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Gas Networks Ireland

Network Development Plan 2015

assessing future demand and supply position

Table of Contents

Appendices

List of Figures

List of Tables

Data Freeze and Rounding

In order to complete the detailed analysis and modelling required to produce this document, the demand and supply scenarios were defined in March 2015, based on the most up to date information at the time.

In presenting the data obtained for publication in the Network Development Plan, energy values have been rounded to one decimal place, and aggregated growth/contraction rates are expressed as whole numbers to aid clarity. In certain cases, rounding may lead to slight variance in sum totals.

Disclaimer

Gas Networks Ireland has 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 Network Development Plan 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 Republic of Ireland's gas market may need.

Section One

Foreword

Welcome to the 2015 ten-year Network Development Plan (NDP) published by Gas Networks Ireland. The NDP was previously published by Gaslink, however as of the 1st of August 2015 the licenses for the operation of the gas transmission and distribution systems in the Republic of Ireland and the obligations therein have been transferred to Gas Networks Ireland.

Gas has a key ongoing role to play in supporting the delivery of Ireland's energy policy. There are many social, economic and environmental advantages to using gas as the transition fuel to a low carbon economy. Gas has significantly lower carbon emissions than either oil or coal and it also has a vital role to play in helping achieve the European standards for particulate emissions reductions.

Ireland's gas interconnectors with Great Britain continue to provide a gateway to the European gas market, whilst ensuring security of energy supply for Ireland's economy. Indigenous gas is also important to Ireland, the existing source of supply at Inch off the south coast of Ireland remains important for the southern region of the gas network. Gas Networks Ireland welcomes the expected first gas flows from the Corrib gas field.

The gas network will continue to provide for increasing flexibility in the renewable energy sector as the primary backup to wind and solar electricity generation. The introduction of Renewable Natural Gas (RNG) to the network will provide an additional source of renewable energy to Ireland's energy mix, which has the added advantage of providing greater reliability than either wind or solar sources. The roll out of Compressed Natural Gas (CNG) has the potential to provide significant economic and environmental benefits as gas (natural and renewable) displaces oil in transport, especially in heavy fleet and buses.

This document sets out our assessment of the future demand and supply position for the natural gas industry in the Republic of Ireland. The document also examines system operation and consequent capital investment requirements.

We hope that you find our new format informative and useful. Gas Networks Ireland continues to value your input and we encourage you to provide feedback so that we can continually add value to the analysis we provide on the status and future of natural gas in the Republic of Ireland. We welcome feedback at networksinfo@gasnetworks.ie.

We would like to acknowledge the contribution of our stakeholders during the process of preparing this document.

Liam O'Sullivan,
Managing Director,
Gas Networks Ireland.

Section Two

Executive Summary

The Network Development Plan (NDP) provides a view of how the gas network will develop over a ten year period. It is based on existing supply and demand for gas, as well as projections for growth in gas infrastructure and consumption. The document also examines system operation and consequent capital investment requirements. The ten year period facilitates the planning and development of the gas network, which can involve long lead times in the delivery of infrastructure projects.

The NDP is an annual document and is consistent with the European Ten Year Network Development Plan (TYNDP), which is published by the European Network of Transmission System Operators for gas (ENTSOG) every two years.

In order to broaden the NDP analysis Gas Networks Ireland is moving from providing a singular forecast of gas demand to a scenario based approach. Two scenarios, a grey scenario and a green scenario have been developed. The grey and green scenarios represent a range of potential gas demands, to be used for network planning purposes and are intended to represent a low growth and a higher growth forecast respectively. It is however the view of Gas Networks Ireland that the actual demand profile is more likely to occupy an intermediate or median position within the range.

In the grey scenario annual Republic of Ireland (ROI) gas demand is expected to grow by 3.8% out to 2023/24 with growth of 19% forecast in the green scenario over the same horizon. In the grey scenario the 1-in-50 peak is expected to grow by 3.1 % over the duration of the analysis and by 16.1% for the green scenario.

There is however some decoupling of annual demand and peak day gas demand in the power generation sector, as a result of wind generation's impact on the operation of gas fired plant in the Single Electricity Market (SEM)[1]. Annual power generation sector gas demand is influenced by increasing wind generation capacity, which is displacing gas fired generation. However, wind generation is assumed to have little impact on the winter peak day. Recent winters have proven that

1 The Single Electricity Market (SEM) is the wholesale electricity market operating in the Republic of Ireland and Northern Ireland.

there is limited wind generation available during cold weather peak demand periods. Consequently, there is a high dependency on gas fired generation, to meet peak day electricity demands.

The gas network continues to play a pivotal role in the Irish energy market and the Irish economy. Key to ensuring the flexibility required by electricity generation to cater for cycling of renewable energy will be a flexible gas network which can respond to the needs of customers. The gas network will play an essential role in facilitating the 40% renewable generation targets set by the Irish government for 2020.

The ROI gas network extends to over 630,000 Irish homes and 24,000 Irish businesses. However it is estimated that there are 300,000 households in urban areas using oil which have a gas distribution network in close proximity, so there is considerable potential to extend gas to a greater number of households. This would allow these energy consumers to avail of the economic and environmental benefits of natural gas. Gas mains infill[2] will increase the overall gas demand which will help reduce tariffs for individual gas consumers creating enhanced sustainability from a cost perspective.

Gas Networks Ireland is keen to promote growth and innovation in the gas industry in order to help enhance the competitiveness of the Irish economy. Key opportunities include development of new solutions and infrastructures for alternative gas utilisation such as Natural Gas Vehicles (NGV's), and the integration of renewable and alternative sources of gas.

Gas Networks Ireland continues to develop the role of Compressed Natural Gas (CNG) within the transport industry through the promotion of NGVs. Operators of haulage and fleet vehicles can benefit from cost savings of up to 30% on their fuel costs. A number of CNG trials are currently being supported to demonstrate the suitability of CNG in the Irish Transport Sector. Gas Networks Ireland are planning to support the establishment of a number of publicly accessible fast-fill stations at strategic locations throughout Ireland. Gas Networks Ireland's objective is that by 2024 at least 5% of the commercial transport market and 10% of the bus market in Ireland will be operating on CNG or Renewable Natural Gas (RNG).

Gas Networks Ireland are also working with a number of parties with a view to facilitating the introduction of renewable gas into the network. Renewable Natural Gas (RNG) is an indigenous, clean, sustainable, and carbon neutral source of energy. Renewable gas can be produced from many organic waste materials and upgraded to a standard which is identical to natural gas which can then be injected into the gas network.

The Corrib gas field is anticipated to commence full commercial production in 2015/16, and will greatly enhance Ireland's security of supply, meeting approximately 56% of Gas Networks Ireland System forecasted annual demand in its first full year of production. However in the medium term the Moffat[3] interconnection point which currently accounts for around 93% of ROI gas demand will re-emerge as the dominant supply source.

The importance of the Moffat Interconnection Point and the security of supply concern regarding the single pipeline was recognised by the European Commission in 2013, who designated the twinning of the Cluden to Brighouse Bay pipeline in southwest Scotland a Project of Common Interest[4] (PCI) and subsequently approved €33.7 million in funds towards the project in 2014. The CER approved the remaining €60m in May 2015 and the pipeline will be completed in 2017. This project will greatly enhance Ireland's security of supply and will help offset potential capacity constraints at Moffat. This will provide greater and more reliable access to European gas supplies and is one of the key enablers in facilitating physical reverse flow at Moffat that would allow the European market access to existing and potential Irish gas supplies.

Gas Networks Ireland will continue to ensure that a resilient, robust and safe gas network is maintained to ensure security of supply to customers through appropriate and efficient investment. Gas Networks Ireland welcome new sources of gas supply, and as always, remain willing to discuss prospective projects with project promoters.

2 Infill refers to mature housing located close to the gas network switching to gas.

3 The Moffat Entry Point is an off-take from the GB National Grid gas transmission system, located in south west Scotland.

4 PCI 5.2 Twinning of Southwest Scotland onshore system between Cluden and Brighouse Bay (Great Britain)

Section Three

Introduction

Key Messages:

- Annual ROI gas demands for 2014/15 are anticipated to be 1.3% below 2013/14 demands following a 5.0% decrease the previous year.
- The Moffat Entry Point currently accounts for 95% of Gas Networks Ireland system demands and 93% of ROI demands.
- The installed all-island wind generation capacity increased by 18.9% in 2014 from the previous year, although monthly wind capacity factors published by EirGrid showed less favourable wind conditions in 2014 compared to 2013.

The Network Development Plan (NDP) published by Gas Networks Ireland, covers the 10 year period from 2014/15 to 2023/24.

The NDP satisfies the requirements of both Condition 11 of the Transmission System Operator licence and Article 22 of Directive 2009/73/EC of the European Parliament to produce a long term development plan.

The publication of the Network Development Plan also satisfies the requirements of Article 19 of the Gas (Interim) (Regulations) Act 2002, as amended by the European Communities (Security of Natural Gas Supply) Regulations 2007 (S.I. No. 697 of 2007). This requires the CER to publish a report outlining supply and demand in the Republic of Ireland over the next seven years.

Gas Networks Ireland holds two licences from the Commission for Energy Regulation (CER) for the operation of the ROI transmission and distribution systems, which cover the following areas:

- Connection to the transmission and distribution systems;
- Transmission and distribution system standards;
- Operating security standards;
- Provision of metering and data services;
- Provision of services pursuant to the Code of Operation (the "Code").

Section Three
Introduction

3.1 Overview of Gas Networks Ireland System

The Gas Networks Ireland transmission system[5] includes onshore Scotland, interconnectors and the ROI system. The interconnector (IC) sub-system comprises of two subsea Interconnectors between ROI and Scotland; compressor stations at Beattock and Brighouse Bay, and 110 km of onshore pipeline between Brighouse Bay and Moffat in Scotland. The Interconnector system connects to the GB National Transmission System (NTS) at Moffat in Scotland. It also supplies gas to the Northern Ireland (NI) market at Twynholm and the Isle of Man (IOM) market via the second subsea Interconnector (IC2). The interconnector system is also used to provide a gas inventory service to ROI shippers.

The Gas Networks Ireland ROI System is 13,685 km in length, consisting of 2,467 km of high pressure steel transmission pipelines and 11,218 km lower pressure polyethylene distribution pipelines, as well as Above Ground Installations (AGIs), District Regulating Installations (DRIs) and compressor stations at entry points in ROI and Scotland. AGIs and DRIs are used to control and reduce pressures on the network.

The ROI system consists primarily of a ring-main system with spur lines serving various network configurations and a compressor station located in Midleton Co. Cork.

The gas infrastructure is differentiated by the following pressure regimes:

- High pressure transmission infrastructure which operates above 16 barg;
- Distribution infrastructure which operates below 16 barg.

The distribution infrastructure is typically operated at 4 barg and less than 100 mbarg for inner city networks.

The Gas Networks Ireland ROI System is 13,685 km in length, consisting of 2,467 km of high pressure steel transmission pipelines and 11,218 km lower pressure polyethylene distribution pipelines

5 The Gas Networks Ireland System includes infrastructure in ROI, NI and South West Scotland, this network development plan only assesses the ROI and South West Scotland infrastructure.

Figure 3-1: Overview of Gas Networks Ireland Transmission System

Section Three
Introduction

3.2 Investment Infrastructure

There is a continuous programme of works to ensure that the network complies with relevant legislation, technical standards and codes. Equally, capacity limitations are identified on the network and addressed through appropriate capital investment programmes in order to ensure continuity of supply to all customers.

The following are some of the significant programmes completed since the publication of the 2014 NDP, in addition to maintaining a rolling planned maintenance programme.

Pressure regulating stations capacity investment:

- Scholarstown Road AGI, Co. Dublin;
- Newtownstalaban AGI, Co. Louth.

Pipeline investment:

- Dundalk reinforcement, Co. Louth;
- Ballymun transmission pipeline replacement, Co. Dublin;
- Spur off Baunlusk to Great Island transmission pipeline to Belview Co. Kilkenny.[6]

Boiler Upgrades:

- Ballyduff AGI, Co. Waterford;
- Aughinish AGI, Co. Limerick;
- Rosanna Lower AGI, Co. Wicklow;
- Ballineen AGI, Co. Cork;
- Ballyclough AGI, Co. Cork;
- Drumgill AGI, Co. Meath.

The following are rolling capital investment programmes to be completed over price control period:

- Aerial Marker Post Replacement;
- Meter Replacement (Domestic and Industrial Commercial).

6 Third party funding provided.

3.3 Historic Demand and Supply

3.3.1 NDP 2014 Forecast Demand and Actual 2014/15 Demand

The forecast annual demand published in last year's NDP for the current gas year, 2014/15, proved accurate, with a variance of circa 1.2% between it and the actual year to date 2014/15 gas demand.

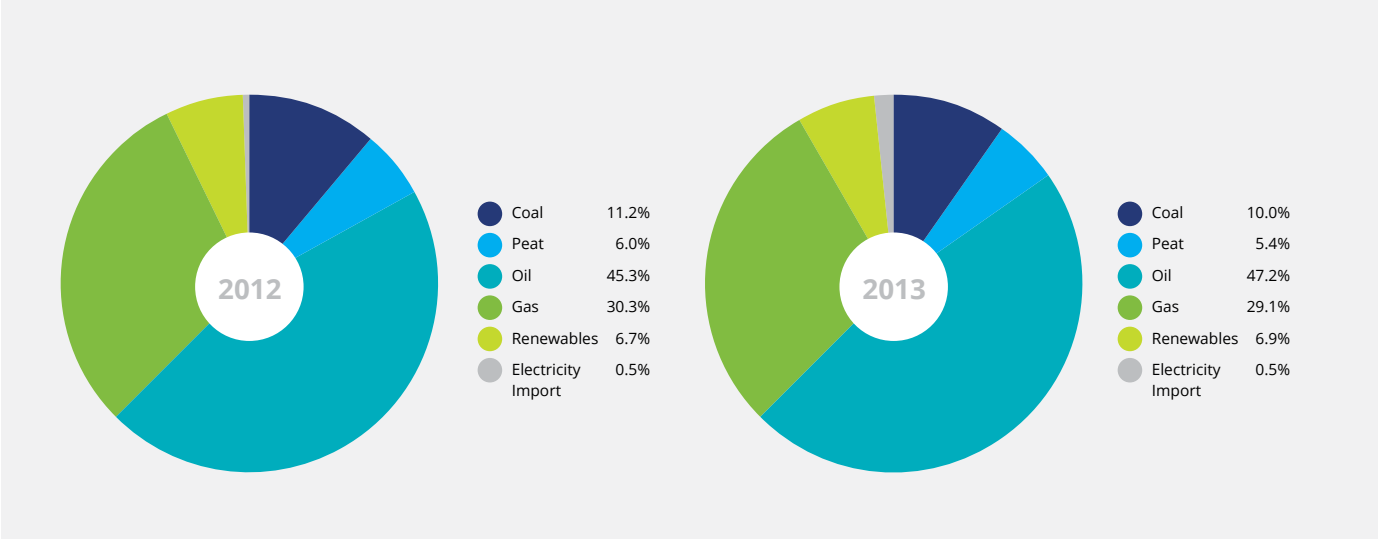
In terms of power generation higher levels of wind generation capacity were the primary factors why gas demand was less than forecast. In the industrial and commercial sector forecasts were ahead of target driven by increased growth in the economy. However in the residential sector demand was marginally lower than forecast as the weather conditions were slightly milder than the assumed reference conditions for the forecast.

3.3.2 ROI Annual Primary Energy Requirement

The Sustainable Energy Authority of Ireland (SEAI) report that Ireland's Total Primary Energy Requirement (TPER) for 2013[7] grew by 0.8% compared to 2012. Total Primary Energy Requirement in 2013 was 13,332 ktoe compared to 13,229 ktoe in 2012.

Oil continued to dominate the 2013 TPER accounting for 47% of total energy demands, as shown in Figure 3-2. Gas accounted for 29% of 2013 energy demands, reflecting its role in electricity generation, process and heating use. Renewable generation grew its share of TPER to 6.9%.

Figure 3-2: ROI TPER Analysis by Fuel (2012 and 2013)



Source: SEAI 2013

7 SEAI Energy Balance figures for 2014 not available at time of writing

Section Three
Introduction

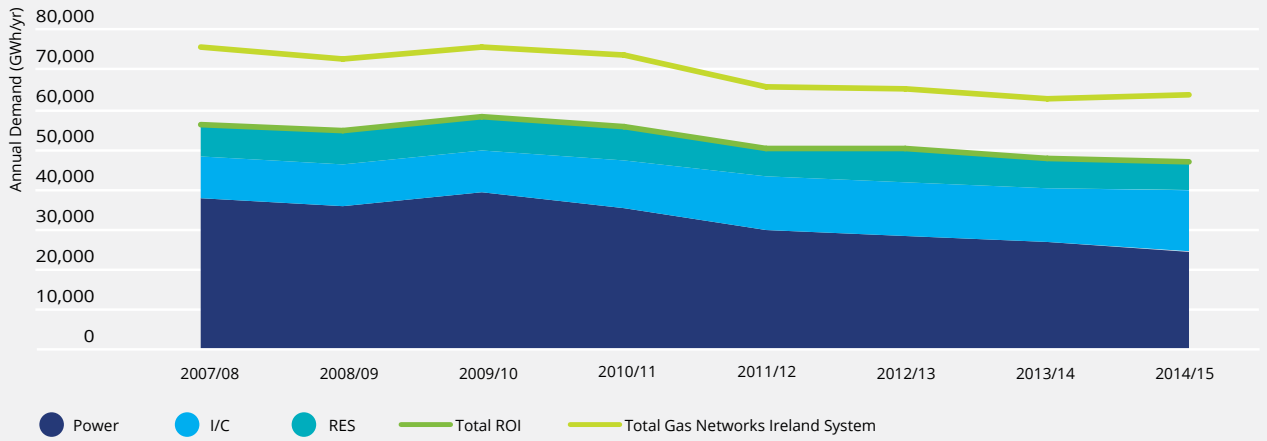
3.3.3 Historic Annual Gas Demand

This section refers to both Gas Networks Ireland System demand and ROI gas demand. The Gas Networks Ireland System demand refers to the combined demands for ROI, Northern Ireland (NI) and Isle of Man (IOM). ROI demand refers to ROI only and includes Inch storage injections where relevant.[8]

Annual ROI gas demands for 2014/15 are anticipated to be 1.3% below 2013/14 demands following a 5.0% decrease the previous year, as shown in Figure 3-3. In the power generation sector, annual gas demand for 2014/15 is anticipated to be 8.7% below 2013/14 levels, following a 4.4% decrease the previous year. The Industrial Commerical (I/C) sector annual gas demand for 2014/15 is however anticipated to grow by 12.1% compared to 2013/14 levels. Residential demand is anticipated to grow by 0.9% for 2014/15, following a decline of 14.9% in 2013/14.

The reduction in power sector gas demands can be attributed to the continuing dominant position for coal fired generation on the Single Electricity Market (SEM) and the increase penetration of wind powered generation on the SEM.

Figure 3-3: Historic Annual Gas Demand



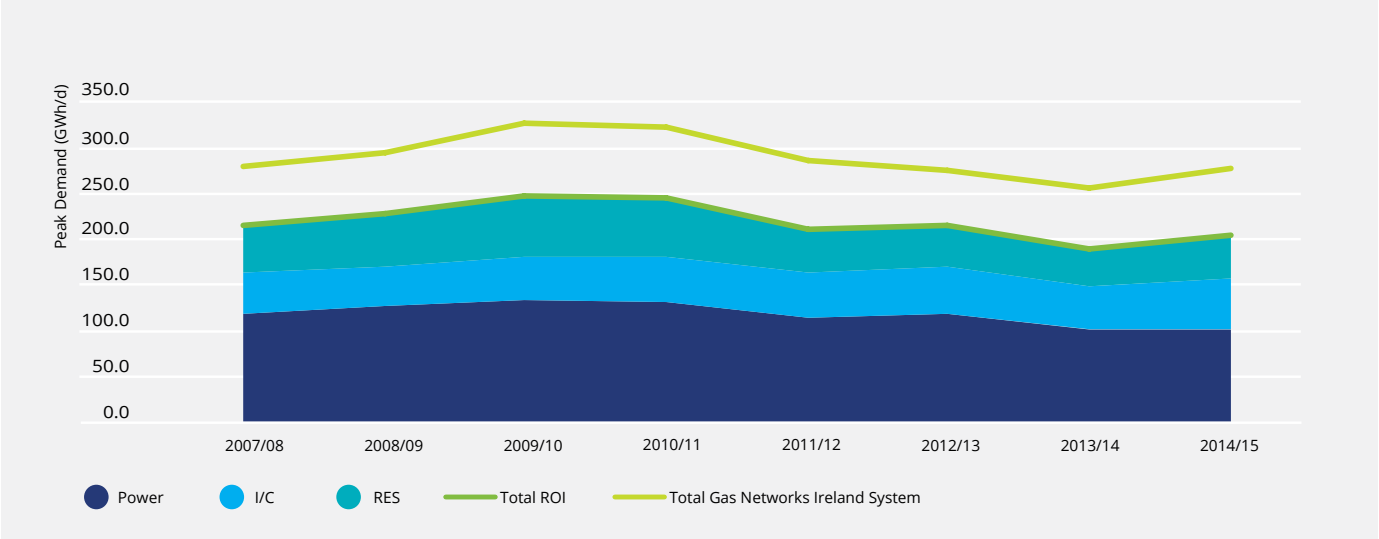
Total annual system gas demands for 2014/15 are estimated to be 1.4% below the previous year's gas demands. As well as the 1.3% reduction in ROI gas demand there will be a 9.9% increase in NI and IOM gas demands, resulting in a 1.4% increase in overall system demand. The historic gas demand is presented in Figure 3-3. The overall throughput for ROI in 2014/15 is expected to be 46,968 GWh or circa 4.3 bcm. Historical annual gas demand numbers are detailed further in Appendix 1.

