Northern Ireland

Gas Capacity Statement

2014/15 – 2023/24



About the Utility Regulator

The Utility Regulator is the independent non-ministerial government department responsible for regulating Northern Ireland's electricity, gas, water and sewerage industries, to promote the short and long-term interests of consumers.

We are not a policy-making department of government, but we make sure that the energy and water utility industries in Northern Ireland are regulated and developed within ministerial policy as set out in our statutory duties.

We are governed by a Board of Directors and are accountable to the Northern Ireland Assembly through financial and annual reporting obligations.

We are based at Queens House in the centre of Belfast. The Chief Executive leads a management team of directors representing each of the key functional areas in the organisation: Corporate Affairs; Electricity; Gas; Retail and Social; and Water. The staff team includes economists, engineers, accountants, utility specialists, legal advisors and administration professionals.

Our Mission	Value and sustainability in energy and water.
Our Vision	We will make a difference for consumers by listening, innovating and leading.

Our Values

Be a best practice regulator: transparent, consistent, proportional, accountable, and targeted.

Be a united team.

Be collaborative and co-operative.

Be professional.

Listen and explain.

Make a difference.

Act with integrity.

Abstract

The aim of the Northern Ireland Capacity Statement (NICS) 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.

Audience

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

Consumer impact

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

Contents

Executive Summary

The Northern Ireland Capacity Statement (NICS) provides an assessment of the ability of the Northern Ireland (NI) gas transmission network to deliver gas over a number of potential scenarios within the next ten years.

The NI Transmission System Operators[1] carried out the assessment using modelling software to test the network's ability to meet three types of demand days (minimum summer demand, average winter demand and severe winter demand) for the following scenarios:

i. Base Case scenario which assumes the existing infrastructure for all years;

ii. Base Case scenario plus the proposed 'Gas to the West' network extension;

iii. Base Case scenario plus the Gas to the West network extension plus a proposed Compressed Air Energy Storage (CAES) project in Larne, Co. Antrim.

The modelling also considered the firm and interruptible demands for the severe winter demand day. The demand data was provided by the Northern Ireland power stations and distribution companies.

This year's statement has assumed a lower Minimum Operating Pressure of 12 barg at the exit points on the NI transmission system rather than the previously adopted optimal design specification of 27 barg. This approach provides consistency with the TSOs' contractual requirements to provide a minimum pressure of 12 barg.

Additionally we have modelled different pressures at Twynholm for each of the demand days as this reflects actual pressure patterns experienced for the different demand days. For Severe Winter Peak Day modelling we have assumed a pressure level of 59.4 barg at Twynholm, which is based on the actual minimum pressure recorded during record peak flow events.

For Average Winter Peak Day and Average Summer Minimum Day scenario Modelling we have assumed a pressure level of 69 barg, which is based on the average of the actual minimum daily pressures observed during the last three winters. This approach differs from last year's statement which assumed a fixed pressure of 56 barg inlet pressure to Twynholm for all demand days modelled.

1 BGE(UK), Belfast Gas Transmission Limited, Premier Transmission limited

The modelling results have shown that on the basis of the forecast demand data and assumptions set out in the paper the network could meet the firm demands for the average winter and minimum summer demands for all years for all scenarios.

For severe winter peak demand on the basis of the forecast demand data and assumptions set out in the paper, the network could meet demands for the following years:

- Base Case – from 2014/15 to 2021/22
- Base Case plus Gas to the West – from 2016/17 to 2019/20
- Base Case plus Gas to the West plus CAES – for 2016/17 only

Outside of these timings, the modelling has indicated that the network experiences low pressure issues and could not deliver the full gas demands. Should these circumstances occur, modelling has shown that use of the South North pipeline will provide the necessary pressure to meet full demand. There are also arrangements to address low pressure issues on the network such as powerstations switching to secondary fuels.

1. Introduction

Background information

1.1 The aim of the Northern Ireland Capacity Statement (NICS) 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.

1.2 The Northern Ireland Transmission System Operators (TSOs) are obliged in their respective network codes and licences to produce a capacity report based upon network analysis of relevant supply and demand scenarios. This statement is based upon the information that the NI TSOs have provided under their respective licences.

Report Structure

1.3 This paper is set out as follows:

Section 2 provides an overview of the existing Northern Ireland transmission network and also future infrastructure projects that are currently being considered.

Section 3 provides information on historic and forecast gas demand for NI.

Section 4 sets out the scenarios that have been modelled in this year's NICS.

Section 5 sets out the modelling results.

Section 6 provides commentary on the results.

Appendix 1: Demand Forecasts

Appendix 2: Summary of System Modelling Assumptions

Appendix 3: Detailed Modelling Results

2. Transmission Network Overview

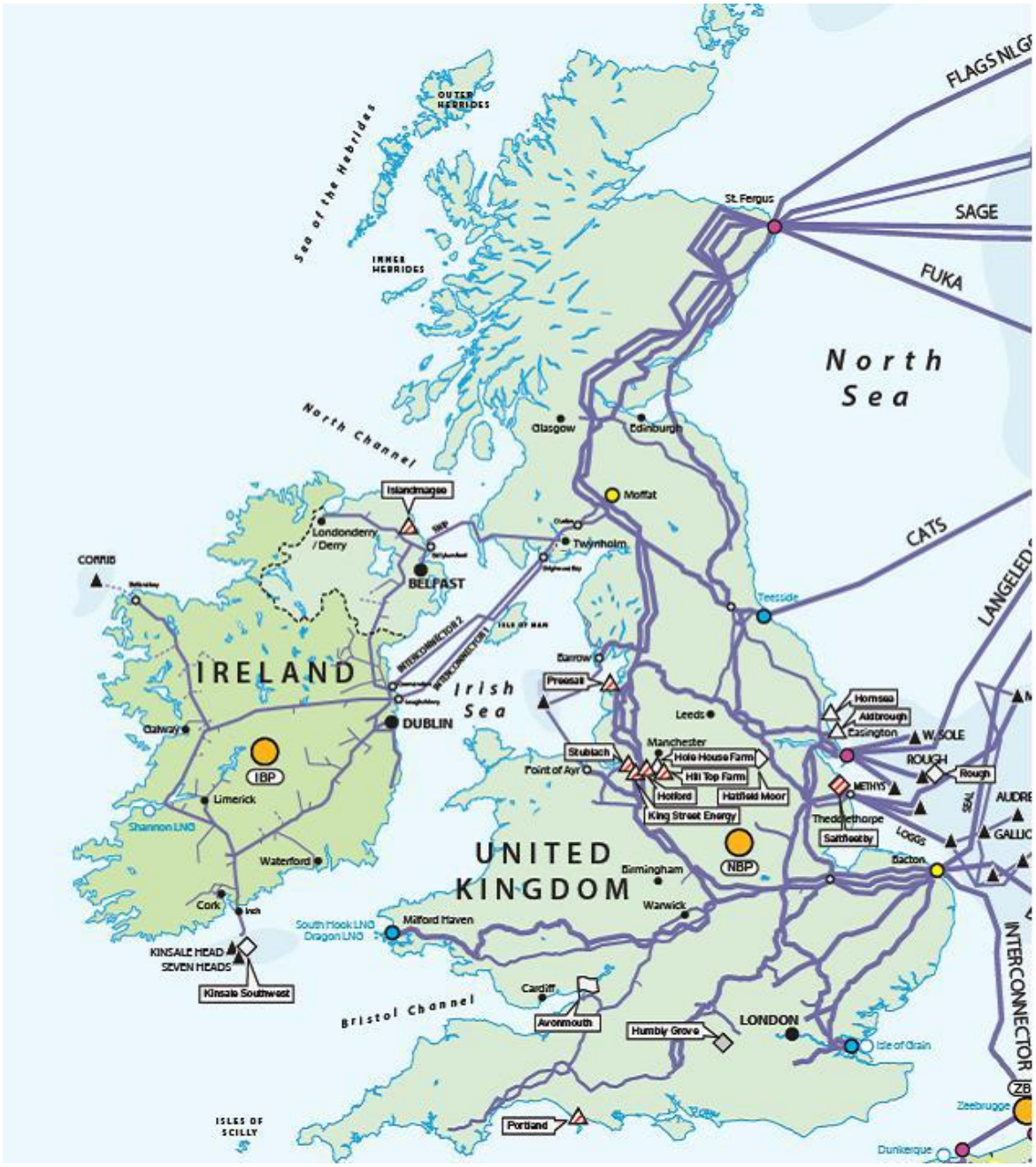
Scottish Onshore system and subsea system

2.1 The Moffat Entry Point connects the Northern Ireland and Ireland gas networks to National Grid's National Transmission System (NTS) in GB. This connection allows for the importation of GB gas to Ireland and Northern Ireland. From the connection with the National Grid system at Moffat, the Scottish onshore system consists of a compressor station at Beattock, which is connected to Brighouse Bay by two pipelines from Beattock to Cluden and a single pipeline from Cluden to Brighouse Bay, all capable of operating at 85 barg.

2.2 A second compressor station at Brighouse Bay compresses the imported gas into the two sub-sea interconnectors to Ireland which can operate at pressures in excess of 140barg if required. Before reaching the Brighouse compressor station, an offtake station at Twynholm supplies gas to Northern Ireland via the SNIP. The SNIP pipeline has a maximum operating pressure of 75barg, although there is a minimum guaranteed supply pressure into this system which is currently 56barg.

2.3 A map of the UK/Ireland transmission network is presented in Figure 1.

Figure 1: UK/Ireland transmission network map



Northern Ireland transmission system

2.4 The Scotland to Northern Ireland 600mm pipeline (SNIP) connects to the BGÉ(UK) system at Twynholm in Scotland and has a maximum operating pressure of 75 barg. The pipeline is 135 km long and 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 PTL.

2.5 The Belfast Gas Transmission Pipeline (BGTP) comprises a further 35kms of 600mm pipeline with a maximum operating pressure of 75 Barg and runs from Ballylumford via Carrickfergus to Belfast, where it supplies the Greater Belfast demand. The North-West Pipeline (NWP), extends a further 112km of 450mm pipeline from Carrickfergus to supply the power station at Coolkeeragh. The NWP, is owned and operated by BGÉ (UK) Ltd. The firmus energy distribution network also connects several towns to the NWP.

2.6 A 450mm pipeline connecting the Interconnector System to the NWP was built in 2006. This pipeline, called the South-North Pipeline (SNP), is 156kms long and extends from the IC2 landfall at Gormanston, Co. Meath in Ireland to Ballyalbanagh on the NWP, approximately 12km west of the Carrickfergus AGI. This pipeline facilitates supplies to towns and industries in the corridor from Newry to Belfast (also being developed by firmus energy) and in the longer term will be able to support the SNIP pipeline in meeting increased demand levels in Northern Ireland.

Northern Ireland distribution system

2.7 Northern Ireland has two gas distribution network companies:

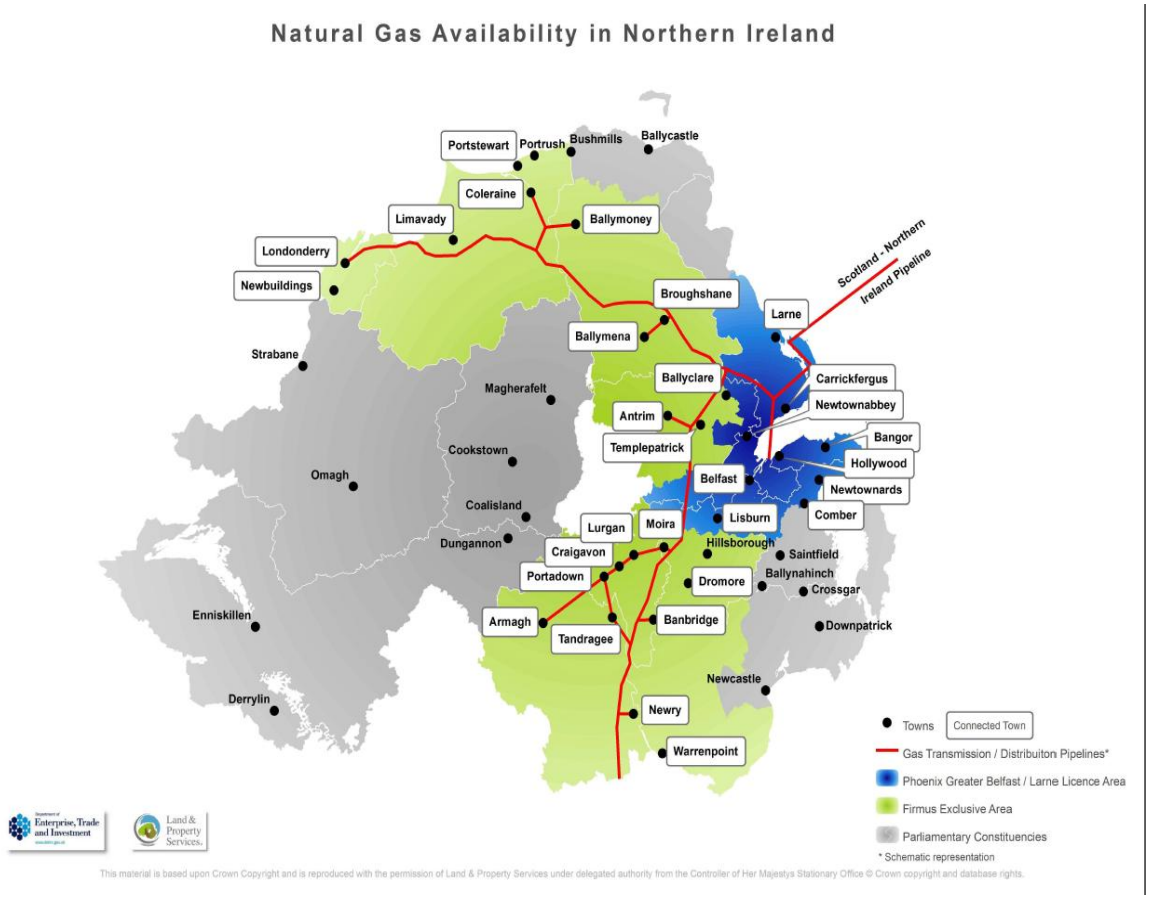
2.8 Phoenix Natural Gas Limited (PNGL) and firmus energy (distribution) Limited (firmus). PNGL own and operate the distribution network in the Greater Belfast and Larne areas. PNGL was awarded their conveyance licence in September 1996. Presently they have over 175,000 customers connected within the Greater Belfast and Larne licence area.

