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Gas Networks Ireland

Gas Forecast Statement 2022

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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 July 2022, based on the most up to date information at the time. In presenting the data obtained for publication in the Gas Forecast Statement, 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 Gas Forecast Statement 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.

1.0

Executive summary

The Gas Forecast Statement (GFS) provides a view of how the gas network may develop over the coming 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.

"Gas Networks Ireland can deliver a net-zero carbon gas network and reduce emissions across a number of key sectors, including those that are traditionally difficult to decarbonise, such as Transport, Agriculture, Industry, High Heating and Power Generation."

The assessment horizon covered in this report covers the ten-year period from gas years 2021/22 to 2030/31 inclusive. The input data and assumptions used for modelling gas supply and demand scenarios over the ten-year period were finalised in July 2022, in line with the modelling 'Data Freeze' date. Further to this modelling Data Freeze, the production of the report extended to September 2022, and hence any non-modelling information such as historic gas demand, project status and other ancillary developments in the gas and wider energy industry are included up until 31st August 2022.

The GFS Best Estimate scenario aligns to the existing policy measures in place at the time of the GFS modelling Data Freeze. While the key purpose of the GFS is to undertake the ten-year gas network adequacy assessment, it is necessary to look beyond the ten-year adequacy assessment timeline to consider the role the gas network can play in decarbonising Ireland's energy system. Ireland has committed to and legislated for net-zero emissions by 2050 and utilisation of the national gas network is vital to achieving this. Gas Networks Ireland is committed to proactively supporting this ambition through the delivery of a net-zero carbon gas network by 2050. By gradually replacing natural gas with renewable gases, such as biomethane and hydrogen, Gas Networks Ireland can deliver a net-zero carbon gas network and reduce emissions across a number of key sectors, including those that are traditionally difficult to decarbonise, such as Transport, Agriculture, Industry, High Heating and Power Generation. Gas Networks Ireland will continue to explore opportunities for greater energy system integration, building on the existing synergies between the gas and electricity transmission systems. An integrated energy system will help to address some of the challenges that cannot be overcome through electrification alone.

Gas Networks Ireland has commenced a range of work packages to ensure the gas network is ready to transport hydrogen, initially via blending and subsequently at scale. This includes completion of a Network Innovation Centre at the Gas Networks Ireland Brownsbarn site in Co. Dublin with funding from the Gas Innovation Fund, and the development of a detailed hydrogen technical and safety strategy which will provide a road map for the transition to hydrogen.

Annual Republic of Ireland (ROI) gas demand for 2021/22 is anticipated to be just 0.5% below 2020/21 demand. ROI gas demand for 2020/21 was 4% lower than 2019/20. This is in contrast with previous years' increases in ROI gas demand of 1.5% in 2019/20 compared to 2018/19 and 2% in 2018/19 compared to 2017/18.

In the Power Generation sector, demand for 2021/22 is projected to show an increase of 5.5% compared to 2020/21. This is in contrast with the 7% decrease in gas demand observed for power generation in 2020/21 compared to 2019/20, which was as a result of several gas-fired generator outages in the summer of 2020/21.

Gas-fired power generation accounted for approximately 46% of Ireland's electricity generation in 2021, which shows the significant role the gas network plays in complementing renewable generation. The partnership between flexible gas-fired power generation and intermittent renewable generation will be a key factor in enabling Ireland's renewable integration ambition into the future, as set out in the National Energy and Climate Plan and Climate Action Plan 2021.

1.0 Executive summary (continued)

In the Industrial & Commercial sector, gas demand for 2021/22 is anticipated to be 7.6% lower than 2020/21. Residential demand is projected to be 13% lower for 2021/22 compared to 2020/21. Lower demand in in both sectors 2021/22 was driven by a milder than average winter and record high gas prices weighing on gas use.

In calendar year 2021, approximately 28% of Ireland's gas demand (ROI) was supplied from indigenous sources. The balance of supply, almost 72% came through the subsea interconnectors via the Moffat Entry Point in Scotland.

In order to inform how the gas network may develop over a ten-year period, and to provide a comprehensive analysis, Gas Networks Ireland has developed three gas demand scenarios for the period 2021/22 to 2030/31, namely Low, Best Estimate and High demand. These scenarios are designed to represent a broad range of likely outcomes and are informed by a range of external and internal factors.

In the Best Estimate scenario, annual ROI gas demand is expected to fall by 12% between 2021/22 and 2030/31. Similarly, in the Low demand scenario, a decrease in ROI gas demand is predicted over the same horizon of 22% while a slight increase in annual gas demand of 3% is projected in the High demand scenario. The decrease in both the Best Estimate and Low scenarios is primarily driven by the anticipated fall in gas demand in both the Power Generation and Residential sectors. The trend in Power Generation demand is linked to increased electrical interconnection and an ambitious build-out target assumed for offshore wind and solar generation in Ireland coupled with revised electricity system constraints designed to achieve a 70% renewable energy share in electricity generation by 2030. These factors offset any growth forecast in electrical demand in the Best Estimate and Low scenarios. In contrast, the slight growth in the High demand scenario is driven by the assumption that the 70% RES-E target will not be met in 2030, falling short by 6%. Assumptions for wind and solar capacity development rates are based on the build-out profiles provided in the EirGrid / SONI All-Island Generation Capacity Statement (GCS) 2022-2031. Should these challenging targets not be met the result would be an increase in annual gas demand in all scenarios, relative to the projections presented above. In contrast, Industrial & Commercial demand is set to increase in the Best Estimate and High gas demand scenarios whereas the Low scenario is projecting a fall in Industrial & Commercial demand across the GFS horizon. Hence, an increase in the number of additional (one-off) connections in the Industrial and Commercial sector, coupled with moderate projected economic growth, negates the fall in gas demand to a degree in the Best Estimate and High demand scenarios.

In the Residential sector, taking account of the targets announced in the Climate Action Plan 2021, negative growth is projected across all scenarios; this is as a result of expected reduced new connections, coupled with an anticipated increase in disconnection rates in this sector as a result of gas boilers coming towards the end of

their useful life, being replaced with heat pumps. Increasing energy efficiency is also taken into account across the GFS horizon in all scenarios. The Best Estimate scenario projects a reduction of 12% in the Residential sector gas demand between 2021/22 and 2030/31.

In contrast, the development of peak day demands across the various scenarios diverges when compared to the annual demand forecasts. Over the forecast horizon, the ROI 1-in-50 (i.e. a severe winter peak day that is statistically likely to occur once every fifty years) peak day demand is predicted to grow by 17%, and by 18% for the average (i.e. a winter peak day that would occur in a typical winter) peak day in the Best Estimate demand scenario between 2021/22 and 2030/31. There is decoupling of peak day and annual gas demand in the power generation sector as a result of renewable generation's impact on the operation of gas-fired plant in the Single Electricity Market (SEM). Towards the end of the period, the increasing penetration of renewable generation, particularly offshore wind and solar photovoltaics (PV), combined with further interconnection has a slight dampening effect on the peak day gas demand. Only the Low scenario 1-in-50 peak forecast is expected to decrease overall, falling by 1%.

The 1-in-50 ROI peak day forecast for the Best Estimate demand scenario is expected to reach its highest point across the GFS horizon in 2024/25, which equates to 31% growth between 2021/22 and 2024/25. Equivalently, 1-in-50 system peak day forecast for the Best Estimate demand scenario is expected to reach its highest point across the GFS horizon in 2024/25, which equates to 29% growth between 2021/22 and 2024/25. Given the scope for growth, the current technical supply capacity at the Moffat Entry Point is projected to be exceeded in the latter eight years of the forecast horizon. Capacity on the interconnector pipelines is adequate to meet all gas demand projections over the ten-year horizon; the potential constraint would arise at the associated compressor station installations in Scotland. Gas Networks Ireland is progressing and proposing a series of short-, medium- and long-term solutions to the Moffat constraint. Temporary operational measures have been identified to mitigate the constraint while the permanent capacity upgrades are put in place.

1.0 Executive summary
(continued)

National policy targets a 70% (to be revised upwards to 80% following the Climate Action Plan 2021) renewable energy share in electricity generation (RES-E), such as from wind and solar, by 2030. While annual gas demand in the medium- to long-term will be inversely related to the delivered level of RES-E on the SEM and increased electrical interconnection, peak day gas demand will not be as impacted as gas-fired power generation will be required to meet almost all of Ireland's electricity requirements on days of low wind. The increasing penetration of renewable generation, particularly of offshore wind and solar PV, does have a slight dampening effect on the peak day gas demand, with installed wind capacity assumed to double over the final four years of the GFS horizon. The high level of electrical interconnection achieved by the final three years of the GFS horizon also has an impact on the peak day gas demand; in the forecast it is assumed that the SEM will be net importing on these days. While electricity interconnectors may operate in the net import direction on such days, equally they may operate as net exporters of electricity on such high demand / low wind days. This will depend on the wider electricity market dynamics, such as those experienced on the most recent winter peak day for gas demand in 2020/21, when the electricity interconnectors operated as net exporters to GB.

The Corrib gas field is expected to meet 21% of annual Gas Networks Ireland system demand (28% of ROI demand) in 2021/22, with the Moffat Entry Point providing the remaining 79% (and 72% of ROI demand).