8 The point of entry to the Gas Networks Ireland system from the Kinsale gas storage and production field off the south coast of Ireland. Inch storage injections are not included in the peak day forecast. Inch is assumed to be a source of supply on such days, when gas is withdrawn from storage.

3.3.4 Historic Peak Day Gas Demand

In 2014/15 ROI peak day gas demand was 8% higher than the 2013/14 peak day gas demand, and was roughly equivalent to the 2006/07 peak day demand. This increase in peak day gas demand was driven primarily by a 17.2% increase in the I/C sector and an increase of 16.8% in residential gas demand compared to the 2013/14 peak day. Peak day demand in the power generation sector was also up slightly, by 0.3%. Figure 3-4 presents the historic trend in peak day gas demands.

Figure 3-4: Historic ROI Peak Day Gas Demand



The Gas Networks Ireland system[9] 2014/15 peak day gas demand was up by 7.7 % on 2013/14 levels. The NI and IOM peak day gas demand was 6.8 % greater than in 2013/14. Historical peak day gas demand numbers are detailed further in Appendix 1.

The reduction in power sector gas demands can be attributed to the continuing dominant position for coal fired generation on the Single Electricity Market (SEM) and the increase penetration of wind powered generation on the SEM.

9 Gas Networks Ireland System includes for gas supplies to ROI, Northern Ireland and Isle of Man.

Section Three
Introduction

3.3.5 Ireland's Weather

Based on a Degree Day (DD) comparison, the most recent winter was approximately 11.2% colder than the previous year, 2013/14. The Winter of 2013/14 was however exceptionally mild.

The coldest day in winter 2014/15, occurred at the beginning of February, with an average temperature of -2.0°c, or a 17.5 DD; the equivalent day in 2013/14 occurred in late January with an average temperature of 1.5°c, or a 14.0 DD.

3.3.6 Wind Powered Generation

The installed all-island wind generation capacity increased by 18.9% in 2014 from the previous year[10] , although monthly wind capacity factors published by EirGrid[11] showed less favourable wind conditions in 2014 compared to 2013. As a result, there was an increase of 8.1% in total wind powered generation in 2014. Wind powered generation in the first 3 months[12] of 2015 experienced 11% growth against the same period in 2014. At the peak day for wind generation in winter 2014/15, daily wind powered generation accounted for 52% of the all-island daily electricity demand (26th of October 2014). However on the 2015 peak day for gas demand (2nd of February 2015) wind accounted for less than 1% of electricity system demand.

3.3.7 Electricity Interconnectors

There are two electrical interconnectors serving the island of Ireland – the East West Interconnector (EWIC) in ROI and the Moyle Interconnector in Northern Ireland. The net import capacity on the electrical interconnectors has increased as a result of the EWIC electrical interconnector commencing full capacity operation mid 2013. This has resulted in lower levels of thermal electricity generation than would have occurred in previous years.

Prevailing market conditions on SEM and its GB equivalent, BETTA (British Electricity Trading and Transmission Arrangements) have resulted in a predominantly GB-IE flow on the EWIC since it commenced operation in late 2012, i.e. import of electricity from Great Britain. The resulting displacement of conventional thermal power generation is approximately equivalent to the typical energy production of a mid-merit CCGT (Combine Cycle Gas Turbine) plant.

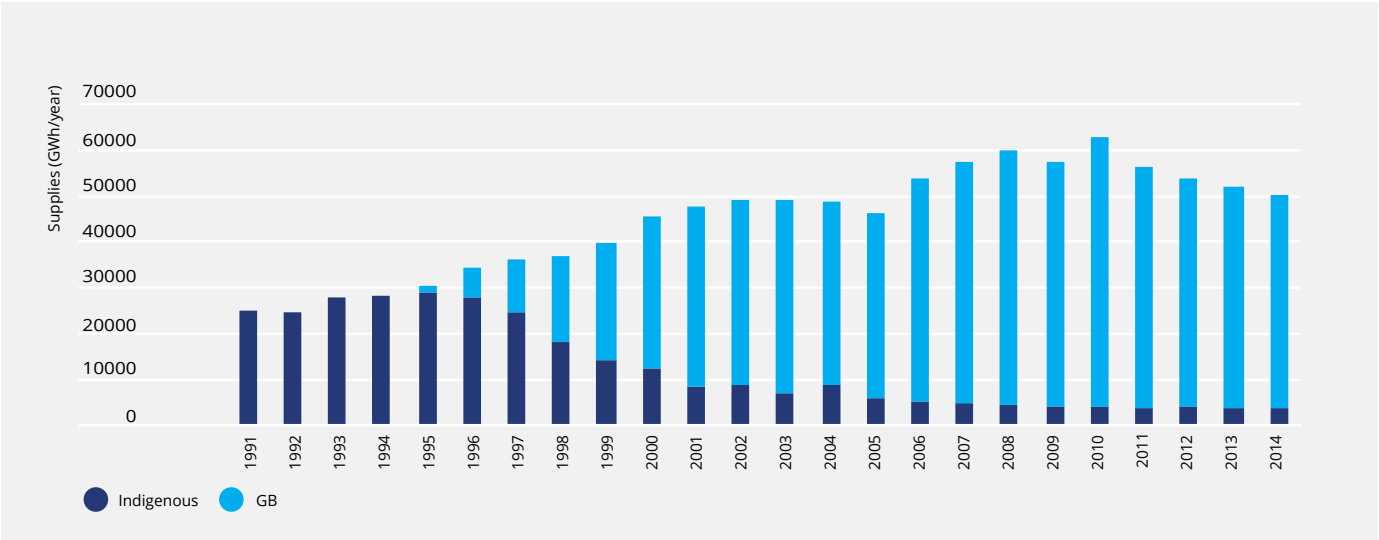
A fault occurred on the north cable of the 500MW Moyle Interconnector in June 2012, causing it to cease operation. The Moyle Interconnector continues to operate at 250 MW transfer capacity (half the full capacity of the interconnector). New cables are being procured and are expected to be commissioned by 2018 from which point full capacity will be restored.

10 Calculations based on EirGrid All-Island Wind and Fuel Mix Report December 2013 and 2014.
11 EirGrid holds the electricity Transmission System Operator (TSO) and Market Operator (MO) in the wholesale trading system in Ireland.
12 Based on 2014 year-to-date EirGrid published wind generation data available at time of writing.

3.3.8 Historic Gas Supply

During 2013/14 the Moffat Entry Point accounted for 95% of system demands and 93% of ROI demands, compared to 94% and 92% for 2012/13. Figure 3-5 shows historic ROI gas supplies.

Figure 3-5: Historic Annual Indigenous Gas Production and Great Britain (GB) Imports



In 2014/15 90% of peak day Gas Networks Ireland System gas demands were met through the Moffat Entry Point, with the remaining 10% supplied through the Inch Entry Point. The Moffat Entry Point met 86% of ROI peak day gas demands in 2012/13 and in 2013/14 with Inch meeting the balance.

During 2013/14 the **Moffat Entry Point accounted for 95% of system demands** and 93% of ROI demands

Section Four

Gas Demand Forecast

Key Messages:

- Gas Networks Ireland has developed two demand scenarios which forecast gas demand across the power, I/C and residential sectors.
- The grey scenario assumes less favourable demand conditions and forecasts growth of 3.8% in gas demand out to 2023/24.
- The green scenario assumes more favourable demand conditions and forecasts growth of 19% in gas demand over the forecast horizon.

4.1 Gas Demands

This chapter presents an overview of the gas demand forecast, and the outlook for gas demand and corresponding gas supply for the period 2015/16 to 2023/24. The NDP forecasts future gas demands by examining the development of individual power, I/C and residential sector gas demands[13].

Gas demand refers to both Gas Networks Ireland System demand and ROI demand. Gas Networks Ireland System demand refers to the total demand transported through the Gas Networks Ireland System, i.e. the combined demands for ROI, NI and IOM. ROI demand refers to ROI only and includes storage injections where relevant[14].

Gas demand refers to both **Gas Networks Ireland System demand and ROI demand**

13 Gas Networks Ireland have developed a document outlining the Methodology for forecasting gas demand. This document is available for download via the following link, http://www.gasnetworks.ie/networkdevelopmentplan

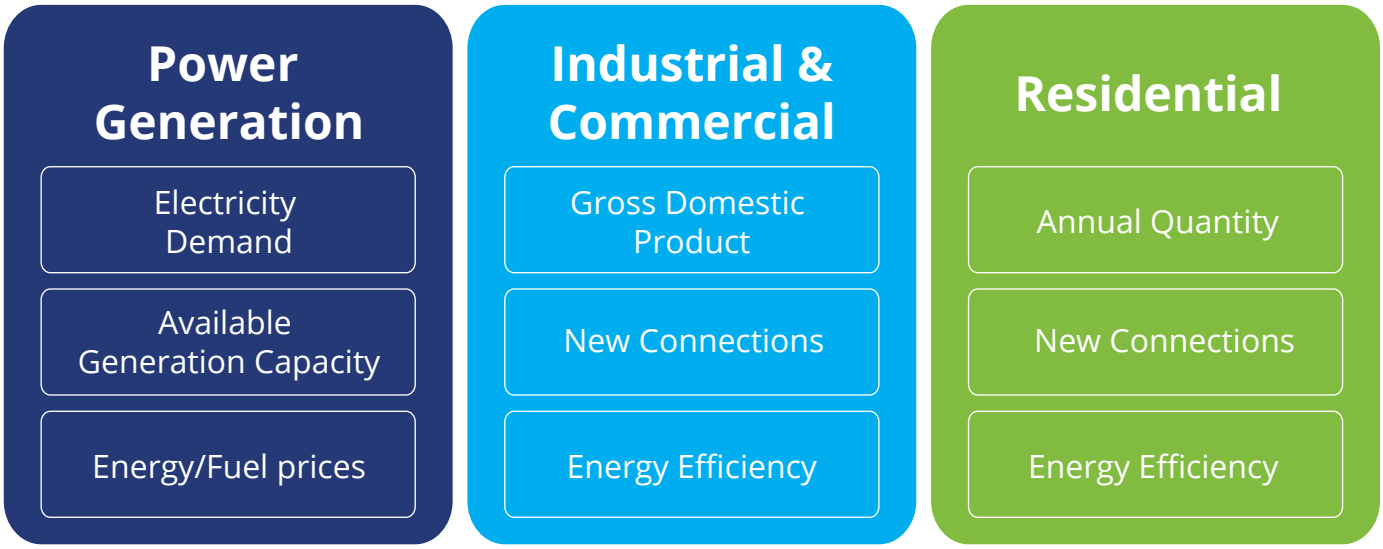
14 Inch storage injections are not included in the peak day forecast. Inch is assumed to be a source of supply on such days, when gas is withdrawn from storage.

Section Four
Gas Demand Forecast

4.1.1 Gas Demand Forecasting

The demand forecast modelling approach used in producing the NDP generates a ten year forecast for the power generation, I/C and residential sectors, based on a series of assumptions[15] which affect demand for each of these sectors. The primary demand assumptions by sector are summarised in Figure 4-1.

Figure 4-1 Key Demand Forecasting Assumptions



A number of forecasts are produced for each year, relating to the type of demand day, namely;

- The 1-in-50 winter peak day, i.e. a severe winter peak day that is statistically likely to occur once every fifty years
- An average winter peak, i.e. a winter peak day that would occur in a typical winter (most years)
- A summer minimum day, i.e. the lowest demand day of the year

The demand forecast is a primary input for the analysis that is undertaken to assess the adequacy of the transmission network and associated assets. The network analysis identifies the areas of the network that will require future development/investment, and as such, all aspects of it must be highly reliable and robust, particularly the peak day demand forecast.

Two separate 1-in-50 peak day events occurred in winter 2009/10 and winter 2010/11. The 1-in-50 peak demand forecasts that were produced for each of the two winters proved to be highly accurate, with forecasted demands and actual demands varying by less that 3% on each occasion, demonstrating that the demand forecasting methodology/process is reliable and robust.

15 A number of external data sources are referenced when generating future gas demands along with additional sector specific assumptions. Details of these assumptions are in Appendix 2.

Table 4-1: 1-in-50 ROI Peak Day comparison

	Actual		Forecast		Variance
Year	(GWh/d)	(mscm/d)	(GWh/d)	(mscm/d)	(%)
2009/10	253	22.9	246	22.3	2.8
2010/11	251	22.7	249	22.5	0.8

The average year peak day forecast is also considered for additional analysis that may be undertaken to assess the adequacy of the network to meet peak flows during a typical winter. The summer minimum day forecast is used to analyse the effect of low flows through the interconnector particularly in terms of the affect on compressor system operation, see section 10.4 for further details. In addition to the daily forecasts an annual gas demand forecast is also produced.

The demand forecasting methodology employed for the NDP is also used for generating forecasts for commercial planning purposes. Both the peak day and annual demand forecasts are inputs to the annual tariff setting process. The annual demand forecast forms the basis for the commodity element of the tariff, which has a relatively low weighting with respect to the overall tariff, i.e. 10%.

The average year peak day forecast is one of the inputs used for generating the (commercial) capacity bookings forecast, which accounts for 90% of overall revenue. The peak day forecast is adjusted to take account of commercial behaviour, and as such, the resultant capacity bookings forecast may vary significantly from the original average year peak day forecast, particularly for the power generation sector.

It's important to note, while the there has been some variation between the capacity forecast used to set the tariff and actual out-turn (capacity bookings), the original peak day forecast remains accurate.

The demand forecasting methodology employed for the **NDP is also used for generating forecasts for commercial planning purposes.**

Section Four
Gas Demand Forecast

4.2 Gas Demand Scenarios

In order to broaden the NDP analysis Gas Networks Ireland is moving from providing a singular forecast of gas demand to a scenario based approach. Two scenarios, a grey scenario and a green scenario have been developed. The grey scenario and green scenario are intended to align line with ENTSOG's (the European Network of Transmission System Operators for Gas) Grey and Green Scenarios respectively.[16]

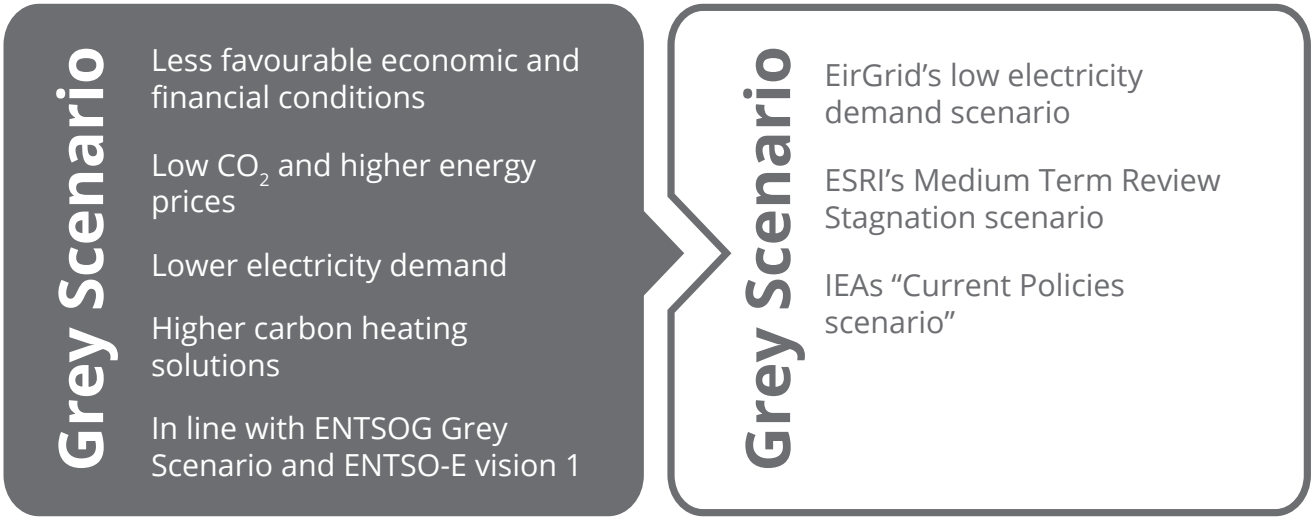
These scenarios represent a range of potential gas demands, to be used for network planning purposes and are intended to represent a low growth and a higher growth forecast. It is however the view of Gas Networks Ireland that the actual demand profile is more likely to occupy an intermediate or median position within the range.

4.2.1 Grey Scenario

The Gas Networks Ireland grey scenario is designed to align with ENTSOG's grey scenario. In this scenario economic and financial conditions are less favourable and there is little growth in electricity demand. This scenario assumes the low electricity demand scenario in the EirGrid / SONI[17] Generation Capacity Statement 2015. Carbon prices are based on the International Energy Agency's (IEA) "Current Policies scenario"[18]. The grey scenario is aligned with the stagnation scenario in the ESRI's (Economic and Social Research Institute) 2013 medium term review in terms of the economic outlook. In the residential sector growth is assumed to come from new connections only as opposed to fuel switching from more carbon intensive fuels to natural gas.

The Grey scenario may represent a pessimistic view of future gas demand, particularly in light of the strong economic growth which has been seen recently. This growth may also drive electricity demand over and above that predicted in EirGrid's low demand scenario.

Figure 4-2 Grey Scenario Concept and inputs



16 See the ENTSOG Ten Year Network Development Plan for further details
17 EirGrid & SONI are the electricity transmission system operators for the Republic of Ireland and Northern Ireland respectively.
18 See the IEA's World Energy Outlook 2014 for further details

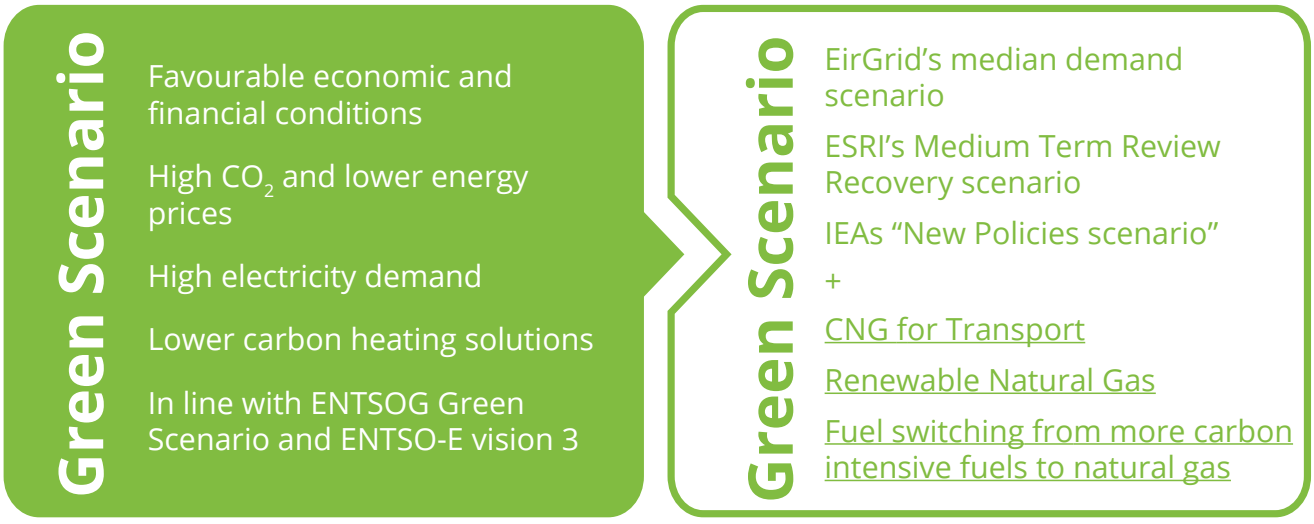
4.2.2 Green Scenario

The Gas Networks Ireland green scenario is designed to align with ENTSOG's green scenario. In the Green Scenario, economic and financial conditions are more favourable and there is significant and sustained growth in electricity demand.

This scenario assumes the median electricity demand scenario in the EirGrid / SONI Generation capacity statement 2015. Carbon prices are based on the IEAs "New Policies scenario" which predicts a higher carbon price which should lead to increased investment in green technologies. The green scenario is aligned with the recovery scenario in the ESRI's 2013 medium term review in terms of the economic outlook. The recovery scenario is more in line with current growth projections.

The green scenario also assumes that there is increased fuel switching in the domestic sector from more carbon intensive fuels such as oil and solid fuels to natural gas as outlined in section 6.2. Further growth in gas demand is envisaged in CNG for transport (see section 6.3). On the supply side the green scenario envisages the development of significant RNG sources; see section 6.4 for further details.

