8 With NI and Stranraer demands ranging from 8.99 – 9.91 mscmd, the current Moffat IP Entry Point capacity (of 8.08 mscmd, via Twynholm) is exceeded in all years, meaning the South North IP Entry Point (i.e. flows via Gormanston) is required in all cases. When Haynestown demand is also included, total system demands range from 9.18–10.31mscmd. The Severe winter peak day firm demand increases by 11% over the period. This is driven by the distribution sector (+17.8% growth in daily peak), with peak day power sector demand remaining flat across the period.

6.9 Minimum system pressures of 12 barg, assisted by flows through Gormanston AGI, are maintained in all cases with a minimum Twynholm inlet pressure of 56 barg and flowing up to the maximum assumed available through Twynholm AGI. Additional capacity required through the South North IP Entry Point ranges from 1.104 – 2.234 mscmd. Maximum diurnal Twynholm inlet pressures are not significantly affected, ranging from 60.9 – 61.6 barg.

6.10 To maintain these same flow requirements, but maintain 39 barg minimum system pressure, higher Twynholm inlet pressure is required, as follows 2020/21; 67.4 – 73 barg diurnal range, 2029/30; 67.7 – 74 barg diurnal range.

6.11 In all cases, with a minimum diurnal Twynholm inlet pressure of 56 barg, maintaining minimum system pressures of 39 barg requires flows to be increased through the South North IP Entry Point, ranging from 3.747 – 4.677 mscmd.

Maximum diurnal Twynholm inlet pressures ranging from 63.6 – 64.9 barg are still required in such circumstances.

Sensitivity Analysis

6.12 With the need for capacity through the South North IP Entry Point under Severe Winter Peak demand scenarios already demonstrated, further sensitivity analysis was done as to the implications on the network of the availability of unused reserved capacity (at (i) Stranraer and (ii) Haynestown), the operation of Carrickfergus AGI in volumetric control and additional demands as outlined in the following sub-sections.

Utilisation of Unused Reserved Capacity Sensitivity

6.13 A portion of the capacity in the NI Network is to be reserved for volume outside of Northern Ireland from the beginning of Gas Year 2020/21. Consequentially, the capacity made available to NI Shippers at each of the two entry points to the NI Network (i.e. the Moffat IP Entry Point and the South North IP Entry Point) will be accordingly reduced. 0.931 GWh/d (equating to 0.084 mscmd) of capacity is to be reserved at Moffat for use at the Stranraer Exit Point (in order to supply an offtake to Stranraer in Scotland), whilst 6.6 GWh/d (equating to 0.597 mscmd) is to be reserved at Gormanston for use at the ROI System Exit Point (in order to supply an offtake to Haynestown, near Dundalk, in the Republic of Ireland). The sensitivity examines, in turn, the impacts of the utilisation of any unused reserved capacity at each entry point.

6.14 The availability of Stranraer unused reserved capacity has a marginal impact on the results as effectively all of Stranraer reserved capacity (0.084 mscmd) is utilised by 29/30 (i.e. Stranraer load of 0.0833 mscmd in the Firm and Interruptible Sever Winter Peak).

6.15 The availability of Haynestown unused reserved capacity was shown not to be necessary for any of the base case scenarios, even under minimum Twynholm inlet pressure assumptions.

Carrickfergus Volumetric Control Sensitivity

6.16 A separate sensitivity analysis examined the implications on the network of operating Carrickfergus station in a volumetric control mode of operation (i.e. where the flow through Carrickfergus (or Carrickfergus and Gormanston flows for NI deliveries) is equal to the sum of the offtake rates of all NI offtakes downstream of Carrickfergus) has in comparison to its assumed operation in the base case of 'free flow' (i.e. flow dictated by prevailing pressures). The effect of this is to place all the diurnal swing flexibility requirements of the system downstream of Carrickfergus AGI onto the upstream system (i.e. the levels of linepack/operating pressure of the SNIP back to Twynholm).

6.17 The sensitivity analysis examines this operation in the 2020/21 study year only, as the operation of the station is to move away from volumetric flow-control mode in the near future, with the TSO's presently working on the implementation of an updated operating mode.

6.18 The modelling results suggest that in volumetric control a combination of higher Twynholm inlet pressure requirement and/or South North IP Entry Point flow may be required to maintain the same 39 barg minimum diurnal system pressure.

Additional Power Station

6.19 A separate sensitivity analysis examined the implications on the network of an additional 383 MWe OCGT (see Appendix 3 c Future Power Station Sensitivity) power plant (assuming 40% efficiency, this equates to 957.5 MW / 2.078 mscmd of gas capacity requirement being connected to the NI transmission network from 2023/24 (the earliest gas year considered feasible for operational commencement of the connection) and also at the final gas year of the forecast horizon, which is the year with the greatest peak daily demand forecast. Two running regimes for the OCGT were tested, one with an 8 hour run rate (i.e. 33% duty cycle) and the second with a 24 hour run rate (i.e. 100% duty cycle).

6.20 For the Severe Winter Peak Firm and Interruptible 100% duty cycle scenario examined, in order to utilise the Moffat IP Entry Point up to the capacity available to NI shippers plus Stranraer demand, whilst maintaining 39 barg minimum operating pressure on the NI transmission system, pressures above 56 barg are required. For example, in the 2029/30 study year, the diurnal Twynholm inlet pressure requirement ranges from 67.1–73.7 barg, with 4.312 mscmd being required through the South North IP Entry Point (refer to results Table A3-24 at section A3.5 of Appendix 3).

6.21 Under conditions of the lower Twynholm contractual 56 barg diurnal inlet pressure, it may not be possible to balance the network and maintain 39 barg pressure across the system. Where only 56–63.4 barg pressure was available, only 6.591 mscmd can be delivered through the Moffat IP Entry Point, and a flow of 5.8 mscmd through the South North IP Entry Point. Under these conditions, only 35.1 barg can be maintained at the extremity of the NI transmission system. The TSO's contractual minimum pressure of 12 barg is maintained. To maintain the 35.1 barg at Coolkeeragh, reverse flows at Carrickfergus are required, a condition which is not routinely possible (without manual intervention at site) using the current (or proposed new) configuration of Carrickfergus AGI (refer to results Table A3- 25 at section A3.5 of Appendix 3).

6.22 When minimum diurnal inlet pressures at Twynholm are set to 56 barg and Gormanston pressure is adjusted so that flows though the Moffat IP Entry Point are maximised to the fully available capacity, pressures at Coolkeeragh drop as low as 15.5 barg in 2029/30 study year (refer to results Table A3- 23 at section A3.5 of Appendix 3). Here no reverse flows are observed at Carrickfergus. Pressures higher than these can be achieved by backing off flows through Twynholm and increasing flows through Gormanston up to the levels shown in the Table A3- 25 at section A3.5 of Appendix 3. The results show that even with

Carrickfergus in a free flow configuration input pressures above 56 barg are required to maintain 39 barg minimum operating pressure on the network.

6.23 For the Severe Winter Peak Firm and Interruptible 33% duty cycle scenario examined, similar results are observed as for the 100% duty cycle scenario when the minimum contractual pressure is assumed available at Twynholm, while Twynholm flows are also maximised, where pressures as low as 13.3 barg are observed. The lower pressure than the 100% duty cycle reflects pressure deficits owing to the assumed flat flow gas supplies from Twynholm and Gormanston. The contribution to supply profile vs offtake profile creates a deficit in the 33% duty cycle (i.e. 8 hour) scenario which was not created in the 100% duty cycle (i.e. 24 hour scenario). This contributes to lower minimum diurnal system pressure in the 33% duty cycle scenario, even with lower overall demand.

6.24 For the 33% Duty cycle scenario, when minimum diurnal inlet pressures at Twynholm are set at the guaranteed contractual level of 56 barg. 39 barg minimum system pressures can be maintained by increasing the flow through Gormanston up to 5.197 mscmd in the 2029/30 study scenario. Here reverse flows at Carrickfergus of up to 0.268 mscmd are required (refer to results Table A3-28 at section A3.5 of Appendix 3). Where elevated inlet pressures at Twynholm of 67.8/73.4 barg are available, then flow via the Moffat IP Entry Point and Twyhnolm is possible up to the maximum capacity available to NI Shippers plus Stranraer demand while maintaining 39 barg minimum system pressure.

6.25 The power station sensitivity meets the TSO’s 12 barg obligation to Shippers as per the NI Network Gas Transmission Code. It is however the case that where Twynholm flows are maximised without the availability of elevated input pressures at Twynholm above the guaranteed contractual level of 56 barg, then minimum system pressure is substantially lower than the 39 barg. This being the pressure that the TSOs currently operate the Northern Ireland transmission system to for both operational and security of supply reasons.

Chapter 7 Commentary

Demand Scenarios

Overview

7.1 The modelling results have indicated, that the NI transmission system has the capacity to meet the peak forecast firm and interruptible demands and has capacity for further load growth (including capacity for an indicative future power station) to the 12 barg requirement of the NI Network Gas Transmission Code.

7.2 It is noted that Average Winter Peak Firm and Interruptible forecast NI demands do not exceed the 8.08 mscmd contractual capacity of the Moffat IP Entry Point, the maximum being 7.913 mscmd by 2029/30 (supplying NI and Stranraer demand). When Haynestown demand is included, the total system demands range up to 8.273 mscmd, however Haynestown is assumed at all times supplied via the South North IP entry point. In line with the TSO's normal operating practice of maintaining system pressure of 39 barg minimum, the ability to physically deliver such demand through the Moffat IP Entry point hinges on the availability and reliability of Twynholm inlet pressure of up to 72.7 barg in the Average Winter Peak Firm and Interruptible 29/30 study year. In the 29/30 study year with diurnal pressures in the 56/62 barg range, only 4.913 mscmd can be supplied through the Moffat IP Entry Point, 3.36 mscmd being necessary to bring through the South North IP Entry Point (including Haynestown demand). The TSO's do have the ability to request enhanced pressures, in so far as is operationally possible, to be delivered, however, they are not guaranteed.

7.3 However, Severe Winter Peak Firm and Interruptible NI and Stranraer forecast demands across the period are greater than 8.08 mscmd and so the use of the South North IP Entry Point is required. The TSO's note that Shipper registrations at the South North IP Entry Point, outside of those awarded under the balancing gas contract are therefore required. There remains sufficient entry and network capacity in the NI Network to account for peak forecast demand and provide for foreseeable and potential connections and load growth to 12 barg, consistent with the entitlement and obligations under the NI Network Gas Transmission Code. There is however an ever-increasing likelihood, with foreseeable and potential load growth, of the Moffat IP Entry Point capacity (as the predominant and primarily utilised entry point) becoming congested for NI Shippers. In such a scenario, demand side response may have to be initiated through the TSO's declaring a 'System Constraint' in line with section 10.3 of the NI Network Gas Transmission Code. This is so that the market has the ability to respond to such shortfall on a supply basis (noting such shortfall could be greater if enhanced Twynholm inlet pressures above 56 barg (in some cases up to 74.7 barg, see Table A3-27) are not available if and when requested). In such an event, shipper registrations at the South North IP Entry Point would give the market the ability to respond to any such shortfall in supply capacity from the Moffat IP Entry Point to maintain balance in overall entry and exit nominations.

Facilitating Firm Demand

7.4 The network has been built to meet firm demands. Therefore, the key results are those which indicate the ability of the network to meet firm demands.

7.5 Capacity above that made commercially available to NI Shippers at the Moffat IP Entry Point will be delivered by flowing gas through the South North IP Entry Point, which has been available to supply gas since construction in 2006. The commercial arrangements are in place to accommodate Shippers wishing to flow gas at this entry point, who should liaise with GMO NI to ensure that all the relevant obligations in the NI Network Gas Transmission Code are met (e.g. applying for an IP Registration). Shippers should be aware of lead times for fulfilling these requirements. In conjunction, CRU and GNI requirements for the shipping of gas in the Republic of Ireland would need to be fulfilled.

7.6 Historically, pressure in excess of the 12 barg contractual level has been provided, but it is not guaranteed. It has been confirmed that it is possible to maintain 12 barg minimum system operating pressure up to approximately 8.08 mscmd capacity through Twynholm alone at the 56 barg contractual inlet pressure. If a user wishes to guarantee pressure at a particular level, they currently have the right to request and pay for enhanced pressure under the NI Network Gas Transmission Code, as PTL has the contractual ability to request, and likewise pay for, elevated Twynholm inlet pressures. Additional demand can be readily accommodated via the use of the South North IP Entry Point.

7.7 The TSO's will have in place balancing gas buy contracts at both the Moffat IP Entry Point (as the primary) and the South North IP Entry Point (as the secondary contract). The combined capacity of these contracts will be not less than 8,667,000 kWh/d. However, the minimum capacity of any contract is 5,000,000 kWh/d (which equates to approximately 0.45 mscm/d), hence this will be the minimum at the South North IP Entry Point. This offers extra redundancy to the TSO's operating the NI network. The procedures on the use of these contracts are outlined in a Schedule to the System Operator Agreement which has received NIAUR approval. This was after the TSO's had undertaken a consultation with industry to outline how, in a set of limited unlikely circumstances, this tool would prove valuable to balancing the system and facilitating demand on the network.