2.9 firmus own and operate the distribution network within the ten towns licence. This area covers a greater geographical area including Londonderry, Limavady, Coleraine (inc. Portstewart, and Bushmills), Ballymoney, Ballymena (Broughshane), Antrim (inc. Ballyclare and Templepatrick), Craigavon (inc. Portadown and Lurgan), Banbridge, Newry (Warrenpoint) and Armagh (Tandragee).

2.10 firmus was awarded their conveyance licence in March 2005 and have over 20,000 customers connected within the ten towns licence area.

2.11 A map outlining the PNGL and firmus distribution licence areas is shown in Figure 2.

Figure 2: Northern Ireland Distribution Network



Network extension – 'Gas to the West'

2.12 The Department of Enterprise, Trade and Investment (DETI) and the Utility Regulator have been progressing work on bringing natural gas to additional towns in the West and North-West of Northern Ireland since 2009.

2.13 A number of technical assessments, economic evaluations and consultations have been carried out and are available on the DETI and Utility Regulator websites for further information.

2.14 In January 2013, the Northern Ireland Executive agreed in principle to provide financial assistance up to £32.5 million towards the cost of constructing new gas networks to the West and North-West.

2.15 A map of the proposed network extension has been included in Figure 3. It is estimated that this project would connect some 34,000 new business and domestic consumers to natural gas in the West and North-West.

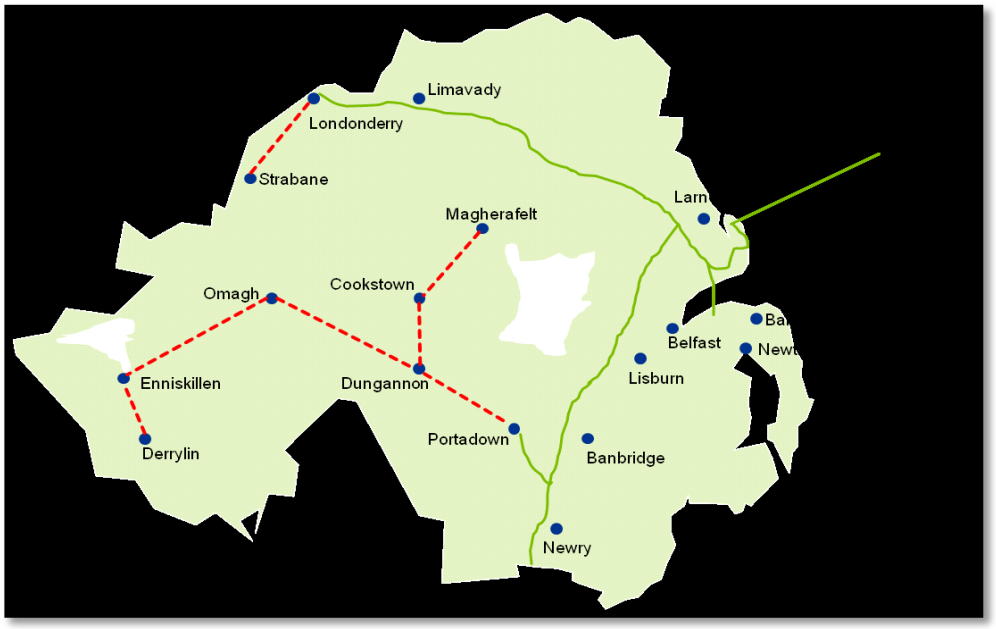
2.16 The Utility Regulator launched the competitive licence application process to extend the gas network to the west and north-west of Northern Ireland in February 2014. More recently in August 2014, the Utility Regulator published its consultation on the preferred applicant in the licence award process[2].

2.17 After the award of new gas licence(s), the new licensee(s) will have to complete detailed design work on the new gas infrastructure, consider any environmental issues, and obtain the necessary wayleaves and planning consent in advance of any construction works commencing.

2.18 As such, it is difficult to determine when the first connections to the pipeline extensions will be in place, however in order to determine the impact of the extensions to the network, the modelling has assumed that the network will be available in gas year 2016-2017.

2 http://www.uregni.gov.uk/gas/projects/gas_to_the_west_initative/

Figure 3: Proposed Network Extensions under the 'Gas to the West' project



Compressed Air Energy Storage

2.19 Gaelectric CAES NI ltd is currently developing a Compressed Air Energy Storage ("CAES") project in Larne, Co. Antrim. The project has been granted a mineral prospecting licence from DETI and has been designated as a Project of Common Interest by the European Commission. Gaelectric CAES NI ltd expects to submit a planning application in 2014, and are in discussions with SONI with respect to connecting the plant to the NI power system.

2.20 During off-peak hours, electricity from the grid powers compressors that drive air into the underground storage vessel which will be formed in salt caverns approximately 700-900m below ground level. When demand increases, the air is released to the surface and heated with natural gas to increase its temperature. The air-gas mixture is used to drive an expander train that will generate 268MW of power. Gaelectric CAES NI Ltd expect to commission the project mid-2017.

Gas Storage

2.21 Islandmagee Storage Limited is progressing plans to develop an underground natural gas storage facility which will have its above-ground facilities near Ballylumford, in County Antrim, Northern Ireland. Seven caverns with a total gas storage capacity of approximately 500 million cubic metres are planned within a layer of bedded salt greater than 200 metres thick located approximately 1,500 metres beneath Larne Lough.

2.22 The project has been granted planning permission, a gas storage licence from the Utility Regulator, and a Mineral Licence from DETI.

2.23 Applications have been submitted for three marine licences to the Department of Environment and Northern Ireland Environment Agency. Further consents will also be needed before the project can proceed to full construction and operation.

2.24 The Islandmagee Storage facility has not been included in this year's capacity statement as it has been modelled in previous years' statements. If readers are interested in the modelling results of scenarios including a gas storage facility at Larne they are available in previous capacity statements.

3. Northern Ireland Gas Demand

Historic NI Annual Demand

3.1 The historic NI gas demand is summarised by sector in Table 1 and shown graphically in Figure 4 below. The distribution category includes the gas demand of Phoenix Natural Gas and firmus energy, while the power sector includes the Ballylumford and Coolkeragh powerstations.

Table 1 Historic NI Annual Demand

	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13
ENERGY (GWh/y)									
Power	13,770	14,922	15,696	14,249	12,489	11,352	11,562	9,137	7,855
Distribution	3,209	3,327	3,394	3,923	4,161	4,569	4,834	5,008	5,579
Total NI	**16,979**	**18,249**	**19,090**	**18,172**	**16,650**	**15,921**	**16,396**	**14,145**	**13,433**
VOLUME (mscm/y)									
Power	1,239	1,343	1,413	1,292	1,128	1,026	1,075	827	711
Distribution	289	299	305	356	376	413	450	453	505
Total NI	**1,528**	**1,642**	**1,718**	**1,648**	**1,504**	**1,439**	**1,525**	**1,280**	**1,216**

3.2 The highest annual demand for NI was recorded in 2006/07. Since then there has been a general decrease in overall volumes driven by lower consumption from the power stations.[3] As noted in last year's assessment the lower demand from the power sector is due to a number of factors. Lower coal prices and more efficient gas plant operating in the Republic of Ireland (RoI) has reduced Northern Ireland power stations' position in the Single Electricity Market (SEM) merit order. Consequently there is less electricity demand from the NI gas fired power stations and therefore lower gas flows.

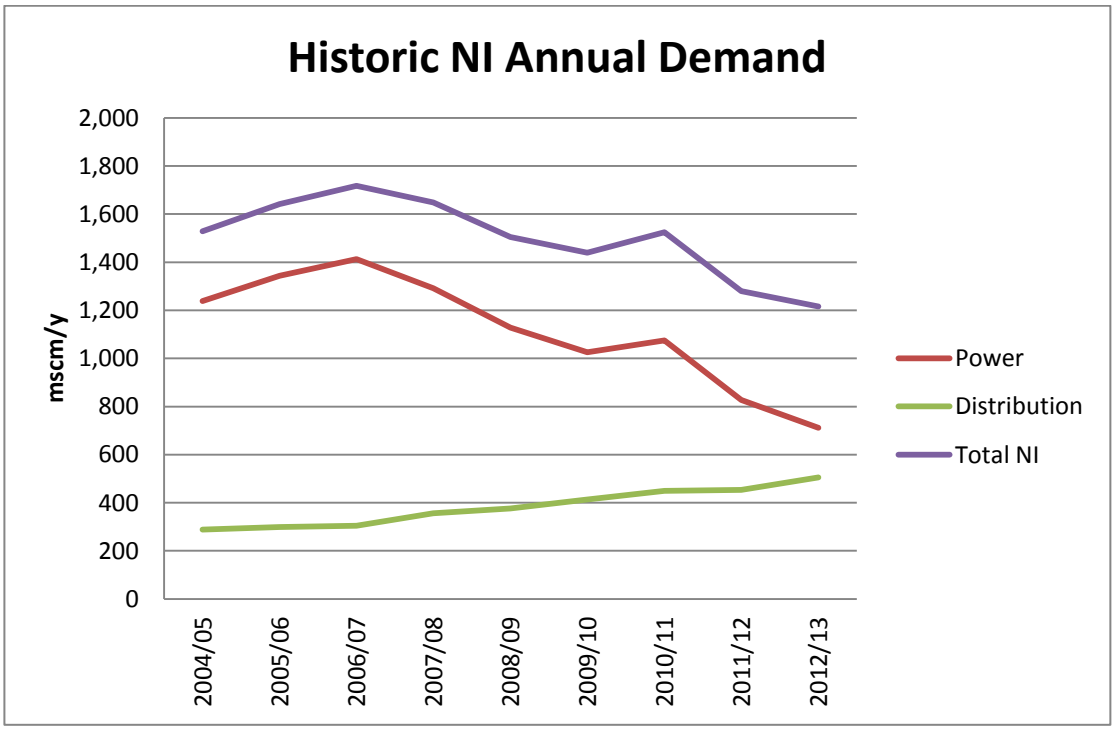
3.3 Increasing competition from wind powered generation has also reduced demand. Changes in volumes are also impacted by maintenance cycles for the generation units.

3 The exception to this was the increase in total demands recorded in 2010/2011 which was due to the unavailability of the Moyle interconnector. This resulted during that year in lower electricity imports and therefore increased use of gas fired power stations in Northern Ireland.

3.4 The exception to this is the distribution sector which has experienced a year-on-year increase reflecting the continuing growth within the domestic and industrial/commercial sector.

3.5 However due to the reduction in demand from the power sector noted above, the total annual gas demand has decreased overall between 2006/2007 until 2012/13.

Figure 4 NI Historic Demand



Forecast NI annual demand

3.6 The power stations and distribution companies have provided 10 year forecast demand figures to the Utility Regulator as inputs into the modelling for the NICS. The figures are summarised in Table 2and presented in Figure 5 below.