Figure 4-3 Green Scenario Concept and inputs



Section Four
Gas Demand Forecast

4.3 Demand Forecast Assumptions

4.3.1 Power Generation

The Irish gas and electricity sectors are highly interdependent. Gas is a critical component of Ireland's electricity generation, currently producing around 45% of the country's annual electricity requirement. Gas fired generators are the largest customer sector in the gas market, accounting for approximately 55% of the total ROI gas demand.

The following summarises the main assumptions regarding the changes in the SEM generation portfolio, as per the EirGrid / SONI All-Island Generation Capacity Statement 2015-2024:

- Wind generation is anticipated to increase to 4014 MW and 1336 MW in ROI and NI respectively, by 2023/24.
- Gas fired generation capacity is expected to increase by approximately 430 MW in 2015 with the addition of the Great Island CCGT plant.
- In NI SONI has signed a contract to secure the provision of 250MW of local reserve at the Ballylumford site, thus extending the life of the three units which were due to close in 2015.
- Low Sulphur Fuel Oil (LSFO) generation is expected to decrease by approximately 800 MW with the closure of Tarbet (from 2021) and Great Island (from 2015) oil fired plants.

The outlook to 2023/24 regarding the merit order in the SEM, as per Gas Networks Ireland's Power Generation gas demand forecasting model, is as follows:

- Renewables are assumed to be priority despatch and will meet 40% of generation by 2023.
- Coal fired plant is anticipated to continue providing base-load generation over the forecast period.
- Peat fired generation is anticipated to fall-off in-line with the expiration of the Public Service Obligation (PSO) levy payments which peat fired stations currently receive.
- The electricity interconnectors, EWIC and Moyle[19], are anticipated to be net importers of electricity and would be expected to be importing at full capacity on peak days.
- Gas fired plant is anticipated to meet the balance of electricity demand.

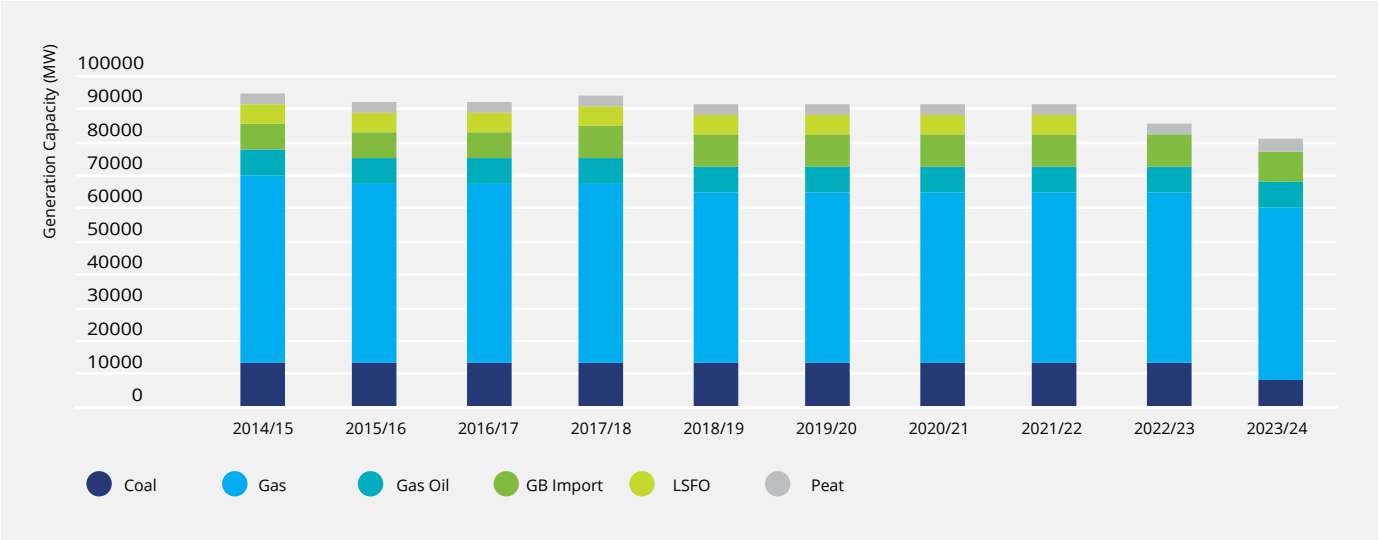
It should be noted that there is some uncertainty in power sector forecasts due to the impending implementation of the Integrated Single Electricity Market (iSEM); iSEM refers to a new High Level Design (HLD) for the Electricity Market in Ireland and Northern Ireland due for completion by the end of 2017. The market will be re-designed to efficiently implement the EU Target Model and ensure efficient cross border trade. Gas Networks Ireland will continue to engage with stakeholders in terms of establishing the impact of iSEM on gas demand.

Gas is a critical component of Ireland's electricity generation, currently producing around 45% of the country's annual electricity requirement.

19 The Moyle Interconnector capacity is currently limited to 250 MW due to a cable fault. It is expected that it will be restored to its full capacity of 450 MW by 2018.

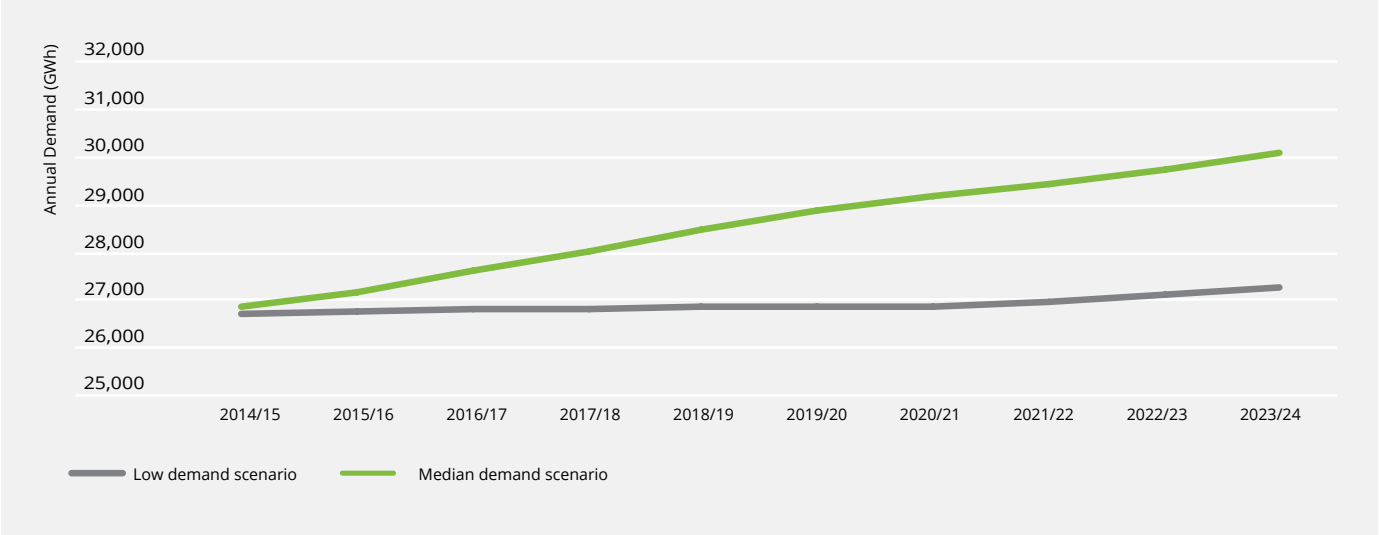
Figure 4-4 illustrates the anticipated level of generation by fuel for thermal plant in the SEM, as per the EirGrid / SONI All-Island Generation Capacity Statement 2015-2024.

Figure 4-4 Forecast Single Electricity Market (SEM) Thermal Generation Mix



The latest EirGrid / SONI, low and median electricity demand scenarios are illustrated in Figure 4-5. The low demand scenario is assumed for the grey scenario and the median demand scenario for the green scenario.

Figure 4-5: ROI Forecast Electricity Demand



Section Four
Gas Demand Forecast

4.3.1.1 EWIC and Gas Demand

A sensitivity analysis included in this year's NDP to determine the impact that a variation in EWIC flows would have on 1-in-50 peak day gas demand, i.e. no electricity imports and electricity exports; the base case assumes that EWIC will be importing at full capacity on a 1-in-50 peak day.

The analysis indicates that the 1-in-50 peak day gas demand would increase by approximately 18 GWh/d when there are no EWIC electricity imports and approximately 32 GWh/d when EWIC is exporting.

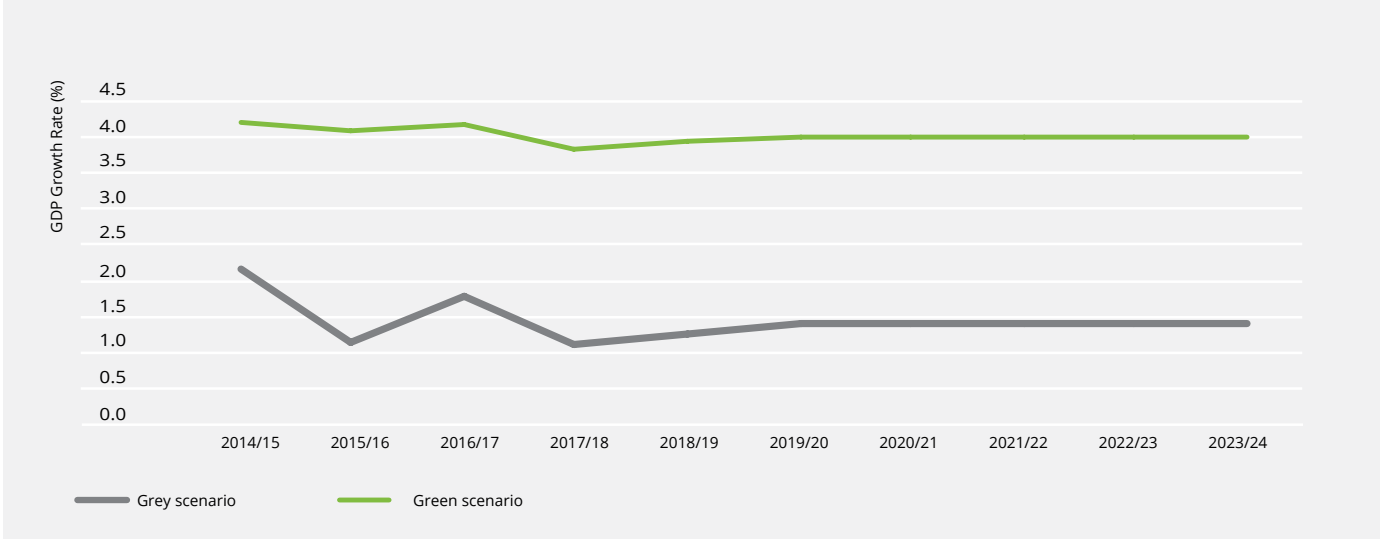
Analysis also indicates that in the event of no EWIC imports, the capacity limit of the Moffat Entry Point would be reached by 2020/21 for the "1-in-50" winter peak or by 2019/20 in the case where EWIC is exporting.[20]

4.3.2 Industrial and Commercial

Industrial and Commercial sector gas demand is assumed to continue to increase in line with anticipated new connection numbers and proportional to Gross Domestic Product (GDP)[21]. Figure 4-6 presents the GDP growth rate assumptions over the forecast period.

The grey scenario aligns with the ESRI's 2013 Medium Term Review (MTR) stagnation scenario and the green scenario with the MTR's recovery scenario. These projections have been reviewed in light of the latest ESRI Quarterly Economic Commentary, Central Bank Bulletin and the Organisation for Economic Cooperation and Development (OECD) Economic Outlook.

Figure 4-6: GDP Assumptions

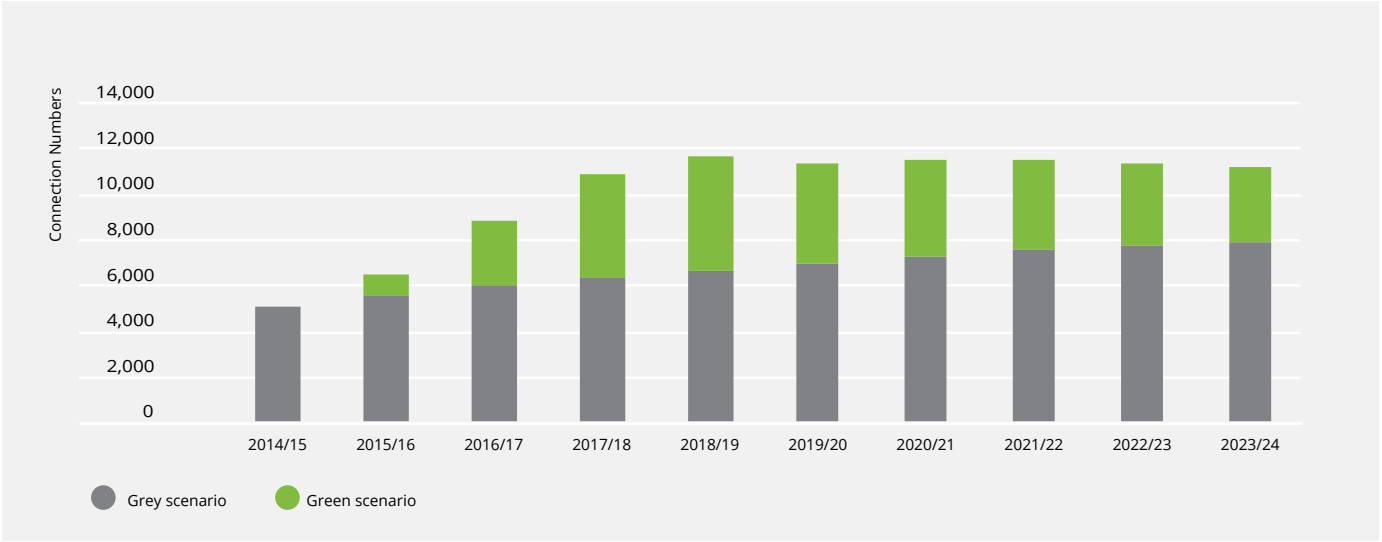


20 The twinning of the South West Scotland Onshore System (SWOS) will help mitigate against this scenario, see section 8 for further details.
21 I/C sector growth rate is assumed to be 80% of GDP based on observed historical trends.

4.3.3 Residential

The forecast of new residential customer numbers is shown in Figure 4-7. The new connections numbers in the grey scenario are based on the observed fuel switching in mature housing and new housing connections based on enquiries from developers and observed trends in new meter connections. The green scenario numbers are incremental to the grey scenario and are in line with Gas Networks Ireland's residential infill growth strategy. This initiative aims to increase fuel switching for houses located in close proximity to the gas network, from more carbon intensive fuels such as oil or solid fuels to natural gas (see section 6.2 for further details).

Figure 4-7: Residential Connection Numbers



4.3.3.1 Efficiency

Energy efficiency savings impacting on I/C and residential gas demands are derived from the National Energy Efficiency Action Plan 2014 (NEEAP3). The combined gas demand for the I/C and residential sectors is anticipated to reduce by approximately 1.1%[22] annually (up to 2020) as a result of energy efficiency measures.

Assumptions relating to energy efficiency savings are further outlined in Appendix 3: Energy Efficiency Assumptions.

22 This is based on current demand in these sectors and does not take into consideration other factors affecting growth.

Section Four
Gas Demand Forecast

4.3.4 Compressed Natural Gas

The gas demand forecast also includes transport sector demand. The transport forecast relates to the anticipated development of Compressed Natural Gas (CNG) within the transport industry through the promotion of Natural Gas Vehicles (NGVs). Gas Networks Ireland are currently targeting at least 5% penetration of CNG or Renewable Natural Gas (RNG) for commercial transport and 10% of the bus market in Ireland by 2024.[23] See Table 4-2 for projected transport sector demand.

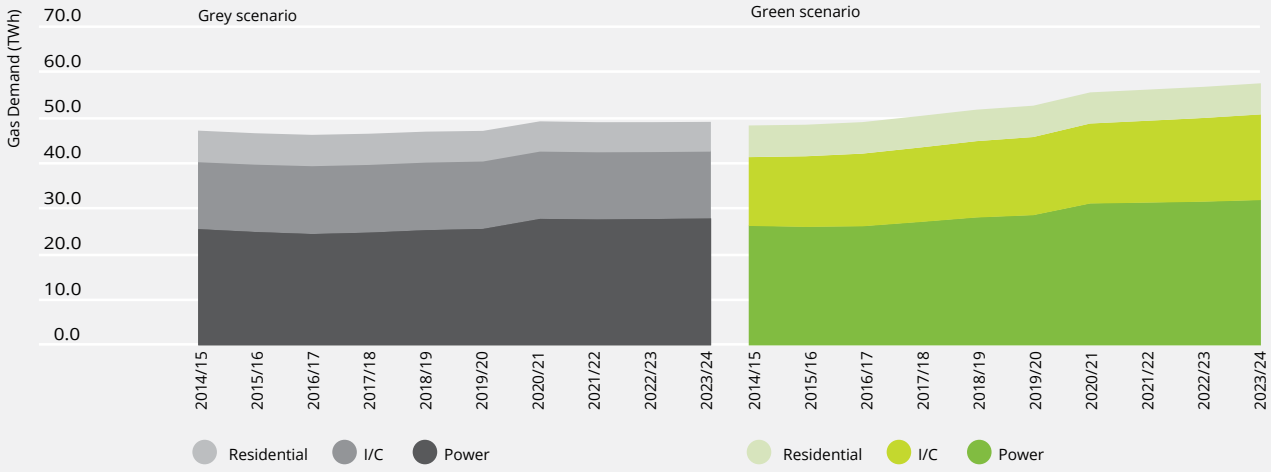
Table 4-2: Annual CNG demand

	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24
CNG Demand (GWh)	14.4	30.5	53.0	82.4	119.1	182.1	286.4	419.5	609.7

4.4 The Demand Outlook

In the grey scenario annual ROI gas demand is expected to grow by 3.8% out to 2023/24 with growth of 19% forecast in the green scenario over the same horizon. The aggregate ROI system demands are presented in Figure 4-8.

Figure 4-8 Annual Demand by Sector



23 Please refer to section 6.3 for further detail on Gas Network Ireland's plans regarding CNG and NGVs.

4.4.1 Annual Demand

In the grey scenario demand from the power generation sector is expected to decrease initially due to the impact of renewable energy sources. An increase in gas demand for the power generation sector is however expected in the medium term with the growth in wind capacity levelling off somewhat and with two peat plants coming off PSO in 2020. In the green scenario the initial slow rate of increase accelerates driven by increased electricity demand as per the EirGrid/SONI median demand scenario. This growth accelerates further in the medium term, again due to the levelling off of wind capacity growth and due to the impact of reduced peat fired power generation. Over the period of analysis gas demand in the power generation sector is expected to grow by 9.2% and 21.5% in the grey and green scenarios respectively.

In the I/C sector the grey scenario demand profile is more or less flat due to the low GDP growth rate assumed which is balanced out by the impact of energy efficiency measures as set out in NEEAP3. In the green scenario demand is seen to increase in line with the higher GDP forecasts and the assumed additional growth in new I/C connections as demand outstrips NEEAP 3 energy savings. The I/C sector demand to 2023/24 is expected to grow by 24.7% in the green scenario.

In the residential sector grey scenario despite some growth in new connections demand is expected to decrease due to the impact of domestic energy efficiency measures. Demand is also expected to contract in the green scenario but not to the same extent as in the grey scenario. This is due to the assumed growth in new connections over and above those assumed in the base case. The overall effect is a contraction of 5.7% in the grey scenario and 1.3% in the green scenario to 2023/24.

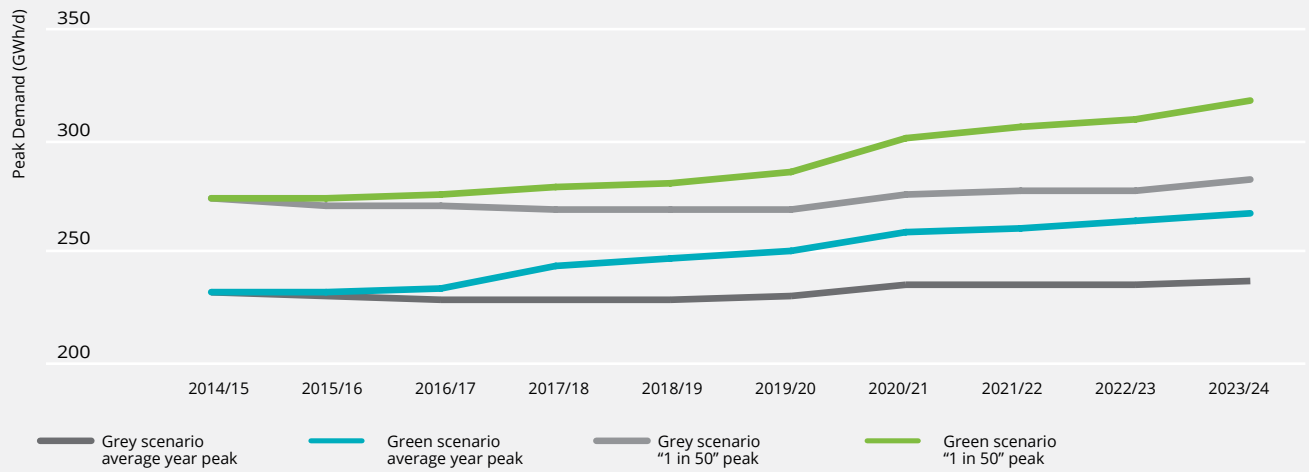
In the base scenario demand from the power generation sector is expected to decrease initially **due to the impact of renewable energy sources.**

Section Four
Gas Demand Forecast

4.4.2 Peak Demand

The 1-in-50 and average year peak day gas demands for ROI are given in Figure 4-9. In the grey scenario the 1-in-50 peak is expected to grow by 3.1 % over the duration of the analysis and by 16.1% for the green scenario.

