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Gas Networks Ireland

Network Development Plan 2019

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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 September 2019, 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 1.0
Foreword

Welcome to the 2019 ten-year Network Development Plan (NDP) published by Gas Networks Ireland.

This document 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 gas consumption and development of infrastructure.

Natural gas is the perfect fuel to assist Ireland's transition to a low carbon economy and is the optimal complementary energy source for renewable energy such as wind and solar given its flexibility. Natural gas continues to play a key role in Ireland's energy system providing approximately 30% of the country's primary energy needs. Approximately 700,000 households and businesses in Ireland rely on natural gas for a secure and competitive source of heating. In 2018, 52% of Ireland's electricity was powered by natural gas with a strong demand growth of 23% expected between 2018/19 to 2027/28.

"Gas Networks Ireland welcomes the strength of the ambition outlined in the Climate Action Plan, published by the Government on 17th June 2019."

Gas Networks Ireland welcomes the strength of the ambition outlined in the Climate Action Plan, published by the Government on 17th June 2019. In recognising that Ireland must significantly increase its commitments to tackling climate disruption, Gas Networks Ireland published "Vision 2050 – A Net Zero Carbon Gas Network for Ireland" in October 2019 which sets out how it can reduce Ireland's total carbon emissions by one third and create a net zero carbon gas network by 2050 through a combination of technologies.

Ervia, Gas Networks Ireland's parent company, is supporting the Government-led steering group which is exploring the feasibility of CCS for Ireland. In September 2019, Ervia signed a Memorandum of Understanding with Equinor and will now work with Equinor and the Norwegian Government's wider 'Northern Lights' project which aims to drive CCS development across Europe.

Renewable gas will provide an indigenous and sustainable energy source, contributing significantly to the reduction of emissions from Irish agriculture. The introduction of renewable gas onto the Irish gas network for the first time in 2019 at Cush, Co. Kildare marked a significant milestone for the gas network, this development of the first renewable gas injection facility has the capacity to generate enough renewable gas for 9,000 homes. Gas Networks Ireland is targeting 11TWh per annum renewable gas (20% of current demand) in the network within a 10 year timeframe subject to the introduction of relevant policy supports. However, Gas Networks Ireland also recognises that the renewable gas industry needs to take a series of steps to achieve this level of ambition and will require a coordinated approach across all stakeholders.

Gas Networks Ireland is developing a network of Compressed Natural Gas (CNG) re-fuelling stations for public and private network operators. The first public access station was commissioned at the Circle K Service Station in Dublin Port with a further station constructed at the M7 Cashel motorway service station in 2019.

The year 2020 will mark the end of approximately four decades of the Republic of Ireland being supplied natural gas by the Kinsale gas fields. Gas Networks Ireland is fully committed to ensuring that gas will continue to flow through its other entry points and that security of gas supply will not be negatively impacted. 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.

We would like to acknowledge the contribution of all stakeholders during the process of preparing this document. We welcome feedback at: NDP@gasnetworks.ie

Denis O'Sullivan,
Managing Director,
Gas Networks Ireland

Section 2.0
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.

"Through a combination of technologies, Gas Networks Ireland sets out how it can reduce Ireland's total carbon emissions by one third and create a net zero carbon gas network"

The assessment horizon covered in this report covers the ten year period from 2018/19 to 2027/28 inclusive. The input data and assumptions used for modelling gas supply and demand scenarios over the ten year period were finalised in September 2019, in line with the modelling 'Data Freeze' date. The impact of Covid-19 is not assessed in the 2019 NDP due to the September 2019 data freeze, however future NDPs will consider the impact Covid-19 may have on gas demands. Further to this modelling data freeze, production of the report extended to the end of 2019, and hence any non-modelling information such as project status and other ancillary developments in the gas and wider energy industry, available up until 31st December 2019 have been included in this report. The publication of the Climate Action Plan by the Government in 17th of June 2019 has impacted on the 2019 NDP timelines which has been revised to consider the key statements of the Climate Action Plan. Gas Networks Ireland is working to align the publication date of future reports with corresponding years. This report is being published in accordance with our statutory requirements.

Gas Networks Ireland, together with its parent company Ervia, published in October 2019, the Vision 2050 – A Net Zero Carbon Gas Network for Ireland. Through a combination of technologies, Gas Networks Ireland sets out how it can reduce Ireland's total carbon emissions by one third and create a net zero carbon gas network. Vision 2050 outlines the role that the gas network and key technologies such as renewable gas, compressed natural gas for transport, CCS and hydrogen will play in tackling climate change while also ensuring that Ireland has a sustainable and secure energy future. Vision 2050 demonstrates how the gas network supports decarbonisation for domestic customers, industrial users, transport, agriculture and power generation.

Gas Networks Ireland is currently preparing a Network Implementation Plan following review and analysis of feedback submitted as part of a screening consultation with the relevant statutory consultees in regard to Gas Networks Ireland's draft Network Development Plan 2018 for the purposes of compliance with S.I. No. 435/2004 – European Communities (Environmental Assessment of Certain Plans and Programmes) Regulations 2004, as amended ("SEA Regulations") and S.I. No. 477/2011– European Communities (Birds and Natural Habitats) Regulations, as amended ("AA Regulations"). The Network Implementation Plan will set out in more detail the manner in which projects identified in the Network Development Plan will be developed and the potential for cumulative effects on the environment that may arise from these projects.

Annual Republic of Ireland (ROI) gas demands for 2018/19 were above (2.0%) 2017/18 demands following on from a similar increase (2.3%) in the previous year.

In 2018 approximately 61% of Ireland's gas demand was supplied from indigenous sources. The balance of supply, almost 39% came through the subsea interconnectors via the Moffat Entry Point in Scotland.

In order to provide a comprehensive analysis, Gas Networks Ireland has developed three gas demand scenarios for the period 2018/19 to 2027/28, namely Low, Best estimate 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. The NDP Best Estimate scenario is aligned to the ENTSOG/ENTSOE TYNDP Best Estimate and National Trends scenarios.

In the Best Estimate demand scenario annual ROI gas demand is expected to grow by 23% between 2018/19 and 2027/28 with 4% growth forecast in the Low demand scenario and growth of 39% forecast in the High demand scenarios respectively over the same horizon.

Section 2.0
Executive Summary
(continued)

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 18.2% and by 21.7% for the average year peak in the Best Estimate demand scenario.

Annual ROI gas demands for 2019/20 are anticipated to be 2.4% higher than 2018/19 demands. In the power generation sector, annual gas demand for 2019/20 is anticipated to be 2.6% above 2018/19 levels. This follows a 3.5 % increase the previous year. Since 2014/15, power sector annual gas demand has grown by almost 34%. The increase in power sector gas demands in this period, despite growth in wind capacity can be attributed to increasing electricity demand, reduced electricity interconnector imports from Great Britain (GB), and more recently carbon and fuel prices favouring gas-fired generation ahead of coal in the merit order. Following the introduction of changes to the wholesale electricity market in October 2018, electrical interconnector behaviour has generally displayed efficient behaviour in that the interconnectors are generally importing to Ireland when Irish electricity prices are higher than Great Britain markets, and exporting at times of high wind when electricity prices are lower than in Great Britain. The Moneypoint generating station in Co. Clare is expected to come to the end of its operating life in its current configuration as a coal fired plant in 2025, according to the 2019 Climate Action Plan. As stated in the Energy White Paper, a suitable replacement will have to be identified. Gas Networks Ireland believes that a modern combined cycle gas turbine (CCGT) gas plant offers by far the most efficient and cost effective solution for the Moneypoint site in the long term, connecting to the existing gas ring-main transmission system via a new spur transmission pipeline to Moneypoint.

"Annual ROI gas demands for 2019/20 are anticipated to be 2.4% higher than 2018/19 demands. In the power generation sector, annual gas demand for 2019/20 is anticipated to be 2.6% above 2018/19 levels."

The Corrib gas field is expected to meet approximately 30% of annual Gas Networks Ireland system demands (39% of ROI demand) in 2019/20, with the Inch and Moffat Entry Points providing the remaining 1% and 69% respectively.

Kinsale Energy Limited (KEL) has advised that Celtic Sea operations (and flows at the Inch Entry Point) are anticipated to cease in Q2 2020 which has been factored into the NDP supply forecasts.

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 of which 300,000 are located in close proximity to the gas network and could be readily connected to gas resulting in significant benefits from an environmental perspective, considering natural gas emits 23% less CO_2 and negligible levels of nitrogen dioxide (NO_x) & sulphur dioxide (SO_x) versus oil. The ESRI have carried out research on 'access to and consumption of natural gas: spatial and socio-demographic drivers' and the resultant report recognises that increasing the number of dwellings connected to the gas network has the potential to reduce emissions where dwellings are switching from e.g. coal and oil[1].

Ireland has rapidly emerged as a prime data hosting destination. Gas Networks Ireland has developed a combined offering of natural gas, renewable gas and dark fibre services through its subsidiary Aurora Telecom to provide the data centre sector with its primary source of energy and fibre connectivity. Natural gas can be used for onsite energy generation leveraging the existing reliable gas network infrastructure, offering data centre operators substantial savings in terms of energy costs and as such Gas Networks Ireland expects the penetration of gas connections in this sector to increase in the coming years.

Gas Networks Ireland is currently targeting at least 5% penetration of Compressed Natural Gas (CNG) or bio-CNG for commercial transport and 10% of the bus market in Ireland by 2025. By the end of the current NDP period (2027/28), Gas Networks Ireland is expecting to see annual CNG demand of circa 0.8 TWh/yr. Gas Networks Ireland is conducting a project for a nationwide 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. The initial phase of this network rollout is through the Causeway Study which has begun to deliver this essential infrastructure. The CNG Stations will be strategically located to deliver the required outputs of the Causeway Study and to maximise utilisation of the assets.

The first public access station has been constructed at the Circle K Service Station in Dublin Port. It has capacity to refuel up to 70 HGVs per day. This station is fully operational and is integrated with Circle K's systems and as such CNG is sold through the station in a similar fashion to diesel and petrol. Gas Networks Ireland and Clean Ireland Recycling officially opened the first private fast-fill CNG station at the Clean Ireland Recycling premises in Smithstown Industrial Estate, Shannon, Co. Clare. The company has also received delivery of dedicated CNG waste collection vehicles, the first of their kind in Ireland. The specially commissioned, lower-emission CNG trucks have replaced a portion of Clean Ireland Recycling's diesel powered fleet, with the rest of the fleet also transitioning to CNG in the coming years.

In 2017, Gas Networks Ireland launched its Compressed Natural Gas Vehicle Fund making up

1 https://www.esri.ie/pubs/WP639.pdf

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Executive Summary
(continued)

to €20,000 available to businesses towards the purchase of a new Natural Gas Vehicle (NGV). The Vehicle Fund has made a total of €700k of funding available to transport operators, supporting the purchase of a range of commercial vehicles including trucks, buses and vans powered by Compressed Natural Gas (CNG), and is part of a process to promote natural gas as a transport fuel in Ireland. The Vehicle Fund is supported by the Commission for Regulation of Utilities (CRU) and is co-financed by the European Union's TEN-T Programme under the Connecting Europe Facility as part of the Causeway Project. This has been successfully allocated supporting 39 dedicated natural gas vehicles in the market. These vehicles alone are expected to utilise up to 20GWh/yr of CNG, emitting approximately 4,600 tonnes less of CO_2 per year.

The first renewable gas injection facility in Ireland was commissioned in Cush Co. Kildare with the first renewable gas flowing in 2019. Gas Networks Ireland is targeting 20% renewable gas on the gas network (within a 10 year timeframe of supports being available) and this is equal to circa 11 TWh of renewable gas. Gas Networks Ireland recognises that the renewable gas industry needs to take a series of steps to achieve this level of ambition. Therefore a lower interim target could be put in place in the short term to kick start the industry and this target could be revised upwards in the future based on proven sustainable delivery.

"During late 2017 and early 2018, the gas network has again demonstrated its resilience through extreme weather events Storms Emma and Ophelia, with no loss of gas supply to households, businesses or the power generation sector."

Gas Networks Ireland is in the third year of its fourth regulatory Price Control period (PC4) which concludes in September 2022. The CRU has given a capital allowance of €554m for investment in the distribution and transmission networks.

Capacity limitations are identified on the network and addressed through appropriate capital investment programmes in order to ensure continuity of supply to all customers. Gas Networks Ireland has completed 20 such projects during 2019. These projects were subject to the appropriate consenting and planning regimes as set out in section 3.

Gas Networks Ireland continuously undertakes detailed system modelling of the network in order to assess the capacity of the network. The Best Estimate demand scenario identified in section 6 is modelled to identify any potential capacity constraints. Gas Networks Ireland will mitigate against these modelled system constraints to maintain system resilience and security of supply. Any such mitigating works are identified as part of the Network Implementation Plan.

During late 2017 and early 2018, the gas network has again demonstrated its resilience through extreme weather events Storms Emma and Ophelia, with no loss of gas supply to households, businesses or the power generation sector.

Gas Networks Ireland will continue to ensure that a resilient, robust and safe gas network is maintained 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 gas supply will not be negatively impacted.

Section 3.0
Introduction

Key Messages:

The gas network currently consists of 2,477 km of high pressure steel transmission pipelines and 11,913 km lower pressure polyethylene distribution pipelines.

Natural gas is available in 21 counties and there are circa 700,000 users in Ireland.

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.

3.1 Licence/Regulatory Obligations

Gas Networks Ireland is a wholly owned subsidiary of Ervia and was established in accordance with the Gas Regulation Act 2013, as amended. It owns and operates the natural gas transmission and distribution networks in Ireland. As Ireland's gas Transmission System Operator (TSO), Gas Networks Ireland is required to submit a ten-year Network Development Plan to the Commission of Regulation of Utilities (CRU) in accordance with Article 22 of EU Directive 2009/73/EC and Article 11 of the EC (Internal Market in Natural Gas and Electricity) (Amendment) Regulations 2015. Gas Network Ireland is also obliged to submit a long term development statement to the CRU in accordance with condition 11 of its Transmission System Operator and Distribution System Operator licences. The publication of the NDP also satisfies the requirements of Section 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 CRU to monitor and publish a report outlining gas supply and demand in Ireland over seven years.

In accordance with Article 3 of EU Regulation 347/2013, as amended, on guidelines for trans-European energy infrastructure, Gas Networks Ireland is obliged to confer with regional groups on relevant regional and national infrastructure plans.

The project of common interest (PCI 5.3), Shannon LNG, has been included on the 4th PCI list published in October 2019. This independent third party project potentially involves a new entry point near Ballylongford in Co. Kerry and a connection to the ROI gas transmission system.

The project of common interest (PCI 12.6), the Ervia Cork Carbon Capture Utilisation & Storage (CCUS) project, was included on the 4th list of PCI projects as published in October 2019. This potential project will involve the development of the necessary infrastructure to transport captured CO_2 from a CCUS cluster of heavy industry (oil refinery) and two gas fired CCGTs to enable the CO_2 to be transported either to local geological store or if unavailable to another store managed by another CCUS project developer.

3.2 Environmental and Planning Considerations

The purpose of the NDP is to assess the gas network's capacity based on existing and forecast supply and demand in order to guarantee the adequacy of the gas transportation system and security of supply. While it outlines a number of capital projects which will be delivered over the coming years, future proposed large capital projects and proposed new technologies, these projects are subject to the appropriate consenting and planning regimes as set out under the Gas Acts 1976 to 2009, the Planning and Development Acts 2000 to 2011 and other relevant National and European law. In order to assist with its obligations in this regard, Gas Networks Ireland implements an environmental and planning assessment procedure for works designed and planned for Gas Networks Ireland. This procedure includes an environmental assessment tool known as 'envirokit' supported by a guidance document known as 'enviroplan'. Together they are a bespoke environmental planning and assessment tool modelled on environmental legal and regulatory requirements and best environmental practice, including requirements pursuant to the EIA Directive (85/337/EEC), as amended and the Habitats Directive (92/43/EEC), as amended. This procedure ensures that environmental and planning matters and appropriate mitigation measures are considered and communicated during the design and project planning stages of all Gas Network Ireland projects. Gas Networks Ireland is currently preparing a Network Implementation Plan which will be screened for the purposes of compliance with the SEA and AA Regulations and which will set out in more detail the manner in which projects identified in the Network Development Plan will be developed and it will also assess the potential for cumulative effects on the environment that may arise from these projects.

3.3 Overview of the Gas Networks Ireland System

Gas Networks Ireland builds, develops and operates Ireland's world-class gas infrastructure, maintaining over 14,390 km of gas pipelines and two sub-sea interconnectors.

Section 3 Introduction (continued)

The Gas Networks Ireland transmission network 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. 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 via Twynholm, Scotland 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 2,477 km of high pressure steel transmission pipelines and 11,913 km lower pressure polyethylene distribution pipelines, as well as Above Ground Installations (AGIs), District Regulating Installations (DRIs) and compressor stations. 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.

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 January and December 2010 when record sub-zero temperatures were recorded. During late 2017 and early 2018, the gas network again demonstrated its resilience through extreme weather events, storm Emma and Ophelia, with no loss of gas supply to households, businesses or the power generation sector. Natural gas is available in 21 counties and there are circa 700,000 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: Gas Networks Ireland National Pipeline Breakdown

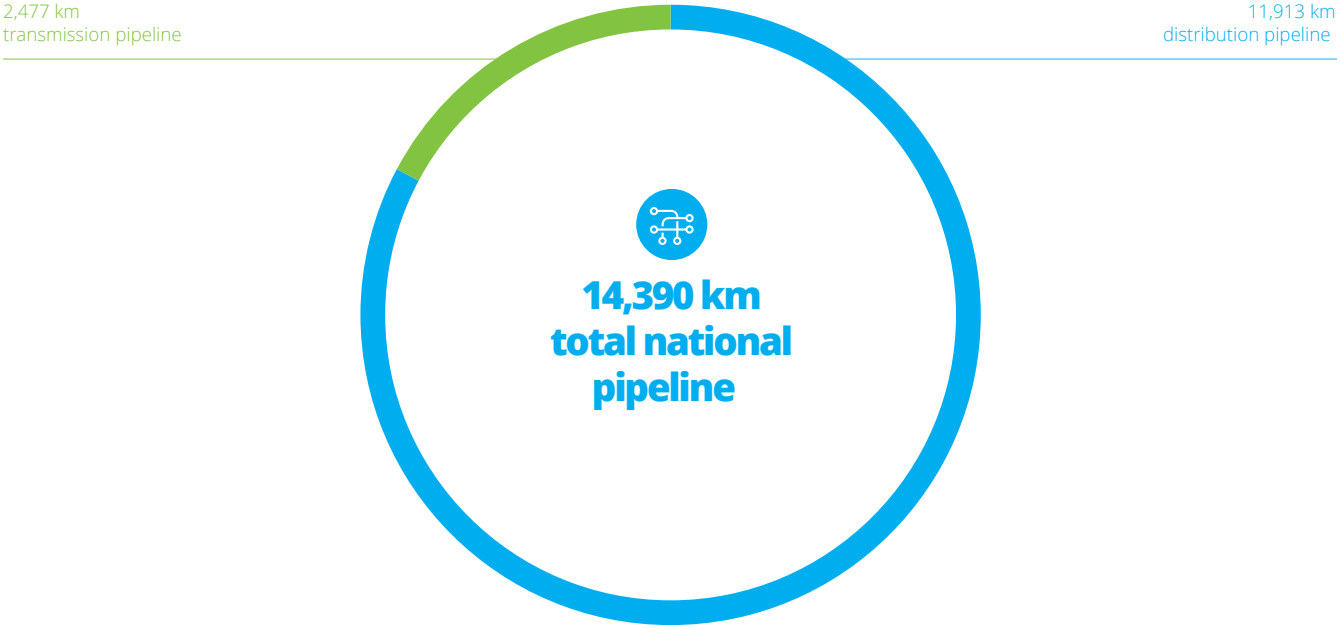


Figure 3-2: Overview of the Gas Networks Ireland Transmission System

Section 4.0
The Future Of The Gas Network

Key Messages:

Gas Networks Ireland, together with its parent company Ervia, published "Vision 2050 – A Net Zero Carbon Gas Network for Ireland" on the 3rd of October 2019.

Replacing diesel in HGVs and buses with CNG would deliver immediate emissions reductions, air quality improvement (by eliminating particulate matter) and noise reduction.

Gas Networks Ireland is targeting 11TWh/ annum renewable gas in the network within a 10 year timeframe (20% of current demand).

CCS can capture up to 100% of the CO_2 emissions produced from the use of fossil fuels in electricity generation and industrial processes, significantly reducing the amount of carbon dioxide entering the atmosphere.

Hydrogen may be stored indefinitely and may be used in heat, transport or power generation.

Gas Networks Ireland welcomes the strength of the ambition and the associated governance set out in the Climate Action Plan and recognises that Ireland must significantly increase its commitments to tacking climate disruption.

Gas Networks Ireland, together with its parent company Ervia, published "Vision 2050 – A Net Zero Carbon Gas Network for Ireland"[2] on the 3rd of October 2019. Through a combination of technologies, Gas Networks Ireland sets out how it can reduce Ireland's total carbon emissions by one third and create a net zero carbon gas network. Gas Networks Ireland's vision is that by 2050 half of the gas on Ireland's network will be renewable gas and hydrogen. The other half will be 'abated gas' where carbon dioxide has been removed through the Carbon Capture and Storage (CCS) process, preventing emissions from entering the atmosphere and contributing to climate change.

Vision 2050 outlines the role that the gas network and key technologies such as renewable gas, compressed natural gas (CNG) for transport, CCS and hydrogen will play in tackling climate change while also ensuring that Ireland has a sustainable and secure energy future. Vision 2050 demonstrates how the gas network supports decarbonisation for domestic customers, industrial users, transport, agriculture and power generation.

Today, gas is used to generate approximately 50% of Ireland's electricity. A move to 70% renewable sources for electricity generation, such as wind and solar, is planned by 2030 as part of ambitious national climate action targets. 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.

Achieving 70% renewable sources for electricity generation will require a significant reliance on gas powered electricity generation to provide the balance of requirements and to ensure Ireland has a secure energy supply at all times.

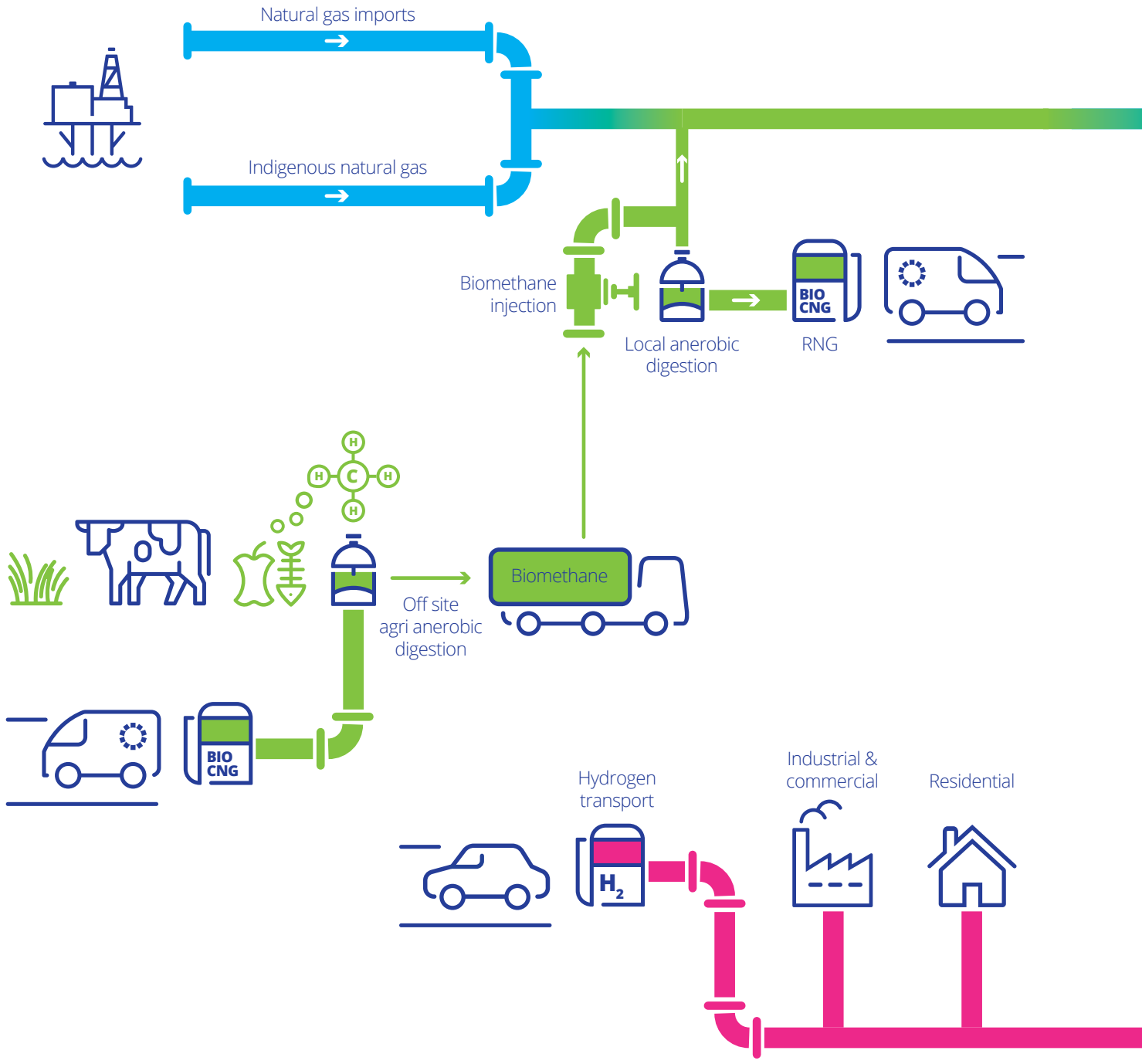
Natural Gas is the earth's cleanest fossil fuel. It emits 40% less CO_2 than coal and 22% less CO_2 than oil[3]. It also produces negligible levels of nitrogen dioxide (NO_x) and sulphur dioxide (SO_x) compared to oil or coal. Switching from these higher carbon fuels to natural gas can deliver immediate emissions benefits. The existing gas network is already capable of taking on significant new energy demands. Crucially, up to 100% of the carbon dioxide emissions from gas powered electricity generation can be captured through CCS, meaning Ireland can continue to benefit from the reliability of the gas network in a low carbon future.

"Vision 2050 demonstrates how the gas network supports decarbonisation for domestic customers, industrial users, transport, agriculture and power generation."

