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Gas Networks Ireland

Network Development Plan 2017

assessing future demand and supply position

Table of Contents

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 2017, 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 2017 ten-year Network Development Plan (NDP) published by Gas Networks Ireland.

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

Natural gas is a clean, reliable and competitive energy source that has a key role to play in helping Ireland meet its energy needs and environmental targets in the medium and long term. The existing infrastructure has demonstrated its reliability in delivering safe cost effective energy to gas customers over many decades. Gas Networks Ireland is committed to the further development and evolution of the network to ensure it continues to meet the changing needs of gas customers in a cost effective and environmentally friendly manner. In recent years the gas network has been extended to Nenagh and Wexford towns. Gas Networks Ireland is currently in the planning phase to extend the gas network to Listowel in Co. Kerry and this pipeline is expected to be completed in 2018. These network extensions highlight the competitive contribution gas brings to industrial, commercial and residential sectors.

The operation of the gas system has changed considerably since the network was originally designed, particularly with Corrib coming on line. While the new Entry Point has brought with it enhanced security of supply, it has also created a need for low and variable flows in South West Scotland at the Moffat Entry point, which impacts the running of Gas Networks Ireland's compressor station and how flow rates are profiled over the course of a gas day.

Gas Networks Ireland will undertake a program of capital works at both Beattock and Brighouse Bay Compressor Stations in Scotland during the next five years, to ensure both stations continue to operate in a safe and reliable manner and comply with the statutory requirements associated with their operation. These investments will relate to the replacement of end-of-life assets such as gas coolers, valves and obsolete control systems.

There are also a number of upgrade projects relating to enhancements at the stations, all of which will deliver considerable benefits for the downstream gas consumers.

The Twinning of the South West Scotland Onshore system (PCI 5.2), is in the construction phase and remains on schedule for completion in the gas year 2017/18 and will enhance security of supply to the island of Ireland. Gas Networks Ireland was allocated funding by the EU Commission for feasibility studies for physical reverse flow at Moffat (PCI 5.1.1) following successful evaluation of an application through the EU Innovation and Networks Executive Agency. The study is expected to be completed over the next fifteen months.

Decarbonisation of the energy market is one of the biggest long-term challenges facing Ireland and Europe as a whole out to 2050 and beyond. Gas Networks Ireland is committed to the decarbonisation of Ireland's energy system and to this end we are actively investigating key transformational technologies to help decarbonise the gas sector by 2050. These technologies include Renewable Gas, Smart Metering, Carbon Capture and Storage for electricity and industry, Power-to-Gas and Hydrogen for heating and transport. Gas Networks Ireland is also investing in Compressed Natural Gas (CNG) which has the potential to decarbonise the transport sector and contribute to Ireland's climate change targets.

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. With the onset of Brexit, Gas Networks Ireland is fully committed to ensuring that gas will continue to flow through its interconnectors and that security of gas supply will not be negatively impacted.

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 may develop over a ten year period. It is based on current supply and demand for gas, as well as projections for growth in gas consumption and development of infrastructure. The document also examines system operation and consequent capital investment requirements.

In order to provide a comprehensive analysis, Gas Networks Ireland has developed three gas demand scenarios for the period 2016/17 to 2025/26, namely low, median and high demand scenarios. These scenarios are designed to represent a broad range of possible outcomes and are informed by a range of external and internal factors.

In the median demand scenario annual ROI gas demand is expected to grow by 12.5% between 2016/17 and 2025/26 with no growth forecast in the low demand scenario and growth of 23% forecast in the high demand scenarios respectively over the same horizon.

The development of peak day demands across the various scenarios shows the same broad trends as the annual demand forecasts. However, there are a number of key differences, particularly with regard to the power generation sector gas demand profile. Over the forecast horizon 1-in-50 peak day demand is predicted to grow by 8.9% and by 13% for the average year peak in the median demand scenario.

The Corrib gas field came on line on the 31st of December 2015 and is now operating at full capacity. Corrib is expected to meet approximately 56% of annual Gas Networks Ireland system demands in 2016/17. However the Moffat entry point will remain key in terms of energy security as Corrib production declines in the medium term. The Kinsale storage facility has commenced blowdown of Southwest Kinsale cushion gas in 2016, with production expected to cease in 2021.

Annual ROI gas demands for 2016/17 are anticipated to be 4.9% above 2015/16 demands following a 9.2% increase the previous year. In the power generation sector, annual gas demand for 2016/17 is anticipated to be 7.1% above 2015/16 levels, following a 17.6 % increase the previous year. The increase in power sector gas demands despite growth in wind capacity can be attributed to increasing electricity demand and in particular increasing electricity exports to GB. This is a result of the Carbon price floor introduced in GB which was raised to £18 per ton CO_2 in April 2015.

Ireland has rapidly emerged as a prime data hosting destination. Gas Networks Ireland is focused on developing a combined offering of Natural Gas, Renewable Gas and Combined Heat and Power (CHP), as the primary source of energy for the Data Centre sector. Gas can be used for onsite electricity generation leveraging the existing reliable natural gas network infrastructure, offering Data Centre operator's substantial savings in terms of energy costs.

In the transport sector, Compressed Natural Gas (CNG) is emerging as an alternative fuel, particularly in commercial transport to power trucks and buses, offering a real solution to reducing emissions from diesel-fuelled heavy vehicles. Gas Networks Ireland is undertaking a European funded project called the Causeway Study and intend to deliver 14 high capacity fast fill CNG stations and a single renewable gas injection point. The first public station in the rollout programme is due for completion this year at the Topaz Dublin Port service station. This will be quickly followed by key strategic locations on the motorway network. In the longer term Gas Networks Ireland is proposing to develop a 70-station CNG fuelling network, collocated in existing forecourts, on major routes and/or close to urban centres. The Causeway Study is also being supported by the CRU who have approved €12.83m of innovation funding to enable the project to be completed.

Ireland has rapidly emerged as a prime data hosting destination. Gas Networks Ireland is focused on developing a combined offering of Natural Gas, Renewable Gas and Combined Heat and Power (CHP), as the primary source of energy for the Data Centre sector.

This year the construction of a new CNG station at Clean Ireland Recycling in Shannon, Co. Clare, was completed, Ireland's first private fast fill CNG Station to be supported under the Innovation Fund.

New EU wide obligations require a minimum of 1.25% of transport to be sourced from what is termed "advanced biofuels". Currently in an Irish context, the most commercially viable advanced fuels from indigenous sources are generally gaseous fuels, such as renewable gas from certain classes of waste, seaweed, industrial algaes or power to gas. Gas Networks Ireland is involved in a project to install the first renewable gas injection facility in Ireland with Green Generation in Co. Kildare. This injection facility will be designed to inject up to 1,200 m3/hr of renewable gas and will act as a template for following project designs.

The Moneypoint generating station in Co. Clare is expected to come to the end of its operating life in its current configuration in 2025. As stated in The Energy White Paper, a suitable replacement will have to be identified. Gas Networks Ireland believes that a modern CCGT gas plant offers by far the most efficient and cost effective solution for the Moneypoint site in the long term. Gas Networks Ireland has carried out an analysis which indicates that there would be sufficient capacity on the ring-main transmission system to cater for a CCGT connection via a new spur transmission pipeline to Moneypoint

As part of the current price control (PC3), €387 million will be invested in the gas network. Gas Networks Ireland is currently in a consultation process with the Commission for Regulation of Utilities (CRU) for a fourth Price Control (PC4). This will cover the five year period from October 2017 to September 2022.

Gas Networks Ireland is currently in the planning phase to extend the gas network

Section Two
Executive Summary

to Listowel, Co. Kerry. The pipeline is expected to be operational in 2018. Also the gas network extension to Nenagh Town Centre, Co. Tipperary and Wexford Town, Co. Wexford are currently nearing completion. These network extensions highlight the competitive contribution gas brings to industrial, commercial and residential sectors.

The operation of the gas system has changed considerably since the network was originally designed, particularly with Corrib coming on line. While the new Entry Point has brought with it enhanced security of supply, it has also created a need for low and variable flows in South West Scotland at the Moffat Entry point, which impacts the running of Gas Networks Ireland's compressor station and how flow rates are profiled over the course of a gas day.

Gas Networks Ireland will be undertaking a programme of capital works at both Beattock and Brighouse Bay Compressor Stations in Scotland during the next five years, to ensure both stations continue to operate in a safe and reliable manner and comply with the statutory requirements associated with their operation. These investments will relate to the replacement of end-of-life assets such as gas coolers, valves and obsolete control systems. There are also a number of upgrade projects relating to enhancements at the stations, some of which will deliver considerable benefits and efficiencies for the downstream gas consumers.

Capital investment will be required at Midleton within the next five years which relate to works which will ensure, one of Ireland's most critical installations on the transmission network, can continue to operate in a safe and environmentally compliant manner, post cessation of production operations in 2021.

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.

The Twinning of the South West Scotland Onshore system (PCI 5.2), is in the construction phase and remains on schedule for completion in the gas year 2017/18 and will enhance security of supply to the island of Ireland. Gas Networks Ireland was allocated funding by the EU Commission for feasibility studies for physical reverse flow at Moffat (PCI 5.1.1) following successful evaluation of an application through the EU Innovation and Networks Executive Agency. Funding of 50% of the total budget for the feasibility study was granted, the maximum grant allowed for studies. The study is expected to be completed over the next fifteen months.

Decarbonisation of the energy market is one of the biggest long-term challenges facing Ireland and Europe as the European Union's ambition is to transition to a low carbon economy by 2050. Gas Networks Ireland is committed to the decarbonisation of Ireland's energy system. We are actively investigating key transformational technologies to decarbonise the gas sector by 2050. These technologies include Renewable Gas, Smart Metering, Carbon Capture and Storage for electricity and industry, Power-to-Gas and Hydrogen for heating and transport. Gas Networks Ireland is also investing in CNG which has the potential to decarbonise the transport sector and contribute to Ireland's climate change targets.

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. With the onset of Brexit, Gas Networks Ireland is fully committed to ensuring that gas will continue to flow through its interconnectors and that security of gas supply will not be negatively impacted.

Section Three

Introduction

Key Messages:

Annual ROI gas demands for 2016/17 are anticipated to be 4.9% above 2015/16 demands following a 9.2% increase the previous year,

In 2016 over 60% of Ireland's gas demand was supplied from indigenous sources. The balance of supply, almost 40% came through the subsea interconnectors via the Moffat Entry Point.


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Section Three
Introduction

The Network Development Plan (NDP), published by Gas Networks Ireland, covers the 10 year period from 2016/17 to 2025/26.

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 Commission for Regulation of Utilities (CRU) to publish a report outlining supply and demand in Ireland over the next seven years.

Gas Networks Ireland holds two licences from the Commission for Regulation of Utilities (CRU) 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").

Gas Networks Ireland holds two licences from the Commission for Regulation of Utilities (CRU) for the operation of the ROI transmission and distribution systems

3.1 Overview of the Gas Networks Ireland System

Gas Networks Ireland builds, develops and operates Ireland's gas infrastructure, maintaining over 13,954 km of gas pipelines and two sub-sea interconnectors.

The Gas Networks Ireland transmission network[1] includes onshore Scotland, interconnectors and the onshore ROI network. The interconnector (IC) sub-system comprises of two subsea Interconnectors between ROI and Scotland; compressor stations at Beattock and Brighouse Bay, and currently 110 km of onshore pipeline between Brighouse Bay and Moffat in Scotland. The Interconnector system connects to Great Britain's (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).

From just 31 km of transmission pipeline in 1978, the Gas Networks Ireland network currently consists of 2,427 km of high pressure steel transmission pipelines and 11,527 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 onshore part of the 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 natural gas network has demonstrated resilience and reliability through severe winter weather conditions, particularly during December and January 2010 when record sub-zero temperatures were recorded.

1 The Gas Networks Ireland network includes assets in ROI and GNI (UK) Limited own assets in NI & South West Scotland This Network Development Plan only assesses the ROI and South West Scotland infrastructure.

Section Three
Introduction

Safety and a strong customer focus are at the heart of how the business operates, along with a commercial ethos, reflecting its responsibility for a major gas infrastructure that contributes to Ireland's social and economic progress. Natural gas is available in over 160 population centres in 20 counties and there are almost 680,000 users in Ireland. Gas Networks Ireland is responsible for connecting all new gas customers to the network, and for work on service pipes and meters at customers' premises, on behalf of all gas suppliers in Ireland.

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

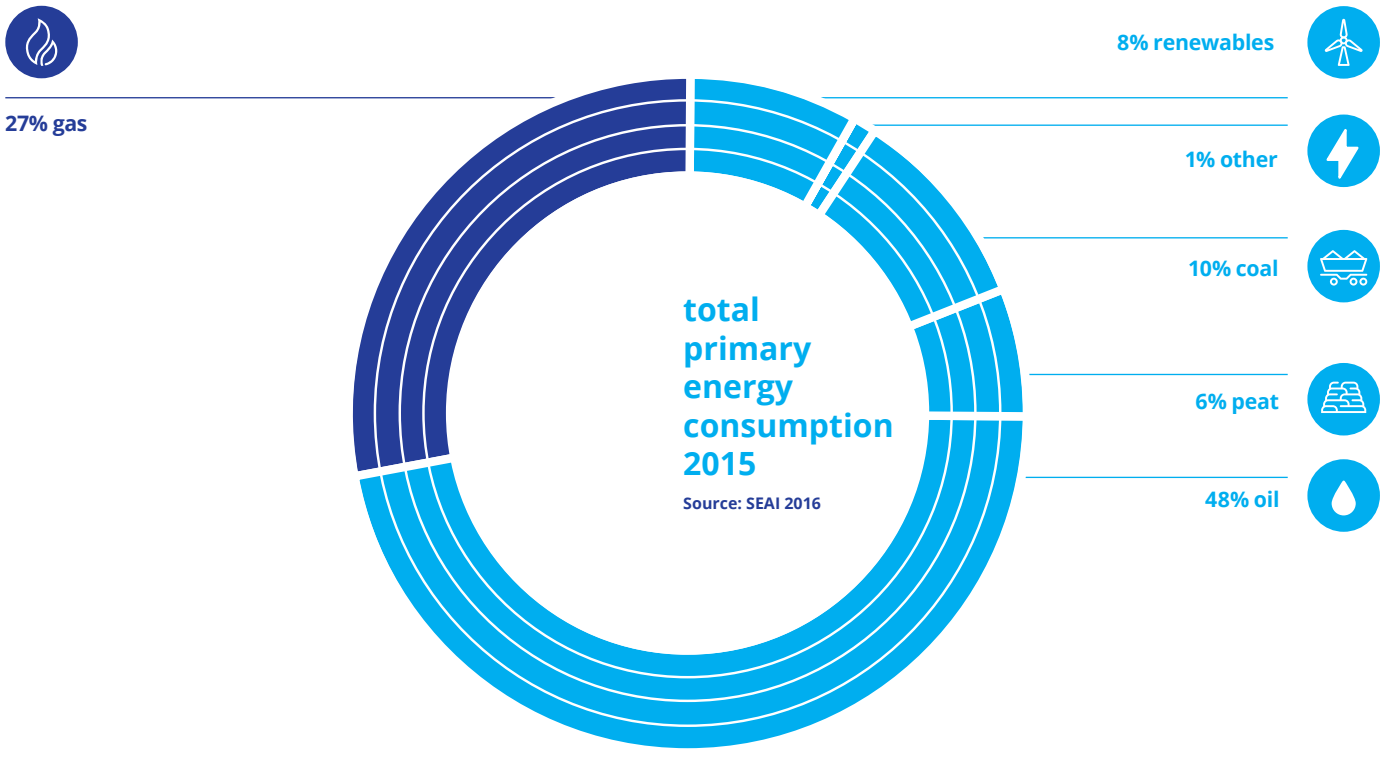
3.2 The Role of Gas in Ireland's Energy

Natural gas accounts for 27% of primary energy consumption in Ireland – a share that is in line with both worldwide and European averages. Gas demand is categorised into Power, Industrial/Commercial and Residential sectors each holding 57%, 29% and 14% of the market respectively. The gas used in Ireland's power sector accounts for 52% of Ireland's electricity generation.[2]

The Irish economy is largely dependent on imported energy sources. In particular, Ireland has an unusually high dependence on oil – 48% of primary energy comes from oil. As a country where almost 60% of our energy consumption is from imported oil and coal, natural gas must be a cornerstone of Ireland's energy policy as the country transitions to a low carbon economy.

Natural gas is an essential part of Ireland's energy mix and will play a vital role in Ireland's future energy policy as we transition to a low carbon future.

Figure 3-2: Total Primary Energy Consumption 2015



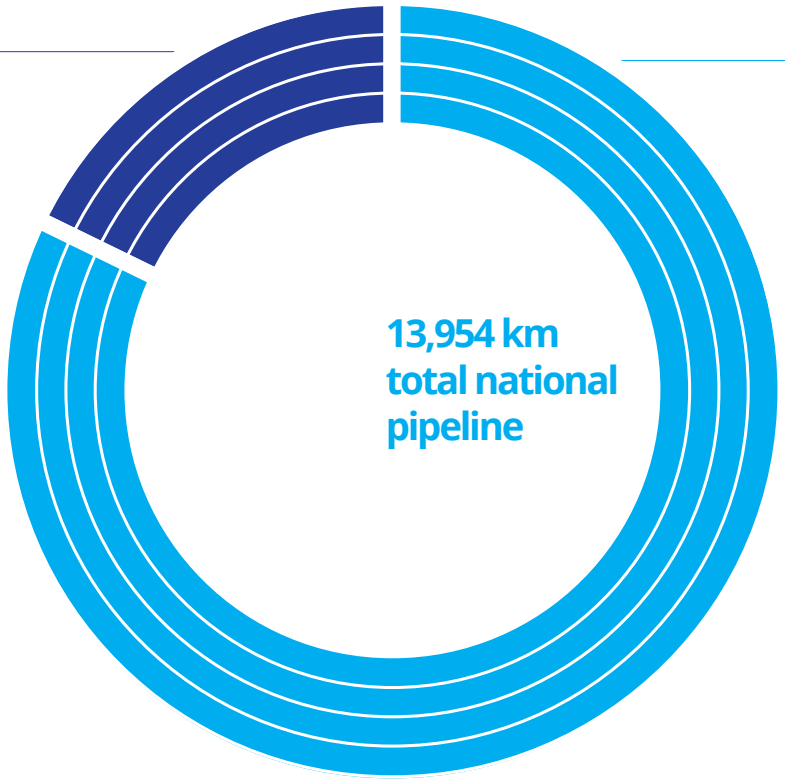
2 Source: Gas Networks Ireland 2017

Section Three
Introduction

Natural gas is a trusted, proven fuel source with an existing reliable infrastructure worth €2.6 billion that has been heavily invested in over the last three decades. This infrastructure currently delivers natural gas to over 680,000 customers across Ireland. The gas network is well established and needs minimum infrastructure investment vis-à-vis other newer energy solutions, such as wind and solar, to provide lower carbon emission solutions and sustainable energy options for Irish homes and businesses.

This infrastructure currently delivers natural gas to over 680,000 customers across Ireland and is available in 20 counties.

2,427 km transmission pipeline



11,527 km distribution pipeline

Natural Gas is Flexible

There is no doubt that Ireland needs an ambitious energy policy driven by renewables. And while Ireland has excellent renewable resources, renewable energy, by its very nature, is intermittent – sometimes the wind doesn't blow or the sun doesn't shine. As such, in order for renewable energy to achieve its full potential, investment in complementary energy is required. Natural gas is the optimal complementary energy source for renewable energy such as wind and solar. Natural gas in combination with either solar photovoltaic or solar thermal panels is the ideal method of complying with Building Regulations 2011: Part L (Conservation of Fuel and Energy - Dwellings).

A renewable driven energy policy needs to be underpinned by the reliability of conventional fuel such as natural gas. An energy policy based on replacing heavy carbon emitters such as coal and oil with cleaner natural gas, combined with greater renewable energy use, makes sense.

Section Three
Introduction

Natural Gas is Clean

Natural gas is the earth's cleanest fossil fuel resulting in far less emissions than other fossil fuels. Comprising of more than 95% pure methane, natural gas emits significantly less carbon dioxide than other fuels and also produces negligible levels of nitric oxide and sulphur oxide compared to oil or coal. Natural gas has[3]:

- 56% less CO_2 emissions than electricity
- 40% less CO_2 emissions than coal
- 22% less CO_2 emissions than oil
- 11% less CO_2 emissions than lpg

Figure 3-3: Fossil Fuels Emissions

Natural gas has 56% less CO_2 emissions than electricity

Natural gas has 40% less CO_2 emissions than coal

3 Source: SEAI 2017 Emissions Factor

Fuel Type	Emissions Factor (t CO_2/TJ (NCV))
Electricity (2015)	129.9
Coal	94.6
Gas/Diesel Oil	73.3
LPG	63.7
Natural Gas	56.9

Note: CO_2 emission factors for electricity vary from year to year depending on the fuel mix used in power generation

Natural gas has 22% less CO_2 emissions than oil

Natural gas has 11% less CO_2 emissions than liquid petroleum gas

Section Three
Introduction

Natural Gas is Cost Competitive

Price signals for natural gas until 2021 are very positive versus oil or liquid petroleum gas (LPG). The abundance of natural gas has been driving the price of gas downwards. Additionally, the more gas customers there are connected to the gas network, the more likely it is that there will be lower network tariffs as the costs are spread over a larger number of customers.

Demand for natural gas has experienced phenomenal growth in Ireland in recent years, with the number of natural gas users growing by almost 300,000 over the past fifteen years.

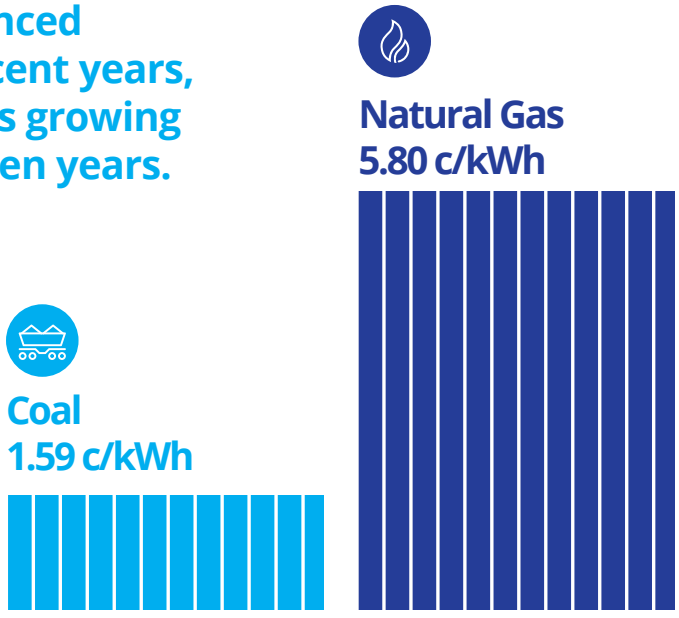
More and more people recognise the benefits of natural gas, in business, at home and, of course, for the environment. The energy created by natural gas can be used in many ways, such as heating, drying, chilling, catering, air conditioning and power generation.

Comparison of Energy Costs for Commercial/ Industrial Fuels, (Delivered Energy Cost Cent/ kWh)[4]:

- Coal 1.59 c/kWh
- Natural Gas 5.80 c/kWh
- Wood 6.71 c/kWh
- Oil 7.55 c/kWh
- LPG Bulk 7.94 c/kWh
- Electricity 18.06 c/kWh

Figure 3-4: Comparison of Energy Costs for Commercial/Industrial Fuels

Demand for natural gas has experienced phenomenal growth in Ireland in recent years, with the number of natural gas users growing by almost 300,000 over the past fifteen years.