7.8 Should the use of balancing gas be an infeasible option to maintain this typical operating pressure, arrangements are in place, through a TSO declaration of a 'System Constraint' under 10.3 of the NI Network Gas Transmission Code, if it becomes necessary for the TSOs to mandate demand side response in the form of a power station reducing consumption. Alternatively suppliers to the power stations could bring firm capacity through the South North IP Entry Point, assuming they have the ability to and sufficient capacity is available for them to book in that system. If such load shedding of power sector demand was insufficient to balance the network, similar arrangements are in place to communicate with Distribution Shippers as to how their demands should be reduced, through their Interruptible customers in the first instance.

7.9 In this context, it is worth highlighting the potential implications from a whole energy system perspective of the EU Clean Energy Package, and in particular Article 22 (4) and (5) of Electricity Regulation (EU) 2019/943[19]. Article 22 states "*Capacity mechanisms shall incorporate the following requirements regarding CO2 emission limits: (a) from 4 July 2019 at the latest, generation capacity that started commercial production on or after that date and that emits more than 550 g of CO2 of fossil fuel origin per kWh of electricity shall not be committed or to receive payments or commitments for future payments under a capacity mechanism, (b) from 1 July 2025 at the latest, generation capacity that started commercial production before 4 July 2019 and that emits more than 550 g of CO2 of fossil fuel origin per kWh of electricity and more than 350 kg CO2 of fossil fuel origin on average per year per installed kWe shall not be committed or receive payments or commitments for future payments under a capacity mechanism*". While the awarding of a capacity contract is not a prerequisite to a power station remaining in service, it is seen as a vital revenue stream. These emissions limits may affect coal, distillate and possibly some gas generation. (Note, it is expected this legislation will be transposed into UK law to similarly take effect upon the expiry of the transition period following the UK's withdrawal from the European Union, currently 31 December 2020).

7.10 The SEM Committee's Information Paper[20] on the interaction this will have on future power generation capacity contracts clarifies that the requirements on new capacity already applies for Awarded Capacity arising from the SEM Capacity Market 2023/2024 T-4 Capacity Auction (in which EP Kilroot were successful). The upcoming T-4 capacity auction expected to be held in Q4 2020 relating to the Capacity Year 2024/25 will also capture existing capacity which must comply with the tighter emissions limits (from part way through the capacity year). The SEM Committee have addressed this issue in Decision Paper SEM-20-034[21] published 5th June 2020.

7.11 With regards to generation which is primarily gas-fired, this may have had implications for the purpose and operation of the Northern Ireland Fuel Security Code[22] and the associated relevant provisions of the SONI Grid Code[23] which require that any generator must comply with the Fuel Security Code, i.e. gas-fired power stations availability on secondary fuel. In June 2020, the SEM Committee in (SEM-20-036)[24] stated that the fuel share used when operating under Secondary or Back-up Fuel should be excluded from the calculation of

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[19] https://eur-lex.europa.eu/eli/reg/2019/943/oj
[20] https://www.semcommittee.com/sites/semc/files/media-files/SEM-19-074%20SEMC%20Information%20Paper%20-%20CEP%20%26%20T-4%20CY202324%20Interaction_1.pdf
[21] https://www.semcommittee.com/sites/semc/files/media-files/SEM-20-034%20CRM%202024-25%20T-4%20Capacity%20Auction%20Parameters%20decision%20paper.pdf
[22] https://www.economy-ni.gov.uk/sites/default/files/publications/deti/FSC%20%20PUBLISHED%20VERSION%20OCTOBER%202015.pdf
[23] http://www.soni.ltd.uk/how-the-grid-works/grid-codes/
[24] https://www.semcommittee.com/sites/semc/files/media-files/SEM-20-036%20CEP%20Technical%20Guidance%20Information%20Note.pdf

both specific and annual emissions. This is important as any changes to gas fired power station's availability on secondary fuel may have had implications for how the gas TSOs respond to system constraints.

Network Development

7.12 The Corrib gas field is in decline and ROI gas demand will exceed indigenous supply capacity in 2020/21 and subsequent years. The balance of gas demand is increasingly expected to be met by imports from the Moffat IP Entry Point.

7.13 ROI indigenous supply contributed to throughput variations on GNI (UK)'s SWSOS transportation system, and so the decision to undertake 'batching' of Twynholm flows (because of same across the SWSOS) for operational reasons on a regular basis. This results in flows outside of a flat profile for demands required at the Moffat IP Entry Point and so affects daily diurnal pressures on the downstream system (i.e. SNIP and therefore the NI transmission system). However, it has and will not affect the delivery of the End of Day Quantity (EODQ) or availability of 56 barg minimum inlet pressure at Twynholm.

7.14 The twinning of the SWSOS between Cluden and Brighouse Bay was completed in 2018. The pipeline reduces operational pressure losses across the SWSOS system as a result of a fully twinned pipeline system from Beattock to Brighouse Bay. Gas Networks Ireland is assessing the future operating regime for the SWSOS in order to optimise system pressures and fuel gas savings for the Scotland compressor fleet and will be in close communication with TSO's and regulators as operating experience continues to inform this.

7.15 The GMO, on behalf of the TSO's, continue to monitor the impact of the SEM wholesale electricity market with respect to the NI gas market. In particular, it appears that power sector Shippers nomination behaviour continues to be such that greater flexibility is required of the gas system, with Shippers citing increased volatility and uncertainty to their dispatch trends as major contributing factors.

7.16 There is interest from two potential power stations projects seeking a connection to the gas transmission network, namely Belfast Power and EPH Kilroot, and a potential gas storage project by Islandmagee Storage Ltd., any of which may have significant impacts to future gas flows to and within the Northern Ireland Network. Sensitivity analysis was performed this year and further network analysis in subsequent years will be required as more information and certainty on the details of these projects is known. Such projects would be subject to project specific network modelling as part of their connection request process which will better inform the impact their introduction could have to the NI transmission network.

7.17 The capacity statement has provided an assessment of the network up to and including 2029/30. The Transportation Agreement (TA) between GNI(UK) and PTL which governs the provision of capacity from Moffat to Twynholm ends in 2021 and the TSOs and Regulatory Authorities are currently discussing an extension beyond this. More clarity on the implications of the extension agreement can be expected for the production of next year's NIGCS.

7.18 The TSO's are currently in the process of planning the implementation of an updated operating configuration for Carrickfergus AGI. The 'Operation of Carrickfergus AGI in Volumetric Control' sensitivity was considered for the upcoming Gas Year 2020/21, only, as the new operating configuration is currently foreseen to be in place for subsequent gas years. The new configuration will be expected to deliver the envisaged pressure benefits of a 'free flow' style configuration, although 'reverse flow' through the AGI (from the NWP to the BTP) will not be routinely possible (without manual intervention at site) using the current (or proposed new) configuration of Carrickfergus AGI.

7.19 The results of the network modelling supports the conclusion of pressure benefits and potential for reduced balancing actions resulting from the aforementioned planned change to the operating configuration of Carrickfergus AGI (although of course the exact extent of this in practice will vary with all other network conditions and assumptions, for example the flat flow profile of Twynholm flows, which is a significantly simplified assumption subject to much day to day operational variance). However – positively – as in all previous years it can be said that no security of supply issues are suggested by the volumetric flow-control mode for the coming winter (Carrickfergus AGI has operated in volumetric flow-control since its construction). This is on the basis that Shippers have the commercial capability (i.e. shippers are registered at the South North IP Entry Point) to access the levels of capacity via the South North IP Entry Point which may become required should there be unavailability of the enhanced levels of Twynholm inlet pressure the operating mode drives. There are commercial implications to such, however the scope of this document is to outline such permutation from a technical perspective, in order for the market and all stakeholders to be aware of and take account of as appropriate.

7.21 The Gas Market Operator for Northern Ireland, on behalf of the TSO's, continue to monitor the impact of the SEM wholesale electricity market with respect to the NI gas market. In particular, it appears that power sector Shippers nomination behaviour continues to be such that greater flexibility is required of the gas system, with Shippers citing increased volatility and uncertainty to their dispatch trends as major contributing factors.

7.22 The potential network investment signals derived from the analysis (especially in light of growing demand contributed to by new connections in the power generation sector) support the need for greater co-ordination between gas and electricity sectors. This is particularly important in the context of an all-island electricity commercial market (especially as physical transmission capacity constraints decrease with greater interconnectivity), but separated gas networks and markets on the island of Ireland.

7.23 The scale and complexity of putting in place any physical infrastructure and/or commercial arrangements which may be deemed necessary arising from a gas connection study should not be overlooked as a potential significant risk to successful projects who are awarded capacity in T-4 auctions. The Gas TSO's recommend and encourage early engagement in determining the gas network's capacity adequacy and/or to indicate what further solutions may be required. Any actual physical network investment requirements will only be determined from such specific studies.

7.24 Understanding the interaction between the respective energy (gas and electricity) networks is critical to planning for the interaction of the markets so as to produce efficient outcomes on a whole energy supply system basis. The TSO's expect this co-ordination to be a crucial aspect of developing energy policy and strategy aimed at delivering a decarbonised energy transition. The gas grid is widely expected to play a crucial role in decarbonising energy (and potentially other sectors, such as transport etc.), not least in support of greater integration of intermittent renewable energy, and it is particularly important to understand the implication this may have in reducing synchronous gas-fired power generation load factors, whilst maintaining peak gas capacity requirements.

Appendix 1 – Northern Ireland Demand Forecast

Entry Point Capacities

Table A1 - 1 Entry Point Capacities

	Capacity Available to NI from Entry Points					
	Moffat IP Entry Point			South North IP Entry Point		
	Contractual Capacity	Stranraer Reserved Capacity	Capacity available to NI shippers	Commercially Available and Physical Capacity[25]	Haynestown reserved capacity	Capacity available to NI shippers
GWh/d	89.28	0.931	88.349	66.3	6.6	59.7
mscmd	8.08	0.084	7.996	6	0.6	5.4

[25] Shipper registration at the South North IP Entry Point is required so that the market has the ability to book capacity at the South North IP Entry point. Only booked capacity is guaranteed, any unbooked capacity up to the 6 mscmd is not guaranteed.

Severe Winter Peak Day

a) Base Case (Firm)

Table A1 - 2 Base Case (Firm)

Severe Winter Peak Day Demands (Firm) (mscmd)				
Year	**Power**	**Distribution (NI, Stranraer & Haynestown)**	**NI Total (excluding Haynestown)**	**Total System Demand**
2020/21	3.94	4.84	8.59	8.78
2021/22	3.94	5	8.74	8.94
2022/23	3.94	5.22	8.91	9.16
2023/24	3.94	5.4	9.08	9.34
2024/25	3.94	5.52	9.2	9.46
2025/26	3.94	5.73	9.31	9.67
2026/27	3.94	5.8	9.37	9.74
2027/28	3.94	5.85	9.41	9.79
2028/29	3.94	5.9	9.45	9.84
2029/30	3.94	5.97	9.51	9.91

b) Base Case (Firm & Interruptible)

Table A1 - 3 Base Case (Firm & Interruptible)

Severe Winter Peak Day Demands (Firm & Interruptible) (mscmd)				
Year	**Power**	**Distribution (NI, Stranraer & Haynestown)**	**NI Total (excluding Haynestown)**	**Total System Demand**
2020/21	3.94	5.24	8.99	9.18
2021/22	3.94	5.41	9.15	9.35
2022/23	3.94	5.62	9.31	9.56
2023/24	3.94	5.8	9.48	9.74
2024/25	3.94	5.93	9.61	9.87
2025/26	3.94	6.14	9.72	10.08
2026/27	3.94	6.21	9.78	10.15
2027/28	3.94	6.26	9.82	10.2
2028/29	3.94	6.3	9.85	10.24
2029/30	3.94	6.37	9.91	10.31

Average Winter Peak Day

a) Base Case (Firm)

Table A1 - 4 Base Case (Firm)

Average Winter Peak Day Demands (Firm) (mscmd)				
Year	Power	Distribution (NI, Stranraer & Haynestown)	NI Total (excluding Haynestown)	Total System Demand
2020/21	3.37	3.85	7.05	7.22
2021/22	3.37	3.97	7.17	7.34
2022/23	3.37	4.17	7.32	7.54
2023/24	3.37	4.31	7.46	7.68
2024/25	2.78	4.45	7	7.23
2025/26	2.78	4.66	7.11	7.44
2026/27	2.78	4.81	7.25	7.59
2027/28	2.78	4.9	7.34	7.68
2028/29	2.78	5.01	7.44	7.79
2029/30	2.78	5.11	7.53	7.89

b) Base Case (Firm & Interruptible)

Table A1 - 5 Base Case (Firm & Interruptible)

Average Winter Peak Day Demands (Firm & Interruptible) (mscmd)				
Year	Power	Distribution (NI, Stranraer & Haynestown)	NI Total (excluding Haynestown)	Total System Demand
2020/21	3.37	4.21	7.41	7.58
2021/22	3.37	4.35	7.55	7.72
2022/23	3.37	4.55	7.7	7.92
2023/24	3.37	4.68	7.83	8.05
2024/25	2.78	4.83	7.38	7.61
2025/26	2.78	5.04	7.49	7.82
2026/27	2.78	5.18	7.62	7.96
2027/28	2.78	5.28	7.72	8.06
2028/29	2.78	5.38	7.81	8.16
2029/30	2.78	5.49	7.91	8.27