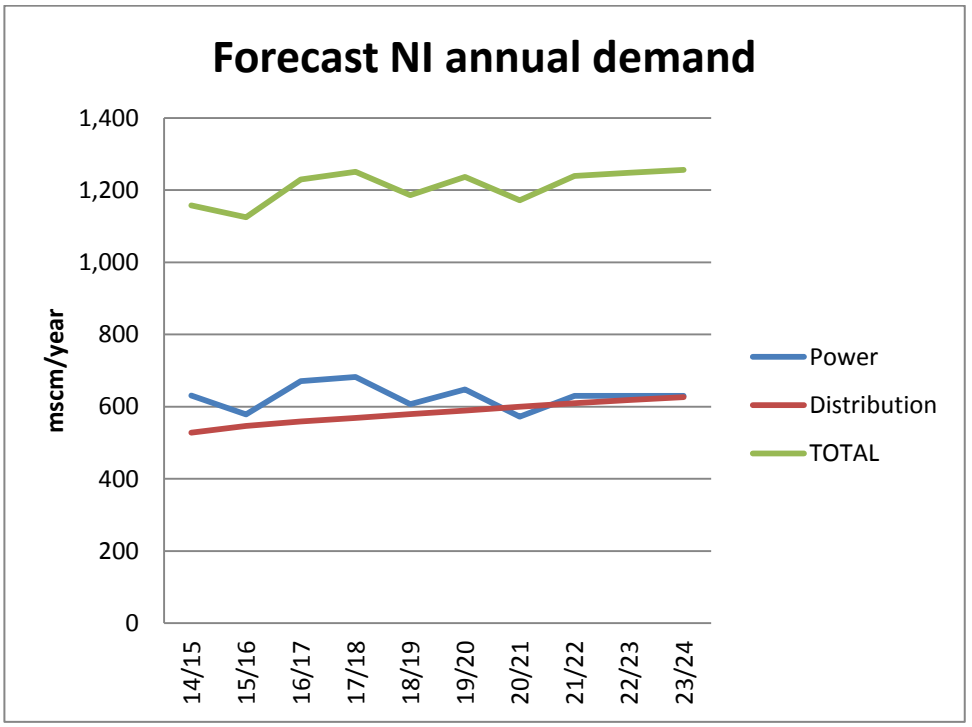
3.7 Overall demand is forecast to grow by 8% between 2014/15 to 2023/24

however there are fluctuations in demands within that period which are primarily driven by the power sector (see below). Table 2 and figure 2 demonstrate the forecast changes for total demand and also the individual sectors for the years considered. These figures exclude demands arising from Gas to the West and the proposed CAES project. The following sections provide some further details on each of the sectors.

3.8 Table 2: NI forecast demand for 2014/15 to 2023/24

Year	1	2	3	4	5	6	7	8	9	10
(mscm)	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24
Power	631	578	671	682	607	647	572	630	630	630
Distribution	528	547	559	569	579	590	600	609	618	626
TOTAL	1,158	1,125	1,229	1,251	1,186	1,237	1,172	1,239	1,248	1,256

Figure 5: NI forecast demand for 2014/15 to 2023/24



Power Station

3.9 Forecast figures were provided by the two gas fired power stations, Ballylumford and Coolkeeragh. The total power generation figures provided in Table 2 are the aggregated demand for the two sites.

3.10 The generators forecasts were based on a combination of an assessment of historic flows together with assumptions on future operating requirements. Future assumptions included an assessment of the coal-gas price differential, likely market running of the plant including the impact of higher efficiency plants operating in RoI plus future outage requirements. The expected increased capacity of the North/South electrical transmission tie-line expected in 2018/19 was also considered within the generators' assessments.

3.11 The range of competing factors influencing the forecast annual demand figures for the powerstations has resulted in a fluctuating forecast demand profile over the period. This is demonstrated graphically in Figure 2.

Distribution

3.12 Forecast figures were provided by the two gas distribution companies, PNGL and firmus. The total distribution figures provided in Table 2 are the aggregated demand forecasts for both distribution companies. Figures provided for the purposes of the NI capacity statement were based on the distribution companies own modelling forecasts which incorporated the expected growth rates within the domestic and I/C sectors over the 10 years modelled.

3.13 The distribution sector is forecast to grow by 17% over the ten year period. The year-on-year increase reflects the distribution companies' expected growth rates within the domestic and industrial/commercial sectors.

3.14 The figures provided for both distribution companies have been taken from the GD14 (Gas Distribution Price Control 2014 - 2016) submissions and updated to reflect forecasts for the relevant years. Demand forecasts include the companies' assessment of gas demand

for existing and expected new connections for the domestic and industrial/commercial sectors. The figures do not include forecasts for the Gas to the West network extension.

Forecast NI Winter Peak-day gas demand

3.15 In order to assess the system on days of different demand patterns, three sample demand days are analysed for each scenario over the 10 year period modelled: 1-in-20 year winter peak day, average year winter peak day and average year summer minimum.

3.16 All of the demand data used for the modelling is presented in Appendix 1.

3.17 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 i.e. the severe winter peak day firm demand representing the demands expected in 1 out of 20 years and an average year peak day firm representing an average winter peak day demand.

1-in-20 Winter Peak Demand (Firm)

3.18 The figures for the base case 1-in-20 Winter Peak Demand are presented below in Table 3. The base case is the scenario which tests the forecast demand associated with the existing infrastructure i.e. no 'Gas to the West' or CAES project demands.

Table 3: 1-in-20 winter peak demand for base case scenario

Year	Severe Winter Peak Day Demands/Supplies (mscmd)			
	Power	Non-Power	Total	Twynholm
2014/15	4.36	3.14	7.50	7.50
2015/16	4.36	3.25	7.61	7.61
2016/17	4.36	3.36	7.72	7.72
2017/18	4.36	3.46	7.82	7.82
2018/19	4.36	3.56	7.92	7.92
2019/20	4.36	3.66	8.02	8.02

2020/21	4.36	3.76	8.12	8.12
2021/22	4.36	3.86	8.22	8.22
2022/23	4.36	3.94	8.30	8.30
2023/24	4.36	4.03	8.39	8.39

3.19 The 1-in-20 winter peak demand (firm) figures in table 3 above represent the combined total of the individual 1-in-20 peak demands for each of the power stations and distribution companies. These figures therefore represent a simultaneous firm demand for both sectors.

3.20 It can be seen that the power stations peak 1-in-20 demand remains unchanged while there is a year-on-year growth for the distribution sector. This trend reflects previous forecasts and actual growth for the distribution sector.

3.21 The total forecast demand figure of 7.50 mscm/day for 2014/15 is the same as the firm capacity booking on the PTL system for 2014/15. This forecast total demand and the firm capacity are both higher than the actual winter peak demands that have been recorded. For example, the highest peak daily demand was 6.7 mscm/day on 7th January 2010. This was considered a severe winter although it should be noted that Coolkeeragh powerstation was temporarily off line for a short period that day so peak flows could have been higher.

Average Winter Peak Demand (Firm)

3.22 Again, the average winter peak demand figures (presented in Table 4) represent the combined total of the individual average winter peak demands for each of the power stations and distribution companies.

3.23 It is difficult to pinpoint an ‘average’ year, however the forecast figures that have been provided are largely in line with the range of actual figures that have been recorded.

Table 4: Average winter peak demand for base case scenario

Year	Average Winter Peak Day Demands/Supplies (mscmd)			
	Power	Non-Power	Total	Twynholm
2014/15	2.80	2.00	4.80	4.80
2015/16	2.80	2.08	4.88	4.88
2016/17	2.60	2.15	4.75	4.75
2017/18	2.60	2.21	4.81	4.81
2018/19	2.60	2.27	4.87	4.87
2019/20	2.60	2.34	4.94	4.94
2020/21	2.60	2.40	5.00	5.00
2021/22	2.60	2.46	5.06	5.06
2022/23	2.60	2.51	5.11	5.11
2023/24	2.60	2.56	5.16	5.16

4. Modelling Scenarios

Modelling overview and assumptions

Modelling Approach

4.1 A hydraulic model of the NI transmission system was constructed using Pipeline Studio® software. Pipeline Studio® pipeline modelling software allows the user to configure and analyse the demand on the network for a number of scenarios.

4.2 The model was run for the ten years of the capacity statement from 2014/15 – 2023/24 inclusive, to determine if the existing Northern Ireland transmission system has the capacity to meet forecasted flow requirements.

4.3 As noted in the previous section, in order to assess the system on days of different demand patterns, three sample demand days were analysed for each scenario over the 10 year period: 1-in-20 year ("severe") winter peak day, average year winter peak day and average year summer minimum. Also, where it was appropriate, the analysis also modelled firm plus interruptible demand and firm demand only.

4.4 The modelling considers the ability of the system to meet the peak or minimum daily demand within that day. It does not consider the ability of the system to respond to within day demand changes.

4.5 The scenarios that have been modelled are presented in the modelling scenario overview below.

Modelling Assumptions

4.6 The following section outlines changes to some of the key assumptions from last year's NICS. Detailed Modelling assumptions can be reviewed in Appendix 2.

4.7 The modelling in last year's NICS assumed a Minimum Operating Pressure of 27 bar across the network. This year's modelling has changed this assumption. The reasoning is set out below.

4.8 The previously assumed minimum pressure of 27 barg was based on an optimal design of the NWP, which considered the anticipated demand and supply conditions at the time of its design; we understand that 27 barg pressure also equates to the minimum pressure required at Coolkeeragh AGI for the power station to operate on gas.

4.9 This year's statement has assumed a lower minimum pressure limit of 12 barg at the various transmission Exit Points on the NI transmission system rather than the optimal design specification of the NWP. This approach provides consistency with the TSOs' contractual requirements to provide a minimum pressure of 12 barg. We understand that the AGIs can operate at pressures less than 27 barg.

4.10 A second key assumption in last year's NICS modelling was a 56 barg pressure level at Twynholm which was applied across all three types of demand days modelled. The assumption of 56 barg was based on the minimum pressure at Twynholm that BGE(UK) are contractually required to provide PTL. However, this level has never been reached; actual pressures recorded have always been higher than 56 barg.

4.11 Therefore in order to refine the 56 barg assumption the TSOs have used actual pressures recorded at Twynholm to vary the assumption on the pressure available at Twynholm by the particular demand day modelled. This is appropriate as pressure levels at Twynholm are generally lower on severe winter peak days compared to average winter days and summer minimum days.

4.12 For Severe Winter Peak Day modelling we have therefore assumed an Anticipated Normal Operating Pressure (ANOP) of 59.4 barg. This is based on the minimum pressure recorded during record peak flow events on the 9th December 2010.

4.13 For Average Winter Peak Day and Average Summer Minimum Day scenario Modelling we have assumed an ANOP of 69 barg, this is based on the average of the minimum daily pressures observed during

the last three winters.

4.14 A summary of the key changes between this year's and last year's modelling is set out below in Table 5. Further assumptions are detailed in Appendix 2.

Table 5: Summary of key changes between 2013 and 2014 NICS modelling assumptions

	2013	**2014**
Twynholm pressure		
Severe winter peak	56 barg	59.4 barg
Average Winter and summer minimum	56 barg	69 barg
Type of operation	Flow control	Flow control
Pressure drop	2.5 barg	2.5 barg
Flow profile	Flat flow	Flat flow
Design capacity	8.64 mscm	8.64 mscm
Contractual capacity	8.08 mscm	8.08 mscm
Carrickfergus		
Type of operation	Flow control	Flow control
Pressure drop	3 barg	2 barg
Gas to the West		
Treatment of network extension	Point load off SNP and NWP	Point load off SNP and NWP
Pressure requirements/Boundary Conditions		
Maximum Operating Pressure	75 barg	75 barg
Minimum Operating Pressure	27 barg	12 barg
Maximum Pipeline velocities	10-12 m/s	20m/s velocities exceeding 12 m/s will be noted

Modelling Scenario Overview

4.15 Three scenarios were modelled for this year's NICS. Each of the scenarios is discussed below. Table 6 summarises the model runs that have been completed for each of the scenarios.

Scenario 1 – Base Case

4.16 The Base Case assumes the existing infrastructure for all years. The three demand days (severe winter, average winter peak and summer minimum) have been modelled for both firm only and firm and interruptible loads.

Scenario 2–Base Case and Gas to the West

4.17 This scenario assumes the existing infrastructure as considered in the base case plus the extension of the network for Gas to the West. The modelling approach undertaken for the Gas to the West extension assumed a point load at Derryhale AGI, the proposed connection point on the SNP for the 'Gas to the West'. The point load at Derryhale is equal to the aggregate demand for the proposed off-takes along this route. Similarly, the proposed network extension to Strabane was reflected as a point load on the NWP.

4.18 The three demand days (severe winter, average winter peak and summer minimum) have been modelled for both firm only and firm and interruptible loads.

Scenario 3– Base Case and Gas to the West and CAES

4.19 This scenario assumes the existing infrastructure, plus the Gas to the West extension and also the proposed CAES facility. The modelling approach undertaken for this scenario assumed a point load on the network at Ballylumford since this exit point is close to the proposed site of the facility.

4.20 The three demand days (severe winter, average winter peak and summer minimum) have been modelled for both firm only and firm and interruptible loads.

Table 6: Suite of network modelling completed for the NI GCS 2014 (Note: 'F' – Firm, 'F & I' – Firm and Interruptible).

	Base Case	Base Case & Gas to the West	Base Case & Gas to the West & Gaelectric
Day	1	2	3
Severe Winter Peak Day (F&I)	✓	✓	✓
Severe Winter Peak Day (F)	✓	✓	✓
Average Winter Peak Day (F&I)	✓	✓	✓
Average Winter Peak Day (F)	✓	✓	✓
Summer Minimum Day (F&I)	✓	✓	✓
Summer Minimum Day (F)	✓	✓	✓

5. Modelling Results

Summary of modelling results

5.1 Based on the demand figures supplied, and the modelling assumptions outlined in section 4, the network analysis demonstrates that:

Base Case

5.2 The Northern Ireland transmission network would have sufficient capacity to meet summer minimum day and average winter peak day demands on a firm, and firm and interruptible basis.

5.3 The network would have sufficient capacity to meet severe winter peak day demand on a firm basis for years 2014/15 through to 2021/22. Beyond this, i.e. years 2022/23 and 2023/24, the Northern Ireland transmission network does not have the capacity to meet the full demand, based on minimum contractual pressure limits and upstream pressure assumptions. The use of capacity short fall measures or the use of the South-North pipeline to rebalance the system (subject to the capacity being available upstream of the Gormanston entry point) would be required under such conditions to meet system demands.