Figure 4-9: Peak Day Gas Demand Forecast



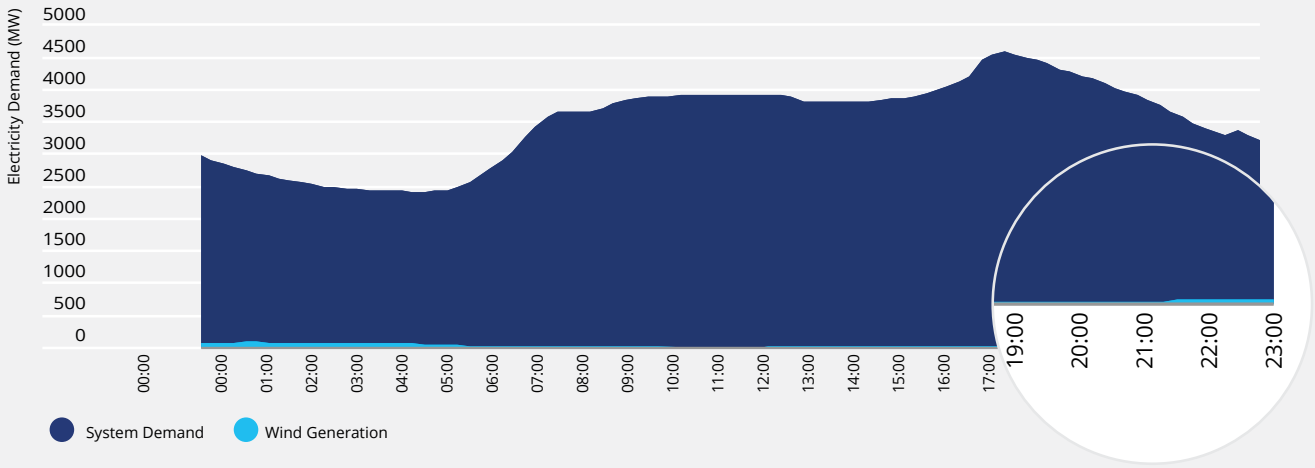
Peak day demand for the I/C and residential sectors follow the same broad trends as outlined in the annual demand for two scenarios under consideration. In the Industrial & Commercial sector the demand profile is flat in the grey scenario with projected growth of 33% in the green scenario over the duration. The residential 1-in-50 peak demand is expected to contract by 5.7% and 1.3 % for grey and green scenarios respectively.

However there is some decoupling of peak day and annual gas demand in the power generation sector. The divergence in gas power generation annual and peak day gas demand is as a result of wind generation's impact on the operation of gas fired plant in the SEM. Annual power generation gas demand is impacted by increasing wind generation capacity, which is displacing gas fired generation in the SEM.

Wind generation is assumed to have little impact on the winter peak day. Recent winters have shown that there is limited wind generation available during cold weather peak demand periods. Consequently, there's a high dependency on thermal generation, particularly gas fired generation, to meet the high levels of electricity demand which occur during such cold weather periods. On this basis, peak day gas demand is anticipated to grow in line with electricity demand forecasts.

Figure 4-10 illustrates the level of dependency the SEM can have on conventional generation on the peak day. Despite an installed wind generation capacity of 2122 MW in the ROI, wind accounted for an average of just 1.1% of system demand over the course of the 2014/15 peak day which occurred on the 2nd of February 2015. The balance of system demand is principally made up of thermal generation along with electricity imports and other renewables.

Figure 4-10 2014/15 Peak Day Electricity Demand and Wind Generation



Wind generation is assumed to have **little impact on the winter peak day.**

Section Five

Gas Supply

Key Messages:

- The Corrib field is due to start production in the 2015/16 gas year and will account for up to 56% of Gas Networks Ireland System demands in its first full year of production
- The Moffat entry point will remain key in terms of energy security as Corrib production declines in the medium term.

Figure 5-1 Bellanaboy Gas Terminal

Figure 5-2 presents the forecast Gas Networks Ireland System[24] annual gas supply for the period to 2023/24 for the grey scenario. The Moffat Entry Point currently supplies circa 95% of the annual System gas demands.

The Corrib gas field is expected to meet approximately 56% of annual Gas Networks Ireland system demands (77% of ROI demand) in its first full year of commercial production (2015/16), with the Inch and Moffat Entry Points providing the remaining 5% and 39% respectively. The remainder of the forecast sees Corrib gas supplies decline to approximately 50% of initial peak production levels. The anticipated reduction in Corrib and Inch gas supplies will re-establish the Moffat Entry Point as the dominant supply point from 2017/18, supplying between 73% and 76% of annual Gas Networks Ireland System demands (approximately 64% of ROI demand) by 2023/24.

The Gas Networks Ireland System 1-in-50 peak day gas supply profile for the grey scenario is presented in Figure 5-3. The Corrib gas field is anticipated to supply approximately 38% of ROI peak day gas demand in 2015/16 and Inch is expected to provide 12%. The Moffat Entry Point is expected to meet nearly 50% and 63% of ROI demand and Gas Networks Ireland System demands respectively in 2015/16. Moffat is anticipated to revert to its current position by 2023/24, when it's forecasted to meet 83% and 88% of ROI and Gas Networks Ireland System demands respectively. The current gas supply outlook highlights the continued critical role of the Moffat Entry Point throughout the forecast period.

24 Gas Networks Ireland System supply is equivalent to the total gas supplied at the Moffat, Inch and Bellanaboy Entry Points, including all supplies for ROI, NI and IOM.

Section Five
Gas Supply

Figure 5-2: Annual Gas Networks Ireland System Gas Supply Forecast – Grey Scenario

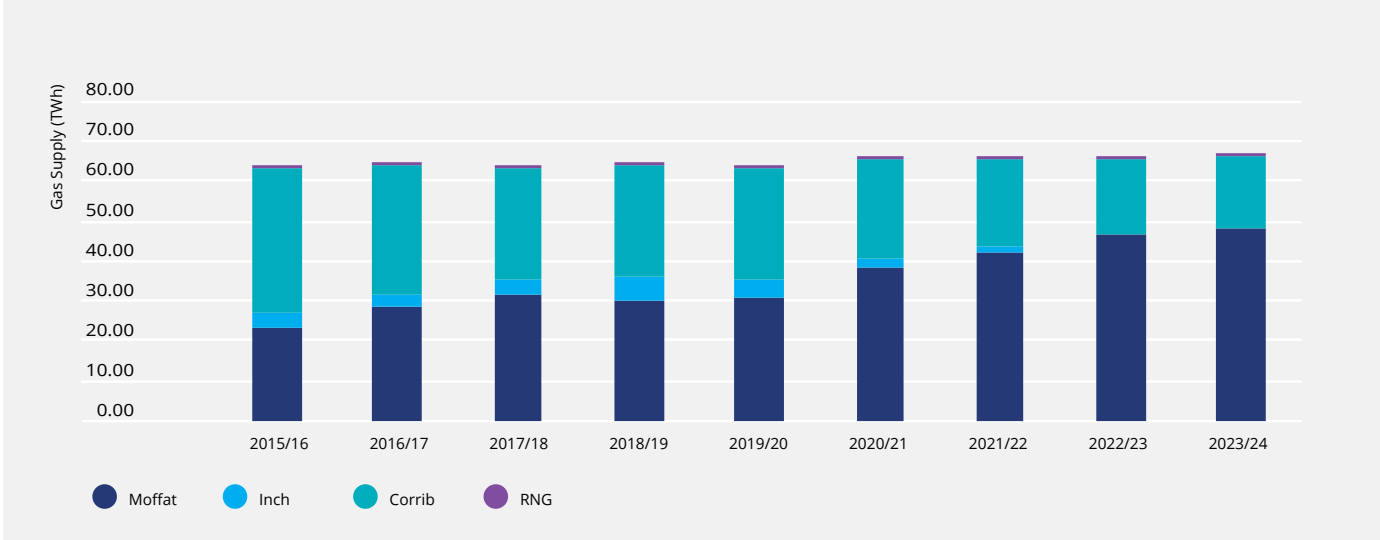
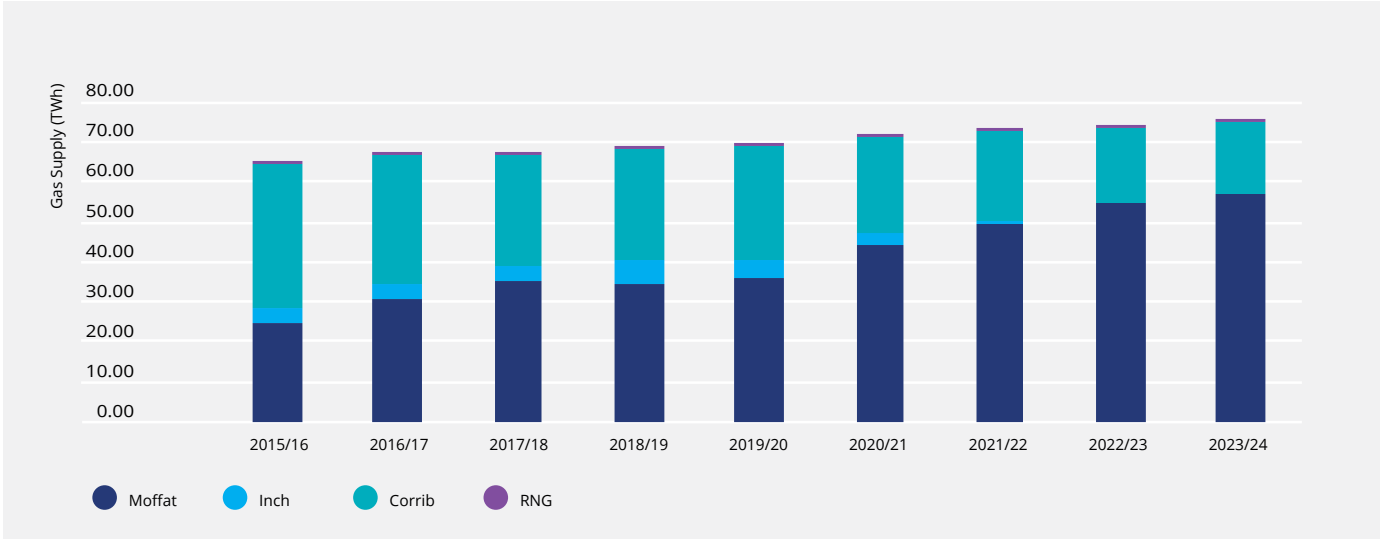


Figure 5-3: 1-in-50 Peak Day Gas Supply Forecast – Grey Scenario



5.1.1 Moffat

The Moffat Entry Point continues to function as the largest source of gas supply to the Gas Networks Ireland transmission system and is forecast to maintain this position into the future. It has a current technical capacity of 31 mscm/d (342 GWh/d) and supplies gas to ROI, NI and IOM. It has reliably met the systems energy demand requirements and ensured security of supply for Ireland since the construction and commissioning of IC1 in 1993. This connection to the GB National Transmission System (NTS) provides access to global energy markets and facilitates Ireland's participation in an integrated European energy market.

5.1.2 Celtic Sea Gas Storage

The Kinsale storage facility is operated by PSE Kinsale Energy Limited using the depleted Southwest Kinsale gas field. It currently has a working volume of c. 230 mscm (2,472 GWh), which is equivalent to approximately 5% of Ireland's annual gas consumption in 2013/14. It has a maximum withdrawal rate of 2.7 mscm/d (29.3 GWh/d) and a maximum injection rate of 2.55 mscm/d (27.6 GWh/d).

KEL has recently advised the CER that it plans to cease full storage operations in 2016 and commence blowdown of Southwest Kinsale cushion gas. There is the potential for a reduced storage service during 2016/17 which will be decided upon based on the market prices at that time. Blowdown is where the pressure support cushion gas from Southwest Kinsale is produced and sold into the market. Once the storage service ceases there will no further injections into Southwest Kinsale and production gas will be supplied from the Inch entry point during winter and summer periods. Currently production is expected to cease in 2020/2021.

Gas Networks Ireland will engage with PSE Kinsale Energy Limited in order to determine the exact blowdown schedule for the Southwest Kinsale gas field. This information was not available at the time of writing but will form the basis for subsequent analysis which will be developed and presented in the forthcoming 2015/16 Winter Outlook and subsequent NDPs.

5.1.3 Corrib Gas

The Corrib gas field is anticipated to commence supplying gas in 2015/16 and commissioning at terminal is ongoing. Initially it will operate at reduced capacity, to allow uprating of Mayo – Galway pipeline. During days of low demand in summer, Corrib is projected to meet full ROI gas demand. Table 5-1 shows the forecast maximum daily supply from Corrib.

Table 5-1 Corrib Forecast Maximum Daily Supply

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Daily Supply (mscm/d)	4.2	9.91	8.49	7.43	7.28	7.41	6.31	5.8	4.95	4.57
Daily Supply (GWh/d)	44.0	103.8	88.9	77.8	76.2	77.6	66.1	60.7	51.8	47.9

5.1.4 Shannon LNG

Shannon LNG have indicated an earliest possible start date of 2018 for commercial operation, assuming a resolution to a number of uncertainties and delays. Shannon LNG has received planning permission for both its proposed Liquefied Natural Gas (LNG) terminal near Ballylongford in Co. Kerry, and for the associated transmission pipeline that will deliver the gas into the ROI transmission system. The initial phase will involve the construction of an LNG storage tank(s), and re-gasification facilities with a maximum export capacity of up to 17.0 mscm/d (191.1 GWh/d).

5.1.5 Renewable Natural Gas

Energy from biomethane (renewable gas) has the potential to contribute significantly to Ireland's renewable energy targets. In particular renewable gas could greatly assist Ireland in meeting the EU targets for thermal energy from renewables (RES-H) and transport fuel from renewable (RES-T). Renewable natural gas is discussed further in section 6.4.

5.1.6 Other Supply Developments

Gas Networks Ireland welcomes new sources of gas supply and are willing to fully engage with both prospective onshore and offshore sources. Gas Networks Ireland has an excellent track record in delivering infrastructure projects.

Section Six

Ireland's sustainable pathway and the role of natural gas

Key Messages:

- Gas powered generation is the ideal partner for renewable power generation providing the required flexibility and security.
- Switching to gas from more carbon intensive fuels such as coal and oil can lower costs to the end consumer and help tackle fuel poverty.
- Increasing the penetration of Compressed Natural Gas (CNG) in the transport sector can help improve competitiveness and help lower emissions.
- Renewable Natural Gas (RNG) is an indigenous, clean, sustainable, and carbon neutral source of energy which can be injected into the gas network.

Climate change challenges mean that we have to make the most efficient use of the available energy sources. Natural gas, which is a cleaner burning fuel than coal and oil, offers solutions to Ireland's economic and environmental challenges in a secure, sustainable and competitive way with minimal additional investment needed.

Expanding the use of natural gas, through key strategic projects will enable society to realise the benefits of natural gas, opening up new opportunities for Ireland. Increasing gas penetration has the potential to reduce gas tariffs through investment in key initiatives such as Compressed Natural Gas (CNG) for transport and Renewable Natural Gas, which can deliver strategic benefits to the energy industry.

Expanding the use of natural gas, through key strategic projects will enable society to realise the benefits of natural gas, **opening up new opportunities for Ireland.**

Section Six

Ireland's sustainable pathway and the role of natural gas

6.1 Power Generation Sector

Figure 6-1 Great Island CCGT Power Plant

Gas is used as a fuel in the power sector accounting for approximately 45% of Ireland's electricity generation in 2014. Ireland's portfolio of CCGT gas power plants are amongst the most efficient in the world and provide the responsiveness and flexibility required to support wind generation. Gas generation can be switched on and off quickly, making gas-fired power stations the fuel of choice to accommodate sudden changes in electricity demand or supply. This is especially important where there is a lot of wind generation (which is an intermittent renewable source) on the system. Gas fired power plants are the most environmentally friendly thermal plant, producing significantly lower emissions than coal, peat or oil fired plant, see Table 6-1.

Table 6-1 Indicative carbon emissions by fuel type[25]

Generator Type	Plant Efficiency	tCO_2 / MWh generated
Gas Fired	55%	0.37
Coal Fired	35%	0.96
Peat Fired	36%	1.15
Oil Fired	29%	0.91

25 Based on carbon emission factors published by the SEAI.

Equally, the role of power generation in the gas market cannot be overstated. The construction of gas fired plants was an important factor in making it more economical to extend the gas network across Ireland, bringing gas to over 630,000 Irish homes and 24,000 Irish businesses, including some of our largest multinational and indigenous industries.

The strong relationship between gas and electricity has proven to be very beneficial to Ireland; providing and maintaining competitive energy prices and a secure and reliable supply of energy.

Maximising the utilisation of the gas infrastructure can help ensure a competitive tariff. Conversely, low utilisation of the gas infrastructure could result in higher more volatile tariffs and energy prices. Energy prices are crucial to Ireland's competitiveness in the international market. Foreign Direct Investment in Ireland and Irish exports could be adversely affected by higher energy prices, jeopardizing future economic growth and job creation.

6.1.1 Security of Electricity Supply

Current market conditions are reducing gas fired generation's participation in the SEM; particularly low coal and carbon prices. If current market conditions prevail for the foreseeable future the economic viability of gas fired plant could be under threat, potentially resulting in plant closures and/or a lack of investment in the existing portfolio.

Such closures would result in a reduction of Ireland's gas fired generation capacity, essential in providing the backup generation for the periods of low or no wind generation. This would have serious implications for the security of electricity supplies.

6.1.2 Supporting Renewable Generation

Ireland is on track to increase its renewable generation capacity to meet 40% of electricity demand by 2020. The other 60% will be met by conventional generation and electricity imports. These numbers are based on an annual measure; they don't reflect the variability across the year, which will inevitably result due to the intermittent nature of wind.

The 2014/15 peak day demonstrated the need for significant backup to renewable generation, with wind accounting for only 1.1% of ROI power demand requiring conventional plant to generate the significant majority of the high levels of electricity required, see Figure 4-10. This peak day profile is far from unusual with peak days gas demand often associated with light winds thus illustrating the power generation system's dependence on conventional generation, particularly gas fired generation, to meet demand.

Ireland has also developed and paid for two energy interconnectors to Great Britain in the past ten years – IC2 (second gas interconnector) and EWIC (East-West electricity interconnector). Both projects cost approximately €500 million but the East-West High Voltage Direct Current (HVDC) interconnector has an energy transmission capacity of 500 MW and IC2 has a potential energy transmission capacity of 15,000 MW i.e. thirty times that of the HVDC link.

Therefore there is sufficient capacity in the existing gas infrastructure to help meet energy targets including emission reductions and energy efficiency improvements. Furthermore maximising or "sweating the assets" can help deliver reductions in consumer prices.

Section Six

Ireland's sustainable pathway and the role of natural gas

6.1.3 Supporting low carbon generation:

The current market conditions in the SEM are adversely impacting gas fired generators and both the gas and electricity markets, resulting in the potential for an increase in energy prices, diminished security of electricity supplies and increased CO_2 emissions.

The Gas Network is robust and resilient and can facilitate further gas fired power generation including the conversion of other more polluting thermal plant to gas.

No significant investment is required to address these issues; both the gas infrastructure and generation assets are in place. What is required is a change in policies that will stimulate the market to utilise and underwrite the continued operation of these assets.

The Gas Network is robust and resilient and can facilitate further gas fired power generation including the conversion of other more polluting thermal plant to gas.

6.2 Residential Connections Growth

Ireland has an extensive network relative to its population and a lower penetration in terms of customers per km of pipeline compared to most European Countries. There is scope to increase utilisation of the gas network through gas mains infill and further expansion of the network. Gas mains infill is the process of connecting new customers to the gas network which are already in the vicinity of the gas main. In the majority of cases, where houses are on (or very close to) the existing gas network, a connection to the network is a very cost-effective way of reducing energy bills and tackling fuel poverty.

It is estimated that there are over 700,000 households in Ireland using oil for central heating and 300,000 of those using oil have a gas network nearby and could be readily connected to gas. Therefore, there is considerable potential to connect a greater number of households to the gas network, which could provide both economic and environmental benefits. Households currently using fuels such as oil or LPG (Liquefied Petroleum Gas) would have the opportunity to switch to gas thus making a saving of circa 30% per household per year compared to their current oil or LPG bill. Switching all 300,000 oil fired households in urban areas to natural gas would immediately reduce Ireland's annual energy import costs by circa €200m per year[26].