Average Spring Day

a) Base Case (Firm)

Table A1 - 6 Base Case (Firm)

Average Spring Day Demands (Firm) (mscmd)				
Year	**Power**	**Distribution (NI, Stranraer & Haynestown)**	**NI Total (excluding Haynestown)**	**Total System Demand**
2020/21	2.44	2.19	4.48	4.63
2021/22	2.44	2.26	4.55	4.7
2022/23	2.44	2.36	4.6	4.8
2023/24	2.44	2.44	4.67	4.88
2024/25	1.61	2.51	3.91	4.12
2025/26	1.61	2.64	3.95	4.25
2026/27	1.61	2.68	3.99	4.29
2027/28	1.61	2.7	4	4.31
2028/29	1.61	2.72	4.02	4.33
2029/30	1.61	2.73	4.03	4.34

b) Base Case (Firm and Interruptible)

Table A1 - 7 Base Case (Firm and Interruptible)

Average Spring Day Demands (Firm & Interruptible) (mscmd)				
Year	**Power**	**Distribution (NI, Stranraer & Haynestown)**	**NI Total (excluding Haynestown)**	**Total System Demand**
2020/21	2.44	2.44	4.73	4.88
2021/22	2.44	2.52	4.81	4.96
2022/23	2.44	2.62	4.86	5.06
2023/24	2.44	2.71	4.94	5.15
2024/25	1.61	2.77	4.17	4.38
2025/26	1.61	2.9	4.21	4.51
2026/27	1.61	2.94	4.25	4.55
2027/28	1.61	2.96	4.26	4.57
2028/29	1.61	2.98	4.28	4.59
2029/30	1.61	2.99	4.29	4.6

Summer Minimum Day

a) Base Case (Firm)

Table A1 - 8 Base Case (Firm)

Summer Minimum Day Demands (Firm) (mscmd)				
Year	**Power**	**Distribution (NI, Stranraer & Haynestown)**	**NI Total (excluding Haynestown)**	**Total System Demand**
2020/21	1.73	0.7	2.3	2.43
2021/22	1.73	0.72	2.32	2.45
2022/23	1.73	0.79	2.34	2.52
2023/24	1.73	0.82	2.37	2.55
2024/25	1.16	0.84	1.82	2
2025/26	1.16	0.94	1.83	2.1
2026/27	1.16	0.95	1.83	2.11
2027/28	1.16	0.96	1.84	2.12
2028/29	1.16	0.96	1.84	2.12
2029/30	1.16	0.97	1.85	2.13

b) Base Case (Firm & Interruptible)

Table A1 - 9 Base Case (Firm & Interruptible)

Summer Minimum Day Demands (Firm & Interruptible) (mscmd)				
Year	**Power**	**Distribution (NI, Stranraer & Haynestown)**	**NI Total (excluding Haynestown)**	**Total System Demand**
2020/21	1.73	0.79	2.39	2.52
2021/22	1.73	0.81	2.41	2.54
2022/23	1.73	0.88	2.43	2.61
2023/24	1.73	0.91	2.46	2.64
2024/25	1.16	0.93	1.91	2.09
2025/26	1.16	1.03	1.92	2.19
2026/27	1.16	1.05	1.93	2.21
2027/28	1.16	1.05	1.93	2.21
2028/29	1.16	1.06	1.94	2.22
2029/30	1.16	1.06	1.94	2.22

Appendix 2 – Summary of System Modelling Assumptions

General Assumptions

- The systems upstream and downstream of the NI Transmission System have not been considered in this analysis, notwithstanding the assumption regarding the 56 barg inlet pressure at Twynholm.
- All entry points are modelled on a flat flow basis, unless otherwise indicated.
- The NI Network has a maximum operating pressure of 75 barg.
- All scenarios simulate the 24-hour demand cycle of the NI transmission system repeated over a three-day period to obtain steady consistent results.
- All demands are modelled as energy flows. Volumetric flows are derived from supplied energy demand values by assuming a Moffat Gas Calorific Value of 39.8 MJ/m^3 (measured typical historical value)
- A minimum system pressure limit of 12 barg is assumed for all offtakes on the NI system, in line with the TSO's contractual commitments at the various exit points on the NI transmission system per the NI Network Gas Transmission Code.

Demand Assumptions

- Forecasted annual and peak NI demands are as per those provided to the TSO's
- by NI Shippers and users of the NI transmission system (note, this includes SGN at Stranraer and GNI at Haynestown).
- NI Shippers have provided separate figures for firm and interruptible demands.
- Where applicable, models are run for both firm and firm & interruptible demands. Profiles for Haynestown were supplied by GNI(UK) and profiles for Stranraer were supplied by SGN.
- The hourly profiles of the NI power stations total demand is based on the information provided to the TSO's in the questionnaire responses at the outset of producing this report or as subsequently updated in agreement with the TSOs.
- The hourly demand for all other AGI off-takes is derived from their historic contribution to similar day demands as modelled (severe winter peak profiles vary from typical profiles used in other scenarios).

Network Operation / Pressure Assumptions

Twynholm

- The capacity to be made available to NI Shippers at the Moffat IP Entry Point shall be assumed to be 89.28 GWh/d (equating to 8.08 mscmd), minus 0.931GWh/d to be reserved for Stranraer (equating to 0.084 mscmd). Hence, the base case analysis shall assume capacity available through Twynholm for NI deliveries shall be up to 7.996 mscmd. A quantum equal to Stranraer demand shall at all times be added to the flow requirements through Twynholm for NI deliveries. Flows above this up to the design capacity of Twynholm AGI (i.e. up to 8.64 mscmd) level shall not be permitted in the model.

- The minimum diurnal inlet pressure at Twynholm AGI was assumed to be 56 barg for each scenario in line with the contractual obligations between the TSO's. As a sensitivity inlet pressures at Twynholm were allowed to vary in order to achieve the various pressure requirements and boundary conditions.
- Twynholm AGI is modelled as a flow-control regulating AGI, with an assumed pressure drop across the AGI of 2.5 barg. The daily flows through the Twynholm entry point are assumed to follow a flat flow profile, with the diurnal swing in the demand profile being absorbed by the downstream system.
- Pressures at Twynholm (SNIP) are inlet pressures in the diurnal cycle. The current Maximum Operating Pressure of the SNIP is 75 barg, so with the 2.5 barg design pressure drop across the station, the maximum permissible inlet pressure is 77.5 barg.

Gormanston

- The flow through Gormanston AGI shall be the capacity required over the available capacity of Twynholm AGI or that portion of the overall NI demand which is required in order to achieve the various target pressures of the modelling (i.e. 12/39 barg). The capacity to be made available to NI Shippers at the South North IP Entry Point shall be assumed to be 66.3 GWh/d (equating to 6 mscmd), minus the 6.6 GWh/d to be reserved for Haynestown (equating to 0.6 mscmd). The base case analysis shall therefore assume capacity available through Gormanston AGI Phase 2 for NI deliveries shall be up to 5.4 mscmd. A quantum equal to Haynestown demand shall at all times be added to the flow requirements through Gormanston AGI for NI deliveries.
- Gormanston AGI is modelled as a volumetric flow-control regulating AGI, with the daily flows through the Gormanston Entry Point assumed to follow a flat flow profile, with the diurnal swing in the demand profile being absorbed by the downstream system.
- The contractual capacity and physical limit at the Gormanston Entry Point is 6 mscmd and flows above this level shall not be permitted in the model.
- Pressures quoted at Gormanston are outlet pressures and were allowed to vary in order to achieve the various pressure requirements and boundary conditions. This is significantly affected by the flows through the station.
- There was no minimum inlet pressure assumed at Gormanston AGI, only a Maximum Operating Pressure on the outlet of 75 barg, as is currently declared on the South North Pipeline.

Carrickfergus

- Carrickfergus AGI was modelled in free flow, whereby the regulator is modelled as 'wide-open' and flow is determined by prevailing pressures, including permitting reverse flow (i.e. from the NWP to the BTP) if pressures would so require.
- The outlet pressure (in whichever direction of flow through the station) at Carrickfergus is determined by the inlet pressure (i.e. whichever system is operating at higher pressure than the other) at the station less an assumed pressure drop across the station of 2 barg (provide a 2 barg differential exists between the system, otherwise no flow will be permitted).
- In day to day operation Carrickfergus is operated in volumetric flow-control, modelling the station in free flow allows the diurnal swing in the demand profile to be absorbed by the downstream system.

Future Network Development Assumptions

- A flat flow profile at Twynholm is assumed, as such this modelling has not considered the impact of Corrib Entry Point becoming operational on the RoI gas transmission network or the impact of the twinning of the SWSOS network between Cluden and Brighouse Bay in Scotland. This can (and has had) a significant effect on a flat flow profile through the Moffat IP Entry Point (via Twynholm) being maintained (compressor station 'batching' of flows being deemed necessary), which has knock on operational (pressures) implications on the Northern Ireland network across any given day.

Appendix 3 – Detailed Modelling Results

Overview

The tables in the following sub-sections of this Appendix demonstrate the results of the modelling which detail the conditions within Northern Ireland transmission system for the Base Case scenarios, on both a Firm only and Firm and Interruptible basis, for the following typical demand days;

1) Severe Winter Peak Day
2) Average Winter Peak Day
3) Average Spring Day
4) Summer Minimum Day

In addition, three scenarios of sensitivity analysis have been undertaken for increased demand scenarios, these being;

a) Availability of Stranraer and Haynestown unused reserved capacity.
b) Carrickfergus modelled with a volumetric control mode.
c) Additional Power Station connection

The NI Network Gas Transmission Code (Appendix 4, Exit Point Information) requires that the TSO's make gas available for offtake at each Exit Point on the system at a pressure of no less than 12 barg.

In practice however, the TSO's normally maintain pressures in excess of 39 barg, as per the System Operator Agreement (Schedule 9, Joint Balancing Procedure for the Northern Ireland Network).

Inlet pressure at the Moffat IP Entry Point (the assumed primary supply of gas capacity up to its contractual limit of 8.08 mscmd) is guaranteed to be 56 barg. Pressures above this level, whilst possible to be requested, are not guaranteed and without such it may be infeasible for flows up to 8.08 mscmd via the Moffat IP Entry Point to be delivered to normal system minimum operating pressure requirements. It is noted, however, that the PTL has the contractual ability to request, and likewise pay for, elevated Twynholm inlet pressures.

Therefore, analysis of the above demand scenarios has been performed under the following pressure conditions;

i) Twynholm minimum pressure 56 barg, minimum system pressure of 12 barg
ii) Twynholm minimum pressure 56 barg, minimum system pressure of 39 barg
iii) Twynholm minimum pressure as required, minimum system pressure of 39 barg

This year, for the first time, the concept of reserved capacity is introduced into the report. Two gas offtakes, one at Stranraer in Scotland and one at Haynestown in the

Republic of Ireland represent offtakes from the Northern Ireland Gas Transmission grid that are physically located outside of Northern Ireland. These two Exit Points from the NI Network are to have – from Gas Year 2020/21 onwards – capacity in the NI Network reserved for their use. This allows clear analysis of the capacity available to NI shippers over the 10-year study horizon.

The capacity to be made available to NI Shippers at the Moffat IP Entry Point is assumed to be 89.28 GWh/d, minus 0.931 GWh/d to be reserved for Stranraer (equating to 0.084 mscmd). Hence, the base case analysis assumes capacity available through Twynholm for NI deliveries will be up to 7.996 mscmd. A quantum equal to Stranraer demand is at all times added to the flow requirements through Twynholm for NI deliveries. Likewise, the capacity to be made available to NI Shippers at the South North IP Entry Point is assumed to be 66.3 GWh/d, minus 6.6 GWh/d to be reserved for Haynestown (equating to 0.6 mscmd). Hence, the base case analysis assumes capacity available through Gormanston AGI Phase 2 for NI deliveries will be up to 5.4 mscmd. A quantum equal to Haynestown demand is at all times added to the flow requirements through Gormanston AGI for NI deliveries.

As per the approach employed in the Network Modelling for the previous number of Gas Capacity Statements, rather than analysing every scenario through transient modelling across all years, in some cases it was sufficient to deem a scenario compliant with pressure requirements, by the association of results from adjoining years with the supply and demand trend. Where such results were obtained by association, rather than through detailed transient modelling, pressures and velocities are listed in the results tables in Section 5 as 'OK'.

The below notes apply to all of the tables in the following sub-sections of this appendix;

1. Pressures at Twynholm are the minimum and maximum inlet pressures in the diurnal cycle. The current Maximum Operating Pressure of the SNIP is 75 barg, so with the 2.5 barg design pressure drop across the station, the maximum permissible inlet pressure is 77.5 barg.
2. Pressures quoted at the Gormanston AGI are the minimum and maximum outlet pressures, respectively, in the diurnal cycle and are those downstream of the AGI in the South North pipeline.
3. Pressures at Coolkeeragh, Ballylumford and Tullykeneye (i.e. the extremity of the Gas to the West network extension) are the minimum and maximum respectively in the diurnal cycle and are those in the pipeline upstream of the AGI.
4. Pressures quoted at the Carrickfergus AGI are the minimum and maximum, respectively, in the diurnal cycle and are those downstream of the AGI in the North West pipeline.
5. Velocities of flows were assessed at three locations in the NI transmission system, with the maximum being recorded and denoted with [i], [ii] or [iii] as below to indicate the location of the maximum velocity of flow.