The Data Centre market continues to grow, and new demands cannot be met by the current electricity grid, leading to some Data Centres taking the decision to generate electricity on-site themselves, using natural gas to complement flexible electrical connections to the electrical grid. Based on a recent Commission for Regulation of Utilities (CRU) decision, Data Centres with their own independent electricity generators may get priority for grid connections in the future, adding further potential demand for natural gas power generation in this sector. In addition, new regulations on fuel storage for back-up facilities, combined with the sector's desire to invest in low carbon fuel sources with a pathway to decarbonisation, are driving Data Centres to select natural gas as the source of back-up fuel, displacing higher carbon fuels like diesel/kerosene. The recent Government Statement on the Role of Data Centres in Ireland's Enterprise Strategy sets out a series of principles to inform and guide decisions on future Data Centre development. There is a clear preference for Data Centre developments that can demonstrate the additionality of their renewable energy use in Ireland and can demonstrate a clear pathway to decarbonise and ultimately provide net zero data services. Gas Networks Ireland believe that Data Centres connecting to the gas network could meet these principles through the increased use of biomethane and hydrogen and are currently assessing the statement impacts and consulting with Government. For the purposes of this GFS horizon, the Low and Best Estimate scenarios have been limited to Data Centre customers with connection agreements already in place.

"The Corrib gas field is expected to meet 21% of annual Gas Networks Ireland system demand (28% of ROI demand) in 2021/22, with the Moffat Entry Point providing the remaining 79% (and 72% of ROI demand)."

Gas Networks Ireland is conducting a project for a nationwide Compressed Natural Gas (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 the network rollout is being conducted through the Causeway Study which has begun to deliver this essential infrastructure. Public access stations have been constructed at Circle K Service Stations in Dublin Port, Cashel (on the M8 motorway), Clonshaugh in Dublin and Ballysimon Road in Limerick. The stations are fully operational and have been integrated with Circle K's systems, and as such CNG is now sold through the forecourt in a similar fashion to diesel and petrol. A further five public access Causeway stations, currently at various stages of development, will be delivered over the next two years. Two further public access CNG stations, co-located at existing forecourts or new build sites, are also planned by Gas Networks Ireland as part of the GRAZE Project, partly funded by grant funding from the Climate Action Fund. Six further public stations are targeted along the comprehensive road network helping to develop the CNG station network across the country. By the end of the GFS horizon, Gas Networks Ireland expects to see annual CNG demand of circa 506 GWh/yr, equivalent to meeting the

1.0 Executive summary
(continued)

annual fuel requirement of approximately 1,012 Heavy Goods Vehicles (HGVs). Utilising CNG with biomethane, bio-CNG, to power HGVs, offers a real solution to decarbonising the HGV fleet. When powered 100% by bio-CNG, this equates to circa 103kTCO_2-eq annual savings when the CNG stations reach their anticipated capacity.

Gas Networks Ireland commissioned the first biomethane gas grid injection facility in 2019, and it was officially declared an Entry Point in May 2020. Gas Networks Ireland now facilitates direct grid injection projects through a connection policy framework and is also supporting remote cluster developments with the development of Central Grid Injection (CGI) infrastructure. As with other renewable energy technologies, biomethane requires National policy and incentive supports to allow this industry to develop and grow to become a long-term competitive fuel. Government and EU policy in relation to renewable gases such as biomethane and hydrogen is evolving quickly in response to the war in Ukraine and a desire to accelerate the green transition. Gas Networks Ireland has produced three biomethane gas production forecasts (Low, Best Estimate and High) spanning the current range of policy targets. The Gas Networks Ireland Low biomethane scenario is aligned in the Government's National Energy and Climate Plan (NECP) 2021-2030 and Climate Action Plan (CAP) 2021, which set the target for indigenous biomethane at 1.6 TWh by 2030. The recent Government announcement on sectoral greenhouse gas emissions ceilings (consistent with the RePowerEU plan) increased the biomethane target produced from agro-forestry and anaerobic digestion up to 5.7 TWh by 2030, this target is included in the GFS High Scenario. The GFS Best Estimate scenario is based on achieving an intermediate level of 3.2 TWh/year of indigenous biomethane by 2030/31.

"Gas Networks Ireland now facilitates direct grid injection projects through a connection policy framework and is also supporting remote cluster developments with the development of Central Grid Injection (CGI) infrastructure."

The EU Green Deal (published in December 2019) presented a high-level roadmap of key policies and measures to frame the EU's plans for decarbonisation and its ambition to become net zero by 2050. It has resulted in more ambitious targets and increased pressure to decarbonise, at both EU and National levels. Of particular interest to Gas Networks Ireland and the European energy industry were the 2020 publication of the EU strategies for Energy System Integration and Hydrogen (July 2020) and Reducing Methane Emissions (October 2020). These three strategies collectively pave the way towards a "fully decarbonised, more efficient and interconnected energy sector". As a key step in delivering on the Green Deal, the European Commission's 'Fit for 55 Package', published on 14th July 2021 set binding targets to achieve climate neutrality by 2050 and a commitment to cut carbon emissions by at least 55% by 2030 (compared to 1990 levels). The proposed 'Hydrogen and gas markets decarbonisation package' (revising Directive 2009/73/EU and Regulation 715/2009/EU) was published in December 2021. This revision aims to redesign a competitive, decarbonised gas market, fit for renewable gases including biomethane and hydrogen. Since the Russian invasion of Ukraine in February 2022, the volume of new energy initiatives from the

European Union has continued to accelerate. Building on the Fit for 55 package, the RePowerEU Plan included a proposal to increase the headline 2030 renewables target from 40% to 45% under the Fit for 55 package, including a goal to increase biomethane production to 35bcm by 2030 as well as a target of producing 10 million tons of domestic renewable hydrogen plus 10 million tonnes of hydrogen imports by 2030. Gas Networks Ireland will continue to monitor these developments and proactively engage with EU and National stakeholders to assess the implications for the Irish gas market.

Gas Networks Ireland continuously undertakes detailed system modelling of the network in order to assess its capacity. The Best Estimate demand scenario identified in Section 5 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. In 2021, twelve projects were completed, including 1 AGI Capacity Upgrade, and 11 Reinforcements of the Distribution Network. These projects were subject to the appropriate consenting and planning regimes as set out in Section 2.

Gas Networks Ireland's business plan for the next price control period (PC5) was submitted to the CRU in September 2022. This plan sets out the investment requirements for a five-year period to September 2027 to ensure the provision of a safe high-quality service for all gas customers, a continued focus on efficient spend, efficiently facilitating the energy transition and maintaining a safe and resilient network. The timely approval of capital funding and progression of the capacity upgrade works at the Gas Networks Ireland Compressor Stations in Scotland is a key priority to ensure the growth in the 1-in-50 peak day forecast can continue to be met.

2.0

Introduction

Key messages:

The gas network currently consists of 2,476 km of high-pressure steel transmission pipelines and 12,188 km of lower pressure polyethylene distribution pipelines.

Natural gas is available in 22 counties and there are c. 716,000 users 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 CRU in accordance with Article 22 of EU Directive 2009/73/EC and Article 11 of the EC[1] (Internal Market in Natural Gas and Electricity) (Amendment) Regulations 2015. Amendments to the EU Directive 2009/73/EC (enacted under EU 2022/869 in May 2022) and proposed revisions to the Regulation revises the requirement for a Ten-Year Network Development Plans (TYNDP) from yearly to every two years. In interim years when a ten-year Network Development Plan is not requested by the CRU, the Gas Forecast Statement (GFS) 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.

2.1 Environmental and planning considerations

The purpose of the Gas Forecast Statement 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 in the interim years where the Network Development Plan (NDP) is not required. While it outlines a number of capital projects, and new technologies, which will be delivered over the coming years, 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 by 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.

2.2 Overview of the Gas Networks Ireland system

Gas Networks Ireland builds, develops and operates Ireland's world-class gas infrastructure, maintaining over 14,664 km of gas pipelines and two sub-sea interconnectors.

The Gas Networks Ireland transmission network includes onshore Scotland, the interconnectors and the onshore ROI network. The interconnector sub-system is comprised

1 EC- European Commission

of two subsea interconnectors between ROI and Scotland; and two compressor stations in Scotland at Beattock and Brighouse Bay. The interconnector system connects to GB's 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 has currently developed to 2,476 km of high-pressure steel transmission pipelines and 12,188 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; and
- 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 2010 and December 2010 when prolonged 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. The gas network is available in 22 counties and there are circa 716,000 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 2-1: Overview of the Gas Networks Ireland transmission system

3.0

The role of the gas network in decarbonising Ireland's energy system

Key messages:

Gas Networks Ireland welcomes the strength, urgency, ambition and the clear associated governance set out in the Climate Action and Low Carbon Development (Amendment) Act 2021, the Programme for Government and Climate Action Plan 2021.

Ireland has committed to and legislated for net-zero emissions by 2050 and utilising the national gas network is vital to achieving this. Gas Networks Ireland is committed to proactively supporting this ambition through the delivery of a net-zero carbon gas network by 2050.

By gradually replacing natural gas with renewable gases, such as biomethane and hydrogen, Gas Networks Ireland can deliver a net-zero carbon gas network and reduce emissions across a number of key sectors, including those that are traditionally difficult to decarbonise, such as Transport, Agriculture, Industry, Heating and Power Generation.

The continued roll-out of biomethane and CNG technologies will deliver immediate emissions reductions.

Gas Networks Ireland will continue to explore opportunities for greater energy system integration, building on the synergies which inherently exists between the gas and electricity transmission systems. An integrated energy system will help to address some of the challenges that cannot be overcome through electrification alone.

Gas Networks Ireland has commenced a range of work packages to ensure the gas network will be ready to support the transport of hydrogen initially via blending and subsequently at scale.

As noted in Section 2, the purpose of the GFS is to assess the gas network's capacity based on existing and forecast supply and demand in order to guarantee the ten-year adequacy of the gas transportation system and security of supply in the interim years where the NDP is not requested by the CRU. Similar to the NDP, the supply and demand assumptions which define the scenarios presented in this GFS are based on a prudent assessment of current energy policy in Ireland. The Best Estimate scenario aligns to the existing policy measures in place at the time of the GFS modelling Data Freeze. As a result, the Best Estimate scenario aligns to the measures and ambition outlined in the Climate Action Plan (CAP) 2021[2] and the National Energy and Climate Plan (NECP)[3] for 2021 – 2030.