4 Source SEAI January 2017 - Commercial/Industrial Fuels Comparison of Energy Costs Note: Prices selected are for a medium sized business user. All prices used are based on average seasonal efficiencies of each fuel type. Solid Fuel Boiler: 65%-75%, Condensing Boiler: 85-97%, District Electric Heater: 100%

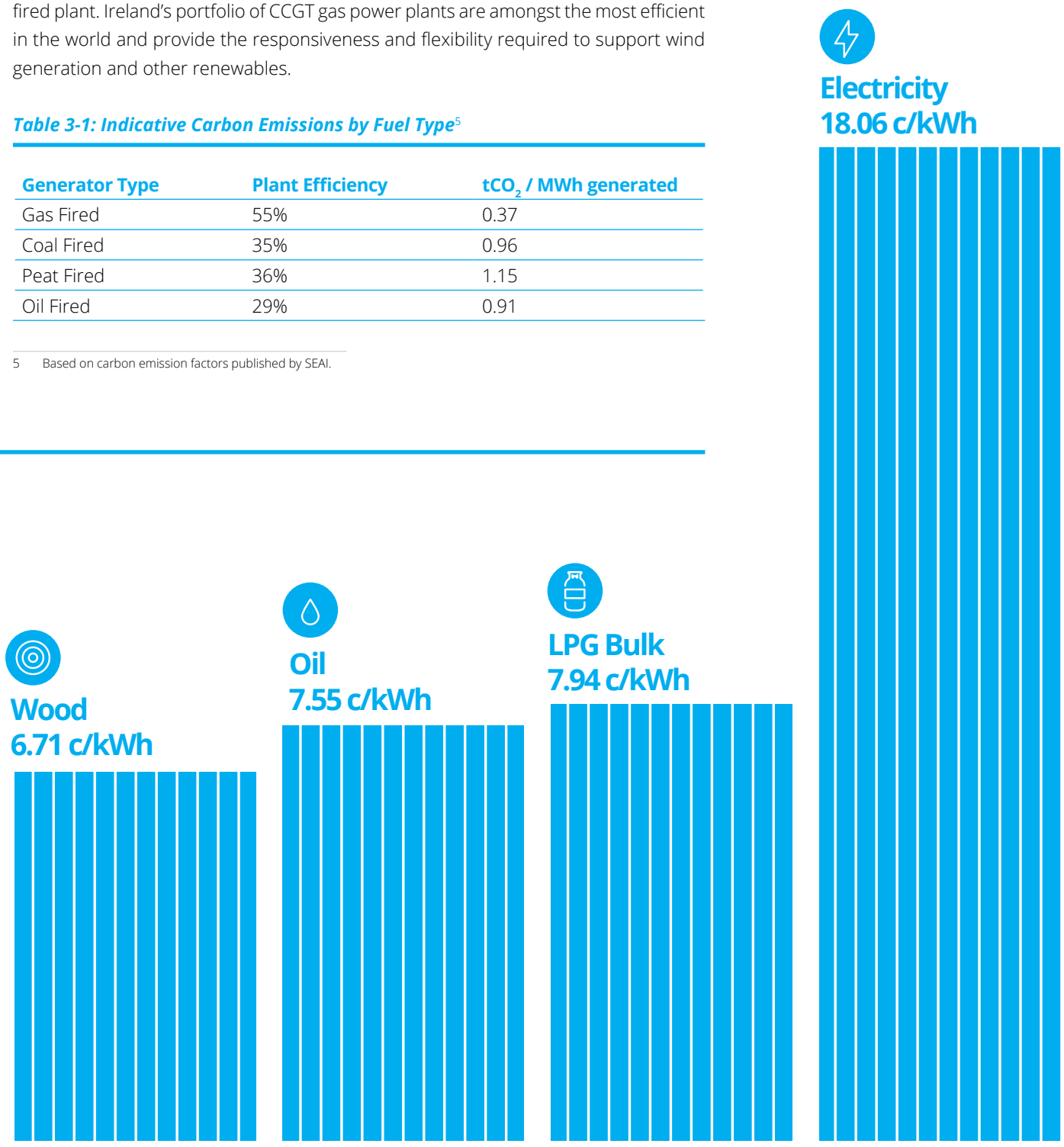
Natural Gas is Efficient

Natural gas is an efficient fuel, gas fired power plants are the most environmentally friendly thermal plant, producing substantially lower emissions than coal, peat or oil fired plant. 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 and other renewables.

Table 3-1: Indicative Carbon Emissions by Fuel Type[5]

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

5 Based on carbon emission factors published by SEAI.

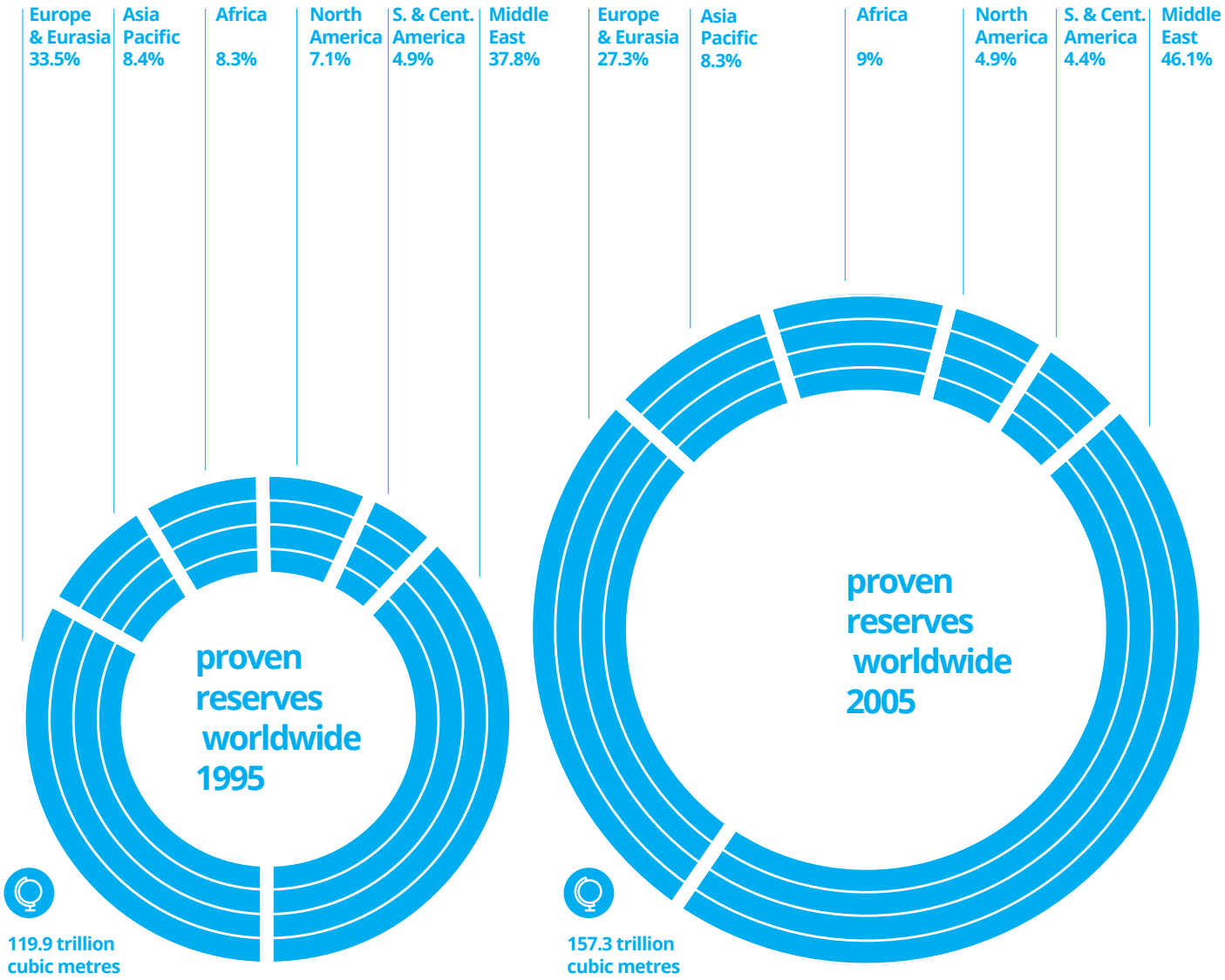


Section Three
Introduction

Natural Gas is Abundant[6]

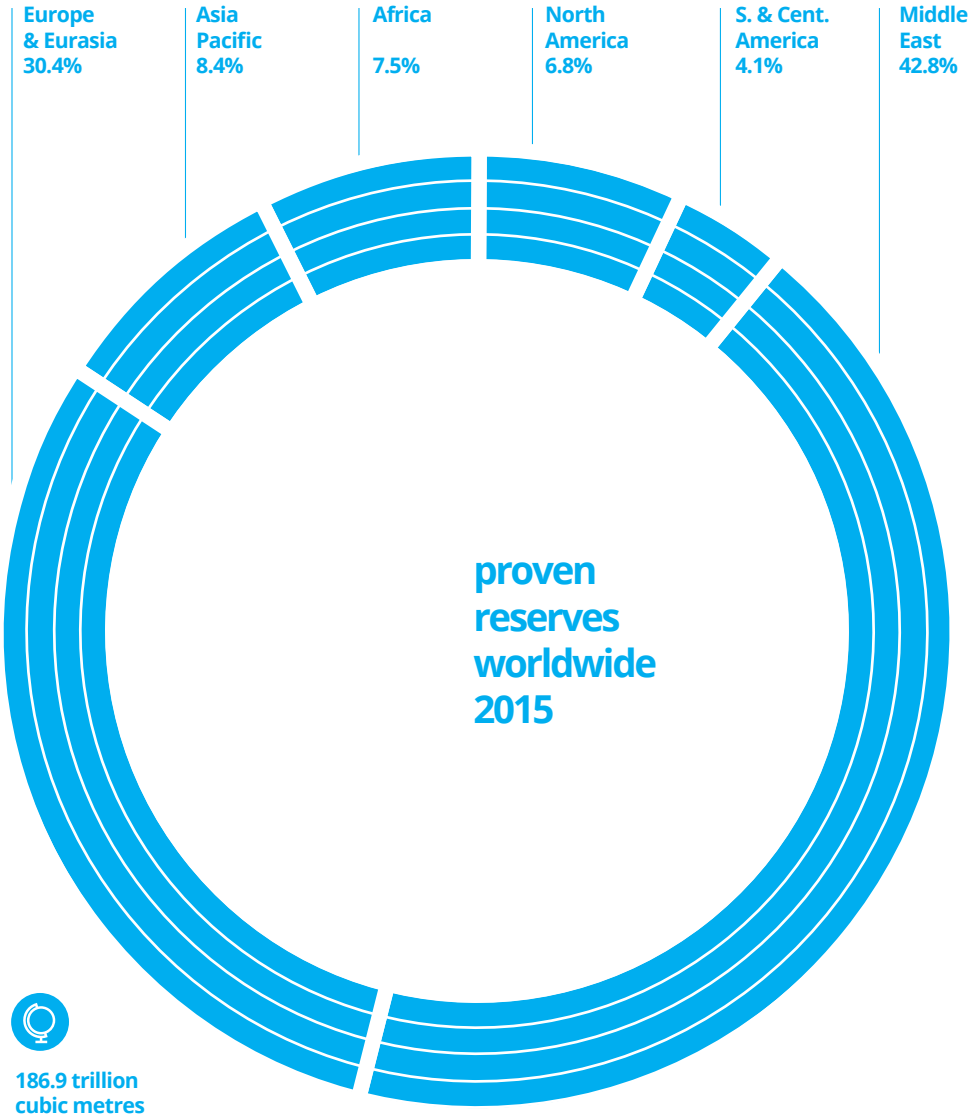
World total proven natural gas reserves at the end of 2015 stood at 186.9 trillion cubic metres (tcm). For Ireland the future supply of gas is secure. Ireland has two sub-sea interconnectors linking it to a competitive and highly liquid UK gas market. In addition, the new 50 km natural gas pipeline in Scotland is scheduled for completion in 2017/18.

Figure 3-5: Proven Reserves Worldwide



6 Source: BP Statistical Review of World Energy 2016.

This project when completed will reinforce our interconnection to the UK and enhance Ireland's energy security. The first flow of gas from the Corrib field came onto the Irish natural gas network in 2015. This first indigenous source of natural gas since 1976 has the potential to meet approximately 56% of annual Gas Networks Ireland system demands in 2016/17, greatly enhancing security of supply.

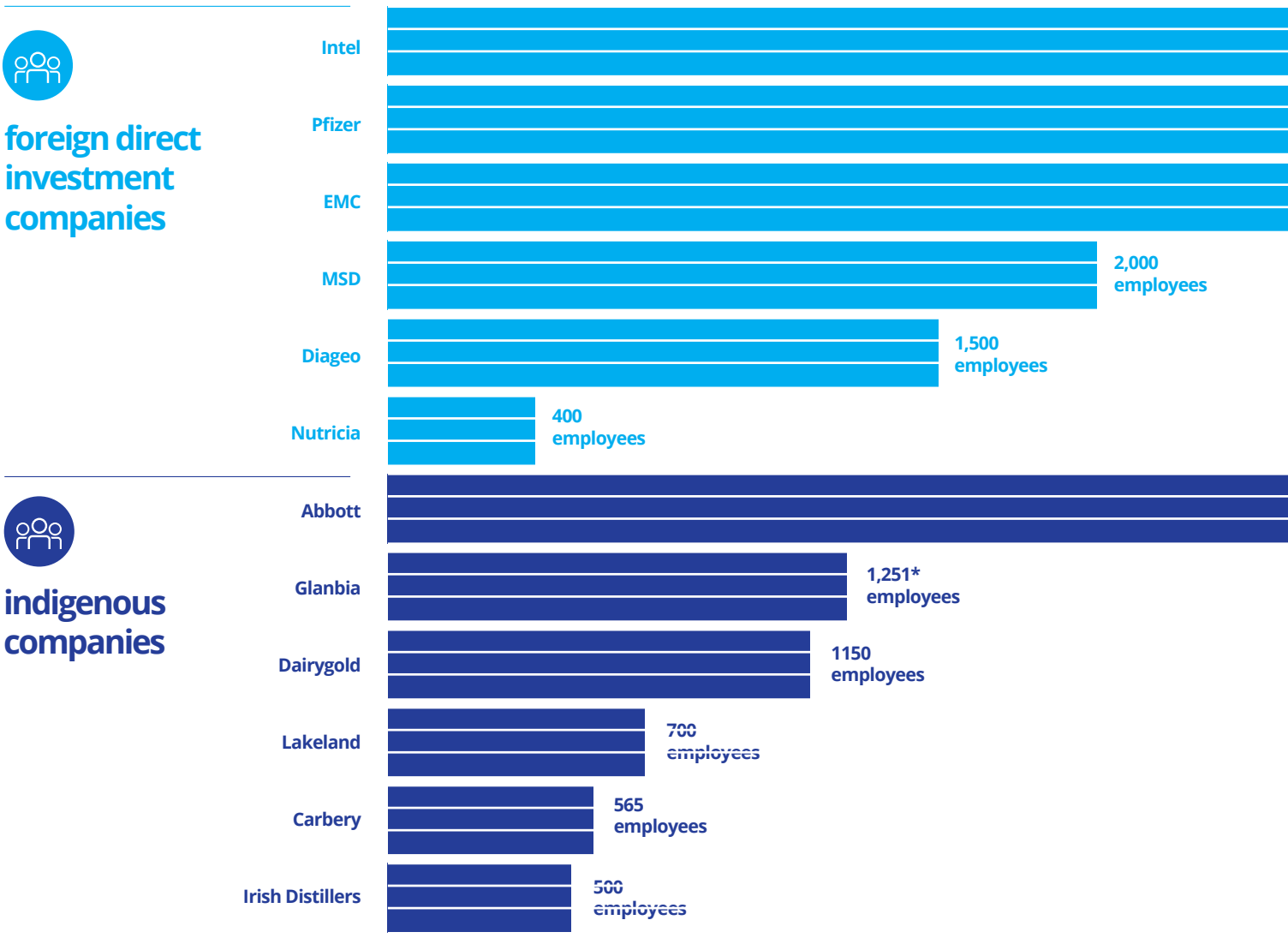


Section Three
Introduction

Natural Gas promotes Economic Growth

Natural gas as a clean, secure, low cost energy source is a key driver of job creation and economic growth. Industry depends on natural gas and gas availability is a key criteria for international companies when they are deciding where to invest. Having natural gas supplied to a town enhances its attractiveness and opportunities for growth and job creation. Many large employers in Ireland are also large users of natural gas.

Figure 3-6: Sample of Large I/C Gas Customers in Ireland[7,8]



7 Source: Irish Times Top 1000 Companies 2016
8 Source: Glanbia Annual Report 2015, Dairy Ireland

International and Irish businesses are looking for cleaner and more sustainable energy solutions all the time. Renewable gas is a key offering for these companies and will help support job creation and growth.

Industry depends on natural gas and gas availability is a key criteria for international companies when they are deciding where to invest. Having natural gas supplied to a town enhances its attractiveness and opportunities for growth and job creation. Many large employers in Ireland are also large users of natural gas.

Section Three
Introduction

3.3 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 2016 NDP, in addition to maintaining a rolling planned maintenance programme.

Pipeline investment:

- Construction of distribution network reinforcements at 14 locations;
- Construction of a distribution network within Nenagh town.
- Construction of a distribution network within Wexford town.

Boiler Upgrades:

- Huntstown AGI, Co. Dublin;
- Ballough AGI, Co. Dublin; and
- Nangor AGI, Co. Dublin.

Other:

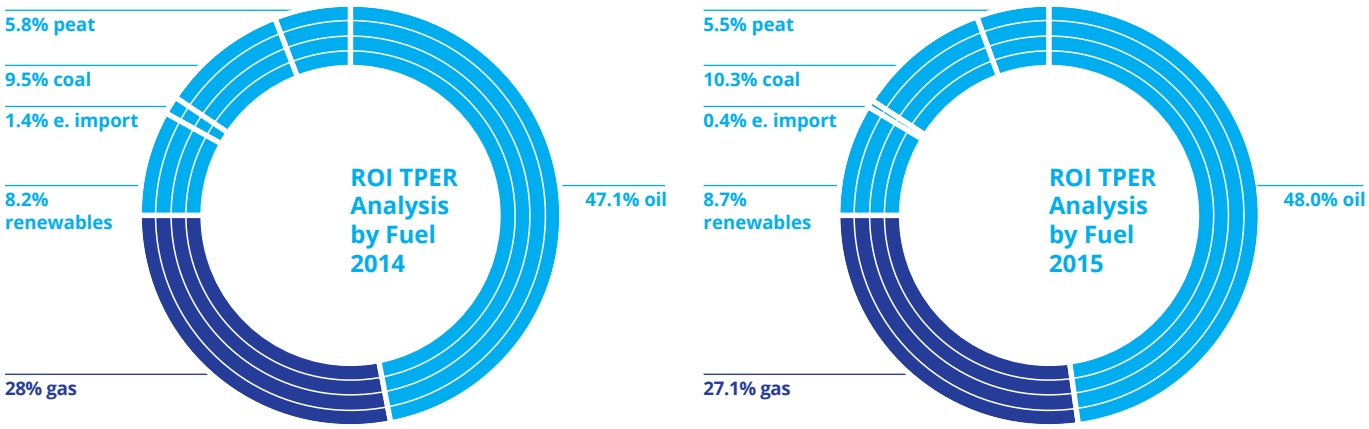
- Completion of pipe support remediation works at 18 AGI locations;
- Service exchange of 2 turbine cores at Brighouse Bay Compressor Station and various upgrade works at compressor station sites;
- A total of 95,747 meters replaced as part of the domestic meter replacement programme since 2012; and
- A total of 1,223 meters replaced as part of the industrial & commercial meter replacement programme since 2012.

3.4 Historic Demand & Supply

3.4.1 ROI Annual Primary Energy Requirement

The Sustainable Energy Authority of Ireland (SEAI) reported that Ireland's Total Primary Energy Requirement (TPER) for 2015 grew by 4.6% in 2015. Oil continued to dominate the 2015[9] TPER accounting for 48% of total energy demands, as shown in Figure 3-7. Gas accounted for 27.1% of 2015 energy demands, reflecting its role in electricity generation, process and heating use. Renewable generation grew its share of TPER to 8.7%.

Figure 3-7: ROI TPER Analysis by Fuel (2014 & 2015)



Source: SEAI 2016

3.4.2 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).

Annual ROI gas demands for 2016/17 are anticipated to be 4.9% above 2015/16 demands following a 9.2% increase the previous year, as shown in Figure 3-8. In the power generation sector, annual gas demand for 2016/17 is anticipated to be 7.1% above 2015/16 levels, following a 17.6 % increase the previous year. The increase in power sector gas demands despite growth in wind capacity can be attributed to increasing electricity demand and in particular increasing electricity exports to Great Britain (GB). This is a result of the Carbon price floor introduced in GB which was raised to £18 per ton CO_2 in April 2015.

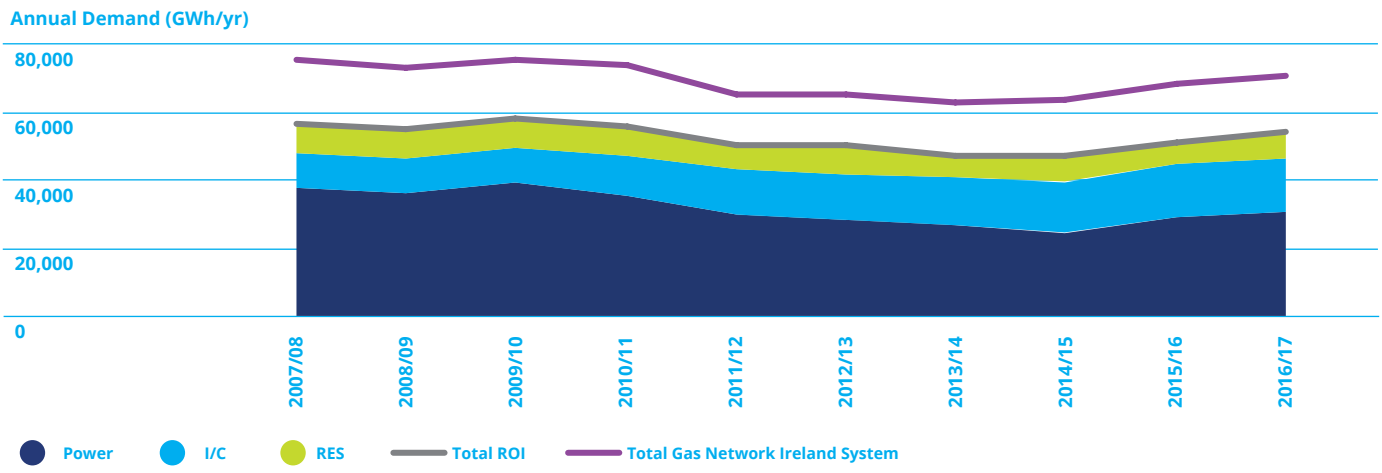
9 SEAI Energy Balance figures for 2016 not available at time of writing.

Section Three
Introduction

The Industrial & Commercial (I/C) sector annual gas demand for 2016/17 is anticipated to grow by 0.6% compared to 2015/16 levels. Within the I/C sector, Daily Metered (DM)[10] demand is expected to grow by about 0.7% with the Non Daily Metered[11] (NDM) portion of I/C demand unchanged.

Based on current estimates residential gas demand increased by 5.2% in 2016/17, following a decrease of 7.8% in 2015/16. Colder winter weather would have been the main factor affecting the increase.

Figure 3-8: Historic Annual Gas Demand



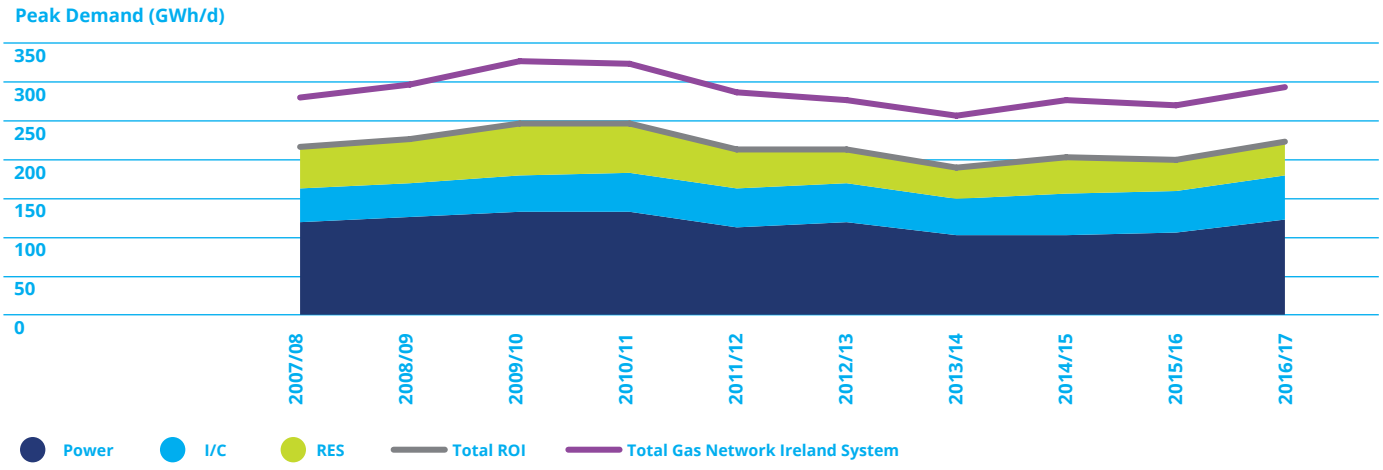
Total annual system gas demands for 2016/17 are estimated to be 3.8% above the previous year's gas demand. As well as a 4.9% increase in ROI gas demand, it is anticipated that there will be a 0.6% increase in NI and IOM gas demands. The historic gas demand is presented in Figure 3-8. The overall throughput for ROI in 2016/17 is expected to be 53,975 GWh or circa 5 bcm.

10 In this instance Daily Metered (DM) customers refers to Daily Metered (DM) and Large Daily Metered (LDM) customers i.e. any customer which consumes over 5.55 GWh annually.
11 The Non Daily Metered (NDM) sector refers to those who consume less than 5.55 GWh of gas annually. This covers small I/C and residential properties.

3.4.3 Historic Peak Day Gas Demand

In 2016/17 ROI peak day gas demand was 11% higher than the 2015/16 peak day gas demand. This increase in peak day gas demand was driven primarily by a 16.1% increase in the power generation sector and an increase of 3.1% in the industrial & commercial sector gas demand compared to the 2015/16 peak day. Peak day demand in the residential sector was also up by 9.8%. Figure 3-9 presents the historic trend in peak day gas demands.

Figure 3-9: Historic ROI Peak Day Gas Demand



The Gas Networks Ireland system[12] 2016/17 peak day gas demand was up by 8.4% compared to the 2015/16 peak. The NI and IOM peak day gas demand was 0.6 % more than in 2015/16.

3.4.4 Ireland's Weather

Based on a Degree Day (DD) comparison, the most recent winter (October '16 to March '17) was approximately 3.5% colder than the previous year, however the winter of 2015/16 was exceptionally mild. Relative to the long run degree day average, winter of 2016/17 was approximately 5.3% warmer.

The coldest day in winter 2016/17, occurred on the 21st of January, with an average temperature of -0.25°C, or a 15.75 DD. The corresponding peak day in 2015/16 occurred in late February with an average temperature of 0.25°C, or a 15.25 DD.

3.4.5 Wind Powered Generation

The installed all-island wind generation capacity increased by 18.3% in 2016 from the previous year[13]. However wind powered generation output fell by 6.5% in 2016 compared to 2015, due to lower load factors. On the peak day for wind generation in winter 2016, daily wind powered generation accounted for up to 64% of ROI daily electricity demand (24th of December 2016) and as little as 0.5% of demand on the minimum day for wind generation (20th of October 2016). On the 2016/17 peak day for gas demand (30th of November 2016) wind accounted for circa 3.5% of electricity system demand.