2 https://www.gasnetworks.ie/vision-2050/future-of-gas/GNI_Vision_2050_Report_Final.pdf
3 Government of Ireland, 2019, Climate Action Plan, https://www.gov.ie/en/publication/5350ae-climate-action-plan/

Section 4.0
The Future of The Gas Network
(continued)

Figure 4–1: The Future Of The Gas Network



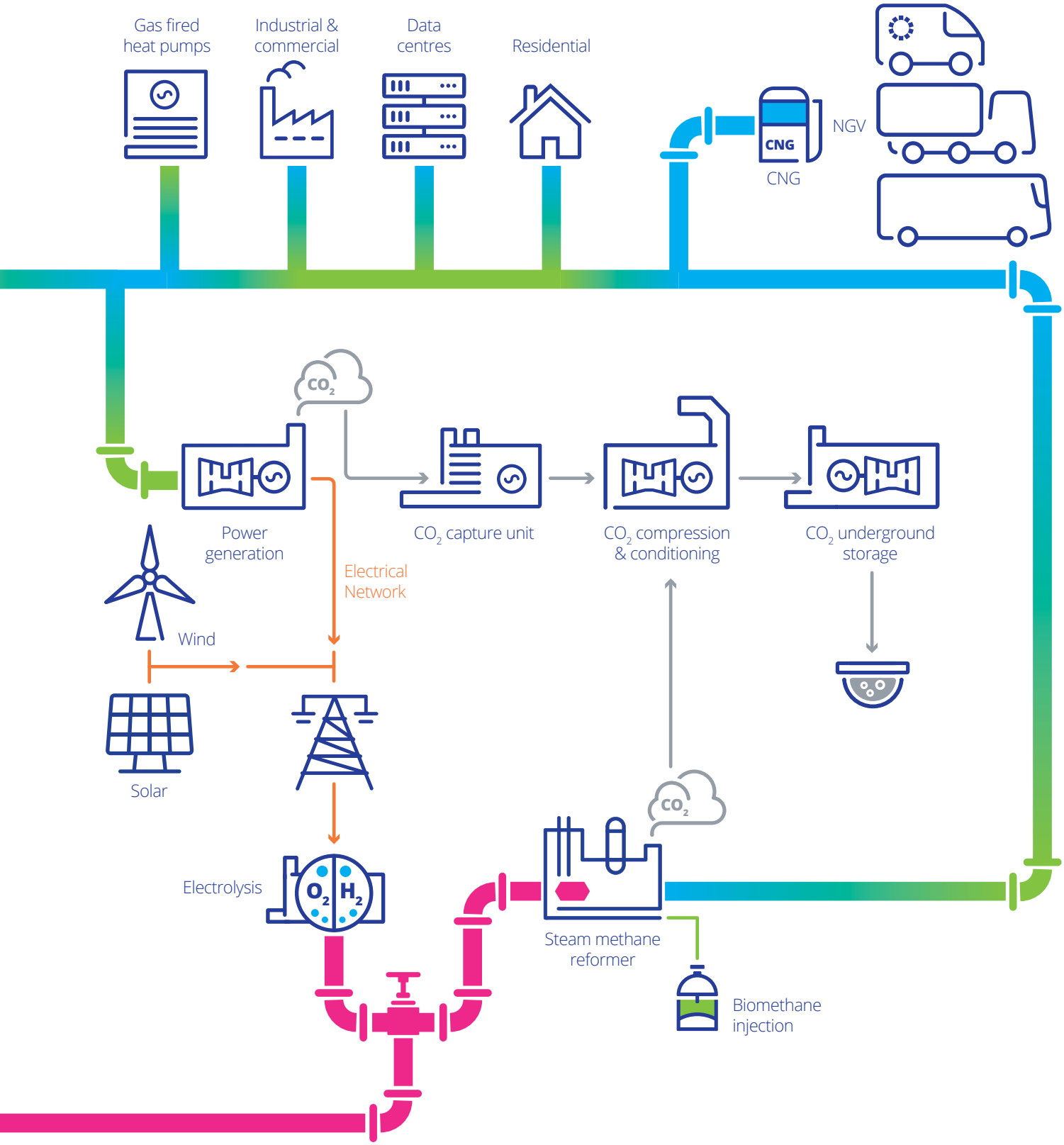
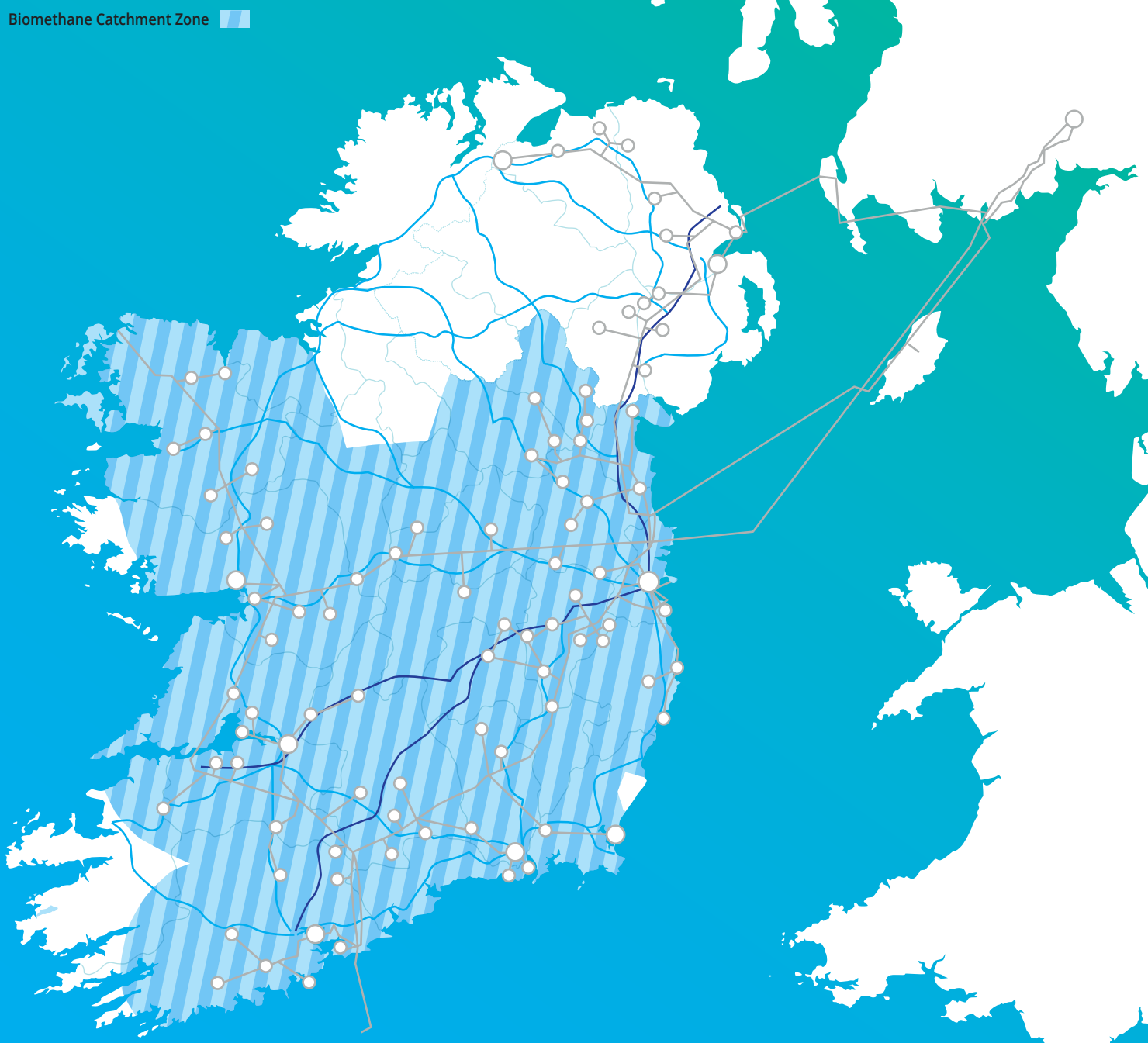

Gas fired heat pumps
Industrial & commercial
Data centres
Residential
CNG
CNG
NGV
CO_2
Power generation
CO_2 capture unit
CO_2 compression & conditioning
CO_2 underground storage
Electrical Network
Wind
Solar
Electrolysis
O_2
H_2
CO_2
Steam methane reformer
Biomethane injection

Figure 4-2: Biomethane Catchment Zone



Section 4.0
The Future of The Gas Network
(continued)

"Gas Networks Ireland is targeting 11TWh per annum renewable gas in the network within a 10 year timeframe subject to the introduction of relevant policy supports (20% of current demand)."

4.1 Compressed Natural Gas (CNG)

CNG is natural gas stored under high pressure. Replacing diesel in HGVs and buses with CNG would deliver immediate emissions reductions, air quality improvement (by eliminating particulate matter) and noise reduction. CNG is particularly well suited to deliver the high power and distance requirements of heavy-duty transport such as HGVs, buses and ships. Bio-CNG is renewable gas stored under high pressure. It can be used as a renewable transport fuel in the same way as CNG but delivers even greater emissions savings. Gas Networks Ireland is conducting studies for a nationwide CNG fuelling network, co-located in existing forecourts, on major routes and/ or close to urban centres. This comprehensive refuelling station network, will allow a transition to both natural gas and renewable gas as alternative fuels. Section 8.4 provides more detail in relation to CNG.

4.2 Renewable Gas

Renewable Gas is biomethane (purified biogas) produced from existing waste streams and a variety of sustainable biomass sources, including grass, animal waste, crop residues and food waste. It is net zero carbon, extremely versatile and fully compatible with existing gas network infrastructure. It is identical in standard to natural gas and can be used for all the same applications, using the same machinery (boilers, appliances, etc). It can be blended with, or can act as a substitute for, natural gas.

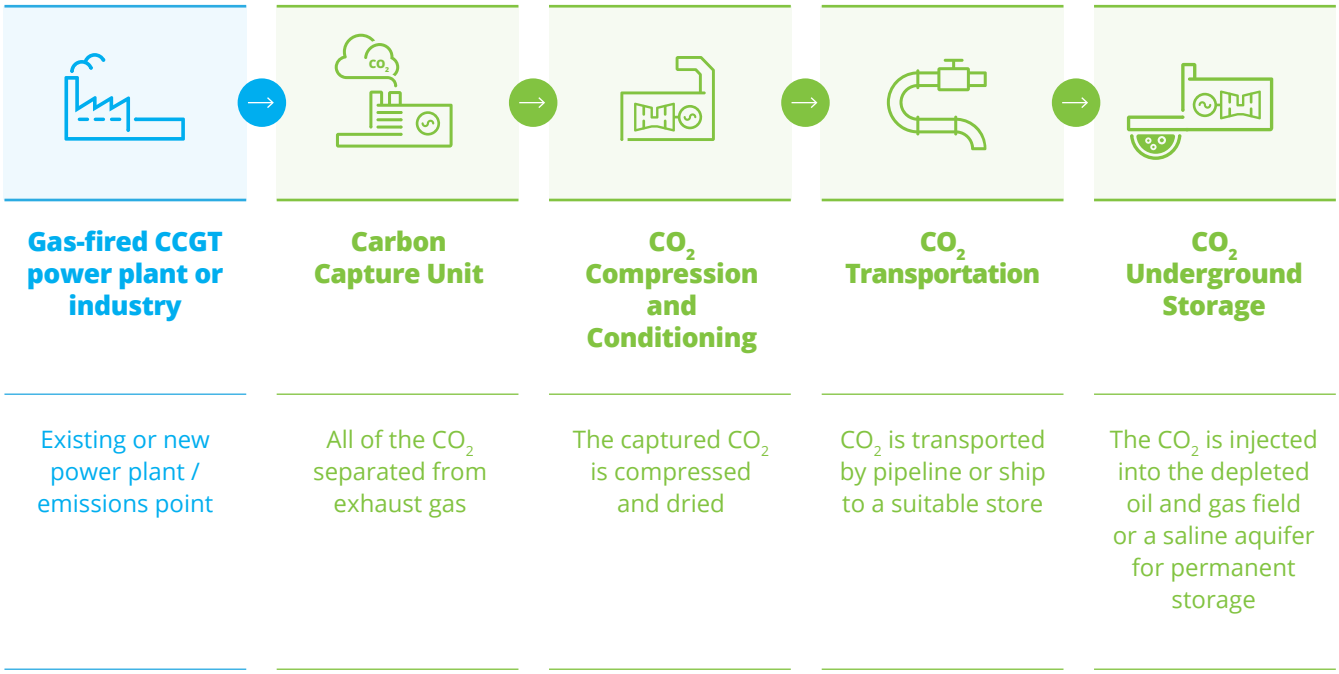
Action 130 of the Climate Action Plan sets out the Government's intention to set a target for the level of energy to be supplied by indigenous biomethane injection in 2030, taking account of the domestic supplies of sustainable feedstock and consider how the supports necessary to reach such a target would be funded[4]. Gas Networks Ireland is targeting 11TWh per annum renewable gas in the network within a 10 year timeframe subject to the introduction of relevant policy supports (20% of current demand). Gas Networks Ireland believes that this target is achievable but recognises that it is challenging and that the industry needs to be kick started now to progress towards the target. Gas Networks Ireland is already active in facilitating the emergence and uptake of this new energy source via the existing gas network. A network of renewable gas injection points is under development with the first commissioned in 2019. Gas Networks Ireland is working with Teagasc, Marine and Renewable Energy Ireland (MaREI) and other key stakeholders to develop plans for a renewable gas industry for Ireland in partnership with farmers and communities. Gas Networks Ireland is implementing a system to issue certificates for renewable gas injected into the GNI grid (Green Gas Certificates). This system will provide proof of the origin and sustainability of renewable gas sources which will stimulate the use of renewable gas by industry and other sectors.

Figure 4–2 highlights all geographical regions within a 50km radius of the existing gas transmission network. It is envisioned that Centralised Grid Injection facilities will be geographically dispersed across the country at locations in close proximity to the existing gas grid. Renewable gas producers within 50km of the existing gas grid will be able to avail of these facilities, using high capacity gas storage trailers to transport their gas via road, and inject into the national gas grid. The locations of these Central Gas Injection facilities are not yet finalised and Gas Networks Ireland is currently assessing their feasibility. This map provides an indication to prospective producers whether they are likely to be within this catchment zone.

4 https://www.dccae.gov.ie/en-ie/climate-action/publications/Documents/16/Climate_%20Action_Plan_2019_Annex_of_Actions.pdf

Section 4.0
The Future of The Gas Network
(continued)

Figure 4-3: Carbon Capture and Storage



4.3 Carbon Capture and Storage (CCS)

Carbon Capture and Storage (CCS) is a suite of technologies that can capture up to 100% of the carbon dioxide (CO_2) emissions produced from the use of fossil fuels in electricity generation and industrial processes, significantly reducing the amount of carbon dioxide entering the atmosphere. The captured CO_2 is then compressed and conditioned and transported to a suitable storage site, either an offshore depleted gas field or a saline aquifer.

From a policy perspective, the Irish Government's National Mitigation Plan[5] (NMP) (2017) recognised that "CCS could facilitate decarbonisation of our electricity sector while allowing an appropriate level of gas fired generation to balance intermittent renewable generation". The policy document committed to an action to "explore the feasibility of utilising suitable reservoirs of CO_2 storage" while also recognising that a feasibility study should be undertaken to determine the potential application of CCS in Ireland in the future.

Leading on from the NMP, in June 2019 the Government published its "Climate Action Plan 2019 – To Tackle Climate Breakdown". Action 33 from the Climate Action Plan further identified the potential for CCS and set about the establishment of a Steering Group to examine and oversee the feasibility of the utilisation of CCS in Ireland.

Working in conjunction with the Government's CCS Steering Group, Gas Networks Ireland and Ervia are currently carrying out a study into the feasibility of CCS for Ireland. In October 2019, EirGrid, the electricity Transmission System Operator (TSO), published their Tomorrow's Energy Scenarios (TES) 2019 report. The TES sets out a range of credible pathways for Ireland's clean energy transition, with specific focus on what it means for the electricity transmission system over the next 20 years. The TES is based on Government policy objectives around renewable electricity (RES-E) and emission reductions targets. Two of the three scenarios modelled deliver the 70% RES-E target by 2030 with both scenarios deploying CCS as a decarbonising technology.

5 https://www.dccae.gov.ie/en-ie/climate-action/topics/national-mitigation-plan/Pages/default.aspx

The scenario which does not deploy CCS does not meet wither the RES-E or the emissions reduction targets. EirGrid identify the benefit of 'pursuing both CCS and renewable gas options for Ireland as this reduces the reliance on a single option, while helping to mitigate as much as possible a long-term reliance on non-abated fossil fuels'.

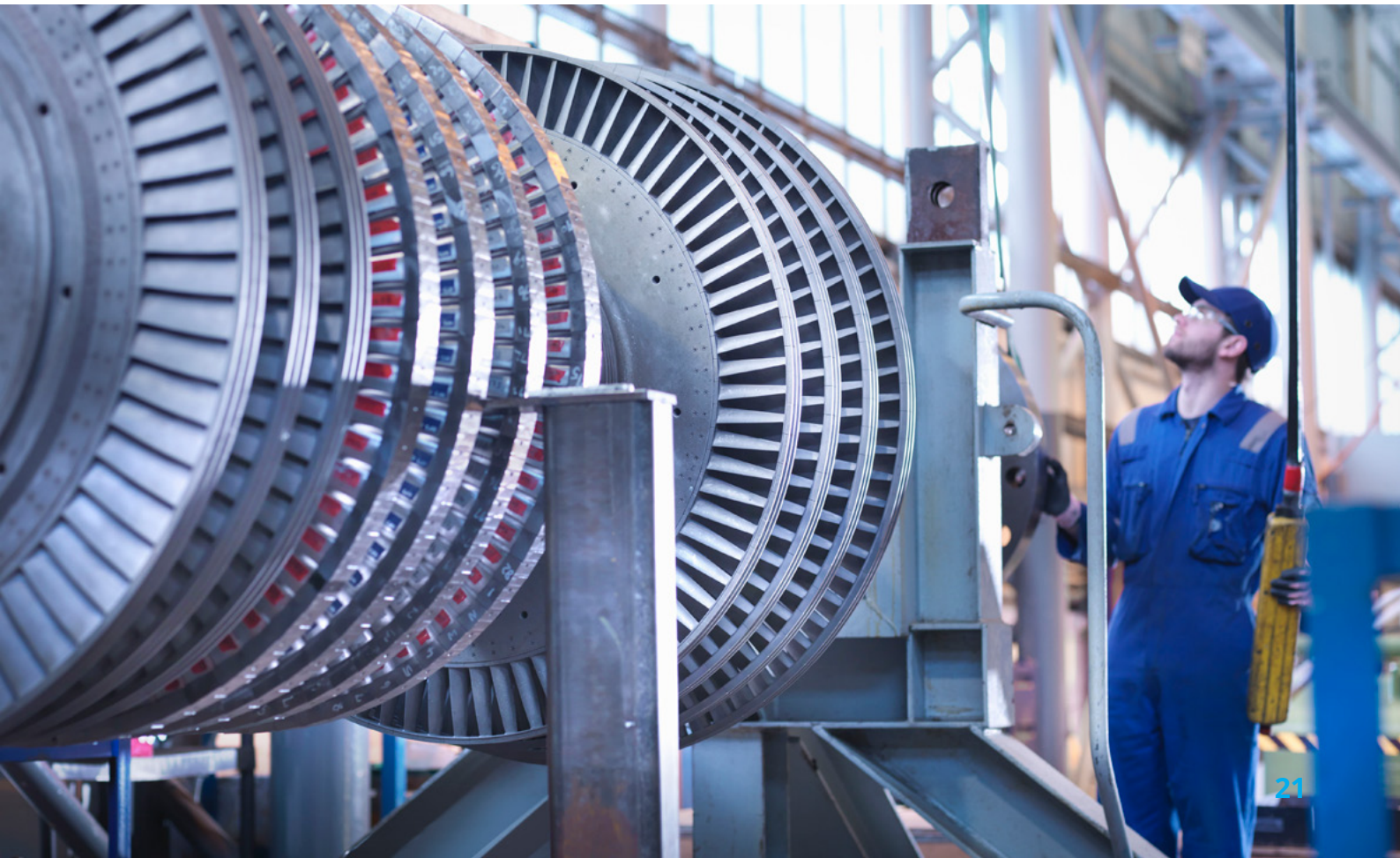
Currently in Ireland natural gas fired power generation makes up more than 52% (2018) of Ireland's current electricity needs and at certain times of the year, June/July 2018, this has averaged at over 70% and has peaked at up to 90%. Ireland also has a large percentage of its electricity needs met by intermittent renewable generation (circa 31%) which in the long term is expected to need low-carbon dispatchable generation to back it up and to provide electricity when there isn't any renewable generation available.

Given Ireland's limited alternative options for low-carbon dispatchable generation, CCS on gas-fired power generation has emerged as a viable option.

Globally it is also recognised that there are certain manufacturing industries that have no solution to decarbonise other than CCS. These include oil refining, cement manufacturing and incineration, all of which are operating in Ireland and producing significant emissions.

Gas Networks Ireland in conjunction with Ervia is investigating the potential for a large-scale CCS project in Ireland to capture the CO_2 from a number of gas-fired CCGT power plants so that they provide low-carbon electricity. The initial phase of the feasibility study looked to quantify the potential for CCS across electricity generation and industry and concentrated on indigenous storage at the depleted Kinsale Head gas field. Initial assessments of the potential for storage at the Kinsale field are positive and over the coming years Ervia will progress further the feasibility and the potential for CCS with indigenous storage.

During this phase of the feasibility study, Ervia engaged with the Norwegian company



Section 4.0
The Future of The Gas Network
(continued)

Equinor, a world leader in CCS technology. In September 2019, Ervia signed a Memorandum of Understanding with Equinor and will now work with Equinor and the Norwegian Government's wider 'Northern Lights' project which aims to drive CCS development across Europe. If successful, the project would see carbon emissions from Ireland's electricity production and large industry captured and exported via ship to be permanently stored in Norway's vast geological reserves in the North Sea. This is known as the 'Export Option' and will be explored further, in parallel with the indigenous storage option.

The project has been granted Project of Common Interest (PCI) status in October 2019 which enables it to apply for Connecting Europe Facility (CEF) funding. The title of the project is the Ervia Cork Carbon Capture Utilisation & Storage (CCUS) Project (PCI 12.6). This project will involve the development of the necessary infrastructure to transport captured CO_2 from a CCUS cluster of heavy industry (oil refinery) and two gas fired CCGTs to enable the CO_2 to be transported either to local geological store or if unavailable to another store managed by another CCUS project developer. The import infrastructure and geological store will also be made available as a backup storage facility to other CCUS developments. The utilisation of CO_2 was included in the project scope to account for the reuse of a proportion of CO_2 as a feedstock to industry.

4.4 Hydrogen

Gas Networks Ireland in conjunction with Ervia is actively monitoring developments in hydrogen across Europe to determine the role it may play in decarbonising the gas network in Ireland. Hydrogen is a carbon free flammable gas that can be stored indefinitely and be produced from renewable electricity, therefore it is attracting increasing interest as a decarbonisation pathway.

Gas Networks Ireland is active in several European gas associations that are engaged in evaluating the suitability of current gas networks to carry either a blend of natural gas and hydrogen or 100% hydrogen. The gas distribution network in Ireland utilises polyethylene pipework which is understood to be compatible with 100% hydrogen. There are also ongoing studies evaluating the compatibility of the steel transmission network with varying levels of hydrogen. Studies such as the UK's Leeds H21 project have determined that current gas networks have sufficient capacity to deliver customers energy needs through hydrogen without significant reinforcement.

This is only one of a number of decarbonisation pathways being considered. Biomethane will be the first step towards decarbonisation with there being the potential for hydrogen to facilitate deeper decarbonisation through methanation, blending or near 100% hydrogen.

Gas Networks Ireland in conjunction with Ervia maintain links with a number of Ireland's leading academic institutions who are conducting research into the potential role of hydrogen in Ireland. Gas Networks Ireland is an associate partner in the GenComm project led by Belfast Metropolitan College and in which the National University of Ireland Galway (NUIG) and Viridian are key participants. This Interreg funded project plans to produce renewable hydrogen in Northern Ireland. Gas Networks Ireland is also part of the Energy Systems Integration Partnership Programme (ESIPP) and work closely with University College Dublin (UCD) in a number of projects including modelling how power to gas may interact with gas network. The Hydrogen Utilisation and Green Energy (HUGE) project has also recently commenced with NUIG in which Gas Networks Ireland is part of the Stakeholder Advisory Committee.

The Hydrogen Ireland Association was formed in March 2019 where Ervia and Gas Networks Ireland are active in the initial working group focussed on the prospects for hydrogen injection to the gas networks on the island.

Transport

The National Development Plan commits the Government to no new non-zero emission cars to be sold in Ireland post 2030. Hydrogen Fuel Cell Electric Vehicles can be fully refuelled at service stations in approximately 3 minutes and have a range of 500–600km which is comparable to existing cars. Hydrogen cars are already

produced by several major manufacturers and may play a role where longer range and quick refuelling is required. Alongside Compressed Gas Vehicles, Hydrogen vehicles have the potential to decarbonise the long distance, high utilisation and goods vehicle sectors. Ervia/Gas Networks Ireland is a member of Hydrogen Mobility Ireland which is an ongoing project evaluating the feasibility of commencing hydrogen production, refuelling and vehicles in Ireland. The group's initial report was published in October 2019 and proposes two production facilities and three refuelling sites to support the initial deployment of hydrogen vehicles.

Power to gas

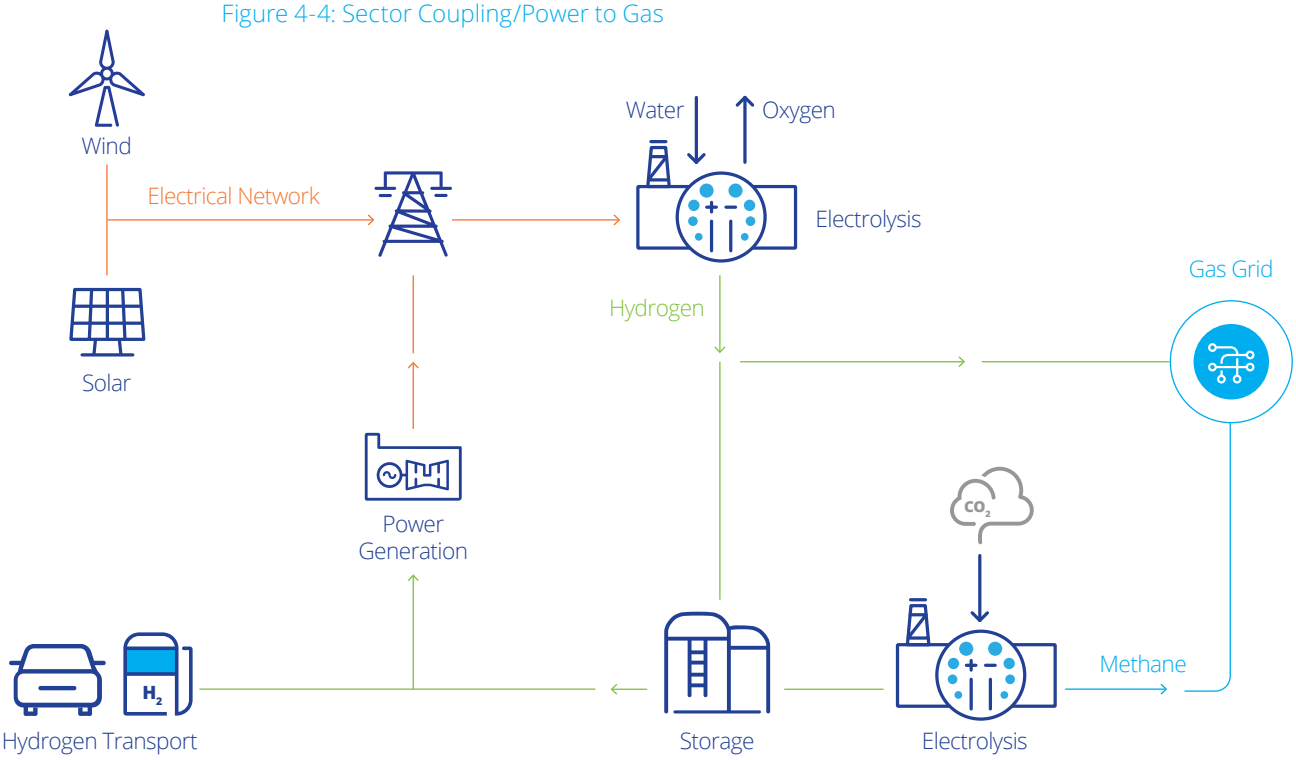
Power to gas describes the production of hydrogen by electrolysis, the chemical decomposition of water into hydrogen and oxygen. Electrolysis is a well-established industrial process at a small scale that is the focus of significant research and development to improve efficiency and bring down the costs of production.