Further to the above energy policy publications, Ireland's Programme for Government (PfG)[4] sets a commitment to reducing overall greenhouse gas emissions by 7% per annum from 2021 to 2030, with the aim of achieving net-zero emissions by 2050. The Climate Action and Low Carbon Development (Amendment) Bill 2021 also sets a commitment to net-zero emissions by 2050. These are significantly higher targets than set out in previous policy and are set to shape the Irish energy landscape into the coming decades.

Gas Networks Ireland continues to monitor ongoing energy policy development and will incorporate all further policy measures and ambitions into the GFS Best Estimate scenario as these measures and ambitions become known. In this section, we look beyond the ten-year network adequacy assessment timeline, to consider the role the gas network will play in decarbonising Ireland's energy system.

3.1 Policy background

Climate change is one of the greatest and most urgent global challenges, affecting communities, human health and the environment. Significant growth in population and economic activity continues to increase the demands on energy. Policy developments at National and European level continue to evolve at pace, and Ireland is committed to achieving net-zero emissions of greenhouse gases by 2050 at the latest. Relevant National and European policy developments are summarised in Figure 3.1.

Figure 3-1: National and European energy policy developments

National policy developments

Programme for Government	June 2020
National Energy and Climate Plan 2021 – 2030	June 2020
Climate Action and Low Carbon Development Act	July 2021
Climate Action Plan 2021	November 2021
Carbon Budgets 2021	February 2022
Hydrogen Strategy for Ireland	anticipated Q4 2022

European policy developments

EU Green Deal	December 2019
EU Hydrogen Strategy	July 2020
EU Energy System Integration Strategy	July 2020
Fit for 55 Package	July 2021
EU Hydrogen and gas network decarbonisation package	December 2021
REPowerEU	March 2022

2 Government of Ireland, 2021, Climate Action Plan, https://www.gov.ie/en/publication/6223e-climate-action-plan-2021/
3 National Energy and Climate Plan 2021-2030 https://assets.gov.ie/94442/f3e50986-9fde-4d34-aa35-319af3bfac0c.pdf
4 Programme for Government https://assets.gov.ie/130911/fe93e24e-dfe0-40ff-9934-def2b44b7b52.pdf

3.0 The role of the gas network in decarbonising Ireland's energy system (continued)

Programme for Government

In 2020, the Programme for Government committed Ireland to an average 7% per annum reduction in overall greenhouse gas (GHG) emissions from 2021 to 2030, and to achieving net-zero emissions by 2050 at the latest. This 51% reduction by 2030 is more than double the 23% emission reductions targeted in the 2019 Climate Action Plan. This increase in emission reductions from 23% to 51% means that Ireland will need to consider all initiatives and technologies that would reduce emissions on a no regrets basis.

National Energy and Climate Plan 2021 - 2030

In 2019, the Department of the Environment, Climate and Communications (DECC) submitted Ireland's National Energy and Climate Plan (NECP) for 2021 – 2030 to the European Commission. The NECP has proposed an indicative target for biomethane of 1.6 TWh by 2030, which will be reviewed in 2023 as part of the review process for the National Energy and Climate Plan, and as outlined in Action 169 of Climate Action Plan 2021. The 2023 review will take account of the development of supports and market development for biomethane as it progresses towards the indicative target. This is an important step in the development of the biomethane market in Ireland and in furthering the decarbonisation of the Heat, Transport and Agriculture sectors. The NECP highlights the business opportunities that new technologies such as anaerobic digestion, biomethane, biomass, heat recovery, carbon capture and micro-generation will bring. The NECP also outlines that the Climate Action Plan and the recommendations from the Low Emission Vehicle Taskforce recognise the need to incentivise the growth of low emission vehicles and that supports for the growth of CNG and hydrogen vehicles are being considered. This is essential to decarbonising the transport sector and particularly with regard to HGVs, which are difficult to decarbonise.

Climate Action and Low Carbon Development Act 2021

On the 23rd of March 2021, the Climate Action and Low Carbon Development (Amendment) Bill 2021 was published which makes the Government legally accountable for Ireland's target of net-zero emissions by 2050. The Bill amends the Climate Action and Low Carbon Development Act 2015 to significantly strengthen the framework for governance of climate action by the State in order to realise Ireland's national, EU and international climate goals and obligations. The Bill places Ireland's commitment to achieve a climate neutral economy no later than 2050 (known as the 'national climate objective') on a statutory basis. In addition, the Bill strengthens public participation and provides that, for each of the relevant plans, strategies, and carbon budgets, DECC will consult with the public. In July 2021, the Bill was signed into law by the President of Ireland, as the Climate Action and Low Carbon Development (Amendment) Act 2021.

Climate Action Plan

In 2019, the Irish Government published their first Climate Action Plan (CAP), with the aim of tackling climate change by setting out sectoral targets, actions and timelines. In addition to setting out a pathway to 2030, it also set out clear governance arrangements which will significantly enhance accountability and purpose in implementing the proposals. Gas Networks Ireland welcomed the strength and urgency of the ambition and the associated governance set out in the Plan.

In November 2021, the Government published an updated Climate Action Plan (CAP 2021) containing over 490 actions. It provides a detailed plan for taking decisive action to achieve a 51% reduction in overall greenhouse gas emissions by 2030 and setting us on a path to reach net-zero emissions by no later than 2050, as committed to in the Programme for Government and set out in the Climate Act 2021.The Climate Action Plan 2021 document contains an overarching action (Action 169) to decarbonise the natural gas grid.

"Gas Networks Ireland welcomed the strength and urgency of the ambition and the associated governance set out in the Climate Action Plan."

Specific sub-actions relate to development of green hydrogen include:

- assessing the potential for energy system integration between the electricity and gas networks including the production, storage and use of green hydrogen;
- developing a regulatory/policy roadmap for using the gas network to transport hydrogen; and
- testing the feasibility of safely injecting green hydrogen blends into the gas network.

Specific sub-actions for further development of biomethane include:

- developing biomethane grid injection infrastructure through the GRAZE Gas project with support from the Climate Action Fund; and
- reviewing (in 2023) the indicative biomethane network injection target for 2030.

Further sub-actions also relate to decarbonising the natural gas network:

- Establishment of an official biomethane certification scheme.
  - In 2020, Gas Networks Ireland implemented a voluntary registration scheme for biomethane;
  - In July 2022 the Minister approved this certification scheme, establishing Gas Networks Ireland's scheme as the official certification scheme for biomethane in the gas network, with certificates to be issued by Gas Networks Ireland.
- Action 172 proposes the introduction of a renewable energy obligation in the Heat Sector. The purpose of this obligation would be to stimulate the demand for renewable energy in the Heat sector.

3.0 The role of the gas network in decarbonising Ireland's energy system (continued)

Carbon Budgets

Ireland's carbon budget programme, comprising three 5-year budgets (2021-2025; 2026-2030; and 2031-2035), came into effect on 6 April 2022. A carbon budget represents the total amount of emissions, measured in tonnes of CO_2 equivalent, that may be emitted by a country or region during a specific time period. The carbon budget for the period 2021-2025 aims to reduce emissions by 4.8% on average annually for five years, while the second budget from 2026-2030 will look to up that annual reduction to 8.3%. The budgets are further broken down into sectoral emissions ceilings, which determine how each sector of the economy contributes to the achievement of the carbon budgets.

The sectoral emissions ceilings have been set for the electricity, transport, buildings, industry and agriculture sectors, with reductions in emissions ranging from 25% to 75% per sector by 2030, relative to 2018 emission levels. In addition, the agreement reached on sectoral emissions ceilings also commits additional resources for solar (more than doubling the target to 5,500 MW), off-shore wind (moving from a target of 5,000 MW to 7,000 MW), green hydrogen (an additional 2,000 MW), agri-forestry and anaerobic digestion (up to 5.7 TWh of biomethane) – to further accelerate the reduction of overall economy-wide emissions.

Hydrogen Strategy for Ireland

The Department of the Environment, Climate and Communications has stated in the National Energy Security Framework, published on 13th April 2022, that the development of an integrated hydrogen strategy for Ireland is to be prioritised, in line with the Climate Action Plan. This will be of particular relevance for Gas Networks Ireland as the gas network will play a leading role in hydrogen transportation. The Government issued a public consultation on developing a hydrogen strategy for Ireland in July 2022. The consultation closes on 2nd September with the strategy publication anticipated in Q4 2022.

European Policy Developments

The **EU Green Deal** (published in December 2019) presented a high-level roadmap of key policies and measures to guide future European energy and decarbonisation policy. EU strategies on individual components of the Green Deal have been published, including the **EU's Hydrogen Strategy** and the **Energy System Integration Strategy**, and in July 2021, the European Commission adopted the '**Fit for 55 Package**' – a set of legislative proposals to ensure the EU reaches its updated 55% emissions reduction target for 2030 (compared to 1990 levels). This package is seen as a key next step in delivering the Green Deal and in putting Europe on the path to becoming the world's first net-zero continent by 2050.

The **EU Hydrogen and gas market decarbonisation package** was published in December 2021. The package aims to enable the market to decarbonise gas consumption and facilitate the integration of renewable and low-carbon gases into the existing gas network. The package creates a level playing field based on EU-wide rules for hydrogen market and infrastructure and removes barriers that hamper their development.