12 Gas Networks Ireland System includes for gas supplies to ROI, Northern Ireland and Isle of Man.
13 From Eirgrid's All-Island Generation Capacity Statement 2017-2026.

Section Three
Introduction

3.4.6 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, with import capacities of 500 MW and 450 MW respectively.

Up until recently, the prevailing market conditions on the Single Electricity Market (SEM)[14] and its UK equivalent, BETTA (British Electricity Trading and Transmission Arrangements) have resulted in a predominantly GB-IE flow on the EWIC, i.e. import of electricity from Great Britain. However since the carbon price floor in GB which was raised to £18 per ton CO_2 in April 2015 this relationship has reversed with the balance of electricity flows on the interconnectors now in favour of IE-GB exports.

Low fuel prices may also mean that the impact of the carbon price differential is more pronounced. Tightening capacity margins in the UK may also result in higher power generation costs in the UK in the long term.

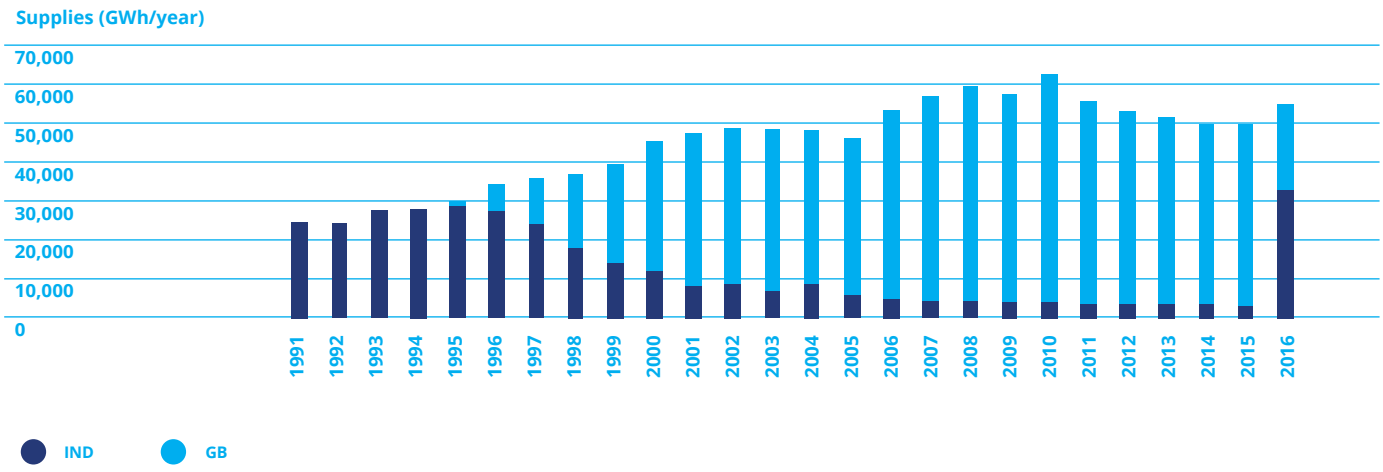
It is expected that as Carbon prices on the European Emission Trading Scheme (EU ETS) rise in line with various projections[15] the balance will swing back slowly in favour of GB-IE imports in the medium to long term, with electricity exports to GB persisting in the short term.

Gas Networks Ireland will continue to work with industry partners to understand interconnector dynamics that will continue to have a major impact on the development of gas demand in the power generation sector.

3.4.7 Historic Gas Supply

The Corrib Gas Field came on line on the 31st of December 2015. This has led to dramatic change in the ROI supply position and on gas interconnector flows. In 2016 over 60% of Ireland's gas demand was supplied from indigenous sources. The balance of supply, almost 40% came through the subsea interconnectors via the Moffat Entry Point.

Figure 3-10: Historic Annual Indigenous Gas Production and Great Britain (GB) Imports



14 The Single Electricity Market (SEM) is the wholesale electricity market operating in the Republic of Ireland and Northern Ireland.
15 The 2016 World Energy Outlook predicts an EU carbon price of €18 per ton CO_2 by 2020.

Section Four

Gas Demand Forecasts

Key Messages:

Gas Networks Ireland has developed low, median & high demand scenarios which forecast gas demand across the power generation, I/C, residential and transport sectors.

In the median demand scenario annual ROI gas demand is expected to grow by 12.5% between 2016/17 and 2025/26.

The 1-in-50 peak year, peak day forecast is expected to grow by 8.9% between 2016/17 and 2025/26.

Section Four
Gas Demand Forecasts

4.1 Gas Demands

This section presents an overview of the gas demand outlook for the period 2016/17 to 2025/26. The NDP forecasts future gas demands by examining the development of individual Power, Industrial & Commercial, Residential and Transport sector gas demands[16].

The demand forecasts presented in this chapter refer to ROI demand only, unless otherwise stated. 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. Gas Networks Ireland system demand forecasts are presented in Appendix 2.

4.1.1 Gas Demand Forecasting

The demand forecast modelling methodology used in producing the NDP generates a ten year forecast for the power generation, Industrial & Commercial (I/C) Residential & Transport sectors, based on a series of assumptions[17] which affect demand for each of these sectors. The primary forecasting inputs by sector are summarised in Figure 4-1.

Figure 4-1: Key Demand Forecasting Assumptions

Power Generation	Industrial & Commercial	Residential
Electricity Demand	Gross Domestic Product	Annual Quantity
Available Generation Capacity	New Connections	New Connections
Energy/Fuel prices	Energy Efficiency	Energy Efficiency

The primary demand forecast outputs for each of the scenarios under review are as follows;

- 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)
- Annual demand forecasts i.e. the aggregate demand for each year of the forecast.

16 Gas Networks Ireland have developed a document outlining the Methodology for forecasting gas demand. This document is available for download on Gas Networks Ireland's website: https://www.gasnetworks.ie

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

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 than 3% on each occasion, demonstrating that the demand forecasting methodology/process is reliable and robust.

Table 4-1: 1-in-50 Peak Day Forecasting Assumptions

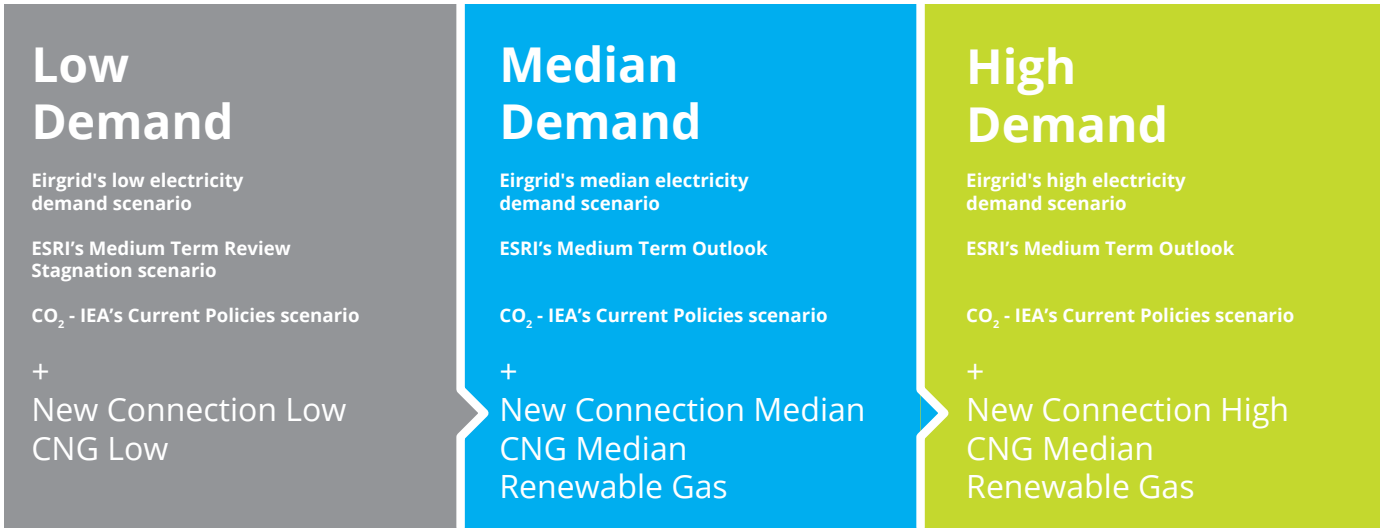
Year	Actual		Forecast		Variance
	(GWh/d)	(mscm/d)	(GWh/d)	(mscm/d)	(%)
2009/10	253	22.9	246	22.3	2.8
2010/11	251	22.7	249	22.5	0.8

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, as is the annual demand total.

4.2 Gas Demand Scenarios

In order to provide a comprehensive analysis Gas Networks Ireland has developed three gas demand scenarios for the period 2016/17 to 2025/26, namely low, median and high demand scenarios. These scenarios are designed to represent a broad range of likely outcomes and are informed by a range of external and internal factors.

Figure 4-2: Gas Demand Scenarios Overview



Section Four
Gas Demand Forecasts

These scenarios represent a range of potential gas demands, to be used for network planning purposes to test the capability of the gas network. Gas demand is dependent on a number of external factors, including economic growth, electricity demand growth and other power generation sector developments. The median scenario is designed to take the middle of the road view in terms of how these factors will develop over time.

4.3 Demand Forecast Assumptions

4.3.1 Power Generation Sector

The Irish gas and electricity sectors are highly interdependent. Gas is a critical component of Ireland's electricity generation, producing around 47%[18] of the country's annual electricity requirement in 2015/16. Gas fired generators are the largest customer sector in the gas market, accounting for approximately 56% of the total ROI demand in 2015/16.

The following summarises the main assumptions regarding the changes in the SEM generation portfolio, as per the EirGrid / SONI All-Island Generation Capacity Statement 2017-2026:

- Wind generation is anticipated to increase to 4,858 MW and 1325 MW in ROI and NI respectively, by 2025/26.
- The Kilroot coal power plant is now subject to Industrial Emissions Directive (IED) restrictions, leading to restricted running hours from July 2020 and closure by the end of 2023.
- North-South Interconnector will be completed by the end of 2020[19].
- Dublin Waste to Energy is to be commissioned in 2017.

The outlook to 2025/26 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 short to medium term, however higher carbon prices are expected to have an impact from the mid-2020s.
- 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, are anticipated to be net exporters of electricity to GB in the short term, due to the introduction of a carbon price floor of £18/ton CO_2 in GB. In the medium to long term it is expected that the balance will shift in favour of imports to Ireland as CO_2 prices rise on the ETS.
- Gas fired plant is anticipated to meet the balance of electricity demand.

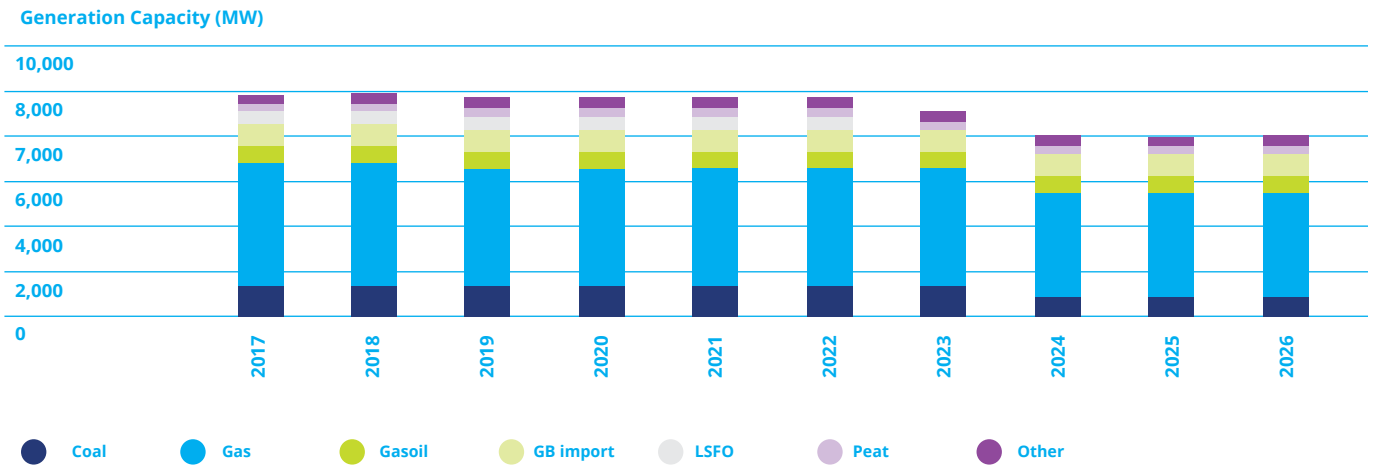
It should be noted that there is some uncertainty in power sector forecasts due to the impending implementation of iSEM. The Integrated Single Electricity Market (iSEM) refers to a new High Level Design (HLD) for the Electricity Market in Ireland and Northern Ireland and is due to go live in May 2018. The market will be re-designed to efficiently implement the European Target Model and ensure efficient cross border trade.

18 Source: Gas Networks Ireland 2017
19 Source: Eirgrid All-Island Generation Capacity Statement 2017-2026

In terms of capacity, generators will compete in a capacity auction to supply the capacity market. This may lead to some thermal plants being decommissioned or mothballed if they are not successful in this process. Gas Networks Ireland will continue to engage with stakeholders in terms of establishing the impact of iSEM and capacity auctions on gas demand set out in the Generation Capacity Statement.

Figure 4-3 illustrates the anticipated level of generation by fuel for thermal plant in the SEM, based on the EirGrid / SONI All-Island Generation Capacity Statement 2017-2026. This is based on thermal plant capacities given for 2016 with known commissioning / decommissioning dates as set out in the Generation Capacity Statement.

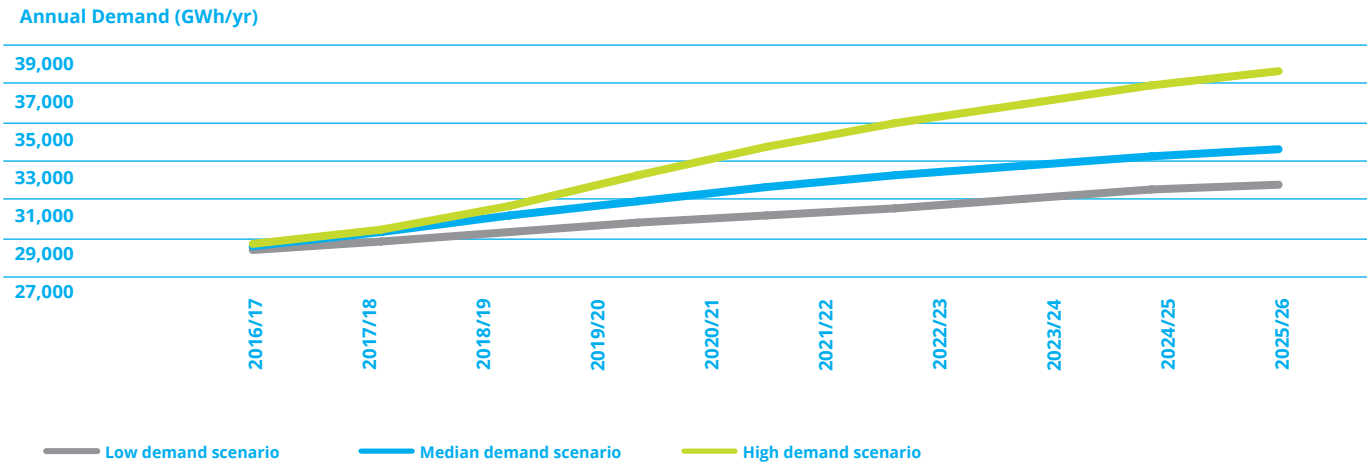
Figure 4-3: Forecast Single Electricity Market (SEM) Thermal Generation Mix



The latest EirGrid / SONI low, median and high electricity demand scenarios are illustrated in Figure 4-4. These electricity demand forecasts are used to differentiate Gas Networks Ireland's low, median and high gas demand scenarios for the power generation sector.

Section Four
Gas Demand Forecasts

Figure 4-4: EirGrid Generation Capacity Statement Electricity Demand Forecasts for ROI



4.3.2 Industrial and Commercial Sector

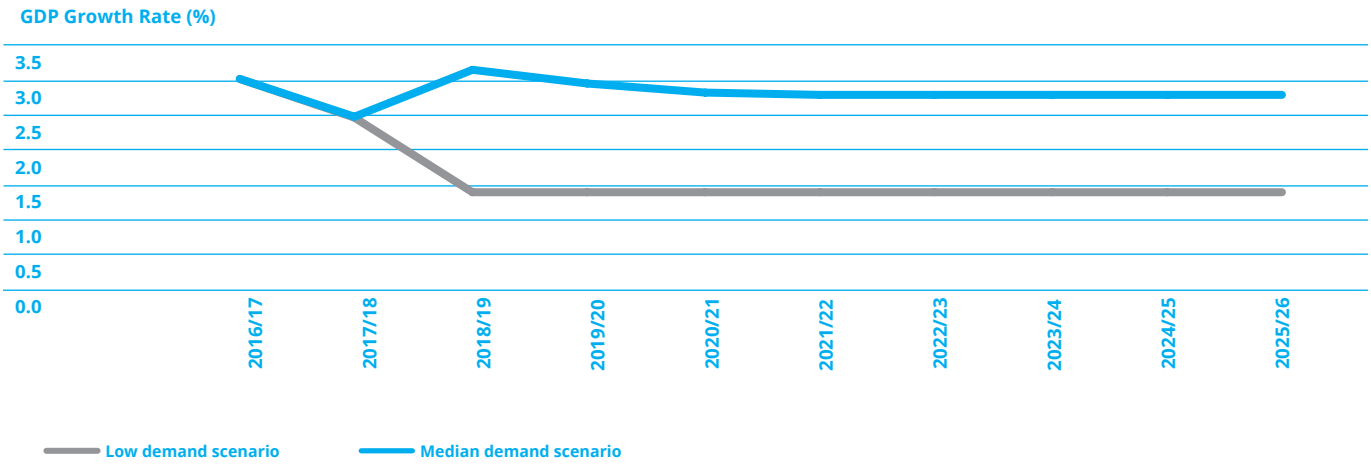
Industrial & Commercial (I/C) sector gas demand is assumed to continue to increase in line with anticipated new connection numbers and proportional to Gross Domestic Product (GDP)[20]. Figure 4-5 presents the GDP growth rate assumptions over the forecast period. Increasingly, Corporate and Social Responsibility targets with obligations to de-carbonise have become a significant consideration, especially among foreign direct investment / multi-national companies in recent times. A clear roadmap for the availability of renewable gas is thus becoming a key requirement for many of these companies in choosing to locate or expand in Ireland. It is assumed that these requirements can be met with the pending introduction of state support measures for production and injection of bio-methane (Renewable Heat Incentive – RHI) and Gas Networks Irelands initiatives to support this new sector as outlined in sections 5.5 and 6.5.

The short term GDP forecasts are a composite of a number of short term forecasts from the ESRI, Central Bank, OECD, IMF and others. The short term forecast for all three scenarios is assumed to be the same for the first two years of the analysis as there is a greater degree of certainty with these short term forecasts compared to medium to long term forecasts. In the medium term, GDP projections are based on the ESRI's 2013 Medium Term Review (MTR) stagnation scenario for the low demand scenario. In the cases of the median and high demand scenarios GDP growth projections take account of the ESRI's Economic Outlook document published in December 2016.

While GDP is the primary driver of growth in the Industrial & Commercial sector, an additional incremental allowance is made for new connections in this sector for the median and high demand scenarios in line with Gas Networks Ireland's I/C new connections growth strategy.

20 Industrial & Commercial sector growth rate is assumed to be 80% of GDP based on observed historical trends.

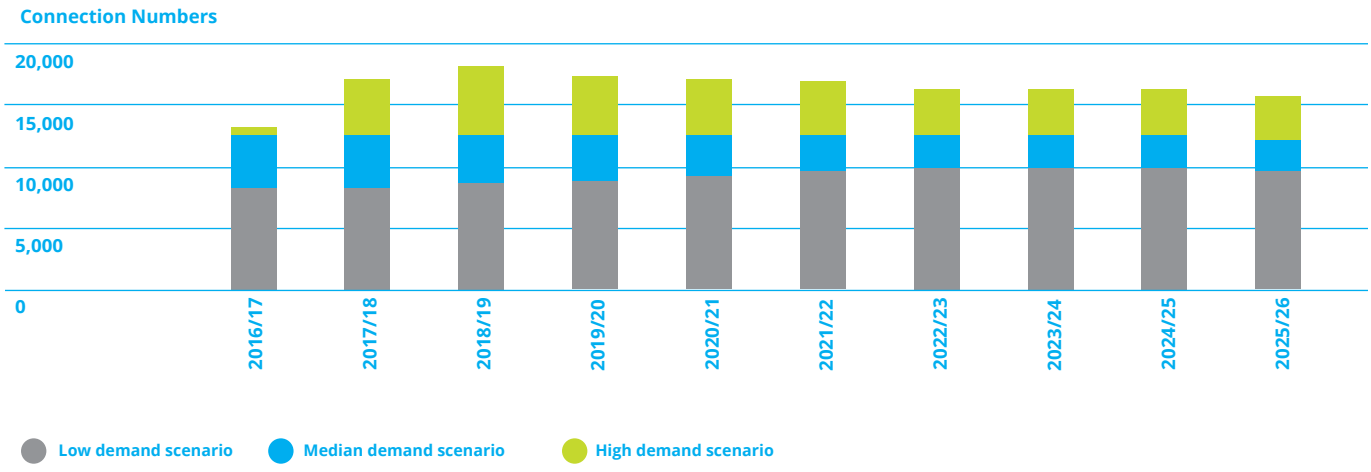
Figure 4-5: GDP Assumptions



4.3.3 Residential Sector

The forecast for new residential connections is shown in Figure 4-6. The new connections numbers in the low demand scenario are based on the observed fuel switching in mature housing and new housing forecasts, based on enquiries from developers and observed trends in new meter connections. The median and high demand scenario numbers are incremental to the low demand scenario projections and represent a range associated with Gas Networks Ireland's residential connections growth strategy. This initiative aims to increase fuel switching for individual 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 6.1 for further details). The growth strategy also intends to capture new gas estates i.e. housing estates which are not currently connected to the gas network but are located in close proximity.

Figure 4-6: Residential Connection Numbers



Section Four
Gas Demand Forecasts

4.3.3.1 Energy 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%[21] 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.

4.3.4 Compressed Natural Gas Sector

The gas demand forecast also includes transport sector gas demand. The transport forecast relates to the development of Compressed Natural Gas (CNG) within the transport industry through the promotion of Natural Gas Vehicles (NGVs). Gas Networks Ireland is currently targeting at least 5% penetration of CNG or Renewable Gas (RG) for commercial transport and 10% of the bus market in Ireland by 2025. Gas Networks Ireland is undertaking a European funded project called the Causeway Study and intend to deliver 14 high capacity fact fill CNG Stations and a renewable gas injection point. The CRU approved €12.83m of innovation allowances to support the Causeway Study and ensure that Gas Networks Ireland could avail of the European funding to facilitate its completion. The first public station in the rollout programme is due for completion this year at the Topaz Dublin Port service station. This will be quickly followed by key strategic locations on the motorway network. In the longer term Gas Networks Ireland is proposing to develop a 70-station CNG fuelling network, collocated in existing forecourts, on major routes and/or close to urban centres. See section 6.4 for further details on Gas Network Ireland's plans regarding CNG and NGVs. Table 4-2 gives the projected transport sector demand for each scenario. The median demand scenario assumes that 35 CNG fuelling stations are in place by 2024/25, while the high demand scenario assumes a figure of 70.

Table 4-2: Annual CNG Demand Forecasts (GWh)

	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26
Low demand scenario	2.6	6.6	19.2	44.8	83.1	134.6	200.6	272.2	315.5	323.9
Median demand scenario	2.6	6.6	19.2	44.8	83.1	134.6	200.6	272.2	358.7	477.0
High demand scenario	2.6	6.6	19.2	44.8	83.1	134.6	200.6	300.7	468.5	706.1

4.4 The Demand Outlook

4.4.1 Power Generation Sector Gas Demand

As described in section 3.4.2, power generation sector gas demand has risen substantially since 2015 as a result of increased electricity interconnector exports to GB. It is expected that this trend will continue in the short to medium term in all scenarios. However the trend will gradually swing back in favour of imports from GB to Ireland over the forecast horizon as carbon prices on the ETS rise as forecasted.[22]

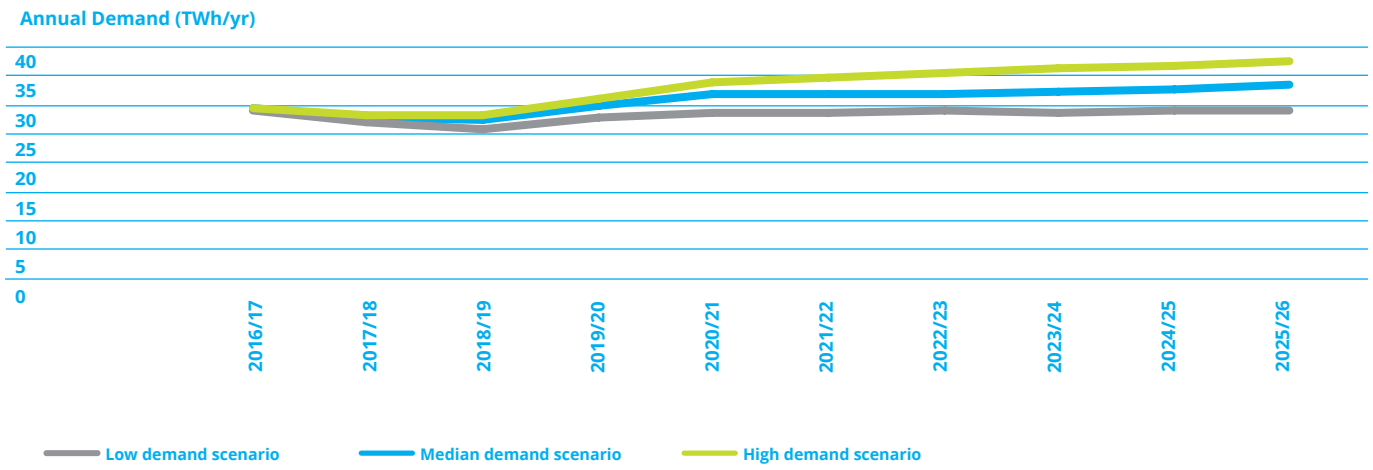
In the median demand scenario power generation sector gas demand is expected to reduce initially due to the growth in wind capacities and also due to the commissioning of the Dublin Waste to Energy plant (61 MW) in 2017. An increase in gas demand for the power generation sector is however expected in the medium term with the growth in wind capacity levelling off somewhat and with two peat plants coming off PSO in 2020. The Kilroot coal plant in NI will also be subject to the Industrial Emissions Directive (IED) restrictions from July 2020 and as a result its run hours will be limited. The North-South electricity interconnector will also be

21 This is based on current demand in these sectors and does not take into consideration other factors affecting growth.
22 Gas Networks Ireland uses forecasts of carbon pricing from the International Energy Agency's World Energy Outlook document.

complete in the end of 2020 which should lead to an increase in ROI gas demand due to the effective removal of the existing physical constraint on the electricity transmission network between NI & ROI. Over the forecast horizon growth of 13.9% is predicted in the power generation sector in the median scenario.