5.4 For the severe winter peak day firm & interruptible demand, on most years (with the exception of 2015/16) the Northern Ireland transmission network would not have the capacity to meet the full demand, based on minimum contractual pressure limits and upstream pressure assumptions. The use of capacity short fall measures or the use of the South-North pipeline to rebalance the system (subject to the capacity being available upstream of the Gormanston entry point) would be required under such conditions to meet system demands.

Base Case plus Gas to the West plus CAES

5.5 The Northern Ireland transmission network has sufficient capacity to meet the resulting summer minimum day and average winter peak day demands on a firm, and firm and interruptible basis.

5.6 On a severe winter peak day, the addition of the Gas to the West firm

demand to the Base Case brings forward the point in time when the minimum contractual pressure limits cannot be met. i.e. the additional firm demand from the Gas to the West extension can be met to 2019/20.

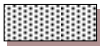
5.7 The further addition of CAES to the Base Case and Gas to the West demand expedites this trend, i.e. the additional firm demands can be met in 2016/17 only.

Key to presentation of results

5.8 The following sections outline the results of the Network Analysis. The summary results are colour-coded as follows:

All Pressures within contractual limits

Pressures outside contractual limits and / or results unobtainable due to infeasible conditions in the model



Year not modelled

5.9 When a red (pressure violation) is flagged in the summary results tables, a further explanation is presented, and a complete results table detailing the pressures on the network included in Appendix 3.

5.10 Figures are coloured red in the pressure tables in Appendix 3 where they are below the minimum contractual pressure limits (12 bar).

5.11 Detailed network analysis has not been carried out 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 modelling, pressures and velocities are listed in the results tables in Appendix 3 as ‘Within Range’.

5.12 Likewise, where a scenario has failed to solve by association with a previous year, pressures and velocities are listed in the tables in Appendix 3 as ‘FAIL’.

5.13 In scenarios where the model has failed to solve due to infeasible conditions in the model (e.g. pressures reaching 0 barg), associated pressures and velocities are also listed as *'FAIL'*. Modelling has not been attempted for the subsequent years on that scenario (provided the demand trend is increasing).

Scenario 1 – Base Case

Summary of Severe Winter Peak Day Results

5.14 Base Case analysis demonstrates that on the basis of the forecast demands and assumptions outlined the Northern Ireland transmission network would have sufficient pressure to meet severe winter peak day demands on a firm basis up to 21/22.

5.15 On a firm & interruptible basis the Northern Ireland transmission network would have sufficient pressure to meet severe winter peak day demands for the year 2015/16 only. For all other years, minimum contractual pressure limits (12 bar) cannot be met for all points on the NI Transmission system for severe winter peak day demands on firm & interruptible as modelled.

5.16 Table 7 presents the modelling results for the Base Case scenario for Firm and Firm and Interruptible severe winter demand.

Table 7: Modelling results for the Base Case scenario for Firm and Firm and Interruptible severe winter demand

Gas Year	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24
Firm							1	1	1	1
Firm & Interruptible	1,2	1	1	1	1	1,2	1,2	1,2	1,2	1,2

Notes:

1. The existing contractual capacity of the Twynholm Entry point (8.08 mscmd) is exceeded

2. The design capacity of Twynholm AGI (8.64 mscmd) is exceeded

5.17 The results tables in Appendix 3.1 detail the conditions within Northern Ireland (SNIP, South-North and North-West Pipelines) for severe winter peak day firm & interruptible demands and severe winter peak day firm demands

5.18 Further information on the Firm and Interruptible and Firm only modelling results are provided below.

Severe Winter Peak Day (F)

5.19 The results in Appendix 3.1 show that pressure at the inlet to Coolkeeragh falls below the minimum contractual limit (12 bar) from 2022/23. This occurs at a demand of 8.3 mscm.

5.20 Network analysis was not attempted in 2023/24 since pressures have fallen below the minimum pressure limit at the Coolkeeragh Exit Point in the previous year, and demand is greater in 2023/24.

5.21 Network analysis was not completed for 2015/16 – 2020/21. Results were deemed 'Within Range' by association with results and demands for the adjacent years.

5.22 Notably, the 8.08 mscm contractual limit of the SNIP is surpassed in 2020/21 and in all subsequent years.

Severe Winter Peak Day (F&I)

5.23 The results in Appendix 3.1 show that the pressure at the inlet to Coolkeeragh falls below the minimum contractual limit (12 bar) for all years modelled, with the exception of 2015/16.

5.24 Network analysis results cannot be obtained for 2014/15 since pressures have fallen below zero at the inlet to the Coolkeeragh AGI (the most peripheral point on the NI system). This occurs at a demand of 8.96 mscm. Notably the 8.08 contractual limit of the SNIP is surpassed in all years.

5.25 Notably, the forecast Northern Ireland Severe Winter Peak Day Firm & Interruptible demand is greater in 2014/15 than in subsequent years. This results from the scheduled closure of the Ballylumford 'B' Power Station at the end of 2015. Following the forecast demand reduction in 2015/16, growth is forecast in subsequent years, driven by distribution load growth. The Northern Ireland Severe Winter Peak Day Firm & Interruptible demand is forecast to recover above 2014/15 levels from 2023/24. Appendix 1 shows the Northern Ireland demand forecast.

5.26 Network analysis was not attempted for 2017/18 and subsequent years, since pressures have fallen below the minimum contractual limit (12 bar) at the inlet to Coolkeeragh AGI in 2016/17, and demands are greater in all subsequent years.

Average Winter Peak Day

5.27 Base Case analysis demonstrates that on the basis of forecast demands and assumptions used, the Northern Ireland transmission network has sufficient pressure to meet average winter peak day demands on a firm, and firm & interruptible basis.

5.28 Table 8 presents the modelling results for the Base Case scenario for firm and firm and interruptible average winter demand.

Table 8: Modelling results for the Base Case scenario for Firm and Firm and Interruptible average winter demand

Gas Year	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24
Firm										
Firm & Interruptible										

5.29 The pressures at the key points on the NI transmission network are within the operating pressure limits of the system and can provide the pressure to deliver the gas flows demanded for all years modelled.

5.30 The results tables in Appendix 3.4 detail the conditions within Northern Ireland (SNIP, South-North and North-West Pipelines) for Average

winter peak day firm & interruptible demands and Average winter peak day firm demands.

Summer Minimum Day

5.31 Base Case analysis demonstrates that the Northern Ireland transmission network has sufficient pressure to meet summer minimum day demands on a firm, and firm & interruptible basis.

5.32 Table 9 presents the modelling results for the Base Case scenario for the firm and firm and interruptible summer minimum demand.

Table 9: Modelling results for the Base Case scenario for Firm and Firm and Interruptible summer minimum demand

Gas Year	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24
Firm										
Firm & Interruptible										

5.33 The pressures at the key points on the NI transmission network are within the operating pressure limits of the system and can provide the pressure to deliver the gas flows demanded for all years modelled.

5.34 The results tables in Appendix 3.5 detail the conditions within Northern Ireland (SNIP, South-North and North-West Pipelines) for Summer minimum day firm & interruptible demands and Summer minimum day firm demands.

Scenario 2 – Base Case and Gas to the West

Summary of Severe Winter Peak Day results

5.35 The addition of Gas to the West demands brings forward the point in time when the contractual pressure limits cannot be met and/or the model outputs infeasible conditions, i.e. pressures at Coolkeeragh reach zero.

5.36 Base Case (with Gas to the West) analysis demonstrates that the Northern Ireland transmission network would not have sufficient

pressure to meet severe winter peak day demands on a firm and interruptible basis. On a firm basis, the pressure is insufficient from 2020/21.

5.37 Table 10 presents the results for the Base Case scenario and Gas to the West for firm and firm and interruptible severe winter demand.

Table 10: Modelling results for the Base Case and Gas to the West scenario for firm and firm and interruptible severe winter demand

Gas Year	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24
Firm				1	1	1	1	1	1,2	1,2
Firm & Interruptible			1	1,2	1,2	1,2	1,2	1,2	1,2	1,2

Notes:

1. The existing contractual capacity of the Twynholm Entry point (8.08 mscmd) is exceeded
2. The design capacity of Twynholm AGI (8.64 mscmd) is exceeded

5.38 The results tables in Appendix 3.2 detail the conditions within Northern Ireland (SNIP, South-North and North-West Pipelines), Base Case and Gas to the West, for severe winter peak day, firm & interruptible demands and severe winter peak day firm demands.

Severe Winter Peak Day (F&I)

5.39 The additional Gas to the West demand results in lower pressures on the network for 2016/17. Network analysis was not attempted for 2017/18 and subsequent years, since pressures have fallen below the minimum pressure limit (12 bar) at the Coolkeeragh Exit Point in 2016/17, and demand is greater in all subsequent years.

5.40 Notably, the 8.08 mscm contractual limit of the SNIP is surpassed in all years.

Severe Winter Peak Day (F)

5.41 The results show that pressure at the inlet to Coolkeeragh falls below

the minimum contractual limit (12 bar) from 2020/21. Network analysis was not attempted for 2021/22 and subsequent years since pressures have fallen below the contractual limit (12 bar) at the inlet to the Coolkeeragh AGI in 2020/21, and demand is greater in all subsequent years.

5.42 Network analysis was not completed for 2017/18 – 2018/19. Results were deemed 'Within Range' by association with results and demands for the adjacent years.

5.43 Notably, the 8.08 mscm contractual limit of the SNIP is surpassed from 2017/18 with the additional Gas to the West demands, whereas this limit is forecast to be exceeded from 2020/21 for severe winter peak demand forecasts without Gas to the West demands.

Average Winter Peak Day

5.44 Base Case (with Gas to the West) analysis demonstrates that the Northern Ireland transmission network has sufficient pressure to meet average winter peak day demands on a firm, and firm & interruptible basis.

5.45 Table 11 presents the modelling results for the Base Case and Gas to the West scenario for the firm and firm and interruptible average winter demand.

Table 11: Modelling results for the Base Case and Gas to the West scenario for firm and firm and interruptible average winter demand

Gas Year	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24
Firm & Interruptible										
Firm										

5.46 The pressures at the key points on the NI transmission network are within the operating pressure limits of the system and can provide the pressure to deliver the gas flows demanded for all years modelled.

5.47 The results tables in Appendix 3.4 detail the conditions within Northern Ireland (SNIP, South-North and North-West Pipelines) for Average

winter peak day firm & interruptible demands and Average winter peak day firm demands.

Summer Minimum Day

5.48 Base Case (with Gas to the West) analysis demonstrates that the Northern Ireland transmission network has sufficient pressure to meet summer minimum day demands on a firm, and firm & interruptible basis.

5.49 Table 12 presents the modelling results for the Base Case and Gas to the West scenario for the firm and firm and interruptible summer minimum demand.

Table 12: Modelling results for the Base Case and Gas to the West scenario for firm and firm and interruptible summer minimum demand

Gas Year	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24
Firm & Interruptible										
Firm										

5.50 The pressures at the key points on the NI transmission network are within the operating pressure limits of the system and can provide the pressure to deliver the gas flows demanded for all years modelled.

5.51 The results tables in Appendix 3.5 detail the conditions within Northern Ireland (SNIP, South-North and North-West Pipelines) for Summer minimum day firm & interruptible demands and Summer minimum day firm demands.

Scenario 3 – Base Case and Gas to the West and CAES

Summary of Severe Winter Peak Day results

5.52 Base Case (with Gas to the West and CAES) analysis demonstrates that the Northern Ireland transmission network does not have sufficient pressure to meet severe winter peak day demands on a firm and interruptible basis. On a firm basis, the network does not have sufficient pressure to meet severe winter peak day demands from 2016/17.

5.53 Table 13 presents the modelling results for the Base Case and Gas to the West and CAES scenario for the firm and firm and interruptible severe winter demand.

Table 13: Modelling results for the Base Case and Gas to the West scenario for firm and firm and interruptible severe winter demand

Gas Year	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24
Firm & Interruptible			1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2
Firm			1	1	1	1,2	1,2	1,2	1,2	1,2

Notes:

1. The existing contractual capacity of the Twynholm Entry point (8.08 mscmd) is exceeded
2. The design capacity of Twynholm AGI (8.64 mscmd) is exceeded

5.54 The results tables in Appendix 3.3 detail the conditions within Northern Ireland (SNIP, South-North and North-West Pipelines), Base Case and Gas to the West and CAES, for severe winter peak day, firm & interruptible demands and severe winter peak day firm demands

Severe Winter Peak Day (F&I)

5.55 Pressures below zero at the inlet to the Coolkeeragh AGI result in infeasible conditions in the model in all years.Notably, the 8.08 mscm contractual limit of the SNIP is surpassed in all years.

Severe Winter Peak Day (F)

5.56 The results show that pressure at the inlet to Coolkeeragh falls below the minimum contractual limit (12 bar) from 2017/18. Network analysis was not attempted for 2019/20 and subsequent years since pressures have fallen below the minimum contractual limit (12 bar) at the inlet to the Coolkeeragh AGI in 2018/19, and demand is greater in all subsequent years. Notably, the 8.08 mscm contractual limit of the SNIP is surpassed in all years.