Power to gas is an entirely renewable carbon free method of production when renewable electricity is used. The renewable electricity used may come from either dedicated wind or solar farms or use surplus electricity resulting from periods when it is otherwise constrained or curtailed from being supplied to the electricity grid. This may also help to provide the electricity system stability. The hydrogen produced may be stored indefinitely and may be used in heat, transport or power generation. Ervia and Gas Networks Ireland are currently looking at the feasibility of this technology for Ireland and maintain links with major manufacturers in Europe. Ervia and Gas Networks Ireland also participated in the National Treasury Management Agency (NTMA) led study evaluating the lowest cost configurations for power to gas and expect to continue collaboration with other semi-state organisations in this area.

Hydrogen production and the role of CCS

Today, most hydrogen is produced by the process of Steam Methane Reforming (SMR). This is a method of producing hydrogen at large scale using natural gas as an input fuel. Carbon dioxide is a by-product that may be captured in the CCS process (see section 4.3 above), the resulting

Figure 4-4: Sector Coupling/Power to Gas

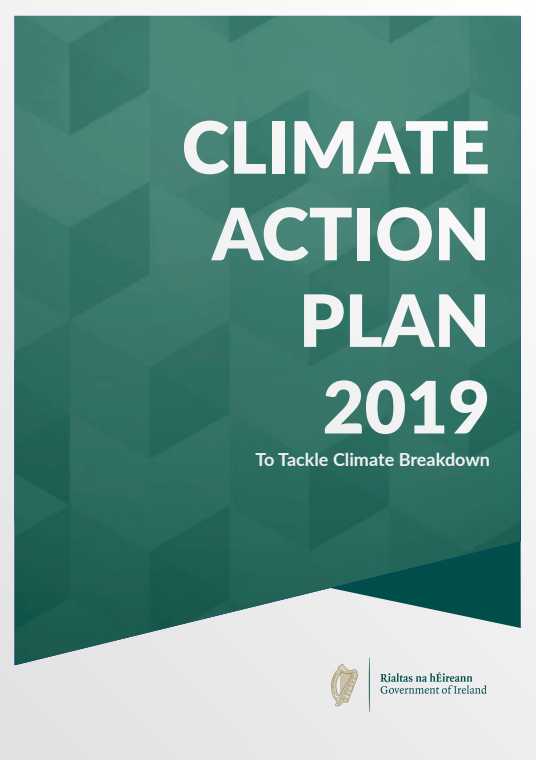


Section 4.0
The Future of The Gas Network
(continued)

'clean hydrogen' is considered a low-carbon fuel. SMR is a mature technology and the most cost effective method of producing hydrogen. Autothermal Reformation (ATR) is an alternative production technology that also uses natural gas as a feedstock. By developing CCS in Ireland, it enables the opportunity to produce low carbon hydrogen that can be used to decarbonise heating, industrial and transport sectors in Ireland. Hydrogen production using natural gas as a feedstock may allow the widespread use of hydrogen at a lower initial cost than power to gas, decarbonising the gas network sooner and allowing time for power to gas to scale up and reduce in cost.

4.5 Climate Action Plan

The Climate Action Plan 2019[6] (CAP), published by the Government on 17th June 2019, tackles climate breakdown by setting out sectoral targets, actions and timelines for implementing specific actions. There are over 180 actions in the Plan that focus on setting out a pathway to 2030, consistent with achieving a net zero target by 2050. The CAP also sets out clear governance arrangements which will significantly enhance accountability and purpose in implementing the proposals. Gas Networks Ireland welcomes the strength of the ambition and the associated governance set out in the CAP. Ireland must significantly increase its commitments to tackling climate disruption, and Gas Networks Ireland is delighted to share its vision for the significant role that the gas network can play in supporting Ireland's climate commitments. Gas Networks Ireland welcomes the CAP as a living document which will be updated annually.



As Gas Networks Ireland achieves progress towards its vision, the Vision 2050 document will be periodically refreshed to chart the progress achieved, and to share critical developments in new and emerging clean gas technologies. The gas network plays a critical role in Ireland's economy today, delivering approximately 30% of the country's primary energy needs; serving homes, businesses and electricity generation. Gas is a critical component of Ireland's electricity generation, producing 52%[7] of the country's annual electricity requirement in 2018.

6 Government of Ireland, 2019, Climate Action Plan, https://www.gov.ie/en/publication/5350ae-climate-action-plan/
7 Source: EirGrid System & Renewable Summary Report July 2019

Section 5.0
Historic Demand & Supply

Key Messages:

Annual ROI gas demands for 2018/19 were above (2.0%) 2017/18 demands following on from a similar increase (2.3%) in the previous year.

In 2018 approximately 61% of Ireland's gas demand was supplied from indigenous sources. The balance of supply, almost 39% came through the subsea interconnectors via the Moffat Entry Point in Scotland.

This section relates to a Gas Networks Ireland review of the historic profiles for supply and demand. Historic annual gas demand and peak day gas demands are analysed as well as historic gas supplies.

5.1 ROI Annual Primary Energy Requirement

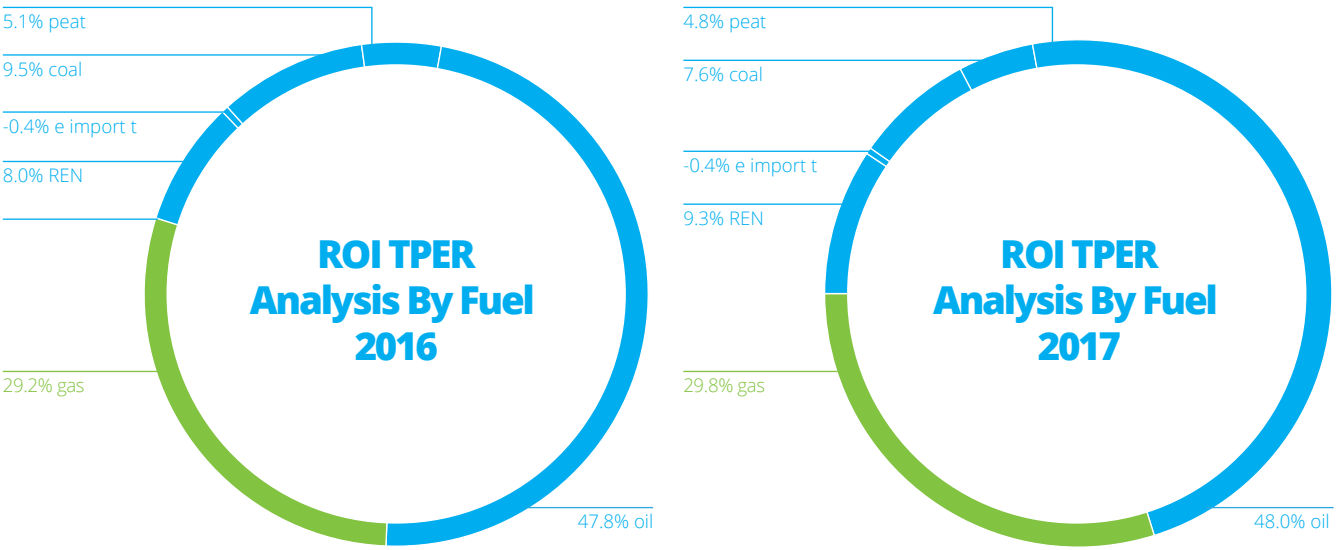
The Sustainable Energy Authority of Ireland (SEAI) reported that Ireland's Total Primary Energy Requirement (TPER) for 2017[8] grew by 0.4% compared to 2016. Oil continued to dominate the 2017 TPER accounting for 48.0% of total energy demands, as shown in Figure 5–1. Gas accounted for 29.8% of 2017 energy demands, reflecting its role in electricity generation, process and heating use. Renewable energy sources accounted for 9.3% of TPER in 2017.

5.2 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 2018/19 were above (2.0%) 2017/18 demands following on from a similar increase (2.3%) in the previous year, as shown in Figure 5.2. In the power generation sector, annual gas demand for 2018/19 is 3.5% above 2017/18 levels, following a 0.8 % decrease the previous year. The power sector gas demand has grown by over 33% since 2014/15. The increase in power sector gas demands in this period, despite growth in wind capacity can be attributed to increasing electricity demand, reduced electricity interconnector imports from Great Britain, and more recently carbon and fuel prices favouring gas-fired generation ahead of coal in the merit order for electricity generation. Following the introduction of updates to the wholesale electricity market in October

Figure 5-1: ROI TPER Analysis By Fuel (2016 & 2017)



Section 5.0
Historic Demand & Supply
(continued)

Figure 5-2: Historic Annual Gas Demand

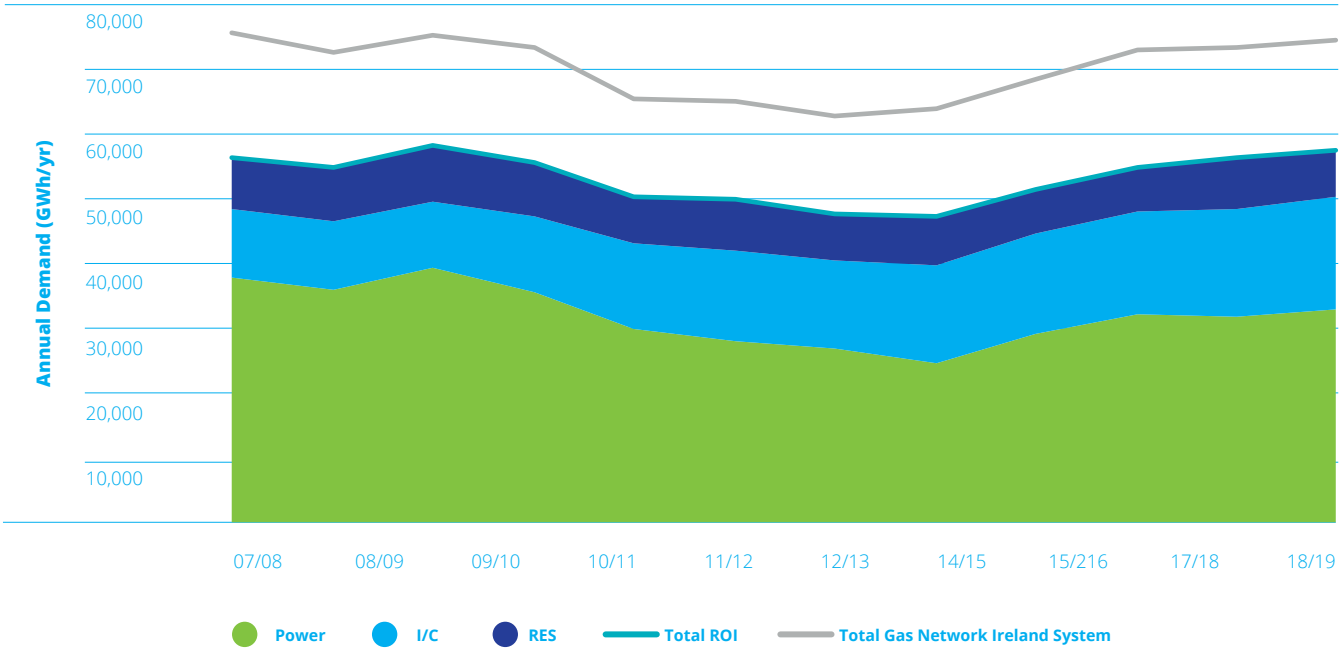
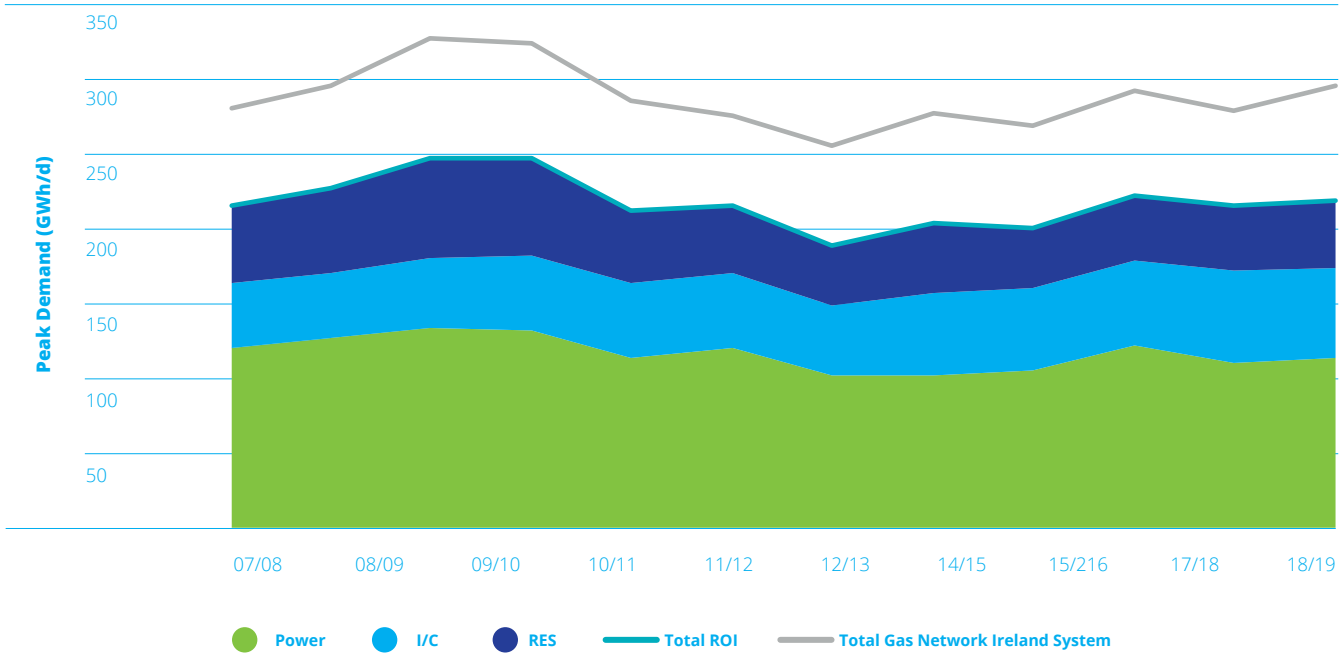


Figure 5-3: Historic Peak Day Gas Demand



2018, electrical interconnector behaviour has generally displayed efficient behaviour in that the interconnectors are generally importing to Ireland when Irish electricity prices are higher than Great Britain markets, and exporting at times of high wind when Irish electricity prices are lower than in Great Britain.

The Industrial & Commercial (I/C) sector annual gas demand for 2018/19 grew by 4.0% compared to 2017/18 levels. Within the I/C sector, Daily Metered (DM)[9] demand grew by 6%, with the Non-Daily Metered[10] (NDM) portion of I/C demand down by 0.7%. It is worth noting that the NDM sector is heavily influenced by weather.

Residential demand decreased by 8.1% for 2018/19, following growth of 12.4% in 2017/18. The extreme winter weather experienced in early 2018 would have been the main factor, with a milder winter compared to the extremities of the previous year leading to a significant decrease in 2018/19.

Total annual system gas demand for 2018/19 is 1.6% above the previous year's gas demand. As well as a 2.0% increase in ROI gas demand, there was a 0.1% decrease in NI and IOM gas demands. The historic gas demand is presented in Figure 5–2. The overall throughput for ROI in 2018/19 is 57,481 GWh or circa 5 bcm.

5.3 Historic Peak Day Gas Demand

In 2018/19 ROI peak day gas demand is 1.2% higher than the 2017/18 peak day gas demand. This was during a relatively mild winter 2018/19 in terms of weather, with less extremities experienced than the previous year. While there was a slight decrease in gas demand in the NDM sector (with weather correction), gas demand in the power generation sector has increased due to changing dynamics in the sector, among them outages at coal-fired Moneypoint power station and carbon prices favouring gas fired generation ahead of coal.

"Within the I/C sector, Daily Metered (DM) demand grew by 6%, with the Non-Daily Metered (NDM) portion of I/C demand down by 0.7%. It is worth noting that the NDM sector is heavily influenced by weather."

The peak day demand in the NDM sector occurred on the 31st of January 2019, with gas demand reaching 76.4 GWh/d.

The Gas Networks Ireland system[11] 2018/19 peak day gas demand was up by 5.5% compared to the 2017/18 peak. The NI and IOM peak day gas demand was 20.3% higher than in 2017/18.

5.4 Ireland's Weather

Based on a Degree Day (DD) comparison, the most recent winter (October '18 to March '19) was approximately 17% warmer than the previous year. Relative to the long run degree day average, winter of 2018/19 was approximately 10.7% warmer.

The coldest day in winter 2018/19, occurred on the 31st of January, with an average temperature of -0.9°C, or a 16.4 DD. The corresponding peak day in 2017/18 occurred on the 1st of March with an average temperature of -2.8°C, or an 18.3 DD.

The relatively mild weather in winter 2018/19 did not result in a 1-in-50 year peak day demand in the NDM sector, like the previous winter period. The overall demand on the 31st of January was not even a peak day for winter 2018/19 as strong winds reduced gas demand in the power generation sector. The peak day for gas demand in winter 2018/19 occurred on the 22nd of January with an ROI peak day demand of 225.5 GWh/d. The average temperature on the 22nd of January 2019 was 2.25°C or 13.25 DD.

9 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
10 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.
11 Gas Networks Ireland System includes for gas supplies to ROI, Northern Ireland and Isle of Man.

Section 5.0
Historic Demand & Supply
(continued)

5.5 Wind Powered Generation

The installed all-island wind generation capacity increased by 11% in 2018 from the previous year[12]. However, wind powered generation output grew by 19.5%[13] in 2018 compared to 2017. Load factors in wind generation have continued to increase in 2018. On the peak day for wind generation in winter 2018/19, daily wind powered generation accounted for up to 76.5% of ROI daily electricity demand (8th of February 2019) and as little as 2.7% of demand on the minimum day for wind generation (10th of January 2019). On the 2018/19 peak day for gas demand (22nd of January 2018) wind accounted for circa 36% of electricity system demand.

5.6 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 early 2015, 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. Following this, the carbon price floor in Great Britain was raised to £18 per ton CO_2 in April 2015 this relationship reversed with the balance of electricity flows on the interconnectors going 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.

Subsequently following the upgrade of the Single Electricity Market (SEM) via the Integrated Single Electricity Market (I-SEM) project in October 2018, electrical interconnector behaviour has generally displayed efficient behaviour in that the interconnectors are generally importing to Ireland when SEM prices are higher than Great Britain markets, and exporting at times of high wind

12 From EirGrid's All-Island Generation Capacity Statement 2019–2028.
13 System and Renewable Data Summary Report July 2019
14 The Single Electricity Market (SEM) is the wholesale electricity market operating in the Republic of Ireland and Northern Ireland.

when prices in the SEM are lower than in Great Britain[15].

Carbon prices on the European Emission Trading Scheme (EU ETS) continue to rise in line with various projections. It is expected that this trend will continue in the short to medium term in all scenarios. However the trend may gradually swing back in favour of imports from Great Britain to Ireland over the back end of the forecast horizon should carbon prices on the ETS continue to rise as forecasted[16]. This will depend on how carbon policy develops in the UK post-Brexit, which at present remains uncertain.

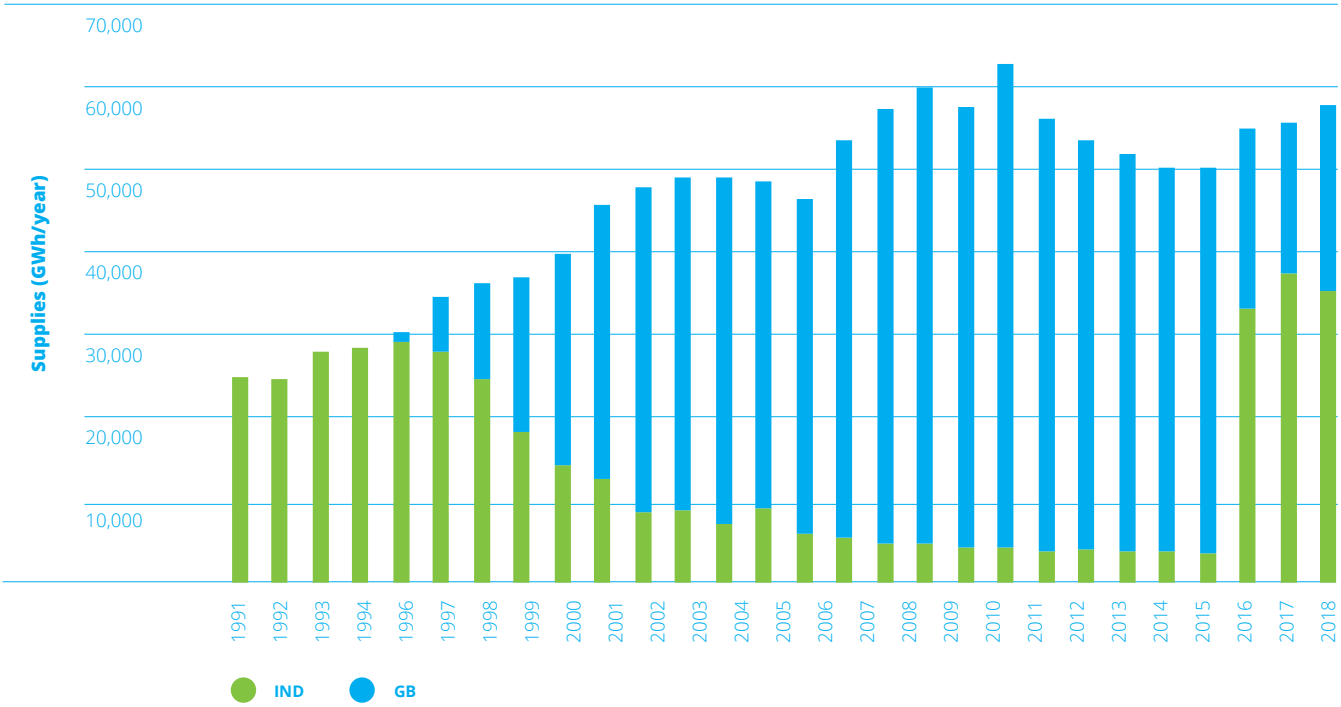
It is noted there are a number of proposed electrical interconnector projects involving Ireland, including the Celtic (France) and Greenlink (Great Britain) Interconnectors. Both Interconnectors have received Project of Common Interest status, with the Celtic Interconnector now having approved funding from the EU.

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

5.7 Historic Gas Supply

The Corrib Gas Field came online on the 31st of December 2015. This has led to dramatic change in the ROI supply position and on gas interconnector flows. In 2018 approximately 61% of Ireland's gas demand was supplied from indigenous sources. The balance of supply, almost 39% came through the subsea interconnectors via the Moffat Entry Point in Scotland.

Figure 5-4: Historic Annual Indigenous Gas Production and Great Britain (GB) Imports



15 SEM committee SEM-19-035: Single Electricity Market Performance 1 April 2019 – 30 June 2019
16 Gas Networks Ireland uses forecasts of carbon pricing from the International Energy Agency's World Energy Outlook document.

Section 6.0
Gas Demand Forecasts

Key Messages:

Gas Networks Ireland has developed Low, Best Estimate & High demand scenarios which forecast gas demand across the power generation, industrial & commercial, residential and transport sectors.

In the Best Estimate demand scenario annual ROI gas demand is expected to grow by 23% between 2018/19 and 2027/28.

The 1-in-50 peak day forecast is expected to grow by 18% between 2018/19 and 2027/28.

This section presents an overview of the gas demand outlook for the period 2018/19 to 2027/28. The NDP forecasts future gas demands by examining the development of individual Power, Industrial & Commercial, Residential and Transport sector gas demands[17].

6.1 Gas Demands

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.

Note on gas year 2018/19 demand forecasts:
Due to the timing of development of the NDP, actual historic demand data is known for gas year 2018/19, and hence the projected figures for 2018/19 have been replaced by actual historic data in the tables below, with the exceptions of the 1-in-50 Peak Day demand category – it is known that a 1-in-50 event did not occur in gas year 2018/19 and hence the demand projections for this category have been omitted and labelled N/A.

6.2 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[18] which affect demand for each of these sectors. The primary forecasting inputs by sector are summarised in Figure 6–1.

Figure 6–1: Key Demand Forecasting Assumptions

Power Generation	Industrial & Commercial	Residential	Transport
Electricity Demand	Gross Domestic Product	Annual Quantity	Fast Fill Stations
Available Generation Capacity	New Connections	New Connections	Heavy Goods Vehicles & Buses
Energy/Fuel prices	Energy Efficiency	Energy Efficiency	Usage Profiles

17 Gas Networks Ireland have developed a document outlining the Methodology for forecasting gas demand. This document is available for download via the following link: https://www.gasnetworks.ie/corporate/company/our-network/Methodology-for-forecasting-gas-demand.pdf
18 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.

Section 6.0
Gas Demand Forecasts
(continued)

Table 6-1: 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 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.

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.

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.

6.3 Gas Demand Scenarios

In order to provide a comprehensive analysis Gas Networks Ireland has developed three gas demand scenarios for the period 2018/19 to 2027/28, namely Low, Best Estimate 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.

These scenarios represent a range of potential gas demands, to be used for network planning

Figure 6-2: Gas Demand Scenarios Overview[19]

Low Demand	Best Estimate	High Demand
EirGrid's low electricity demand scenario	EirGrid's median demand scenario	EirGrid's high demand scenario
CO_2 – IEA's New Policies scenario	CO_2 – IEA's New Policies scenario	CO_2 – IEA's New Policies scenario
Bloomberg futures fuel pricing	Bloomberg futures fuel pricing	Bloomberg futures fuel pricing
Blended short term GDP projections plus ESRI's stagnation scenario	Blended short term GDP projections plus ESRI's Economic outlook 2016	Blended short term GDP projections plus ESRI's Economic outlook 2016
+ New Connection Low CNG Low	+ New Connection Best Estimate CNG Best Estimate	+ New Connections High CNG High

19 Bloomberg futures fuel pricing as taken on 27th September 2019

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 Best Estimate scenario is designed to take the median view in terms of how these factors will develop over time.