The **REPowerEU** plan (May 2022) outlines the EU's path to energy independence from Russian fossil fuel by 2027 and fast forward the green transition. The plan puts forward short, mid-term and long-term targets and measures, including demand reduction, diversification of suppliers, and acceleration of the transition to renewable energy sources. The Plan also includes a goal to increase biomethane production to 35bcm, across the EU, by 2030, as well as a target of producing 10 million tonnes of domestic and 10 million tonnes of imported renewable hydrogen by 2030.

Further detail on European Policy Developments is included in Section 7.

3.2 Decarbonising Ireland's gas network

Gas Networks Ireland is committed to decarbonising the gas network, to help Ireland achieve a net-zero emissions energy system by 2050. A decarbonised gas network can help reduce emissions, support the achievement of Ireland's climate ambitions and secure Ireland's energy security with least disruption. The gas network infrastructure is not inherently a fossil fuel network and it can be adapted to transport zero-carbon gases such as hydrogen, just as it has adapted to facilitating new and emerging energy carriers such as natural gas and biomethane in the recent past.

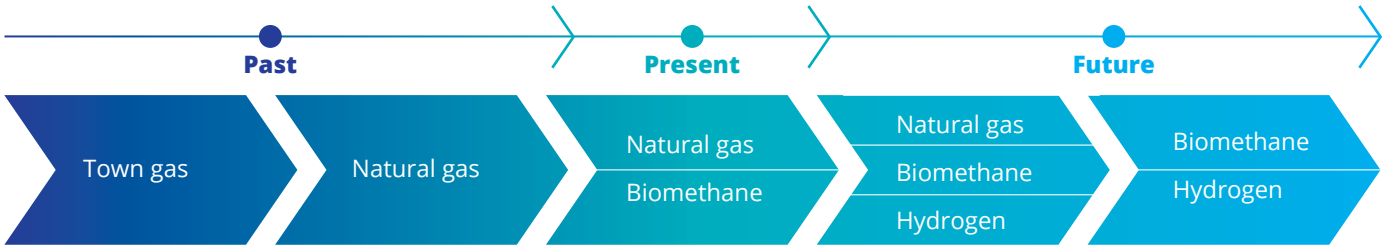
The gas network plays a critical role in Ireland's economy today, delivering approximately 34%[5] of the country's primary energy needs, serving homes, businesses and electricity generation. In the context of the wider energy system, gas is a critical component powering the production of 45.8%[6] of the country's annual electricity requirement in 2021. National policy seeks an 80% renewable energy share in electricity generation (RES-E), such as from wind and solar, by 2030. While Ireland has excellent renewable resources, renewable energy, by its very nature, is weather dependant and intermittent. Sometimes the wind doesn't blow, or the sun doesn't shine. As such, for renewable energy to achieve its full potential, investment in complementary energy systems is required. The gas network provides the optimal complementary energy source for renewable energy such as wind and solar. It is well established[7] that achieving 80% RES-E 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 emits 40% less CO_2 than coal and 22% less CO_2 than oil[8]. It also produces negligible levels of nitrogen dioxide (NOx) and sulphur dioxide (SOx) 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. Integration of biomethane and CNG technologies have enabled the commencement of the decarbonisation journey for the gas network. This means Ireland can continue to benefit from the reliability of the gas network in a low carbon future.

Looking beyond 2030, the gas network can be fully decarbonised by utilising hydrogen. For this to happen, the gas and electricity networks will need to be further integrated. An integrated energy system can deliver clean energy and deliver Ireland to net-zero emissions by 2050 in line with the policy ambition set out at national and European level as summarised above in section 3.1.

Figure 3-2: Gas infrastructure adapting to multiple energy carriers



5 Based on SEAI Energy in Ireland 2021 - https://www.seai.ie/publications/Energy-in-Ireland-2021_Final.pdf
6 System and Renewable Data Summary Report – EirGrid
7 Refer to EirGrid All Island Generation Capacity Statement 2022-2031; and the Electricity Association of Ireland in collaboration with the MaREI Centre in their report 'Our Zero e-Mission Future', February 2021
8 Based on SEAI Energy in Ireland - https://www.seai.ie/publications/Energy-in-Ireland-2021_Final.pdf

3.0 The role of the gas network in decarbonising Ireland's energy system (continued)

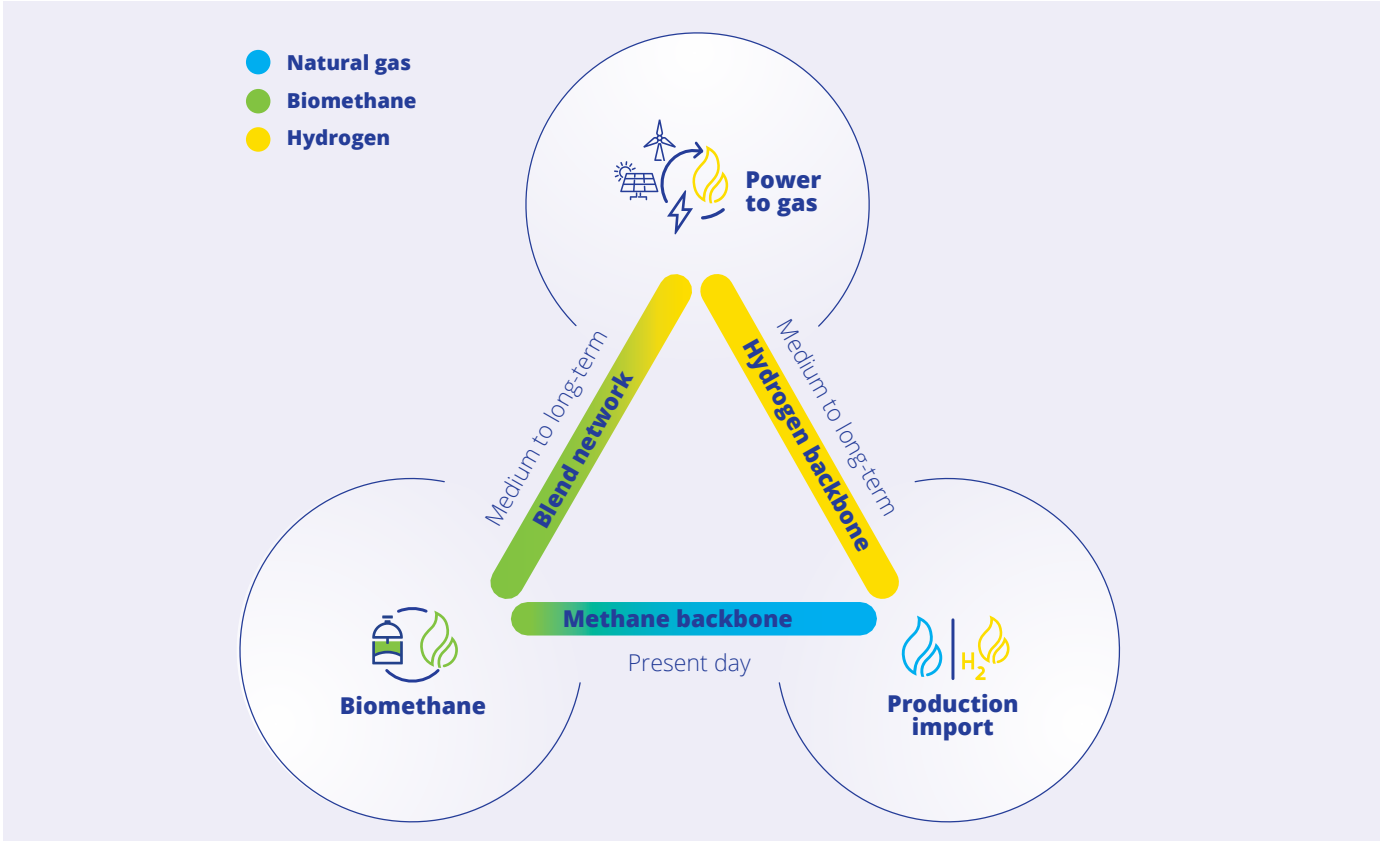
A net-zero carbon gas network supports increased decarbonisation across electricity generation, industry, heating and transport and can play a role in achieving negative emissions which experts agree are required to achieve net-zero. The guiding principles for transportation of renewable gases and for sector coupling are set out below, followed by a high-level overview of the key enabling technologies, as introduced in the preceding paragraphs.

3.2.1 Principles for transportation of renewable gases

Gas Networks Ireland is the proud owner and operator of one of the most modern gas networks in Europe, however, we recognise that our network must be repurposed to transport renewable gases. Our organisation and its network are uniquely placed to deliver the necessary changes, and we're actively working towards these goals. This will also require collaboration with other energy partners to collectively ensure net zero carbon by 2050. Gas Networks Ireland has developed a series of scenarios which consider the importance and impact of policy decisions on the scale of decarbonisation that can be achieved. Our ambition demonstrates how the gas network supports decarbonisation for domestic customers, industrial users, transport, agriculture and power generation.

As National and European energy policy evolves, Gas Networks Ireland is continuously reviewing

Figure 3-3: Principles for transportation of renewable gases



and developing further potential pathways to achieve a decarbonised gas network by 2050, such as the increased role of hydrogen in the future energy system. It is likely that there will be multiple pathways to decarbonising the gas network and the wider energy system. Therefore, a broad framework is considered: a set of principles for the transportation of renewable gases (and thereby decarbonisation of the gas network). Figure 3.3 shows how renewable gases could be transported within the gas network through a variety of emerging pathways.

The natural gas network as it exists today consists of a Methane Backbone, with small volumes of biomethane blended. In the short to medium-term, the level of biomethane blending will increase substantially. In the medium to long-term, blending of natural gas and biomethane with hydrogen will enable initial volumes of hydrogen to be utilised – contributing to a gradual decarbonisation of the gas mix. In the long-term, a dedicated Hydrogen Backbone may be developed, through the re-purposing of existing pipelines and/or construction of new pipelines. The manner in which the gas network is decarbonised over time will depend on policy decisions and the available technical solutions.