Gas mains infill would increase the demand for gas and bring greater load onto the network thus helping to reduce network tariffs for all gas consumers. In addition, natural gas emits 22% less CO_2 than oil for the same thermal output. This coupled with improvements in efficiency in gas-fired central heating systems could result in a reduction of 30% in CO_2 emissions when switching from oil to gas.[27]

26/27 The Future of Oil and Gas in Ireland', Policy Advisory by the Irish Academy of Engineering, February 2013. Ref: 01/ 02 A/ 02.13.

Section Six

Ireland's sustainable pathway and the role of natural gas

Over the past decade Gas Networks Ireland has been involved in the economic analysis of connecting new towns where gas is currently not available. The analysis was carried out over three phases, with circa 70 towns being analysed and 21 towns approved for connection. Towns were only connected where the analysis of costs and revenues resulted in the town having a positive net present value[28], on its own or as part of a group. Gas Networks Ireland will continue to periodically review non-gas towns to assess their viability for connection.

The analysis was carried out over three phases, with circa 70 towns being analysed and **21 towns approved for connection**.

28 Net present value analysis relates current investment to future returns taking inflation and other factors into account.

6.3 Compressed Natural Gas (CNG) for Transport

Gas Networks Ireland continues to develop the role of Compressed Natural Gas (CNG) within the transport industry through the promotion of Natural Gas Vehicles (NGVs). Compressed Natural Gas is a proven technology in transport and offers a wide range of benefits, which are as follows,

- **A proven technology** – CNG as an existing technology is well established as a transport fuel throughout Europe and as such offers a low risk alternative fuel option for operators. CNG vehicle offers comparable range to diesel and petrol vehicles.
- **Convenient** – CNG fast fill stations ensure that CNG is received at comparable speed to diesel and petrol.
- **Cost effective** - Operators of haulage and fleet vehicles will benefit from cost savings of approximately 30% on their normal petrol or diesel fuel costs. This saving offers a more competitive position from which to attract new business for the operator and to the Irish road haulage industry in general. Furthermore the government has committed to a fixed excise duty rate for Natural Gas for the next 8 years, helping to ensure a low and stable price.
- **Reduction in Emissions** - The reductions in greenhouse gas emissions are particularly important; NGVs emit approximately 20% less CO_2 than comparative diesel vehicles and 99% less particulate matter.
- **Synergies with gas network** – there are considerable synergies between the layout of the gas network and major national transportation/haulage routes. The gas network is thus well positioned to provide the required infrastructure at strategic locations on the national roads network.
- **Synergies with RNG** – CNG in transport offers a gateway for sustainable gas to penetrate the transport market. The combination of renewable natural gas or biogas could offer a source of CO_2 neutral transport fuel for Ireland.
- **Compliance with EU Policy** – The EU have underlined the need for CNG refuelling through the Deployment of Alternative Fuels Infrastructure Directive which aims to establish CNG refuelling facilities along key routes at every 150km by 2025. This will serve to further support the development of CNG refuelling locations across Ireland and Europe.
- **Increased utilisation of the network** - Increased utilisation of the gas network outside of peak demand periods allows further efficiencies to be obtained in the operation of the network. This in turn could reduce the per unit cost of transporting the gas through the network.

Section Six

Ireland's sustainable pathway and the role of natural gas

CNG is ideally positioned to provide real alternatives for Irish transport especially within public transport and haulage vehicles as an alternative to diesel. Availing of natural gas as an alternative to diesel or petrol within the transport sector would assist Ireland in reducing its dependency on oil as a transport fuel while at the same time providing emissions reductions and cost savings. This would help Ireland achieve the 2020 targets and in turn reduce any penalties which could result from excess emissions.

A number of CNG trials are currently being supported to demonstrate the suitability of CNG in the Irish Transport Sector. The trials are being carried out with companies from the target commercial operator market including the dairy sector, public transport and haulage companies. The results of the trials completed to date have proven CNG is a viable alternative to traditional fuels.

To facilitate commercial fleet operators, Gas Networks Ireland are planning to support the establishment of a number of publicly accessible fast-fill stations at strategic locations throughout Ireland. Currently, there are three dedicated CNG refuelling locations in Ireland. Key sites have been identified across the country where CNG refuelling stations will be established. These sites were identified due to their accessibility to the main transport routes.

Gas Networks Ireland's objective is that by 2024 at least 5% of the commercial transport market and 10% of the bus market in Ireland will be operating on CNG or Renewable Natural Gas (RNG). The market will be supported by a private and public refuelling network, connected to the natural gas network.

6.4 Renewable Natural Gas (RNG)

Renewable Natural Gas (RNG) is an indigenous, clean, sustainable, and carbon neutral source of energy. Renewable gas can be produced from many organic waste materials and upgraded to a standard which is identical to natural gas. RNG can be injected into the gas pipeline network or it can be used independently as a fuel for heating, transport or power generation. RNG is also referred to as Biogas, Biomethane or Green Gas. Renewable gas will also be produced with other emerging and carbon neutral technologies such as Power to Gas and Algae cultivation, which will provide a sustainable source of RNG into the future.

RNG can be injected into the existing Irish natural gas grid infrastructure for use by customers in the industrial and public sector as a fuel for Heat or process energy, including combined heat and power (CHP) or tri-generation (CHP in combination with absorption chilling for cooling demand). RNG is also a zero carbon fuel that can be used in Commercial and Public Transport with NGV goods vehicles, buses, or taxis. Pending EU wide obligations[29] will oblige a minimum of 1.25% of transport to be sourced from what is termed "advanced biofuels", and in an Irish context, the only indigenous opportunities for sourcing such fuels are in gas form, such as RNG from certain classes of waste, seaweed, industrial algae's or power to gas. The Irish gas network has the capacity to facilitate RNG without the need for major new reinforcement or investment, which is a common constraint in the case of many other alternative energies.

Increasingly, multi-national companies are introducing, new corporate global targets for renewable energy[30]. With primary location decision often being made with access to affordable and secure gas in mind; this is now expanding to a desire for affordable and secure renewable gas. RNG is thus emerging as a potentially important factor in terms of securing such ongoing and future investment and the associated economic stimulus. RNG is already well developed and available at competitive rates in other European countries, leaving Ireland at a competitive disadvantage within the EU at this time of global economic recovery.

The development of RNG on the Irish gas grid enhances energy security and diversity of supply while also creating direct employment and enhancing rural and regional economic development. In the long term the development of an indigenous RNG industry will play a key role in decarbonising Ireland's energy requirements through a balanced portfolio of renewable energy sources.

To facilitate commercial fleet operators, Gas Networks Ireland are planning to support the establishment of a number of publicly accessible **fast-fill stations at strategic locations throughout Ireland.**

29 A draft law to cap the production of traditional biofuels and accelerate the shift to alternative sources, such as seaweed and waste, was approved by the EU Environment Committee in February 2015.

30 Global Climate Declaration Scheme, http://www.ceres.org/declaration/sign

Section Six

Ireland's sustainable pathway and the role of natural gas

Utilising mature technologies, with the right investment, RNG has the potential to satisfy over 30% of Ireland's gas demand by 2030. This figure is derived from existing and available waste and residue sources in Ireland. RNG production processes are the most environmentally clean and economically viable means of processing such wastes compared to the current practises in Ireland of composting, landfill, exporting, land spreading, incineration, etc. Capitalising on this opportunity would reduce the country's reliance on imported fuels and provide Ireland with a renewable indigenous fuel source. Gas Networks Ireland is proposing a target to achieve 20% RNG on the gas network by 2030.

With the new emerging technologies such as Power to Gas with methanation, algae, and gasification it is clear that far more ambitious targets are possible for 2050. Several EU gas network operators have already committed to a drive towards fully de-carbonised gas grids. Gas Networks Ireland recognises this significant potential and has commenced studies on the potential scale and roadmap for Ireland. Collaboration among EU network operators is an important step towards achieving this potential.

Table 6-2 Potential 10 year growth for RNG, with a 2030 target of 20%

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual RNG Capacity (GWh)	20	170	400	960	1440	2280	2640	3120	4350	5980
% of Demand	0.04%	0.34%	0.8%	2%	3%	5%	5%	6%	9%	12%

6.5 Innovation Investment

Gas Networks Ireland is committed to promoting creativity an encouraging new market developments to meet gas consumer needs. Key opportunities include development of new solutions and infrastructures for alternative gas utilisation such as Natural Gas Vehicles (NGV's), the integration of renewable and alternative sources of gas, and the development of other novel services and products that can support the Irish gas network and its uses into the future.

Innovation is crucial to the continued success and growth of the gas industry in Ireland. To ensure a competitive energy service for commercial and domestic consumers, it is essential to increase the utilisation of the gas grid, to help keep costs down for all consumers.

A broad range of innovation topics are being promoted for academic and commercial studies, research, and development. The current list of priority topics is provided below, and the call for applications/proposals for small to medium scale projects are continuing on an open basis.

The funding approval process is designed to prioritise proposals that meet the following broad objectives;

- Increased grid utilisation;
- Provide a reliable and secure supply of gas;
- Provide long term benefits to the gas consumer e.g. lower tariffs;
- Transition to low emissions;
- Promote and enhance energy savings.

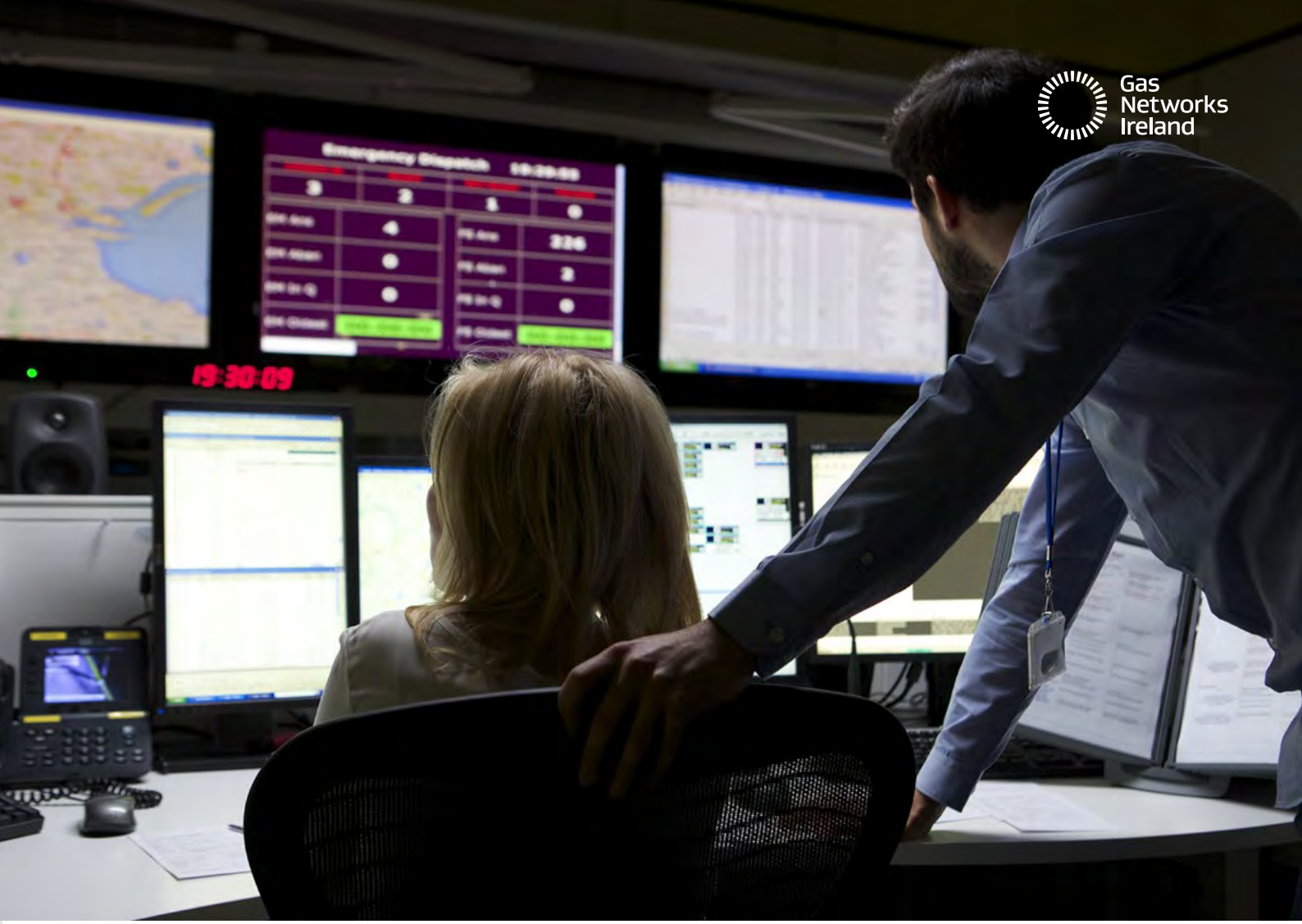
Innovation is crucial to the continued success and growth of the gas industry in Ireland.

Section Seven

System Operation

Key Messages:

- Increasing renewable generation is having an increasing impact on flow profiles and system operation, particularly at the Moffat Entry Point.
- Gas Networks Ireland have recently implemented a short term network planning tool, in response to increasing system operational challenges.



Gas Network Ireland's primary responsibility is to transport gas from entry to exit, on behalf of our customers, while ensuring the network is operated safely and efficiently.

Managing the flow of the gas from the entry points to the end consumer is a sophisticated 24-hour operation. It involves constant monitoring of transmission gas flows and system pressures through a Supervisory Control and Data Acquisition (SCADA) system and also via gas control management of the distribution system, through a separate SCADA system, including GIS and on-line access to Gas Networks Ireland systems. It uses telemetry data from all the operational sites to monitor the system.

The grid controllers man the control room 24/7 and are responsible for monitoring the alarms on the network via SCADA. The grid controllers are also responsible for monitoring the Gas Transportation Management System (GTMS) and managing the daily nomination and allocation process ensuring that the correct volume of gas is being transported at all times to meet shippers and customers requirements. Grid control is also responsible for coordinating the response to emergencies. The National Gas Emergency Manager (NGEM) conducts regular emergency exercises from the control room.

Safe and efficient system operation is achieved on a daily basis by ensuring that:

- Pressure within the system is maintained so it does not exceed safety limits or fall below minimum levels to ensure the security of downstream networks;
- Alarms are responded to and escalated in a timely and appropriate manner;
- Quality of the transported gas meets the criteria defined under regulations;
- Operation of compressors are within environmental site specific licences;
- Capabilities and processes are in place to effectively manage a natural gas emergency.

Section Seven
System Operation

7.1 Challenges

The operation of the gas system has changed since the network was originally designed. These changes are a result of user requirements, resulting in very different gas flow patterns than those for which the network was originally designed. Non-uniform profiles may trigger a requirement for system investment and will continue to be monitored through network planning analysis.

7.1.1 Demand Variation

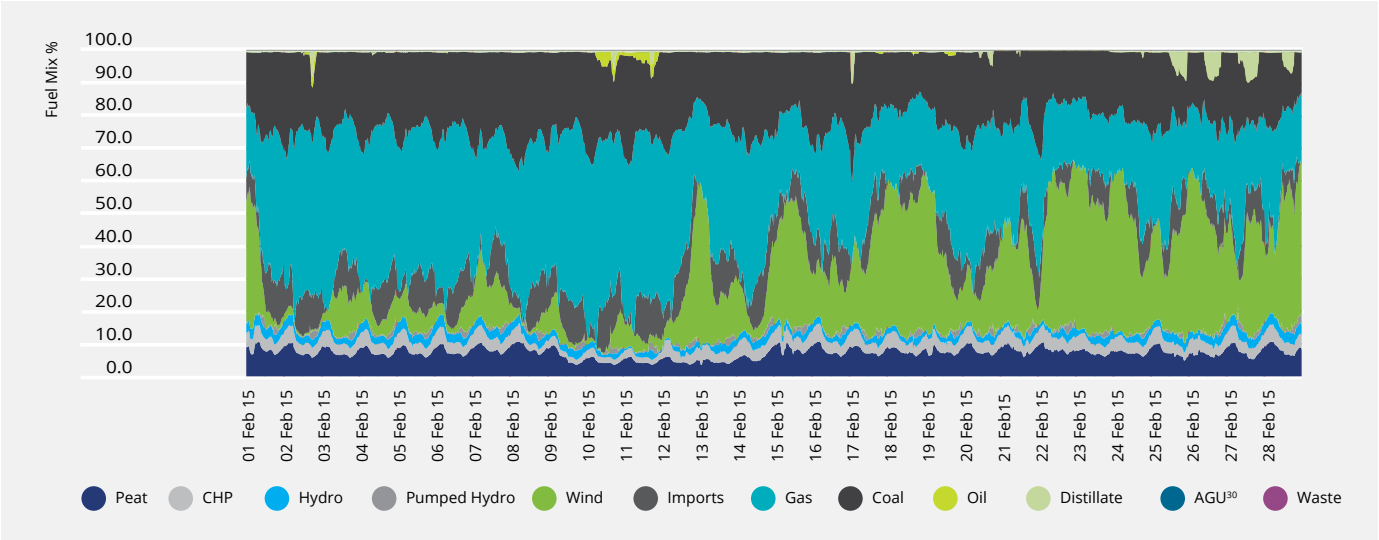
As wind generation increases, traditional thermal plants (fuelled by natural gas, coal or oil) have to accommodate the fluctuations in wind generation output to meet a moderately inelastic electricity demand. This has an impact on flow profiles and system operation of the gas network. Relatively small changes in power sector generation can have a disproportionate affect on gas demand.

As gas plants provide flexibility in the electricity sector, any generation changes such as increased wind powered generation and increased imports will result in reduced gas demand from conventional generation plant. Owing to operational requirements, the impact of these changes may have an impact on a disproportionately higher number of gas fired generators than may be expected.

As traditional thermal plants are unable to change their production instantly, the electricity system cannot rely on wind alone due to its large and sudden variations. A significant dependency remains on the natural gas network to provide flexibility and ensure security of supply in the power generation sector.

Figure 7-1 shows the impact on gas demand as a consequence of varying levels of wind powered generation. Across the month of February 2015, wind powered generation contributed between 0.1% and 65% to the power generation fuel mix. Gas fired generation contributed between 19% and 67% over the same period.

Figure 7-1: Power Generation Fuel Supply Mix February 2015



Source: EirGrid

In response to this increased flow variation and other challenges being faced in the operation of the transmission network, Gas Networks Ireland have recently implemented a short term network planning tool. This tool comprises both online and offline hydraulic models of the Interconnector sub-system and the full Gas Networks Ireland network (excluding NI), and is primarily used to support operational decision making over short time horizons, such as within-day and day-ahead.

The online models are required to accurately and reliably calculate the current/real-time pipeline state, based on real-time SCADA data. In addition to a highly accurate and reliable leak detection system, the online models are capable of calculating and presenting key operational information such as linepack/inventory, system balancing requirements, local gas composition.

The offline model assists in determining the optimal forward flow profiles in response to shipper nominations and re-nominations on the gas network, via look-forward functionality. In addition to the look-ahead functionality, the offline model is required for simulating 'what-if' scenarios (to assess the impact of a network event, e.g. loss of a section of pipeline) and applications such as survival time analysis.

This tool will play a pivotal role in ensuring optimal operation of the transmission network, with regard to efficiency, economy, safety and security of supply.

31 AGU - Aggregated Generator Unit

Section Eight

Security of Gas Supply

Key Messages:

- The twinning project in Southwest Scotland was awarded €33.7 million by the European Commission, the project was approved by the CER and will be completed by 2017.
- A Cost Benefit Analysis was submitted in May 2015 for Physical reverse flow at Moffat to European Commission in order to maintain the opportunity for selection as future PCI project in the second PCI round list, expected to be announced in November 2015.

8.1 Projects of Common Interest (PCI)

In October 2013, the European Commission adopted a list of 248 key energy infrastructure projects. These projects have been selected by twelve regional groups established by the new guidelines for trans-European energy infrastructure (TEN-E).

Carrying the label "projects of common interest" (PCI) they will benefit from faster and more efficient permit granting procedures and improved regulatory treatment. The following Gas Networks Ireland projects were approved as PCI projects on the 14th of October 2013;

- PCI 5.2, Twinning of the South West Scotland Onshore System;
- PCI 5.1.1 Physical Reverse Flow at Moffat Interconnection Point (Ireland / United Kingdom)[32]

One other ROI project was approved by the EU in October 2013;

- PCI 5.3, Shannon LNG Terminal located between Tarbet and Ballylongford.

PCI 5.2, Twinning of the South West Scotland Onshore System, was awarded €33.7 million by the EU which equates to 36.4% of the total project costs, representing the maximum amount that the project can receive. This was a significant achievement as only 6 projects across the EU received grants for works. The CER approved the project in May 2015 and the pipeline will be completed in 2017.