"Gas demand is dependent on a number of external factors, including economic growth, electricity demand growth and other power generation sector developments."

6.4 Alignment of NDP Scenarios with ENTSOG Ten Year Network Development Plan

ENTSOG and ENTSO-E are the European Network of Transmission System Operators for Gas and Electricity respectively. As well as developing Network Codes, ENTSOG and ENTSO-E are responsible for the delivery of Ten Year Network Development Plans (TYNDP) under EU Gas Regulation (EC) 715/2009 and EU electricity Regulation (EC) No 714/2009 respectively.

Regulation (EU) 347/2013 requires that the ENTSOG and ENTSO-E use scenarios to underpin their respective Ten-Year[20] Network Development Plans (TYNDPs). For the purposes of the 2020 TYNDPs ENTSOG and ENTSO-E have jointly developed a set of credible scenarios that describe possible development paths for the European energy system out to 2050[21].

For the short and medium-term, a 'Best Estimate' or (bottom-up) scenario is used, with no divergence in projected outcomes until after 2025. For the longer term, a number of scenarios have been developed. These include two top-down scenarios entitled the 'Global Ambition' and 'Distributed Energy' and a central bottom up scenario called the 'National Trends'. These scenarios are described as follows:

- **National Trends** is the central scenario based on draft National Energy and Climate Plans (NECPs) developed in accordance with Regulation (EU) 2018/1999 on the governance of the energy union and climate action, as well as on other national policies already stated by EU member states. The National Trends scenario is compliant with the EU's long term energy and climate ambitions.
- **Global Ambition** considers a future that is led by development in centralised energy production and power generation. Economies of scale lead to significant cost reductions in emerging technologies such as offshore wind, but also imports of energy from competitive sources are considered as a viable option. The Global Ambition scenario is compliant with the EU's long term energy and climate ambitions.
- **Distributed Energy** takes a de-centralised approach to the energy transition. A key feature of the scenario is the role of the energy consumer who actively participates in the energy market and helps to drive the system's decarbonisation. Another key feature is distributed energy production e.g. Renewable Gas and Power to Gas technology and other small-scale solutions and circular approaches. The Distributed Energy scenario is compliant with the EU's long term energy and climate ambitions.

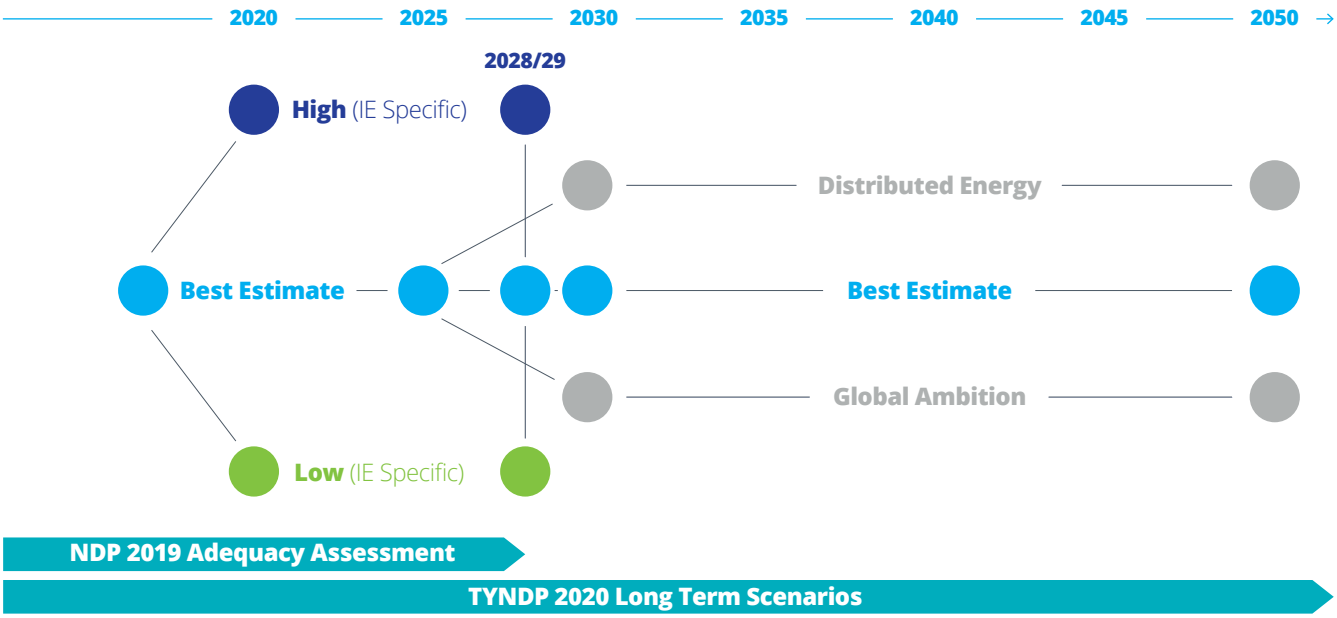
Gas Networks Ireland fed directly into the central bottom up scenario i.e. 'Best Estimate' which covers the period up to 2025, and following on from that the 'National Trends' Scenario. Gas Networks Ireland was also directly involved in the development of the assumptions which underpin the 'Global Ambition' and 'Distributed Energy' scenarios and would have agreed key assumptions with EirGrid in this regard and fed these assumptions into the joint ENTSOG / ENTSO-E scenario building work group.

Across the NDP forecasting horizon (2018/19 to 2027/28) there is no divergence in outcomes until 2025. Even from 2025 to 2029 in terms of gas demand there is only limited divergence in the outcomes across the three TYNDP scenarios.

20 Despite being called a Ten Year Network Development Plan the scenario horizon extends out to 2050
21 https://www.entsog.eu/sites/default/files/2019-11/TYNDP_2020_Joint_ScenarioReport_web.pdf

Section 6.0
Gas Demand Forecasts
(continued)

Figure 6-3: Alignment between the NDP Demand Scenarios and the TYNDP Scenarios



The NDP Best Estimate scenario is aligned to the TYNDP Best Estimate and National Trends scenarios. Because the primary purpose of the NDP is to assess and stretch the adequacy of the gas network over the 10 year period, Gas Networks Ireland develop Ireland-specific High and Low demand scenarios. The low level of divergence between the TYNDP scenarios to 2027/28 would not be sufficient to capture Ireland-specific scenario uncertainty. The Ireland-specific High and Low demand scenarios are closely aligned to the High and Low scenarios for electricity demand per the EirGrid / SONI All-Island Generation Capacity Statement 2019–2028[22].

Figure 6–3 above summarises the alignment between the NDP demand scenarios and the TYNDP scenarios.

6.5 Demand Forecast Assumptions

This section presents an overview of the assumptions made for the gas demand outlook for the period 2018/19 to 2027/28.

6.5.1 Power Generation Sector

The Irish gas and electricity sectors are highly interdependent. Gas is a critical component of Ireland's electricity generation, producing 52%[23] of the country's annual electricity requirement in 2018. Gas fired generators are the largest customer sector in the gas market, accounting for approximately 57% of the total ROI demand in 2018.

The following summarises the main assumptions regarding the changes in the SEM generation portfolio, as per the EirGrid / SONI All-Island Generation Capacity Statement 2019–2028:

- EirGrid has assumed the Moneypoint coal-fired power plant will not be available from 2025 as a result of the European Union Clean Energy Package decision to exclude generation emitting more than 550g/kWh from capacity markets such as SEM. Across our 3 scenarios, Moneypoint is therefore assumed unavailable from December 2025. It is noted that ESB has not provided a closure notice for these units.
- The Kilroot[24] coal-fired power plant is assumed to restrict capacity from mid-2020, and close

22 http://www.eirgridgroup.com/library/
23 Source: EirGrid System & Renewable Summary Report July 2019
24 While situated in Northern Ireland, closure of Kilroot would have an anticipated impact on ROI gas demand, as it would impact the behaviour of other generators operating in the single electricity market

by the end of 2024 due to Industrial Emissions Directive (IED) restrictions on coal-firing.

- Plant closures are assumed in Tarbert (TB1, TB2, TB3, and TB4) and on Aghada unit AT1 by end of 2023.
- While EirGrid in their Generation Capacity Statement have assumed that the peat plant at Edenderry, Lough Ree and West Offaly will be approximately 30–35% powered by biomass by 2020, best available information at the time of the modelling data freeze has informed an assumption that these plants will close from December 2020, with Edenderry continuing to co-fire on biomass for the duration of the NDP forecast horizon. A subsequent announcement by ESB in November 2019 that the plants at Lough Rae and West Offaly will cease generation of electricity at the end of December 2020 has validated these assumptions.
- Planning for the North-South Interconnector has been granted in Ireland. However the project has encountered delays in Northern Ireland and it is noted SONI are working to resolve the planning challenges. The North-South Interconnector is assumed not complete within the duration of the NDP forecast horizon.
- It is noted there are a number of proposed electrical interconnector projects involving Ireland, including the Celtic Interconnector. As these projects are at a preliminary stage, EirGrid have not included them in their adequacy assessments. These interconnector projects are assumed not complete within the duration of the NDP forecast horizon.
- 5 new gas-fired generation plant in the Dublin area were successful in the recent CY2022/23 T-4 capacity auctions. It is noted that at the time of EirGrid Generation Capacity Statement publication, these units did not have signed connections agreements in place. Therefore Gas Networks Ireland has assumed these units[25] to be available from 2023 only in the High and Best Estimate demand scenarios. These units are not assumed available in the Low demand scenario.

The Irish Government has a target of 40% of electricity to be generated from renewable sources by 2020[26]. Beyond 2020, assumptions on renewables integration targets in our scenarios have been informed by the draft National Energy and Climate Plan[27] (NECP) and the Government Climate Action Plan 2019[28]. It is noted that the EirGrid/SONI Generation Capacity Statement has used the draft NECP targets to inform assumed wind capacity development rates post-2020.

- Gas Networks Ireland has assumed the same wind capacity development rates in our Best Estimate and High NDP gas demand scenarios, thus targeting 55% of electricity to be generated from renewable sources by 2030.
- In these scenarios, wind generation is anticipated to increase to 5,857 MW and 1,400 MW in ROI and NI respectively, by 2028.

EirGrid in the Generation Capacity Statement have also provided an example renewable energy generation portfolio which could achieve the 70% RES-E target by 2030, per the Government Climate Action Plan 2019.

- In our Low gas demand scenario, Gas Networks Ireland has assumed this example renewable energy generation portfolio to inform wind capacity development rates required to target 70% of electricity to be generated from renewable sources by 2030, per the Climate Action Plan.
- In this scenario, wind generation is anticipated to increase to 8,840 MW and 1,400 MW in ROI and NI respectively, by 2028.

In our Power Generation dispatch model, Gas Networks Ireland takes account of generator technical parameters (e.g. maximum and minimum generator limits), level of installed electrical interconnection between countries, and operational constraints in place on the transmission system (e.g. the maximum level of non-synchronous generation that can be accommodated on the system instantaneously).

25 One of these 5 units is assumed to be replacing the existing North Wall gas turbine, which is scheduled for a 3 year outage from end of 2019, returning in 2023 at a similar size.
26 http://www.dccae.gov.ie/energy/en-ie/Energy-Initiatives/Pages/White-Paper-on-Energy-Policy-in-Ireland-.aspx
27 https://www.dccae.gov.ie/en-ie/energy/consultations/Documents/42/consultations/Draft%20NECP%20Ireland.pdf
28 https://www.dccae.gov.ie/en-ie/climate-action/publications/Documents/16/Climate_Action_Plan_2019.pdf

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- Technical parameters for generation plant have been modelled per the 2018–23 SEM PLEXOS model validation[29].
- Electricity interconnection is modelled per the assumptions set out earlier in this section.
- Technical operational constraints on the EirGrid system have been modelled per the existing EirGrid operational constraints[30].

In order to achieve the stated RES-E ambition levels by 2030, it is recognised that in addition to the installed wind capacity development rates assumed in the NDP scenarios, additional measures will be required to address existing technical constraints on the power system. Measures will be required in order to reduce the wind curtailment rates that will otherwise transpire following development of the installed wind capacity build-out profiles per the assumed levels. Potential measures may include:

- Reduction of thermal generator minimum-generation thresholds, in order to create sufficient headroom for renewable generation on days of high wind
- Increasing the System Non-Synchronous Penetration (SNSP) level from existing 65%[31], in order to allow more penetration of wind instantaneously that would otherwise need to be curtailed
- Facilitation of wind export that may otherwise be curtailed on days of high wind, via electrical interconnection or alternative technologies.

Further measures to increase future production rates from wind turbines may also be required:

- Increase wind capacity factor on onshore and offshore wind turbines in order to yield higher production rates from wind turbines.

The above changes cannot be modelled in our demand projections, as the details, and technical feasibility of the changes required are not verified at this point.

Consequentially, the RES-E ambition levels associated with the NDP scenarios, are not actually met by the installed wind capacity development rates assumed. In the event the above technical constraints are addressed, future NDP scenarios will model revised technical assumptions, and this will result in a reduction in annual gas demand, against those levels projected in this document. Peak day gas demand will not be impacted significantly, as peak day gas demand in the power generation sector typically occurs on days of low wind.

The outlook to 2028/29 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.
- Peat fired generation is anticipated to fall-off at the end of 2019 in-line with the expiration of the Public Service Obligation (PSO) levy payments which peat fired stations currently receive. Further to this, it is anticipated that West Offaly and Lough Ree power stations will cease production of electricity at the end of 2020.
- 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.
- Over the course of the previous 12 months, coal fired plant has adopted a lower position in the merit order relative to previous years following increased carbon prices and reduced wholesale gas prices. This trend is anticipated to continue over the short to medium term, with coal fired generation anticipated to fall off completely in the longer term in line with the assumptions outlined previously.
- Gas fired plant is anticipated to meet the balance of electricity demand.

29 Commissioned by the CRU and UREGNI, an update and validated model of the I-SEM electricity market has been produced and published by NERA Economic Consultants: https://www.semcommittee.com/publications/sem-18-175-sem-plexos-model-validation-2018-2023-information-paper
30 http://www.eirgridgroup.com/library/
31 http://www.eirgridgroup.com/library/

Figure 6-4: Forecast Single Electricity Market (SEM) Thermal Generation Mix

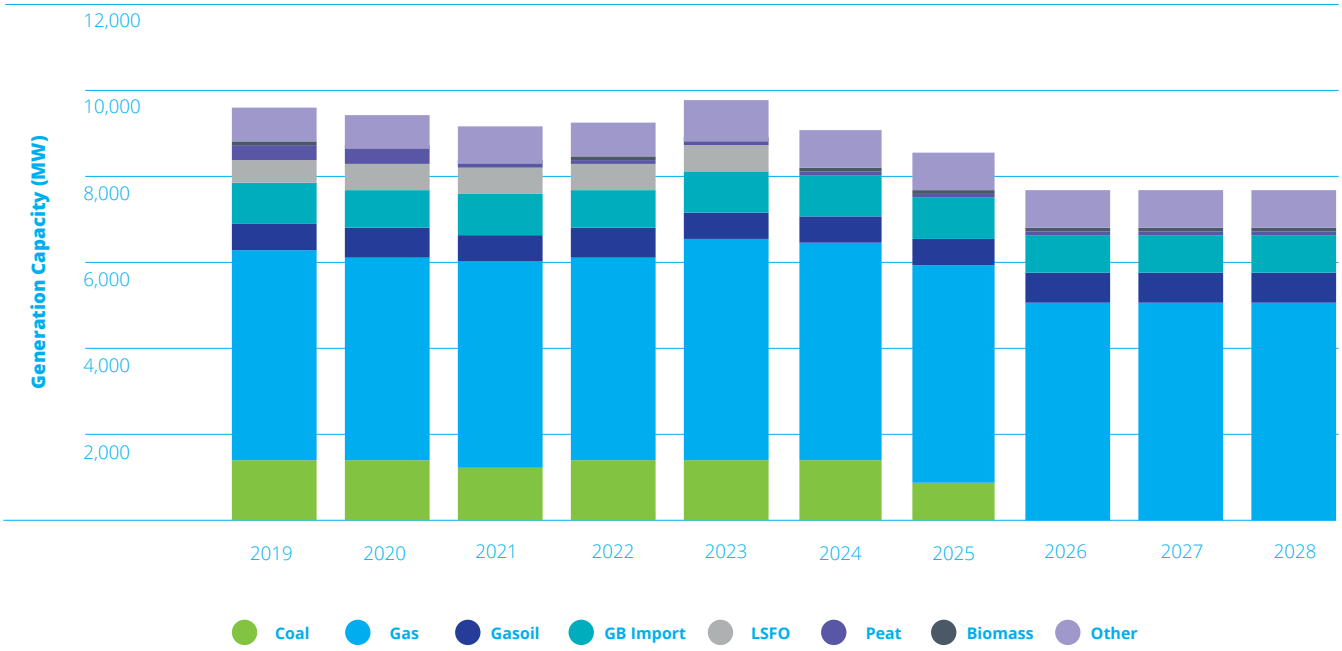
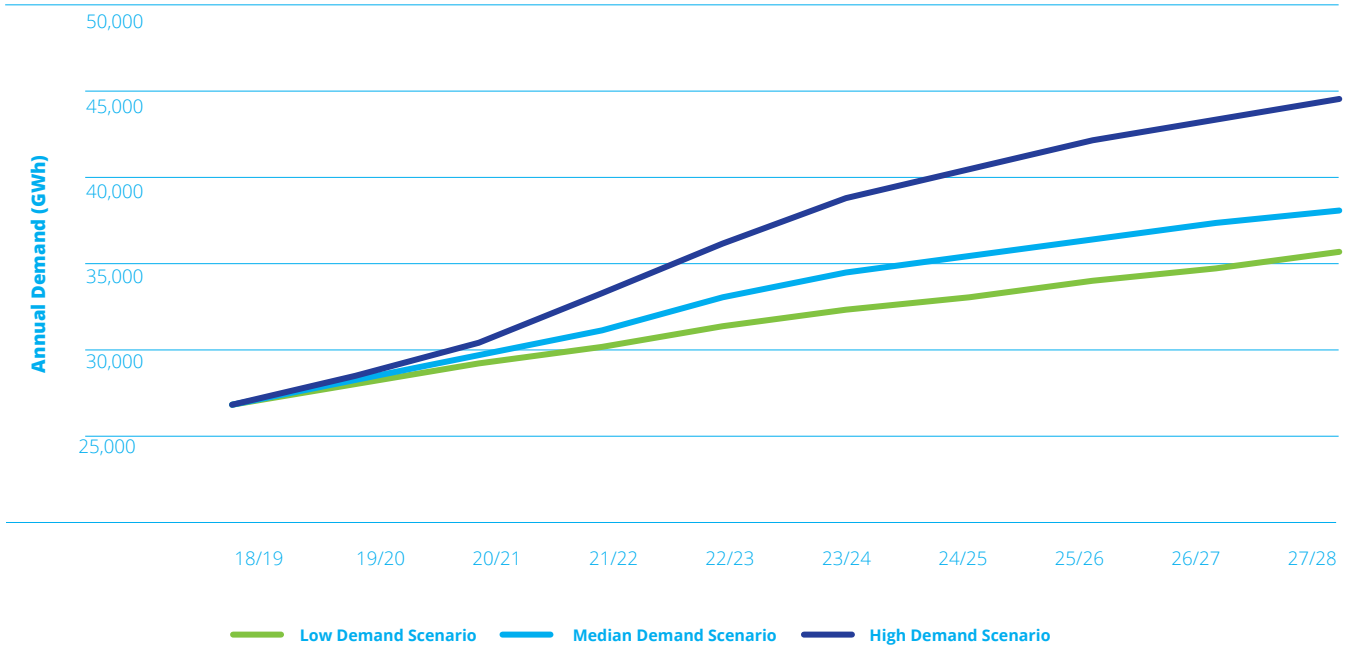


Figure 6-5: EirGrid Generation Capacity Statement Demand Forecasts for ROI



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(continued)

Figure 6–4 illustrates the anticipated level of generation by fuel for thermal plant in the SEM, based on the EirGrid / SONI All-Island Generation Capacity Statement 2019–2028. This is based on thermal plant capacities given for 2019 with known commissioning/decommissioning dates as set out in the Generation Capacity Statement.

The latest EirGrid / SONI low, median and high electricity demand scenarios are illustrated in Figure 6–5. These electricity demand forecasts are used to differentiate Gas Networks Ireland's Low, Best Estimate and High gas demand scenarios for the power generation sector.

Prior to the introduction of updates to the Single Electricity Market in October 2018, Gas Networks Ireland assessed the potential impact of the updates on the gas transmission network. A series of potential stressed gas demand profiles were developed and the capability of the gas transmission network to respond was assessed. In all scenarios, the capability of the network to cater for the stressed demand was proven.

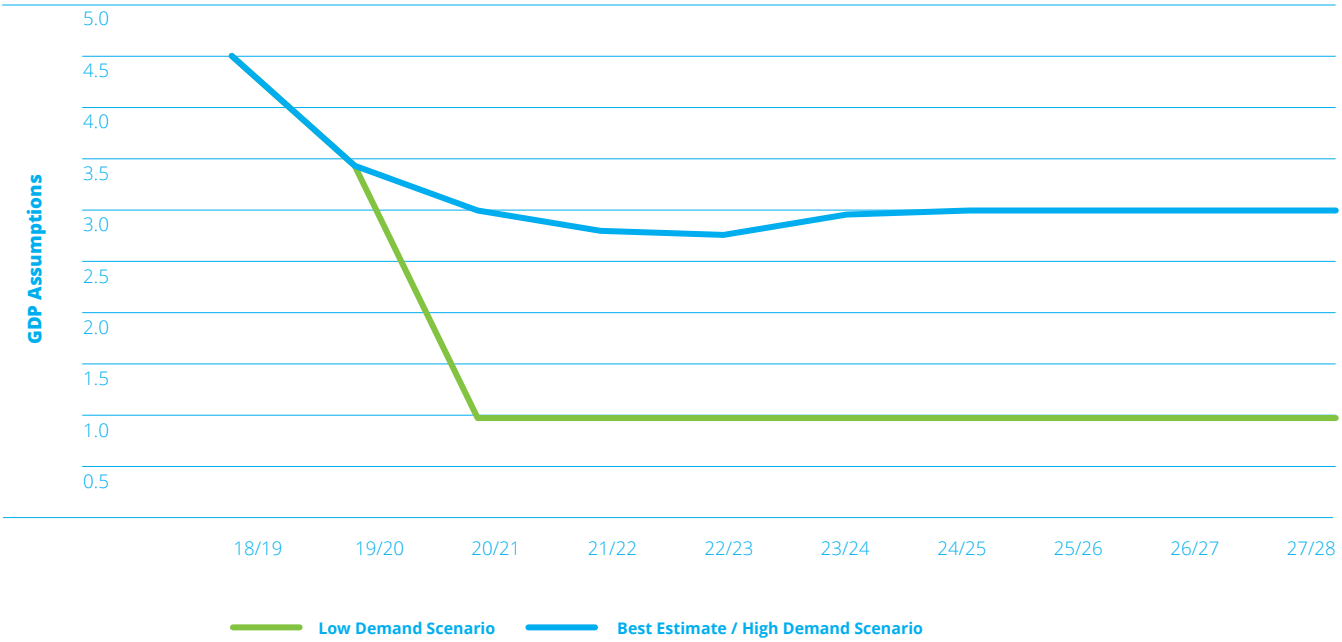
An assessment of the first 12 months of the updated SEM operation has shown how the Gas Networks Ireland transmission system continues to supply gas to flexible gas-fired power generation, with gas contributing an average of c. 51% of Ireland's power generation fuel mix in the 12 months following commencement of updates to the SEM. On days of low wind, gas has contributed towards 90% of the generation fuel mix.

6.5.2 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)[32]. Figure 6–6 presents the GDP growth rate assumptions over the forecast period.

The short term GDP forecasts are a composite of a number of short term forecasts from the Economic & Social Research Institute (ESRI), Central Bank, the Organisation for Economic Co-operation and Development (OECD), the International Monetary Fund (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.

Figure 6-6: GDP Assumptions



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

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 Best Estimate 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 Best Estimate and High demand scenarios in line with Gas Networks Ireland's I/C new connections growth strategy.

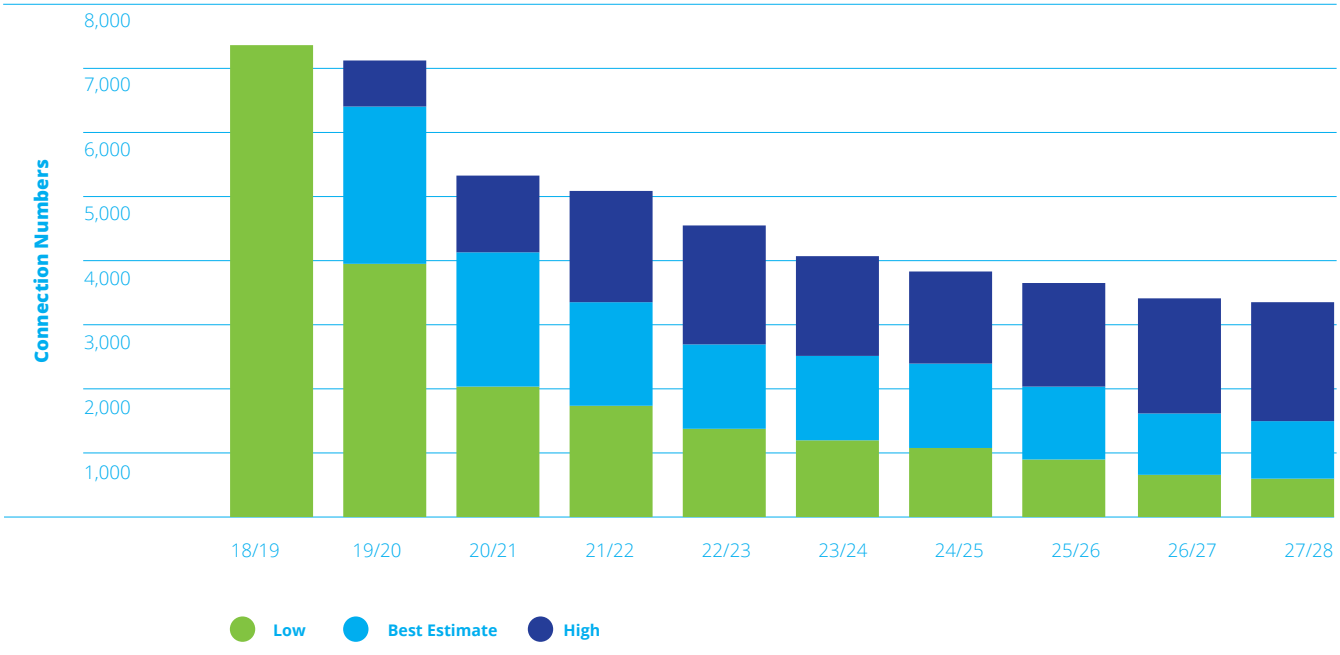
6.5.3 Residential Sector

The forecast for new residential connections is shown in Figure 6–7. On the back of the Government's Climate Action Plan, published in June 2019, containing a proposed effective ban on the installation of natural gas boilers in new homes from 2025, Gas Networks Ireland has already experienced a significant reduction in demand for natural gas connections for newly built homes. This is a natural reaction from builders, developers, architects and M&E consultants to a government paper recommending an effective ban on natural gas boilers, albeit 6 years in the future, with almost all new housing developments now being designed with electric heat pump heating solutions and without a natural gas supply. The expected reduction in demand is expected to be very significant in 2020 with new housing orders reducing by 50 – 70% of the 2019 run rate and remaining at a very low level through the NDP timeframe. Apartments may continue to be developed with natural gas central boiler solutions and potentially Combined Heat and Power (CHP) technology, however this market is also challenged by the heat pump offerings (exhaust air heat pumps). Gas Networks Ireland will continue to support the building and developer community with natural gas solutions for new homes and will promote renewable gas as a pathway for new and existing homes to decarbonise.