In addition to delivering a decarbonised gas network, the above components will serve to further enhance Ireland's Security of Supply position, through the introduction of an additional energy supply carrier (hydrogen) to Ireland's energy mix, and by enabling the bulk transport of indigenously produced renewable gases (biomethane and hydrogen).

3.2.2 Principles for sector coupling

The European Commission launched its 'Strategy for Energy System Integration' on the 8th of July 2020. This is one of the most ambitious and all-encompassing elements of the European 'Green Deal', providing the basis for "the coordinated planning and operation of the energy system as a whole, across multiple energy carriers, infrastructures, and consumption sectors". It envisages an integrated energy system which delivers decarbonisation "at the least cost across sectors while promoting growth and technological innovation". One of the key interfaces in an integrated system will be between gas and electricity grids. By leveraging the bulk storage

3.0 The role of the gas network in decarbonising Ireland's energy system (continued)

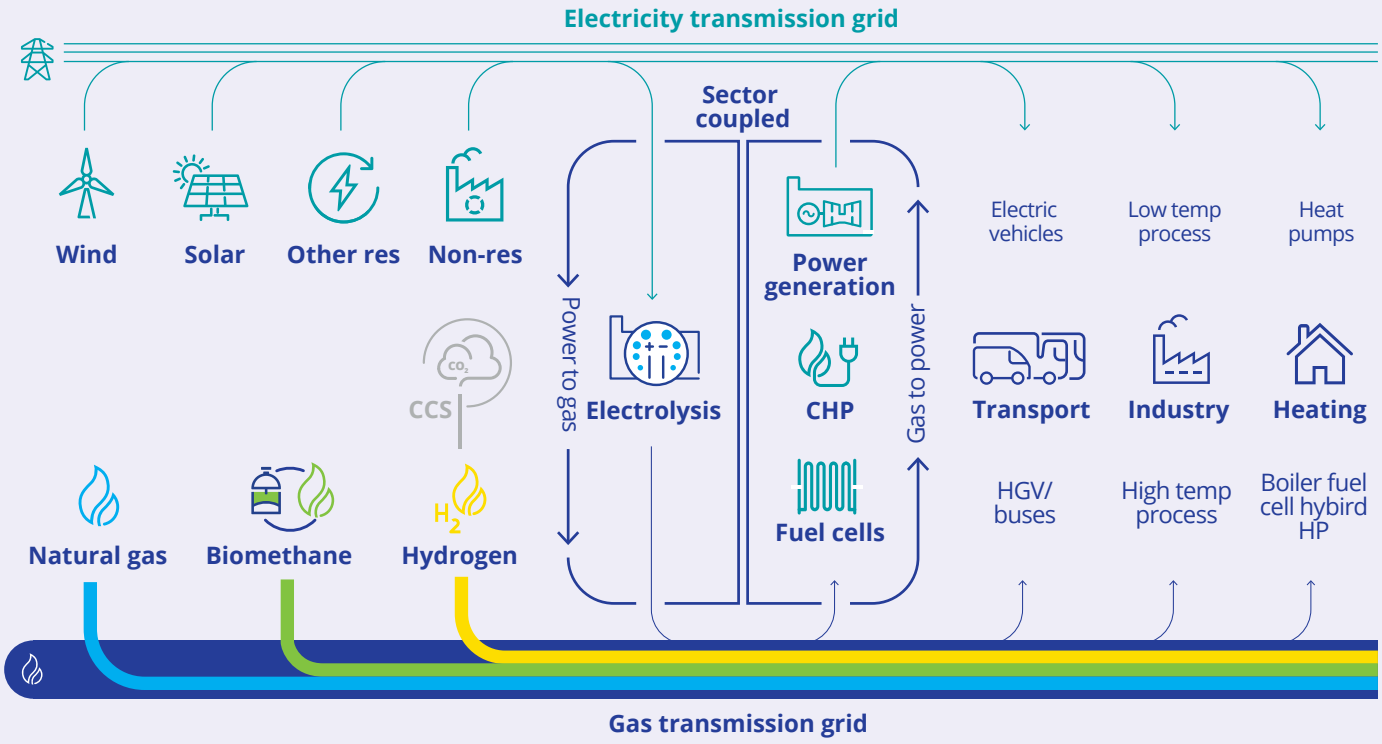
capability of gas infrastructure and utilising innovative technologies such as Power to Gas and hydrogen networks, a decarbonised and secure energy system can be achieved.

As per Action 169 of Climate Action Plan 2021, Gas Networks Ireland will continue to explore opportunities for greater energy system integration, building on the existing synergies between the gas and electricity transmission systems. Figure 3-4 demonstrates the principles of a potential coupled energy system. Such a system can address the challenges that cannot be overcome through electrification alone. These include serving the energy needs of high-temperature industrial processes, heavy goods transport, as well as harnessing and storing (through utilisation of the storage capability of the gas system) renewable wind generation which might otherwise be curtailed at times of low electricity demand. Cross-vector integration between electricity, gas and heat can serve as an additional source of energy system flexibility and security of supply.

3.2.3 Key enabling technologies

Utilising a combination of technologies, various pathways to delivery of a net-zero gas network in 2050 will become available. Technologies such as biomethane and CNG are already integrated on our network and are delivering reduced emissions within the heating and transport sectors. Achieving a net-zero gas network will require growth of these existing technologies and will also require development of and investment in hydrogen at scale (as referred to in Action 169 of Climate Action Plan 2021). In addition, Gas Networks Ireland notes Action 126 of Climate Action Plan 2021 to "Examine and oversee the feasibility of the utilisation of

Figure 3-4: Principles for sector coupling



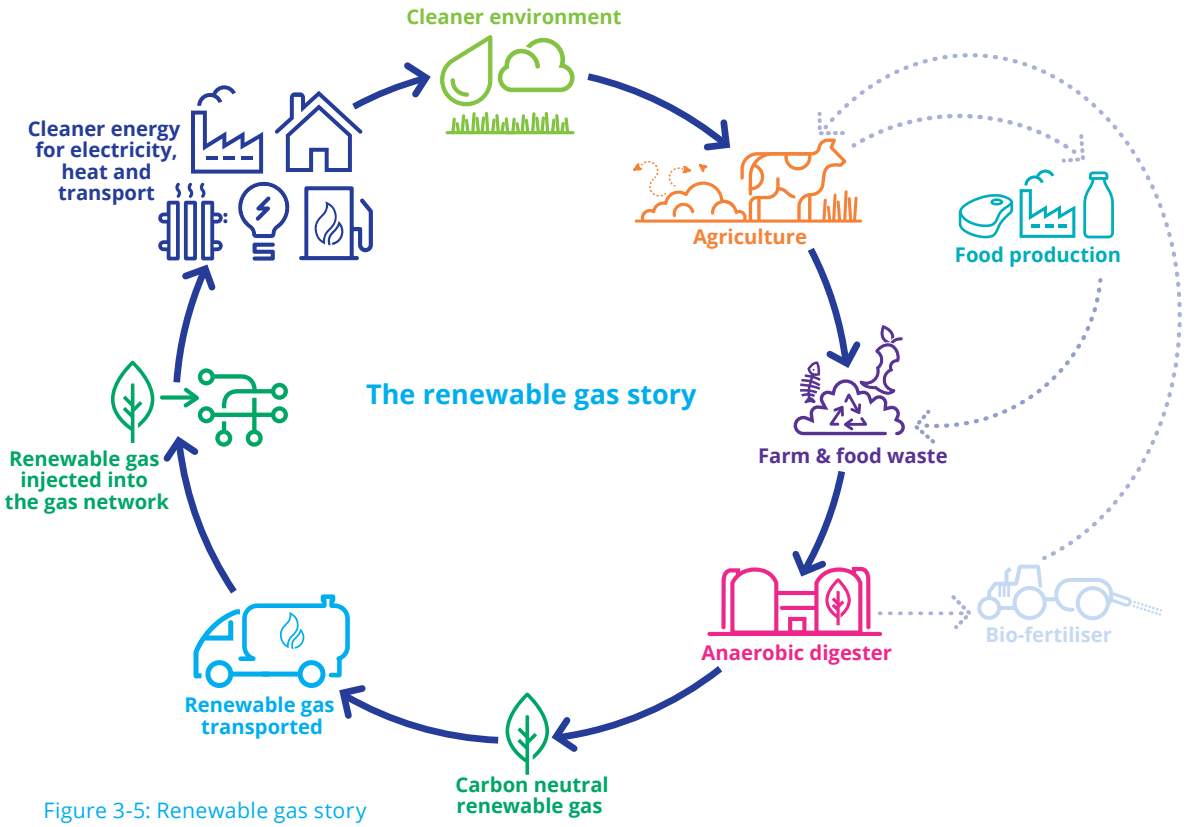


Figure 3-5: Renewable gas story

Carbon Capture and Storage in Ireland". This section considers each of these technologies, in the context of enabling a pathway to achieve a net-zero gas network by 2050.

Compressed Natural Gas (CNG)

CNG is natural gas stored under high pressure. Replacing diesel in HGVs and buses with CNG can deliver immediate emissions reductions, air quality improvement (by eliminating particulate matter) and noise reduction. Well-to-wheel emissions reductions from current generation CNG HGVs range from -12 per cent (Department of Transport, 2018[9]) to -20 per cent (Cenex, 2019[10]) relative to diesel equivalents. CNG also contains no additives and has far less emissions of nitrogen oxide, sulphur oxide and particulate matter than diesel. CNG is particularly well suited to delivering the high power and distance requirements of heavy-duty transport including HGVs, buses and ships. Development and utilisation of bio-CNG offers a real solution to decarbonising the HGV fleet. Bio-CNG is biomethane 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 delivering 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 biomethane as alternative fuels.