The low demand scenario uses the same inputs and assumptions apart from the electricity demand forecasts instead using Eirgrid's low demand forecast. The resultant narrative is similar to the median scenario but lags behind due to the lower electricity demand projected. Similarly, the high demand scenario uses Eirgrid's high demand forecasts resulting in a higher gas demand forecast for the power generation sector. This results in growth of 27% in the high demand scenario and 0% or no growth in the low demand scenario.

Figure 4-7: Power Generation Sector Gas Demand

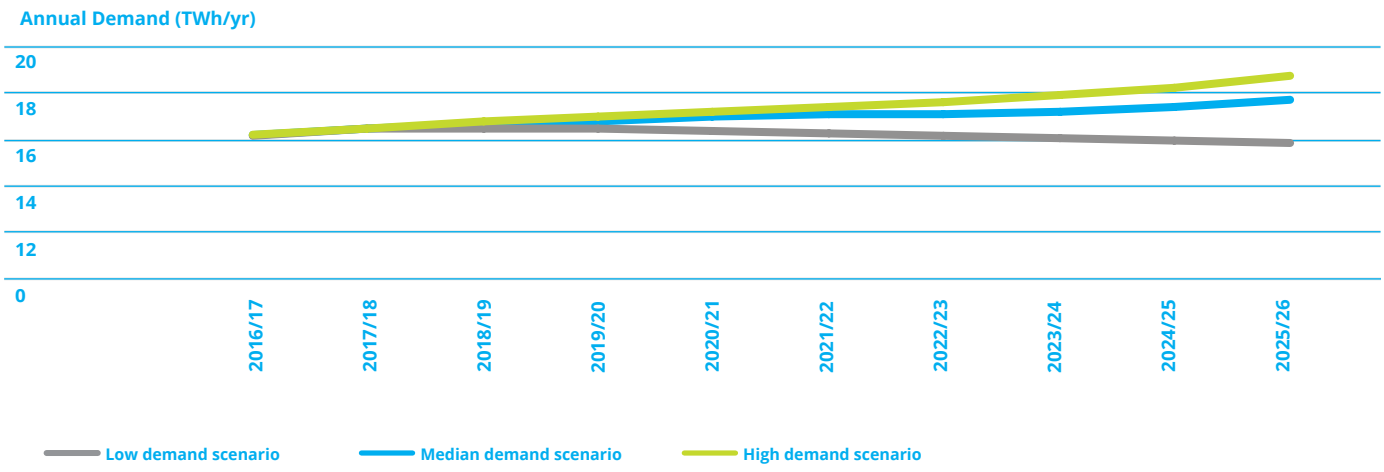


4.4.2 Industrial and Commercial Sector Gas Demand

In the Industrial & Commercial (I/C) sector the low demand scenario profile shows a slight decline, of around 2.2%, in gas demand due to the low GDP growth rate assumed and the impact of energy efficiency measures as set out in NEEAP3. In the median & high demand scenarios 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 NEEAP3 energy savings. The I/C sector demand to 2025/26 is expected to grow by 9.6% and 15.6% in the median and high demand scenarios respectively.

Section Four
Gas Demand Forecasts

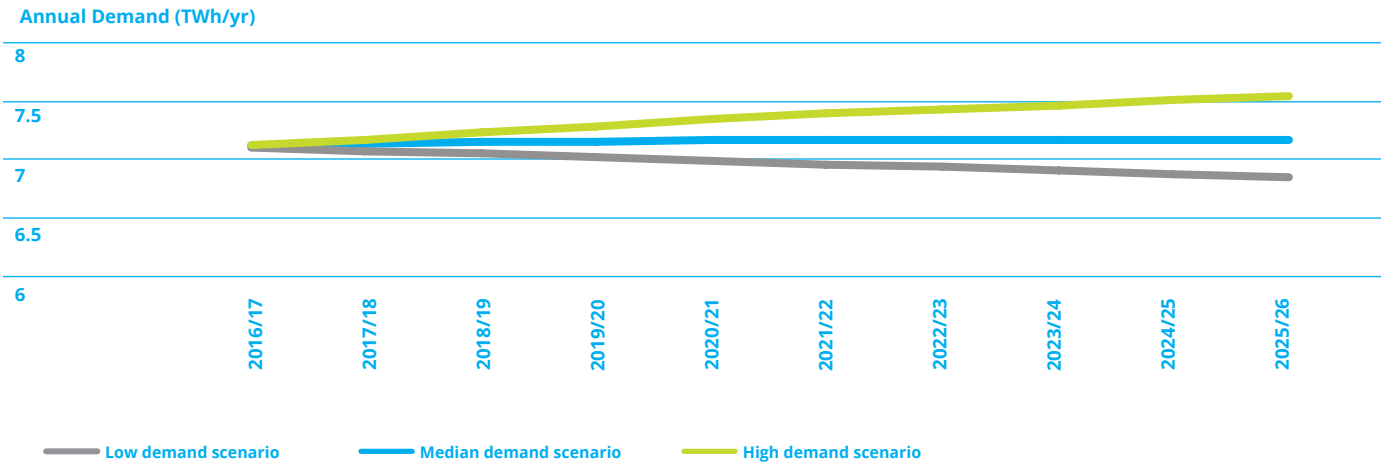
Figure 4-8: Industrial & Commercial Sector Gas Demand



4.4.3 Residential Sector Gas Demand

In the residential sector, for the low demand scenario, despite some growth in new connections demand is seen to decrease due to the impact of domestic energy efficiency measures, contracting by around 3.5%. In the median scenario gas demand is expected to remain stable with gas growing by 5.8% in the high demand scenario driven by the higher growth projections for new connections.

Figure 4-9: Residential Sector Gas Demand



4.4.4 Total Annual Gas Demand

In the median demand scenario, annual ROI gas demand is expected to grow by 12.5% between 2016/17 and 2025/26 with growth of 0% and 23% forecast in the low and high demand scenarios respectively over the same horizon. These differ from previous forecasts which predicted higher growth rates due to the fact that we are starting from a higher base in terms of gas demand. This is primarily as a result of growth in power generation sector gas demand as a result of the change in electricity interconnector flow towards exports. This dynamic is expected to swing slowly back in favour of electricity imports over the forecast horizon leading to flatter demand growth profile than in previous years.

The aggregate ROI system demands for the median scenario are presented in Figure 4-10. Figure 4-11 gives the relative weightings of each sector over the forecast period for the median demand scenario.

Figure 4-10: Total Annual ROI Gas Demands

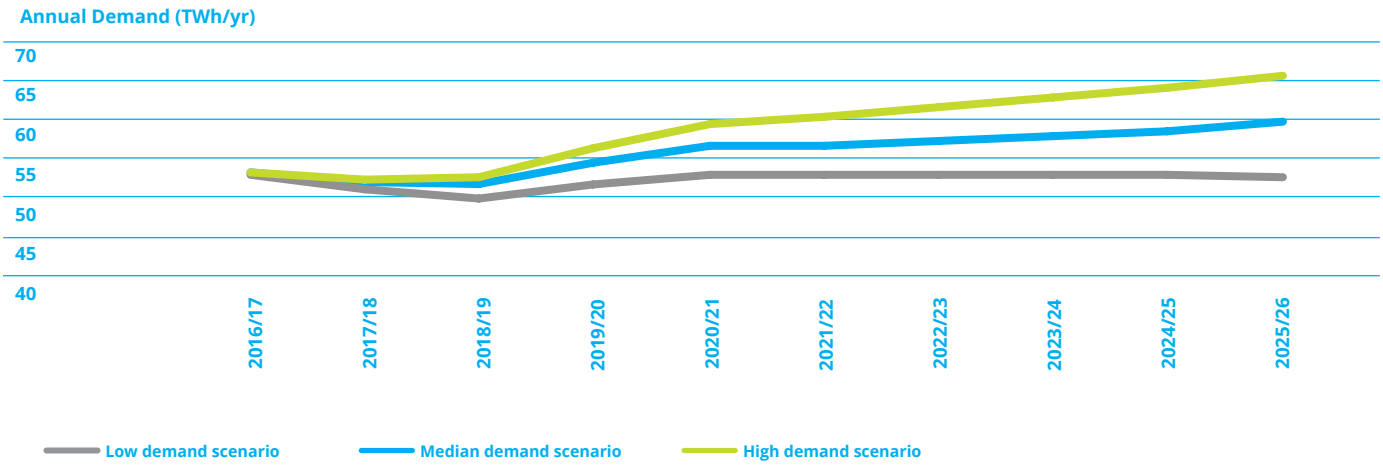
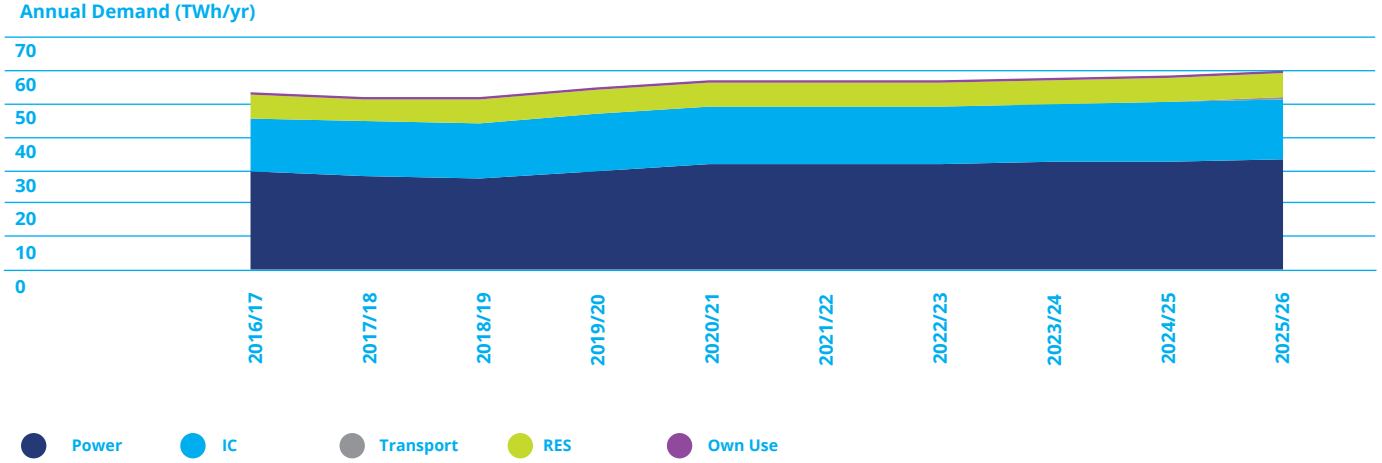


Figure 4-11: Median Scenario Annual ROI Demand by Sector

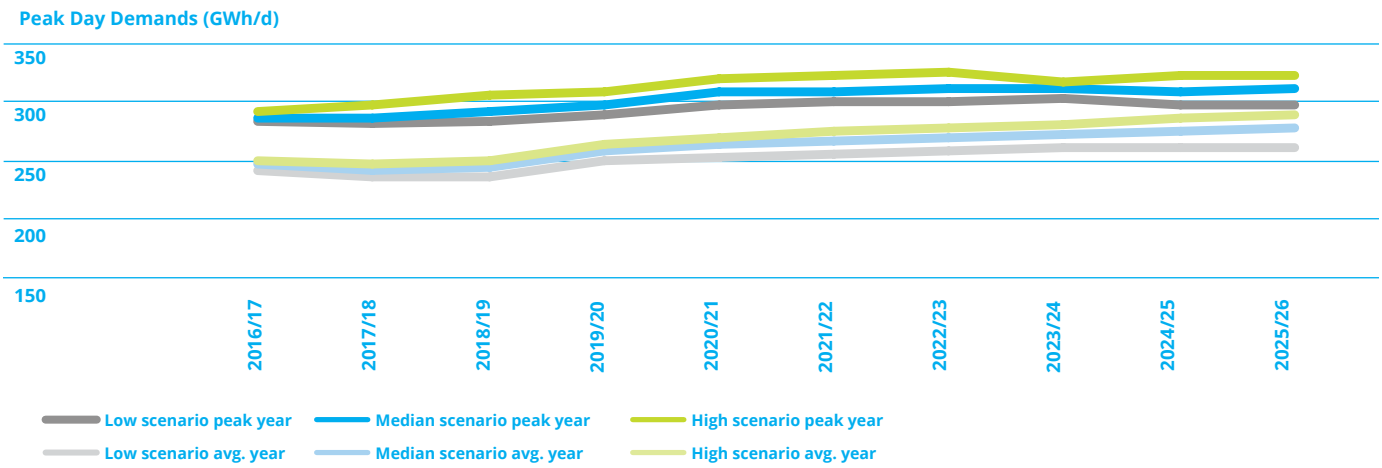


Section Four
Gas Demand Forecasts

4.4.5 Peak Day Gas Demand

The 1-in-50 and average year peak day gas demands for ROI are given in Figure 4-12. The 1-in-50 peak is expected to grow by 8.9% in the median scenario and between 5.6% and 10.7% for the low and high demand scenarios over the duration of the analysis. Average year peaks are expected to grow by 13% in the median scenario and by between 7.8% and 15.8% in the low and high demand scenarios. The development of peak day demands across the various scenarios shows the same broad trends as the annual demand forecasts.

Figure 4-12: Peak Day Gas Demand Forecast



However, there are a number of key differences, particularly with regard to the power generation sector gas demand profile. The nature of the impact of restrictions at the Kilroot coal plant in Northern Ireland is different for the annual and peak demand cases. The IED will lead to a restriction in the number of hours which the plant will run from 2020 which will have a marked impact on the annual demand total. However it is assumed that despite the restricted hours that the Kilroot coal plant would be fully available on the peak day such that there would be no impact on peak day gas demand. Peak day gas demand is only impacted once the plant closes fully in 2023, hence the different dynamic between peak day and annual forecasts.

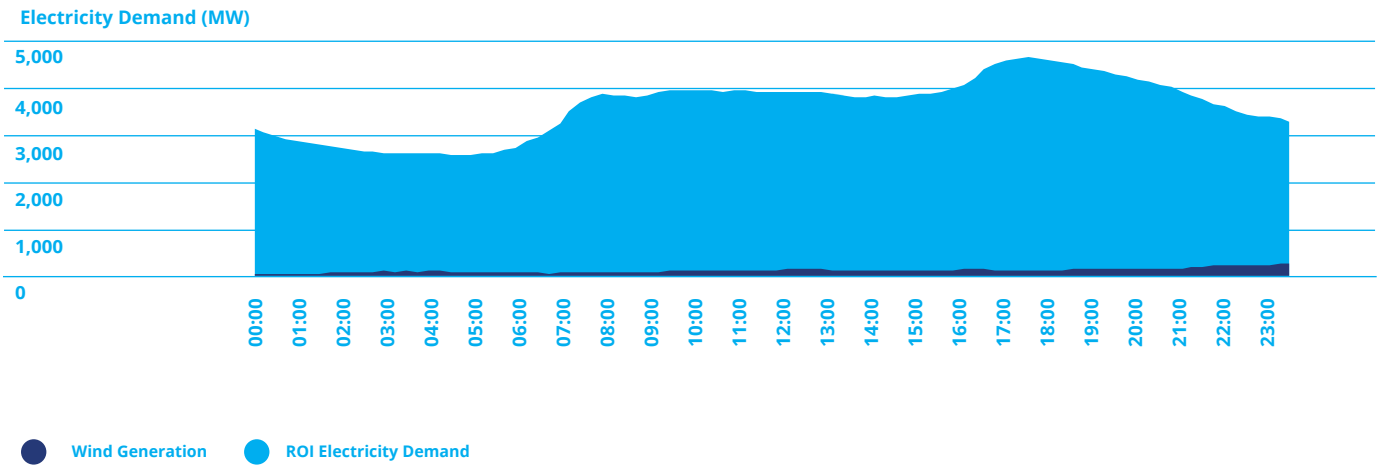
There is also some decoupling of peak day and annual gas demand in the power generation as a result of wind generation's impact on the operation of gas fired plant in the SEM. Annual power generation gas demand is impacted by increasing wind generation capacity, which is displacing gas fired generation or at least offsetting growth in demand.

However, wind generation is assumed to have little impact on the winter peak day. Recent winters have proven that there is limited wind generation available during cold weather peak demand periods. Consequently, there is 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.

Figure 4-13 illustrates the level of dependency the SEM can have on conventional generation on the peak day. Despite an installed wind generation capacity of over 2600 MW in the ROI, wind accounted for an average of just 3.5% of system demand over the course of the 2016/17 peak day which occurred on the 30th of November 2016. At one point wind generation accounted for just

1.4% of electricity demand. The balance of system demand is principally made up of thermal generation along with electricity imports and other renewables.

Figure 4-13: 2016/17 Peak Day Electricity Demand and Wind Generation



4.4.6 Demand Sensitivities

4.4.6.1 Electricity Interconnectors and the Impact on Gas Demand

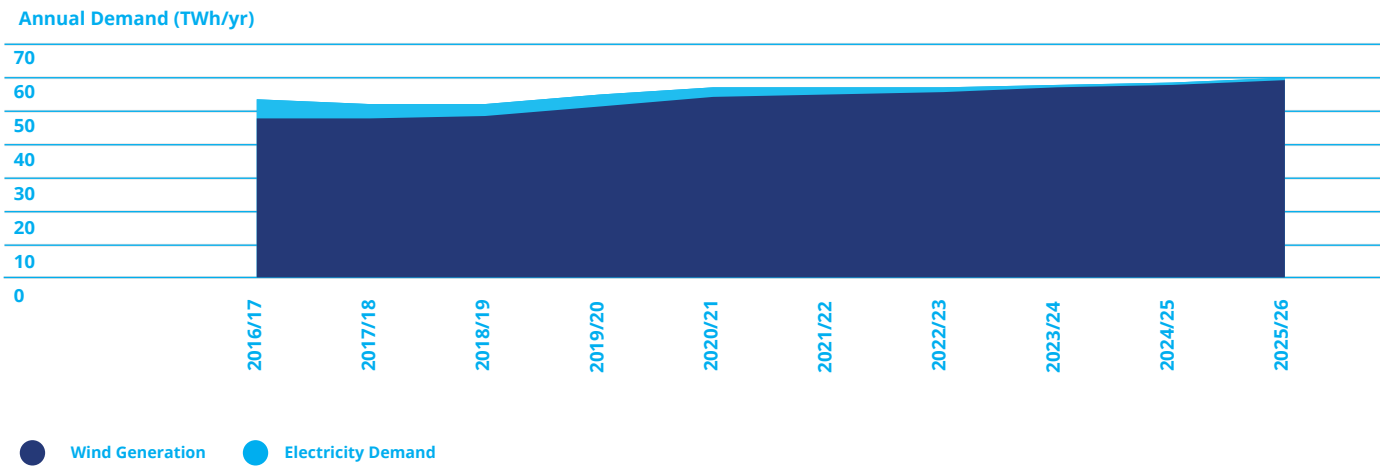
Since the UK government raised the carbon price floor to £18 / ton CO_2 in April 2015 electricity interconnector flows have changed dramatically. Prior to this the flow dynamic had been heavily in favour of electricity imports into Ireland. However since April 2015 there has been a significant shift in the dynamic and now the balance is in favour of electricity exports to Great Britain. This has had a significant increase in power sector gas demand and on gas demand as a whole as described in section 3.4.2.

However the carbon price floor was introduced as a unilateral measure by the UK government and could be withdrawn if there was a significant change in government policy there, although in its 2016 Autumn Statement the UK government reaffirmed its commitment to the carbon price floor until 2021.

This sensitivity considers a case where the carbon price floor is withdrawn and considers the impact on gas demand. This would lead to a return to the interconnector flow dynamic prior to April 2015. Initially this would lead to a significant drop off in gas demand, of the order of 10.7%. However as noted in section 4.4.1 interconnector flows would be expected to swing slowly back in favour of electricity imports into Ireland over the medium to long term in any case as Carbon prices on the ETS approach the GB carbon price as expected. This means that by 2025/26 the differential would have reduced to only 0.5 %.

Section Four
Gas Demand Forecasts

Figure 4-14: Total Annual Gas Demand – Electricity Interconnector Sensitivity



4.4.7 Moneypoint to Gas

The Moneypoint plant in Co. Clare is one of Ireland's largest generating stations utilising coal as its primary fuel. Moneypoint is expected to come to the end of its operating life in its current configuration in 2025. The Energy White Paper – Ireland's Transition to a Low Carbon Energy Future" states:

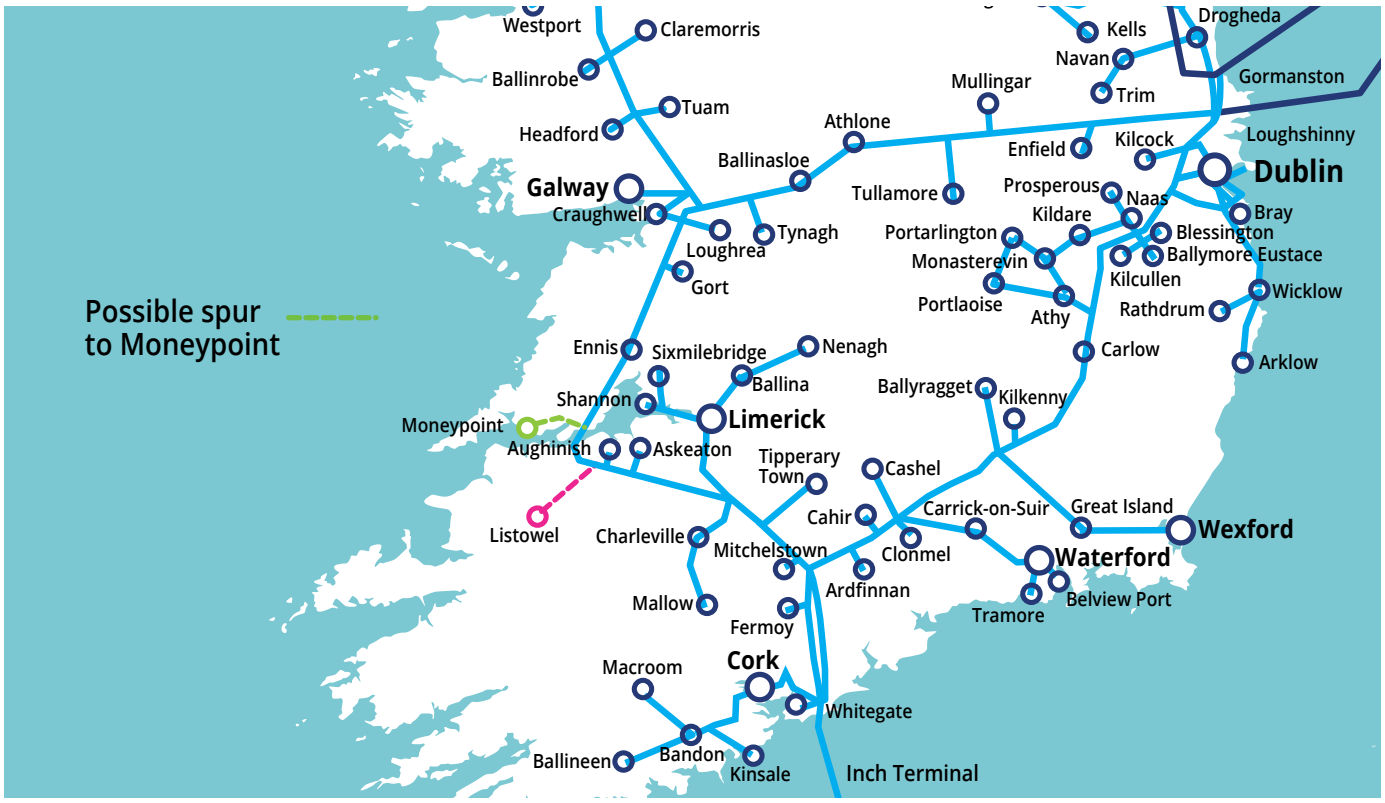
"Before Moneypoint comes to the end of its operating life in its current configuration, in 2025, the most suitable replacement low-carbon generation technology will have to be identified. Key decisions on the future of Moneypoint will be taken before 2020."