[i] Ballylumford Inlet
[ii] Carrickfergus Outlet
[iii] Coolkeeragh

Maximum permissible pipeline velocities are as per the standards detailed in IGEM/TD13.

The following flows are reported in the base case tables on the following pages:

- Flow via Twynholm (and Moffat IP Entry Point) up to the capacity to be made available to NI shippers i.e. 7.996 mscmd (8.08 mscmd less the 0.084 mscmd capacity to be reserved for Stranraer) plus Stranraer demand.
- Flow via Gormanston (and South North IP Entry Point) as necessary up to the capacity to be made available to NI shippers i.e. 5.4 mscmd (6 mscmd less the 0.6 mscmd capacity to be reserved for Haynestown) plus Haynestown demand.

Sensitivities Overview

a) Utilisation of Unused Reserved Capacity Sensitivity

The following are reported in the tables:

- Flow via Twynholm (and Moffat IP Entry Point) maximised up to contractual capacity of 8.08 mscmd (i.e. allowing use of under-utilised Stranraer reserved capacity).
- Flow via Gormanston (and South North IP Entry Point) as necessary up to physical capacity of 6 mscmd (i.e. allowing use of under-utilised Haynestown reserved capacity) plus Haynestown demand.

b) Carrickfergus Volumetric Control Sensitivity

In addition to the flows and pressure of the base case scenarios, the following are additionally reported in the tables:

- Pressures at the Carrickfergus inlet are those upstream of the AGI (i.e. on the Middle Division Offtake side) and those at the outlet are downstream of the AGI in the North West Pipeline.

c) Future Power Station Sensitivity

Results presented similar to the base cases.

A3.1 Severe Winter Peak Day

a) Severe Winter Peak Day- Base Case (Firm)

Table A3- 1: Twynholm Min Pressure 56 barg, Min System Pressure 12 barg

Year	Twynholm		Gormanston		Coolkeeragh	Carrickfergus	Ballylumford	Tullykeneye	NI System
	Flow	Pressure (1)	Flow	Pressure (2)	Pressure (3)	Pressure (4)	Pressure (3)	Pressure (3)	Max Velocity (5)
	msc m/d	(barg)	msc m/d	(barg)	(barg)	(barg)	(barg)	(barg)	m/s
Limits	8.08 Max	77.5 Max	6.00 Max	75 (Max)	12 (Min)	12 (Min)	12 (Min)	12 (Min)	20 (Max)
20/21	8.076	56/60.7	0.704	23.7/33	14.7/28.3	24.9 / 35.5	29.4 / 39.5	20.9 / 29.6	10.8 [i]
21/22	OK	OK	OK	OK	OK	OK	OK	OK	OK
22/23	OK	OK	OK	OK	OK	OK	OK	OK	OK
23/24	OK	OK	OK	OK	OK	OK	OK	OK	OK
24/25	OK	OK	OK	OK	OK	OK	OK	OK	OK
25/26	OK	OK	OK	OK	OK	OK	OK	OK	OK
26/27	OK	OK	OK	OK	OK	OK	OK	OK	OK
27/28	OK	OK	OK	OK	OK	OK	OK	OK	OK
28/29	OK	OK	OK	OK	OK	OK	OK	OK	OK
29/30	8.079	56/61.3	1.834	27.9/37.6	13.6/29.6	24.8/36.7	29.2 / 40.5	19/29	10.94 [i]

a) Severe Winter Peak Day- Base Case (Firm)

Table A3- 2 Twynholm Min Pressure 56 barg, Min System Pressure 39 barg

Year	Twynholm		Gormanston		Coolkeeragh	Carrickfergus	Ballylumford	Tullykeneye	NI System
	Flow	Pressure (1)	Flow	Pressure (2)	Pressure (3)	Pressure (4)	Pressure (3)	Pressure (3)	Max Velocity (5)
	mscmd	(barg)	mscmd	(barg)	(barg)	(barg)	(barg)	(barg)	m/s
Limits	8.08 (Max)	77.5 (Max)	6.00 (Max)	75 (Max)	39 (Min)	39 (Min)	39 (Min)	39 (Min)	20 (Max)
20/21	5.324	56/63.0	3.456	54.8/60.4	39/48.9	43/51.5	44.6/53.8	45.1/51.8	4.96 [i]
21/22	OK	OK	OK	OK	OK	OK	OK	OK	OK
22/23	OK	OK	OK	OK	OK	OK	OK	OK	OK
23/24	OK	OK	OK	OK	OK	OK	OK	OK	OK
24/25	OK	OK	OK	OK	OK	OK	OK	OK	OK
25/26	OK	OK	OK	OK	OK	OK	OK	OK	OK
26/27	OK	OK	OK	OK	OK	OK	OK	OK	OK
27/28	OK	OK	OK	OK	OK	OK	OK	OK	OK
28/29	OK	OK	OK	OK	OK	OK	OK	OK	OK
29/30	5.500	56 / 64.3	4.413	60 / 65.8	39 / 49.7	43.4 / 52.5	43.8 / 54.8	45 / 52.3	5.31 [i]

a) Severe Winter Peak Day- Base Case (Firm)

Table A3- 3: Twynholm Pressure as required, Min System Pressure 39 barg

Year	Twynholm		Gormanston		Coolkeeragh	Carrickfergus	Ballylumford	Tullykeneye	NI System
	Flow	Pressure (1)	Flow	Pressure (2)	Pressure (3)	Pressure (4)	Pressure (3)	Pressure (3)	Max Velocity (5)
	mscmd	(barg)	mscmd	(barg)	(barg)	(barg)	(barg)	(barg)	m/s
Limits	8.08 (Max)	77.5 (Max)	6.00 (Max)	75 (Max)	39 (Min)	39 (Min)	39 (Min)	39 (Min)	20 (Max)
20/21	8.076	67.3/72.7	0.704	43.2/51.6	39/49	44 / 52.9	47.4/56.1	41.7/49.7	10.94 [i]
21/22	OK	OK	OK	OK	OK	OK	OK	OK	OK
22/23	OK	OK	OK	OK	OK	OK	OK	OK	OK
23/24	OK	OK	OK	OK	OK	OK	OK	OK	OK
24/25	OK	OK	OK	OK	OK	OK	OK	OK	OK
25/26	OK	OK	OK	OK	OK	OK	OK	OK	OK
26/27	OK	OK	OK	OK	OK	OK	OK	OK	OK
27/28	OK	OK	OK	OK	OK	OK	OK	OK	OK
28/29	OK	OK	OK	OK	OK	OK	OK	OK	OK
29/30	8.079	67.6/73.6	1.834	45.9/55.1	39/50.5	44.2/54.3	47.7/57.4	41/50.2	6.55 [i]

b) Severe Winter Peak Day- Base Case (Firm and Interruptible)

Table A3- 4: Twynholm Min Pressure 56 barg, Min System Pressure 12 barg

Year	Twynholm		Gormanston		Coolkeeragh	Carrickfergus	Ballylumford	Tullykeneye	NI System
	Flow	Pressure (1)	Flow	Pressure (2)	Pressure (3)	Pressure (4)	Pressure (3)	Pressure (3)	Max Velocity (5)
	mscmd	(barg)	mscmd	(barg)	(barg)	(barg)	(barg)	(barg)	m/s
Limits	8.08 (Max)	77.5 (Max)	6.00 (Max)	75 (Max)	12 (Min)	12 (Min)	12 (Min)	12 (Min)	20 (Max)
20/21	8.076	56/60.9	1.104	25.1/34.7	14.3/28.8	24.9/ 36	29.3/ 39.9	21.1/30.4	10.85 [i]
21/22	OK	OK	OK	OK	OK	OK	OK	OK	OK
22/23	OK	OK	OK	OK	OK	OK	OK	OK	OK
23/24	OK	OK	OK	OK	OK	OK	OK	OK	OK
24/25	OK	OK	OK	OK	OK	OK	OK	OK	OK
25/26	OK	OK	OK	OK	OK	OK	OK	OK	OK
26/27	OK	OK	OK	OK	OK	OK	OK	OK	OK
27/28	OK	OK	OK	OK	OK	OK	OK	OK	OK
28/29	OK	OK	OK	OK	OK	OK	OK	OK	OK
29/30	8.079	56/61.6	2.234	30.2/39.8	13.1 / 30.1	24.7 / 37.3	29.1/ 41	19.2/29.6	11.01 [i]

b) Severe Winter Peak Day- Base Case (Firm and Interruptible)

Table A3- 5: Twynholm Min Pressure 56 barg, Min System Pressure 39 barg

Year	Twynholm		Gormanston		Coolkeeragh	Carrickfergus	Ballylumford	Tullykeneye	NI System
	Flow	Pressure (1)	Flow	Pressure (2)	Pressure (3)	Pressure (4)	Pressure (3)	Pressure (3)	Max Velocity (5)
	mscmd	(barg)	mscmd	(barg)	(barg)	(barg)	(barg)	(barg)	m/s
Limits	**8.08 (Max)**	**77.5 (Max)**	**6.00 (Max)**	**75 (Max)**	**39 (Min)**	**39 (Min)**	**39 (Min)**	**39 (Min)**	**20 (Max)**
20/21	5.433	56/63.6	3.747	56.7/62.2	39/49.2	43.2/51.9	44.1/54.2	45.5/52.3	5.17 [i]
21/22	OK	OK	OK	OK	OK	OK	OK	OK	OK
22/23	OK	OK	OK	OK	OK	OK	OK	OK	OK
23/24	OK	OK	OK	OK	OK	OK	OK	OK	OK
24/25	OK	OK	OK	OK	OK	OK	OK	OK	OK
25/26	OK	OK	OK	OK	OK	OK	OK	OK	OK
26/27	OK	OK	OK	OK	OK	OK	OK	OK	OK
27/28	OK	OK	OK	OK	OK	OK	OK	OK	OK
28/29	OK	OK	OK	OK	OK	OK	OK	OK	OK
29/30	5.636	56/ 64.9	4.677	61.8/67.6	39/ 49.9	43.7/52.9	43.2/ 55.2	45.5/52.8	5.56 [i]

b) Severe Winter Peak Day- Base Case (Firm and Interruptible)

Table A3- 6: Twynholm Pressure as required, Min System Pressure 39 barg

Year	Twynholm		Gormanston		Coolkeeragh	Carrickfergus	Ballylumford	Tullykeneye	NI System
	Flow	Pressure (1)	Flow	Pressure (2)	Pressure (3)	Pressure (4)	Pressure (3)	Pressure (3)	Max Velocity (5)
	mscmd	(barg)	mscmd	(barg)	(barg)	(barg)	(barg)	(barg)	m/s
Limits	**8.08 (Max)**	**77.5 (Max)**	**6.00 (Max)**	**75 (Max)**	**39 (Min)**	**39 (Min)**	**39 (Min)**	**39 (Min)**	**20 (Max)**
20/21	8.076	67.4/73	1.104	44.1/52.9	39/49.6	44.1 / 53.4	47.5/56.6	41.9/ 50.4	6.54 [i]
21/22	OK	OK	OK	OK	OK	OK	OK	OK	OK
22/23	OK	OK	OK	OK	OK	OK	OK	OK	OK
23/24	OK	OK	OK	OK	OK	OK	OK	OK	OK
24/25	OK	OK	OK	OK	OK	OK	OK	OK	OK
25/26	OK	OK	OK	OK	OK	OK	OK	OK	OK
26/27	OK	OK	OK	OK	OK	OK	OK	OK	OK
27/28	OK	OK	OK	OK	OK	OK	OK	OK	OK
28/29	OK	OK	OK	OK	OK	OK	OK	OK	OK
29/30	8.079	67.7/74	2.234	47.4/56.9	39 / 51	44.3/ 54.9	47.8/58	41.2/50.8	6.57 [i]

A3.2 Average Winter Peak Day

a) Average Winter Peak Day- Base Case (Firm)

Table A3- 7: Twynholm Min Pressure 56 barg, Min System Pressure 12 barg

Year	Twynholm		Gormanston		Coolkeeragh	Carrickfergus	Ballylumford	Tullykeneye	NI System
	Flow	Pressure (1)	Flow	Pressure (2)	Pressure (3)	Pressure (4)	Pressure (3)	Pressure (3)	Max Velocity (5)
	mscmd	(barg)	mscmd	(barg)	(barg)	(barg)	(barg)	(barg)	m/s
Limits	**8.08 (Max)**	**77.5 (Max)**	**6.00 (Max)**	**75 (Max)**	**12 (Min)**	**12 (Min)**	**12 (Min)**	**12 (Min)**	**20 (Max)**
20/21	7.050	56/60.1	0.170	31.1/37.9	26.1/35.3	33.1/40.5	36.7/43.9	29.8/36.2	8.08 [ii]
21/22	OK	OK	OK	OK	OK	OK	OK	OK	OK
22/23	OK	OK	OK	OK	OK	OK	OK	OK	OK
23/24	OK	OK	OK	OK	OK	OK	OK	OK	OK
24/25	OK	OK	OK	OK	OK	OK	OK	OK	OK
25/26	OK	OK	OK	OK	OK	OK	OK	OK	OK
26/27	OK	OK	OK	OK	OK	OK	OK	OK	OK
27/28	OK	OK	OK	OK	OK	OK	OK	OK	OK
28/29	OK	OK	OK	OK	OK	OK	OK	OK	OK
29/30	7.533	56/60.1	0.36	25.2/33.5	18.7/30.3	28.9/37.5	33.6/41.5	22.2/29.8	10.62 [ii]

a) Average Winter Peak Day- Base Case (Firm)