Biomethane

Biomethane (purified biogas) is 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.

The Climate Action Plan (November 2021) sets out several actions to support the development of biomethane production and related infrastructure, as summarised above in Section 3.1.

9 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/739462/transport-energy-model.pdf
10 https://www.cenex.co.uk/app/uploads/2019/11/Dedicated-to-Gas-Assessing-the-Viability-of-Gas-Vehicles.pdf

3.0 The role of the gas network in decarbonising Ireland's energy system (continued)

It is envisioned that a number of Centralised Grid Injection facilities will, in time, be geographically dispersed across the country at locations in close proximity to the existing gas grid. Biomethane producers within 80 km 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, for injection into the national gas grid. Gas Networks Ireland is expected to begin construction of Ireland's first large-scale central gas injection facility in Mitchelstown, Cork in summer 2023 as part of the Green Renewable Agricultural Zero Emission (GRAZE) biomethane project. Direct injection anaerobic digestion facilities are also supported under the Gas Networks Ireland Connection Policy. As of July 2022, Gas Networks Ireland have issued approximately 135 initial stage connection feasibility reports in response to connection enquiries from potential developers.

Hydrogen

Hydrogen is a gas that can be produced in various different ways, including from renewable electricity. Hydrogen produces zero CO_2 emissions when combusted, and can be blended with natural gas or used in its pure form. It is well suited to storage. Hydrogen is therefore considered an attractive option to decarbonise energy systems and has significant potential to drive a cleaner energy future for Ireland.

Internationally, hydrogen is currently primarily produced for the industrial gas market by separating it from natural gas, this is referred to as grey hydrogen. This process can be decarbonised by capturing and storing the resulting carbon dioxide, this is referred to as low carbon or blue hydrogen. Green hydrogen is produced by electrolysis powered by renewable electricity.

"Hydrogen produces zero CO_2 emissions when combusted, and can be blended with natural gas or used in its pure form"

Green hydrogen has the potential to feature as a key primary energy carrier in enabling Ireland to achieve net-zero greenhouse gas emissions by 2050, as evident by inclusion of actions 54a, 54b and 54c of the Interim Climate Actions 2021.'Power to gas' describes the production of hydrogen by electrolysis, the chemical decomposition of water into hydrogen and oxygen. The hydrogen produced is classified as Green hydrogen when it is produced by renewable electricity and carbon does not feature in the production process or gas itself. Green hydrogen is the Government's preferred production method in the long-term once both the production equipment and renewable electricity sources such as offshore wind scale up sufficiently.

The European Commission communication 'A Hydrogen Strategy for a Climate-neutral Europe' sets out the ambition for hydrogen in Europe and the phases the Commission foresees in its development. There is recognition that hydrogen is required to achieve full decarbonisation of the energy mix and will be needed to decarbonise high heat applications in industry and heavy use transport. Hydrogen is also envisaged as playing a role in space heating and dispatchable power generation. The EC and the UK have signalled an intention to put substantial investment into hydrogen and establish it as a major pillar in their future decarbonised energy systems. Potential demand side uses for Hydrogen span Heating, Industrial, Transport and Power Generation sectors:

- **Heating / industrial**: Hydrogen is a flammable gas and therefore may be utilised in applications ranging from domestic boilers to high heat industrial processes. Hydrogen boilers have been developed for domestic use and commercial boilers are under development.

Hydrogen ready boilers which are compatible with natural gas may facilitate a lower cost and a low disturbance conversion in the future. Hydrogen heating may be particularly suited to existing buildings, providing a carbon free heating technology without the need for the expense of a deep retrofit;

- **Transport**: Gas Networks Ireland is a member of Hydrogen Mobility Ireland, which is an initiative focussed on developing hydrogen refuelling infrastructure for Ireland. Hydrogen may play a long-term role in heavy use transport, in vehicles carrying heavy loads or vehicles in constant use. The gas network may play a role in the hydrogen supply chain that serves hydrogen refuelling stations; and
- **Power generation**: Hydrogen fuelled power generation is at an early stage of development. It is, however, noted that major power generation equipment suppliers are engaged in evaluating both the use of hydrogen blends and 100% hydrogen in gas turbines. This opens the prospect of carbon-free large-scale long-duration dispatchable power generation.

Carbon Capture and Storage (CCS)

Carbon Capture and Storage (CCS) is a suite of technologies that can effectively capture up to 100% of the carbon dioxide (CO_2) emissions produced from industrial processes and the use of fossil fuels in electricity generation and industrial heating, 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.

Action 126 from Climate Action Plan 2021 targets the establishment of a framework for analysis of the potential for CCS deployment for Ireland. Gas Networks Ireland will continue to monitor ongoing activity in relation to CCS in Ireland, including work stemming from Climate Action Plan 2021 and studies presently ongoing in assessing the feasibility of CCS as a solution to carbon emission abatement in Ireland, and will incorporate the outcomes into potential future decarbonisation pathways as appropriate.

3.2.4 Readiness of the gas network for transport of hydrogen

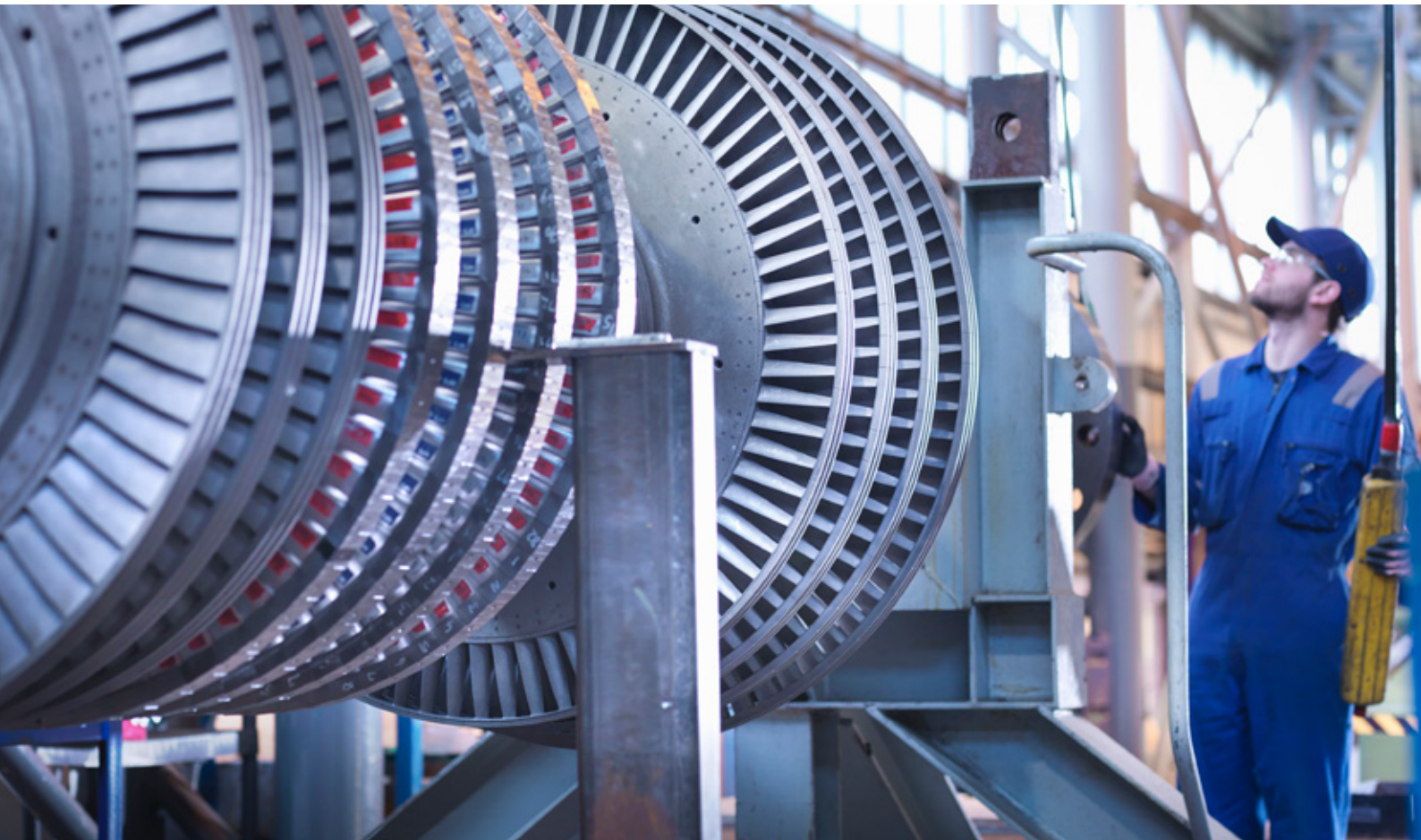
For over 40 years, Gas Networks Ireland has safely transported natural gas through Ireland's national gas network. Gas Networks Ireland is committed to delivering a net-zero emissions network by 2050, a crucial element in delivering on the wider long-term decarbonisation challenge for Ireland.

As part of this commitment, work has commenced to ensure the gas network will be ready to support the transport of hydrogen, as soon as volumes become available.

3.0 The role of the gas network in decarbonising Ireland's energy system (continued)

Gas Networks Ireland has developed a Network Innovation Centre at the Brownsbarn AGI site in Dublin with funding from the Gas Innovation Fund. This facility is independent of the gas network and will use blends of natural gas and hydrogen for the purposes of assessing the compatibility of hydrogen with elements of the distribution network and gas appliances used in Ireland. Working in conjunction with University College Dublin, a wide range of tests are planned to gain a better understanding of natural gas/hydrogen blends. The facility will be able to begin the process of evaluating aspects of the network that are particular to Ireland and will also provide an opportunity for Gas Networks Ireland staff and stakeholders to gain experience of hydrogen blends. This begins the process of ensuring that Ireland's existing gas infrastructure is capable of safely transporting and storing hydrogen.