Average Winter Peak Day

5.57 Base Case (with Gas to the West and CAES) analysis demonstrates that the Northern Ireland transmission network has sufficient pressure to meet average winter peak day demands on a firm, and firm & interruptible basis.

5.58 Table 14 presents the modelling results for the Base Case and Gas to the West and CAES scenario for the firm and firm and interruptible average winter demand.

Table 14: Modelling results for the Base Case and Gas to the West and CAES scenario for firm and firm and interruptible average winter demand

Gas Year	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24
Firm & Interruptible										
Firm										

5.59 The pressures at the key points on the NI transmission network are within the operating pressure limits of the system and can provide the pressure to deliver the gas flows demanded for all years modelled.

5.60 The results tables in Appendix 3.4 detail the conditions within Northern Ireland (SNIP, South-North and North-West Pipelines) for Average winter peak day firm & interruptible demands and Average winter peak day firm demands.

Summer Minimum Day

5.61 Base Case (with Gas to the West and CAES) analysis demonstrates that the Northern Ireland transmission network has sufficient pressure to meet summer minimum day demands on a firm, and firm & interruptible basis.

5.62 Table 15 presents the modelling results for the Base Case and Gas to the West and CAES scenario for the firm and firm and interruptible summer minimum demand.

Table 14: Modelling results for the Base Case and Gas to the West and CAES scenario for firm and firm and interruptible summer minimum demand

Gas Year	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24
Firm & Interruptible										
Firm										

5.63 The pressures at the key points on the NI transmission network are within the operating pressure limits of the system and can provide the pressure to deliver the gas flows demanded for all years modelled.

5.64 The results tables in Appendix 3.5 detail the conditions within Northern Ireland (SNIP, South-North and North-West Pipelines) for Summer minimum day firm & interruptible demands and Summer minimum day firm demands.

Additional Modelling

Gormanston Balancing Flows

5.65 The TSOs carried out further modelling to utilise the Gormanston entry point to the NI system to supply balancing flows into the South-North pipeline. Balancing flows were applied to the level required in order to achieve the minimum contractual pressure limit of 12 bar at the inlet to the Coolkeeragh AGI.

5.66 The following Severe Winter Peak Day Demand Scenarios were analysed:

- 2023/24; Base Case & Gas to the West & CAES; Firm & Interruptible
- 2023/24; Base Case & Gas to the West & CAES; Firm

5.67 The figures for the 2023/24 Base Case and Gas to the West and CAES winter peak days were used as these were the highest demands forecast over all of the scenarios. Thus, pressure issues would be most

severe under these demands which allows for an assessment of the ability of the network to provide balancing flows through Gormanston under extreme conditions i.e. high demands and low pressures.

5.68 The results of the additional modelling presented in table 16 show the balancing flows through Gormanston entry point required in order to maintain the minimum contractual pressure limit of 12 barg at the inlet to Coolkeeragh AGI.

Table 16: Balancing flows through Gormanston to maintain the minimum contractual pressure limit of 12 barg at the inlet to Coolkeeragh AGI

Demand Scenario	Gormanston Balancing Flow	Coolkeeragh Min Inlet Pressure
Firm & Interruptible	1.75 mscmd	12.5 barg
Firm	0.82 mscmd	12.3 barg

5.69 The complete results showing pressure conditions on the network are shown in Appendix 3.6[4].

System Pressure required to achieve 27 bar at Coolkeeragh AGI

5.70 As stated previously the minimum contractual pressure in the NI TSO network codes are 12 barg. The practice of the TSOs has been to provide pressure in excess of this where it is available but it is not guaranteed.

5.71 Power stations currently have the right to request and pay for enhanced pressure under their relevant network codes. This option has not been exercised by both stations.

5.72 Further modelling was carried out in order to assess the system pressure required at the inlet to Twynholm AGI, to achieve 27 barg at the Coolkeeragh AGI; this being the minimum pressure required for the power station to operate on gas.

4 The 8.08 mscm contractual limit of the SNIP is surpassed in both demand scenarios. Additional balancing flows through Gormanston entry point could be utilised (subject to the capacity being available upstream of the Gormanston entry point) to reduce the flow on the SNIP to within the contractual limit but this was not considered in this analysis.

5.73 The following Severe Winter Peak Day Demand Scenarios were analysed:

- 2014/15; Base Case; Firm & Interruptible
- 2014/15; Base Case; Firm

5.74 The results of the additional modelling presented in table 17 show the minimum system pressures required at the inlet to Twynholm AGI, in order to maintain a minimum inlet pressure of 27 barg at Coolkeeragh AGI.

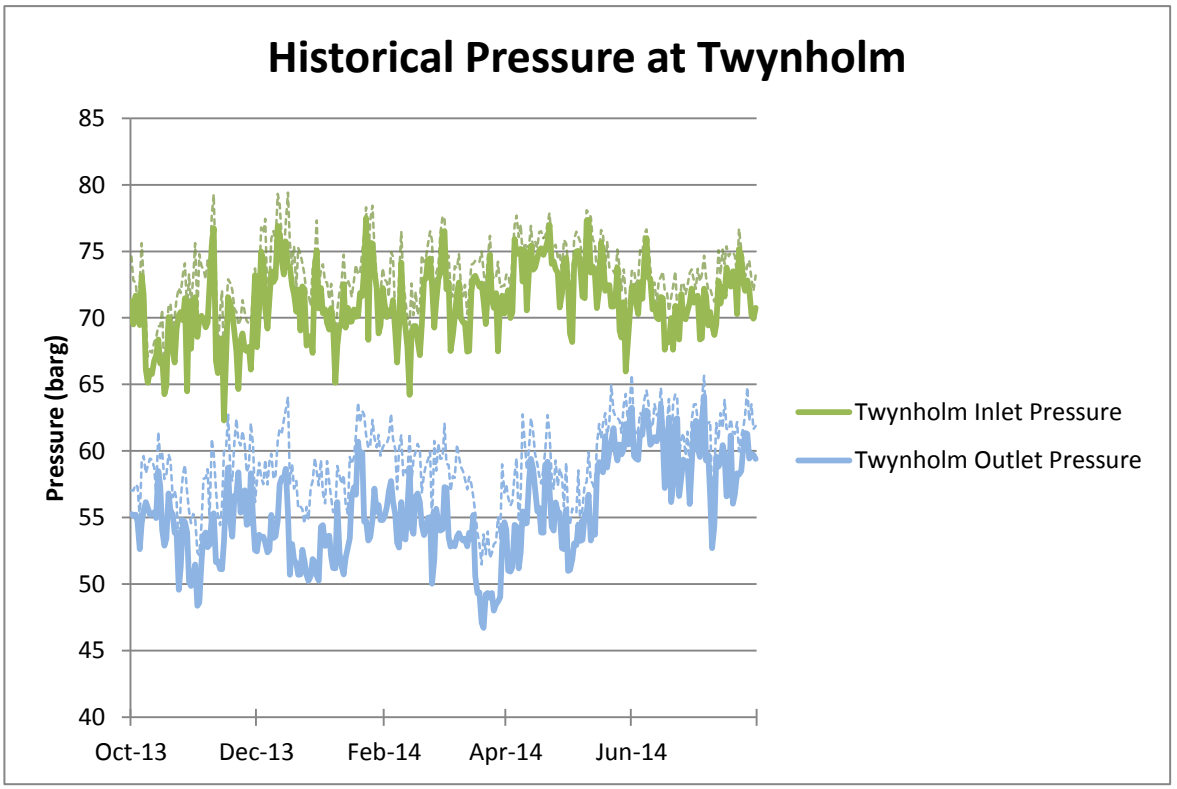
Table 17: Minimum system pressures at the inlet to Twynholm AGI, to maintain a minimum inlet pressure of 27 barg at Coolkeeragh AGI.

Demand Scenario	Twynholm Inlet Pressure	Coolkeeragh Min Inlet Pressure
Firm & Interruptible	69 barg	27.5 barg
Firm	61.5 barg	26.9 barg

5.75 The complete results showing pressure conditions on the network are shown in Appendix 3.6.

5.76 Figure 6 provides a record of the historical pressure levels at Twynholm from October 2013 to July 2014.

Figure 6: Historical pressures recorded at Twynholm AGI.



5.77 The Daily Minimum (solid line) and Daily Average (dashed line) daily pressure is plotted at the Twynholm inlet (green) and outlet (blue) for the period 1st October 2013 – 31st July 2014. Some key points on the data supporting the graphs are provided below:

i. The minimum inlet pressure recorded at Twynholm over the period was 62.3 barg
ii. The minimum outlet pressure recorded at Twynholm over the period was 46.7 barg (not coincident with the minimum inlet pressure recorded)
iii. The average inlet pressure at Twynholm varied between 65.45 and 79.42 barg over the period
iv. The average outlet pressure at Twynholm varied between 51.48 and 65.70 barg over the period

5.78 Notably the minimum pressure level (point i) recorded over the period was 62.3 barg. This is above the minimum system pressure required at

the inlet to Twynholm AGI outlined in the modelling (61.5 barg), in order to maintain a minimum inlet pressure of 27 barg at Coolkeeragh AGI for firm demand.

5.79 This indicates that the network has provided the required pressure to maintain a minimum inlet pressure of 27 barg at Coolkeeragh AGI for firm demand. But, this does not guarantee that these pressure levels will be maintained in future years.

System Pressure required to achieve 12 barg at Coolkeeragh AGI

5.80 The TSOs also considered what system pressure would required at the inlet to Twynholm AGI, in order to achieve the minimum contractual pressure limit at the inlet to the Coolkeeragh AGI (12 bar).

5.81 The following Severe Winter Peak Day Demand Scenarios were analysed:

- 2014/15; Base Case; Firm & Interruptible
- 2014/15; Base Case; Firm

5.82 The results of the additional modelling showed that the following minimum system pressure was required at the inlet to Twynholm AGI, in order to maintain a minimum inlet pressure of 12 barg at Coolkeeragh AGI:

Demand Scenario	Twynholm Inlet Pressure	Coolkeeragh Min Inlet Pressure
Firm & Interruptible	63 barg	12.5 barg
Firm	55 barg	12.3 barg

5.83 The complete results showing pressure conditions on the network are shown in Appendix 3.6.

6. Commentary

6.1 The modelling results have indicated that on the basis the demands modelled and the assumptions used the transmission network could meet firm demand for severe winter peak demand for the following years:

- Base Case – from 2014/15 to 2021/22
- Base Case plus Gas to the West – from 2016/17 to 2019/20
- Base Case plus Gas to the West plus CAES – for 2016/17 only

6.2 Additionally the network could meet the firm demands for the average winter and minimum summer demands for all years for all scenarios.

6.3 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. The results also indicate the ability of the network to meet firm and interruptible demands.

6.4 The key change between this year's statement and that of last year is the assumption of a lower minimum pressure limit of 12 barg in line with the TSOs' contractual commitments at the various transmission Exit Points on the NI transmission system rather than the 27 barg optimal design specification of the NWP.

6.5 We understand that 27 barg at the Coolkeeragh AGI is the minimum pressure required for Coolkeeragh power station to operate on gas. As stated previously the practice of the TSOs has been to provide pressure in excess of the 12 barg contractual level where it is available but it is not guaranteed. Power stations currently have the right to request and pay for enhanced pressure under their relevant network codes. This option has not been exercised by both stations.

6.6 Where the modelling has indicated potential low pressure issues flip-flop arrangements are in place or suppliers to the power stations could bring gas to the SNP using the Irish interconnector system assuming capacity is available for them to book in that system.

6.7 Regarding the CAES scenario, the modelling has indicated that on a firm basis, the network does not have sufficient pressure to meet severe

winter peak day demands from 2016/17 for the Base Case plus Gas to the West plus CAES demands. This results in pressure levels lower than 12 bar at Coolkeeragh power station.

6.8 Under these circumstances, additional demand can be accommodated via the SNP. Modelling has indicated that a total NI demand of 9.90 mscm/day (8.15 mscm via SNIP and 1.75 mscm via Gormanston) can be met when using the SNIP and SN whilst maintaining 12 bar contractual pressure at Coolkeeragh. This would meet firm (and interruptible) demands for the Base Case plus Gas to the West plus CAES scenario up to and including 2023/24.

6.9 Use of the SN pipeline is also required in the Base Case and Base Case plus Gas to the West, when demand exceeds 8.08 mscm in 2020/21 and 2017/18 respectively. As noted above the SNP can facilitate these demands.

6.10 Commercial arrangements are in place to accommodate flows from the Gormanston Entry point. We understand that the CER is currently reviewing the SNP Exit tariff and we await the outcome of this review which is expected shortly.