6.5.3.1 Energy Efficiency

Energy efficiency savings impacting on Industrial & Commercial and residential gas demands are derived from the National Energy Efficiency Action Plan 2017[33] (NEEAP4). Assumptions relating to energy efficiency savings are further outlined in Appendix 3: Energy Efficiency Assumptions.

Figure 6-7: Residential New Connection Numbers



33 https://www.dccae.gov.ie/documents/NEEAP%204.pdf

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Gas Demand Forecasts
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6.5.4 Compressed Natural Gas Sector

The transport sector gas demand is also included in the gas demand forecast. 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 conducting feasibility studies for a nationwide CNG fuelling network, co-located in existing forecourts, on major routes and/ or close to urban centres. This comprehensive refuelling station network, will allow a transition to both natural gas and renewable gas as alternative fuels. This ambition will help meet Ireland's requirements under the EU's Alternative Fuels Infrastructure Directive. Gas Networks Ireland is targeting the conversion of 24% of HGVs and 13% of buses to CNG or bio-CNG by 2030.

Gas Networks Ireland is leading a project called the Causeway Study, which is funded by the Commission for Regulation of Utilities (CRU) and the Connecting Europe Facility (CEF) Transport Fund.

The first public access station has been constructed at the Circle K Service Station in Dublin Port, one of the busiest HGV refuelling stations in the country. The station is currently operational and has capacity to refuel up to 70 HGVs per day.

See section 8.4 for further details on Gas Network Ireland's plans regarding CNG and NGVs. Table 6–2 gives the projected transport sector demand for each scenario. The Best Estimate demand scenario assumes that 467.4GWh is in place by 2024/25, while the High demand scenario assumes a figure of 834.6GWh.

Table 6–2: Annual CNG Demand Forecasts (GWh)

	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28
Low Scenario	2.5	11.5	35.6	90.4	161.9	227.1	275.4	294.1	294.7	294.7
Best Estimate Scenario	2.5	11.5	35.6	93.7	188.7	318.8	467.4	599.8	699.5	762.4
High Scenario	2.5	16.8	66.9	180.2	354.8	575.5	834.6	1,143.2	1,477.2	1,816.8

6.6 The Demand Outlook

This section presents an overview of the gas demand outlook for the period 2018/19 to 2027/28.

6.6.1 Power Generation Sector Gas Demand

As described in section 5.2, power generation sector gas demand has risen substantially since 2015 as a result of reduced electricity interconnector imports from Great Britain, growing electricity demand, and more recently carbon and fuel prices favouring gas-fired generation ahead of coal in the merit order for electricity generation. Following the updates to the wholesale electricity market in October 2018, electrical interconnector behaviour has generally displayed efficient behaviour in that the interconnectors are generally importing to Ireland when Irish electricity prices are higher than Great Britain markets, and exporting at times of high wind when prices in the SEM are lower than in Great Britain[34]. It is expected that this trend will continue in the short to medium term in all scenarios. However the trend may gradually swing back in favour of imports from Great Britain to Ireland over the back end of the forecast horizon should carbon prices on the ETS continue to rise as forecasted[35]. This will depend on how carbon policy develops in the UK post-Brexit, which at present remains uncertain.

In the Best Estimate demand scenario, power generation sector gas demand is expected to continue to increase, despite the projected growth in installed wind capacities. Growth in the short to medium term is driven by continued favouring of base load gas plant in the merit order ahead of coal and the anticipated closure of 2 peat stations at the end of 2020. In the longer term, further growth in this sector is driven by the continued increase in electricity demand coupled with anticipated closure of coal-fired generation units, out-pacing the projected levels of renewable generation penetration. It is noted that while growth in installed wind capacities are modelled over the longer term, technical constraints on the power system and on generation plant minimum limits are modelled at existing levels. Should these constraints be reduced, an element of the gas demand growth projected in this sector will be reduced.

Over the forecast horizon, growth of 28% is predicted in the power generation sector in the Best Estimate scenario. This demand growth is reflective of the strong growth in electricity demand with EirGrid predicting growth of 31% in their median electricity demand scenario.

The High demand scenario uses the same inputs and assumptions apart from the electricity demand forecasts, instead using EirGrid's high demand forecast. The resultant narrative is similar to the Best Estimate scenario but leads Best Estimate in growth due to the higher electricity demand projected – growth of 47% is projected in the High demand scenario. Similarly, the Low demand scenario uses EirGrid's Low demand forecasts. In addition, the Low demand scenario assumes a higher rate of installed wind capacity build out. These factors result in a lower gas demand forecast for the power generation sector of 4% over the 10-year horizon. It is notable that the Low gas demand forecast initially shows a reduction in gas demand in this sector, until year 7 where growth is anticipated resulting from the anticipated closure of coal-fired generation.

"In the Best Estimate demand scenario, power generation sector gas demand is expected to continue to increase, despite the projected growth in installed wind capacities."

34 SEM committee SEM-19-035: Single Electricity Market Performance 1 April 2019 – 30 June 2019
35 Gas Networks Ireland uses forecasts of carbon pricing from the International Energy Agency's World Energy Outlook document.

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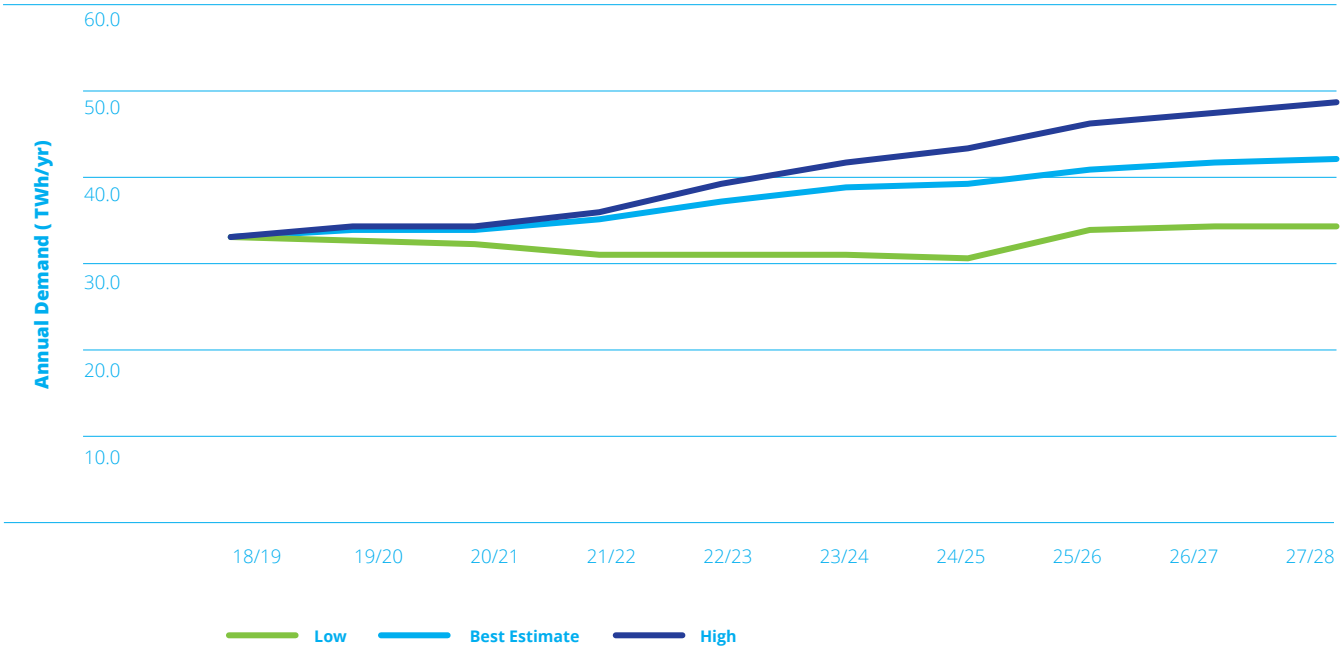
(continued)

Figure 6–8: Power Generation Sector Gas Demand



6.6.2 Industrial and Commercial Sector Gas Demand

In the Industrial & Commercial (I/C) sector, the Best Estimate demand scenario profile shows strong growth of 19% over the period of interest. This is a result of the strong economic performance predicted over the forecast horizon and takes account of NEEAP4 Energy Efficiency measure in this sector. In the Low and High demand scenarios, Industrial & Commercial sector gas demand is expected to grow by 5% and 30% respectively.

6.6.3 Residential Sector Gas Demand

In the residential sector, taking account of recent targets announced in the Climate Action Plan, negative growth is projected across all scenarios. This is as a result of reduced new connections assumptions, coupled with an anticipated increase in disconnection rates in this sector. The Best Estimate scenario projects a reduction of 4% in the residential gas demand sector across the forecast horizon. In the High and Low demand scenarios between 2% and 5% reduction in demand is predicted.

6.6.4 Compressed Natural Gas Sector Gas Demand

In the compressed natural gas sector, positive growth is projected across all scenarios. Gas Networks Ireland has successfully both public and private CNG stations on the distribution gas network with new connection expected to continue and increase of the 10 year NDP period. The Best Estimate demand scenario projects that 762.4GWh is in place by 2027/28, while the High demand scenario assumes a figure of 1816.8GWh.

Figure 6-9: Industrial & Commercial Sector Gas Demand

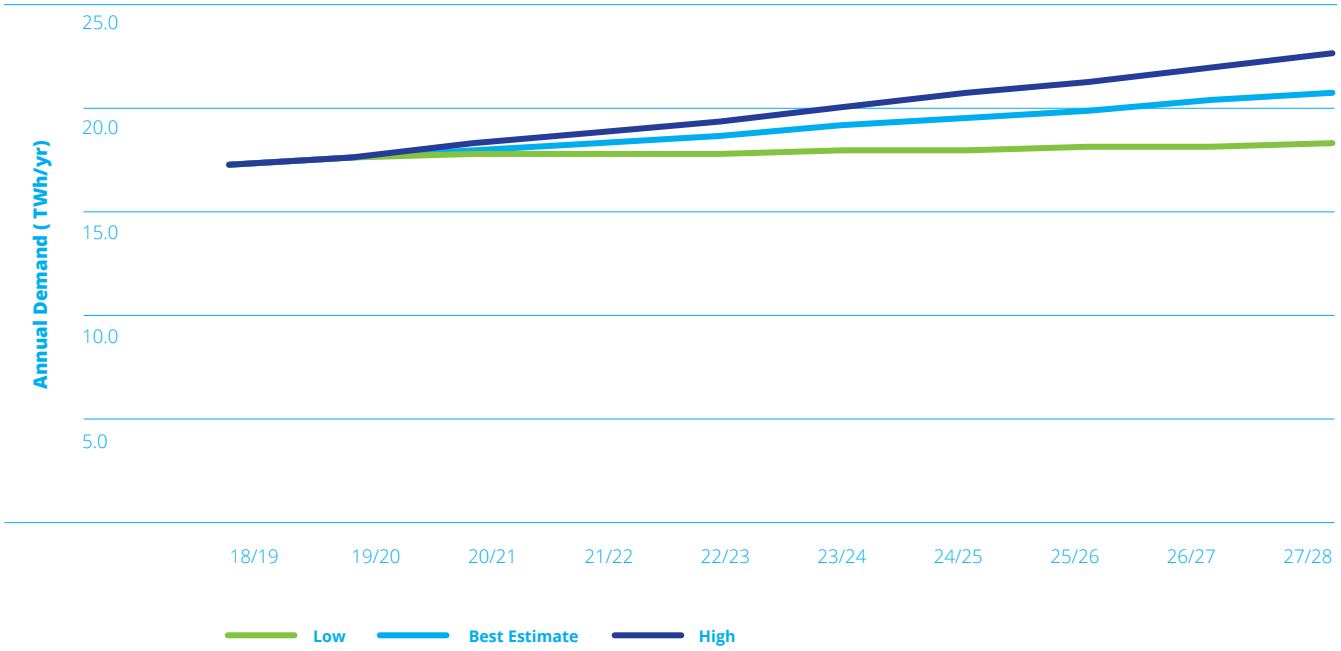
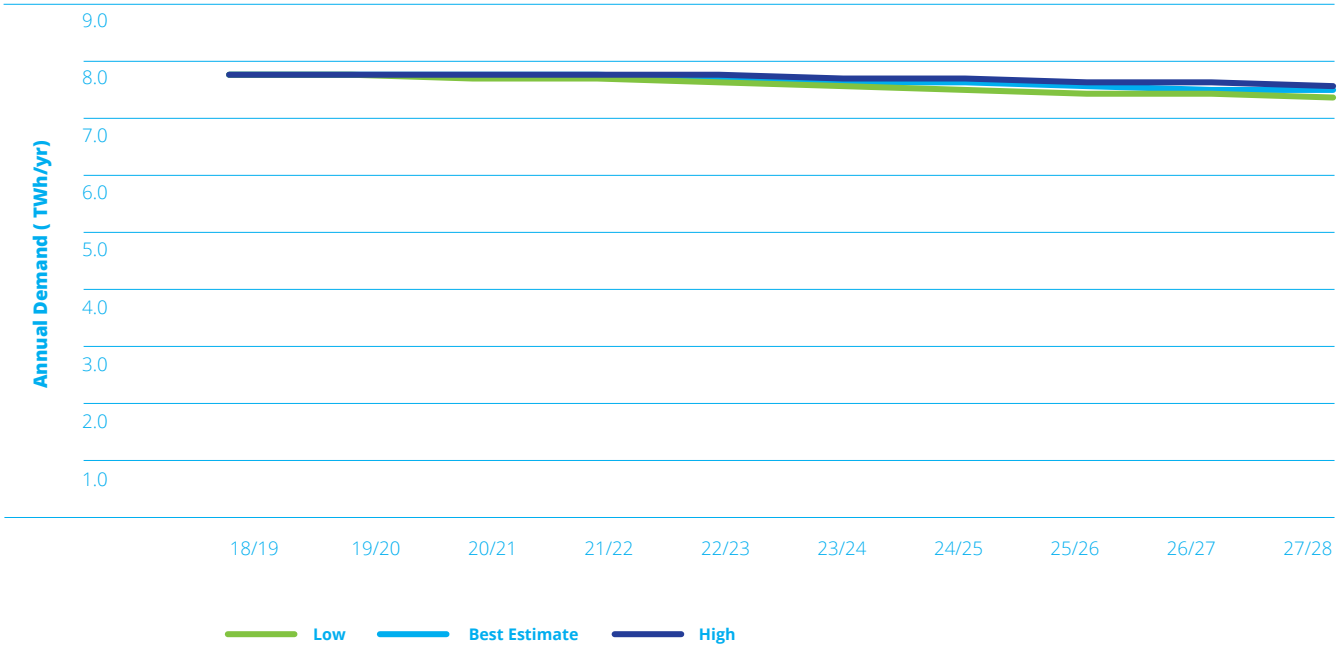


Figure 6-10: Residential Sector Gas Demand



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Gas Demand Forecasts
(continued)

Figure 6-11: Compressed Natural Gas Sector Gas Demand

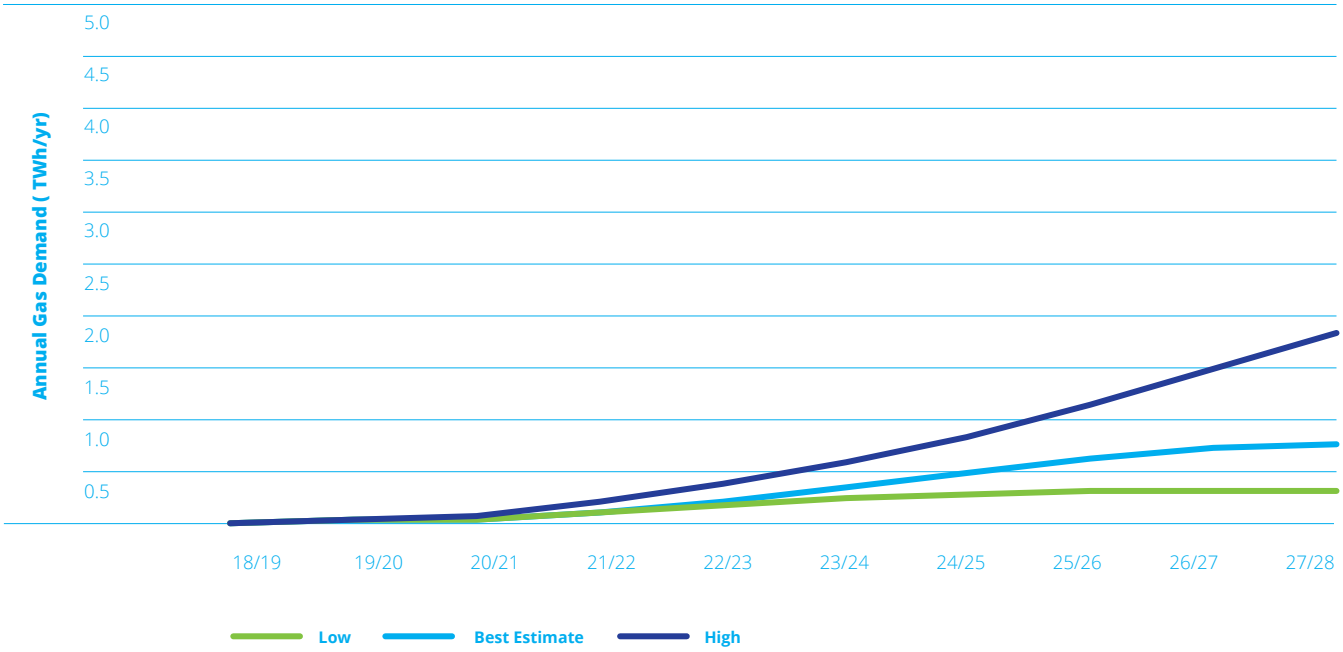


Figure 6-12: Total Annual ROI Gas Demands

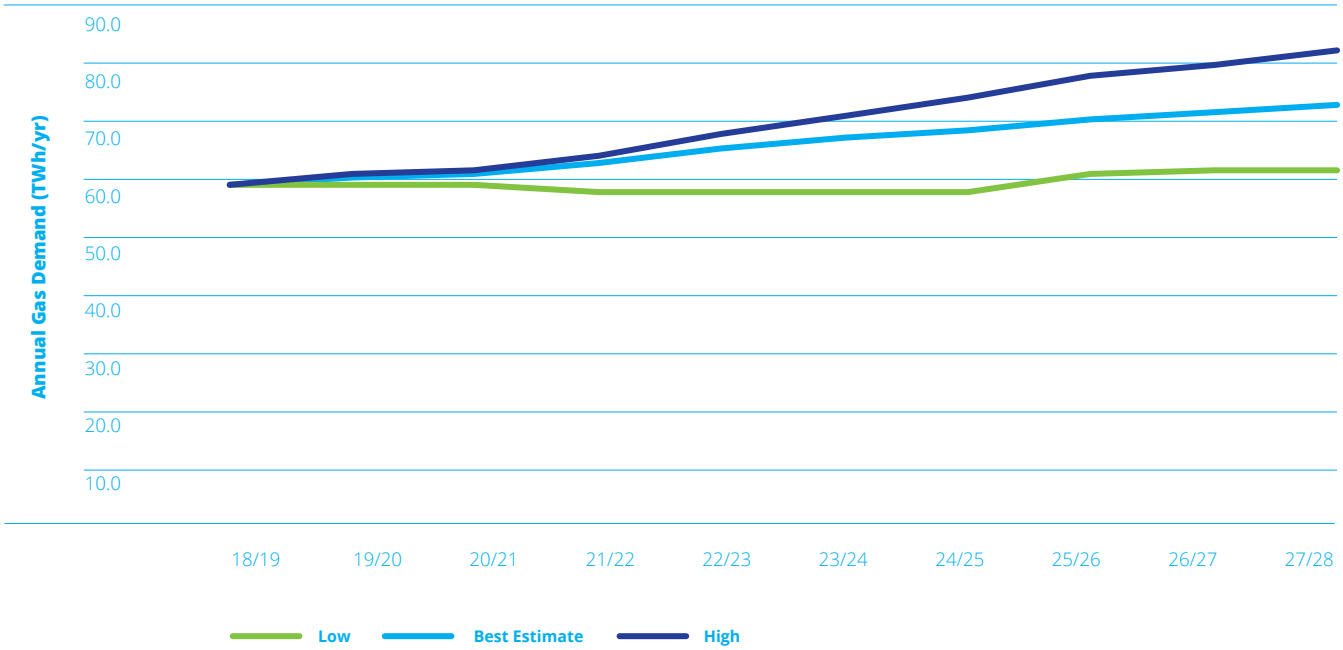
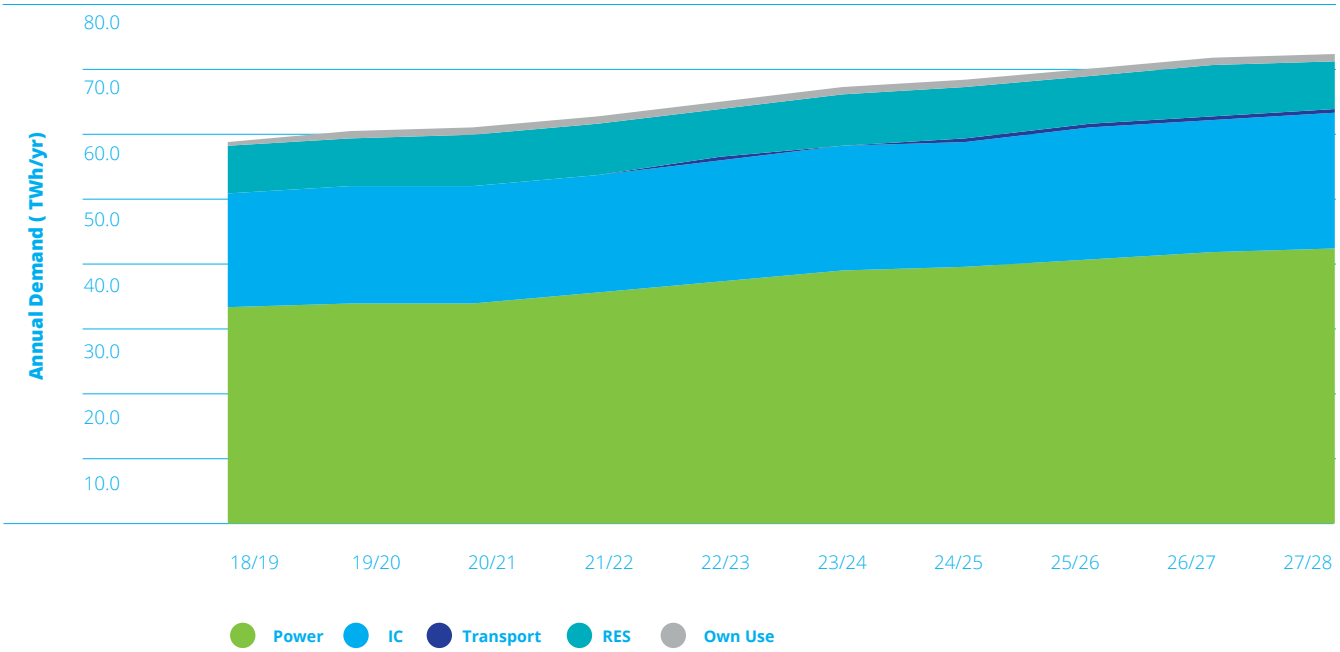


Figure 6-13: Best Estimate Scenario Annual ROI Demand by Sector



6.6.5 Total Annual Gas Demand

In the Best Estimate demand scenario, annual ROI gas demand is expected to grow by 23% between 2018/19 and 2027/28 with growth of 4% and 39% forecast in the Low and High demand scenarios respectively over the same horizon. The strong growth is primarily as a result of growth in power generation sector gas demand driven by growth in electricity demand, and anticipated closures of other thermal plant on the SEM. In comparison to previous years, the change in electricity interconnector flow towards neutral, following the market price differential between GB and IE is also expected to have an impact in the short to medium term. This dynamic is expected to swing slowly back in favour of electricity imports towards the back-end of the forecast horizon, thus offsetting a portion of the gas demand growth that would have otherwise been anticipated in the long term resulting from closure of coal-fired power generation.

The aggregate ROI system demands for the Best Estimate scenario are presented in Figure 6–12. Figure 6–13 gives the relative weightings of each sector over the forecast period for the Best Estimate demand scenario.

6.6.6 Peak Day Gas Demand

The 1-in-50 and average year peak day gas demands for ROI are given in Figure 6–14. The 1-in-50 peak is expected to grow by 18.2% in the Best Estimate scenario and between 7.1% and 21.7% for the Low and High demand scenarios over the duration of the analysis. Average year peaks are expected to grow by 21.7% in the Best Estimate scenario and by between 9.4% and 28% 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.

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Gas Demand Forecasts
(continued)

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 2024, 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. Although this is not always the case, there is often 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.

6.6.7 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 as stated in the 2019 Climate Action Plan. Also 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."