Gas Networks Ireland is active in a number of European gas organisations that are assessing the readiness of existing gas networks to carry hydrogen and blends of natural gas and hydrogen. There is increasing confidence in the ability of the polyethylene distribution networks to carry up to 100% hydrogen. The polyethylene material itself is compatible and experience is being gained through demonstration projects on new and existing networks. Work on assessing the compatibility of steel transmission pipelines is ongoing and there is progress in identifying the challenges and mitigations associated with transporting hydrogen. Gas Networks Ireland is a member of the Advisory Board of the EU funded HIGGS project (Hydrogen in Gas Grids) which aims to analyse the requirements of existing gas infrastructure and components to facilitate the injection of hydrogen into the high-



pressure natural gas network. A testing facility has been constructed in Aragon, Spain as part of this project. The evaluation of the suitability of the gas network in Ireland will be a major focus for Gas Networks Ireland in the coming years to establish the suitability of safely transporting hydrogen and blends of hydrogen.

Gas Networks Ireland is also actively supporting the work of the Gas Technical Standards Committee (GTSC) of the National Standards Authority of Ireland (NSAI) to develop Irish and European Gas infrastructure standards for hydrogen and hydrogen blends on existing natural gas networks. The European standards body CEN is currently undertaking a programme of pre-normative research to support this work and NSAI has established a Hydrogen Coordination Committee under the GTSC to ensure full engagement by Ireland with the programme.

Gas Networks Ireland maintains links with a number of Ireland's leading academic institutions which are conducting research into the potential role of hydrogen in Ireland. UCD Energy Institute and Gas Networks Ireland are undertaking a joint project to test and demonstrate the safe operation of natural gas appliances and aspects of the distribution gas network using blends of hydrogen. This work is being undertaken at the Network Innovation Centre, which Gas Networks Ireland has established in Citywest, Dublin. Under Science Foundation Ireland's Industry RD&I Fellowship Programme Dr Ali Ekhtiari, UCD Energy Institute, has partnered with Gas Networks Ireland, on a project examining *End-User Considerations in the Transition to a Green Gas Network*.

Gas Networks Ireland is participating in project HyLIGHT a 3-year project funded by Science Foundation Ireland (SFI) and an industry consortium through MaREI the SFI Research Centre for Energy, Climate and Marine, University College Cork (UCC), Dublin City University (DCU) and University of Galway. The overall aim of HyLIGHT is to provide the knowledge, data and the necessary tools to guide the cost-effective decarbonisation and roadmaps for sustainable large-scale implementation of hydrogen technologies in Ireland to enable sector integration for a zero-carbon, secure, resilient energy system.
Next Generation Energy Systems (NexSys) is an all-island, multidisciplinary energy research programme. NexSys is hosted by the UCD Energy Institute in partnership with eight other leading research institutions: ESRI, DCU, Queen's University Belfast, University of Galway, Maynooth University, Trinity College Dublin, UCC, and Ulster University. Gas Networks Ireland is a co-funding industry partner, supporting and working with NexSys. By 2027, NexSys will have identified credible and accelerated pathways for a net zero energy system, and have developed technologies and talent needed for the energy transition.

Gas Networks Ireland are undertaking a joint research project with Ulster University in relation to *Pre normative research on the safety of gas networks with hydrogen blends*. The project will collaborate with the European Gas Research Group (GERG) to undertake research on safety aspects of the transportation of hydrogen blends on the gas transmission and distribution network with the aim of developing innovative preventive and mitigation strategies.

Renewable electricity developers are engaging with Gas Networks Ireland, exploring the potential for hydrogen production and this has resulted in several connection enquiries being submitted and responded to, and several formal connection enquiries in progress. This provides an early indication of the level of interest there may be from renewable developers to enter a new green hydrogen production market. Gas Networks Ireland has started looking into the

3.0 The role of the gas network in decarbonising Ireland's energy system (continued)

implications of hydrogen producers connecting to the network, raising questions such as where the appropriate locations for connection are, and what storage would be required to ensure both gas quality and the available quantity can be maintained for customers. Further engagement with prospective producers will also result in the development of the technical requirements and identifying the costs associated with hydrogen injection.

A key step in achieving hydrogen readiness is the development of a hydrogen safety case that meets the requirements of all applicable standards, regulatory requirements and national policy. Gas Networks Ireland is currently developing a detailed hydrogen technical and safety strategy which will ultimately provide a road map for the business to transition to hydrogen. This will acknowledge the technical challenges, assess the impact and propose an implementation process for delivery of the technical strategy. The development of the technical strategy will include a high-level impact assessment which identifies the key risks associated with the transition to hydrogen and will be key in providing clear evidence that the transition will be managed to a risk level that is as low as reasonably practicable. The technical strategy will complement existing Gas Networks Ireland knowledge, experience and hydrogen initiatives, some of which are outlined above.

Gas Networks Ireland continues to monitor hydrogen developments in other jurisdictions. Notably in the UK, where future developments may determine the potential availability of hydrogen at the Moffat Entry Point. The Acorn Hydrogen Project[11] is a hydrogen production facility being developed at St Fergus, Scotland. The UK Hydrogen Strategy[12] targets development of 'archetypes' of a hydrogen economy through the 2020s, culminating in an ambition for 5 GW of low carbon hydrogen production capacity by 2030.

Gas Networks Ireland is also a member of the European Hydrogen Backbone (EHB) initiative which consists of a group of thirty-one energy infrastructure operators, united through a shared vision of a climate-neutral Europe enabled by a thriving renewable and low-carbon hydrogen market.

The EHB initiative aims to accelerate Europe's decarbonisation journey by defining the critical role of hydrogen infrastructure – based on existing and new pipelines – in enabling the development of a competitive, liquid, pan-European renewable and low-carbon hydrogen market.

The initiative has developed detailed hydrogen pipeline network maps envisaging how Ireland could be connected to the wider European hydrogen backbone by 2040.

"A key step in achieving hydrogen readiness is the development of a hydrogen safety case that meets the requirements of all applicable standards, regulatory requirements and national policy. "

11 https://theacornproject.uk/wp-content/uploads/2020/05/Hydrogen-Coast-DIGITAL.pdf
12 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1011283/UK-Hydrogen-Strategy_web.pdf

4.0

Historic demand & supply

Key messages:

Annual ROI gas demands for 2021/22[13] are anticipated to be 0.5% below 2020/21 demand levels. Demand in the Industrial & Commercial sector and Residential sector are anticipated to decrease while demand in the Power Generation sector is anticipated to increase.

The reduction in gas demand can be attributed to increases in the wholesale and retail price of gas as a result of the invasion of Ukraine by Russia. Gas Networks Ireland continues to monitor the situation and its potential impact on gas supply and demand in Ireland.

In 2021, 28.5% of Ireland's gas demand was supplied from indigenous sources. The balance of supply (71.5%) came through the subsea interconnectors via the Moffat Entry Point in Scotland.

13 Actual consumption up to and including the month of August, estimation for September

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.

4.1 ROI annual primary energy requirement

The Sustainable Energy Authority of Ireland (SEAI) reported that Ireland's Total Primary Energy Requirement (TPER) for 2020 fell by 8.7% compared to 2019. The key driver of this decrease was the COVID-19-related restrictions which were in place from March 2020 through to the end of 2020.

Despite a 5% fall in the share of TPER vs. 2019, oil contributed to the highest proportion of the 2020 TPER, accounting for 45% of total energy demands, as shown in Figure 4-1. Gas accounted for 34.1% of 2020 energy demands, an increase of 2.8% vs. 2019, reflecting its role in electricity generation, industrial processes and heating requirements. Renewable energy sources accounted for 13.3% of TPER in 2020, increasing by 2.1% vs. 2019.

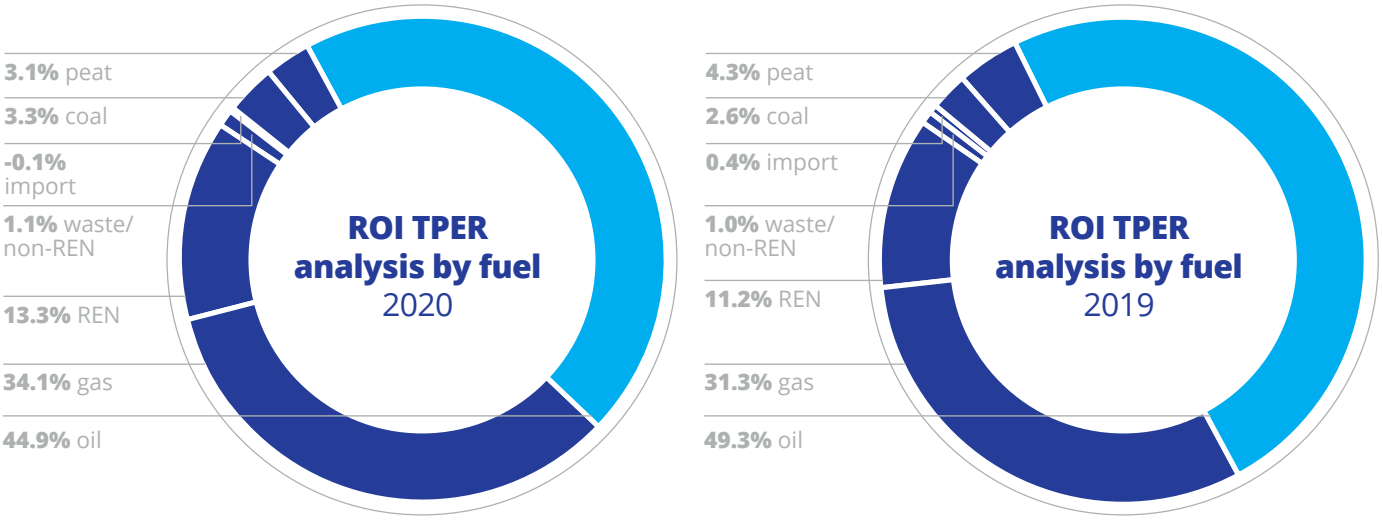
4.2 Historic annual gas demand

This section refers to both Gas Networks Ireland System 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 2021/22 are anticipated to be just 0.5% below 2020/21 demands. ROI gas demand for 2020/21 was 4% lower than 2019/2020; this was due to some large gas-fired generators being on outage in the summer of 2020/21. This is in contrast with previous years' increases in ROI gas demand of 1.5% in 2019/20 compared to 2018/19 and 2% in 2018/19 compared to 2017/18, as shown in Figure 4-2.