Gas Networks Ireland has carried out analysis to assess the capacity of the existing national transmission network to cater for gas fired Combined Cycle Gas Turbines (CCGT) at Moneypoint. The analysis shows there is sufficient capacity on the national transmission network to cater for a CCGT plant of equivalent output on the existing site in Moneypoint via a new spur transmission pipeline approximately 20 km in length. An indicative route of the spur line is represented in Figure 4-15.

The gas network is becoming diverse with renewable gas which will further enhance resilience to the electricity sector, on completion of the 50 km section of pipeline in Scotland, Ireland will have a dual gas interconnector system between Ireland and the United Kingdom, further enhancing Ireland's energy security.

See section 6.6 for further information on the case for converting Moneypoint to natural gas.

Figure 4-15: Possible Routing of Pipeline to Moneypoint



The analysis indicates there is sufficient capacity on the national transmission network to cater for a CCGT via a new spur transmission pipeline to Moneypoint.

Section Five

Gas Supply

Key Messages:

The Corrib gas field commenced production on the 31st of December 2015 and accounted for 39.3% of ROI gas demand in 2015/16.

Corrib is expected to meet up to 56% of annual Gas Networks Ireland system demands in 2016/17, with the Inch and Moffat Entry Points providing the remaining 4.8% and 39.2% respectively.

The Moffat entry point will remain key in terms of energy security as Corrib production declines in the medium term.

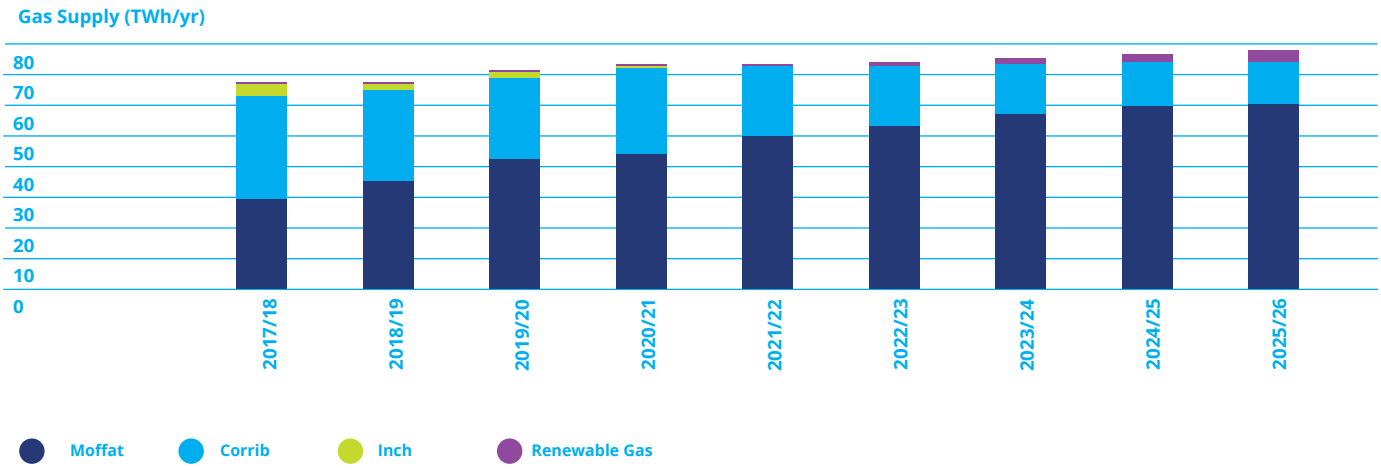
Section Five
Gas Supply

Figure 5-1 presents the forecast Gas Networks Ireland system[23] annual gas supply for the period to 2025/26 for the median demand scenario. In 2015/16 the Moffat Interconnection point accounted for around 54.2% of ROI demand.

The Corrib gas field commenced production on the 31st of December 2015 and accounted for 39.3% of ROI gas demand in 2015/16. Corrib is expected to meet up to 56% of annual Gas Networks Ireland system demands (72% of ROI demand) in 2016/17, with the Inch and Moffat Entry Points providing the remaining 4.8% and 39.2% respectively. By 2025/26 Corrib gas supplies will have declined to less than 40% 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 2018/19. By the end of the forecast horizon Moffat will account for approximately 79% of annual Gas Networks Ireland system demands (approximately 73% of ROI demand).

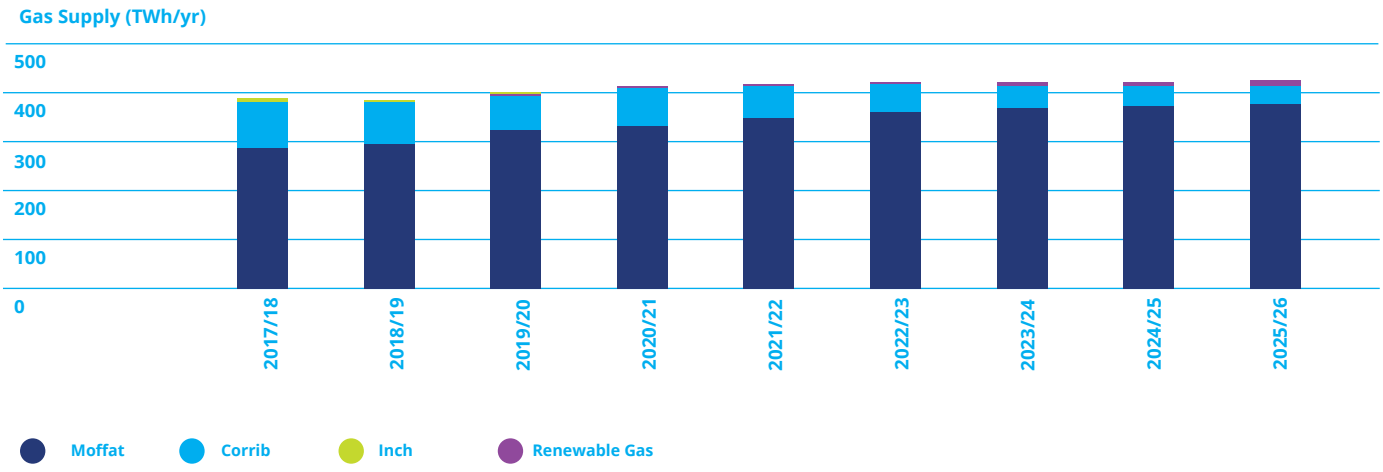
The Gas Networks Ireland system 1-in-50 peak day gas supply profile for the median scenario is presented in Figure 5-2. The Corrib gas field would be expected to supply approximately 33% of ROI peak day gas demand in 2017/18 in the event of a 1-in-50 winter peak day, with Inch accounting for around 4%. The Moffat Entry Point would be expected to meet nearly 63% and 73% of ROI demand and Gas Networks Ireland system demands respectively in 2017/18, in such circumstances. Moffat is anticipated to meet 86% and 90% of ROI and Gas Networks Ireland system peak day demands respectively in 2025/26. The gas supply outlook highlights the continued critical role of the Moffat Entry Point throughout the forecast period.

Figure 5-1: Annual Gas Networks Ireland System Gas Supply Forecast – Median Scenario



23 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.

Figure 5-2: 1-in-50 Year Peak Day Gas Supply Forecast – Median Scenario



5.1 Moffat Entry Point

The Moffat Entry Point has a current technical capacity of 31 mscm/d (342 GWh/d) and supplies gas to ROI, NI and IOM. This technical capacity is expected to increase to 34 mscm/d following the completion of the twinning of South West Scotland Onshore system (PCI 5.2). 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) facilitates Ireland's participation in an integrated European energy market.

5.2 Corrib Gas

The Corrib gas field came on line on the 31st of December 2015. Following on from the successful completion of commissioning on the 29th of June 2016, Corrib is now operating at full capacity. During days of low demand in summer, Corrib is projected to meet full ROI gas demand. Table 5-1 shows the forecast maximum daily supplies from Corrib.

Table 5-1: Corrib Forecast Maximum Daily Supply

	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26
Daily Supply (mscm/d)	9.91	9.40	8.29	8.38	8.04	6.42	5.31	4.51	3.79	4.00
Daily Supply (GWh/d)	103.5	98.2	86.6	87.5	84.0	67.1	55.5	47.1	39.6	41.8

Section Five
Gas Supply

5.3 Celtic Sea Gas Storage

The Kinsale storage facility is operated by PSE Kinsale Energy Limited (KEL) using the depleted Southwest Kinsale gas field. KEL advised the CRU in 2015 that it plans to cease full storage operations in 2016/17 and commence blowdown of Southwest Kinsale. Blowdown is where the gas used for pressure support in Southwest Kinsale is produced and sold into the market. There will be no further injections into Southwest Kinsale. Production and storage gas will be supplied from the Inch entry point for winter 2016/17, with production gas only supplied from the Inch entry point from summer 2017 onwards. Currently production is expected to cease in 2020/2021.

Table 5-2: Inch Forecast Maximum Daily Supply

	17/18	18/19	19/20	20/21	21/22	22/23	22/23	23/24	24/25	25/26
Daily Supply (mscm/d)	1.41	0.77	0.52	0.38	0.0	0.0	0.0	0.0	0.0	0.0
Daily Supply (GWh/d)	14.87	8.08	5.43	3.96	0.0	0.0	0.0	0.0	0.0	0.0

Once production/blowdown ceases, it is likely that the compression facilities and assets at Midleton Compressor Station will be decommissioned. See section 9.1.3.3 for details on the future plans for the Midleton site.

5.4 Shannon LNG

Shannon LNG has indicated an earliest possible start date of 2021 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 which will deliver gas into the ROI transmission system. The initial phase will involve the construction of LNG process tanks, and re-gasification facilities with a maximum export capacity of up to 17.0 mscm/d (191.1 GWh/d).

5.5 Renewable Gas

Energy from bio-methane or Renewable Gas (RG) has the potential to contribute significantly to Ireland's renewable energy targets. In particular, RG could greatly assist Ireland in meeting the EU targets for thermal energy from renewables (RES-H) and transport fuel from renewables (RES-T). In addition to being a carbon neutral fuel, renewable gas production can also deliver significant greenhouse gas mitigations for the Agriculture sector, with elimination of GHG emissions from current slurry storage, slurry land spreading practices, and crop residue emissions. A study published by the EU Commission in March 2017 – "Optimal use of biogas from waste stream, An assessment of the potential of biogas from digestion in the EU beyond 2020", highlights that Ireland has the highest potential for biogas production per capita within the EU by 2030, with a potential of 13 TWh/annum forecast.

As with other renewable energy technologies, renewable gas requires state policy and incentive supports to allow this industry develop and grow to a long term competitive fuel. With the pending implementation of the first Renewable Heat Incentive (RHI) for production and grid injection of bio-methane, Gas Networks Ireland has produced three renewable gas production forecasts (low, medium and high) based on assumed different levels of support via an RHI scheme (or equivalent).

Table 5-3 gives Gas Networks Ireland's medium national renewable gas production forecast. Renewable gas is discussed further in section 6.5

Table 5-3: Renewable Gas Supply Forecast

	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26
RG production (GWh/yr)	0.75	18.25	87.75	310.75	713.25	1,152.75	1,610.75	2,164.25	2,824	3,561

5.6 Floating Storage & Regasification Units

The European Commission's "Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy" [24] gives concrete expression to the EU's ambition to bring about a transition to a sustainable, secure and competitive energy system. Liquefied Natural Gas (LNG) offers many benefits from improving security of supply, competitiveness and has the potential to reduce environmental impacts and hence the EU's sustainability objective, this is highlighted in the "EU's strategy for liquefied natural gas and storage"[25].

The EU highlights the emergence of floating storage and regasification units (FSRUs) as cost-effective solutions and has changed the dynamics of investment in import capacity due to lower investment costs and shorter lead times. The EU cites the example of the Klaipeda FSRU in Lithuania that shows the prospect of a new LNG source in the market that can drive improvements in terms of gas security of supply and price competitiveness.

The FSRU acts as a central hub for LNG storage, where LNG vessels can dock alongside the FSRU as required to transfer gas into the network via the FSRU and also permits LNG vessels to provide permanent storage options for security of supply. A larger and more liquid global LNG market presents an opportunity for the EU.

5.7 Other Supply Developments

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

24 EU Commission (2015) 80
25 EU Commission (2016) 49 final

Section Six

Gas Growth

Key Messages:

Key initiatives such as Compressed Natural Gas for transport and Renewable Gas will help Ireland meet its environmental targets and customer needs in the transport and heat sectors.

Natural gas and renewable gas can help households, SMEs and large I/C customers to reduce costs, reduce emissions and the gas network ensures that customers have access to a safe, reliable, convenient source of energy.

Natural gas and renewable gas have an important role to play in Ireland's transition to a low carbon economy.

Section Six
Gas Growth

Gas can be used in transport and this is a new area of focus for Gas Networks Ireland as it provides an alternative low carbon fuel to the transport sector and increases demand on the gas network. As more people use the gas transportation system this can help to reduce network tariffs for all customers which is important for the competitiveness of gas and benefits all gas customers. The introduction of renewable gas gives customers access to an indigenous source of renewable energy to help them decarbonise their energy usage and provides environmental benefits to Ireland as a whole. It is evident that gas, both natural and renewable, has an essential role in Ireland's transition to a low carbon economy.

6.1 Residential New Connections Growth

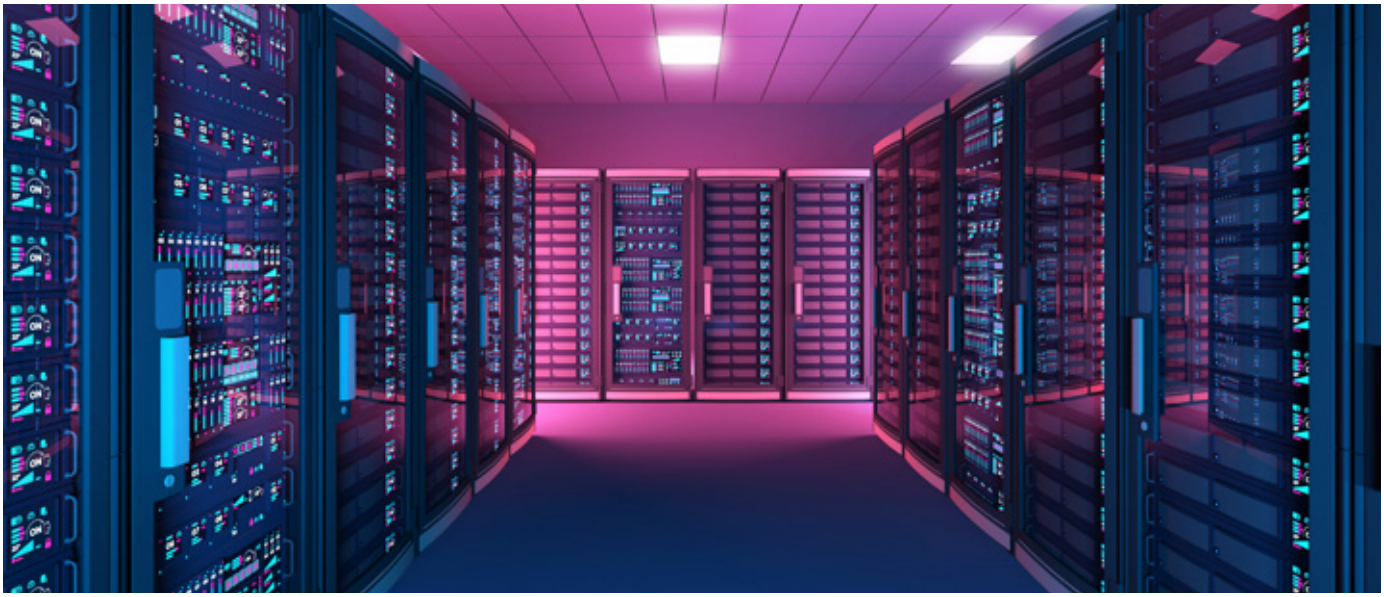
There are a large number of properties located close to the gas network which are not connected to it. It is estimated that there are over 700,000 households in Ireland using oil for central heating and 300,000 of those have a gas network nearby and could be readily connected to gas[26] resulting in a more convenient cost effective heating solution for the consumer and significant benefits from an environmental perspective. Gas Networks Ireland provides Pay-As-You-Go gas meters that can help people to manage their energy usage and costs.

The Government strategy on social housing targets the development of 35,000 social housing units over the six years from 2015 to 2020[27]. Of the 35,000 houses, 22,000 are expected to be new builds, 2,000 are expected to be existing dwellings that will be refurbished or brought back into use, with the remaining 11,000 expected to be leased. There is also an opportunity to install cheaper, cleaner and more convenient gas heating in social housing.

26 The Future of Oil and Gas in Ireland', Policy Advisory by the Irish Academy of Engineering, February 2013.
27 http://www.housing.gov.ie/sites/default/files/publications/files/social_strategy_document_20141126.pdf

There has been increased activity in the new housing sector which was highlighted in a recent CSO publication showing planning permissions granted for dwelling units in 2016 up by 26% compared with 2015[28]. The Central Bank has stated in its Q2 quarterly bulletin that the evidence from a broad range of domestic spending and activity data is that the Irish economy continues to grow at a healthy pace, supported by the strength of domestic demand[29]. In addition, the quarter bulletin outlined that building and construction spending is accelerating, registering an increase of 13.7% in 2016, driven by an increase in housing investment of 19% and an increase in non-residential building of 11.4%. As a result circa Gas Networks Ireland expects to connect 125,000 new domestic customers to the gas network by the end of the NDP period which will result in 1,306GWh of annual demand.

6.2 Industrial & Commercial Sector Development



Many I/C customers with thermal heat requirements are actively looking to natural gas and renewable gas as a means of decarbonising their processes and reducing costs. In 2016 the Renewable Gas Forum of Ireland (RGFI), of which Gas Networks Ireland is a member, surveyed large manufacturing companies in Ireland about their thermal energy needs. The results highlighted that 75% of those companies that were surveyed have specific targets to reduce their carbon footprint and 57% of the companies surveyed would be interested in using renewable gas to help achieve their targets. Natural gas is viewed as providing a reliable, convenient, flexible, cost effective, environmentally friendly fuel source and renewable gas also has the potential to offer the additional benefit of carbon neutral emissions. Further information about renewable gas can be found in section 6.5. Some of the other key areas of focus for the I/C sector are detailed in the following sections. Overall, Gas Networks Ireland expects to add circa 3,000 GWh of annual demand from the I/C sector by the end of the NDP period.

28 Central Statistics Office Press Statement CSO releases "Planning Permissions Quarter 4, 2016" http://www.cso.ie/en/media/csoie/newsevents/documents/pressreleases/2017/PPQ42016.pdf
29 https://centralbank.ie/docs/default-source/publications/quarterly-bulletins/quarterly-bulletin-no-2-2017.pdf?sfvrsn=9

Section Six
Gas Growth

6.2.1 Data Centres

Ireland has rapidly emerged as a prime data hosting destination due to its global connectivity to Europe and the Americas, combined with excellent utility infrastructure, moderate climate, stable economic policies and IDA[30] support. Data centres are inherently large users of electricity with their annual usage varying from 12 GWhe for a small data centre to a 520 GWhe for a very large data centre. There are approximately 25 data centres currently operating in Ireland with substantial future growth predicted in this sector.

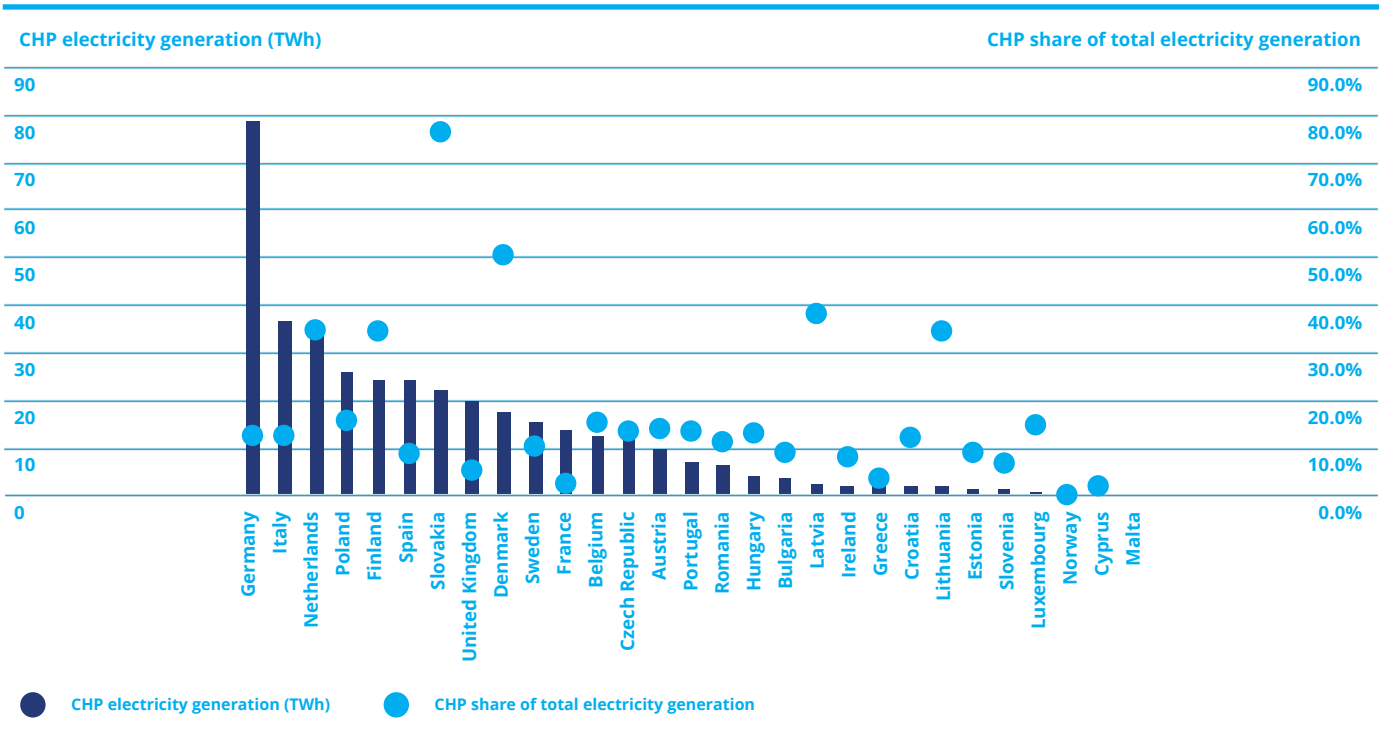
Gas Networks Ireland has developed a combined offering of Natural Gas, Renewable Gas and Combined Heat and Power (CHP), as the primary source of energy for the data centre sector. Gas can be used for onsite electricity generation leveraging the existing reliable natural gas network infrastructure, offering data centre operators' substantial savings in terms of energy costs. Gas Networks Ireland has contracted with two data centres and remains focused on connecting further data centres to the gas network. Data centres are a potentially large source of demand for example the two data centres that have contracted with Gas Networks Ireland have a demand for gas of circa 400 GWh.

6.2.2 Combined Heat & Power

Combined Heat & Power (CHP) technology combines the generation of electricity at a local level with the use of heat for process use and/or space heating. CHP technology provides distributed power generation reducing the reliance on the national electricity grid. Gas fired CHP plants are highly efficient in their use of energy and offers substantial savings when compared to grid electricity.

The number of CHP installations in Ireland is currently below the European average as illustrated in Figure 6 1, which shows that CHP represents an estimated 7.8% of the total electricity generated in Ireland in 2013, compared to an EU average of 11.7% [31].

Figure 6-1: CHP Share of Total Electricity Production – Source Eurostat



30 The IDA (Industrial Development Agency) is a semi state body whose main objective is to encourage investment into Ireland by foreign-owned companies
31 as per, Eurostat Combined Heat and Power (CHP) data 2005-2013

Applications of CHP technology range from smaller users such as nursing homes, hospitals and hotels up to large industrial applications such as data centres, dairy processing plants and the pharmaceutical sector. Gas Networks Ireland held a CHP conference in October 2016 which was well attended by over 160 participants.

6.2.3 Other Developments

Since the elimination of the milk quota system on 1st April 2015 the dairy industry has seen substantial growth and this is predicted to continue. Teagasc has predicted that milk production will expand considerably due to changes in the milk quota system and Gas Networks Ireland has seen increased energy usage from the dairy sector. Gas Networks Ireland has been promoting the most up-to-date technologies, including CHP, to optimise energy efficiency and reduce the carbon footprint of these facilities. A number of gas users in the dairy sector have upsized their facilities or built new dairy processing facilities resulting in increased gas usage in this sector. Gas Networks Ireland is also advocating for the use of renewable gas to ensure carbon neutral dairy processing. Renewable gas can be injected into the natural gas grid and off-taken at these processing facilities without any requirement to change equipment.

Ireland continues to attract new Foreign Direct Investment (FDI) developments in the pharmaceutical and bio-medical sector. Gas Networks Ireland is focused on developing further gas demand growth in this key sector of the economy, and ensuring that existing customers utilise the most up to date and sustainable technologies, including CHP and renewable gas.

6.3 New Towns and Suburbs Policy

Gas Networks Ireland has connected over 20 new towns during the last ten years. Nenagh and Wexford town have recently been connected to the gas network and Listowel is due to be connected in 2017. Gas Networks Ireland will pursue further new town connections where demand is sufficient to meet the requirements of the new towns section of the connections policy. In addition, the connection policy which was updated in 2015 contains a section on the treatment of suburb projects. This section allows for the gas network to be extended to industrial zones or streets/regions that are close to the gas network but not connected. They can be connected as long as it results in a minimal increase to the existing network. Gas Networks Ireland has identified a number of suburb projects and will be connecting them in the near future.