Table A3- 8: Twynholm Min Pressure 56 barg, Min System Pressure 39 barg

Year	Twynholm		Gormanston		Coolkeeragh	Carrickfergus	Ballylumford	Tullykeneye	NI System
	Flow	Pressure (1)	Flow	Pressure (2)	Pressure (3)	Pressure (4)	Pressure (3)	Pressure (3)	Max Velocity (5)
	mscmd	(barg)	mscmd	(barg)	(barg)	(barg)	(barg)	(barg)	m/s
Limits	**8.08 (Max)**	**77.5 (Max)**	**6.00 (Max)**	**75 (Max)**	**39 (Min)**	**39 (Min)**	**39 (Min)**	**39 (Min)**	**20 (Max)**
20/21	5.120	56/61	2.1	47.1/52.6	43/49.5	39/46.9	45.5/51.9	42.7/48.6	4.44 [i]
21/22	OK	OK	OK	OK	OK	OK	OK	OK	OK
22/23	OK	OK	OK	OK	OK	OK	OK	OK	OK
23/24	OK	OK	OK	OK	OK	OK	OK	OK	OK
24/25	OK	OK	OK	OK	OK	OK	OK	OK	OK
25/26	OK	OK	OK	OK	OK	OK	OK	OK	OK
26/27	OK	OK	OK	OK	OK	OK	OK	OK	OK
27/28	OK	OK	OK	OK	OK	OK	OK	OK	OK
28/29	OK	OK	OK	OK	OK	OK	OK	OK	OK
29/30	4.959	56/61.6	2.934	50.5/56.5	39/47.8	43.3/50.6	46/53.1	42.7/49.3	4.33 [i]

a) Average Winter Peak Day- Base Case (Firm)

Table A3- 9: Twynholm Pressure as required, Min System Pressure 39 barg

Year	Twynholm		Gormanston		Coolkeeragh	Carrickfergus	Ballylumford	Tullykeneye	NI System
	Flow	Pressure (1)	Flow	Pressure (2)	Pressure (3)	Pressure (4)	Pressure (3)	Pressure (3)	Max Velocity (5)
	mscmd	(barg)	mscmd	(barg)	(barg)	(barg)	(barg)	(barg)	m/s
Limits	**8.08 (Max)**	**77.5 (Max)**	**6.00 (Max)**	**75 (Max)**	**39 (Min)**	**39 (Min)**	**39 (Min)**	**39 (Min)**	**20 (Max)**
20/21	7.050	63.5/67.8	0.170	42.5/48.9	39/46.9	44/50.7	47.2/53.8	41.5/47.7	5.95 [ii]
21/22	OK	OK	OK	OK	OK	OK	OK	OK	OK
22/23	OK	OK	OK	OK	OK	OK	OK	OK	OK
23/24	OK	OK	OK	OK	OK	OK	OK	OK	OK
24/25	OK	OK	OK	OK	OK	OK	OK	OK	OK
25/26	OK	OK	OK	OK	OK	OK	OK	OK	OK
26/27	OK	OK	OK	OK	OK	OK	OK	OK	OK
27/28	OK	OK	OK	OK	OK	OK	OK	OK	OK
28/29	OK	OK	OK	OK	OK	OK	OK	OK	OK
29/30	7.533	66.2/70.8	0.36	42.4/49.9	39/48	44.8/52.3	48.6/55.7	40.6/47.7	6.56 [ii]

b) Average Winter Peak Day- Base Case (Firm and Interruptible)

Table A3- 10: Twynholm Min Pressure 56 barg, Min System Pressure 12 barg

Year	Twynholm		Gormanston		Coolkeeragh	Carrickfergus	Ballylumford	Tullykeneye	NI System
	Flow	Pressure (1)	Flow	Pressure (2)	Pressure (3)	Pressure (4)	Pressure (3)	Pressure (3)	Max Velocity (5)
	mscmd	(barg)	mscmd	(barg)	(barg)	(barg)	(barg)	(barg)	m/s
Limits	**8.08 (Max)**	**77.5 (Max)**	**6.00 (Max)**	**75 (Max)**	**12 (Min)**	**12 (Min)**	**12 (Min)**	**12 (Min)**	**20 (Max)**
20/21	7.410	56/60.2	0.170	27.9/35.4	22/32.3	30.5/38.6	34.5/42.3	26.3/33.3	9.33 [ii]
21/22	OK	OK	OK	OK	OK	OK	OK	OK	OK
22/23	OK	OK	OK	OK	OK	OK	OK	OK	OK
23/24	OK	OK	OK	OK	OK	OK	OK	OK	OK
24/25	OK	OK	OK	OK	OK	OK	OK	OK	OK
25/26	OK	OK	OK	OK	OK	OK	OK	OK	OK
26/27	OK	OK	OK	OK	OK	OK	OK	OK	OK
27/28	OK	OK	OK	OK	OK	OK	OK	OK	OK
28/29	OK	OK	OK	OK	OK	OK	OK	OK	OK
29/30	7.913	56/60	0.36	20.5/29.7	11.5/25.7	25.3/34.9	30.8/39.3	16.5/24.6	13.02[ii]
	7.913	56.1/60.2	0.36	20.8/30	12/26	25.5/35.1	31/39.5	16.8/25	12.88[ii]

b) Average Winter Peak Day- Base Case (Firm and Interruptible)

Table A3- 11: Twynholm Min Pressure 56 barg, Min System Pressure 39 barg

Year	Twynholm		Gormanston		Coolkeeragh	Carrickfergus	Ballylumford	Tullykeneye	NI System
	Flow	Pressure (1)	Flow	Pressure (2)	Pressure (3)	Pressure (4)	Pressure (3)	Pressure (3)	Max Velocity (5)
	mscmd	(barg)	mscmd	(barg)	(barg)	(barg)	(barg)	(barg)	m/s
Limits	8.08 (Max)	77.5 (Max)	6.00 (Max)	75 (Max)	39 (Min)	39 (Min)	39 (Min)	39 (Min)	20 (Max)
20/21	5.080	56/61.4	2.5	49.1/54.7	39/47.4	43.1/50.1	45.6/52.5	43.2/49.4	4.43 [i]
21/22	OK	OK	OK	OK	OK	OK	OK	OK	OK
22/23	OK	OK	OK	OK	OK	OK	OK	OK	OK
23/24	OK	OK	OK	OK	OK	OK	OK	OK	OK
24/25	OK	OK	OK	OK	OK	OK	OK	OK	OK
25/26	OK	OK	OK	OK	OK	OK	OK	OK	OK
26/27	OK	OK	OK	OK	OK	OK	OK	OK	OK
27/28	OK	OK	OK	OK	OK	OK	OK	OK	OK
28/29	OK	OK	OK	OK	OK	OK	OK	OK	OK
29/30	4.913	56/62	3.36	53.1/59.1	39/48.3	43.5/51.3	46.1/53.7	43.3/50.2	4.31 [i]

b) Average Winter Peak Day- Base Case (Firm and Interruptible)

Table A3- 12: Twynholm Pressure as required, Min System Pressure 39 barg

Year	Twynholm		Gormanston		Coolkeeragh	Carrickfergus	Ballylumford	Tullykeneye	NI System
	Flow	Pressure (1)	Flow	Pressure (2)	Pressure (3)	Pressure (4)	Pressure (3)	Pressure (3)	Max Velocity (5)
	mscmd	(barg)	mscmd	(barg)	(barg)	(barg)	(barg)	(barg)	m/s
Limits	8.08 (Max)	77.5 (Max)	6.00 (Max)	75 (Max)	39 (Min)	39 (Min)	39 (Min)	39 (Min)	20 (Max)
20/21	7.410	65.1/69.6	0.170	42.5/49.4	39/47.4	44.3/51.5	47.7/54.7	41.5/48	6.23 [ii]
21/22	OK	OK	OK	OK	OK	OK	OK	OK	OK
22/23	OK	OK	OK	OK	OK	OK	OK	OK	OK
23/24	OK	OK	OK	OK	OK	OK	OK	OK	OK
24/25	OK	OK	OK	OK	OK	OK	OK	OK	OK
25/26	OK	OK	OK	OK	OK	OK	OK	OK	OK
26/27	OK	OK	OK	OK	OK	OK	OK	OK	OK
27/28	OK	OK	OK	OK	OK	OK	OK	OK	OK
28/29	OK	OK	OK	OK	OK	OK	OK	OK	OK
29/30	7.913	68/72.7	0.36	42.5/50.5	39/48.5	45.2/53.2	49.2/56.7	40.5/48.1	6.86 [ii]

A3.3 Average Spring Day

a) Average Spring Day- Base Case (Firm)

Table A3- 13: Twynholm Min Pressure 56 barg, Min System Pressure 12 barg

Year	Twynholm		Gormanston		Coolkeeragh	Carrickfergus	Ballylumford	Tullykeneye	NI System
	Flow	Pressure (1)	Flow	Pressure (2)	Pressure (3)	Pressure (4)	Pressure (3)	Pressure (3)	Max Velocity (5)
	mscmd	(barg)	mscmd	(barg)	(barg)	(barg)	(barg)	(barg)	m/s
Limits	8.08 (Max)	77.5 (Max)	6.00 (Max)	75 (Max)	12 (Min)	12 (Min)	12 (Min)	12 (Min)	20 (Max)
20/21	4.482	56/59	0.15	44.3/48	42.4/46.9	45/48.7	47.5/51.2	43.9/47.5	3.9 [ii]
21/22	OK	OK	OK	OK	OK	OK	OK	OK	OK
22/23	OK	OK	OK	OK	OK	OK	OK	OK	OK
23/24	4.673	56/59.2	0.21	43.6/47.6	41.6/46	44.4/48.4	46.9/50.9	43/46.9	4.13 [ii]
24/25	3.913	56/58.5	0.21	45.5/48.7	43.7/47.5	46.4/49.4	49/ 51.9	44.91/48	3.76 [ii]
25/26	OK	OK	OK	OK	OK	OK	OK	OK	OK
26/27	OK	OK	OK	OK	OK	OK	OK	OK	OK
27/28	OK	OK	OK	OK	OK	OK	OK	OK	OK
28/29	OK	OK	OK	OK	OK	OK	OK	OK	OK
29/30	4.033	56/58.6	0.31	45.1/48.5	43.2/47.3	46.1/49.3	48.7/51.9	44.3/47.7	3.91 [ii]

b) Average Spring Day- Base Case (Firm and Interruptible)

Table A3- 14: Twynholm Min Pressure 56 barg, Min System Pressure 12 barg

Year	Twynholm		Gormanston		Coolkeeragh	Carrickfergus	Ballylumford	Tullykeneye	NI System
	Flow	Pressure (1)	Flow	Pressure (2)	Pressure (3)	Pressure (4)	Pressure (3)	Pressure (3)	Max Velocity (5)
	mscmd	(barg)	mscmd	(barg)	(barg)	(barg)	(barg)	(barg)	m/s
Limits	8.08 (Max)	77.5 (Max)	6.00 (Max)	75 (Max)	12 (Min)	12 (Min)	12 (Min)	12 (Min)	20 (Max)
20/21	4.732	56/59.2	0.15	43.3/47.3	41.3/46.1	44.2/48.2	46.8/50.7	42.9/46.8	4.23 [ii]
21/22	OK	OK	OK	OK	OK	OK	OK	OK	OK
22/23	OK	OK	OK	OK	OK	OK	OK	OK	OK
23/24	4.943	56/59.3	0.21	42.4/46.7	40.3/45.5	43.4/47.7	48.1/51.5	41.7/45.9	4.51 [ii]
24/25	4.173	56/58.7	0.21	44.6/48.1	42.7/46.9	45.7/49	48.4/51.6	43.9/47.3	4.09 [ii]
25/26	OK	OK	OK	OK	OK	OK	OK	OK	OK
26/27	OK	OK	OK	OK	OK	OK	OK	OK	OK
27/28	OK	OK	OK	OK	OK	OK	OK	OK	OK
28/29	OK	OK	OK	OK	OK	OK	OK	OK	OK
29/30	4.293	56/58.8	0.31	44.1/47.9	42.1/46.6	45.3/48.8	48.1/51.5	43.2/47	4.26 [ii]

A3.4 Summer Minimum Day

a) Summer Minimum Day- Base Case (Firm)