Appendix 1: Northern Ireland Demand Forecast

Base Case - Severe Winter Peak Day

Firm

Year	Severe Winter Peak Day Demands/Supplies (mscmd)			
	Power	Non-Power	Total	Twynholm
2014/15	4.36	3.14	7.50	7.50
2015/16	4.36	3.25	7.61	7.61
2016/17	4.36	3.36	7.72	7.72
2017/18	4.36	3.46	7.82	7.82
2018/19	4.36	3.56	7.92	7.92
2019/20	4.36	3.66	8.02	8.02
2020/21	4.36	3.76	8.12	8.12
2021/22	4.36	3.86	8.22	8.22
2022/23	4.36	3.94	8.30	8.30
2023/24	4.36	4.03	8.39	8.39

Firm & Interruptible

Year	Severe Winter Peak Day Demands/Supplies (mscmd)			
	Power	Non-Power	Total	Twynholm
2014/15	5.16	3.80	8.96	8.96
2015/16	4.36	3.91	8.27	8.27
2016/17	4.36	4.00	8.36	8.36
2017/18	4.36	4.10	8.46	8.46
2018/19	4.36	4.20	8.56	8.56
2019/20	4.36	4.30	8.66	8.66
2020/21	4.36	4.41	8.77	8.77
2021/22	4.36	4.50	8.86	8.86
2022/23	4.36	4.59	8.95	8.95
2023/24	4.36	4.67	9.03	9.03

Base Case - Average Winter Peak Day

Firm

Year	Average Winter Peak Day Demands/Supplies (mscmd)			
	Power	Non-Power	Total	Twynholm
2014/15	2.80	2.00	4.80	4.80
2015/16	2.80	2.08	4.88	4.88
2016/17	2.60	2.15	4.75	4.75
2017/18	2.60	2.21	4.81	4.81
2018/19	2.60	2.27	4.87	4.87
2019/20	2.60	2.34	4.94	4.94
2020/21	2.60	2.40	5.00	5.00
2021/22	2.60	2.46	5.06	5.06
2022/23	2.60	2.51	5.11	5.11
2023/24	2.60	2.56	5.16	5.16

Firm & Interruptible

Year	Average Winter Peak Day Demands/Supplies (mscmd)			
	Power	Non-Power	Total	Twynholm
2014/15	2.80	2.52	5.32	5.32
2015/16	2.80	2.62	5.42	5.42
2016/17	2.60	2.68	5.28	5.28
2017/18	2.60	2.74	5.34	5.34
2018/19	2.60	2.79	5.39	5.39
2019/20	2.60	2.86	5.46	5.46
2020/21	2.60	2.92	5.52	5.52
2021/22	2.60	2.98	5.58	5.58
2022/23	2.60	3.03	5.63	5.63
2023/24	2.60	3.08	5.68	5.68

Base Case - Summer Minimum Day

Firm

Year	Summer Minimum Day Demands/Supplies (mscmd)			
	Power	Non-Power	Total	Twynholm
2014/15	1.80	0.41	2.21	2.21
2015/16	1.80	0.42	2.22	2.22
2016/17	1.80	0.44	2.24	2.24
2017/18	1.80	0.45	2.25	2.25
2018/19	1.50	0.47	1.97	1.97
2019/20	1.50	0.48	1.98	1.98
2020/21	1.50	0.49	1.99	1.99
2021/22	1.50	0.50	2.00	2.00
2022/23	1.50	0.52	2.02	2.02
2023/24	1.50	0.53	2.03	2.03

Firm & Interruptible

Year	Summer Minimum Day Demands/Supplies (mscmd)			
	Power	Non-Power	Total	Twynholm
2014/15	1.80	0.53	2.33	2.33
2015/16	1.80	0.55	2.35	2.35
2016/17	1.80	0.57	2.37	2.37
2017/18	1.80	0.58	2.38	2.38
2018/19	1.50	0.59	2.09	2.09
2019/20	1.50	0.60	2.10	2.10
2020/21	1.50	0.62	2.12	2.12
2021/22	1.50	0.63	2.13	2.13
2022/23	1.50	0.64	2.14	2.14
2023/24	1.50	0.65	2.15	2.15

Base Case Severe Winter Peak Day + Gas to the West

Firm

Year	Severe Winter Peak Day Demands/Supplies (mscmd)				
	Power	Non-Power	GTW	Total	Twynholm
2014/15	4.36	3.14	0.00	7.50	7.50
2015/16	4.36	3.25	0.00	7.61	7.61
2016/17	4.36	3.36	0.13	7.85	7.85
2017/18	4.36	3.46	0.27	8.09	8.09
2018/19	4.36	3.56	0.29	8.21	8.21
2019/20	4.36	3.66	0.30	8.32	8.32
2020/21	4.36	3.76	0.31	8.44	8.44
2021/22	4.36	3.86	0.32	8.54	8.54
2022/23	4.36	3.94	0.33	8.64	8.64
2023/24	4.36	4.03	0.35	8.73	8.73

Firm & Interruptible

Year	Severe Winter Peak Day Demands/Supplies (mscmd)				
	Power	Non-Power	GTW	Total	Twynholm
2014/15	5.16	3.80	0.00	8.96	8.96
2015/16	4.36	3.91	0.00	8.27	8.27
2016/17	4.36	4.00	0.21	8.57	8.57
2017/18	4.36	4.10	0.42	8.87	8.87
2018/19	4.36	4.20	0.45	9.01	9.01
2019/20	4.36	4.30	0.47	9.13	9.13
2020/21	4.36	4.41	0.48	9.25	9.25
2021/22	4.36	4.50	0.50	9.36	9.36
2022/23	4.36	4.59	0.52	9.46	9.46
2023/24	4.36	4.67	0.53	9.56	9.56

Base Case Average Winter Peak Day + Gas to the West

Firm

Year	Average Winter Peak Day Demands/Supplies (mscmd)				
	Power	Non-Power	GTW	Total	Twynholm
2014/15	2.80	2.00	0.00	4.80	4.80
2015/16	2.80	2.08	0.00	4.88	4.88
2016/17	2.60	2.15	0.11	4.86	4.86
2017/18	2.60	2.21	0.22	5.04	5.04
2018/19	2.60	2.27	0.24	5.11	5.11
2019/20	2.60	2.34	0.25	5.19	5.19
2020/21	2.60	2.40	0.26	5.26	5.26
2021/22	2.60	2.46	0.27	5.33	5.33
2022/23	2.60	2.51	0.28	5.39	5.39
2023/24	2.60	2.56	0.29	5.45	5.45

Firm & Interruptible

Year	Average Winter Peak Day Demands/Supplies (mscmd)				
	Power	Non-Power	GTW	Total	Twynholm
2014/15	2.80	2.52	0.00	5.32	5.32
2015/16	2.80	2.62	0.00	5.42	5.42
2016/17	2.60	2.68	0.17	5.45	5.45
2017/18	2.60	2.74	0.35	5.68	5.68
2018/19	2.60	2.79	0.37	5.76	5.76
2019/20	2.60	2.86	0.39	5.84	5.84
2020/21	2.60	2.92	0.40	5.92	5.92
2021/22	2.60	2.98	0.41	5.99	5.99
2022/23	2.60	3.03	0.43	6.06	6.06
2023/24	2.60	3.08	0.44	6.12	6.12

Base Case Summer Minimum Day + Gas to the West

Firm

Year	Summer Minimum Day Demands/Supplies (mscmd)				
	Power	Non-Power	GTW	Total	Twynholm
2014/15	1.80	0.41	0.00	2.21	2.21
2015/16	1.80	0.42	0.00	2.22	2.22
2016/17	1.80	0.44	0.03	2.27	2.27
2017/18	1.80	0.45	0.05	2.31	2.31
2018/19	1.50	0.47	0.06	2.02	2.02
2019/20	1.50	0.48	0.06	2.04	2.04
2020/21	1.50	0.49	0.06	2.05	2.05
2021/22	1.50	0.50	0.06	2.07	2.07
2022/23	1.50	0.52	0.07	2.08	2.08
2023/24	1.50	0.53	0.07	2.10	2.10

Firm & Interruptible

Year	Summer Minimum Day Demands/Supplies (mscmd)				
	Power	Non-Power	GTW	Total	Twynholm
2014/15	1.80	0.53	0.00	2.33	2.33
2015/16	1.80	0.55	0.00	2.35	2.35
2016/17	1.80	0.57	0.04	2.41	2.41
2017/18	1.80	0.58	0.08	2.46	2.46
2018/19	1.50	0.59	0.09	2.18	2.18
2019/20	1.50	0.60	0.09	2.20	2.20
2020/21	1.50	0.62	0.10	2.21	2.21
2021/22	1.50	0.63	0.10	2.23	2.23
2022/23	1.50	0.64	0.10	2.24	2.24
2023/24	1.50	0.65	0.11	2.26	2.26

Base Case Severe Winter Peak Day + Gas to the West + CAES

Firm

Year	Severe Winter Peak Day Demands/Supplies (mscmd)					
	Power	Non-Power	GTW	CAES	Total	Twynholm
2014/15	4.36	3.14	0.00	0.00	7.50	7.50
2015/16	4.36	3.25	0.00	0.00	7.61	7.61
2016/17	4.36	3.36	0.13	0.39	8.24	8.24
2017/18	4.36	3.46	0.27	0.39	8.48	8.48
2018/19	4.36	3.56	0.29	0.39	8.60	8.60
2019/20	4.36	3.66	0.30	0.39	8.71	8.71
2020/21	4.36	3.76	0.31	0.39	8.83	8.83
2021/22	4.36	3.86	0.32	0.39	8.93	8.93
2022/23	4.36	3.94	0.33	0.39	9.03	9.03
2023/24	4.36	4.03	0.35	0.39	9.12	9.12

Firm & Interruptible

Year	Severe Winter Peak Day Demands/Supplies (mscmd)					
	Power	Non-Power	GTW	CAES	Total	Twynholm
2014/15	5.16	3.80	0.00	0.00	8.96	8.96
2015/16	4.36	3.91	0.00	0.00	8.27	8.27
2016/17	4.36	4.00	0.21	0.39	8.96	8.96
2017/18	4.36	4.10	0.42	0.39	9.26	9.26
2018/19	4.36	4.20	0.45	0.39	9.40	9.40
2019/20	4.36	4.30	0.47	0.39	9.52	9.52
2020/21	4.36	4.41	0.48	0.39	9.64	9.64
2021/22	4.36	4.50	0.50	0.39	9.75	9.75
2022/23	4.36	4.59	0.52	0.39	9.85	9.85
2023/24	4.36	4.67	0.53	0.39	9.95	9.95

Base Case Average Winter Peak Day + Gas to the West + CAES

Firm

Year	Average Winter Peak Day Demands/Supplies (mscmd)					
	Power	Non-Power	GTW	CAES	Total	Twynholm
2014/15	2.80	2.00	0.00	0.00	4.80	4.80
2015/16	2.80	2.08	0.00	0.00	4.88	4.88
2016/17	2.60	2.15	0.11	0.31	5.18	5.18
2017/18	2.60	2.21	0.22	0.31	5.35	5.35
2018/19	2.60	2.27	0.24	0.31	5.43	5.43
2019/20	2.60	2.34	0.25	0.31	5.50	5.50
2020/21	2.60	2.40	0.26	0.31	5.58	5.58
2021/22	2.60	2.46	0.27	0.31	5.64	5.64
2022/23	2.60	2.51	0.28	0.31	5.71	5.71
2023/24	2.60	2.56	0.29	0.31	5.76	5.76

Firm & Interruptible

Year	Average Winter Peak Day Demands/Supplies (mscmd)					
	Power	Non-Power	GTW	CAES	Total	Twynholm
2014/15	2.80	2.52	0.00	0.00	5.32	5.32
2015/16	2.80	2.62	0.00	0.00	5.42	5.42
2016/17	2.60	2.68	0.17	0.31	5.77	5.77
2017/18	2.60	2.74	0.35	0.31	6.00	6.00
2018/19	2.60	2.79	0.37	0.31	6.08	6.08
2019/20	2.60	2.86	0.39	0.31	6.16	6.16
2020/21	2.60	2.92	0.40	0.31	6.23	6.23
2021/22	2.60	2.98	0.41	0.31	6.30	6.30
2022/23	2.60	3.03	0.43	0.31	6.37	6.37
2023/24	2.60	3.08	0.44	0.31	6.44	6.44

Summer Minimum Day + Gas to the West + CAES

Firm

Year	Summer Minimum Day Demands/Supplies (mscmd)					
	Power	Non-Power	GTW	Gaelectric	Total	Twynholm
2014/15	1.80	0.41	0.00	0.00	2.21	2.21
2015/16	1.80	0.42	0.00	0.00	2.22	2.22
2016/17	1.80	0.44	0.03	0.13	2.39	2.39
2017/18	1.80	0.45	0.05	0.13	2.43	2.43
2018/19	1.50	0.47	0.06	0.13	2.15	2.15
2019/20	1.50	0.48	0.06	0.14	2.18	2.18
2020/21	1.50	0.49	0.06	0.15	2.20	2.20
2021/22	1.50	0.50	0.06	0.17	2.24	2.24
2022/23	1.50	0.52	0.07	0.17	2.25	2.25
2023/24	1.50	0.53	0.07	0.17	2.27	2.27

Firm & Interruptible

Year	Summer Minimum Day Demands/Supplies (mscmd)					
	Power	Non-Power	GTW	CAES	Total	Twynholm
2014/15	1.80	0.53	0.00	0.00	2.33	2.33
2015/16	1.80	0.55	0.00	0.00	2.35	2.35
2016/17	1.80	0.57	0.04	0.13	2.54	2.54
2017/18	1.80	0.58	0.08	0.13	2.59	2.59
2018/19	1.50	0.59	0.09	0.13	2.31	2.31
2019/20	1.50	0.60	0.09	0.14	2.33	2.33
2020/21	1.50	0.62	0.10	0.15	2.36	2.36
2021/22	1.50	0.63	0.10	0.17	2.40	2.40
2022/23	1.50	0.64	0.10	0.17	2.41	2.41
2023/24	1.50	0.65	0.11	0.17	2.43	2.43

Appendix 2: Summary of System Modelling Assumptions

General Assumptions

- All entry points are modelled on a flat flow basis, unless otherwise indicated.
- The systems upstream and downstream of the NI Transmission System have not been considered in this analysis, notwithstanding the assumption regarding the 59.4 barg inlet pressure at Twynholm.
- Unless otherwise stated, Twynholm is the only source of supply utilised in the models.
- The SNIP, North-West and South-North Pipelines are assumed to have 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 flow is determined from energy flow and local gas calorific value.
- A minimum system pressure limit of 12 barg is assumed for all off-takes on the NI system, barg in line with the TSOs contractual commitments at the various Exit Points on the NI transmission system.