Section Six
Gas Growth

6.4 Compressed Natural Gas

Ireland is facing an emissions challenge in transport which requires immediate action. Using Compressed Natural Gas (CNG) to power trucks and buses offers a real solution to reducing emissions from diesel-fuelled heavy vehicles. This is important considering that heavy goods vehicles account for 20% of all energy related carbon dioxide (CO2) emissions in the road transport sector, despite accounting for only 3% of the total number of road vehicles [32]. The Energy White Paper – "Ireland's Transition to a Low Carbon Energy Future", identifies developing "a national policy framework to underpin and support the deployment of infrastructure for the use of alternative transport fuels, including compressed natural gas (CNG)" as a key renewable energy action. The Department of Transport, Tourism and Sport published its National Policy Framework in June 2017 which highlighted that in line with the requirement of the Alternative Fuels Infrastructure Directive, Ireland expects to develop 19 CNG stations by 2020 and a total of 70 stations by 2025, all located in strategic urban and suburban locations. The document also outlines a target of 102 public and private CNG stations across Ireland by 2030.

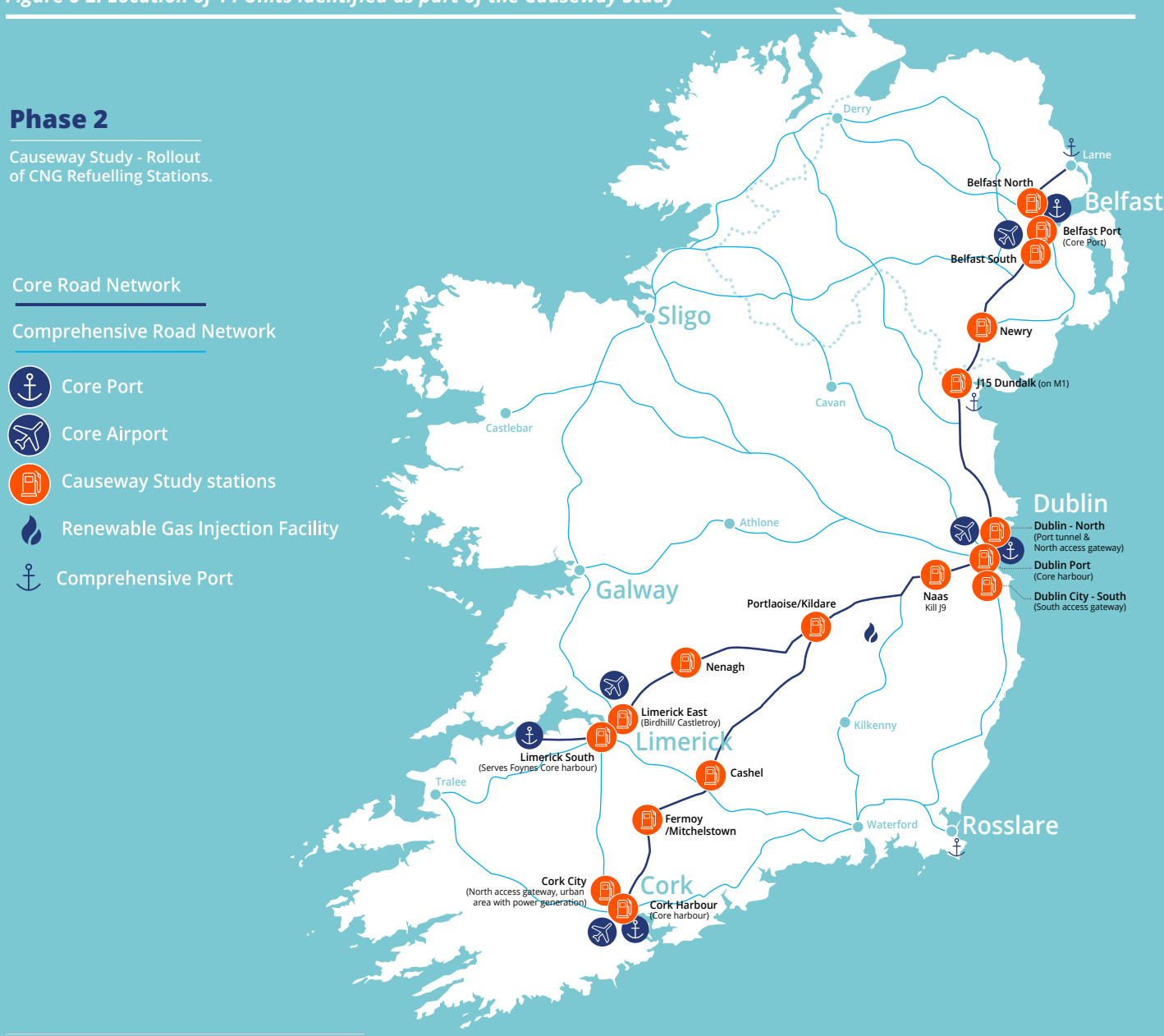
Another notable undertaking within the White Paper is the establishment of a Green Bus Fund to promote sustainable public transport. This initiative intends "to support energy efficient and renewable transport, by establishing a "green bus fund to support the purchase of cleaner and greener public transport vehicles in the period to 2020".

In order to facilitate these initiatives and encourage the uptake of CNG by commercial fleet operators Gas Networks Ireland is undertaking a European funded project called the Causeway Study. This study aims to examine the impact of increased levels of fast fill CNG stations on the operation of the transmission and distribution gas networks in the Republic of Ireland (ROI). The CRU approved innovation funding of €12.83m to allow Gas Networks Ireland to avail of European Funding for the project. To that end, a pilot network of 14 CNG units along the TEN-T (Trans European Transport Network) Core Road Network will be built as a pilot

32 Energy in Transport 2014, Sustainable Energy Authority of Ireland

activity to assess the impact on the gas network. Activities will encompass developing an understanding of the operation and planning of the network, CNG equipment, CNG user demand patterns and behaviours, and the injection of renewable gas into the gas transmission system. The National Mitigation Plan[33] (NMP) was published in July 2017 and the deployment of 14 CNG refuelling stations and a renewable gas injection facility is one of the actions in the NMP with regard to decarbonising transport. Another action within the NMP is to continue to encourage the adoption of natural gas as a cleaner transport fuel by maintaining the excise rate applied at the minimum rate allowable under the Energy Tax Directive.

Figure 6-2: Location of 14 Units identified as part of the Causeway Study



33 http://www.dccae.gov.ie/en-ie/climate-action/publications/Documents/7/National%20Mitigation%20Plan%202017.pdf

Section Six
Gas Growth

The Causeway Study consists of 6 activities with deliverables and milestones which must be completed by 2020. These activities are Programme Management, Pilot CNG Network, CNG Vehicles and Supports, Renewable Gas Injection Facility, System Operation & Data Analysis and Communication & Dissemination. The installation of the 14 CNG stations across the network is essential to the success of the Causeway Study and to achieving a critical mass of demand on the gas network. The CNG Stations will be strategically located to deliver the required outputs of the Causeway Study and to maximise utilisation of the assets.

In the longer term, Gas Networks Ireland is proposing to develop a 70-station CNG fuelling network, co-located in existing forecourts, on major routes and/or close to urban centres. This will help satisfy the requirements of the EU's Alternative Fuels Directive which aims to establish CNG refuelling facilities along the TEN-T Core Road Network and is in line with the National Policy Framework for Alternative Fuels Infrastructure as published by the Department of Transport Tourism and Sport on the 31st May 2017. This comprehensive refuelling station network, will allow a transition to both natural gas and renewable gas as alternative fuels. The existing natural gas network can be utilised as a national vehicle refuelling network, giving the commercial transport sector access to a cleaner, cheaper fuel with a similar operational performance to diesel. For areas not connected to the natural gas network, CNG can be supplied in a similar way as diesel is supplied to service stations, by transporting it by road.

As a commercial proposition CNG is also much cheaper than diesel and operators of CNG vehicles can avail of substantial fuel costs savings. Furthermore the government has committed to a fixed excise duty rate for natural gas and renewable gas until 2023, helping to ensure a low and stable price.

Gas Networks Ireland is currently targeting at least 5% penetration of CNG or RG for commercial transport and 10% of the bus market in Ireland by 2025. By the end of the current NDP period, Gas Networks Ireland is expecting to see annual CNG demand of circa 477 GWh. Please see section 4.3.4 for more information on the projected transport sector gas demand.

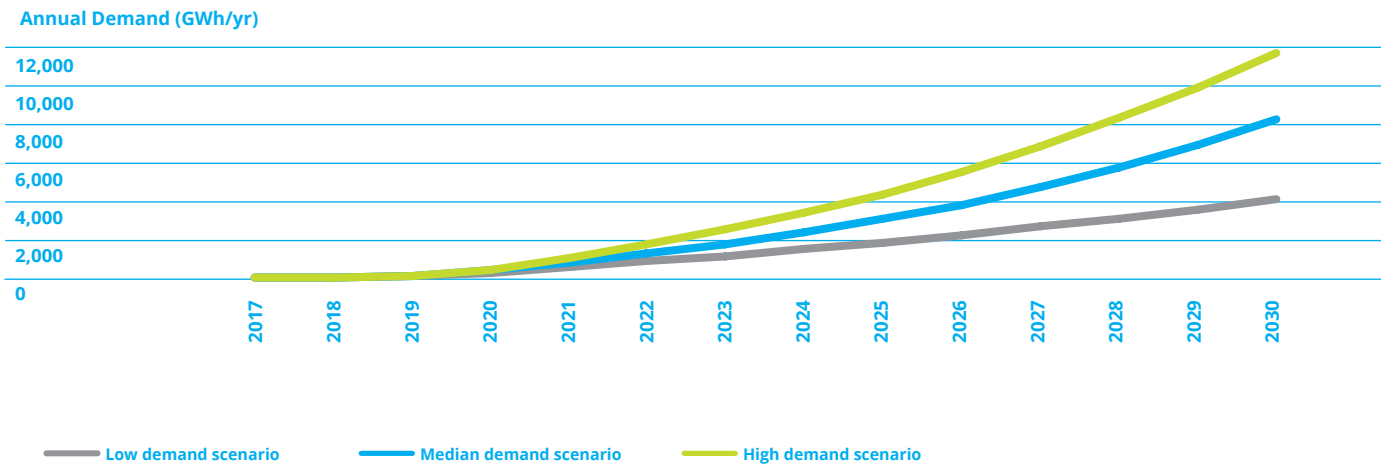
Figure 6-3: Clean Ireland Recycling CNG Facility

6.5 Renewable Gas

Renewable Gas (RG) is an indigenous, clean, sustainable, and carbon neutral source of energy. Renewable gas can be produced from many organic materials and upgraded to a standard which is identical to natural gas. RG can be injected into the gas pipeline network or it can be used independently as a fuel for heating, transport or power generation. RG is also referred to as biogas, bio-methane or green gas. Biogas can be purified to bio-methane to be classified as RG and to be suitable for grid injection, thus this represents a significant source of RG. 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 RG into the future. Renewable gas production can also deliver significant greenhouse gas mitigations for the Agriculture sector, with elimination of GHG emissions from current slurry storage, slurry land spreading practices, and crop residue emissions. A study published by the EU Commission in March 2017 – "Optimal use of biogas from waste stream, An assessment of the potential of biogas from digestion in the EU beyond 2020", highlights that Ireland has the highest potential for biogas production per capita within the EU by 2030, with a potential of 13 TWh/annum forecast[34].

RG is already well developed and available at competitive rates in other European countries, leaving Ireland at a competitive disadvantage within the EU. The Department of Communications, Climate Action and Environment (DCCAE) is currently developing a Renewable Heat Incentive (RHI) for Ireland. State support is required to cover the price gap between wholesale natural gas and the cost of producing bio-methane. The inclusion of bio-methane in the RHI is critical for the development of renewable gas to grid projects in Ireland. Gas Networks Ireland is targeting 20% RG on the gas network by 2030, which is in-line with projections in a wide range of peer reviewed publications on Ireland's sustainable and accessible resources for biogas production. Gas Networks Ireland has produced three renewable gas production forecasts (low, medium and high) based on assumed different levels of support via an RHI scheme (or equivalent).

Figure 6-4: Potential Renewable Gas Supply 2017 - 2030



The National Mitigation Plan recognises that biogas from waste streams and from energy crops is one of the options for renewable heating and highlights that the planned Renewable Heat Incentive (RHI) scheme will provide a key policy support measure for this development.

34 https://ec.europa.eu/energy/sites/ener/files/documents/ce_delft_3g84_biogas_beyond_2020_final_report.pdf

Section Six
Gas Growth

As mentioned in section 6.2, multi-national companies are increasingly seeking to procure renewable gas to meet their corporate global Corporate and Social Responsibility obligations to decarbonise . RG is particularly valued by many of these companies, especially those in the pharmaceutical, food or beverage processing sectors which have large thermal loads and require clean, reliable and secure supply of primary energy[35]. RG is emerging as an important factor in terms of securing ongoing and future investment in Ireland with the associated economic benefits. Other benefits of facilitating RG on the Irish gas grid include enhanced energy security and diversity of supply, while also creating direct employment and enhancing rural and regional economic development. RG production processes are the most environmentally friendly and economical means of processing such wastes, compared to the current practises in Ireland of composting, landfill, exporting, land spreading and incineration.

Gas Networks Ireland is involved in a project to install the first renewable gas injection facility in Ireland with Green Generation in Co. Kildare. A Network Entry Facility is a facility which allows renewable gas to enter a gas network. The Network Entry Facility for this project is designed to inject up to 1,200 m3/hr of renewable gas (108 GWhr/annum) and will act as a template for following project designs. More than a dozen other developments are being progressed with Gas Networks Ireland through Renewable Gas Forum Ireland (RGFI).

Figure 6-5: Green Generation, Nurney, Co. Kildare. First bio-methane grid injection project in Ireland

Green Gas Certification & Guarantees of Origin.

The current re-cast draft of the EU Renewable Energy Directive provides for clear recognition of renewable gas and associated Guarantees of Origin for supply of renewable gas via gas grid systems. A key requirement that comes with this recognition is for a robust Green Gas Certification scheme and service. To that end, the International Energy Research Centre, Gas Networks Ireland and the Renewable Gas Forum of Ireland are jointly funding a contract with Deutsche Biomasseforschungszentrum (DBFZ) and the German Energy Agency, to develop a certification scheme for renewable gas in Ireland. Marine & Renewable Energy Ireland

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

(MaREI) will be assisting DBFZ in engaging the Irish Departmental and State Authorities on this project. Green Gas Certificates will allow end users to purchase renewable gas in confidence and give government and regulators the certainty that the sales of renewable gas are transparent and accounted for. The scheme will be the first of its kind in Ireland.

6.6 Electricity Sector

The Moneypoint generating station in Co. Clare is expected to come to the end of its operating life in its current configuration in 2025. As stated in The Energy White Paper, a suitable replacement will have to be identified. As detailed in section 4.4.7, Gas Networks Ireland has carried out an analysis which indicates that there is sufficient capacity to accommodate a CCGT on the gas grid at Moneypoint's current location, via a new spur transmission pipeline approximately 20 km in length. Gas Networks Ireland believes that a modern CCGT gas plant offers by far the most efficient technology and represents a low risk option using a cost effective and proven technology.

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 and other renewables. Gas fired power plants are the most environmentally friendly thermal plant, producing substantially lower emissions than coal, peat or oil fired plant, see Table 6-1 and when coupled with Carbon Capture and Storage (CCS) there is the potential to provide practically zero carbon electricity to the Irish economy.

Table 6-1: Indicative Carbon Emissions by Fuel Type[36]

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

Gas fired generation accounted for approximately 49% of Ireland's electricity generation in 2016. 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 680,000 users including some of our largest multinational and indigenous industries.

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

Converting Moneypoint to a gas fired power generation plant would have significant benefits for existing gas & electricity customers. Maximising the utilisation of the gas infrastructure can help ensure a competitive gas tariff. With the completion of the twinning project in Scotland and with Corrib coming on stream gas supplies are more secure than ever. Furthermore with potential developments in RG and LNG the gas network provides access to diversified gas supplies.

36 Based on carbon emission factors published by SEAI.

Section Seven

Projects of Common Interest

Key Messages:

The Twinning of the South West Scotland Onshore system (PCI 5.2), is in the construction phase and remains on schedule for completion in the gas year 2017/18 and will enhance security of supply to the island of Ireland.

Gas Networks Ireland was allocated funding by the EU Commission for feasibility studies for physical reverse flow at Moffat following successful evaluation of an application through the EU Innovation and Networks Executive Agency. Funding of 50% of the total budget for the feasibility study was granted, the maximum grant allowed for studies. The study is expected to be completed over the next fifteen months.

Figure 7-1: PCI 5.2: Construction ongoing of 50 km Section of Pipeline in Scotland

Section Seven
Projects of Common Interest

7.1 Projects of Common Interest

To help create an integrated EU energy market, the European Commission has drawn up a list of 195 key energy infrastructure projects known as Projects of Common Interest (PCIs). These are essential for completing the European internal energy market and for reaching the EU's energy policy objectives of affordable, secure and sustainable energy.

To become a PCI, a project must have a significant impact on the energy markets and market integration of at least two EU countries, boost competition on energy markets and boost the EU's energy security by diversifying sources, and contribute to the EU's climate and energy goals by integrating renewables.

Candidate projects are proposed by their promoters. They are then assessed by so-called Regional Groups that include representatives from EU countries, the Commission, transmission system operators and their European networks, project promoters, regulatory authorities, as well as the Agency for the Cooperation of Energy Regulators (ACER). ACER is responsible for assessing gas projects' compliance with the PCI criteria and their European added value.

After these assessments, the Commission adopts the list of approved PCIs via a delegated act procedure.

The list of projects is then submitted by the Commission to the European Parliament and Council.

The first list of PCIs was published in 2013. The list is updated every two years to integrate newly required projects and remove obsolete ones. The third PCI list is expected to be published in the last quarter of 2017 by the EU Commission.

The previously approved project, PCI 5.2 Twinning of the South West Scotland Onshore system remains on schedule with construction ongoing and the pipeline will be operational for the gas year 2017/18 and will enhance security of supply to the island of Ireland. It brings many other benefits and compliments another PCI, PCI 5.1.1 Physical Reverse Flow at Moffat interconnection point (Ireland/United Kingdom). GNI (UK) submitted an application under the Connecting Europe Facility (CEF) for feasibility studies for Physical Reverse Flow at Moffat in 2016. CEF funding of 50% (maximum grant allowed for studies) of the total budget was thus granted. Completion of PCI 5.2 is a key prerequisite for physical reverse flow at Moffat.[37]

To become a PCI, a project must have a significant impact on the energy markets and market integration of at least two EU countries, boost competition on energy markets and boost the EU's energy security by diversifying sources, and contribute to the EU's climate and energy goals by integrating renewables.

37 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.

Section Eight

Commercial Market Arrangements

Key Messages:

Gas Networks Ireland supports the development of new entrants to both the retail and wholesale markets.

At EU level, following recent development of network codes through various ENTSOG workgroups the focus has moved to implementation at national level.

With the onset of Brexit, Gas Networks Ireland is fully committed to ensuring that gas will continue to flow through its interconnectors and that security of gas supply will not be negatively impacted.

Section Eight
Commercial Market Arrangements

8.1 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; and
- 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. It is expected that Brexit will result in the UK no longer being part of the Internal Energy Market. This will have a knock on effect on Ireland, whereby Ireland will still need to implement EU legislation and regulation but the UK will no longer be obliged to do so. Gas Networks Ireland remains committed to working closely with neighbouring transporters, regulators and government departments to ensure that all necessary transitional and/or enduring arrangements are in place prior to Brexit occurring so as there will be no negative impact to gas flows to Ireland via the interconnectors.

8.2 European Developments

Following the development of network codes through various workgroups, facilitated by ENTSOG[38], the focus has moved to implementation at national level. A project team was established in order to deliver the modification to the Code of Operations and associated market rules that are required to deliver compliance.

The objective of the project was to deliver the necessary work packages to support the EU Network Code requirements as described in the following sections and is now nearing completion.

8.2.1 Capacity Allocation Mechanism

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

A revised code, Regulation (EU) 2017/459, amended the Network Code on Capacity Allocation Mechanisms (CAM NC), became applicable on the 6th April 2017. The amended CAM NC consists of a number of changes including the Annual Auction of Capacity at Interconnection Points (IPs), which will now take place in July (previously March), and introduces new quarterly auctions throughout the gas year.

It also includes rules relating to incremental capacity at Interconnection Points. The harmonised rules outline the process to be followed for the development of incremental capacity.

The first phase of the incremental capacity process requires transmission system operators to undertake a demand assessment. Gas Networks Ireland will review any submissions received and produce a Market Demand Assessment Report no later than the 27th of July 2017. As part of the process, Gas Networks Ireland will consult with our adjacent transmission system operators at IPs to ensure all stakeholder views are included in the report.

8.2.2 Balancing

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 transmission system operator (TSO) having a residual role. The Balancing Network Code formally became Regulation EU 312/2014 in March 2014, with the majority of its provisions implemented on the 1st of October 2015. This included changes to the timings for the submission of nominations and also allowed for a TSO to submit a nomination to another TSO at an Interconnection Point and to have that automatically be passed through to the adjacent TSO – a Single Sided Nomination. Further work is necessary to fully implement all the requirements under this Code by 2019, although it is anticipated that this will be completed sooner. In the intervening time, Gas Networks Ireland will apply appropriate interim measures.

A significant milestone in the achievement of full compliance will require Gas Networks Ireland to undertake its gas balancing requirements where viable/possible via trading on an Irish Balancing Point based trading platform. Gas Networks Ireland has issued a tender seeking to utilise the services of such a platform. There is currently no such trading platform in operation. Gas Networks Ireland is working with industry and the CRU to develop related market rules and processes.

38 The European Network of Transmission System Operators for Gas (ENTSOG).

Section Eight
Commercial Market Arrangements

8.2.3 Tariffs

The Network Code on harmonised transmission tariff structures for gas came into force on the 6th April 2017, with full implementation required by May 2019. The code sets out the Union-wide rules for transmission 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. The draft Network Code contained an exhaustive list and details of the possible primary cost allocation methodologies and secondary adjustments.

In ROI, the CRU undertook a review of the transmission tariff structure as a new methodology was required before Corrib commenced commercial production. The CRU sought to 'future-proof' the new methodology to ensure it will be EU compliant as much as possible when the tariff code is effective from October 2017.

In July 2015 the CRU published its decision paper on the new Transmission Tariff methodology to apply from 1st October 2015. The 2015/16 Transmission Tariffs were calculated and approved based on this new model. This new methodology is significantly different from the previous methodology as described in Table 8-1.

Table 8-1: Transmission Tariffs Calculation Methodology

Previous Methodology	'New' Matrix Methodology
Revenues associated with Entry Points & Exit	Revenue is based on a single system and a pre-determined Entry/ Exit Split
Separate commodity charges for each Entry Point	A single Entry Commodity tariff calculated for Entry Points
Under/Over recoveries corrected at each Entry/Exit Point	Single Under/Over recovery across the system
On Entry Point Tariff at Inch Storage	Two Entry Point tariffs applicable at Inch, Storage and Production

In ROI, the CRU undertook a review of the transmission tariff structure as a new methodology was required before Corrib commenced commercial production. The CRU sought to 'future-proof' the new methodology to ensure it will be EU compliant as much as possible when the tariff code is effective from October 2017.

8.2.4 Transparency

Under the 3rd European Energy Directive and the resultant Network Codes, a number of transparency requirements have ensued for transmission system operators in relation to the publication of data items, such as capacities, flows and tariffs. The new ENTSOG Transparency Platform went live on October 1st 2014, including the implementation of a new data warehouse. Further updates to Gas Networks Ireland's submission to the ENTSOG Platform were required as a result of the implementation of the CAM Network Codes on the 1st of November 2015. Gas Networks Ireland is also working to introduce the reporting of operation and market data via its own website, in addition to interconnection point data.

Section Nine

Gas Network Capacity

Key Messages:

- The ROI transmission system has sufficient capacity to meet future gas flow requirements in the short to medium term.
- The current price control (PC3) will conclude in October 2017.
- Gas Networks Ireland has made a submission to the CRU for the fourth Price Control (PC4). This will cover the five year period from October 2017 to September 2022.
- Extension of the network to Listowel, Co. Kerry, Wexford Town, Co. Wexford and Nenagh Town Co. Tipperary.
- Future investment may be required to improve network capability in response to changing flow requirements or increased system flexibility.
- The southern region of the transmission system requires pressure uprating in the short to medium term.


Networks
Ireland

Section Nine
Gas Network Capacity

The results of the network analysis for the demand scenarios presented in section 4 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[39].