Table A3- 15: Twynholm Min Pressure 56 barg, Min System Pressure 12 barg

Year	Twynholm		Coolkeeragh		Coolkeeragh	Carrickfergus	Ballylumford	Tullykeneye	NI System
	Flow	Pressure (1)	Flow	Pressure (2)	Pressure (3)	Pressure (4)	Pressure (3)	Pressure (3)	Max Velocity (5)
	mscmd	(barg)	mscmd	(barg)	(barg)	(barg)	(barg)	(barg)	m/s
Limits	8.08 (Max)	77.5 (Max)	6.00 (Max)	75 (Max)	12 (Min)	12 (Min)	12 (Min)	12 (Min)	20 (Max)
20/21	2.299	56/57.2	0.13	49.7/51	48.4/50.2	49.9/51.2	52/ 53.3	49.6/50.9	2.11 [ii]
21/22	OK	OK	OK	OK	OK	OK	OK	OK	OK
22/23	OK	OK	OK	OK	OK	OK	OK	OK	OK
23/24	2.37	56/57.3	0.18	49.5/51	48.3/50.2	49.8/51.2	51.9/53.4	49.5/50.9	2.17 [ii]
24/25	1.82	56/56.8	0.18	50.2/51	48.9/50.2	50.4/51.2	52.6/53.4	50.1/50.9	2.04 [ii]
25/26	OK	OK	OK	OK	OK	OK	OK	OK	OK
26/27	OK	OK	OK	OK	OK	OK	OK	OK	OK
27/28	OK	OK	OK	OK	OK	OK	OK	OK	OK
28/29	OK	OK	OK	OK	OK	OK	OK	OK	OK
29/30	1.849	56/56.9	0.28	50.1/51.2	48.9/50.3	50.4/ 51.4	52.6/53.5	50/ 51	2.11 [ii]

b) Summer Minimum Day- Base Case (Firm and Interruptible)

Table A3- 16: Twynholm Min Pressure 56 barg, Min System Pressure 12 barg

Year	Twynholm		Gormanston		Coolkeeragh	Carrickfergus	Ballylumford	Tullykeneye	NI System
	Flow	Pressure (1)	Flow	Pressure (2)	Pressure (3)	Pressure (4)	Pressure (3)	Pressure (3)	Max Velocity (5)
	mscmd	(barg)	mscmd	(barg)	(barg)	(barg)	(barg)	(barg)	m/s
Limits	8.08 (Max)	77.5 (Max)	6.00 (Max)	75 (Max)	12 (Min)	12 (Min)	12 (Min)	12 (Min)	20 (Max)
20/21	2.389	56/57.3	0.13	49.5/50.9	48.3/50.1	49.8/51.2	51.9/53.3	49.4/50.8	2.2 [ii]
21/22	OK	OK	OK	OK	OK	OK	OK	OK	OK
22/23	OK	OK	OK	OK	OK	OK	OK	OK	OK
23/24	2.46	56/57.4	0.18	49.4/50.9	48.1/50.1	49.7/ 51.2	51.8/53.3	49.3/50.8	2.26 [ii]
24/25	1.91	56/56.9	0.18	50/51	48.8/50.2	50.3/51.2	52.5/53.4	49.9/50.9	2.14 [ii]
25/26	OK	OK	OK	OK	OK	OK	OK	OK	OK
26/27	OK	OK	OK	OK	OK	OK	OK	OK	OK
27/28	OK	OK	OK	OK	OK	OK	OK	OK	OK
28/29	OK	OK	OK	OK	OK	OK	OK	OK	OK
29/30	1.939	56/57	0.28	50/51.1	48.7/50.3	50.3/51.4	52.5/53.5	49.9/51	2.21 [ii]

A3.5 Sensitivity Analysis

a) Utilisation of Unused Reserved Capacity Sensitivity

A portion of the capacity (in terms of volumetric/energy flows) at each of the two entry points to the NI Network (the Moffat IP Entry Point – via Twynholm – and South North IP Entry Point – via Gormanston) is reserved (i.e. not made commercially available to NI Shippers) for use at Exit Points outside of Northern Ireland. These offtakes are at Stranraer in Scotland and an offtake off the SNP to supply (in the future) Haynestown (near Dundalk) in the Republic of Ireland. Stranraer has a reserved capacity of 0.931 GWh/d (equating to 0.084 mscmd) at Moffat while Haynestown has a reserved capacity of 6.6 GWh/d (equating to 0.597 mscmd) at Gormanston. The demands at Stranraer are assumed supplied from Moffat, while Haynestown demands are assumed to be supplied from Gormanston. The forecast demands at Stranraer and Haynestown are less than the reserved capacity in all study years and scenarios within the NIGCS time horizon. This sensitivity is designed to examine the impacts of making the unused reserved capacity at Stranraer and Haynestown available to the NI Shippers. Severe Winter Peak Firm as well as Firm and Interruptible load results are shown. As known from the main body of the report, no security of supply issues are expected in the Severe Winter Peak in the base cases as adequate technical and commercial capacity exists to meet demand.

In the Severe Winter Peak Firm and Interruptible scenario, the full available capacity of the South North IP is not fully utilised, therefore any scenario where unused reserved Haynestown capacity is utilised is not examined.

For the scenarios where Stranraer’s unutilised reserved capacity is made available to the NI system, minimum system pressures at Coolkeeragh increase by up to 0.1 barg. Similarly, up to 0.004 mscmd extra is available to NI shippers via the Moffat IP entry point in 20/21 (and up to 0.001 mscmd in 29/30).

i) Severe Winter Peak Day (Firm) – 12 barg - Unused Reserved Capacity Available

Table A3- 17: Twynholm Min Pressure 56 barg, Min System Pressure 12 barg

Year	Twynholm		Gormanston		Coolkeeragh	Carrickfergus	Ballylumford	Tullykeneye	NI System
	Flow	Pressure (1)	Flow	Pressure (2)	Pressure (3)	Pressure (4)	Pressure (3)	Pressure (3)	Max Velocity (5)
	mscmd	(barg)	mscmd	(barg)	(barg)	(barg)	(barg)	(barg)	m/s
Limits	**8.08 (Max)**	**77.5 (Max)**	**6.00 (Max)**	**75 (Max)**	**12 (Min)**	**12 (Min)**	**12 (Min)**	**12 (Min)**	**20 (Max)**
20/21	8.080	56/60.7	0.700	23.6/32.9	14.6/28.2	24.9/35.5	29.3/39.4	20.9/29.5	10.81 [ii]
29/30	8.080	56/61.3	1.833	27.8/37.6	13.6/29.5	24.7/36.7	29.2/40.5	19/29	10.94 [i]

ii) Severe Winter Peak Day (Firm) – 39 barg - Unused Reserved Capacity Available

Table A3- 18: Twynholm Pressure as required, Min System Pressure 39 barg

Year	Twynholm		Gormanston		Coolkeeragh	Carrickfergus	Ballylumford	Tullykeneye	NI System
	Flow	Pressure (1)	Flow	Pressure (2)	Pressure (3)	Pressure (4)	Pressure (3)	Pressure (3)	Max Velocity (5)
	mscmd	(barg)	mscmd	(barg)	(barg)	(barg)	(barg)	(barg)	m/s
Limits	**8.08 Max**	**77.5 (Max)**	**6.00 (Max)**	**75 (Max)**	**39 (Min)**	**39 (Min)**	**39 (Min)**	**39 (Min)**	**20 (Max)**
20/21	8.080	67.3/72.7	0.700	43.2/51.6	39/49	44/52.9	47.5/56.1	41.7/49.7	6.53 [i]
29/30	8.080	67.6/73.6	1.833	45.9/55.1	39/50.5	44.2/54.3	47.7/57.4	41/50.2	6.55 [i]

iii) Severe Winter Peak Day (Firm and Interruptible) – 12 barg - Unused Reserved Capacity Available

Table A3- 19: Twynholm Min Pressure 56 barg, Min System Pressure 12 barg

Year	Twynholm		Gormanston		Coolkeeragh	Carrickfergus	Ballylumford	Tullykeneye	NI System
	Flow	Pressure (1)	Flow	Pressure (2)	Pressure (3)	Pressure (4)	Pressure (3)	Pressure (3)	Max Velocity (5)
	mscmd	(barg)	mscmd	(barg)	(barg)	(barg)	(barg)	(barg)	m/s
Limits	**8.08 (Max)**	**77.5 (Max)**	**6.00 (Max)**	**75 (Max)**	**12 (Min)**	**12 (Min)**	**12 (Min)**	**12 (Min)**	**20 (Max)**
20/21	8.080	56/60.9	1.100	25.1/34.6	14.2/28.7	24.8/35.9	29.3/39.8	21.1/30.4	10.87 [i]
29/30	8.080	56/61.6	2.233	30.2/39.8	13.1/30.1	24.7/37.3	29.1/41	19.2/29.6	11.01 [i]

i) Severe Winter Peak Day (Firm and Interruptible) – 39 barg - Unused Reserved Capacity Available

Table A3- 20: Twynholm Pressure as required, Min System Pressure 39 barg

Year	Twynholm		Gormanston		Coolkeeragh	Carrickfergus	Ballylumford	Tullykeneye	NI System
	Flow	Pressure (1)	Flow	Pressure (2)	Pressure (3)	Pressure (4)	Pressure (3)	Pressure (3)	Max Velocity (5)
	mscmd	(barg)	mscmd	(barg)	(barg)	(barg)	(barg)	(barg)	m/s
Limits	**8.08 Max**	**77.5 (Max)**	**6.00 (Max)**	**75 (Max)**	**39 (Min)**	**39 (Min)**	**39 (Min)**	**39 (Min)**	**20 (Max)**
20/21	8.080	67.4/73	1.104	44.1/52.9	39/49.6	44.1/53.4	47.5/56.6	41.9/50.4	6.54 [i]
29/30	8.080	67.7/74.1	2.233	47.4/56.9	39/51	44.3/54.9	47.8/58	41.2/50.8	6.57 [i]

b) Carrickfergus Volumetric Control Sensitivity

Simplifications in the modelling assumptions of the Base Case analysis are made for Twynholm, Gormanston and Carrickfergus AGIs. The Twynholm and Gormanston AGI entry points are modelled as volumetric flow-control regulating AGIs, with an assumed pressure drop across each AGI of 2.5 barg. The daily flows through the two entry points are assumed to follow a flat flow profile with the flow equal to 1/24 of the daily demand per hour. Carrickfergus AGI which is also a volumetric flow-control regulating AGI is modelled in free flow, whereby the regulator is modelled as 'wide-open' and flow is determined by prevailing pressures with an assumed pressure drop across the AGI of 2 barg. This is a simplification of the real world operation and allows the diurnal swing in the demand profile to be absorbed by the entire NI Network, including the system downstream of Carrickfergus AGI, as such the buffering effect of line pack is shared for the whole system to smooth the flat flow input.

Carrickfergus is a transfer point where gas moves from one TSO's network to the other on the NI gas transmission system. Carrickfergus station currently operates in a volumetric flow-control mode (which typically aims to keep downstream pressure in the region of 45 barg – supply pressure allowing – by matching flows through the station with total downstream demand requirements on a continuous basis). This compares with a 'free flow' mode of operation, which was assumed in the base case analyses, the effect of which is to remove any diurnal pressure swing downstream of Carrickfergus AGI. To maintain the assumed flat flow input profile at Twyhnolm, the system upstream of Carrickfergus will at times require greater Twynholm inlet pressure in order to physically enable the same entry flow profile through Twynholm AGI. The inlet pressure required to physically flow volumes of gas into the SNIP/SNP increase as the operating pressure at the relevant entry point increases. The constraint on being able to deliver such a volume of gas at the required assumed flat flow profile is the availability of the required maximum diurnal pressure.

The purpose of this sensitivity is to better approximate and illustrate the real-world behaviour of the network by simulating such volumetric control mode of operation at Carrickfergus. This concept of the difference between free flow and volumetric flow control operation is illustrated in Figure A3-1 below, which shows illustrative network diurnal pressure ranges across the NI Network in each operating mode reflective of the modelling results. The simulation verifies while maintaining a flat flow input at Twynholm, in a "free flow" configuration, lower pressures and smaller pressure swings can be expected upstream of Carrickfergus while higher pressures and larger pressure swings can be expected downstream of Carrickfergus.