Figure 6-14: Peak Day Gas Demand Forecast

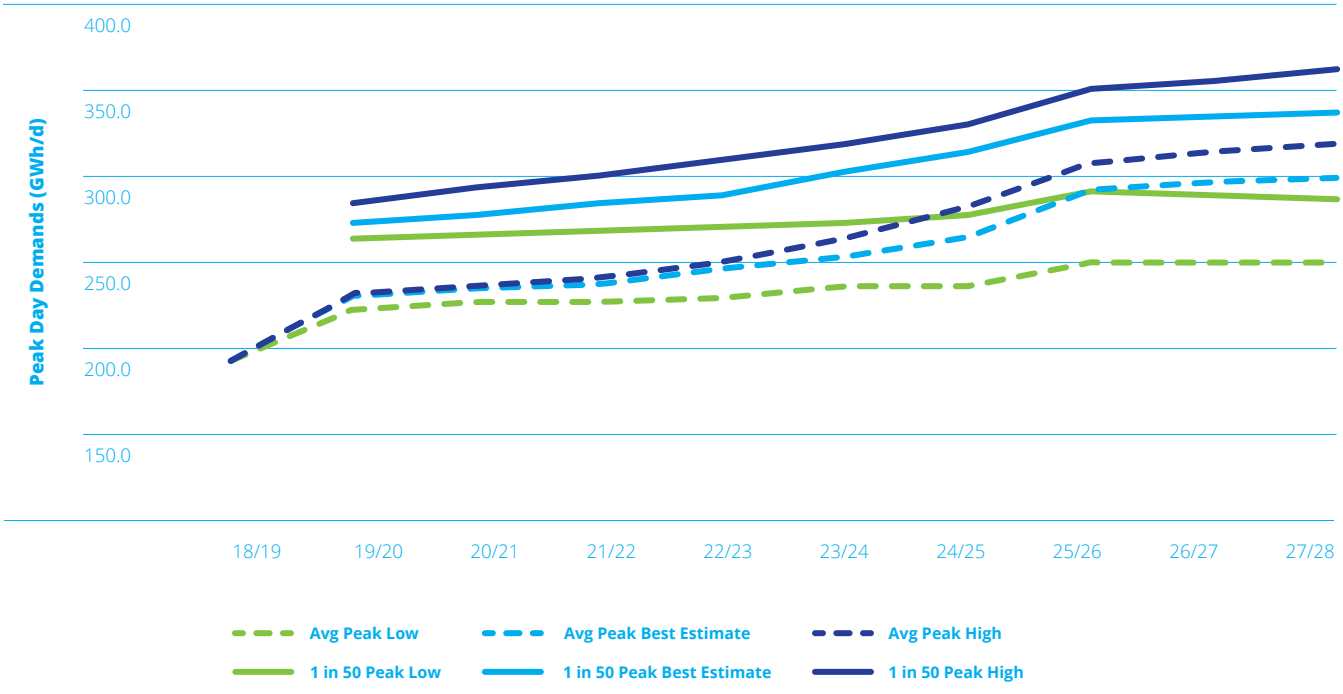


Figure 6-15: Location of Moneypoint in relation to the gas network

Of the low carbon generation alternatives available to the Moneypoint plant, Gas Networks Ireland believes the installation of a modern combined cycle gas turbine (CCGT) plant at Moneypoint offers by far the most efficient technology and represents a low risk option using a cost effective and proven technology. Given its flexibility, gas is the optimal complementary energy source for renewable energy such as wind and solar as gas turbines can be adjusted upward and downward fairly rapidly according to load changes. Moneypoint is located in relatively close proximity to Gas Networks Ireland's ring main and could be connected via a new spur transmission pipeline approximately 20 km in length. Figure 6–15 shows the location of the existing Moneypoint site in relation to the gas network.

Ireland's portfolio of CCGT 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 produce substantially lower emissions than coal, peat or oil fired plant (see Table 6–3) and when coupled with Carbon Capture and Storage (see section 4.3) there is the potential to provide practically zero carbon electricity to the Irish economy.

Gas fired generation accounted for approximately 52% of Ireland's electricity generation in 2018. 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 approximately 700,000 customers in Ireland, including some of Ireland's 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.

Table 6-3: 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

36 Based on carbon emission factors published by SEAI.

Section 7.0
Gas Supply

Key Messages:

The Corrib gas field is expected to meet up to 30% of annual Gas Networks Ireland system demands (39% of ROI demand) in 2019/20, with the Inch and Moffat Entry Points providing the remaining 1% and 69% respectively.

The Moffat Entry Point in Scotland will remain key in terms of energy security as Corrib production declines in the medium term.

This section presents an overview of the gas supply outlook for the period 2018/19 to 2027/28.

The reduction in Corrib and Inch gas supplies has now re-established the Moffat Entry Point in Scotland as the dominant supply point. In 2018/19 the Corrib gas field accounted for around 46% of ROI supply, with the Inch Entry Point accounting for a further 5% of gas supplies. Gas imports via the Moffat Entry Point accounted for balance of gas supplies (49%).

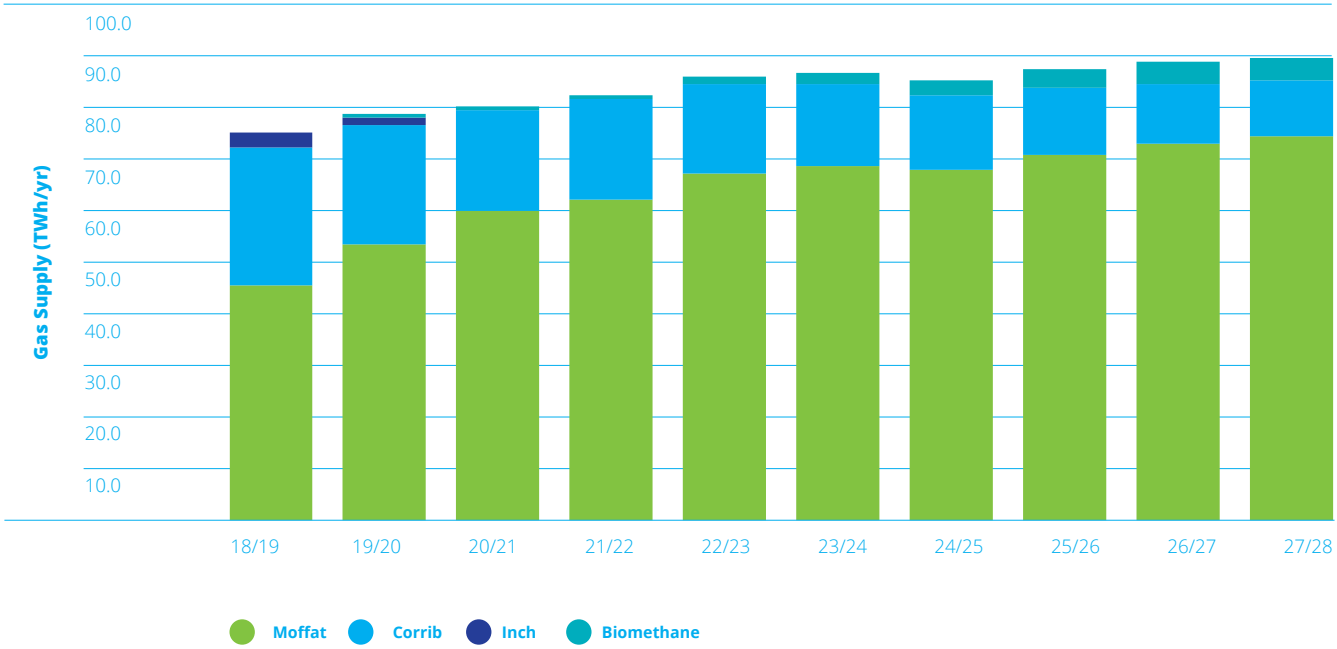
Corrib is expected to meet up to 30% of annual Gas Networks Ireland system demands (39% of ROI demand) in 2019/20, with the Inch and Moffat Entry Points providing the remaining 1% and 69% respectively. By 2027/28 Corrib gas supplies will have declined to less than 30% of initial peak production levels. By the end of the forecast horizon Moffat will account for approximately 83% of annual Gas Networks Ireland system demands (approximately 78% of ROI demand).

Figure 7–1 presents the forecast Gas Networks Ireland system[37] annual gas supply for the period to 2027/28 for the Best Estimate demand scenario.

The Gas Networks Ireland system 1-in-50 peak day gas supply profile for the Best Estimate scenario is presented in Figure 7–2. The Corrib gas field would be expected to supply approximately 22% of ROI peak day gas demand in 2019/20 in the event of a 1-in-50 winter peak day, with Inch accounting for around 2%. The Moffat Entry Point would be expected to meet nearly 76% and 82% of ROI demand and Gas Networks Ireland system demands respectively in 2019/20, in such circumstances. Moffat is anticipated to meet 88% and 91% of ROI and Gas Networks Ireland system peak day demands respectively in 2027/28.

The gas supply outlook highlights the continued critical role of the Moffat Entry Point throughout the forecast period. It is noted that based on the Best Estimate projection, the technical entry capacity at the Moffat Entry Point (see Section 7.1)

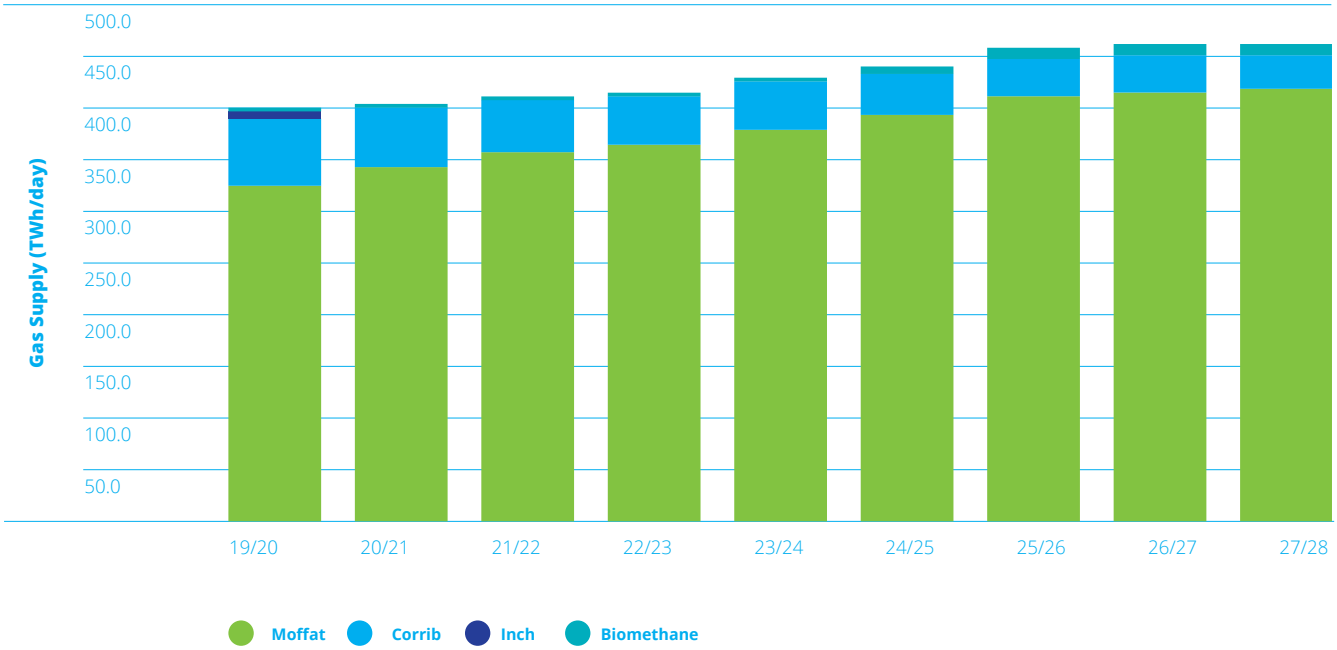
Figure 7-1: Annual Gas Networks Ireland System Gas Supply Forecasts – Best Estimate Scenario



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

Section 7.0 Gas Supply (continued)

Figure 7-2: 1-in-50 Peak Day Gas Supply Forecast – Best Estimate Scenario



would be exceeded on a 1-in-50 peak day in the last 4 years of the forecast horizon. Gas Networks Ireland will continue to monitor supply and demand developments in the interim period, and take prudent steps to ensure sufficient capacity will be available on the transmission system into the longer term.

7.1 Moffat Entry Point

Following completion of the twinning of South West Scotland Onshore system (PCI 5.2) in 2018, the Moffat Entry Point technical capacity has been increased to 35 mscm/d (386.9 GWh/d) and supplies gas to ROI, NI and IOM. The Moffat Entry Point has reliably met the systems energy demand requirements 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. Shippers active in the wholesale gas market in ROI are also typically active in the GB market or have access via contractual arrangements upstream counterparties. The UK wholesale gas market is extremely liquid with diverse supply sources from the UK, Norway, mainland Europe and further afield via LNG import terminals. Wholesale supply contracts into the ROI market are typically of 1 year in duration and for variable volumes as much of the demand in ROI is related to the Power Generation Market.

7.2 Corrib Gas

The Corrib gas field, following commencement of production in December 2015 and a subsequent period operating at full capacity, reached a production plateau at the beginning of 2018. A steady decline in production has been observed at Corrib since then, in line with supply profile projections as detailed in previous Network Development Plans. Table 7–1 shows the forecast maximum daily supplies from Corrib.

7.3 Celtic Sea Gas Storage

The Kinsale storage facility is operated by PSE Kinsale Energy Limited (KEL) using the depleted Southwest Kinsale gas field. KEL has advised Gas Networks Ireland that blowdown[38] of Southwest

38 Blowdown is where the gas used for pressure support in Southwest Kinsale is produced and sold into the market.

Kinsale cushion gas is progressing. Cushion gas is currently being supplied from the Inch Entry Point and is anticipated to continue until production ceases completely, currently anticipated in the first half of 2020. There will be no further injections into Southwest Kinsale.

7.4 Renewable Gas

Energy from bio-methane or renewable gas has the potential to contribute significantly to Ireland's renewable energy targets. In particular, renewable gas could greatly assist Ireland in meeting the EU targets for thermal energy from renewables (RES-H) and transport fuel from renewables (RES-T). In addition to being a potentially 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 support scheme for the 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.

Table 7–3 gives Gas Networks Ireland's medium national renewable gas production forecast. Renewable gas is discussed further in section 8.5.

7.5 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.

Table 7-1: Corrib Forecasts Maximum Daily Supply

	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28
Daily Supply (mscm/d)	7.46	6.56	5.82	5.25	4.76	4.31	3.91	3.59	3.23	2.93
Daily Supply (GWh/d)	78.1	68.6	60.9	54.9	49.8	45.1	40.9	37.6	33.8	30.7

Table 7-2: Inch Forecasts Maximum Daily Supply

	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28
Daily Supply (mscm/d)	0.70	0.53	0	0	0	0	0	0	0	0
Daily Supply (GWh/d)	7.3	5.5	0	0	0	0	0	0	0	0

Table 7-3: Renewable Gas Supply Forecast

	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28
Production (GWh/yr)	0	25	132	528	1,334	2,152	3,182	3,849	4,341	4,966

Section 8.0
Gas Growth

Key Messages:

The gas network in Ireland is critically important and strategic infrastructure providing a natural gas supply to circa 700,000 customers across the country.

The gas network remains key to Ireland's economic growth, with close to 1,000 businesses and circa 9,000 homes connecting to natural gas every year.

Gas Networks Ireland also estimate that there are up to 300,000 households in Ireland, located on or close to the gas network, using oil for central heating that could be readily connected to natural gas resulting in a more convenient cost effective heating solution for the consumer and significant benefits from an environmental perspective.

The first publicly accessible CNG station has been constructed at the Circle K Service Station in Dublin Port. It has capacity to refuel up to 70 HGVs per day.

Gas Networks Ireland and Clean Ireland Recycling officially opened the first private fast-fill CNG station at the Clean Ireland Recycling premises in Smithstown Industrial Estate, Shannon, Co. Clare.

The first renewable gas injection facility in Ireland was commissioned in Cush Co. Kildare in 2019 with the first renewable gas flowing in 2019.

Gas Networks Ireland currently transports natural gas to its circa 700,000 customers but 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.

The ESRI carried out research on 'access to and consumption of natural gas: spatial and socio-demographic drivers' and the resultant report recognises that increasing the number of dwellings connected to the gas network has the potential to reduce emissions where dwellings are switching from e.g. coal and oil. It is evident that gas, both natural and renewable, has an essential role in Ireland's transition to a low carbon economy. The advent of renewable gas has a profound impact on the challenge of decarbonising domestic heating. Once a sufficient level of renewable gas is on the network there is an opportunity that close to 1 million homes (those on, or within easy access of, the gas network) could be decarbonised via the gas network.

Gas can now also 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.

As set out in further detail in section 3, Gas Networks Ireland's design and planning teams assist in the development of transmission system projects and key infrastructural projects which are vital for the socio-economic development of the State.

A key focus in the development of such projects is on matters of proper planning and sustainable development having due regard for the environment as set out in further detail in section 3.

8.1 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[39] resulting in significant benefits from an environmental perspective, considering natural gas emits 23% less CO_2 and negligible levels of NO_x & SO_x versus oil. Gas Networks Ireland also provides pre-payment gas meters that can help customers to manage their energy usage and costs. Natural gas is a more convenient cost effective solution for homeowners nationwide.

There has been increased activity in the new housing sector which was highlighted in a recent CSO publication entitled 'New Dwelling Completions'[40] showing that there were 4,920 new dwelling completions in Q2 2019 compared with 4,400 completions for Q2 2018, which is an increase of 11.8%. The CSO information also shows that in the first half of 2019 there were 9,185 new dwelling completions which is a 16.8% increase on the same period of 2018, 7,867 completions. In 2017, Gas Networks Ireland received orders for in excess of 9,200 new dwellings (an increase of 30% year on year), for new homes built on or near the gas network. However, stiff competition from air to water electric heat pumps has since slowly began to erode Gas Networks Ireland's market share. In addition, the recent publication of the most up to date domestic building regulations, i.e. Part L 2019 (commonly referred to as nearly Zero Energy Building standards or nZEB standards), and the effective ban on gas boilers in new homes from 2025 onwards, contained within the Government's Climate Action Plan on Climate Disruption published in June 2019, has increased the challenge of achieving ambitious new housing targets as set by the Regulator.

39 The Future of Oil and Gas in Ireland', Policy Advisory by the Irish Academy of Engineering, February 2013.
40 https://www.cso.ie/en/releasesandpublications/er/ndc/newdwellingcompletionsq22019/

Section 8.0 Gas Growth (continued)

However, natural gas in combination with solar panel technology currently forms part of a solution to meeting Part L of the Building regulations. Gas Networks Ireland will continue to provide solutions to meet the requirements including the addition of renewable gas. Although the Government's policy is for the electrification of home heating to achieve decarbonisation, Gas Networks Ireland believes that as the gas network decarbonises with renewable gas in the short to medium term and hydrogen in the medium to long term, gas will also deliver decarbonisation in the heat sector. Gas Networks Ireland's vision for a decarbonised gas network is set out in its 'Vision 2050: A Net Zero Carbon Gas Network for Ireland'[41] which was published in October 2019.

8.2 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. 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, without the need for costly equipment upgrades (the exact same equipment can be used to burn renewable gas). Further information about renewable gas can be found in section 8.5. 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 3.3 TWh/yr of annual demand from the I/C sector by the end of the NDP period.

8.2.1 Data Centres

There are a number of key sectors which could potentially influence capacity with their growth demand over the coming years. Data centres for example have emerged as a potential growth sector in Ireland due to its global connectivity to Europe and the Americas, combined with excellent utility infrastructure, moderate climate, stable economic policies and IDA[42] 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 now over 50 data centres[43] currently operating in Ireland with substantial future growth predicted in this sector subject to planning. These data centres are already impacting the electricity grid capacity, as the demand for electricity from these mainly Dublin-located centres is putting a significant strain on the Eirgrid infrastructure.

Gas Networks Ireland has developed a combined offering of natural gas, renewable gas and dark fibre services through its subsidiary Aurora Telecom to provide the data centre sector with its primary source of energy and fibre connectivity. Natural gas can be used for onsite energy generation leveraging the existing reliable gas network infrastructure, offering data centre operators' substantial savings in terms of energy costs and as such Gas Networks Ireland expects

41 https://www.gasnetworks.ie/vision-2050/future-of-gas/GNI_Vision_2050_Report_Final.pdf
42 The IDA (Industrial Development Agency) is a semi state body whose main objective is to encourage investment into Ireland by foreign-owned companies
43 Ireland's Data Hosting Industry Q2 2018 Update http://www.bitpower.ie/images/RDDSTUDY/Bitpower_2018_Q2_Update_V4.pdf

the penetration of gas connections in this sector to increase in the coming years.

8.2.2 Combined Heat & Power

Growth in the Combined Heat & Power (CHP) sector is another area which could potentially influence capacity in the coming years. The 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, while providing significant carbon and energy savings versus utilising grid electricity. In 2017 the installed CHP technology in Ireland avoided an estimated 423 $ktCO_2$ emissions (up 16% from 2016) and provided for an estimated 1,887 GWh in primary energy savings.

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. In 2017 there was a 2.1% increase in the CHP capacity in Ireland. Natural gas remains the fuel of choice for CHP plants throughout Ireland and accounts for over 90% of the installed operational capacity. The reliability, combined with the high efficiency of natural gas CHP, also offers substantial savings when compared to grid electricity. Gas Networks Ireland has been promoting the increased utilisation of CHP technology for a number of years now, including two CHP Conferences held during the last 3 years promoting the use of this highly efficient, low emissions solution. Forecasts show that the number of CHP installations in Ireland will continue to increase as large industrial users and hotel/leisure centres realise the benefits of investing in this technology.

8.2.3 Other Developments

Growth in the dairy sector continues to show upward trends since the elimination of the milk quota system on 1st April 2015 and 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. The increase in gas usage is expected to continue with IFCN6[44] Dairy forecasting an increase in milk production per farm of over 50% by 2030; this increase will be to address the worldwide demand

44 IFCN is a global dairy related research network that helps to better understand the dairy world by providing globally comparable dairy economic data and even forecasts. https://ifcndairy.org/

for milk and milk products. 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.

Other sectors of note include 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.

"Gas Networks Ireland is progressing a number of suburb project proposals and the first of these commenced construction in Q3 2019 and is expected to be completed in early 2020."

A project of note during the past 2 years has been the Center Parcs Holiday Village development in Longford. Gas Networks Ireland worked closely with this UK company to bring the gas network from Athlone to this new development over a distance of circa 25km, illustrating the importance of the gas network to this hospitality sector. Center Parcs also constructed circa 25km of low pressure downstream network within the site to bring natural gas to all 400 lodges, commercial units and their 3 CHP engines for onsite electricity generation. The project was delivered on time and on budget by Gas Networks Ireland and enabled an on-time opening of the facility during the summer of 2019.

8.3 New Towns and Suburbs Policy

The towns of Nenagh, Wexford and Listowel have recently been connected to the gas network along with a new connection to Center Parcs in Longford. Gas Networks Ireland facilitate further new town connections to increase the penetration of the gas network in Ireland, where demand is sufficient to meet the requirements of the new towns section of the Gas Networks Ireland connections policy.

Gas Networks Ireland will also expand the gas network through the suburb projects policy which is outlined in the connections policy. This approach allows the gas network to be

Section 8.0 Gas Growth (continued)

extended to industrial zones or streets/regions that are close to the existing gas network but not connected. These areas can be connected as long as it they are commercially feasible and represent minimal increases to the existing network. Gas Networks Ireland is progressing a number of suburb project proposals and the first of these commenced construction in Q3 2019 and is expected to be completed in early 2020 (Galway).

As set out in section 3, Gas Networks Ireland applies a bespoke environmental planning and assessment tool used by Gas Networks Ireland's design and planning teams in consultation with the Gas Networks Ireland environmental team to assess the environmental impact of such projects.

8.4 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 (HGV) 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].

In order to provide an affordable low carbon alternative fuel to diesel in the Irish market, Gas Networks Ireland is conducting a project for a nationwide 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[46] Core Road Network. It is also 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 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 2025, helping to ensure a low and stable price. Gas Networks Ireland is currently targeting at least 5% penetration of CNG or bio-CNG 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 0.8 TWh/yr. Please see section 6.5.4 for more information on the projected transport sector gas demand.

Gas Networks Ireland is utilising high capacity fast fill technology which provides quick, efficient and safe refuelling which is very similar in nature to that of diesel refuelling. The normal fill time for a natural gas HGV is 3–5 minutes from empty. This is essential to recognise that these are commercial vehicles and that they need to be generating income and doing work on a consistent and reliable basis.

45 SEAI Energy in Transport 2014 report.
46 TEN-T – Trans-European Transport Network. https://ec.europa.eu/transport/themes/infrastructure/ten-t_en

Figure 8-1: Dublin Port CNG Station

The initial phase of this network rollout is through the Causeway Study which has begun to deliver this essential infrastructure. The Causeway Study consists of 6 activities such as are Programme Management, Pilot CNG Network, CNG Vehicles and Supports, Renewable Gas Injection Facility, System Operation & Data Analysis and Communication & Dissemination. The CNG Stations will be strategically located to deliver the required outputs of the Causeway Study and to maximise utilisation of the assets.

The first public access station has been constructed at the Circle K Service Station in Dublin Port. It has capacity to refuel up to 70 HGVs per day. The Dublin Port location is one of the busiest HGV refuelling stations in the country and is strategically located within Dublin Port. It is equipped with both NGV 1 and NGV 2[47] nozzles, supporting both HGVs and LGVs and cars, if required. This station is fully operational and is integrated with Circle K's systems and as such CNG is sold through the station in a similar fashion to diesel and petrol.

Gas Networks Ireland and Clean Ireland Recycling officially opened the first private fast-fill CNG station at the Clean Ireland Recycling premises in Smithstown Industrial Estate, Shannon, Co. Clare. The Shannon site is part of Gas Networks Ireland's wider strategy to develop a market for natural gas as a lower-emission transport fuel.

Section 8.0 Gas Growth (continued)

A CNG compressor and private refuelling station have been installed at Clean Ireland Recycling's Shannon operation, and the company, a leader in environmentally friendly waste management services since its establishment in the early 1990s, has also received delivery of dedicated CNG waste collection vehicles, the first of their kind in Ireland. The specially commissioned, lower-emission CNG trucks have replaced a portion of Clean Ireland Recycling's diesel powered fleet, with the rest of the fleet also transitioning to CNG in the coming years.

In 2017, Gas Networks Ireland launched its Compressed Natural Gas Vehicle Fund making up to €20,000 available to businesses towards the purchase of a new Natural Gas Vehicle (NGV). The Vehicle Fund has made a total of €700k of funding available to transport operators, supporting the purchase of a range of commercial vehicles including trucks, buses and vans powered by Compressed Natural Gas (CNG), and is part of a process to promote natural gas as a transport fuel in Ireland. The Vehicle Fund is supported by the Commission for Regulation of Utilities (CRU) and is co-financed by the European Union's TEN-T Programme under the Connecting Europe Facility as part of the Causeway Project. This has been successfully allocated supporting 39 dedicated natural gas vehicles in the market. These vehicles alone are expected to utilise up to 20GWh/yr of CNG, emitting approximately 4,600 tonnes less of CO_2 per year.

8.5 Renewable Gas

Biogas, which is a form of renewable gas, can be produced through the digestion of wet organic biomass, purified to biomethane and injected directly into the gas network without modification to the network or end user equipment. This can provide benefits to the agriculture, heat and transport sectors while contributing significantly to meeting Ireland's current and future climate change targets.

Gas Networks Ireland is targeting 20% renewable gas on the gas network within a decade which is equal to circa 11.0TWh of renewable gas (Gas Network Ireland's high national renewable gas production forecast). This figure is supported

47 NGV 1 nozzles are suitable for Light Goods Vehicles and cars while NGV 2 nozzles are suitable for HGVs and larger vehicles.

by independent reports by the EU Commission and the SEAI. To achieve this ambitious level of renewable gas, there needs to be supports in place for anaerobic digestion (AD) with separate initiatives for the agriculture sector and the commercial waste industry sector.