Demand Assumptions

- Forecasted annual and peak NI demands will be taken from information provided to the Northern Ireland Regulator by system shippers in NI.
- Information on the proposed Gaelectric Compressed Air Energy Storage connection was provided by Gaelectric CAES NI Ltd.
- The hourly gas demand of the NI power stations will be based on historic diurnals.
- The hourly demand for all other AGI off-takes will be derived from their historic contribution to peak-day and minimum day demands. Diurnal demand curves will be from actual peak and minimum days.
- Gas flow volumes will be derived from supplied energy demand values by assuming a Moffat Gas Calorific Value of 39.77 MJ/m^3 (measured historical value)

- NI Shippers have provided separate figures for firm and interruptible demands. Where applicable, models were run for both firm and firm & interruptible demands.
- The Gas to the West demand peak day forecasts have been derived using forecast annual volumes from the *Potential Extension of Natural Gas and Related Services in Northern* Ireland feasibility study report and applying appropriate load factors.
- In order to model the firm and interruptible split for the Gas to the West, the non-power firm to interruptible ratio for the existing NI system demand was applied

Network Operation/Pressure Assumptions

Twynholm

- The ANOP at Twynholm AGI is assumed to be 59.4 barg for severe winter peak days and 69 barg for both average winter peak days and summer minimum days.
- 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.
- The design capacity of Twynholm AGI is 8.64 mscmd; and the contractual capacity at the Twynholm exit point (on the BGÉ UK system) is 8.08 mscmd. Flows were not limited in the model, but where flows in excess of the contractual or design capacity were encountered, they were noted.

Carrickfergus

- Carrickfergus AGI will be modelled in flow control mode, whereby the hourly flow through Carrickfergus equals the sum of the hourly downstream demands on the BGE NI system.
- The outlet pressure at Carrickfergus is determined by the inlet pressure at the station less an assumed pressure drop across the station of 2 barg.

Future Network Development Assumptions

- The modelling has not considered the impact of Corrib with regards to demands on the SWSOS network and the resulting impact to pressures available to the NI network.

- The analysis undertaken for the Gas to the West scenario assumed a point load at Derryhale AGI, the proposed connection point on the SNP for the 'Gas to the West'. The point load at Derryhale is equal to the aggregate demand for the proposed off-takes along this route. Similarly, the proposed network extension to Strabane was reflected as a point load on the NWP.

- The analysis taken for the CAES scenario assumed a point load at the Ballylumford exit as this was the most appropriate place on the network to model the demands.

Appendix 3: Detailed Modelling Results

The tables in Appendix A3.1, A3.2 and A3.3 below detail the conditions within Northern Ireland (SNIP, South-North and North-West Pipelines) for

(a) severe winter peak day firm & interruptible demands
and
(b) severe winter peak day firm demands

for the Base Case, Base Case & Gas to the West, and Base Case & Gas to the West & Caes scenarios respectively.

Results for Average Winter Peak Day demand are contained in Appendix 3.4, with Summer Minimum Day demand results contained in Appendix 3.5.

Results of additional analysis carried out for the Severe Winter Peak Day demand scenario are contained in Appendix 3.6.

System Pressures at Coolkeeragh and Ballylumford must remain above 12 barg through the diurnal cycle in order to meet minimum system pressures. As noted in Section 4 these are the minimum pressure limits the transporter will maintain, as set out in the Shipper's Network Exit Parameter Schedule in respect of each Exit Point on the system.

Pressures below zero at the inlet to Coolkeeragh AGI (the most peripheral point on the NI system), result in infeasible conditions in the model.

Figures are coloured red in the pressure tables where they are below the minimum contractual pressure limits (12 bar).

A3.1 Base Case Modelling Results

Severe Winter Peak Day (F&I)

Year	Twynholm (SNIP)		Carrickfergus	Coolkeeragh		B'lumford
	Flow	Pressure [1]	Pressure [2]	Pressure [3]	Velocity [4]	Pressure [5]
	(mscmd)	(barg)	(barg)	(barg)	(m/s)	(barg)
Limits	8.08 / 8.64	75 (Max)	12 (Min)	12 (Min)	20 [6] (Max)	12 (Min)
2014/15	8.96	FAIL	FAIL	FAIL	FAIL	FAIL
2015/16	8.27	56.9 / 52.5	32.2 / 21.3	24.7 / 12.1	9.3	36.6 / 26.0
2016/17	8.36	56.9 / 52.6	31.5 / 20.3	23.6 / 10.3	10.9	36.0 / 25.2
2017/18	8.46	FAIL	FAIL	FAIL	FAIL	FAIL
2018/19	8.56	FAIL	FAIL	FAIL	FAIL	FAIL
2019/20	8.66	FAIL	FAIL	FAIL	FAIL	FAIL
2020/21	8.77	FAIL	FAIL	FAIL	FAIL	FAIL
2021/22	8.86	FAIL	FAIL	FAIL	FAIL	FAIL
2022/23	8.95	FAIL	FAIL	FAIL	FAIL	FAIL
2023/24	9.03	FAIL	FAIL	FAIL	FAIL	FAIL

Notes:

1. Pressures at Twynholm (SNIP) are the maximum and minimum in the diurnal cycle at the outlet of Twynholm AGI.
2. Pressures at the Carrickfergus AGI are the maximum and minimum in the diurnal cycle, and are those downstream of the AGI in the North West pipeline.
3. Pressures at Coolkeeragh are the maximum and minimum in the diurnal cycle and are those in the pipeline upstream of the AGI.
4. Velocities at Coolkeeragh are the maximum in the diurnal cycle and are those in the inlet pipeline to the AGI.
5. Pressures at Ballylumford are the maximum and minimum in the diurnal cycle and are those in the pipeline.
6. Maximum pipeline velocities as per the standards detailed in IGEM/TD13

Severe Winter Peak Day (F)

Year	Twynholm (SNIP)		Carrickfergus	Coolkeeragh		B'lumford
	Flow	Pressure [1]	Pressure [2]	Pressure [3]	Velocity [4]	Pressure [5]
	(mscmd)	(barg)	(barg)	(barg)	(m/s)	(barg)
Limits	**8.08 / 8.64**	**75 (Max)**	**12 (Min)**	**12 (Min)**	**20 [6] (Max)**	**12 (Min)**
2014/15	7.5	56.9 / 52.3	37.4 / 28.4	32.2 / 22.8	4.9	40.9 / 32.0
2015/16	7.61	Within Range	Within Range	Within Range	Within Range	Within Range
2016/17	7.72	Within Range	Within Range	Within Range	Within Range	Within Range
2017/18	7.82	Within Range	Within Range	Within Range	Within Range	Within Range
2018/19	7.92	Within Range	Within Range	Within Range	Within Range	Within Range
2019/20	8.02	Within Range	Within Range	Within Range	Within Range	Within Range
2020/21	**8.12**	Within Range	Within Range	Within Range	Within Range	Within Range
2021/22	**8.22**	56.9 / 52.5	32.6 / 21.7	25.7 / 13.3	8.4	36.8 / 26.3
2022/23	**8.30**	56.9 / 52.5	31.8 / 20.7	**24.8 / 11.8**	9.5	36.3 / 25.5
2023/24	**8.39**	**Fail**	**Fail**	**Fail**	**Fail**	**Fail**

Notes:

1. Pressures at Twynholm (SNIP) are the maximum and minimum in the diurnal cycle at the outlet of Twynholm AGI.
2. Pressures at the Carrickfergus AGI are the maximum and minimum in the diurnal cycle, and are those downstream of the AGI in the North West pipeline.
3. Pressures at Coolkeeragh are the maximum and minimum in the diurnal cycle and are those in the pipeline upstream of the AGI.
4. Velocities at Coolkeeragh are the maximum in the diurnal cycle and are those in the inlet pipeline to the AGI.
5. Pressures at Ballylumford are the maximum and minimum in the diurnal cycle and are those in the pipeline.
6. Maximum pipeline velocities as per the standards detailed in IGEM/TD13

A3.2 Base Case and Gas to the West Modelling Results

The additional Gas to the West demands are forecast to flow in 2016/17. The pressures from 2014/15 to 2015/16 are therefore unchanged from the base case scenario and are not included in the tables.

Severe Winter Peak Day (F&I)

Year	Twynholm (SNIP)		Carrickfergus	Coolkeeragh		B'lumford	Gas to West Offtake
	Flow	Pressure [1]	Pressure [2]	Pressure [3]	Velocity [4]	Pressure [5]	Pressure [6]
	(mscmd)	(barg)	(barg)	(barg)	(m/s)	(barg)	(barg)
Limits	8.08 / 8.64	75 (Max)	12 (Min)	12 (Min)	20 [7] (Max)	12 (Min)	12 (Min)
2016/17	8.57	56.9 / 52.8	29.8 / 17.8	20.9 / 4.2	24.2	34.6 / 23.4	24.8 / 13.6
2017/18	8.87	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
2018/19	9.01	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
2019/20	9.13	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
2020/21	9.25	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
2021/22	9.36	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
2022/23	9.46	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
2023/24	9.56	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL

Notes:

1. Pressures at Twynholm (SNIP) are the maximum and minimum in the diurnal cycle at the outlet of Twynholm AGI.
2. Pressures at the Carrickfergus AGI are the maximum and minimum in the diurnal cycle, and are those downstream of the AGI in the North West pipeline.
3. Pressures at Coolkeeragh are the maximum and minimum in the diurnal cycle and are those in the pipeline upstream of the AGI.
4. Velocities at Coolkeeragh are the maximum in the diurnal cycle and are those in the inlet pipeline to the AGI.
5. Pressures at Ballylumford are the maximum and minimum in the diurnal cycle and are those in the pipeline.
6. Pressures at the 'Gas to the West' off take are the maximum and minimum in the diurnal cycle at the off take to the Derryhale AGI on the South-North pipeline.
7. Maximum pipeline velocities as per the standards detailed in IGEM/TD13

Severe Winter Peak Day (F)

Year	Twynholm (SNIP)		Carrickfergus	Coolkeeragh		B'lumford	Gas to West Offtake[6]
	Flow	Pressure [1]	Pressure [2]	Pressure [3]	Velocity [4]	Pressure [5]	Pressure
	(mscmd)	(barg)	(barg)	(barg)	(m/s)	(barg)	(barg)
Limits	**8.08 / 8.64**	**75 (Max)**	**12 (Min)**	**12 (Min)**	**20 [7] (Max)**	**12 (Min)**	**12 (Min)**
2016/17	7.85	56.9 / 52.3	35.1 / 25.3	29.1 / 18.5	6.1	39.0 / 29.3	32.6 / 23.6
2017/18	**8.09**	Within Range	Within Range	Within Range	Within Range	Within Range	Within Range
2018/19	**8.21**	Within Range	Within Range	Within Range	Within Range	Within Range	Within Range
2019/20	**8.32**	56.9 / 53.1	33.1 / 21.8	26.7 / 13.0	8.6	37.4 / 26.5	29.9 / 18.4
2020/21	**8.44**	56.9 / 52.6	30.8 / 19.3	**22.7 / 8.4**	13.1	35.4 / 24.4	26.0 / 15.2
2021/22	**8.54**	**FAIL**	**FAIL**	**FAIL**	**FAIL**	**FAIL**	**FAIL**
2022/23	**8.64**	**FAIL**	**FAIL**	**FAIL**	**FAIL**	**FAIL**	**FAIL**
2023/24	**8.73**	**FAIL**	**FAIL**	**FAIL**	**FAIL**	**FAIL**	**FAIL**

Notes:

1. Pressures at Twynholm (SNIP) are the maximum and minimum in the diurnal cycle at the outlet of Twynholm AGI.
2. Pressures at the Carrickfergus AGI are the maximum and minimum in the diurnal cycle, and are those downstream of the AGI in the North West pipeline.
3. Pressures at Coolkeeragh are the maximum and minimum in the diurnal cycle and are those in the pipeline upstream of the AGI.
4. Velocities at Coolkeeragh are the maximum in the diurnal cycle and are those in the inlet pipeline to the AGI.
5. Pressures at Ballylumford are the maximum and minimum in the diurnal cycle and are those in the pipeline.
6. Pressures at the 'Gas to the West' off take are the maximum and minimum in the diurnal cycle at the off take to the Derryhale AGI on the South-North pipeline.
7. Maximum pipeline velocities as per the standards detailed in IGEM/TD13

A3.3 Base Case and Gas to the West and CAES Modelling Results

The additional CAES demands are forecast to flow in 2016/17. The pressures from 2014/15 to 2015/16 are therefore unchanged from the base case scenario and are not included in the tables.