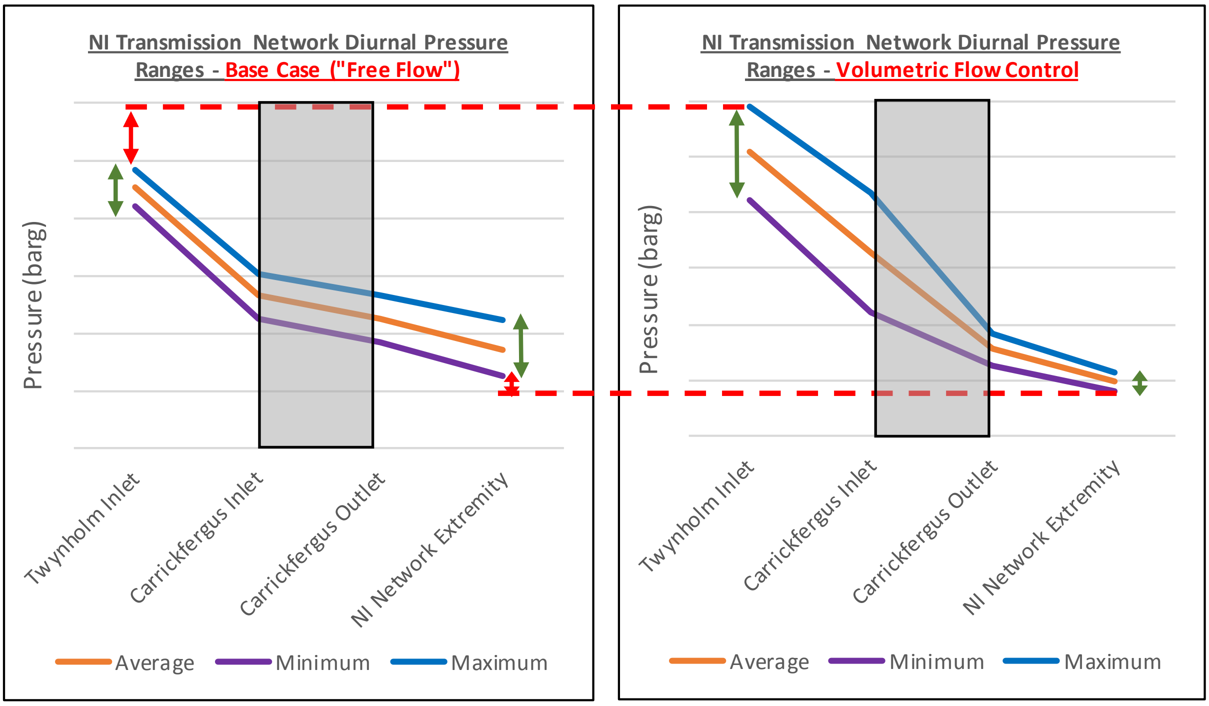

Figure A3-1: NI Network pressure profiles with 'Free Flow' versus 'Volumetric Flow Control' operation of Carrickfergus AGI

The scenario locks the flow through Carrickfergus (or through Carrickfergus and Gormanston) at every hour equal to the sum of the offtake rate of all meters downstream of Carrickfergus and upstream of Gormanston).

The TSO's are in the process of planning the implementation of a new operating configuration at Carrickfergus AGI. This will potentially reduce the number of balancing actions across the NI network with potential savings for NI consumers. The new configuration will deliver the envisaged pressure profile benefits associated with 'free flow' (as modelled), in so far as 'reverse flow' through the AGI (that being volumes of gas flowing from the NWP to the BTP because of prevailing pressure conditions) is not otherwise required. This is not routinely possible (without manual intervention at site) using the current (or proposed new) configuration of Carrickfergus AGI.

It is important to note, similar to all previous years, no security of supply issues are expected for the coming winter (volumetric or free flow-control mode) as the South North IP Entry Point remains fully available. This is on the basis that Shippers have the commercial arrangements in place to access the levels of capacity via the South North IP Entry Point which may become required should there be unavailability of the enhanced levels of Twynholm inlet pressure. A free flow style control mode at Carrickfergus is expected to allow a greater volume of gas to flow via the Moffat IP Entry point prior to the South North IP Entry point starting to flow the balance of the NI system demand.

c) Future Power Station Sensitivity

The results of the SEM 2023/2024 T-4 Capacity Auction shows generation units that have secured capacity contracts in respect of Capacity Year 2023/2024. The TSO's understand two units (GU_503430 and GU_503440) associated with EP Kilroot Ltd to be new gas-fired power generation based in Northern Ireland, as outlined in the table below;

Table A3- 21: New Gas Power Generation for Northern Ireland

CMU ID	Party Name	Awarded Capacity (MWe de-rated)	Assumed Gas Turbine de-rating Factor[26]	Assumed Installed Capacity (MWe)
GU_503430	EP KILROOT LIMITED	80.03	0.905 (80 < IC ≤ 90 unit)	88.4
GU_503440	EP KILROOT LIMITED	258.06	0.876 (290 < IC ≤ 300 unit)	294.6

Based on the above, the assumption made in the NIGCS is of the combined units having an installed capacity of 383 MWe. Furthermore, the TSO's understand both units to be open-cycle gas turbines which have a lower efficiency than combined-cycle gas turbines. For an OCGT, it appears reasonable to assume a typical 40% efficiency rating (which implies 957.5 MW at maximum rated capacity). As OCGT technology, this plant is unlikely to run as base load, however with the coal-fired generation at Kilroot's output having dropped from 255 MWe to 199 MWe in July 2020 and with the retirement of the plant from circa 2023 all coupled with any potential delay to the North South electrical Interconnector, these new OCGTs may see run hours above typical peaking plant.

To best approximate real-world conditions, diurnal profiles (based on representative historic dispatch patterns) are applied to the CCGTs at Ballylumford and Coolkeeragh. However, to thoroughly stress test the network with the new OCGTs, two scenarios were examined:

i. for the first, a demand profile of 2.078 mscm/day was assumed based on this OCGT on load at 100% duty cycle, i.e. power station operating at 100% output 100% of the time throughout each of the scenario days modelled. This is equivalent to a CCGT of 622 MWe (65% efficiency assumed) at full output 24 hours a day.

ii. the second examined a demand profile of 0.692 mscm/day based on this OCGT on load at 33% duty cycle, i.e. operating at 100% output 8 hours per day through each of the scenario days modelled. This is equivalent to a CCGT of 622 MW at full output 8 hours per day.

Whist unlikely to reflect typical operating conditions within SEM, these onerous assumptions stress tests the ability of the network to meet up to a worst-case demand scenario where for the 100% duty cycle, the OCGT runs at full output through the

[26] https://www.sem-o.com/documents/general-publications/Initial-Auction-Information-Pack_IAIP2122T-2.pdf, page 6

electricity demand night valley. The additional demand was added to the Severe Winter Peak Day Base Case, Firm and Interruptible 2023/24 and 2029/30 scenarios, these being the earliest assumed operational date and the subsequent peak of the forecast demands.

Table A3- 22: New OCGT demand added.

Firm & Interruptible Severe Winter Peak Demands + Additional Power Station							
Duty Cycle	**Year**	**Base Case Power (mscmd)**	**Base Case Distribution (mscmd)**	**Base Case Total (mscmd)**	**Additional Power Station (mscmd)**	**Total (mscmd)**	**% of Base Case Total Demand**
100 %	**2023/24**	3.94	5.80	9.743	2.078	11.821	121.3 %
	2029/30	3.94	6.37	10.313	2.078	12.391	120.1 %
33 %	**2023/24**	3.94	5.80	9.743	0.692	10.436	107.1 %
	2029/30	3.94	6.37	10.313	0.692	11.005	106.7 %

The following scenarios are examined:

- **i.** 56 barg minimum diurnal Twynholm inlet pressure and flow maximised up to the Moffat IP Entry Point capacity available to NI shippers (i.e. 8.08 mscmd minus Stranraer's reserved capacity) plus Stranraer forecast demand, while attempting to maintain 39 barg minimum NI system pressure.
- **ii.** Twynholm inlet pressure as required in order to maximise flow up to Moffat IP Entry Point capacity available to NI Shippers (i.e. 8.08 mscmd minus Stranraer's reserved capacity) plus Stranraer forecast demand, while maintaining 39 barg minimum NI system pressure.
- **iii.** 56 barg minimum diurnal Twynholm inlet pressure and rerouting flow via Gormanston as necessary in order to maintain 39 barg minimum NI system pressure. Flows at Gormanston are up to the South North IP Entry Point capacity to be made available to NI shippers, plus Haynestown demand, up to 75 barg.

Severe Winter Peak (Firm & Interruptible) 100% OCGT Duty Cycle

Table A3- 23: Twynholm Minimum Pressure 56 barg, Min System Pressure 39 barg, Twynholm Flow Maximised, 100% OCGT Duty Cycle

	Twynholm (SNIP)		Gormanston		Ballylumford	Carrickfergus		Tullykeneye	Coolkeeragh	NI Tx System
	Flow	Pressure [1]	Flow	Pressure [2]	Pressure [3]	Flow	Pressure [4]	Pressure [3]	Pressure [3]	Maximum Velocity [5]
	(mscmd)	(barg)	(mscmd)	(barg)	(barg)	(mscmd)	(barg)	(barg)	(barg)	(m/s)
Scenario	8.08 (max)	75 (max)	6.00 (max)	75 (max)	39 (min)	3.8 (max)	39 (min)	39 (min)	39 (min)	20 (max)
2023/24	8.079	56/61.5	3.742	*43.9/50.2*	*29.1/40.9*	0.727	*24.9/37.3*	*26.9/35.6*	*16.1/32.5*	10.98
2029/30	8.079	56/61.9	4.312	47.7/54.2	*29.1*/41.6	0.624	*24.9/38.1*	*27/36.4*	*15.5/33*	11.13

Table A3- 24: Twynholm Pressure as required, Minimum System Pressure 39 barg, 100% OCGT Duty Cycle

	Twynholm (SNIP)		Gormanston		Ballylumford	Carrickfergus		Tullykeneye	Coolkeeragh	NI Tx System
	Flow	Pressure [1]	Flow	Pressure [2]	Pressure [3]	Flow	Pressure [4]	Pressure [3]	Pressure [3]	Maximum Velocity [5]
	(mscmd)	(barg)	(mscmd)	(barg)	(barg)	(mscmd)	(barg)	(barg)	(barg)	(m/s)
Scenario	8.08 (max)	75 (max)	6.00 (max)	75 (max)	39 (min)	3.8 (max)	39 (min)	39 (min)	39 (min)	20 (max)
2023/24	8.079	66.9/73.1	3.742	56.1/63.1	46.7/56.8	0.728	43.4/53.7	44.4/52.7	39/50.9	6.71
2029/30	8.079	67.1/73.7	4.312	59.3/66.5	47/57.6	0.624	43.6/54.6	44.7/53.5	39/51.6	6.74

Table A3- 25: Twynholm Minimum Pressure 56 barg, Min System Pressure 39 barg, Maximising Minimum System Pressure (respecting physical and commercial constraints), 100% OCGT Duty Cycle

	Twynholm (SNIP)		Gormanston		Ballylumford	Carrickfergus		Tullykeneye	Coolkeeragh	NI Tx System
	Flow	Pressure [1]	Flow	Pressure [2]	Pressure [3]	Flow	Pressure [4]	Pressure [3]	Pressure [3]	Maximum Velocity [5]
	(mscmd)	(barg)	(mscmd)	(barg)	(barg)	(mscmd)	(barg)	(barg)	(barg)	(m/s)
Scenario	8.08 (max)	75 (max)	6.00 (max)	75 (max)	39 (min)	3.8 (max)	39 (min)	39 (min)	39 (min)	20 (max)
2023/24	6.207	56/63.2	5.614	69.9/75	40.8/51.4	*-1.143*	42.2/53	49.4/56.7	38/50.3	6.15
2029/30	6.591	56/63.4	5.8	68.9/74.5	38.9/50.3	*-0.864*	40.0/51.7	46.5/54.5	35.1/48.5	6.84

Severe Winter Peak (Firm & Interruptible) 33% OCGT Duty Cycle

Table A3- 26: Twynholm Minimum Pressure 56 barg, Min System Pressure 39, barg, Twynholm Flow Maximised, 33% OCGT Duty Cycle

Scenario	Twynholm (SNIP)		Gormanston		Ballylumford	Carrickfergus		Tullykeneye	Coolkeeragh	NI Tx System
	Flow	Pressure [1]	Flow	Pressure [2]	Pressure [3]	Flow	Pressure [4]	Pressure [3]	Pressure [3]	Maximum Velocity [5]
	(mscmd)	(barg)	(mscmd)	(barg)	(barg)	(mscmd)	(barg)	(barg)	(barg)	(m/s)
	8.08 (max)	75 (max)	6.00 (max)	75 (max)	39 (min)	3.8 (max)	39 (min)	39 (min)	39 (min)	20 (max)
2023/24	8.079	56/62.3	2.357	32.1/42.4	28.4/42.6	2.111	23.5/ 39.0	22/33.1	*14.1/32.9*	11.92
2029/30	8.079	56/62.7	2.927	35.4/45.5	28.3/43.2	2.005	23.3/39.8	21.5/33	*13.3/33.5*	12.01

Table A3- 27: Twynholm Pressure as required, Minimum System Pressure 39 barg, 33% OCGT Duty Cycle

Scenario	Twynholm (SNIP)		Gormanston		Ballylumford	Carrickfergus		Tullykeneye	Coolkeeragh	NI Tx System
	Flow	Pressure [1]	Flow	Pressure [2]	Pressure [3]	Flow	Pressure [4]	Pressure [3]	Pressure [3]	Maximum Velocity [5]
	(mscmd)	(barg)	(mscmd)	(barg)	(barg)	(mscmd)	(barg)	(barg)	(barg)	(m/s)
	8.08 (max)	75 (max)	6.00 (max)	75 (max)	39 (min)	3.8 (max)	39 (min)	39 (min)	39 (min)	20 (max)
2023/24	8.079	67.5/74.7	2.357	48.4/58.7	47.2/59.2	2.111	43.5/56.2	42.3/52.8	39/52.7	7.01
2029/30	8.079	67.8/73.4	2.927	50.9/61.3	47.5/60.1	2.055	43.8/57.1	42.39/53.3	39/53.5	7.01

Table A3- 28: Twynholm Minimum Pressure 56 barg, Min System Pressure 39 barg (respecting physical and commercial constraints), 33% OCGT Duty Cycle

Scenario	Twynholm (SNIP)		Gormanston		Ballylumford	Carrickfergus		Tullykeneye	Coolkeeragh	NI Tx System
	Flow	Pressure [1]	Flow	Pressure [2]	Pressure [3]	Flow	Pressure [4]	Pressure [3]	Pressure [3]	Maximum Velocity [5]
	(mscmd)	(barg)	(mscmd)	(barg)	(barg)	(mscmd)	(barg)	(barg)	(barg)	(m/s)
	8.08 (max)	75 (max)	6.00 (max)	75 (max)	39 (min)	3.8 (max)	39 (min)	39 (min)	39 (min)	20 (max)
2023/24	5.869	56/66.4	4.567	62.6/ 68.4	42/56.6	-0.085	43.2/54.2	47.3/54.8	39/51.4	6.14
2029/30	5.809	56/66.9	5.197	66.5/ 72.4	42.3/57.4	-0.268	43.4/55.2	48./56	39/52.2	6.09

For the Severe Winter Peak Firm and Interruptible scenario examined, in order to utilise the Moffat IP Entry Point up to its maximum capacity available to NI shippers, whilst maintaining 39 barg minimum operating pressure on the NI transmission system, Twynholm inlet pressures above 56 barg are required in both the 100% and 33% duty cycle scenario, up to 73.7 barg and 74.7 barg, respectively. It is also noted that lower minimum system pressures are observed for the 33% duty cycle scenario

(13.3 barg versus 15.5 barg), which is attributed to the flat flow at the entry points of 1/24th of the power stations daily demand leading to lower pressures.