Agri-AD

It is forecast that up to 10.1TWh per annum of renewable gas can be delivered from the agriculture sector within a 10 year timeframe. Agri-based AD will be supported on the basis that biogas is purified to natural gas standard at the AD site, ready for collection. Gas Networks Ireland in conjunction with other industry stakeholders intends to invest in the renewable gas collection logistics and Central Grid Injection (CGI) facilities located on the gas transmission network where renewable gas quality will be verified and the grid injection process will be managed and metered. The CGI facilities are designed to operate as gas Entry Points on the network where Gas Shippers can register to secure capacity and transact gas into the system for delivery to their gas customers in the heat, power and transport sectors. The first transmission connected CGI facility is being developed in Mitchelstown, Co. Cork as part of GRAZE (Green Renewable Agricultural & Zero Emissions) gas project. The project has been shortlisted for grant funding support from the Department of Communications, Climate Action and Environment's Climate Action Fund. In addition to the GRAZE Gas project, GNI is planning on developing a further 2,800 GWh of renewable gas injection facilities equating to approximately five CGI facilities in a project collectively called 'The Renewable Gas Central Grid Injection Project'. The locations of these facilities have yet to be determined however it is envisaged that these CGIs will be geographically spread along the gas network and provide centralised locations for renewable gas producers from local AD plants (within a 50 km radius) to inject into GNI's transmission system. This will help enable the rollout of renewable gas on a national basis.

GHG emissions from Agriculture represents over 35% of national emissions and are expected to increase further due to a projected increase in

Figure 8-2: Clean Ireland Recycling Fast-fill CNG Station

Section 8.0 Gas Growth (continued)

dairy cow numbers and proposals to increase food production and exports, as set out in Food Harvest 2020. Ireland needs to sustainably address GHG emissions from agriculture, which could threaten the 'Origin Green' sustainability status of Ireland's food and drink production internationally. The food and beverage production processes contribute a further 13% to national emissions and these industries are largely dependent on gas as their primary energy source. The initiative to establish renewable gas production from Agri-AD represents a significant opportunity to decarbonise agriculture and the agri-food supply chain, while also providing the opportunity for the farmers to diversify, and enhancing Ireland's security of supply.

Waste Industry AD

It is forecast that up to 0.9 TWh per annum of renewable gas can be delivered from the commercial waste processing sector. These facilities will be accommodated to connect directly to the gas network in line with the new Connection Policy as published for Q4 2018. These facilities are also designed to operate as a gas Entry Point on the network on the same basis as the CGI facilities.

Targets & Benefits

The EU has set binding targets for Member States to reduce their greenhouse gas (GHG) emissions by 20% compared to 2005 levels by 2020. An EU-wide reduction of 40% GHG emissions by 2030 has also been agreed and in the longer term, ambitious targets to reduce GHG emissions by 80% – 95% by 2050, compared with 1990 levels have been proposed. Ireland is unlikely to meet its 2020 targets and currently does not have a clear path to achieving the 2030 targets.

The majority of EU countries have policies to incentivise renewable gas, and the Department of Communications, Climate Action and Environment (DCCAE) has announced its intention to consider a support scheme for renewable gas grid injection. Subsidising the production of renewable gas represents value for money in achieving the lowest cost decarbonisation solution for heating. The benefits of developing a national renewable gas industry are significant for the Irish economy and environment. These benefits come in the form of (i) revenue to the state from job creation, (ii) carbon tax savings from avoided fossil fuel carbon dioxide (CO_2) emissions, (iii) avoided EU fines by meeting legally binding energy and environmental targets and (iv) the sale of indigenous renewable gas to End Users.

Across Europe, member states added 4.9 TWh of renewable gas in 2016 and this figure is set to increase significantly in the coming years. France has introduced a national strategy backed by legislation mandating 10% renewable gas by 2030[48]. An aggressive rollout strategy is resulting in the installation of injection facilities at a rate of one every two weeks, with close collaboration between the gas network operators and the Department of Agriculture. A more ambitious target of 30% by 2030 is now being considered[49]. The French gas network companies have joined together to promote decarbonisation of the gas network with a 100% renewable gas target for 2050[50], a strategy that is also being adopted by six other European countries[51]. In addition, Denmark has made great strides in the production of renewable gas and it currently has circa 10% renewable gas in the Danish gas grid[52].

The availability of renewable energy is now a key consideration for foreign direct investment (FDI) companies seeking to invest or expand in Ireland. It is estimated that over 50% of Ireland's FDI companies and their suppliers have targets for renewable energy. This is of particular importance for manufacturing companies whose primary energy requirement is natural gas. If renewable gas production receives similar state support

48 French Renewable Gas Panorama 2016, English language report – http://www.grtgaz.com/fileadmin/medias/communiques/2017/EN/Renewable-gas-french-panorama-2016.pdf English Language Website: http://www.grtgaz.com/en/solutions-for-the-future/energy-solutions-with-a-future/biomethane.html
49 GRDF promoting 30% Renewable Gas for 2030 https://www.biogaschannel.com/en/video/market/12/france-2030-it-will-be-possible-meet-30-gas-demand/1432/
50 France targeting 100% for 2050 https://www.grdf.fr/documents/10184/1291504/100%25_En_Study/3227170b-face-4300-96a8-f8339ffe0645
51 Denmark, Switzerland, Netherlands, Sweden, Belgium and Germany http://www.greengasinitiative.eu/
52 https://www.ieabioenergy.com/wp-content/uploads/2019/03/IEA_Greening-the-Gas-Grid_end.pdf

Figure 8-3: Green Generation, Nurney, Co. Kildare

afforded to other renewable energy sources, it offers the least cost and most secure solution for such companies and is already being offered in other EU states to entice FDI businesses.

The first renewable gas injection facility in Ireland was commissioned in Cush Co. Kildare in 2019. The project is jointly funded by Gas Networks Ireland, Green Generation, and the European Commission Connecting Europe Facility. The Network Entry Facility for this project is designed to inject up to 1,200 m3/hr.

Green Gas Certification and Guarantees of Origin.

The re-cast of the EU Renewable Energy Directive (RED II) sets out the sustainability requirements and the reductions in emissions that must be achieved for renewable gas. RED II also requires Member States to issue certificates (Guarantees of Origin) for each MWh of renewable gas injected into 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 jointly funded a project with Deutsche Biomasseforschungszentrum (DBFZ) and the German Energy Agency, to develop the blueprint for a certification scheme for renewable gas in Ireland. This project was completed in September 2018 and GNI is implementing the blueprint that was produced. This will result in the system being operational in 2020. Green Gas Certificates will allow end users to purchase renewable gas in confidence and give government and regulators certainty that the sales of renewable gas are transparent and accounted for. Independent auditing by certification bodies approved by the EC will ensure compliance with RED II requirements.

"Green Gas Certificates will allow end users to purchase renewable gas in confidence and give government and regulators certainty that the sales of renewable gas are transparent and accounted for."

Section 9.0
Commercial Market Arrangements

Key Messages:

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

At EU level, full implementation by Gas Networks Ireland of the EU Network Codes is nearing completion. The focus will now move to the next gas legislative package, which is expected to be delivered in 2020/21

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

9.1 Republic of Ireland Gas Market

Gas Networks Ireland in providing transportation services to shippers and suppliers operating in the wholesale and retail markets interacts regularly with regulatory authorities and gas market participants. 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 which are include in the Code of Operations;
- Support initiatives from various industry bodies;
- Deliver compliance with EU and National legislation as well as playing a driving role in the development of market arrangements to achieve 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. Gas Networks Ireland will continue to ensure that a resilient, robust and safe gas network is maintained 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 gas supply will not be negatively impacted. In this regard Gas Networks Ireland is working closely with key stakeholders including DCCAE, CRU and neighbouring TSOs to ensure that all Brexit related considerations are addressed in the context of minimising changes to Ireland's daily interaction with the UK in the transportation of gas. Depending on the final outcome of the Brexit negotiations, there may be a knock-on effect for Ireland, whereby Ireland will continue to implement EU regulations and legislation and the UK may decide not to as they will no longer be obliged to. The UK have however committed to continuing gas market operations that pertain today and Gas Networks Ireland are confident that there will be no negative impact on gas flows on Brexit day.

"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."

9.2 European Developments

In order to deliver full compliance with the EU Network Codes, a project team was established in Gas Networks Ireland to oversee this process.

The objective of the project team was to deliver the necessary work packages to implement the EU Network Code requirements which are described in the sections below and is now nearing completion.

The EU focus is now moving to the next gas legislative package, which is expected to be delivered in 2020/21.

Gas Networks Ireland is continuing to actively participate in various EU gas association work groups across ENTSOG, Eurogas and GIE, which are focused on influencing the gas package and to input into and monitor technical and regulatory studies feeding into the package. The gas package also looks likely to be impacted by the 'Green Deal' of the new European Commission, expected to be published in early 2020.

9.2.1 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 now take place in July (previously March), and introduced 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. This assessment is required to be undertaken every two years. In 2019 Gas Networks Ireland completed this assessment which revealed no firm signals from the market to increase gas capacity at the interconnection points. A similar exercise will take place in 2021.

GNI has an obligation to make capacity available to system users if it is economic to do so. If there is a signal from the incremental capacity process, or indeed from the annual auctions that additional Capacity is required by Shippers GNI will be required to either invest in new physical capacity and/or to implement the Congestion Management Provisions (CMP) of the Code of Operations. The CMP involve a number of different options whereby GNI can buy back capacity from Shippers on a voluntary basis or implement 'Use-it-or-Lose-it' provisions to take back capacity that a Shipper is not using for re-sale to the general market. A further CMP option allows GNI to 'over-sell' commercial capacity in the knowledge that not all sold commercial capacity will be used co-incidentally on a day.

GNI actively monitors the results of all auctions and hence the availability of Capacity to Shippers at all Entry Points.

Section 9.0
Commercial Market Arrangements
(continued)

9.2.2 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.

In mid-2018, Gas Networks Ireland commenced participation in a designated trading platform to meet its gas balancing requirements. In April, 2019 Gas Networks Ireland, following consultation with gas market participants and the Commission for Regulation of Utilities, introduced changes to the cashout regime and removed/amended certain tolerances. As a result of the above, full compliance with the Balancing Network Code has been achieved.

9.2.3 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.

In June 2019, following extensive engagement with gas market participants including a public consultation process, the Commission for Regulation of Utilities published its decision affirming the continued use of the Matrix Methodology. The other elements of their decision were to introduce a tariff for the virtual reverse flow product at Moffat and that Shrinkage costs will now be recovered as part of the tariff (rather than the Disbursements Account). The multipliers for short-term capacity products were adjusted slightly to align with the EU Network Code (e.g. cumulative monthly multiplier were reduced to 1.5 from 1.55). Quarterly products have been reduced to 1.35 to incentivise the use of the products. Following publication of the Commission's decision, full compliance with the Tariff Network Code has been achieved, notwithstanding that the shrinkage costs inclusion in the Tariff will be delivered for 1 October 2020. While no discount for LNG Entry Points on the Transmission network has been proposed, the Commission has indicated that it will consider the case for a discount for such projects on a case-by-case basis.

9.2.4 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 ENTSOG Transparency Platform went live in October 2014, including the implementation of a new data warehouse. Gas Networks launched a new transparency platform in May 2018 which meets the transparency requirements of the Network Code and also provides the market with additional extensive data on entry and exit flows etc.

"In April, 2019 Gas Networks Ireland introduced changes to the cashout regime and removed/amended certain tolerances. As a result of the above, full compliance with the Balancing Network Code has been achieved."

Section 10.0
Gas Network Capacity

Key Messages:

As part of the forecast modelling, Gas Networks Ireland compares the forecasted demands in section 6 and the forecasted supplies in section 7. The 2019 NDP highlights that the forecasted 1-in-50 peak demand may surpass the combined system entry capacity towards the end of the NDP period in the Best Estimate and High demand scenarios.

Gas Networks Ireland is in the third year of its fourth regulatory Price Control Period (PC4) which concludes in September 2022.

Future investment may be required to improve network capability in response to changing flow requirements or increased system flexibility.

As part of the forecast modelling, Gas Networks Ireland compares the forecasted demands in section 6 and the forecasted supplies in section 7. The 2019 NDP highlights that the forecasted 1-in-50 peak demand may surpass the combined system entry capacity towards the end of the NDP period in the Best Estimate and High demand scenarios.

In order to ensure adequate future capacity Gas Networks Ireland is continually investing in the network. The key capital investments are outlined in section 10.1 below.

10.1 Capital Investment

This section provides information on planned capital investment and future investments proposals for transmission system projects in order to comply with statutory and regulatory requirements.

Gas Networks Ireland's planning and design team assist in the development of transmission system projects and key infrastructural projects which are vital for the socio-economic development of the State. A key focus in the development of projects is on matters of proper planning and sustainable development having due regard for the environment. This process has been outlined in section 3, which involves the application of a bespoke environmental planning and assessment tool used by the Gas Networks Ireland design and planning teams in consultation with the Gas Networks Ireland environmental team.

"Gas Networks Ireland's planning and design team assist in the development of transmission system projects and key infrastructural projects which are vital for the socio-economic development of the State."

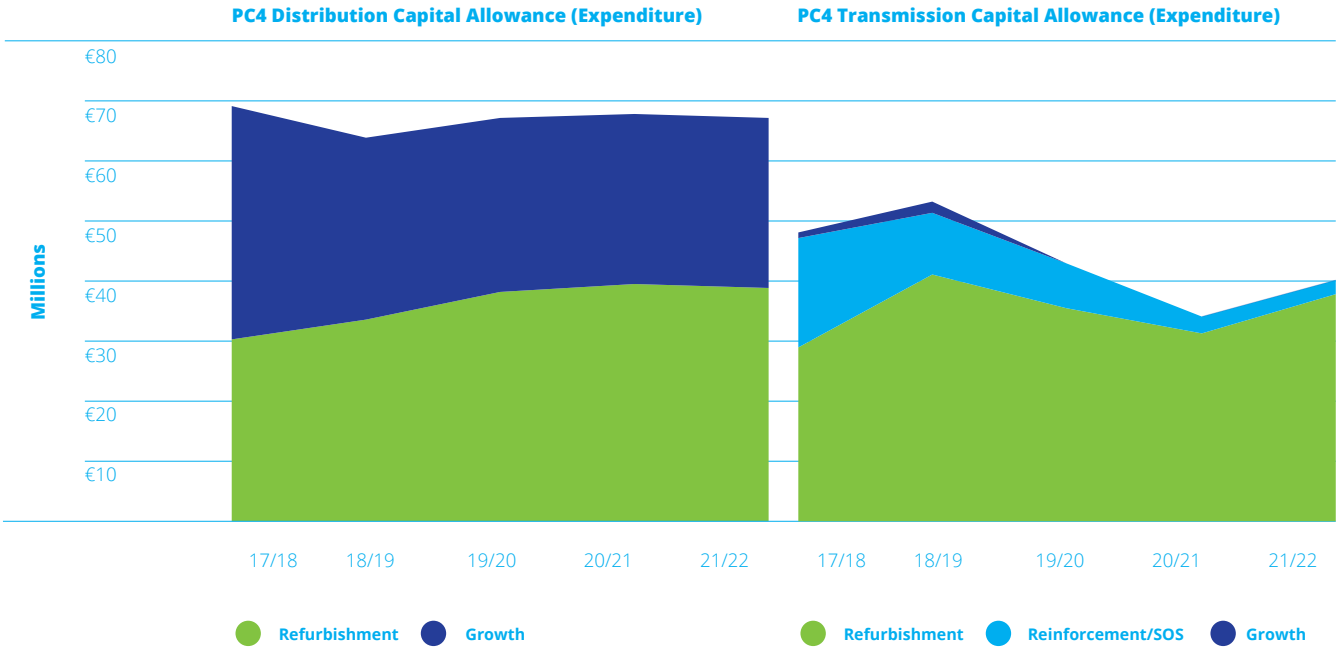
The NDP sets out the projects required to ensure the continuity of supply in the gas transmission system and associated investment requirements. Future investment proposals are subject to approval from the Commission for Regulation of Utilities and the relevant consents and permissions as set out above and in section 3. System operator requirements continue to evolve and both environmental and European legislative requirements will impact on future system operation.

Gas Networks Irelands continuously maintains the gas network to ensure a safe, efficient and reliable gas networks for the benefit of the communities it serves. In keeping with Gas Networks Irelands ISO55000 accreditation, information is gathered during maintenance interventions to inform future maintenance programmes and to shape and drive refurbishment and renewal decisions. Gas Networks Ireland has a comprehensive suite of asset lifecycle policy documents aligned to industry standards that describe in detail the approach to maintaining Gas Networks Irelands network assets. These Functional Specification and Requirements (FSR) documents provide detail on the various asset systems including key sections such as:

- **Scope:** this provides an overview of the assets and provides comprehensive technical detail on the relevant asset system and its anatomy, i.e. each of its primary parts/components.
- **Asset Risk:** these details how asset risk is assessed for, and how an asset risk score is assigned to, the assets, including Asset Health (probability-of-failure), Asset Criticality (consequence-of-failure) and failure modes (for each of the primary components).
- **Asset Lifecycle:** this details the interventions, and associated requirements and criteria, which are applied to the management of the assets across all four stages of the asset lifecycle, including the asset information requirements.

Section 10.0
Gas Network Capacity
(continued)

Figure 10-1: Capital Allowance excluding Non-Pipe and Work in Progress



10.1.1 Regulatory Capital Allowance

Gas Networks Ireland is in the third year of its fourth regulatory Price Control period (PC4) which concludes in September 2022. The CRU has given a capital allowance of €554m for future investment in the distribution and transmission network for the duration of PC4 as illustrated in Figure 10–1 (excluding non-pipe).

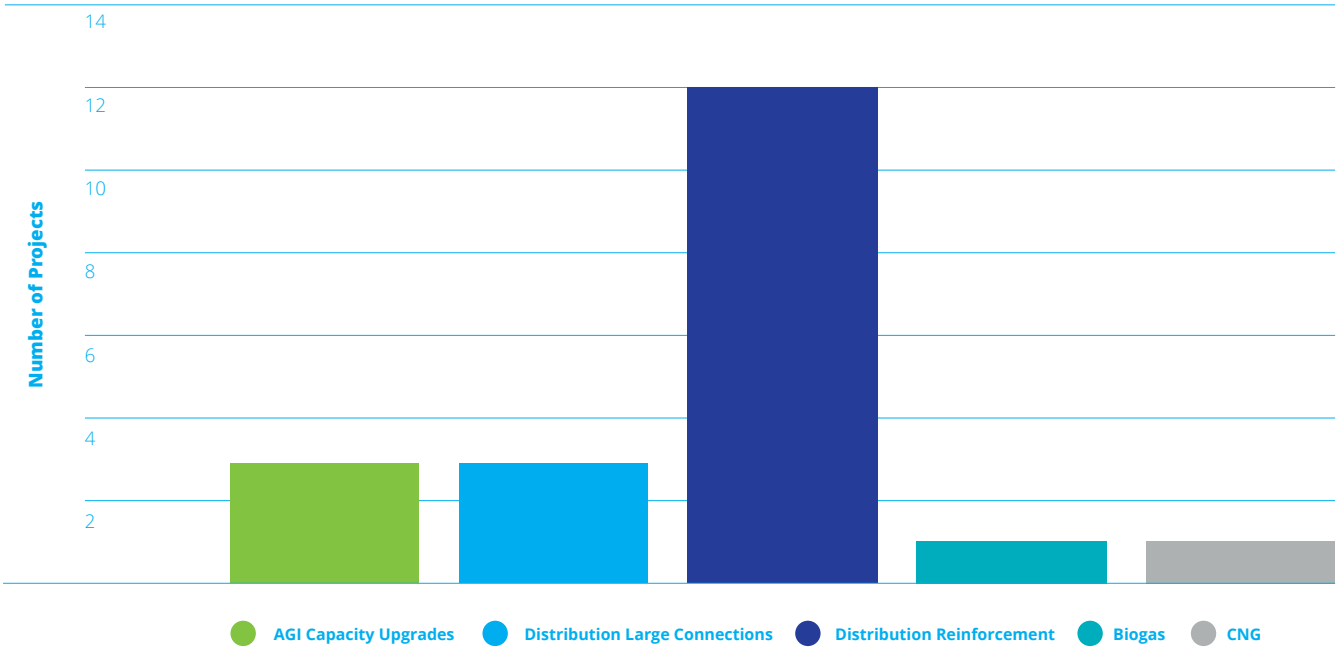
10.1.2 Completed Capital Programmes

Capacity limitations are identified on the network and addressed through appropriate capital investment programmes in order to ensure continuity of supply to all customers. These projects were subject to the appropriate consenting and planning regimes as set out in section 3. The following are significant capacity programmes completed since 2018, in addition to maintaining a rolling planned maintenance programme. These capital capacity programmes include:

- AGI Capacity Upgrades
- Large Connections to the Distribution Network
- Reinforcement of the Distribution Network
- CNG
- Biogas

20 such projects were completed since 2018 in counties Dublin, Kilkenny, Kildare, Meath, Longford, Wexford, Wicklow, Limerick, Waterford and Cork. These projects were subject to the appropriate consenting and planning regimes as set out in section 3.

Figure 10-2: Capital Projects Completed since 2018



10.1.3 Future System Capacity

Gas Networks Ireland continuously undertakes detailed system modelling of the network in order to assess the capacity of the network. The Best Estimate demand scenario identified in section 6 is modelled to identify any potential capacity constraints. Gas Networks Ireland will mitigate against these modelled system constraints to maintain system resilience and security of supply. Any such mitigating works are identified as part of the Network Implementation Plan which Gas Networks Ireland is currently preparing and will set out in more detail the manner in which projects identified in this section will be developed and will assess the potential for cumulative effects on the environment that may arise from these projects. It will also consider significant projects which are listed in table 10.1 above as "Other" projects.

Short Term Requirements

In the short term, Gas Networks Ireland has a number of ongoing projects which are expected to be built within the next 3 years in order to reinforce and increase capacity in the network. These projects consist of Above Ground Installations (AGI) capacity upgrades and new AGIs and are spread across the network. Table 10–1 outlines the type and the region of project required in the short term.

Gas Networks Ireland is focused on the delivery of new Compressed Natural Gas (CNG) stations throughout Ireland. These will be located along core urban and regional road networks. The table above includes CNG stations that are expected to be built in the next 3 years and are classed under "Other – New CNG" projects. The table above also includes Centralised Gas Injection (CGI) facilities.

Section 10.0
Gas Network Capacity
(continued)

Table 10-1: Short Term Requirements

	Border	Dublin	Mid-East	Midlands	Mid-West	South-East	South-West
Upgrade – AGI	0	2	3	0	1	0	0
New – AGI	0	0	0	0	0	0	0
Other – New CNG	0	3	0	2	2	0	0
Other – New CGI	0	0	0	0	0	0	1

Table 10-2: Long Term Requirements

	Border	Dublin	Mid-East	Midlands	Mid-West	South-East	South-West
Upgrade – AGI	2	2	0	0	0	2	0
New – AGI	0	1	0	0	0	0	0

Gas Networks Ireland, in conjunction with other industry stakeholders, intends to invest in CGI facilities located on the gas transmission network where Renewable Gas quality will be verified and the grid injection process will be managed and metered These projects are classed under "Other – New CGI" projects. Section 8.4 and 8.5 outline CNG and Renewable further.

Long Term Requirements

In the long term, Gas Networks Ireland has identified projects which may be required within the next 10 years in order to reinforce and increase capacity in the network. These projects consist of Above Ground Installations (AGI) capacity upgrades and new AGIs and are spread across the network. Table 10–2 outlines the type and the region of project required in the long term.

"In the long term, Gas Networks Ireland has identified projects which may be required within the next 10 years in order to reinforce and increase capacity in the network."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Section 11.0
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, amongst other things, that 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.

TYNDP 2018

Following consideration of the responses received to the CRU public consultation on GNI's draft 2018 TYNDP, the GNI TYNDP development process for the 2018 report and all future reports were updated to include a Strategic Environmental Assessment (SEA) screening and an Appropriate Assessment (AA) screening. Separately, GNI will prepare a document called the Network Investment Plan (NIP) which sets out in more detail how projects are identified in the TYNDP and how they will be developed. The NIP is expected to go through a full SEA and AA followed by a GNI led public consultation. While it is recommended that the TYNDP and NIP are read in conjunction with each other, we note that the NIP development process is outside the scope of the CRU's consultation role on the TYNDP. In the future, the NIP will be managed as a separate document development process by GNI in accordance with the relevant legislation.

The establishment of these new arrangements has caused a significant delay in the development of the 2018 TYNDP and the 2019 TYNDP. As an annual publication, CRU recognises that a timely publication of the TYNDP is key to the value it brings to the public and industry. The CRU will support GNI so the publication timeline will be back on track for future versions of the TYNDP.

In line with this, work on the development of the 2020 TYNDP commenced in Q2 of this year and the CRU consultation process is planned to take place in Q1 2021.

CRU commentary

The CRU welcomes the publication of GNI's Ten-Year Network Development Plan 2019 (TYNDP) as it offers GNI's view of how the gas network in Ireland may develop. The CRU is cognisant of the delayed publication date of this report and recognises that some projections made at the time of compiling the document have been realised by the time of publication. Efforts are being undertaken with GNI to bring future versions of the TYNDP publication back in line with expected publication dates and CRU requests readers understanding at this time when reviewing the data contained within this 2019 TYNDP.

The CRU notes that the gas system in Ireland is evolving as Ireland moves to a decarbonised economy. There are also changes to the supply scenario with the reduction in indigenous gas supply from Corrib and Inch. Corrib is expected to supply up to 39% of Ireland's system demand in 2019/2020 making Moffat the dominant supply point with its contribution only expected to increase over the TYNDP period (78% by 2027/28). In addition, the flows at the Inch Entry point are expected to cease in Q2 2020. With increased reliance on gas imported from Great Britain and the onset of Brexit, the CRU is working closely with DCCAE, GNI, Department for Business, Energy and Industrial Strategy-UK (BEIS) and the European Commission to ensure Ireland's energy security is maintained.

The CRU acknowledges GNI's approach of aligning the Best Estimate scenario with ENTSOG's National Trends while also having two Ireland-specific High and Low demand scenarios. Gas demand is expected to grow by 4% in the low demand scenario and grow between 23% and

"The CRU is committed to protecting the short and long run interest of the public by ensuring, amongst other things, that energy and gas are supplied safely, the lights stay on and the gas continues to flow."

Section 11.0
CRU Commentary
(continued)

39% based on the Best Estimate and High demand scenarios. The CRU notes that these figures are higher (for Best Estimate and High demand scenario) than projections made in previous TYNDPs and can be attributed to GNI's assumptions around new gas-fired generation coming online. These demand figures are also underpinned by sources such as ESRI's GDP growth forecasts 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 designed to further test the capability of the gas network.

The TYNDP also outlines GNI'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 GNI on the progression of such initiatives and ultimately ensure that they bring benefits to the customer.

The CRU realises the critical role of gas in electricity generation which accounted for 52% of electricity generated in 2018. 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 GNI's commentary on the 'Future Role of the Gas Network' as Ireland moves to a decarbonised economy. The CRU notes GNI and its parent company Ervia's focus on the following with regard to the future use of the gas network:

- Compressed Natural Gas;
- Renewable Gas;
- Carbon capture and storage;
- Power to gas;
- Hydrogen utilisation of the gas grid;
- Use of Hydrogen in Transport.

"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."

The CRU is of the view that the role played by GNI 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 GNI to ensure system integrity and minimum pressures are maintained.

Readers should note that this TYNDP process is separate to the approval of revenues for GNI; which is carried out under the Price Control process. Under that process, separate submissions are made by GNI 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 is currently working towards Price Control 5 which would cover the period from 2022 to 2027.