The analysis indicates that the existing transmission network has the capacity to accommodate the increase in gas demand which 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 order to ensure adequate future capacity Gas Networks Ireland is continually investing in the network. The key capital investments are outlined in section 9.1 below. Section 9.1.2 outlines the short to medium term planned capital programmes for:

- Pipelines
- Pressure Regulating Stations
- Distribution Networks
- Communications and Instrumentation
- Meters
- Compressors

Section 9.1.3 outlines the key medium to long term capital investment required for the transmission network

9.1 Capital investment

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

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

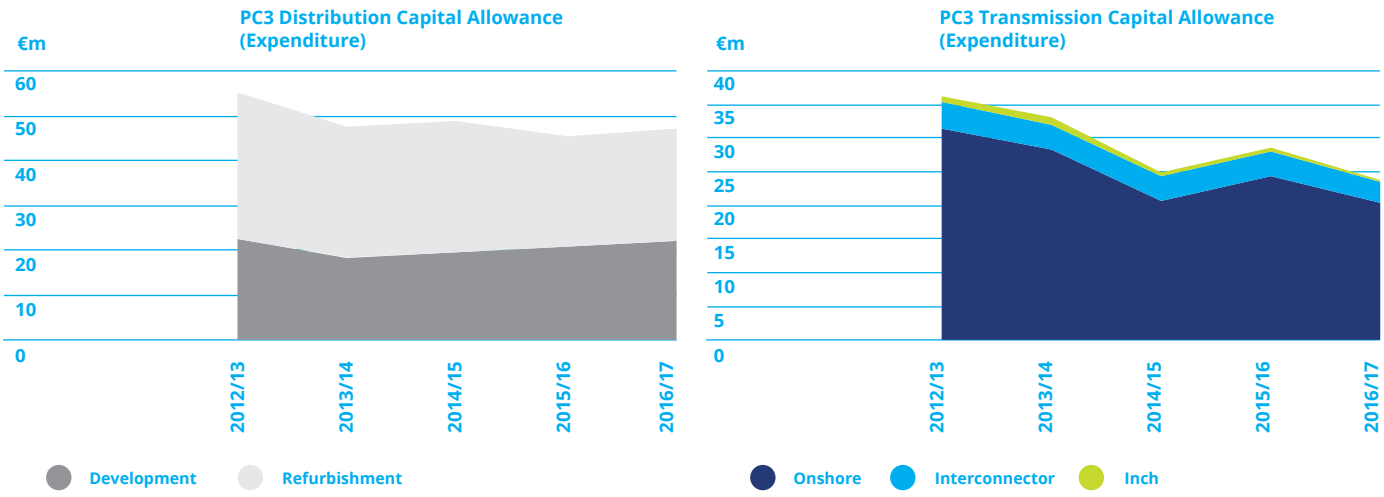
9.1.1 Regulatory Capital Allowance

Gas Networks Ireland is in the final year of its third regulatory Price Control period (PC3) which concludes in October 2017. The CRU has given a capital allowance of €387m for investment in the distribution and transmission network as illustrated in Figure 9-1 (excluding non-pipe and work in progress).

Gas Networks Ireland has made a submission to the CRU for the fourth Price Control (PC4), and this is currently going through a public consultation review process. This will cover the five year period from October 2017 to September 2022.

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

Figure 9-1: PC3 Capital Allowance excluding Non-Pipe and Work In Progress[40]



Outside of this 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.

9.1.2 Planned Capital Programmes

A significant number of projects were completed within time and budget during 2016, see section 3.3 for further details. The following sets out further projects to be completed during the remainder of the PC3 period.

9.1.2.1 Pipelines

Some of the key pipeline programmes to be completed include;

- Extension of the gas network to Listowel Co. Kerry, and completion of the gas networks within Nenagh Town Centre, Co. Tipperary and Wexford Town, Co. Wexford.
- Twinning of Southwest Scotland onshore system between Cluden and Brighouse Bay (United Kingdom)[41]. Construction commenced on this project in March-2017 and is expected to conclude in December 2017.

40 References:- "Commission for Regulation of Utilities 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.

41 This project was awarded €33.7 million by the European Commission and is being delivered outside of the PC3 allowance.

Section Nine
Gas Network Capacity

9.1.2.2 Pressure Regulating Station Refurbishment

The following are some major transmission rolling programmes which are nearing completion as we approach the end of the PC3 period.

- Replacement of all non-condensing boilers on some regulating installations – 2 sites remain to be completed in 2017;
- Replacement of all waterbaths on the system – the PC3 programme is complete.
- Refurbishment works at AGI sites to reduce noise levels and to ensure compliance with all relevant safety requirements – the PC3 programme is nearing completion.
- Remediation works on pipe support structures at AGI sites – the final 10 sites are being completed in 2017.
- Refurbishment of district regulation installations - the PC3 programme is nearing completion.

9.1.2.3 Distribution Network Rolling Programmes

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

- Removal of distribution buried gun barrel service pipes – the PC3 programme is complete.
- Relocation/rehabilitation of polyethylene services within the building line – 93% of the PC3 programme is complete.
- Replacement of batteries in electronic gas meters continues in line with the replacement policy.

9.1.2.4 Communications & Instrumentation

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

9.1.2.5 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 related capital allowances are not being considered as part of the capital allowances for upcoming price control period. 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 mass roll-out of Smart Meters.

9.1.2.6 Compressors

Gas Networks Ireland will be undertaking a programme of capital works at both Beattock and Brighouse Bay Compressor Stations in Scotland during the next five years, to ensure both stations continue to operate in a safe and reliable manner and comply with the statutory requirements associated with their operation. The majority of the works, particularly within the next two to three years, will relate to the replacement of end-of-life assets such as gas coolers, valves and obsolete control systems. There are also a number of upgrade projects relating to enhancements at the stations, some of which will deliver considerable benefits and efficiencies for the downstream gas consumers.

Capital investment will be required at Midleton within the next five years which relate to works which will ensure, one of Ireland's most critical installations on the transmission network, can continue to operate in a safe and environmentally compliant manner, post cessation of production operations in 2021.

During the next five years, there may be certain instances when assets associated with compressor operations will need to be replaced, where maintenance or repair is no longer feasible and where such assets are critical for maintaining flow at the station. Gas Networks Ireland would seek to minimise the cost of such interventions without compromising the reliability of the station, ensuring that the network can continue to transport the gas nominated by Inch Shippers.

9.1.3 Future Investment

Future investment proposals are subject to approval from the Commission for Regulation of Utilities. System operator requirements continue to evolve and both environmental and European legislative requirements will impact on future system operation. Below is an overview of these key projects.

9.1.3.1 The Goatisland to Curraleigh West Reinforcement.

Following the anticipated cessation of Celtic Sea operations and the supplies from the Inch Entry Point, it is envisaged that a section of the ring main will be uprated to 85 barg, with two bi-directional pressure and control installations along the ring main. This will mitigate the requirement in the short term to reinforce the section of pipeline from Goatisland in Co. Limerick to Curraleigh West in Co. Tipperary, however in the long term the need remains to reinforce this section of pipeline.

9.1.3.2 The Ballough Bypass.

Ballough AGI has previously been identified as being a critical installation on the gas transportation system. Ballough AGI is supplied by the offshore pipelines (IC1 and IC2) that supply gas from Scotland to the Republic of Ireland. Therefore the consequence of Ballough AGI being unavailable has the potential to significantly impact gas flow in Ireland. Gas Networks Ireland has initiated a project to construct a bypass pipeline around Ballough AGI that will reduce the importance of Ballough AGI to the network and improve the security of the network as a whole.

The scope of the project will consists of the construction of a new AGI, north of Ballough on the existing 900mm Gormanston to Ballough pipeline including connections to the 900mm pipeline. A new 1.5 km, 750mm bypass pipeline from the new AGI to Pipeline to the West will also be constructed with modifications to the pipework layout also required at Ballough AGI. Construction is expected to be completed by Q4, 2019.

It is envisaged that this project will significantly de-risk Ballough AGI while also permitting the future installation of pressure and flow control at the new AGI to facilitate the uprating of the ring main as mentioned in section 9.1.3.1 The Goatisland to Curraleigh West Reinforcement.

9.1.3.3 Midleton Compressor Station

Midleton Compressor Station compresses gas, supplied from the Kinsale gas field via the Inch Entry Point, from 37.5 barg up to the 70 barg for delivery into the national transmission system. The station is also a major pipeline hub, where 5 transmission pipelines converge, and has a pressure reduction facility for the supply of gas to the older Power Stations at Aghada (East Cork) and a local distribution network.

Between now and 2021, its anticipated that the station will be required to provide year-round compression, as KEL intend to blowdown the cushion gas from the Celtic Sea Storage wells. As noted in last year's NDP, Gas Networks Ireland will continue to work closely with KEL to ensure the appropriate measures are in place to maximize the performance and reliability of compressor operations at the station for the remaining of the field.

Section Nine
Gas Network Capacity

Following the anticipated cessation of Celtic Sea operations and the supplies from the Inch Entry Point, Midleton will continue to remain a primary site of strategic importance on Gas Networks Ireland's transmission network post 2021. It will function as one of the key locations for operations on the Gas Networks Ireland transmission network – it is and will continue to be the primary pipeline hub in the southern part of Ireland, it is critical for the supply of gas (via pressure reduction) to the older power stations in East Cork and a local distribution network, and it provides critical administration functions relating to the operation of transmission network. It is imperative that the site remains functional and safe post 2021, and complies with all of the relevant environmental requirements.

9.1.3.4 Beattock Compressor Station

Gas Networks Ireland has observed considerable change in the operation of the compressor stations in South West Scotland since summer 2016. Shippers nominations at the Moffat Entry, and the consequential flows through the two compressors stations, have been significantly impacted by the advent of gas supplies from the Corrib gas field and the implementation of European Network Codes (October 2015), specifically the removal of the Zero-Imbalance-Position (ZIP) obligation on the Shippers.

Last year's NDP noted that Gas Networks Ireland has implemented a batch flow[42] regime at Moffat when low flow days occur. Such a regime is required due to the gas nominations at Moffat being less than the minimum technical flow limits of the compressor station. The batch-flow regime is viable for the short term, however this would not be sustainable in the medium term as it presents a number of key issues primarily relating to the health of the turbine-compressor assets – frequent stop-starts can diminish the health of the assets, energy efficiency – high fuel gas consumption relative to low gas throughput and an increase in gas venting (from compressors) and the Interconnector Agreement – limits the number of within day station stop-starts.

Gas Networks Ireland anticipates that the low flow situation, will endure despite the forecast recovery in Moffat flows over the next 10 years, albeit the frequency of low flows are expected to decrease.

Gas Networks Ireland will be implementing upgrades to the compressor station assets to minimise the impact of the low flow situation which should deliver both economic and environmental impacts within the next five years and all years thereafter.
Gas Networks Ireland is currently investigating the feasibility of installing flow/pressure control at Beattock to optimise station operations, reducing fuel gas usage and the environmental impact associated with the operation of the turbine-compressor fleet. Such a measure would also optimise the age of the turbine-compressor assets. It should be noted that such an initiative complements existing compressor operations rather than replaces them. The construction of the twinned pipeline in Scotland has been an enabler for such potential upgrades.

The installation of electric drive compressors may prove to be the longer term solution with regard to compressor operations in Scotland. Gas Networks Ireland will continue to monitor the factors that could influence the need for such an upgrade, and provide an update in future Network Development Plans.

42 Batch flow refers to an operating regime at the compressor stations on low flow days, when the average hourly flow nomination is less than the minimum technical flow limit of the station. The total daily nomination on such days is batched for a number of hours in order to overcome the low flow constraint; consequently, there are a number of hours when the station is not running.

9.1.3.5 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 the CRU, with key stakeholders such as Gas Networks Ireland, ESB Networks[43], energy suppliers and others. We are now in Phase 3 of the programme which will involve the following activities,

- Smart Metering consumer policy will be further developed, building on the high level design decisions, through a series of workshops, public consultations and information papers.
- Gas Networks Ireland and ESB Networks 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 gas and electricity meters and a shared communications infrastructure.
- The network companies will lead the detailed design of the market system changes required to support Smart Metering.
- A consumer engagement work-stream has been 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 the Smart Metering systems and infrastructure. Phase 5 will entail the rollout of the Smart Meters themselves.

The main benefit of Smart Metering is the provision of more detailed gas consumption information to the customer. This will enable customers to better manage their energy consumption and reduce their bill. A customer behaviour trial completed by Gas Networks Ireland in 2012 showed a 3.6% consumption saving, on average, due to the greatly enhanced consumption data provided to customers by Smart Metering. Smart Metering will also bring many benefits to Gas Networks Ireland notably the ability to remotely read, lock and unlock our gas meters.

9.1.3.6 Longer Term Projects – Local Area (Regional) Reinforcement

A key part of Gas Networks Ireland strategic planning process is understanding what capital investment is required to mitigate against capacity limitations on the network. This would help ensure that end user supply can be delivered on the network and that supplies can be maintained to protected customers, i.e. Non Daily Metered (NDM) customers and essential services as set out in EU Regulation 994/2010 which is currently going through legislation amendments to ensure that all necessary measures are taken to safeguard an uninterrupted supply of gas throughout the EU, in particular protected customers.

Gas Networks Ireland tests the network's resilience through modelled analysis to a loss of pipeline capacity. Choosing pipelines with the highest flow rate within a network is a reasonable approach to test the network robustness, it is a valuable exercise to consider the pipes of particular vulnerability in a network, whether that is the pipes with the highest flow, velocity or pressure drop per unit length or perhaps more urgently those most at risk physically e.g. bridge or major road crossings etc.

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

Section Nine
Gas Network Capacity

There may be several mitigation measures that could be put in place to offset the pipeline capacity limitations on the network:

- Increase AGI or DRI outlet pressures to support the area affected by low pressures
- Increase looping within the system to increase system resilience
- Demand side measures, which examine the ability to sequentially isolate an area given an infrastructural failure in order to maintain flows through the remaining infrastructure at maximum capacity, or to minimise the number of lost customers.

Capital investment will be required to support the existing infrastructure in a number of regions to mitigate capacity constraints on the gas network. The regions identified are indicative and, under consideration regarding the need for system reinforcement and to increase system resilience, in response to changing supply, demand patterns, increased demand for system flexibility and security of supply. The following geographical regions are considered:

- Cork
- Waterford
- Dublin City & Environs
- Naas & Newbridge
- Portlaoise

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

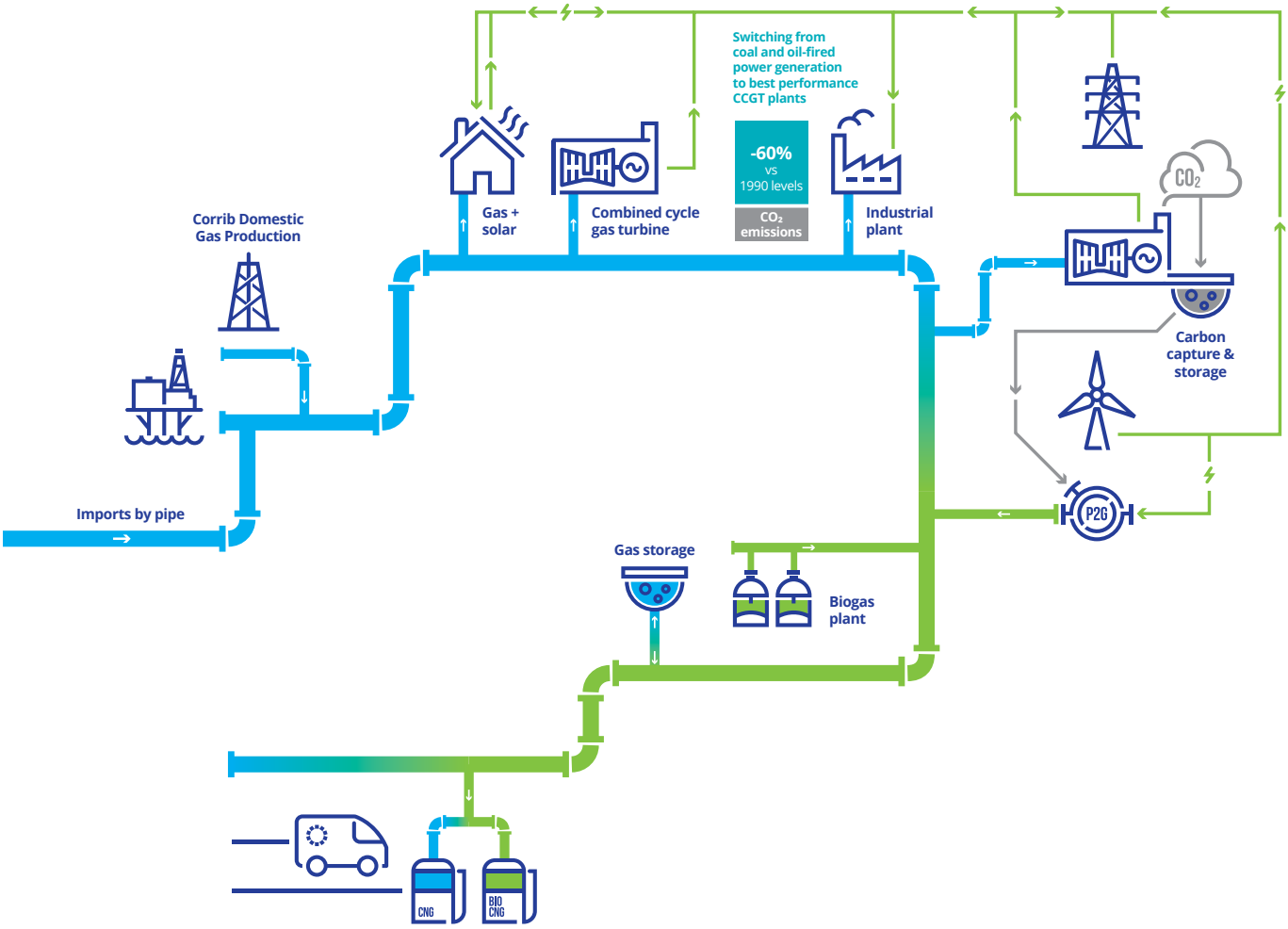
Capital investment may result due to customer enquiries for either increased load, new connections where no spare capacity exists, where the network is operating close to its current capability or to enhance the resilience of a network.

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

There is a greater requirement for system flexibility from the Gas Transporter, Gas Networks Ireland will continue to identify and implement the optimal investment decisions to meet system flexibility requirements and improve network capability.

9.2 The Long Term Role of the Gas Grid

Figure 9-2: 2050 - Gas System Transformation to Support Ireland's Decarbonisation Targets



In February 2011, the European Council reconfirmed the EU objective of a low carbon society by 2050. This was in line with the findings of the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4) [44].

Decarbonisation of the energy market is one of the biggest long-term challenges facing Ireland and Europe as the European Union's ambition is to transition to a low carbon economy by 2050. As a result Ireland has a target to achieve to reduce our greenhouse gas emissions by at least 30% by 2030 and 80%-95% by 2050, compared with 1990 levels.

44 IPCC, "IPCC Fourth Assessment Report (AR4) – Climate Change 2007," 2007.

Section Nine
Gas Network Capacity

In the future, gas will continue to be essential in the energy sector due to its central role in electricity generation, heating and transport sectors. Gas Networks Ireland is committed to decarbonising the gas network to support Ireland in meeting its climate change targets. We believe that the gas sector is well-placed to provide reliable and secure energy and cost-effective carbon reductions by 2050 across the entire economy, from power generation, industry, transport and within the home.

Gas Networks Ireland is committed to the decarbonisation of Ireland's energy system. We are actively investigating key transformational technologies to decarbonise the gas sector by 2050. These technologies include:

- Renewable Gas
- Smart Metering
- Carbon Capture and Storage for electricity and industry
- Power-to-Gas
- Hydrogen for heating and transport.

Gas Networks Ireland is also investing in CNG which has the potential to decarbonise the transport sector and contribute to Ireland's climate change targets.

9.2.1 Compressed Natural Gas

Using Compressed Natural Gas (CNG) to power trucks and buses offers a real solution to reducing emissions from diesel-fuelled heavy vehicles. This is important considering that heavy goods vehicles account for 20% of all energy related carbon dioxide (CO_2) emissions in the road transport sector, despite accounting for only 3% of the total number of road vehicles[45]. Natural gas vehicles have several benefits over conventional diesel vehicles including a 10-20% reduction in CO_2 emissions and 70%, 80% and 99% reductions in nitrogen oxide, sulphur dioxide and particulate emissions respectively. Further details on Gas Networks Ireland's CNG projects can be found in section 6.4.

9.2.2 Renewable Gas

Utilising mature technologies, with the right investment, renewable gas has the potential to satisfy over 20% of Ireland's gas demand by 2030. Renewable gas production processes are the most environmentally friendly and economical means of processing such wastes, compared to the current practises in Ireland of composting, landfill, exporting, land spreading and incineration. 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% renewable gas on the gas network by 2030. Further details on Gas Networks Ireland's renewable gas projects can be found in section 6.5.

9.2.3 Smart Metering

The EU has set a target of 80% of residential consumers having Smart electricity meters by 2020, subject to a cost-benefit analysis. Mandated by Government, the Irish National Smart Metering Programme was established in 2007 by the CRU. The main benefit of Smart Metering is the provision of more detailed gas consumption information to the customer. This will enable customers to better manage their energy consumption and reduce their bill. A customer behaviour trial completed by Gas Networks Ireland showed a 3.6% consumption saving, on average, due to the greatly enhanced consumption data provided by Smart Metering. Further details on Gas Networks Ireland's Smart Metering can be found in section 9.1.3.5.

45 Energy in Transport 2014, Sustainable Energy Authority of Ireland

9.2.4 Carbon Capture and Storage

Gas Networks Ireland is currently exploring the feasibility of carbon capture and storage technologies for integration into the gas grid. Gas fired power generation currently provides up to 49%[46] of Ireland's electricity needs. Significantly it provides the flexibility to allow for intermittent wind power to operate on the system. Gas is also the cleanest fossil fuel for power generation. In order to maintain this flexibility and to maximise the use of the existing gas network and gas-fired power plants, we are investigating the development of Carbon Capture & Storage (CCS) as a key carbon reduction technology for gas-fired power generation. CCS is an emission reduction process designed to prevent large amounts of CO_2 from being released into the atmosphere. The technology involves capturing the carbon emissions from power plants, before transfer to a deep rock formation for permanent storage. Development of CCS is recognised both within the EU and globally as one of the key enabling technologies to meet 2050 targets.

9.2.5 Power-to-Gas

At present when more electricity is produced from wind power than the electricity system can absorb, wind turbines are turned off i.e. curtailed. Power-to-Gas (P2G) harnesses this excess electricity and converts it first into hydrogen through electrolysis. The hydrogen can then be combined with CO_2 to produce methane which can then be injected directly into the gas network. Capturing excess electricity with P2G would allow the gas network to be become Ireland's national energy storage system.

9.2.6 Hydrogen

A significant decarbonisation transformation of the energy system could be achieved by substituting hydrogen for natural gas in the gas network. A major study has been completed in Leeds in the UK on how the gas distribution network could be significantly decarbonised with hydrogen. Gas Networks Ireland will engage with the Leeds Programme Team to understand if similar projects could be developed in Ireland. The potential for blending a small percentage of hydrogen with natural gas is also being researched as a means of reducing carbon emissions whilst utilising the current network and appliance.

46 Source: Eirgrid

Section Ten

CRU Commentary

The CRU's mission is to regulate water, energy and energy safety in the public interest. The CRU is committed to protecting the short and long run interest of the public by ensuring, inter alia, energy and gas are supplied safely, the lights stay on and the gas continues to flow. Our aim is to protect the interest of the energy customers, promote competition and maintain security of supply.

Section Ten
CRU Commentary

The CRU welcomes the publication of Gas Networks Ireland's Ten Year Network Development Plan 2017 (TYNDP), as it offers Gas Networks Ireland's view of how the gas network in Ireland may develop. This process is separate to the approval of revenues for Gas Networks Ireland; which is carried out under the Price Control process. Under that process, separate submissions are made by Gas Networks Ireland as to its revenue needs over a 5 year price control period. The CRU reviews these submissions to ensure that any revenues requested are necessary, appropriate and efficient.

The CRU notes that the gas system in Ireland is evolving as Ireland moves to a decarbonised economy. There are also changes such as the Corrib gas field commencing production in late 2015. Corrib is expected to supply up to 56% of Ireland's system demand in 2016/2017. Corrib has replaced Moffat as the primary source of supply gas to Ireland and will continue to do so in the short to medium term. This results in lower gas flows at the Moffat entry point. In addition, the Kinsale storage facility commenced blowdown of Southwest Kinsale cushion gas in 2016, with production expected to cease in 2021. This blowdown will change the operation of the Midleton compressor station. The CRU acknowledges the challenges these changes bring to the operation of the gas system and will continue to work with Gas Networks Ireland in monitoring.

In addition to the above, while recognising the benefits that new indigenous supplies bring to Ireland (i.e. improving security of supply and reducing Ireland's dependency on energy imports), the CRU notes the continued importance of the Moffat entry point to Ireland's

energy needs and Ireland's energy security. The expected completion, in the 2017/18 gas year, of twinning the gas pipeline in South West Scotland Onshore System (SWSOS), should further enhance Ireland's security of supply, and continued integration to the UK and European gas markets. While there is little reference to Brexit in the TYNDP, the CRU is continuing to monitor this carefully.

The CRU acknowledges the three demand scenario modelling approach adopted by Gas Networks Ireland. This modelling indicates that Ireland's transmission system has sufficient capacity to meet future gas flow requirements in the short to medium term. In the three demand scenarios, gas demand is projected to remain static in the low demand scenario and grow between 12.5%, and 23% based on the median and high demand scenarios. The CRU notes that these demand figures are underpinned by sources such as the ESRI's GDP growth forecasts and IEA's Policies Scenarios and are designed to represent a broad range of possible outcomes. The CRU further notes that these are possible outcomes rather than likely outcomes; with the high and low scenarios in particular designed to further test the capability of the gas network.

The TYNDP also outlines Gas Networks Ireland's growth initiatives which aim to promote sustainable development and increase usage of Ireland's gas network in a cost effective manner. The CRU will continue to work with Gas Networks Ireland on the progression of such initiatives and ultimately ensure that they bring benefits to the customer.

The CRU is cognisant of the continuing critical role of gas in electricity generation; approximately 52% of electricity in Ireland was produced by gas fired generators in 2016. As Ireland transitions 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 renewable generation. This may have an impact on gas flow profiles and network operations.
The CRU welcomes Gas Networks Ireland's commentary on the long term role of the gas network and the role that the gas network will have in the future as Ireland moves to a decarbonised economy. The CRU notes Gas Networks Ireland's focus on the following with regard to the future use of the gas network:

- Compressed Natural Gas;
- Renewable Gas;
- Smart metering;
- Carbon capture and storage;
- Power to gas; and
- Hydrogen utilisation of the gas grid.