In the 33% duty cycle scenario, when minimum diurnal inlet pressures at Twynholm are set to 56 barg and Gormanston pressure is adjusted so that flows through the Moffat IP Entry Point are maximised to the fully commercially available capacity, pressures at Coolkeeragh drop to as low as 14.1 barg (as shown in table A3-26) in the 2023/24 study year and 13.3 barg in 2029/30 study year. For both 33% and 100% duty cycle scenarios, pressures higher than these are achievable by backing off flows through Twynholm and increasing flows through Gormanston up to the levels shown in result tables A3-25 and A3-28. The results show that even with Carrickfergus in a free flow style configuration and allowing ‘reverse flow’ (i.e. bringing volumes of gas from the NWP to the BTP), Twynholm input pressures above 56 barg are required in the 100% duty cycle scenario to maintain 39 barg minimum operating pressure on the network. If reverse flows at Carrickfergus were feasible and minimum diurnal inlet pressures at Twynholm were set to 56 barg, system pressures up to 39 barg would still not be possible in the 100% duty cycle scenario, with maximum pressures of 38 barg in the 2023/24 study year and 35.1 barg in the 2029/30 study year, see Table A3-25. For the 33% duty cycle scenario, it is seen that to maintain 39 barg minimum operating pressures on the network, reverse flows at Carrickfergus would allow for a smaller Twynholm diurnal inlet pressure than without, as in this instance the South North IP Entry Point would be carrying a greater percentage of the total system demand. Any inability to physically deliver the ‘reverse flow’ quantums indicated in A3-28 would necessitate delivery of such energy/volumes of gas through the Moffat IP Entry Point, which would require greater Twynholm inlet pressure to physically enable such flow requirement at this Entry Point to the NI Network to 39 barg.

In addition, as outlined in section 3.20 Belfast Power Ltd. has planning permission to construct a 480 MWe CCGT in Belfast Harbour Estate supplied by an offtake to the Belfast Gas Transmission Pipeline. As no capacity has been awarded in the auction results for the T-4 auctions[27] and for the purposes of this report, this project is not included in the power station sensitivity adequacy studies. The developments of this project will continue to be monitored by the TSO’s with a view to incorporating in future NIGCS publications.

[27] https://www.sem-o.com/documents/general-publications/T-4-2023-2024-Final-Capacity-Auction-Results-Report.pdf

Appendix 4 – Maps

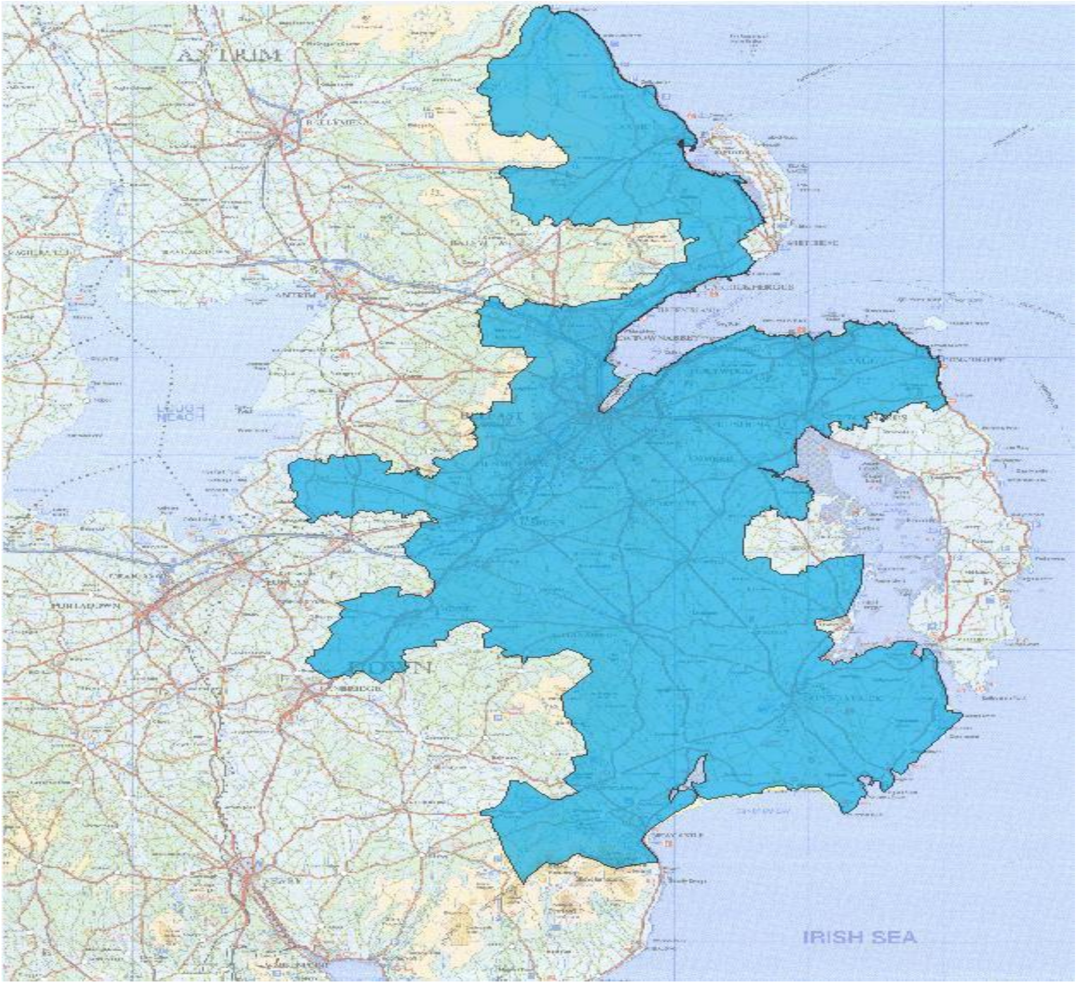

Figure A4-1: PNGL Licensed Area

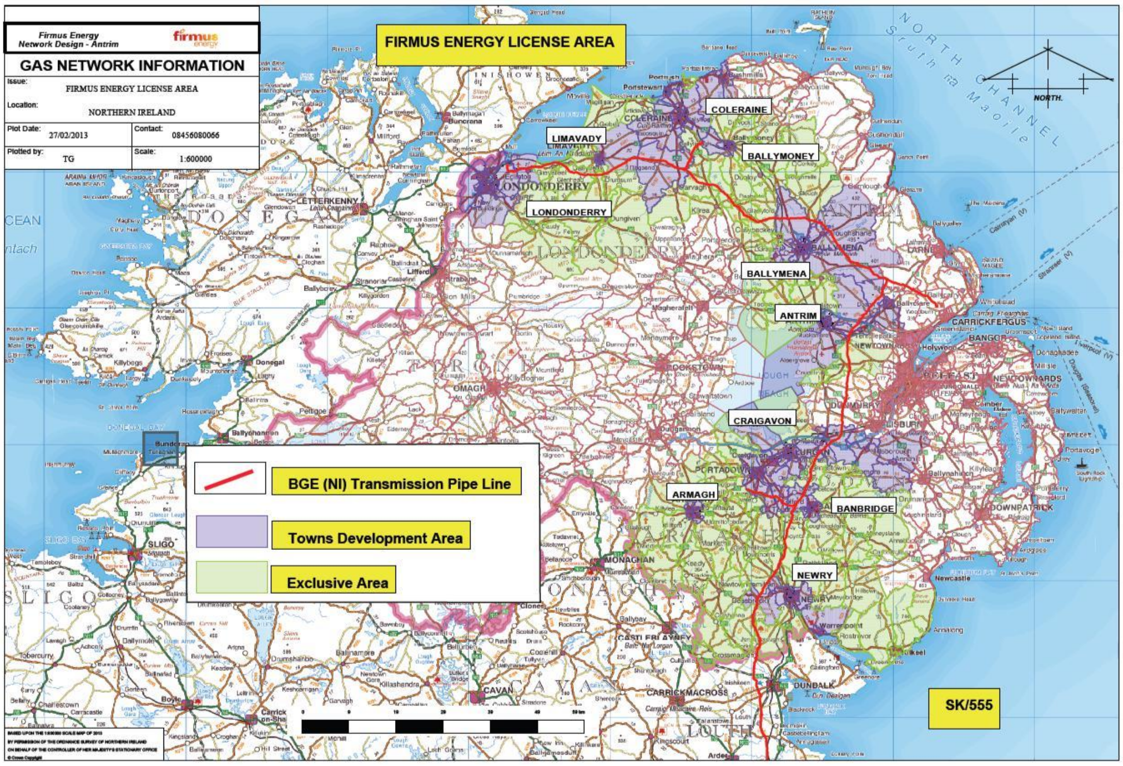

Figure A4-2: FE Licensed Area

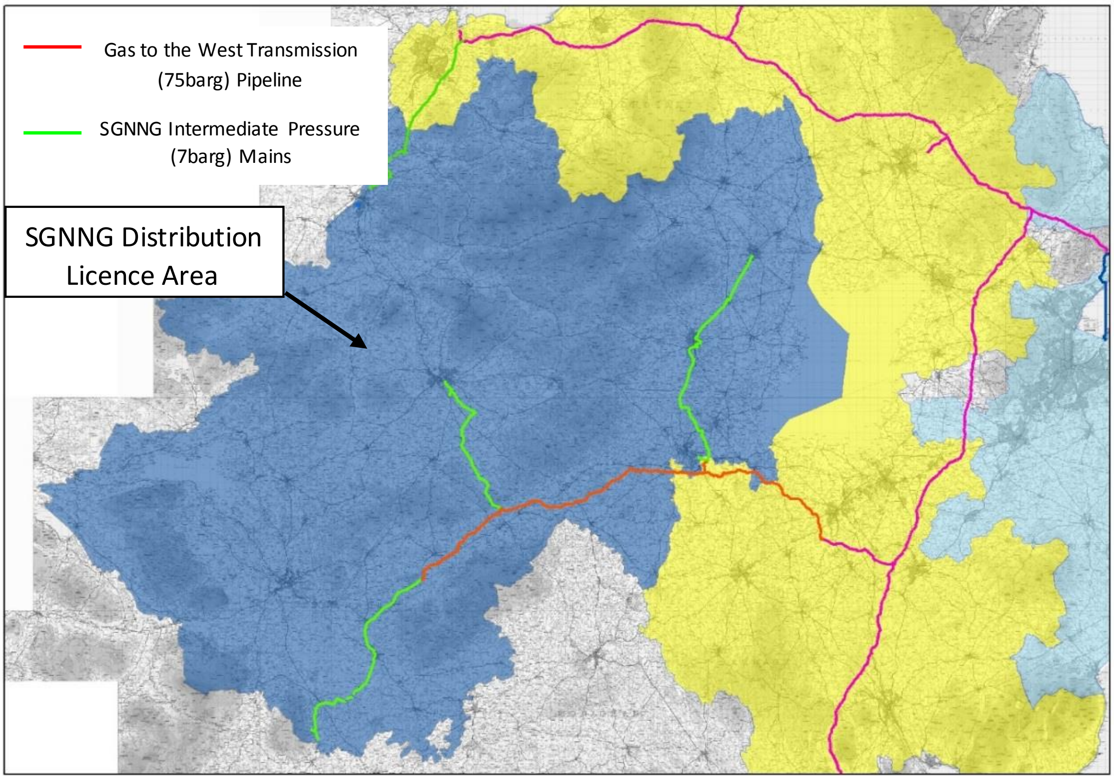

Figure A4-3: SGNNG Licensed Area