32 PCI 5.1.1 is part of a cluster of associated PCIs.

Section Eight
Security of Gas Supply

This project is critical for the security of supply to the island of Ireland and brings many other benefits, such as being the key prerequisite for physical reverse flow at Moffat[33]. Consequently PCI 5.2 compliments another PCI, PCI 5.1.1 physical reverse flow at Moffat interconnection point (Ireland/Great Britain).

There is a precondition that for inclusion in the PCI list, the project must have been included in the preceding European Ten-Year Network Development Plan (TYNDP). For example, projects to be included in the 2015 PCI list will have to demonstrate inclusion in the EU TYNDP.

8.2 Physical Reverse Flow at Moffat

A cost benefit analysis was submitted to European Commission in May 2015 for physical reverse flow at Moffat in order to maintain the opportunity for selection as future PCI project in the second PCI round list which is expected to be announced in November 2015.

This project will look at physical reverse flow from Republic of Ireland to Great Britain, and also to Northern Ireland via the Scotland Northern Ireland pipeline, providing security of supply benefits in addition to increased market integration and increased competition.

Implementing physical reverse flow at Moffat would require significant investment. A key factor would be harmonising the odorisation practices as gas exiting the GB National Grid Transmission system is not odorised and odorant is introduced prior to gas leaving Beattock compressor station for onward flow to Republic of Ireland, Northern Ireland and the Isle of Man.

Physical reverse flow at Moffat was on the first union list granted PCI status (PCI 5.1.1), therefore Gas Networks Ireland will be submitting an application for grant funding to progress a feasibility study during the year through the Connecting Europe Facility (CEF). If successful in grant funding, it is estimated that the study could take 18 – 24 months to complete.

Gas Networks Ireland will continue to develop the network to ensure a safe, secure, robust and resilient gas network is maintained to ensure security of supply to end consumers.

33 Currently flows at the Moffat interconnection point are uni-directional i.e. GB-IE. System modifications including the twinning would be required to accommodate bi-directional flows at Moffat.

8.3 European Regulation 994/2010

As Ireland's designated Competent Authority under EU Regulation No. 994/2010, the CER is required to produce:

- Risk Assessment;
- National Gas Preventive Action Plan;
- National Gas Supply Emergency Plan.

In the event that a Member State cannot fulfil the N-1 standard[34] on a national basis, the Regulation permits the adoption of a regional approach towards meeting the N-1 standard. If the regional approach is adopted, there is an obligation on the Member States involved to produce on a regional basis a:

- Joint Risk Assessment;
- Joint Preventive Action Plan.

As Ireland cannot meet the N-1 criteria on a national basis, the UK and Ireland have adopted a regional approach towards implementation of the regulation. The next Risk Assessment is due to be undertaken in 2016 and Gas Networks Ireland will provided technical support to the CER in terms of the execution of the risk assessment.

Gas Networks Ireland will continue to develop the network to ensure a safe, secure, robust and resilient gas network is maintained to ensure security of supply to end consumers.

8.4 Emergency Preparedness

The CER has designated Gas Networks Ireland to undertake the role of the National Gas Emergency Manager (NGEM) in accordance with SI. 697 of 2007. The NGEM has responsibility for declaring a natural gas emergency, as well as coordinating planning arrangements and any emergency response in accordance with the Natural Gas Emergency Plan (NGEP). The aim of the NGEP is to;

- Protect the safety of the general public;
- Protect property and key infrastructure;
- Minimise disruption resulting from a gas supply emergency.

The NGEM may activate the NGEP if it establishes that it is not possible to maintain an acceptable balance between supply and demand, or there is insufficient gas leading to the possibility of a natural gas emergency developing. As part of the NGEP, the NGEM will establish the Gas Emergencies Response Team (GERT), which will be responsible for implementing the directions of the NGEM to execute the necessary operational response.

34 The N-1 criteria refers to the capacity of the gas network to meet gas demand where the largest piece of infrastructure fails on a day of exceptionally high gas demand.

Section Nine

Commercial Market Arrangements

Key Messages:

- Gas Networks Ireland supports the development of new entrants to both the retail and wholesale markets.
- Congestion Management Procedure (CMP) to be implemented by October 2015.
- Implementation of a Capacity Allocation Mechanism (CAM), by 1st of November 2015.

9.1 Republic of Ireland Gas Market

Gas Networks Ireland in providing transportation services to shippers and suppliers operating in the wholesale and retail markets, also interacts with regulatory authorities and industry. Gas Networks Ireland supports the development of new entrants to both the retail and wholesale markets by facilitating and mentoring their entry into the gas market. The following is a non exhaustive list of Gas Networks Ireland's responsibilities:

- Develop and maintain strategies for the Irish natural gas wholesale and retail markets;
- Establish market rules;
- Support initiatives from various industry bodies;
- Support compliance with EU legislation as well as playing a driving role in the development of market arrangements to meet with industry best practice;
- Implement legal and contractual arrangements required under Irish and European law in relation to shippers and suppliers;
- Coordinate industry meetings at both wholesale and retail levels on an all-island basis;
- Manage the contracts of the companies licensed to ship gas through the transportation system.

Gas Networks Ireland plays a pivotal role in fostering relations with neighbouring transporters, regulators and government departments to further the aim of European gas market integration.

Section Nine
Commercial Market Arrangements

9.2 European Developments

Following recent development of network codes through various ENTSOG workgroups the focus has moved to implementation at national level. A project team has been established which will deliver the modification to the Code of Operations and associated market rules that are required to deliver compliance.

The objective of the project will be to deliver necessary work packages to support the EU Network Code requirements as described in the following sections.

As part of the implementation of the European Capacity Allocation Mechanism Network Code (CAM NC) PRISMA has been selected as its **Capacity Booking Platform for use at each of its Interconnection Points (IP).**

9.2.1 Capacity Allocation Mechanism (CAM)

The objective of the CAM is to enable further development of European cross-border competition and market integration. The CAM Regulation EU 984/2013 is to be implemented from 1st of November 2015.

The CAM code will mean that shippers will be able to buy 'bundled' capacity products at Interconnections Points (Moffat, Gormanston) – entry and exit together via a single auction platform.

Following Industry consultation during the period from June through to September 2014, the CER approved the business rules in October 2014 and directed Gas Networks Ireland to progress the development of detailed legal drafting.

Gas Networks Ireland is actively ensuring that Irish interests at the interconnection points between Ireland, Great Britain and Northern Ireland are represented.

9.2.2 Joint Capacity Booking Platform

As part of the implementation of the European Capacity Allocation Mechanism Network Code (CAM NC) PRISMA has been selected as its Capacity Booking Platform for use at each of its Interconnection Points (IP). Gas Networks Ireland signed a Service Agreement with PRISMA in June 2014 and subsequently began work on developing the interfaces between the platform and Gas Networks Ireland's existing Gas Transmission Management System (GTMS). Gas Networks Ireland is now in the process of registering as a Transmission System Operator (TSO) on the live platform and a plan has been put in place to ensure that all Irish Shippers are registered Shippers on the platform by July 2015. Training of Shippers will take place in August and September 2015 with the first auction taking place on 31 October 2015.

9.2.3 Congestion Management Procedures (CMP)

Congestion Management seeks to address situations whereby parties who hold capacity at a cross-border point do not fully utilise the capacity, thus making that capacity unavailable to a third party. CMP provides a means by which such unutilised capacity can be returned to the market in order to maximise the use of the system in an efficient manner. In accordance with the Third Package, CMP mechanisms were introduced to the Code of Operations on the 1st of October 2013. Business Rules are in the process of being developed to modify these CMP mechanisms to meet new requirements imposed by the CAM NC. The major changes relate to the handling of bundled products where exit capacity from one side of the interconnection point is combined with entry capacity at the other side to create a single 'bundled' product.

The other major changes relate to a new quarterly product and to the fact that all capacity at the IPs is to be marketed via auctions on the PRISMA platform. These changes to the CMP mechanisms in the Code of Operations will be implemented by October 2015.

Section Nine
Commercial Market Arrangements

9.2.4 Balancing

The Balancing Network Code formally became Regulation EU 312/2014 in March 2014 and has an implementation date of 1 October 2015. The fundamental objective of the Balancing Network Code (Regulation EU 312/2014) is to introduce market mechanisms into the balancing regime. Primary responsibility for balancing gas flows on the system resides with network users, with the TSO having a residual role.

The code modification process was initiated in August 2014, with business rules issued in September 2014. A series of consultations (including written consultations, dedicated workshops and general discussion at Code Modification Forum meetings) have taken place.

The initial scope of this modification included the following elements;

- Information provision;
- Nominations;
- Allocations;
- Daily Imbalance charges.

Industry consultation will progress during 2015 to achieve compliance by October 1st.

9.2.5 Tariffs

The draft Network Code on harmonised transmission tariff structures for gas sets out the EU rules for tariffs which have the objective to contribute to market integration, to enhance security of supply, to promote competition and cross-border trade, to ensure non-discriminatory and cost-reflective transmission tariffs and to avoid cross-subsidisation between network users.

ENTSOG finalised the Network Code on Harmonised Transmission Tariff Structures for gas on the 12th of December 2014 and it was submitted to ACER on the 26th of December 2014.

In ROI, the CER is currently undertaking a review of the transmission tariff structure as a new methodology is required before Corrib commences commercial production. The CER also wants to 'future-proof' the new methodology to ensure it will be EU compliant when the tariff code is effective from October 2017, however there is such uncertainty on how the process will conclude, a number of changes are possible.

Gas Networks Ireland will continue as an active participant in the ENTSOG tariff work group working on the various drafts of the code and explanatory documents.

9.2.6 REMIT

Regulation No 1227/2011 on Wholesale Energy Market Integrity and Transparency (REMIT) prohibits insider trading and market manipulation in wholesale energy markets. REMIT imposes obligations on market participants to register with their National Regulatory Authority (NRA) and provide information for the purpose of monitoring trading in wholesale energy markets. All market participants must publicly disclose inside information in an effective and timely manner and must inform the NRA of any wholesale energy market transaction which they suspect might breach the prohibitions on insider trading or market manipulation.

9.2.7 Transparency

Under the various Network Codes and the REMIT provisions, there exists many transparency requirements for TSOs relating to the publication of data items, such as capacities, flows and tariffs. The new ENTSOG Transparency Platform went live on the 1st of October 2014. ENTSOG implemented a new data warehouse as part of its transparency platform on the 1st of October 2014. Further updates to Gas Networks Ireland's submission to the ENTSOG Platform will be required as a result of the implementation of the CAM NC on the 1st of November 2015.

Gas Networks Ireland will continue as an active participant in the ENTSOG tariff work group working on the various drafts of the Code and explanatory documents.

Section Ten

Adequacy of the Gas Network

Key Messages:

- Flexibility is required to meet changing network conditions.
- Midleton Compressor Station is important to the ROI system, and in particular the southern region;
- High pressure section of the ROI transmission system has largely sufficient capacity to meet future gas flow requirements in the short to medium term; and
- Southern region of the transmission system likely to require reinforcement in the medium to long term.

10.1 The ROI Transmission System

The ROI transmission system consists primarily of the high pressure (70 barg) ring-main linking Dublin, Galway and Limerick, a number of spur lines to Cork, Waterford and lower pressure (40 barg and 19 barg) local area (regional) networks in large urban centres. In addition the Mayo-Galway pipeline connects the ring-main to the Bellanaboy terminal, Co. Mayo, where Corrib gas (once flows commence) will enter the Irish transmission system.

The results of the network analysis for both the Grey and Green demand scenarios indicate that the higher pressure tiers of the ROI transmission system have sufficient capacity to meet anticipated future flow requirements for the next ten years.[35]

The analysis indicates that the existing transmission network has the capacity to accommodate the increase in gas demand that would result from fuel switching from carbon intensive fossil fuels, demonstrating that Ireland can achieve a low carbon future without the need for significant investment.

In the medium to long term, the southern region of the ROI transmission system is anticipated to require network investment to compensate for the loss of Inch supply capacity. Gas Networks Ireland will be investigating a range of options over the next 12 – 18 months that will ensure this section of the network has adequate capacity to meet future needs.

35 The lower pressure regional transmission networks may need investment, should localised growth exceed national demand growth projections.

Section
Ten
Adequacy of the
Gas Network

10.2 South West Scotland Onshore System

The Moffat interconnection point connects the Irish gas market to one of the most liquid and well supplied gas markets in the world, Great Britain, which has a multitude of entry points and sources of supply; indigenous production, storage, Norwegian imports, European imports and LNG.

The Moffat entry point and interconnector sub-system have supplied and will continue to supply the significant majority of Ireland's gas demand until Corrib supply commences. Ireland is anticipated to revert to its high dependency on Moffat for gas supplies if no other new supply sources materialise.

The primary concern regarding Ireland's high dependency on Moffat, has been the infrastructure, i.e. the dependency on a single pipeline between Cluden and Brighouse Bay in southwest Scotland to transport nearly 30% of Ireland's energy total primary energy requirement. Interconnectors 1 and 2 exit Beattock compressor station as two separate pipelines for a distance of 30 km and converge at Cluden into single section of pipeline for 50 km to Brighouse Bay compressor station.

The twinning project will result in a fully twinned pipeline between Beattock and Brighouse Bay compressor stations and an entire dual interconnector sub-system between Great Britain and Ireland, as it was originally envisioned when the 2nd interconnector was conceived in the late 1990s. The twinning project will deliver many benefits including;

- enhanced security of supply;
- enhanced operational efficiency;
- enhanced capacity;
- enhanced storage;
- compressor fuel savings.

Gas Networks Ireland will shortly determine the optimal operating regime for the system in Scotland that will deliver the benefits associated with the twinning project, particularly enhanced operational efficiency.

Figure 10-1 South West Scotland Onshore System

Gas Networks Ireland will shortly determine the optimal operating regime for the system in Scotland that will deliver the benefits associated with the twinning project, **particularly enhanced operational efficiency**.

Section Ten
Adequacy of the Gas Network

10.3 Southern Region

This year's NDP, and as highlighted in previous publications, notes a potential capacity constraint in the southern region of the transmission network which coincides with the anticipated cessation of supplies from the Inch Entry Point in 2023.[36]

The cessation of Inch supplies will result in the southern region becoming the most peripheral area on the ROI transmission network with its gas demand being meet by flows via the 18" (450mm) Cork to Dublin pipeline and the 16" (400mm) between Goatisland and Curraleigh West.

This also presents a significant security of supply concern; a disruption to either of the two pipelines would result in a significant interruption to gas demand in the southern region. Security of supply is paramount in this part of the network considering the following;

- It's home to approximately 2,000MW of gas fired plant[37] which accounts for approximately 30% of Ireland's thermal generation fleet;
- It supplies a significant number of large multinational I/C customers and indigenous I/C customers, particularly the Irish agri-food industry, who contribute €24billion annually to the Irish economy and employ 10% of the national workforce;[38]
- It has the largest concentration of residential and SME customers outside of Dublin, who are deemed protected customers under EU Regulation 994/2010, and to whom the TSO (Transmission System Operator) has additional obligations with regard to maintaining gas supplies.[39]

Gas Networks Ireland will be undertaking a study over the next 12 – 18 months to identify the optimum economic and technical solution that will address the potential capacity constraint and mitigate the security of supply risk associated with the southern region of the Irish transmission network, including reinforcing the Goatisland to Curraleigh West pipeline, up-rating pipeline to the West and the continued operation of Midleton Compressor Station (post cessation of Inch supplies).

Gas Networks Ireland will be undertaking a study over the next 12 – 18 months to **identify the optimum economic and technical solution** that will address the potential capacity constraint and mitigate the security of supply risk associated with the southern region of the Irish transmission network

36 This capacity constraint could manifest at an earlier date If Inch supplies were to cease sooner than currently expected
37 This is based on Cork area generation and Great Island CCGT
38 Source – Teagasc
39 Reg 994/2010 – Article 8 – "The Competent Authority shall require the natural gas undertakings, that it identifies, to take measures to ensure gas supply to the protected customers of the Member State".

10.4 Beattock Compressor Station - Increasing flow flexibility and minimum system limits

Previous development plans have noted the requirement for increasing flexibility in the operation of the gas network due to the changing dynamics in the Irish gas market, primarily due to increasing renewable generation in the SEM.

In addition to this, the demand and supply forecast indicates that once Corrib production commences, the Moffat Entry Point will be required to provide low volumes (albeit essential) of balancing supplies during low demand periods.

Further to this, the implementation of new European network codes and products such as Virtual Reverse Flow (VRF), compound the requirement for greater system flexibility.

Gas Networks Ireland have concluded the detailed technical studies (referenced in last year's development plan) that have identified the optimum solution to enhance its operations to meet the needs of the market, and to ensure the safe and secure operation of a flexible and reliable gas network.

These studies point to the need for more flexible compressor/turbine technology to complement the existing fleet at Beattock Compressor Station, and that will accommodate a wider operating range, allow low volumes to flow in an economic and environmentally sustainable manner, and enhance the existing capacity at Moffat.

These studies also confirmed the economic viability of such an investment, however this conclusion is subject to a number of forecast assumptions which will need further validation. Gas Networks Ireland intends to revisit this study once full commercial Corrib flows commence and there is more certainty around other factors that are likely to impact gas demand (particularly within-day) such as the implementation of iSEM.[40]

In the interim, Gas Networks Ireland have decided to implement a batch flow regime on low flow days at Moffat, when it's anticipated that volumes of gas that are less than the minimum technical flow limits of Beattock Compressor Station will be nominated at Moffat. Under such a regime the station will continue to run but will only flow gas for a number of hours during the gas day.

It's important to note that such a regime will not impact on indigenous ROI supplies in the delivery of gas to customers.

40 The Integrated Single Electricity Market (iSEM) refers to a new High Level Design (HLD) for the Electricity Market in Ireland and Northern Ireland due for completion by the end of 2017. The market will be re-designed to efficiently implement the EU Target Model and ensure efficient cross border trade.

Section Eleven

Capital Investment

Key Messages:

- €387million to be invested in the gas network as part of the current price control.
- Extension of the network to Wexford Town, Co. Wexford and Nenagh Town, Co. Tipperary.
- Future investment may be required to improve network capability in response to these changing flow requirements or increased system flexibility.

11.1 Overview

This section provides information on planned capital investment and indicates possible future investments proposals in order to comply with legislation and other requirements.

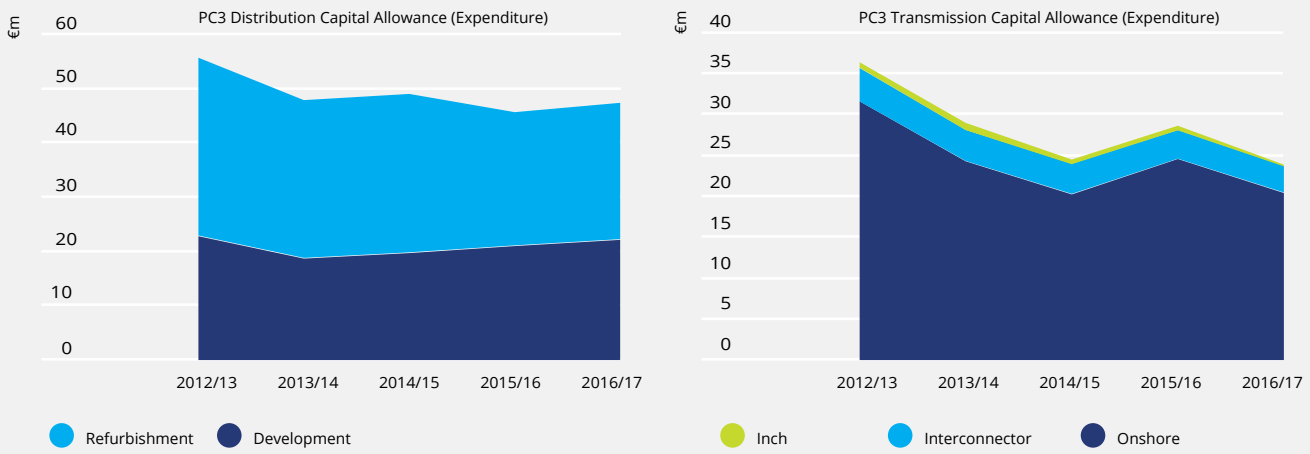
Future investment proposals are subject to approval from the CER. System operator requirements continue to evolve and both environmental and European legislative requirements will impact on future system operation.

11.2 Regulatory Capital Allowance

Gas Networks Ireland is currently in its third regulatory Price Control period ("PC3"). This is a five year period and runs from October 2012 to September 2017. The CER has given a capital allowance of €387m for investment on the distribution and transmission network as illustrated in Figure 11-1 (excluding non-pipe and work in progress).

Section Eleven
Capital Investment

Figure 11-1: PC3 Capital Allowance excluding non-pipe and work in progress[41]



Outside of the price control capital allowance, Gas Networks Ireland continues to work with stakeholders to extend the natural gas network to new towns.

Gas Networks Ireland welcomes new sources of gas supply and as always remain willing to discuss prospective projects with project promoters.

11.3 Planned Capital Programmes

A significant number of projects were completed within time and budget during 2014. The following sets out further projects to be completed over the next 36 month period.