Finally, the CRU would like to take this opportunity to thank Gas Networks Ireland for producing the TYNDP 2019, while acknowledging the work done maintaining Ireland's security of supply.


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Appendices

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)[53]

GWh/yr	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
ROI	55,726	50,435	50,072	47,582	47,136	51,478	55,070	56,348	57,481
NI & IOM	17,852	15,142	15,031	15,132	16,970	16,992	18,168	16,984	17,005
Total	**73,578**	**65,577**	**65,103**	**62,714**	**64,106**	**68,470**	**73,237**	**73,332**	**74,485**

Table A1–2: Historic Gas Networks Ireland Peak Day Gas Demands (Actual)[53]

GWh/d	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
ROI	244.1	211.7	213.2	187.0	203.8	199.4	221.8	215.9	218.5
NI & IOM	79.3	74.1	62.7	68.2	72.8	69.9	70.1	63.1	75.9
Total	**323.4**	**285.8**	**275.9**	**255.2**	**276.6**	**269.2**	**291.9**	**279.0**	**294.4**

53 Actual gas demands are not weather correct and do not include own gas use

Appendix 1: Historic Demand (continued)

Table A1–3: Historic ROI Annual Gas Demands (Actual)[54]

GWh/yr	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
Power[55]	35,365	29,864	28,156	26,910	24,708	29,061	32,181	31,936	33,050
I/C	12,021	13,244	13,700	13,682	15,013	15,581	15,835	16,485	17,149
RES	8,340	7,326	8,216	6,991	7,414	6,835	7,054	7,927	7,282
Total	**55,726**	**50,435**	**50,072**	**47,582**	**47,136**	**51,478**	**55,070**	**56,348**	**57,481**

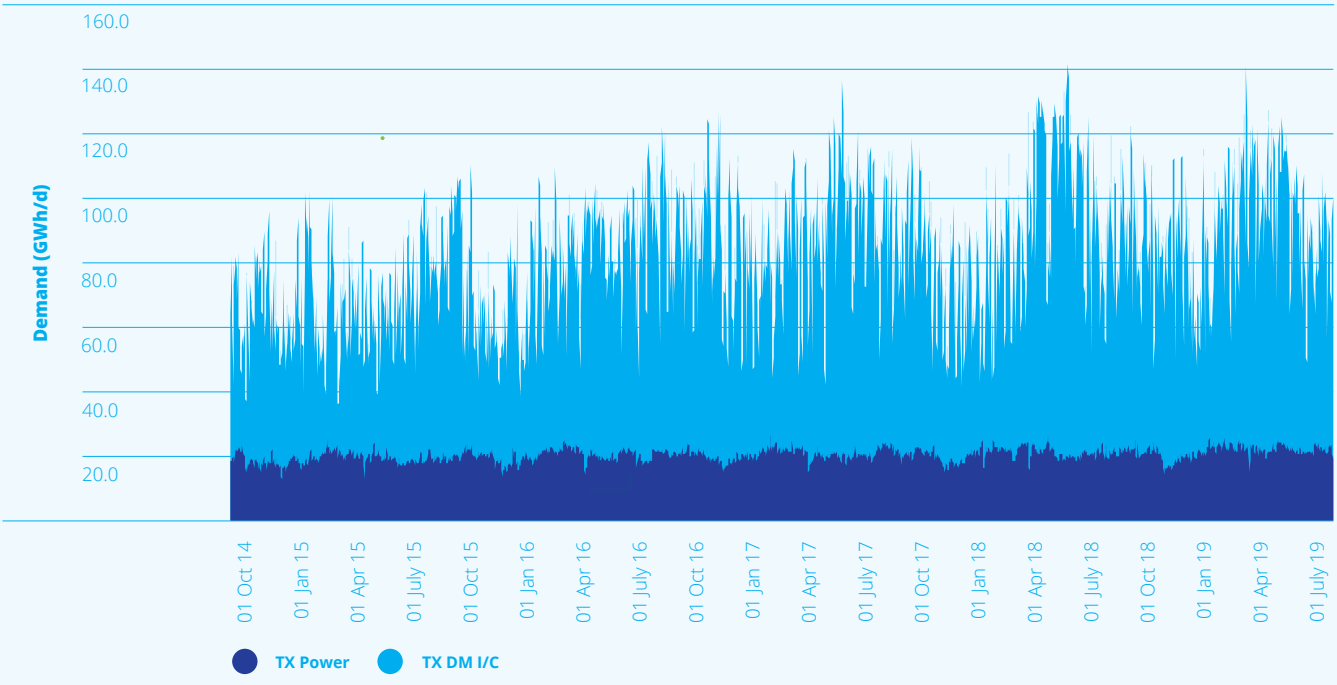
Table A1–4: Historic ROI Peak Day Gas Demands (Actual)[54]

GWh/d	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
Power[55]	132.2	114.1	119.9	102.0	102.4	104.7	121.6	110.1	113.0
I/C	49.6	49.4	50.4	46.8	54.8	54.9	56.6	61.0	60.2
RES	64.2	48.2	44.2	39.9	46.6	40.1	43.6	44.8	45.3
Total	**246.0**	**211.7**	**214.4**	**188.7**	**203.8**	**199.7**	**221.8**	**215.9**	**218.5**

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.

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



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

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

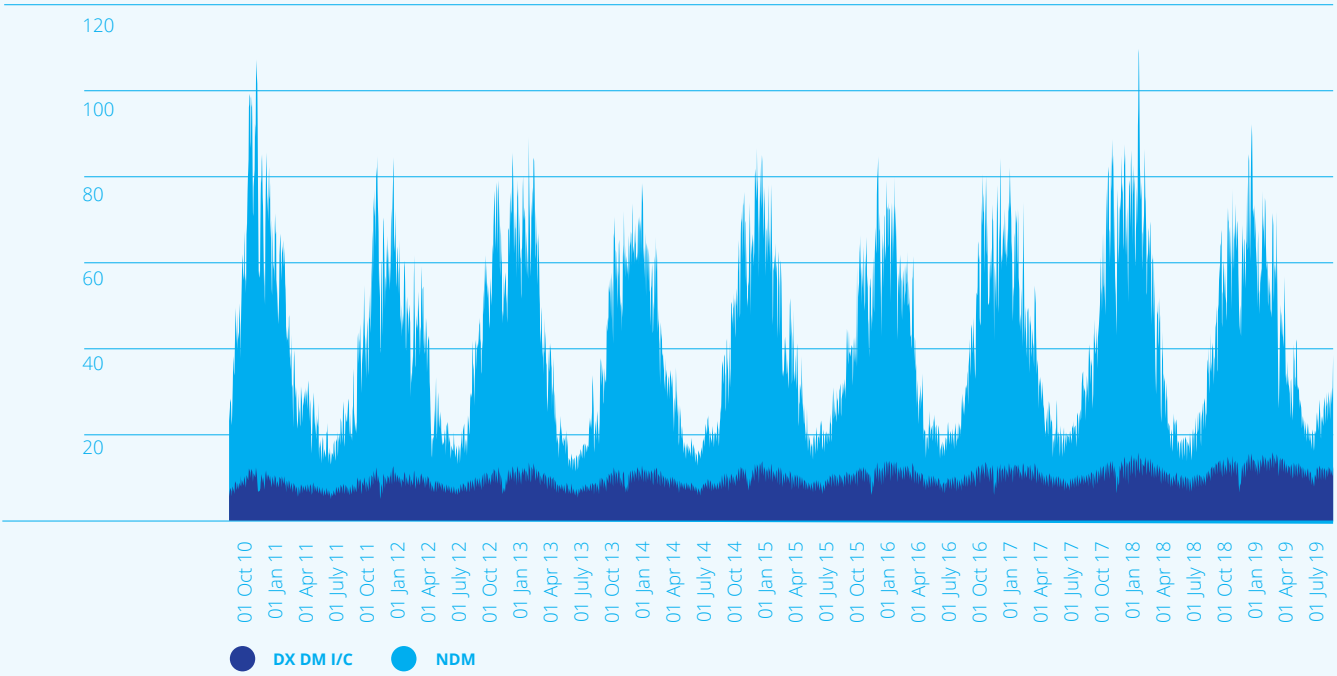


Table A1–5 and Table A1–6 present the historic annual and peak day gas supplies for the Gas Networks Ireland system.

Table A1–5: Historic Annual Supplies through Moffat, Inch and Corrib[56]

GWh/yr	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
Moffat[58]	72,320	64,103	64,148	62,549	63,132	45,731	35,494	39,060	46,544
Inch	3,765	3,952	4,014	3,339	3,724	3,674	3,872	3,696	2,784
Corrib	-	-	-	-	-	20,470	34,659	32,612	26,747
Total	**76,086**	**68,055**	**68,162**	**65,888**	**66,856**	**69,876**	**74,025**	**75,368**	**76,074**

Table A1–6: Historic Peak Day Supplies through Moffat, Inch and Corrib[57]

GWh/d	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
Moffat[58]	303.9	255.7	251.2	232.7	248.3	189.5	172.9	171.4	213.2
Inch	33.7	32.0	26.7	26.4	28.0	19.6	16.8	11.2	9.7
Corrib	-	-	-	-	-	60.1	103.7	97.1	78.5
Total	**337.6**	**287.6**	**277.9**	**259.1**	**276.3**	**269.3**	**293.4**	**279.7**	**301.4**

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.

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

Appendix 1: Historic Demand (continued)

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

GWh/d	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
Peak Day									
TX Power	132.2	114.1	119.9	102.0	102.4	104.7	123.8	106.1	113.0
TX DM I/C	12.0	17.7	17.8	16.1	18.8	21.1	20.0	21.7	20.3
DX DM I/C	12.3	11.9	12.2	12.6	13.3	13.5	13.6	14.0	15.5
DX NDM	89.5	68.0	64.6	57.9	69.4	60.4	61.2	68.4	69.7
Total ROI	246.0	211.7	214.4	188.7	203.8	199.7	218.6	210.1	218.5
Annual									
TX Power	35,365	29,864	28,156	26,910	24,708	29,061	32,181	31,936	33,050
TX DM I/C	4,978	6,147	6,088	6,439	7,085	7,455	7,562	7,642	7,888
DX DM I/C	3,020	3,235	3,419	3,432	3,593	3,776	3,842	4,038	4,494
DX NDM	12,363	11,188	12,409	10,802	11,749	11,184	11,485	12,733	12,049
Total ROI	**55,726**	**50,435**	**50,072**	**47,582**	**47,136**	**51,478**	**55,070**	**56,348**	**57,481**

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

GWh/d	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
Peak Day									
TX Power	133.0	117.4	119.9	108.7	103.2	123.2	127.3	142.2	141.5
TX DM I/C	18.4	20.4	22.9	23.1	25.1	25.4	26.3	26.4	26.0
DX DM I/C	12.3	12.7	13.7	12.8	13.8	14.1	14.0	15.8	15.9
DX NDM	94.9	73.0	75.5	65.8	73.5	71.5	71.0	97.2	76.4
Total ROI	**258.5**	**223.5**	**231.9**	**210.4**	**215.6**	**234.1**	**238.6**	**281.7**	**259.8**
Power	133.0	117.4	119.9	108.7	103.2	123.2	127.3	142.2	141.5
I/C	57.5	53.7	59.1	56.5	62.7	63.4	64.3	74.4	68.6
RES	68.0	52.4	52.9	45.2	49.7	47.6	47.0	65.0	49.6
Total ROI	**258.5**	**223.5**	**231.9**	**210.4**	**215.6**	**234.1**	**238.6**	**281.7**	**259.8**

Appendix 2: Demand Forecasts

Assumptions

As outlined in section 6 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

GDP (%)	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28
Low Scenario	4.54	3.60	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40
Best Estimate Scenario	4.54	3.60	3.19	3.03	3.00	3.15	3.20	3.20	3.20	3.20
High Scenario	4.54	3.60	3.19	3.03	3.00	3.15	3.20	3.20	3.20	3.20

Table A2–2: Residential New Connections

	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28
Low Scenario	7,414	3,999	2,065	1,753	1,390	1,228	1,078	894	699	650
Best Estimate Scenario	7,414	6,423	4,139	3,358	2,745	2,545	2,445	2,056	1,646	1,550
High Scenario	7,414	7,143	4,319	5,095	4,595	4,095	3,850	3,690	3,463	3,400

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 published in the Northern Ireland Gas Capacity Statement. The IOM peak-day is based on information provided by the Manx Electricity Authority (MEA).

Appendix 2: Demand Forecasts (continued)

The electricity demand for the average year is as per EirGrid's All-Island Generation Capacity Statement 2019–2028. 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.

Note on gas year 2018/19 demand forecasts:

Due to the timing of publication of the NDP, actual historic demand data is known for gas year 2018/19, and hence the projected figures for 2018/19 have been replaced by actual historic data in the tables below, with the exceptions of the 1-in-50 Peak Day demand category – it is known that a 1-in-50 event did not occur in gas year 2018/19 and hence the demand projections for this category have been omitted and labelled N/A.

Table A2–3: 1-in-50 Peak Day Demand – Low Demand Scenario

GWh/d	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28
Power	N/A	148.6	150.5	151.9	155.4	156.6	161.9	171.5	170.8	170.3
IC	N/A	69.3	69.8	69.5	69.1	69.6	69.1	69.4	68.8	69.0
RES	N/A	61.3	61.1	60.7	60.3	59.9	59.5	59.0	58.6	58.1
Transport	N/A	0.0	0.1	0.2	0.4	0.6	0.8	0.8	0.8	0.8
Own Use	N/A	5.6	5.9	6.1	6.2	6.3	6.5	6.9	6.9	7.0
Sub total	**N/A**	**284.9**	**287.3**	**288.4**	**291.6**	**293.0**	**297.7**	**307.6**	**305.9**	**305.2**
IOM	N/A	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
NI	N/A	95.6	97.8	101.1	102.2	104.2	106.3	107.3	108.2	109.3
Total	**N/A**	**386.9**	**391.6**	**396.0**	**400.1**	**403.6**	**410.4**	**421.3**	**420.6**	**421.0**

Table A2–4: 1-in-50 Peak Day Demand – Best Estimate Demand Scenario

GWh/d	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28
Power	N/A	156.9	157.8	162.4	164.5	174.6	183.2	196.6	197.1	198.3
IC	N/A	69.3	70.6	71.6	73.4	75.2	76.0	77.7	79.4	80.1
RES	N/A	61.4	61.3	61.1	60.8	60.5	60.1	59.8	59.4	59.0
Transport	N/A	0.0	0.1	0.3	0.5	0.9	1.3	1.6	1.9	2.1
Own Use	N/A	5.8	6.1	6.4	6.5	6.9	7.2	7.3	7.3	7.3
Sub total	**N/A**	**293.4**	**295.9**	**301.7**	**305.8**	**318.0**	**327.8**	**342.9**	**345.1**	**346.8**
IOM	N/A	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
NI	N/A	95.6	97.8	101.1	102.2	104.2	106.3	107.3	108.2	109.3
Total	**N/A**	**395.4**	**400.2**	**409.3**	**414.4**	**428.6**	**440.5**	**456.6**	**459.8**	**462.5**

Table A2–5: 1-in-50 Peak Day Demand – High Demand Scenario

GWh/d	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28
Power	N/A	165.1	169.9	172.5	177.5	182.7	189.0	201.7	203.3	205.0
IC	N/A	69.4	72.1	74.3	76.6	79.2	81.9	84.6	87.3	90.1
RES	N/A	61.3	61.3	61.1	61.0	60.8	60.6	60.3	60.0	59.8
Transport	N/A	0.0	0.2	0.5	1.0	1.6	2.3	3.1	4.0	5.0
Own Use	N/A	6.0	6.4	6.7	7.0	7.3	7.3	7.4	7.4	7.4
Sub total	**N/A**	**301.8**	**309.8**	**315.1**	**323.1**	**331.5**	**341.1**	**357.1**	**362.1**	**367.2**
IOM	N/A	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
NI	N/A	95.6	97.8	101.1	102.2	104.2	106.3	107.3	108.2	109.3
Total	**N/A**	**403.8**	**414.1**	**422.6**	**431.7**	**442.2**	**453.8**	**470.8**	**476.8**	**483.0**

Appendix 2: Demand Forecasts (continued)

Table A2–6: Average Year Peak Day Demand – Low Demand Scenario

GWh/d	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28
Power	113.0	138.3	141.3	143.1	145.3	149.9	151.0	161.0	162.7	162.5
IC	60.2	60.2	60.6	60.4	60.2	60.6	60.3	60.7	60.2	60.5
RES	45.3	48.2	48.0	47.8	47.5	47.1	46.8	46.4	46.1	45.7
Transport	0.0	0.0	0.1	0.2	0.4	0.6	0.8	0.8	0.8	0.8
Own Use	7.0	4.0	4.2	4.3	4.4	4.5	4.6	4.8	4.9	4.9
Sub total	**225.5**	**250.8**	**254.3**	**255.8**	**257.8**	**262.8**	**263.4**	**273.7**	**274.7**	**274.5**
IOM	5.7	5.3	5.2	5.1	4.6	5.1	5.5	5.5	5.5	5.1
NI	70.2	78.5	80.7	83.8	84.6	86.4	82.1	83.3	84.6	85.7
Total	**301.4**	**334.6**	**340.1**	**344.6**	**347.0**	**354.3**	**351.1**	**362.6**	**364.8**	**365.2**

Table A2–7: Average Year Peak Day Demand – Best Estimate Demand Scenario

GWh/d	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28
Power	113.0	144.6	146.0	147.6	152.7	158.1	165.1	187.4	188.1	189.1
IC	60.2	60.2	61.4	62.2	63.8	65.4	66.2	67.7	69.3	70.0
RES	45.3	48.3	48.2	48.1	47.9	47.6	47.3	47.0	46.7	46.4
Transport	0.0	0.0	0.1	0.3	0.5	0.9	1.3	1.6	1.9	2.1
Own Use	7.0	4.1	4.3	4.4	4.6	4.8	4.9	5.4	5.4	5.5
Sub total	**225.5**	**257.2**	**260.1**	**262.6**	**269.5**	**276.8**	**284.8**	**309.1**	**311.4**	**313.0**
IOM	5.7	5.3	5.2	5.1	4.6	5.1	5.5	5.5	5.5	5.1
NI	70.2	78.5	80.7	83.8	84.6	86.4	82.1	83.3	84.6	85.7
Total	**301.4**	**341.0**	**345.9**	**351.4**	**358.8**	**368.2**	**372.5**	**398.0**	**401.6**	**403.8**

Table A2–8: Average Year Peak Day Demand – High Demand Scenario

GWh/d	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28
Power	113.0	146.3	146.9	148.7	154.1	161.7	175.1	192.6	194.0	195.3
IC	60.2	60.3	62.6	64.5	66.6	68.8	71.2	73.6	75.9	78.3
RES	45.3	48.2	48.2	48.1	48.0	47.8	47.7	47.4	47.2	47.0
Transport	0.0	0.0	0.2	0.5	1.0	1.6	2.3	3.1	4.0	5.0
Own Use	7.0	4.1	4.4	4.5	4.7	4.9	5.2	5.6	5.7	5.7
Sub total	**225.5**	**258.9**	**262.2**	**266.3**	**274.4**	**284.8**	**301.4**	**322.4**	**326.9**	**331.4**
IOM	5.7	5.3	5.2	5.1	4.6	5.1	5.5	5.5	5.5	5.1
NI	70.2	78.5	80.7	83.8	84.6	86.4	82.1	83.3	84.6	85.7
Total	**301.4**	**342.7**	**348.1**	**355.2**	**363.6**	**376.3**	**389.1**	**411.2**	**417.1**	**422.1**

Table A2–9: Annual Demand – Low Demand Scenario

TWh/y	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28
Power	33.0	32.6	32.2	30.9	31.1	30.9	30.7	33.9	34.3	34.3
IC	17.4	17.7	17.8	17.8	17.8	18.0	18.0	18.2	18.1	18.3
RES	7.8	7.8	7.7	7.7	7.7	7.6	7.5	7.5	7.4	7.4
Transport	0.0	0.0	0.0	0.1	0.2	0.2	0.3	0.3	0.3	0.3
Own Use	0.6	0.8	0.9	0.8	0.9	0.9	0.9	1.0	1.0	1.0
Sub total	**58.8**	**58.8**	**58.6**	**57.3**	**57.6**	**57.6**	**57.4**	**60.9**	**61.1**	**61.3**
IOM	1.4	1.5	1.4	1.4	1.3	1.4	1.5	1.5	1.5	1.4
NI	15.7	16.2	17.8	18.4	20.1	18.6	16.2	16.2	16.3	16.3
Total	**76.0**	**76.5**	**77.8**	**77.1**	**79.0**	**77.6**	**75.1**	**78.6**	**79.0**	**79.0**

Table A2–10: Annual Demand – Best Estimate Demand Scenario

TWh/y	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28
Power	33.0	33.9	33.8	35.2	37.2	38.6	39.4	40.8	41.5	42.2
IC	17.4	17.7	18.0	18.3	18.8	19.2	19.5	20.0	20.5	20.7
RES	7.8	7.8	7.8	7.8	7.7	7.7	7.6	7.6	7.5	7.5
Transport	0.0	0.0	0.0	0.1	0.2	0.3	0.5	0.6	0.7	0.8
Own Use	0.6	0.8	0.9	0.9	1.0	1.0	1.1	1.1	1.1	1.2
Sub total	**58.8**	**60.2**	**60.6**	**62.3**	**64.8**	**66.9**	**68.0**	**70.1**	**71.3**	**72.3**
IOM	1.4	1.5	1.4	1.4	1.3	1.4	1.5	1.5	1.5	1.4
NI	15.7	16.2	17.8	18.4	20.1	18.6	16.2	16.2	16.3	16.3
Total	**76.0**	**77.9**	**79.8**	**82.1**	**86.2**	**86.9**	**85.7**	**87.8**	**89.2**	**90.0**

Table A2–11: Annual Demand – High Demand Scenario

TWh/y	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28
Power	33.0	34.1	34.3	36.0	39.0	41.5	43.4	46.2	47.4	48.5
IC	17.4	17.7	18.4	18.9	19.5	20.1	20.7	21.4	22.0	22.7
RES	7.8	7.8	7.8	7.8	7.8	7.7	7.7	7.7	7.6	7.6
Transport	0.0	0.0	0.1	0.2	0.4	0.6	0.8	1.1	1.5	1.8
Own Use	0.6	0.8	0.9	0.9	1.0	1.1	1.1	1.2	1.3	1.3
Sub total	**58.8**	**60.4**	**61.4**	**63.8**	**67.6**	**71.0**	**73.8**	**77.6**	**79.7**	**81.9**
IOM	1.4	1.5	1.4	1.4	1.3	1.4	1.5	1.5	1.5	1.4
NI	15.7	16.2	17.8	18.4	20.1	18.6	16.2	16.2	16.3	16.3
Total	**76.0**	**78.1**	**80.6**	**83.6**	**89.0**	**90.9**	**91.4**	**95.3**	**97.6**	**99.6**

Table A2–12: Maximum Daily Supply Volumes

GWh/d	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28
Corrib	78.1	68.6	60.9	54.9	49.8	45.1	40.9	37.6	33.8	30.7
Inch	7.3	5.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Moffat	386.9	386.9	386.9	386.9	386.9	386.9	386.9	386.9	386.9	386.9

Appendix 3: Energy Efficiency Assumptions

National Energy Efficiency Action Plan 2017

The National Energy Efficiency Action Plan 2017 (NEEAP4) sets out the Government's strategy for meeting the energy efficiency savings targets. In 2009, Ireland set a national target to improve its energy efficiency by 20% by 2020, meaning that energy savings of 31,925 GWh should be made. The fourth National Energy Efficiency Action Plan sets out progress towards that target and the measures to maximise progress to the target.

Table A3–1 outlines the NEEAP 4 energy efficiency targets over the period to 2020.

Table A3–1: National Energy Efficiency Action Plan 2017 (NEEAP4) – Energy Savings

	2016 (achieved)	2020 (anticipated)
2002 Building Regulations – Dwellings	1,801	1,864
2008 Building Regulations – Dwellings	560	675
2011 Building Regulations – Dwellings	157	214
2019 (proposed) Building Regulations – Dwellings (NZEB)	0	8
2005/2008 Building Regulations – other than dwellings	762	1,299
Greener Homes Scheme (GHS)	114	114
Energy efficient boiler regulation	320	480
Domestic Lighting (Eco-Design Directive)	170	268
Warmer Homes Scheme (WHS)	269	347
Warmth and Wellbeing Pilot	0	22
Deep retrofit pilot	0	18
Better Energy Communities	228	543
Better Energy Homes (formerly HES)	994	1,324
Major Renovations (Dwellings)	0	12
Public Sector	1,784	2,303
Business	3,062	3,556

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[58] 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 2026/27;

- 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.

Entry Point Assumptions

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

Table A4–1: Entry Point Assumptions

	Moffat	Inch	Corrib
Pressure (barg)	47.0[59]	30.0	Up to 85.0
Gross Calorific Value (MJ/scm)	39.8	37.5	37.7
Max Supply (mscmd)	35	0.7	7.46

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.

58 NI transmission system is not included in the modelling. NI is treated as a demand at Twynholm, Scotland.
59 Anticipated Normal Off-take Pressure (ANOP)

Glossary

AA	Appropriate Assessment
AD	Anaerobic Digester
AGI	Above Ground Installation
ANOP	Anticipated Normal Off take Pressure
BETTA	British Electricity Trading and Transmission Arrangements
CAM	Capacity Allocation Mechanism
CAP	Climate Action Plan
CCGT	Combined cycle gas turbine
CEF	Connecting Europe Facility
CER	Commission for Energy Regulation
CGI	Central Gas Injection
CHP	Combined heat and power
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
ENTSOE	European Network of Transmission System Operators for Electricity
ESRI	The Economic & Social Research Institute
ETS	European Emission Trading Scheme
EWIC	East West Interconnector
EU	European Union
GB	Great Britain
GDP	Gross Domestic Product
GNI	Gas Networks Ireland
GTMS	Gas Transportation Management System
GWh	Gigawatt hour
GWhe	Gigawatt hour electric
GWh/d	Gigawatt hours per day
GWh/y	Gigawatt hours per year
HGV	Heavy Goods Vehicle
I-SEM	Integrated Single Electricity Market Project
I/C	Industrial & Commercial
IC	Interconnector
IDA	Industrial Development Agency
IED	Industrial Emissions Directive
IMF	International Monetary Fund
IP	Interconnection Point
IOM	Isle of Man
KEL	Kinsale Energy Limited
Km	Kilometre
LDM	Large Daily Metered
LGV	Light Goods Vehicle

LNG	Liquefied Natural Gas
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
NGV	Natural Gas Vehicle
NI	Northern Ireland
NO_x	Nitrogen Dioxide
NTS	National Transmission System
OECD	The Organisation for Economic Co-operation and Development
PC4	Fourth Price Control
PCI	Projects of Common Interest
PMA	Pressure Maintenance Agreement
PSO	Public Service Obligation
RES	Renewable Energy Sources
ROI	Republic of Ireland
SEA	Strategic Environmental Assessment
SEAI	Sustainable Energy Authority of Ireland
SEM	Single Electricity Market
SO_x	Sulphur Dioxide
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
UK	United Kingdom