The CRU is of the view that the role played by Gas Networks Ireland will be important as Ireland transitions itself to a low carbon economy; and that the gas network will play a critical role. Therefore the CRU supports initiatives undertaken by Gas Networks Ireland to ensure system integrity and minimum pressures are maintained.

Finally, the CRU would like to take this opportunity to thank Gas Networks Ireland for the production of the 2017 TYNDP, while acknowledging the work done maintaining Ireland's security of supply.

Appendix 1:
Historic Demand

Historic Daily Demand by Metering Type

The historic demand data in Chapter 3.4 is presented by sector (i.e. residential, I/C and power generation), 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. 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; and
- 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	2015/16
ROI	54,734	58,239	55,726	50,435	50,072	47,582	47,136	51,478
NI & IOM	18,022	17,232	17,852	15,142	15,031	15,132	16,970	16,992
Total	**72,756**	**75,471**	**73,578**	**65,577**	**65,103**	**62,714**	**64,106**	**68,470**

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

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	2015/16
ROI	227.5	247.6	244.1	211.7	213.2	187.0	203.8	199.4
NI & IOM	67.7	80.0	79.3	74.1	62.7	68.2	72.8	69.9
Total	**295.2**	**327.5**	**323.4**	**285.8**	**275.9**	**255.2**	**276.6**	**269.2**

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	2015/16
Power[2]	36,007	39,338	35,365	29,864	28,156	26,910	24,708	29,061
I/C	10,415	10,409	12,021	13,244	13,700	13,682	15,013	15,581
RES	8,312	8,492	8,340	7,326	8,216	6,991	7,414	6,835
Total	**54,734**	**58,239**	**55,726**	**50,435**	**50,072**	**47,582**	**47,136**	**51,478**

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

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	2015/16
Power[2]	126.4	134.3	132.2	114.1	119.9	102.0	102.4	104.7
I/C	44.4	46.3	49.6	49.4	50.4	46.8	54.8	54.9
RES	56.7	67.0	64.2	48.2	44.2	39.9	46.6	40.0
Total	**227.5**	**247.6**	**246.0**	**211.7**	**214.4**	**188.7**	**203.8**	**199.7**

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, as well as electricity demand and the penetration of renewables.

Appendix 1:
Historic Demand

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

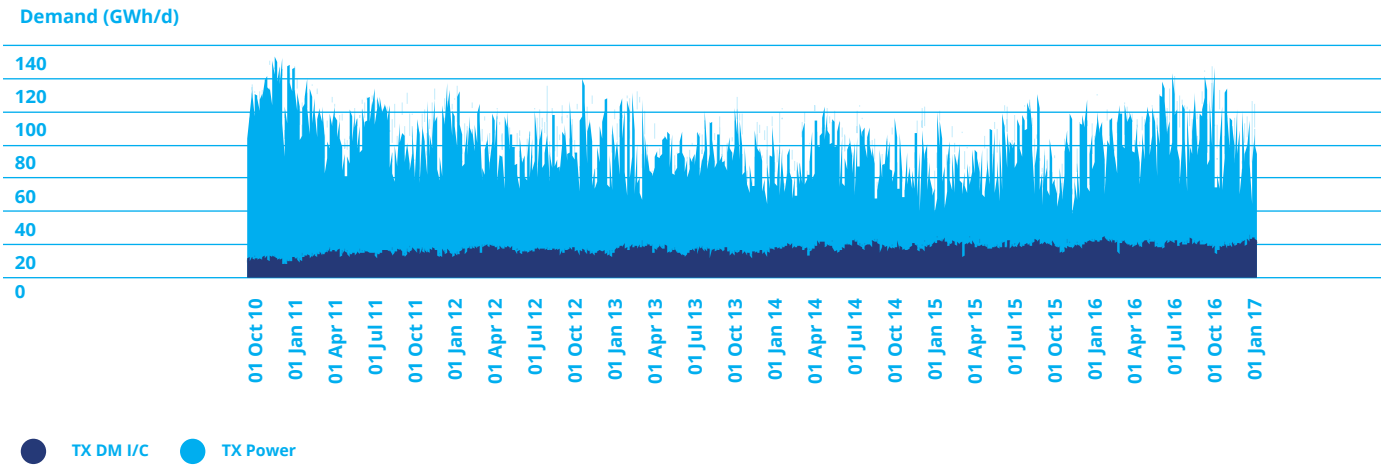


Figure A1-2: Historic Daily Demand of Distribution Connected Sites

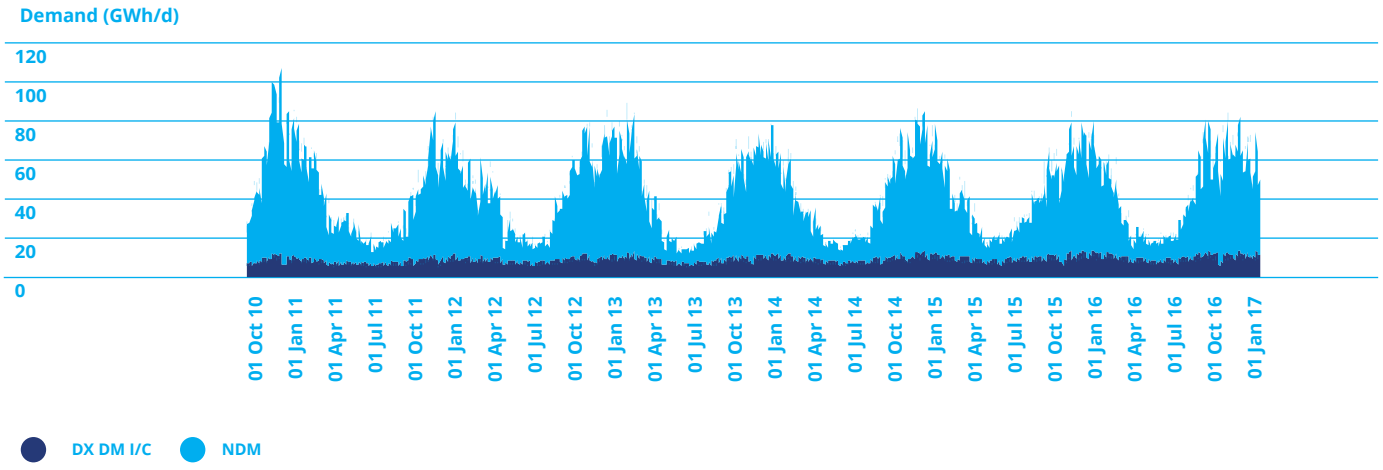


Table A1-5 and Table A1-6 present the historic annual and peak day gas supplies for the Gas Networks Ireland system.

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

GWh/yr	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
Moffat[2]	70,446	73,843	72,320	64,103	64,148	62,549	63,132	45,731
Inch	4,259	4,128	3,765	3,952	4,014	3,339	3,724	3,674
Corrib	-	-	-	-	-	-	-	20,470
Total	**74,705**	**77,971**	**76,086**	**68,055**	**68,162**	**65,888**	**66,856**	**69,876**

1 Daily gas supply taken from Gas Transportation Management System (GTMS)
2 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	2015/16
Moffat[2]	251.4	292.5	303.9	255.7	251.2	232.7	248.3	189.5
Inch	35.6	34.8	33.7	32.0	26.7	26.4	28.0	19.6
Corrib	-	-	-	-	-	-	-	60.1
Total	**287.0**	**327.3**	**337.6**	**287.6**	**277.9**	**259.1**	**276.3**	**269.3**

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

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.

Appendix 1:
Historic Demand

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 (GWh)	2015/16 (GWh)
Peak Day								
TX Power	126.4	134.3	132.2	114.1	119.9	102.0	102.4	104.7
TX DM I/C	10.4	9.1	12.0	17.7	17.8	16.1	18.8	21.1
DX DM I/C	11.0	11.7	12.3	11.9	12.2	12.6	13.3	13.5
DX NDM	79.7	92.5	89.5	68.0	64.6	57.9	69.4	60.4
Total ROI	**227.5**	**247.6**	**246.0**	**211.7**	**214.4**	**188.7**	**203.8**	**199.7**
Annual								
TX Power	36,007	39,338	35,365	29,864	28,156	26,910	24,708	29,061
TX DM I/C	3,518	3,701	4,978	6,147	6,088	6,439	7,085	7,455
DX DM I/C	2,835	2,858	3,020	3,235	3,419	3,432	3,593	3,776
DX NDM	12,374	12,342	12,363	11,188	12,409	10,802	11,749	11,184
Total ROI	**54,734**	**58,239**	**55,726**	**50,435**	**50,072**	**47,582**	**47,136**	**51,478**

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)	2015/16 (GWh)
Peak Day								
TX Power	135.7	134.3	133.0	117.4	119.9	108.7	103.2	123.2
TX DM I/C	12.7	13.7	18.4	20.4	22.9	23.1	25.1	25.4
DX DM I/C	11.2	11.8	12.3	12.7	13.7	12.8	13.8	14.1
DX NDM	79.7	95.2	94.9	73.0	75.5	65.8	73.5	71.5
Total ROI	**239.3**	**254.9**	**258.5**	**223.5**	**231.9**	**210.4**	**215.6**	**234.1**
Power	135.7	134.3	133.0	117.4	119.9	108.7	103.2	123.2
I/C	46.8	51.7	57.5	53.7	59.1	56.5	62.7	63.4
RES	56.8	68.9	68.0	52.4	52.9	45.2	49.7	47.6
Total ROI	**239.3**	**254.9**	**258.5**	**223.5**	**231.9**	**210.4**	**215.6**	**234.1**

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 summarised in Table A2-1 and Table A2-2.

Table A2-1: Future GDP Assumptions

GDP (%)	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26
Low demand scenario	3.0	2.5	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Median demand scenario	3.0	2.5	3.1	3.0	2.8	2.8	2.8	2.8	2.8	2.8
High demand scenario	3.0	2.5	3.1	3.0	2.8	2.8	2.8	2.8	2.8	2.8

Table A2-2: Residential New Connections

	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26
Low demand scenario	8,376	8,340	8,631	8,927	9,329	9,725	9,913	9,943	9,943	9,673
Median demand scenario	12,629	12,629	12,629	12,629	12,629	12,629	12,629	12,629	12,629	12,290
High demand scenario	13,251	17,068	18,161	17,255	17,249	16,895	16,366	16,241	16,241	15,724

Appendix 2:
Demand Forecasts

Forecast

The demand forecasts are summarised in Tables A2-3 to A2-11. Table A2-12 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 A2-3, 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 & A2-8: Peak-day gas demand under 'average year' weather conditions, i.e. the weather conditions that typically occur each year; and
- Tables A2-9, A2-10 & A2-11: 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 supplied by the Northern Ireland Utility Regulator (UREGNI). 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 2016-2025. 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 network planning purposes.

The power generation 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 A2-3: 1-in-50 Peak Day Demand – Low Demand Scenario (GWh/d)

	16/17 GWh	17/18 GWh	18/19 GWh	19/20 GWh	20/21 GWh	21/22 GWh	22/23 GWh	23/24 GWh	24/25 GWh	25/26 GWh
Demand										
Power	149.4	147.6	149.0	155.3	163.9	166.6	166.7	168.9	166.5	167.8
I/C	66.6	67.5	67.8	67.4	66.9	66.4	65.7	65.1	64.3	63.4
RES	61.8	61.6	61.4	61.1	60.9	60.6	60.4	60.2	59.9	59.7
Transport	0.0	0.0	0.1	0.1	0.2	0.4	0.5	0.7	0.9	0.9
Own use	4.9	4.8	5.1	5.5	5.7	6.1	6.2	6.5	6.5	6.5
Sub total	282.7	281.6	283.3	289.4	297.5	300.0	299.6	301.3	298.1	298.3
IOM	6.2	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.5
NI	101.3	88.3	89.3	91.7	99.1	101.8	102.7	104.7	105.7	106.1
Total	**390.1**	**376.3**	**379.0**	**387.5**	**403.0**	**408.2**	**408.7**	**412.3**	**410.2**	**410.8**

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

	16/17 GWh	17/18 GWh	18/19 GWh	19/20 GWh	20/21 GWh	21/22 GWh	22/23 GWh	23/24 GWh	24/25 GWh	25/26 GWh
Demand										
Power	151.7	152.0	154.7	159.1	170.4	170.4	171.5	169.8	168.1	168.5
I/C	66.5	67.4	68.6	69.0	69.4	69.7	69.9	70.1	70.6	71.4
RES	61.9	62.1	62.2	62.2	62.3	62.4	62.3	62.3	62.3	62.3
Transport	0.0	0.0	0.1	0.1	0.2	0.4	0.5	0.7	1.0	1.3
Own use	4.9	4.9	5.3	5.6	5.9	6.3	6.5	6.7	6.8	6.8
Sub total	285.1	286.4	290.8	296.1	308.2	309.0	310.7	309.6	308.8	310.3
IOM	6.2	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.5
NI	101.3	88.3	89.3	91.7	99.1	101.8	102.7	104.7	105.7	106.1
Total	**392.5**	**381.1**	**386.4**	**394.2**	**413.6**	**417.2**	**419.8**	**420.7**	**420.8**	**422.9**

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

	16/17 GWh	17/18 GWh	18/19 GWh	19/20 GWh	20/21 GWh	21/22 GWh	22/23 GWh	23/24 GWh	24/25 GWh	25/26 GWh
Demand										
Power	157.5	161.4	167.1	168.7	179.4	180.0	180.9	171.4	172.8	170.9
I/C	66.5	67.8	69.2	69.9	70.8	71.6	72.4	73.5	74.8	76.8
RES	61.9	62.3	62.8	63.3	63.8	64.2	64.6	64.9	65.2	65.5
Transport	0.0	0.0	0.1	0.1	0.2	0.4	0.5	0.8	1.3	1.9
Own use	5.0	5.1	5.5	5.9	6.2	6.6	6.8	6.9	7.0	7.0
Sub total	291.0	296.5	304.7	308.0	320.4	322.8	325.3	317.5	321.1	322.1
IOM	6.2	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.5
NI	101.3	88.3	89.3	91.7	99.1	101.8	102.7	104.7	105.7	106.1
Total	**398.4**	**391.2**	**400.3**	**406.1**	**425.9**	**431.0**	**434.3**	**428.5**	**433.2**	**434.7**

Notes
1 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 – Low Demand Scenario (GWh/d)

Demand	16/17 GWh	17/18 GWh	18/19 GWh	19/20 GWh	20/21 GWh	21/22 GWh	22/23 GWh	23/24 GWh	24/25 GWh	25/26 GWh
Power	137.7	131.6	130.3	143.2	147.5	149.3	153	155	157.2	158.7
I/C	56.3	57.2	57.4	57.1	56.7	56.3	55.8	55.3	54.7	54.1
RES	46	45.8	45.6	45.4	45.2	45.1	44.9	44.7	44.5	44.3
Transport	0	0	0.1	0.1	0.2	0.4	0.5	0.7	0.9	0.9
Own use	3.1	3.2	3.4	3.8	3.8	4	4.2	4.4	4.5	4.4
Sub total	243.2	237.7	236.8	249.6	253.5	255.1	258.5	260.1	261.8	262.4
IOM	4.6	4.6	4.6	4.6	4.6	4.7	4.7	4.7	4.7	4.7
NI	68.4	71.5	68.9	70.5	72	74	74.4	75.8	76.5	76.8
Total	**316.2**	**313.8**	**310.3**	**324.8**	**330.1**	**333.8**	**337.5**	**340.6**	**342.9**	**343.9**

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

Demand	16/17 GWh	17/18 GWh	18/19 GWh	19/20 GWh	20/21 GWh	21/22 GWh	22/23 GWh	23/24 GWh	24/25 GWh	25/26 GWh
Power	141.2	135.7	136.9	146.5	151.2	156.3	158.9	160.8	161.9	165.8
I/C	56.3	57.1	58.1	58.4	58.8	59.1	59.3	59.5	60	60.8
RES	46	46.1	46.2	46.3	46.3	46.3	46.3	46.3	46.3	46.3
Transport	0	0	0.1	0.1	0.2	0.4	0.5	0.7	1	1.3
Own use	3.2	3.3	3.5	4	4	4.2	4.4	4.6	4.7	4.7
Sub total	246.7	242.2	244.8	255.3	260.5	266.3	269.5	272	273.9	278.9
IOM	4.6	4.6	4.6	4.6	4.6	4.7	4.7	4.7	4.7	4.7
NI	68.4	71.5	68.9	70.5	72	74	74.4	75.8	76.5	76.8
Total	**319.7**	**318.3**	**318.3**	**330.5**	**337.1**	**345**	**348.5**	**352.5**	**355.1**	**360.4**

Table A2-8: Average Year Peak Day Demand – High Demand Scenario (GWh/d)

Demand	16/17 GWh	17/18 GWh	18/19 GWh	19/20 GWh	20/21 GWh	21/22 GWh	22/23 GWh	23/24 GWh	24/25 GWh	25/26 GWh
Power	144.6	139.4	141.0	152.4	157.7	162.4	164.3	165.9	167.3	168.9
I/C	56.3	57.3	58.6	59.2	59.9	60.6	61.3	62.2	63.4	65.1
RES	46.0	46.3	46.7	47.1	47.4	47.7	48.0	48.2	48.4	48.7
Transport	0.0	0.0	0.1	0.1	0.2	0.4	0.5	0.8	1.3	1.9
Own use	3.3	3.3	3.6	4.0	4.1	4.4	4.6	4.7	4.9	4.9
Sub total	250.2	246.3	249.9	262.8	269.3	275.5	278.7	281.9	285.3	289.5
IOM	4.6	4.6	4.6	4.6	4.6	4.7	4.7	4.7	4.7	4.7
NI	68.4	71.5	68.9	70.5	72.0	74.0	74.4	75.8	76.5	76.8
Total	**323.2**	**322.4**	**323.4**	**338.0**	**346.0**	**354.2**	**357.7**	**362.4**	**366.4**	**371.0**

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

	16/17 TWh	17/18 TWh	18/19 TWh	19/20 TWh	20/21 TWh	21/22 TWh	22/23 TWh	23/24 TWh	24/25 TWh	25/26 TWh
Demand										
Power	29.1	27.2	25.8	27.7	28.8	28.7	28.8	28.7	28.9	28.9
I/C	16.2	16.4	16.5	16.5	16.4	16.3	16.2	16.1	16.0	15.8
RES	7.1	7.1	7.0	7.0	7.0	7.0	6.9	6.9	6.9	6.9
Transport	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.3	0.3	0.3
Own use	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.8
Sub total	52.8	51.1	49.9	51.8	52.8	52.8	52.9	52.8	52.9	52.7
IOM	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
NI	15.4	15.7	15.5	15.9	16.9	16.7	17.6	18.0	18.0	18.4
Total	**69.5**	**68.1**	**66.7**	**68.9**	**71.0**	**70.8**	**71.9**	**72.1**	**72.2**	**72.4**

Table A2-10: Annual Demand – Median Demand Scenario (TWh/y)

	16/17 TWh	17/18 TWh	18/19 TWh	19/20 TWh	20/21 TWh	21/22 TWh	22/23 TWh	23/24 TWh	24/25 TWh	25/26 TWh
Demand										
Power	29.3	28.0	27.3	29.8	31.8	31.7	32.0	32.4	32.8	33.4
I/C	16.2	16.4	16.7	16.8	16.9	17.0	17.1	17.2	17.4	17.7
RES	7.1	7.1	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2
Transport	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.3	0.4	0.5
Own use	0.4	0.5	0.5	0.6	0.7	0.8	0.8	0.9	0.9	0.9
Sub total	53.1	52.0	51.7	54.5	56.7	56.8	57.3	58.0	58.6	59.7
IOM	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
NI	15.4	15.7	15.5	15.9	16.9	16.7	17.6	18.0	18.0	18.4
Total	**69.8**	**69.0**	**68.6**	**71.6**	**74.9**	**74.8**	**76.2**	**77.3**	**77.9**	**79.4**

Table A2-11: Annual Demand – High Demand Scenario (TWh/y)

	16/17 TWh	17/18 TWh	18/19 TWh	19/20 TWh	20/21 TWh	21/22 TWh	22/23 TWh	23/24 TWh	24/25 TWh	25/26 TWh
Demand										
Power	29.5	28.1	28.0	31.2	34.0	34.6	35.4	36.2	36.8	37.6
I/C	16.2	16.5	16.8	17.0	17.2	17.4	17.6	17.9	18.2	18.7
RES	7.1	7.2	7.2	7.3	7.3	7.4	7.4	7.5	7.5	7.5
Transport	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.3	0.5	0.7
Own use	0.4	0.5	0.6	0.7	0.7	0.8	0.9	0.9	1.0	1.0
Sub total	53.3	52.3	52.7	56.2	59.3	60.3	61.5	62.8	64.0	65.6
IOM	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
NI	15.4	15.7	15.5	15.9	16.9	16.7	17.6	18.0	18.0	18.4
Total	**70.0**	**69.3**	**69.5**	**73.3**	**77.5**	**78.3**	**80.4**	**82.1**	**83.2**	**85.3**

Appendix 2:
Demand Forecasts

Table A2-12: Maximum Daily Supply Volumes

	16/17 GWh	17/18 GWh	18/19 GWh	19/20 GWh	20/21 GWh	21/22 GWh	22/23 GWh	23/24 GWh	24/25 GWh	25/26 GWh
Supply										
Corrib	103.5	98.2	86.6	87.5	84.0	67.1	55.5	47.1	39.6	41.8
Inch[1]	22.7	14.9	8.1	5.4	4.0	0.0	0.0	0.0	0.0	0.0
Moffat[2]	342.4	342.4	375.0	375.0	375.0	375.0	375.0	375.0	375.0	375.0
Total	**468.6**	**455.5**	**469.7**	**468.0**	**462.9**	**442.1**	**430.5**	**422.1**	**414.6**	**416.8**

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

The National Energy Efficiency Action Plan 2014 (NEEAP3) 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 Government target of a 20% reduction in ROI energy demand across the whole economy by 2020, with a higher 33% target for the Public Sector; and
- The Energy Savings 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.

Appendix 3:
Energy Efficiency Assumptions

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**

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[47], 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 1.0% and 1.3% of the estimated 2015/16 I/C annual demand respectively).

47 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 Interconnector and ROI transmission systems[48] 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 day types were analysed for each supply scenario over a 10 year period to 2025/26,

- 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.

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; and
- Ensuring gas velocities do not exceed their design range of 10 – 12 m/s.

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

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	30.0	Up to 85.0	Up to MOP[1]
Gross Calorific Value (MJ/scm)	39.8	37.5	37.7	40.5
Max Supply (mscmd)	31.0	1.413	9.42	11.3

1 Maximum Operating Pressure of the pipeline
2 Maximum daily supply capacity in 2017/18
3 Max daily deliverability in 2017/18

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). This ANOP pressure has been used in the network modelling.

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

ALARP – As Low As Reasonably Practicable

ANOP – Anticipated Normal Off take Pressure

BETTA – British Electricity Trading and Transmission Arrangements

CAM - Capacity Allocation Mechanism

CBA – Cost benefit analysis

CCGT – Combined cycle gas turbine

CEF – Connecting Europe Facility

CER – Commission for Energy Regulation

CHP – Combined heat and power

CMP – Congestion Management Procedure

CNG – Compressed Natural Gas

CO_2 – Carbon dioxide

CRU – Commission for Regulation of Utilities

DD – Degree Day

DCCAE – Department of Communications, Climate Action and Environment DM – Daily Metered

DRI – District Regulating Installation

EC – European Commission

ENTSOG - European Network of Transmission System Operators for Gas

ESBN – Electricity Supply Board Networks

ESRI – The Economic & Social Research Institute

ESD – Energy Services Directive

ETS – European Emission Trading Scheme

EWIC – East West Interconnector

EU – European Union

GB – Great Britain

GDP – Gross Domestic Product

GERT - Gas Emergencies Response Team

GIS – Geographic Information System

GNI – Gas Networks Ireland

GTMS – Gas Transportation Management System

GWh – Gigawatt hour

GWhe – Gigawatt hour electric

GWh/d – Gigawatt hours per day

GWh/yr – Gigawatt hours per year

I/C – Industrial & Commercial

IC – Interconnector

IDA – Industrial Development Agency

IMF – International Monetary Fund

IP – Interconnection Point

IOM – Isle of Man

KEL – Kinsale Energy Limited

km – Kilometre

KTOE – Thousands of tonnes of oil equivalent

LDM – Large Daily Metered

LNG – Liquefied Natural Gas

LPG – Liquefied Petroleum Gas

LSFO – Low Sulphur Fuel Oil

MEA – Manx Electricity Authority

MOP – Maximum operating pressure

Mscm/d – Million standard cubic metres per day

MW – Megawatt

MWh – Megawatt hour

NDM – Non Daily Metered

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

NRA – National Regulatory Authority

NSMP – National Smart Metering Programme

NTS – National Transmission System

OECD - The Organisation for Economic Co-operation and Development

PC3 – Third Price Control

PCI – Projects of Common Interest

PMA – Pressure Maintenance Agreement

PSO – Public Service Obligation

REMIT – Regulation on Wholesale Energy Market Integrity and Transparency

RES – Renewable Energy Sources

RG – Renewable Gas

ROI – Republic of Ireland

SCADA - Supervisory Control and Data Acquisition

SEAI – Sustainable Energy Authority of Ireland

SEM – Single Electricity Market

SME – Small to Medium Enterprise

SNP – South-North Pipeline

SNIP – Scotland Northern Ireland Pipeline

SWSOS – South West Scotland Onshore System

TPER – Total Primary Energy Requirement

TSO – Transmission System Operator

TWh/yr – Terawatt hours per year

TYNDP – European Ten Year Network Development Plan issued by ENTSOG

UREGNI – Utility Regulator for Northern Ireland

UK – United Kingdom

VRF – Virtual Reverse Flow

Notes

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