11.3.1 Pipelines

Some of the key pipeline programmes to be completed over the next 36 months include;

- Mungret to Inchmore transmission pipeline replacement, Co. Limerick;
- Extension of the gas network to Wexford Town, Co. Wexford and Nenagh, Co. Tipperary;
- Twinning of Southwest Scotland onshore system between Cluden and Brighouse Bay (Great Britain).

41 References:- "Commission for Energy Regulation Decision References:- "Commission for Energy Regulation Decision on October 2012 to September 2017 transmission revenue for Bord Gáis Networks", Decision Paper (CER/12/196) Table 32 and "Commission for Energy Regulation Decision on October 2012 to September 2017 Distribution revenue for Bord Gáis Networks", Decision Paper (CER/12/194) Table 20.

11.3.2 Pressure Regulating Station Refurbishment

The following are some major transmission rolling programmes to be completed within the PC3 period.

- Refurbishment of Sword's Road AGI;
- Replacement of all non-condensing boilers on some regulating installations;
- Replacement of all water baths on the system.

The following are selection of distribution rolling programmes to be completed within the PC3 period.

- Removal of distribution buried gun barrel service pipes;
- Relocation/rehabilitation of polyethylene services within the building line;
- Refurbishment of district regulation installations.

11.3.3 Communications and Instrumentation

There are rolling programmes across PC3 to refurbish and upgrade AGI and DRI site instrumentation which will facilitate enhanced SCADA integration on the gas network.

11.3.4 Meters

While Gas Networks Ireland is working with all stakeholders in developing a smart metering solution, a decision on a rollout has not been made and the CER has not given a capital allowance at this stage. Gas Networks Ireland has a rolling age-based replacement programme for both domestic and Industrial/commercial meters. This programme will continue until it is it is superseded by the installation of smart meters, expected to commence in 2018.

11.3.5 Compressors

Gas Networks Ireland has rolling refurbishment programmes across the three compressor sites. The programmes consist of:

- Pipe work modifications;
- Turbine intake modifications;
- Turbine ancillary equipment modifications.

Gas Networks Ireland uses gas compressors to move gas through and around the transmission system. As a participant of the European Emission Trading Scheme (ETS) each of the three compressors have a CO_2 emissions allowance.

Gas Networks Ireland is committed to the monitoring and reduction of emissions from these compressors. The compressors are also required to meet environmental compliance legislation such as noise monitoring and mitigation.
In order to meet legal obligations and compliance, it is essential to develop and maintain a robust strategy for operation, maintenance, upgrading and replacement of the compressors.

Section Eleven
Capital Investment

This strategy is key to the delivery of efficient and effective operation of the compressors. As a consequence of changing gas flows, Gas Networks Ireland has undertaken a study which has identified the requirements to ensure operation flexibility and efficiency is maintained. The study highlights additional mini compressors would complement the existing compressor regime enhancing operational flexibility, as outlined in section 10.4. Gas Networks Ireland will continue to assess the performance of the compressor and demands for increased system flexibility on an ongoing basis once the Corrib gas field comes on stream.

11.4 Future Investment

In planning the strategic development of the gas network, Gas Networks Ireland has identified strategic areas of the network which could potentially require future investment to ensure security of supply and or to enhance system flexibility. Gas Networks Ireland will continue to keep these areas of the network under review.

11.4.1 The Goatisland to Curraleigh West Reinforcement

As stated in section 10.3, in the long term as Corrib supplies decrease there is likely be a requirement to reinforce the Goatisland to Curraleigh West pipeline to ensure continued supplies. This situation will continue to be monitored in future development plans.

11.4.2 Midleton Compressor Station

Midleton compressor station is strategically important to the ROI transmission system, and, in particular the southern section of the transmission system, given the level of demand in the region due to the proximity of the three Combined Cycle Gas Turbines (CCGT's) in the south/southeast of the country. Gas Networks Ireland will be progressing a study to look at the optimum solutions for the Southern area of the gas network.[42]

With evolving environmental legislation and the need to ensure positive pressures in the region it is anticipated future capital investment will be required to ensure maximum efficiency of Midleton Compressor Station and associated pipelines in the area.

11.4.3 Longer Term Projects – local area (regional) reinforcement

A key part of Gas Networks Ireland planning process is understanding what capital investment is required to mitigate against capacity limitations on the network. It is anticipated that capital investment will be required to support the existing infrastructure in a number of regions. The regions identified are indicative and, considering the need for project reinforcement, will be in response to changing supply, demand patterns and increased system flexibility. The following geographical regions are considered:

- Cork;
- Waterford;
- Dublin;
- Limerick.

42 Midleton Compressor Station is currently approaching the end of its design life; extending its life will require a significant capital investment.

Gas Networks Ireland continue to identify any necessary system modifications required to safeguard customers against system failure, such as loss of strategic pipeline(s) or pressure regulating installation(s).

As the network continues to age it is anticipated that there will be a requirement for capital investment, refurbishment or upgrades, to satisfy integrity, performance and safety requirements of the gas infrastructure.

Capital investment may result due to customer enquiries for either increased load or a new connection where no spare capacity exists or the network is operating close to its current capability.

With continued growth in renewable energy, investment may be required as a result of different flow patterns and injection points other than those for which the network was originally designed.

Gas Networks Ireland are already experiencing different flow profiles as a result of the amount of wind powered generation on the network.

Gas Networks Ireland will continue to monitor and analyse the network. Future projects may be required to improve network capability in response to these changing flow requirements or increased system flexibility.

11.5 Smart Meters

The aim of the National Smart Metering Programme (NSMP) is a national rollout of smart meters to all residential consumers and the vast majority of SMEs (Small to Medium Enterprises). The programme is overseen by CER, with key stakeholders such as Gas Networks Ireland, ESB Networks, energy suppliers and others. Phase 2 of the NSMP involved the high level design of the smart metering solution and concluded with the announcement of a set of associated decisions by the CER in October 2014. We are now in Phase 3 of the programme which involves a range of activities as follows:

- Smart Metering consumer policy will be further developed, building on the high level design decisions, through a series of public consultations and information papers.
- Gas Networks Ireland and ESB Networks[43] will commence a range of procurement activities to procure the relevant components of the smart metering solution for which they are responsible. This will include the smart meters and a mechanism for remotely interacting with the smart electricity and gas meters utilising a shared communications infrastructure.
- The network companies will lead the detailed design of the market systems changes required to support smart metering.
- A consumer engagement approach will be developed to ensure that consumers are informed and empowered to engage with the changes that will take place in electricity and gas markets, and the new services which they can avail of.
- Phase 4 will involve the building and testing of a smart metering systems and infrastructure. Phase 5 will entail the rollout of the smart meters themselves with the majority of smart gas meters expected to be installed by the end of 2020.

43 ESB Networks are the electricity distribution system operator for the Republic of Ireland.

Section Twelve

CER Commentary

The CER's aim is to protect the interest of energy customers, maintain security of supply, promote competition, minimise costs and protect the safety of the public through energy regulation. In this context, the CER welcomes the publication of Gas Network Ireland's 2015 Network Development Plan (NDP), as it provides an important planning tool for the development of Ireland's gas network. It also facilitates greater EU gas market integration and demonstrates that gas supplies can meet current and future Irish gas demand.

The Irish gas network is undergoing significant change as the share of gas flows from Ireland's gas entry points change. In particular, gas flows from Corrib are imminent, which will meet approximately 56% of annual Gas Networks Ireland system demands in its first full year of commercial production. The development of this entry point will diversify Ireland's sources of gas supplies, and will provide important security of supply benefits to Ireland in the short to medium term.

Notwithstanding gas production from Corrib, the CER recognises that Ireland will continue to be reliant on gas supplies from Great Britain via the Moffat entry point. Therefore the decision to progress the twinning of gas pipeline in South West Scotland Onshore System (SWSOS), following the receipt of grant funding from the EU Commission, is important.

The CER is cognisant of developments at the Inch entry point, which will result in PSE Kinsale Energy ceasing storage operations and gas production in the near future. The CER will continue to monitor developments at the Inch entry point and notes

that some additional reinforcement has been signalled within the NDP. The CER will also continue to work closely with relevant stakeholders, and notes that the effects of PSE Kinsale Energy withdrawal from Inch will be considered in Gas Networks Ireland's forthcoming 2015/16 Gas Winter Outlook and subsequent NDPs.

The CER is aware that aggregate Irish gas demand is expected to increase over the coming decade, although the rate of demand growth may vary depending on market developments (e.g. fuel prices, GDP growth, new connections, energy efficiency, etc.). The CER supports the adoption of a scenario modelling approach by Gas Networks Ireland in order to forecast future gas demand. The 2015 NDP indicates that Ireland's gas network is broadly resilient to the future demand growth scenarios modelled, which is important for the consumers that fund network investments through their gas bills.

The CER notes that Gas Networks Ireland is also involved in other initiatives including Compressed Natural Gas for transport, renewable natural gas and a gas-infill strategy, which will promote sustainable development and increase the usage of Ireland's gas network in a cost effective manner. The CER will continue to work with Gas Networks Ireland on the progression of such initiatives.

The CER is cognisant of issues arising from increased gas and electricity market interactions. As Ireland transitions itself to a low carbon economy, renewable electricity generation will require greater flexibility from the Irish gas network, as gas is increasingly used as a backup fuel for intermittent wind and electricity generation. This may have an impact on gas flow profiles and gas network operations. Consequently, the CER supports initiatives undertaken by Gas Networks Ireland to address network operational issues arising from increased renewable electricity generation, and encourages further engagement with EirGrid in considering gas and electricity system interactions.

Finally, the CER would like to take this opportunity to thank Gas Networks Ireland for the production of the 2015 NDP, while acknowledging the previous work undertaken by Gaslink and its staff in the production of previous NDPs.

Appendix 1 Historic Demand

Historic Daily Demand by Metering Type

The historic demand data in Chapter 3.3 is presented by sector (i.e. residential, I/C and power), as this is more useful for forecasting purposes and is also considered to be a more familiar classification for the users of this document. The actual demand data is collected by metering type:

- Large Daily Metered (LDM) sites with an annual demand of 57 GWh or greater, and includes all the power stations and the large I/C sites;
- Daily Metered (DM) sites with an annual demand greater than 5.55 GWh and less than 57 GWh, and includes the medium I/C, hospitals and large colleges etc;
- Non-Daily Metered (NDM) with an annual demand of 5.55 GWh or less, and includes the small I/C and residential sectors.

The demands of the above categories are then re-combined into the following categories for reporting and forecasting purposes, using the monthly billed residential data to split the NDM sector into its residential and I/C components:

- Power sector: The individual power stations are separated out from the LDM total;
- The I/C sector: Which is comprised of the demand from the remaining LDM sites, the DM sector and the NDM I/C sector (calculated as the residual of the total NDM demand and the residential demand);
- Residential sector: Which is calculated as a percentage of the NDM demand, using the ratio of the total billed monthly NDM and residential demand.

The historical daily demand on the transmission and distribution systems is shown in Figure A1-1 and A1-2, with the corresponding annual and peak-day demands tabulated in Table A1-3 and Table A1-4. It should be noted that the figures in the tables may not sum to total due to rounding. The transmission and distribution daily demands have been broken down into the following sub-categories:

- Transmission demand has been subdivided into the power sector demand, with all of the remaining LDM and DM I/C demand combined into the TX DM I/C category;
- Distribution demand has been subdivided into the DX NDM demand, with all of the remaining LDM and DM I/C demand combined into the DX DM I/C category.

Table A1-1: Historic Gas Networks Ireland Annual Gas Demands (Actual)[1]

GWh/yr	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15[2]
ROI	54,734	58,239	55,726	50,435	50,072	47,582	46,968
NI & IOM	18,022	17,232	17,852	15,142	15,031	15,132	16,632
Total	72,756	75,471	73,578	65,577	65,103	62,714	63,600

1 Actual demands shown are not weather corrected and do not include own use gas
2 End of year total forecast from actual year to date totals

Table A1-2: Historic Gas Networks Ireland Peak Day Gas Demands (Actual)[1]

GWh/d	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
ROI	227.5	247.6	244.1	211.7	213.2	187.0	203.8
NI & IOM	67.7	80.0	79.3	74.1	62.7	68.2	72.8
Total	295.2	327.5	323.4	285.8	275.9	255.2	276.6

1 Actual demands shown are not weather corrected and do not include own use gas

Table A1-3: Historic ROI Annual Gas Demands (Actual)[1]

GWh/y	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Power	36,007	39,338	35,365	29,864	28,156	26,910	24,579
I/C	10,415	10,409	12,021	13,244	13,700	13,682	15,334
RES	8,312	8,492	8,340	7,326	8,216	6,991	7,139
Total	54,734	58,239	55,726	50,435	50,072	47,582	47,052

1 Actual demands shown (not weather corrected), with residential estimated as % of NDM
2 Power sector gas demand is amended to account for those I/C connections which generate electricity for their own use less process gas
3 End of year total forecast from actual year to date totals

Appendix 1
Historic Demand

Table A1-4: Historic ROI Peak Day Gas Demands (Actual)[1]

GWh/d	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Power[2]	126.4	134.3	132.2	114.1	119.9	102.0	102.4
I/C	44.4	46.3	49.6	49.4	50.4	46.8	54.8
RES	56.7	67.0	64.2	48.2	44.2	39.9	46.6
Total	227.5	247.6	246.0	211.7	214.4	188.7	203.8

1 Actual demands shown (not weather corrected), with residential estimated as % of NDM
2 Power sector gas demands is amended to account for those I/C connections which generate electricity for their own use less process gas

The transmission connected demand, Figure A1-1, does not appear to be particularly weather sensitive. The gas demand of the power sector in particular is driven by relative fuel-prices rather than the weather (although the gas-price can be weather related as well).

It can be seen from Figure A1-2 that the distribution connected demand is very weather sensitive, peaking in the colder winter period and falling off in the warmer summer period. The NDM demand is particularly weather sensitive, as it includes the residential and small I/C sectors, which primarily use gas for space heating purposes.

Figure A1-1: Historic Daily Demand of Transmission Connected Sites

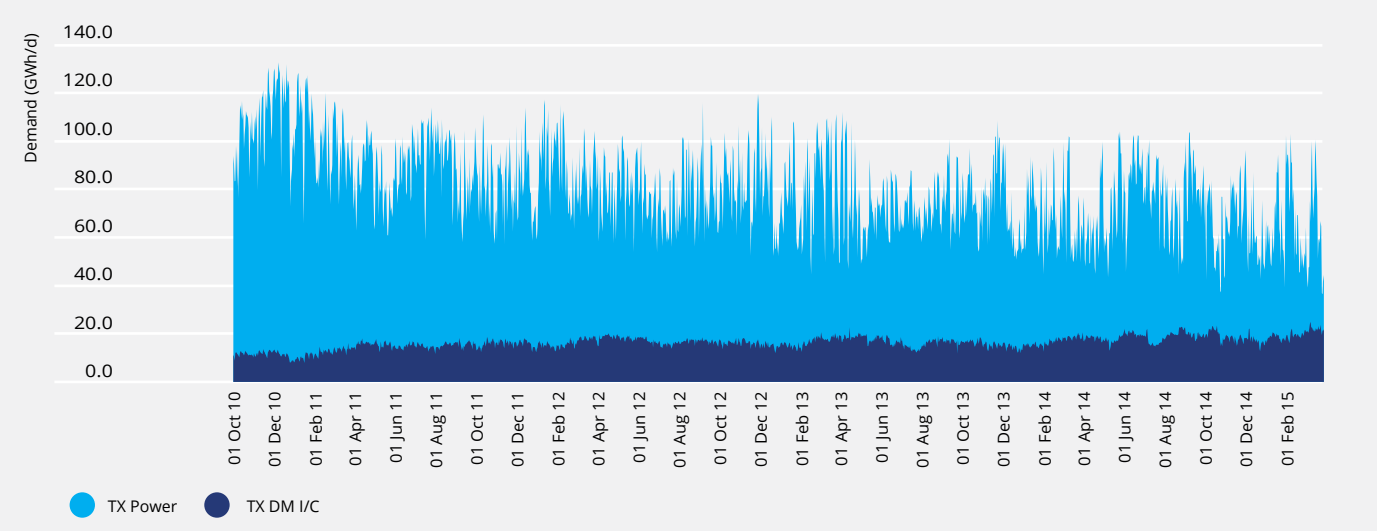


Figure A1-2: Historic Daily Demand of Distribution Connected Sites

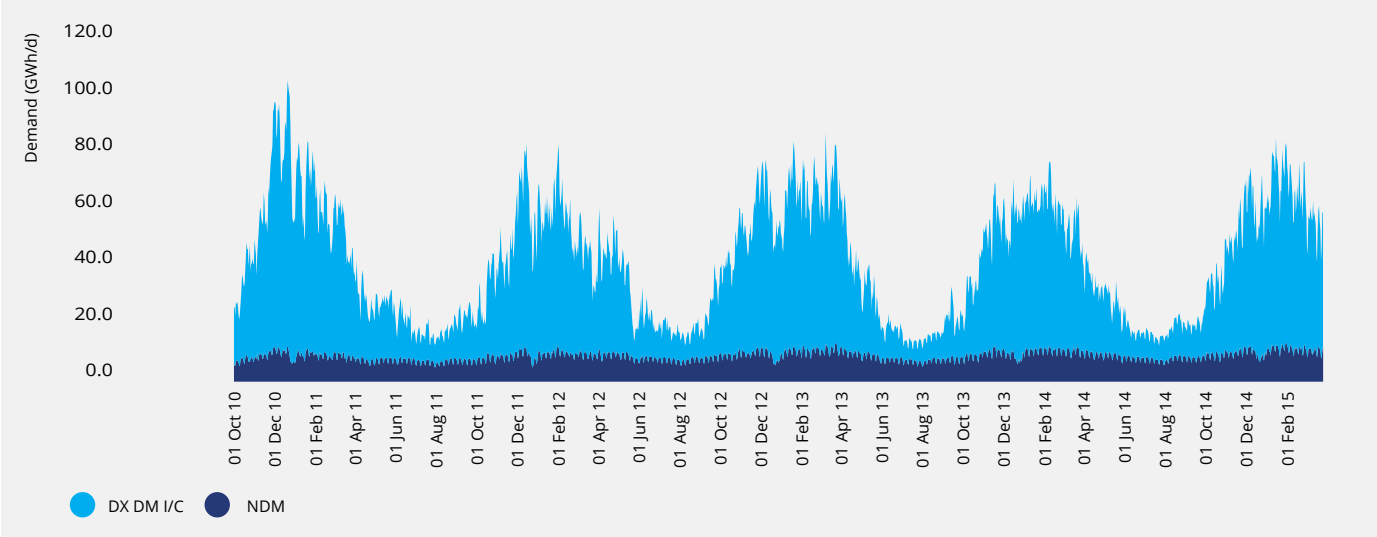


Table A1-5 and Table A1-6 present the historic annual and peak day gas supplies for the Gas Networks Ireland system.

Table A1-5: Historic Annual Gas Supplies through Moffat and Inch[1]

GWh/yr	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15[3]
Moffat[2]	72,645	70,446	73,843	72,320	64,103	64,148	59,566	62,828
Inch	4,772	4,259	4,128	3,765	3,952	4,014	3,288	3,636
Total	77,417	74,705	77,971	76,086	68,055	68,162	62,854	66,464

1 Daily gas supply taken from Gas Transportation Management System (GTMS)
2 End of year total forecast from year to date totals
3 Table shows total Moffat supplies including ROI, NI and IOM

Table A1-6: Historic Peak Day Gas Supplies through Moffat and Inch[1]

GWh/d	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Moffat[2]	251.4	292.5	303.9	255.7	251.2	232.7	248.3
Inch	35.6	34.8	33.7	32.0	26.7	26.4	28.0
Total	287.0	327.3	337.6	287.6	277.9	259.1	276.3

1 Daily gas supply taken from Gas Transportation Management System (GTMS)
2 Table shows total Moffat supplies including ROI, NI and IOM

Appendix 1 Historic Demand

The peak-day demands shown in Table A1-7 represent the coincident peak-day demands, i.e. the peak-day demand of each sector on the date of the overall system peak-day demands. Each sector may have had a higher demand on a different date. The non-coincident peak-day demand of each sector is shown in Table A1-8.