The CAES offtake is modelled at Ballylumford AGI.

Severe Winter Peak Day (F&I)

Year	Twynholm (SNIP)		Carrickfergus	Coolkeeragh		B'lumford (CAES)	Gas to West Offtake
	Flow	Pressure [1]	Pressure [2]	Pressure [3]	Velocity [4]	Pressure [5]	Pressure [6]
	(mscmd)	(barg)	(barg)	(barg)	(m/s)	(barg)	(barg)
Limits	8.08 / 8.64	75 (Max)	12 (Min)	12 (Min)	12 (Min)	20 [7] (Max)	12 (Min)
2016/17	8.96	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
2017/18	9.26	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
2018/19	9.40	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
2019/20	9.52	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
2020/21	9.64	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
2021/22	9.75	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
2022/23	9.85	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
2023/24	9.95	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL

Notes:

1. Pressures at Twynholm (SNIP) are the maximum and minimum in the diurnal cycle at the outlet of Twynholm AGI.
2. Pressures at the Carrickfergus AGI are the maximum and minimum in the diurnal cycle, and are those downstream of the AGI in the North West pipeline.
3. Pressures at Coolkeeragh are the maximum and minimum in the diurnal cycle and are those in the pipeline upstream of the AGI.
4. Velocities at Coolkeeragh are the maximum in the diurnal cycle and are those in the inlet pipeline to the AGI.
5. Pressures at Ballylumford are the maximum and minimum in the diurnal cycle and are those in the pipeline.
6. Pressures at the 'Gas to the West' off take are the maximum and minimum in the diurnal cycle at the off take to the Derryhale AGI on the South-North pipeline.
7. Maximum pipeline velocities as per the standards detailed in IGEM/TD13

Severe Winter Peak Day (F)

Year	Twynholm (SNIP)		Carrickfergus	Coolkeeragh		B'lumford (CAES)	Gas to West Offtake
	Flow	Pressure [1]	Pressure [2]	Pressure [3]	Velocity [4]	Pressure [5]	Pressure [6]
	(mscmd)	(barg)	(barg)	(barg)	(m/s)	(barg)	(barg)
Limits	8.08 / 8.64	75 (Max)	12 (Min)	12 (Min)	12 (Min)	20 [7] (Max)	12 (Min)
2016/17	8.24	56.9 / 52.9	32.5 / 22.9	25.9 / 15.0	7.5	36.7 / 27.3	29.8 / 20.9
2017/18	8.48	56.9 / 53.0	30.7 / 20.4	23.0 / 10.5	10.5	35.2 / 25.3	26.6 / 17.0
2018/19	8.60	56.9 / 53.1	29.7 / 19.0	21.4 / 7.5	14.4	34.3 / 24.1	25.1 / 15.0
2019/20	8.71	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
2020/21	8.83	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
2021/22	8.93	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
2022/23	9.03	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
2023/24	9.12	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL

Notes:

1. Pressures at Twynholm (SNIP) are the maximum and minimum in the diurnal cycle at the outlet of Twynholm AGI.
2. Pressures at the Carrickfergus AGI are the maximum and minimum in the diurnal cycle, and are those downstream of the AGI in the North West pipeline.
3. Pressures at Coolkeeragh are the maximum and minimum in the diurnal cycle and are those in the pipeline upstream of the AGI.
4. Velocities at Coolkeeragh are the maximum in the diurnal cycle and are those in the inlet pipeline to the AGI.
5. Pressures at Ballylumford are the maximum and minimum in the diurnal cycle and are those in the pipeline.
6. Pressures at the 'Gas to the West' off take are the maximum and minimum in the diurnal cycle at the off take to the Derryhale AGI on the South-North pipeline.
7. Maximum pipeline velocities as per the standards detailed in IGEM/TD13

A3.4 Average Winter Peak

Average Winter Peak Day Scenarios were analysed using modelling for the extreme supply and demand scenarios only, ranging from a minimum of 4.80 mscmd (2014/15; Base Case; Firm) to a maximum of 6.44 mscmd (2023/24; Base Case + Gas to the West + CAES; Firm & Interruptible)

Year	Demand	Twynholm (SNIP)		Carrickfergus	Coolkeeragh		B'lumford	Gas to West offtake
		Flow	Pressure [1]	Pressure [2]	Pressure [3]	Velocity [4]	Pressure [5]	Pressure [6]
		(mscmd)	(barg)	(barg)	(barg)	(m/s)	(barg)	(barg)
Limits		8.08 / 8.64	75 (Max)	12 (Min)	12 (Min)	12 (Min)	20 [7] (Max)	12 (Min)
2014/15	F	4.80	66.5 / 63.1	59.3 / 55.3	57.6 / 53.6	1.5	61.7 / 57.7	N/A
2014/15	F&I	5.32	66.5 / 62.7	58.0 / 53.4	56.0 / 51.5	1.6	60.5 / 55.9	N/A
2023/24	F&I	6.44	66.5 / 61.8	54.5 / 48.1	51.9 / 45.7	1.9	57.4 / 51.2	52.2/45.9

Notes:

1. Pressures at Twynholm (SNIP) are the maximum and minimum in the diurnal cycle.
2. Pressures at the Carrickfergus AGI are the maximum and minimum in the diurnal cycle, and are those downstream of the AGI in the North West pipeline.
3. Pressures at Coolkeeragh are the maximum and minimum in the diurnal cycle and are those in the pipeline upstream of the AGI.
4. Velocities at Coolkeeragh are the maximum in the diurnal cycle and are those in the inlet pipeline to the AGI.
5. Pressures at Ballylumford are the maximum and minimum in the diurnal cycle and are those in the pipeline.
6. Pressures at the 'Gas to the West' off take are the maximum and minimum in the diurnal cycle at the off take to the Derryhale AGI on the South-North pipeline.
7. Maximum pipeline velocities as per the standards detailed in IGEM/TD13

Pressures and flows on the Northern Ireland system remain within maximum and minimum limits across the range of scenarios, indicating that pressures and flows on the Northern Ireland system remain within maximum and minimum limits for all scenarios, for all years.

A3.5 Summer Minimum Day

Summer Minimum Day Scenarios were analysed using modelling for the extreme supply and demand scenarios, ranging from a minimum of 2.33 mscmd (2014/15; Base Case; Firm & Interruptible) to a maximum of 2.43 mscmd (2023/24; Base Case + Gas to the West + CAES; Firm & Interruptible).

Year	Demand	Twynholm (SNIP)		Carrickfergus	Coolkeeragh		B'lumford	Gas to West offtake
		Flow	Pressure [1]	Pressure [2]	Pressure [3]	Velocity [4]	Pressure [5]	Pressure [6]
		(mscmd)	(barg)	(barg)	(barg)	(m/s)	(barg)	(barg)
Limits		8.08 / 8.64	75 (Max)	12 (Min)	12 (Min)	12 (Min)	20 [7] (Max)	12 (Min)
2014/15	F&I	2.33	66.5 / 65.0	63.3 / 61.8	62.4 / 60.9	1.0	65.5 / 63.9	N/A
2023/24	F&I	2.43	66.5 / 65.6	63.3 / 62.4	62.7 / 61.5	1.0	65.4 / 64.5	63.0 / 62.1

Notes:

1. Pressures at Twynholm (SNIP) are the maximum and minimum in the diurnal cycle.
2. Pressures at the Carrickfergus AGI are the maximum and minimum in the diurnal cycle, and are those downstream of the AGI in the North West pipeline.
3. Pressures at Coolkeeragh are the maximum and minimum in the diurnal cycle and are those in the pipeline upstream of the AGI.
4. Velocities at Coolkeeragh are the maximum in the diurnal cycle and are those in the inlet pipeline to the AGI.
5. Pressures at Ballylumford are the maximum and minimum in the diurnal cycle and are those in the pipeline.
6. Pressures at the 'Gas to the West' off take are the maximum and minimum in the diurnal cycle at the off take to the Derryhale AGI on the South-North pipeline.
7. Maximum pipeline velocities as per the standards detailed in IGEM/TD13

Pressures and flows on the Northern Ireland system remain within maximum and minimum limits across the range of scenarios, indicating that pressures and flows on the Northern Ireland system remain within maximum and minimum limits for all scenarios, for all years.

A3.6 Additional Modelling Results

Gormanston Balancing Flows

The following table summarises the condition within Northern Ireland (SNIP, South-North and North-West pipelines).

Year / Demand Scenario	Twynholm (SNIP)		Gormanston		Coolkeeragh		B'lumford
	Flow	Pressure [1]	Flow	Pressure [2]	Pressure [3]	Velocity [4]	Pressure [5]
	(mscmd)	(barg)	(mscmd)	(barg)	(barg)	(m/s)	(barg)
Limits	**8.08 / 8.64**	**75 (Max)**	**-**	**75 (Max)**	**12 (Min)**	**20 [6] (Max)**	**12 (Min)**
2023/24 (F & I)	**8.15**	56.9 / 51.9	1.75	36.0 / 27.4	26.6 / 12.3	9.3	36.9 / 25.5
2023/24 (F)	**8.26**	56.9 / 52.5	0.82	31.5 / 22.2	25.4 / 12.5	9.0	36.1 / 25.7

Notes:

1. Pressures at Twynholm (SNIP) are the maximum and minimum in the diurnal cycle at the outlet of Twynholm AGI.
2. Pressures at Gormanston are the maximum and minimum in the diurnal cycle at the outlet of Gormanston AGI.
3. Pressures at Coolkeeragh are the maximum and minimum in the diurnal cycle and are those in the pipeline upstream of the AGI.
4. Velocities at Coolkeeragh are the maximum in the diurnal cycle and are those in the inlet pipeline to the AGI.
5. Pressures at Ballylumford are the maximum and minimum in the diurnal cycle and are those in the pipeline.
6. Maximum pipeline velocities as per the standards detailed in IGEM/TD13

System Pressure required to achieve 27 bar at Coolkeeragh AGI

The following table summarises the condition within Northern Ireland (SNIP, South-North and North-West pipelines).

Year / Demand Scenario	Twynholm (SNIP)			Carrickfergus	Coolkeeragh		B'lumford
	Flow	Inlet Pressure	Outlet Pressure [1]	Pressure [2]	Pressure [3]	Velocity [4]	Pressure [5]
	(mscmd)	(barg)	(barg)	(barg)	(barg)	(m/s)	(barg)
Limits	8.08 / 8.64		75 (Max)	12 (Min)	12 (Min)	20 [6] (Max)	12 (Min)
2014/15 (F & I)	8.96	69.0	66.5 / 61.0	43.6 / 32.7	38.6 / 27.5	4.1	47.4 / 36.4
2014/15 (F)	7.50	61.5	59.0 / 54.2	40.5 / 31.8	35.8 / 26.9	4.1	43.9 / 35.2

Notes:

1. Outlet Pressures at Twynholm (SNIP) are the maximum and minimum in the diurnal cycle at the outlet of Twynholm AGI.
2. Pressures at the Carrickfergus AGI are the maximum and minimum in the diurnal cycle, and are those downstream of the AGI in the North West pipeline.
3. Pressures at Coolkeeragh are the maximum and minimum in the diurnal cycle and are those in the pipeline upstream of the AGI.
4. Velocities at Coolkeeragh are the maximum in the diurnal cycle and are those in the inlet pipeline to the AGI.
5. Pressures at Ballylumford are the maximum and minimum in the diurnal cycle and are those in the pipeline.
6. Maximum pipeline velocities as per the standards detailed in IGEM/TD13

System Pressure required to achieve 12 bar at Coolkeeragh AGI

The following table summarises the condition within Northern Ireland (SNIP, South-North and North-West pipelines).

Year / Demand Scenario	Twynholm (SNIP)			Carrickfergus	Coolkeeragh		B'lumford
	Flow	Inlet Pressure	Outlet Pressure [1]	Pressure [2]	Pressure [3]	Velocity [4]	Pressure [5]
	(mscmd)	(barg)	(barg)	(barg)	(barg)	(m/s)	(barg)
Limits	8.08 / 8.64		75 (Max)	12 (Min)	12 (Min)	20 [6] (Max)	12 (Min)
2014/15 (F & I)	8.96	63.0	60.5 / 55.7	33.7 / 21.4	26.7 / 12.5	9.1	38.1 / 25.8
2014/15 (F)	7.50	55.0	52.5 / 48.3	30.4 / 26.6	23.5 / 11.9	9.3	34.4 / 24.7

Notes:

1. Outlet Pressures at Twynholm (SNIP) are the maximum and minimum in the diurnal cycle at the outlet of Twynholm AGI.
2. Pressures at the Carrickfergus AGI are the maximum and minimum in the diurnal cycle, and are those downstream of the AGI in the North West pipeline.
3. Pressures at Coolkeeragh are the maximum and minimum in the diurnal cycle and are those in the pipeline upstream of the AGI.
4. Velocities at Coolkeeragh are the maximum in the diurnal cycle and are those in the inlet pipeline to the AGI.
5. Pressures at Ballylumford are the maximum and minimum in the diurnal cycle and are those in the pipeline.
6. Maximum pipeline velocities as per the standards detailed in IGEM/TD13