Table A1-7: Historic Coincident Peak Day and Annual ROI Demands

	2008/09 (GWh)	2009/10 (GWh)	2010/11 (GWh)	2011/12 (GWh)	2012/13 (GWh)	2013/14 (GWh)	2014/15[1] (GWh)
Peak-day							
TX Power	126.4	134.3	132.2	114.1	119.9	102.0	102.4
TX DM I/C	10.4	9.1	12.0	17.7	17.8	16.1	18.8
DX DM I/C	11.0	11.7	12.3	11.9	12.2	12.6	13.3
DX NDM	79.7	92.5	89.5	68.0	64.6	57.9	69.4
Total ROI	227.5	247.6	246.0	211.7	214.4	188.7	203.8
Annual							
TX Power	36,007	39,338	35,365	29,864	28,156	26,910	24,579
TX DM I/C	3,518	3,701	4,978	6,147	6,088	6,439	7,536
DX DM I/C	2,835	2,858	3,020	3,235	3,419	3,432	3,540
DX NDM	12,374	12,342	12,363	11,188	12,409	10,802	11,313
Total ROI	54,734	58,239	55,726	50,435	50,072	47,582	46,968

1 End of year Annual total forecast from actual year to date totals

Table A1-8: Historic Non-coincident Peak ROI Demand by Sector

	2008/09 (GWh)	2009/10 (GWh)	2010/11 (GWh)	2011/12 (GWh)	2012/13 (GWh)	2013/14 (GWh)	2014/15 (GWh)
TX Power	135.7	134.3	133.0	117.4	119.9	108.7	103.2
TX DM I/C	12.7	13.7	18.4	20.4	22.9	23.1	25.1
DX DM I/C	11.2	11.8	12.3	12.7	13.7	12.8	13.8
DX NDM	79.7	95.2	94.9	73.0	75.5	65.8	73.5
Total ROI	239.3	254.9	258.5	223.5	231.9	210.4	215.6
Power	135.7	134.3	133.0	117.4	119.9	108.7	103.2
I/C	46.8	51.7	57.5	53.7	59.1	56.5	62.7
RES	56.8	68.9	68.0	52.4	52.9	45.2	49.7
Total ROI	239.3	254.9	258.5	223.5	231.9	210.4	215.6

Appendix 2 Demand Forecasts

Assumptions

As outlined in section 4 a number of assumptions are made regarding a number of key demand drivers. These are presented in tables A2-1 to A2-3.

Table A2-1 New and Retired Power Station Assumptions

Name	Type	Capacity (MW)	Date	Location
New			Start	
Great Island	CCGT	431	Q2 2015	Co. Wexford
Retiring			End	
Great Island	LSFO	212	Q2 2015	Co. Wexford
Tarbert (1,2,3 & 4)	LSFO	592	Q4 2023	Co. Kerry
Total		892		

Table A2-2: Future GDP Assumptions

GDP (%)	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24
Green scenario	4.1	4.2	3.8	3.9	4.0	4.0	4.0	4.0	4.0
Grey scenario	1.2	1.8	1.1	1.3	1.4	1.4	1.4	1.4	1.4

Appendix 2 Demand Forecasts

Table A2-3: Residential New Connections

	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24
Grey Scenario	5,540	5,994	6,336	6,660	7,004	7,371	7,708	7,868	7,894
Green Scenario	6,497	8,863	11,011	11,760	11,467	11,621	11,640	11,374	11,294

Forecast

The demand forecasts are summarised in Tables A2.4 to A2.10. Table A2.10 presents the various supply sources by entry point, both existing and proposed. The values represent the maximum supply volume each source could potentially provide.

The ROI demand is broken down by sector, while the total demand is given for NI and the IOM. It should be noted that the figures in the tables may not sum to total due to rounding.

The forecasts are based on the following weather scenarios:

- Tables A2.4 & A2.5: Peak-day gas demand under severe 1-in-50 weather conditions, i.e. weather so severe that it only occurs once every 50 years;
- Tables A2.6 & A2.7: Peak-day gas demand under 'average year' weather conditions, i.e. the weather conditions that typically occur each year;
- Tables A2.8 & A2.9: Annual gas demand in average year weather conditions.

The NI peak-day demand used for both the 1-in-50 and average year weather forecast is based on information published by the Northern Ireland Utility Regulator (UREGNI) in the Northern Ireland Gas Capacity Statement 2013/14. The IOM peak-day is based on information provided by the Manx Electricity Authority (MEA).

The electricity demand for the average year is as per EirGrid's All-Island Generation Capacity Statement 2015-2024 under the low electricity demand forecast. The 1-in-50 year electricity demand is calculated by projecting forward the actual peak of 5,090 MW, which occurred in 2010 and growing this figure forward in line with the electricity demand forecast growth rate.

The weather correction is only applied to the distribution connected load, i.e. primarily to the residential and small I/C sectors. There is no weather correction applied to the power sector gas demand forecast.

The forecast assumes that the peak-day gas demand of the power sector is coincident with that of the residential and I/C sectors, as this gives the worst case scenario for gas system planning purposes.

The power peak-day gas demand forecast assumes that all of the non gas-fired thermal power stations are available on the day, i.e. all of the peat, coal and oil-fired power stations. If there is a forced outage of one or more of the non gas-fired thermal power stations, then the peak-day gas demand of the sector may be higher than indicated in the above forecasts.

Table A2-4: 1-in-50 Peak Day Demand – Grey Scenario (GWh/d)

	15/16 GWh	16/17 GWh	17/18 GWh	18/19 GWh	19/20 GWh	20/21 GWh	21/22 GWh	22/23 GWh	23/24 GWh
Power	141.3	140.3	139.8	139.8	139.9	147.6	150.3	150.2	154.9
I/C	65.8	66.4	66.2	66.1	65.9	65.8	65.6	65.5	65.3
RES	59.4	59.2	58.9	58.5	57.8	57.1	56.8	56.5	56.2
Transport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Own use	3.7	4.1	4.3	4.1	4.6	5.0	5.1	5.2	5.2
Sub total	270.3	269.9	269.2	268.5	268.3	275.5	277.8	277.4	281.6
Injection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IOM	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9
NI	91.3	98.8	102.2	103.7	105.1	106.4	107.6	108.8	109.9
Total	368.4	375.7	378.3	379.1	380.2	388.8	392.4	393.2	398.4

Table A2-5: 1-in-50 Peak Day Demand – Green Scenario (GWh/d)

	15/16 GWh	16/17 GWh	17/18 GWh	18/19 GWh	19/20 GWh	20/21 GWh	21/22 GWh	22/23 GWh	23/24 GWh
Demand									
Power	142.2	142.1	142.1	142.4	144.5	157.4	159.5	160.2	165.9
I/C	68.2	70.7	73.0	75.5	78.0	80.5	82.9	85.4	87.8
RES	59.1	59.0	59.1	59.1	58.8	58.5	58.5	58.5	58.5
Transport	0.0	0.1	0.1	0.2	0.3	0.5	0.8	1.1	1.7
Own use	3.8	4.2	4.5	4.5	5.0	5.4	5.5	5.5	5.5
Sub total	273.4	276.1	278.9	281.7	286.6	302.3	307.1	310.7	319.5
Injection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IOM	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9
NI	91.3	98.8	102.2	103.7	105.1	106.4	107.6	108.8	109.9
Total	371.6	381.9	388.0	392.3	398.6	415.6	421.6	426.4	436.3

Notes:
1 Injection refers to storage injections from the transmission system into storage facilities
2 Own-use refers to fuel-gas used by the transmission system to transport the gas, e.g. fuel-gas used by the compressor stations and heat exchangers at Above Ground Installations (AGIs)

Appendix 2
Demand Forecasts

Table A2-6: Average Year Peak Day Demand – Grey Scenario (GWh/d)

	15/16 GWh	16/17 GWh	17/18 GWh	18/19 GWh	19/20 GWh	20/21 GWh	21/22 GWh	22/23 GWh	23/24 GWh
Demand									
Power	124.0	122.4	122.2	127.2	129.0	133.9	134.4	134.8	133.2
I/C	57.1	57.6	57.5	55.6	55.4	55.3	55.2	55.1	56.7
RES	46.0	45.8	45.6	43.6	43.1	42.6	42.4	42.1	43.5
Transport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Own use	2.3	2.5	2.6	2.5	2.8	3.0	3.1	3.2	3.3
Sub total	229.4	228.2	227.8	228.9	230.4	234.9	235.0	235.2	236.8
Injection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IOM	4.6	4.6	4.6	4.3	4.3	4.3	4.3	4.3	4.6
NI	59.0	62.8	65.3	66.2	67.1	68.0	68.8	69.5	70.2
Total	293.0	295.6	297.7	299.4	301.8	307.2	308.1	309.1	311.6

Table A2-7: Average Year Peak Day Demand – Green Scenario (GWh/d)

	15/16 GWh	16/17 GWh	17/18 GWh	18/19 GWh	19/20 GWh	20/21 GWh	21/22 GWh	22/23 GWh	23/24 GWh
Demand									
Power	124.6	124.1	135.5	137.0	138.4	143.9	144.5	145.5	146.7
I/C	59.2	61.2	61.2	63.2	65.2	67.1	69.1	71.0	73.0
RES	45.7	45.7	44.2	44.2	44.0	43.8	43.8	43.8	43.8
Transport	0.0	0.1	0.1	0.2	0.3	0.5	0.8	1.1	1.7
Own use	2.4	2.6	2.8	2.8	3.1	3.4	3.5	3.7	3.9
Sub total	231.9	233.6	243.9	247.5	251.0	258.7	261.7	265.2	268.9
Injection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IOM	4.6	4.6	4.3	4.3	4.3	4.3	4.3	4.3	4.3
NI	59.0	62.8	65.3	66.2	67.1	68.0	68.8	69.5	70.2
Total	295.4	301.0	313.5	318.0	322.4	331.0	334.8	339.0	343.5

Table A2-8: Annual Demand – Grey Scenario (TWh/y)

	15/16 TWh	16/17 TWh	17/18 TWh	18/19 TWh	19/20 TWh	20/21 TWh	21/22 TWh	22/23 TWh	23/24 TWh
Demand									
Power	24.8	24.4	24.7	25.2	25.5	27.7	27.6	27.7	27.8
I/C	14.9	15.0	14.9	14.9	14.9	14.8	14.8	14.8	14.7
RES	6.9	6.8	6.8	6.8	6.7	6.6	6.6	6.5	6.5
Transport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Own use	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.6	0.6
Sub total	46.9	46.6	46.9	47.3	47.5	49.7	49.5	49.6	49.6
Injection	2.2	2.2	0.5	0.8	0.0	0.0	0.0	0.0	0.0
IOM	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
NI	12.7	14.3	15.1	14.5	15.1	14.5	15.3	15.4	15.5
Total	63.1	64.4	63.7	63.9	63.9	65.5	66.1	66.2	66.4

Table A2-9: Annual Demand – Green Scenario (TWh/y)

	15/16 TWh	16/17 TWh	17/18 TWh	18/19 TWh	19/20 TWh	20/21 TWh	21/22 TWh	22/23 TWh	23/24 TWh
Demand									
Power	25.9	26.0	26.9	27.9	28.4	31.0	31.1	31.3	31.7
I/C	15.4	15.8	16.2	16.6	17.0	17.4	17.8	18.2	18.6
RES	6.9	6.9	6.9	6.9	6.8	6.8	6.8	6.8	6.8
Transport	0.0	0.0	0.1	0.1	0.1	0.2	0.3	0.4	0.6
Own use	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.7	0.7
Sub total	48.5	49.1	50.5	52.0	52.9	56.0	56.7	57.5	58.5
Injection	2.2	2.2	0.5	0.8	0.0	0.0	0.0	0.0	0.0
IOM	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
NI	12.7	14.3	15.1	14.5	15.1	14.5	15.3	15.4	15.5
Total	64.7	66.9	67.4	68.5	69.3	71.8	73.3	74.2	75.3

Table A2-10: Maximum Daily Supply Volumes

	15/16 GWh	16/17 GWh	17/18 GWh	18/19 GWh	19/20 GWh	20/21 GWh	21/22 GWh	22/23 GWh	23/24 GWh
Supply									
Corrib	103.8	88.9	77.8	76.2	77.6	66.1	60.7	51.8	47.9
Inch[1]	32.9	32.4	32.1	43.1	12.5	7.1	5.7	4.1	4.1
Moffat[2]	342.4	342.4	320.3	320.3	320.3	320.3	320.3	320.3	320.3
Total	479.1	463.7	430.2	439.7	410.4	393.5	386.8	376.2	372.2

Notes:
1 Combination of existing storage and forecast production levels
2 The capacity of Moffat is based on the capacity of Beattock compressor station

Appendix 3 Energy Efficiency Assumptions

National Energy Efficiency Action Plan 2014 (NEEAP3)

The NEEAP 3 for Ireland sets out the Government's strategy for meeting the energy efficiency savings targets identified in the energy White Paper (2007) and the EU Energy Services Directive (ESD). These targets include:

- The White Paper target of a 20% reduction in ROI energy demand across the whole economy by 2020, with a higher 33% target for the Public Sector;
- The Energy Services Directive (ESD) target of a 9% reduction in energy demand by 2016 in the non-ETS sectors.

Table A3-1 outlines the NEEAP 3 energy efficiency targets over the period to 2020.

Table A3-1: NEEAP 3 Energy Efficiency Savings Targets

National Energy Efficiency Action Plan 2014 (NEEAP3) - Energy Savings	2012 (achieved) GWh	2016 (expected) GWh	2020 (expected) GWh
Public Sector			
Green Public Procurement via Accelerated Capital Allowances (ACA)	57	154	287
SEEEP and EERF	88	88	88
Public Sector Building Demonstration Programme	140	140	140
CHP	132	158	183
ReHeat	123	123	123
Public transport efficiency	113	158	158
Better Energy Workplaces (Public Sector)	237	237	237
Public Sector Retrofit (Including Public Sector Programme)	160	1,300	2,500
Total Public Sector savings	1050	2358	3716
Business			
SEAI Large Industry Programmes	1,802	2,235	2,728
SEAI SME Programme	270	404	511
ACA (private sector)	137	368	688
SEEEP and EERF (private sector)	177	177	177
CHP	309	368	428
ReHeat	288	288	288
Better Energy Workplaces (private sector)	274	274	274
Commercial/Industry Sector Retrofit	0	1,000	2,500
Total business savings	3,257	5,114	7,594
Buildings			
2002 Building Regulations -Dwellings	1,294	1,294	1,294
2008 Building Regulations -Dwellings	215	546	1,100
2011 Building Regulations -Dwellings	6	164	441
Building Regulations - Nearly Zero Energy Dwellings	0	9	138
2005 Building Regulations - Buildings other than dwellings	209	250	250
2012 Building Regulations - Buildings other than dwellings	0	146	518
Energy efficient boiler regulation	400	800	1,200
Domestic Lighting (Eco-Design Directive)	533	1,200	1,200
Greener Homes Scheme (GHS)	119	119	119
Better Energy Warmer Homes Scheme (WHS)	130	130	130
Home Energy Savings (HES) scheme	365	365	365
Smart Meter roll-out	0	373	624
Residential retrofit	507	1,500	3,000
Total buildings savings	3,778	6,896	10,379

Appendix 3 Energy Efficiency Assumptions

Impact on Residential Gas Demand

The proposed energy efficiency measures for the residential sector will clearly have a material impact on annual gas demand of the residential sector. The NDP forecast for the residential sector includes the following assumptions:

- Incremental gas demand from new residential connections will continue to reduce due to tighter building regulations[44], which are anticipated to result in improved whole-dwelling energy performance, equivalent to 60% better than 2005 standards;
- Existing residential gas demand will also reduce due to the introduction of more efficient boiler standards (e.g. condensing boilers), smart metering and the impact of the Better Energy Homes schemes.

The NEEAP 3 assumes an incremental reduction of 5,900 GWh in residential energy demand by 2020 (allowing for savings realised up to 2012), comprising of a saving of 1,700 GWh associated with the building regulations (for dwellings) and 4,200 GWh of a saving associated with existing dwellings.

Impact on I/C Gas Demand

The NEEAP 3 assumes a total reduction of 3,300 GWh in I/C energy demand from 2012 to 2016, and a further reduction of 4,600 GWh by 2020. The NDP forecast assumes the following:

- The gas share of these reductions is assumed to be 30%, based on gas share of total I/C TFC in 2012; and
- This would lead to an average annual reduction of 158 GWh/y in I/C annual gas demand up to 2016/17, and 206 GWh/y from 2016/17 onwards (which is equivalent to 1.2% and 1.6% of the estimated 2013/14 I/C annual demand respectively).

44 As per the Building Regulations introduced in May 2011

Appendix 4 Transmission Network Modelling

The purpose of the hydraulic network modelling is to test the adequacy of the existing all-island transmission network for a forecast demand under a number of supply scenarios, establishing where pressures are outside acceptable operational boundaries or where there is insufficient capacity to transport the necessary gas. This chapter summarises the results of the network analysis carried out for this NDP.

Network analysis was carried out using hydraulic network modelling software, Pipeline Studio®. A single hydraulic model of the Gas Networks Ireland transmission system[45] was constructed using Pipeline Studio®. This simulation software was configured to analyse the transient 24 hour demand cycle over a minimum period of three days to obtain consistent steady results.

In order to assess the system on days of different demand pattern three demand type days were analysed for each supply scenario over a 10 year period to 2023/24:

- 1-in-50 year winter peak day;
- Average year winter peak day;
- Average year summer minimum.

These demand days, which were generated from the gas demand forecast, have been chosen as they represent the maximum and minimum flow conditions on the transmission system.

45 NI transmission system is not included in the modelling. NI is treated as a demand at Twynholm, Scotland.

Appendix 4 Transmission Network Modelling

The ability of the ROI transmission system to accommodate the forecast gas flow requirements was validated against the following criteria;

- Maintaining the specified minimum and maximum operating pressures at key points on the transmission systems;
- Operating the compressor stations within their performance envelopes;
- Ensuring gas velocities do not exceed their design range of 10 – 12 m/s.

Entry Point Assumptions

The main Entry Point assumptions are summarised in Table A4-1;

Table A4-1: Entry Point Assumptions

	Moffat	Inch	Corrib	Shannon
Pressure (barg)	47.0[1]	30.0	Up to 85.0	Up to MOP[3]
Gross Calorific Value (MJ/scm)	39.8	37.8	37.7	40.5
Max Supply (mscmd)	31.0[1]	3.2	9.9[2]	11.3

1 Reduces to 45 barg and 29.0 mscmd from 2016/17
2 Maximum daily supply capacity for first year of production
3 Maximum Operating Pressure of the pipeline

As per the existing Pressure Maintenance Agreement (PMA), National Grid is required to provide gas at a minimum pressure of 42.5 barg at Moffat for flows up to 26 mscmd. They have also advised a higher Anticipated Normal Off-take Pressure (ANOP) pressure for Moffat of 47 barg (i.e. the expected pressure under normal circumstances). The ANOP pressure has been used in the network modelling. This ANOP pressure is assumed to reduce to 45 barg from 2016/17, which reduces the technical capacity of the Moffat Entry Point.

A minimum pressure of 30 barg is provided at Inch, and the Corrib Operator is required to provide up to 85 barg at Bellanaboy.

Glossary

ACER - Agency for Cooperation of Energy Regulation

AGI – Above Ground Installation

AGU – Aggregated Generator Unit

ANOP – Anticipated Normal Off-take Pressure

BETTA – British Electricity Trading and Transmission Arrangements

CAM - Capacity Allocation Mechanism

CCGT – Combined cycle gas turbine

CER – Commission for Energy Regulation

CHP – Combined heat and power

CMP – Congestion Management Procedure

CNG – Compressed Natural Gas

CO_2 – Carbon dioxide

DD – Degree Day

DM – Daily Metered

DRI – District Regulating Installation

EERF - Energy Efficiency Retrofit Fund

ENTSOG - European Network of Transmission System Operators for Gas

ESD – Energy Services Directive

ETS – European Emission Trading Scheme

EWIC – East West Interconnector

GB – Great Britain

GDP – Gross Domestic Product

GERT - Gas Emergencies Response Team

GIS – Geographic Information System

GTMS – Gas Transportation Management System

GWh – Gigawatt hour

GWh/d – Gigawatt hours per day

GWh/yr – Gigawatt hours per year

I/C – Industrial and Commercial

IC – Interconnector

IP – Interconnection Point

IOM – Isle of Man

Km – Kilometre

Ktoe - kilotonne of oil equivalent

LDM – Large Daily Metered

LNG – Liquefied natural gas

LSFO – Low Sulphur Fuel Oil

MEA – Manx Electricity Authority

MJ/scm - Megajoules per standard cubic metre

MOP – Maximum operating pressure

m/s - Metres per second

Mscm/d – Million standard cubic metres per day

MW – Megawatt

MWh – Megawatt hour

MWh/house/yr – Megawatt hour per house per year

NDP – Network Development Plan

NEEAP – National Energy Efficiency Action Plan

NGEM - National Gas Emergency Manager

NGEP –National Gas Emergency Plan

NGV – Natural Gas Vehicle

NI – Northern Ireland

No. - Number

NRA - National Regulatory Authority

NSMP – National Smart Metering Programme

NTS – National Transmission System

OECD - The Organisation for Economic Co-operation and Development

PC3 – Price Control 3

PCI – Projects of Common Interest

PMA – Pressure Maintenance Agreement

REMIT – Regulation on Wholesale Energy Market Integrity and Transparency

ROI – Republic of Ireland

SCADA - Supervisory Control and Data Acquisition

SEAI – Sustainable Energy Authority of Ireland

SEEEP - Support for Exemplar Energy Efficiency Projects

SEM – Single Electricity Market

SME – Small to Medium Enterprise

SNP – South-North Pipeline

TEN-E – trans-European Energy Infrastructure

TFC - Total Final Consumption

TPER – Total Primary Energy Requirement

TSO – Transmission System Operator

TYNDP – European Ten Year Network Development Plan issued by ENTSOG

UREGNI – Utility Regulator for Northern Ireland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