In the Power Generation sector, gas demand for 2021/22 is projected to show an increase of 5.5% compared to 2020/21. This is in contrast with the 7% decrease in gas demand observed

Figure 4-1: ROI TPER analysis by fuel (2020 & 2019)



4.0 Historic demand and supply
(continued)

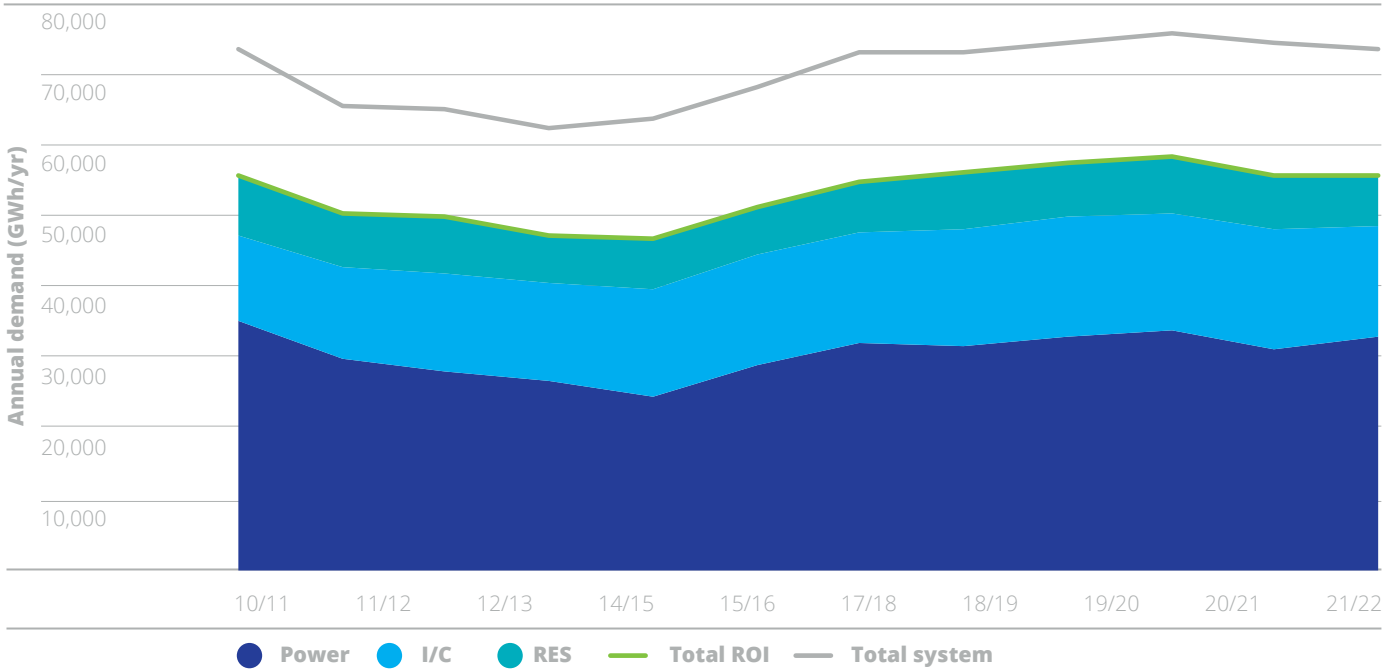
for power generation in 2020/21 compared to 2019/20, which was as a result of several gas-fired generator outages in the summer of 2020/21. Gas demand for power generation increased by 2% between 2019/20 and 2019/18 and, over the longer-term, Power Generation sector gas demand has increased by 34% when compared to 2014/15. The increase in power sector gas demands in this period, despite growth in wind capacity, can be attributed to increasing electricity demand, the closure of peat-fired generators, sustained outages at some other thermal plants (i.e. coal and oil) and the flexible nature of gas-fired generation. Following the introduction of updates to the wholesale electricity market in October 2018, electrical interconnector behaviour has generally been efficient in that the interconnectors are mainly importing to Ireland when Irish electricity prices are higher than GB markets, and exporting at times of high wind when Irish electricity prices are lower than in GB.

The Industrial & Commercial sector annual gas demand for 2021/22 is anticipated to be up to 7.6% lower than 2020/21.

Within the Industrial and Commercial sector, Daily Metered (DM)[14] demand is projected to decrease by 6% in 2021/22, while the Non-Daily Metered[15] (NDM) portion of Industrial and Commercial demand is anticipated to decrease by 8.5%. It is worth noting that the NDM sector is heavily influenced by weather and that this figure isn't weather-corrected.

Residential demand is projected to decrease by 13% for 2021/22. As of end-June 2022, Composite Weather Variable and Degree Day are 6.5% and 13% lower respectively year-on-year (October to June inclusive), which correlates with the fact that Residential demand for these months was 11% lower than the same period in 2020/21.

Figure 4-2: Historic annual gas demand



14 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

15 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.

Transport sector gas demand is projected to increase slightly (5%) in 2021/22, as the roll-out of a nationwide CNG fuelling network continues.

Total Gas Networks Ireland annual system gas demand for 2021/22 is anticipated to decrease by 1.6% compared to the previous year's gas demand. As noted in Section 4.2, ROI gas demand is projected to fall slightly by 0.5% in 2021/22 compared to the previous year. NI and IOM gas demand is anticipated to decrease by 5.6% against 2020/21. The historic gas demand is presented in Figure 4-2. The overall throughput for ROI in 2021/22 is projected to be 55,900 GWh or approximately 5.09 bcm.

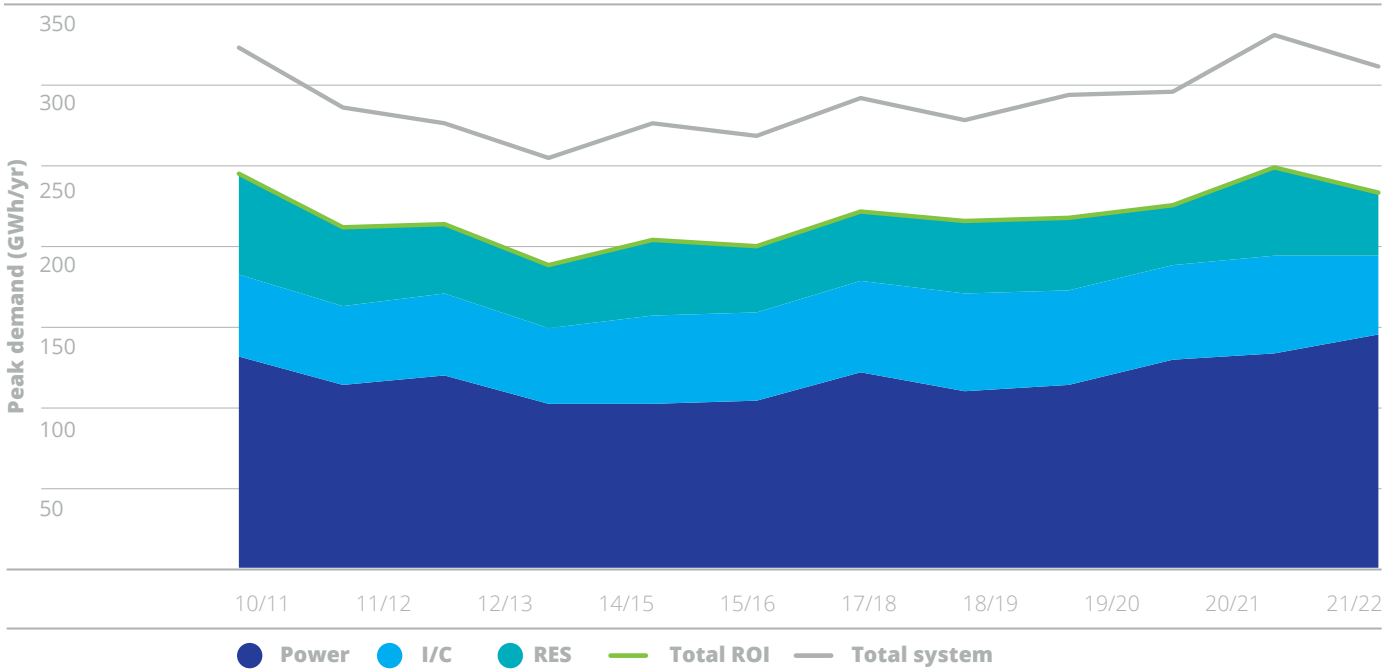
4.3 Historic peak day gas demand

The ROI peak day gas demand for 2021/22 was 233.5 GWh/d, which occurred on 24th January 2022 and is 6% lower than the 2020/21 peak day gas demand. The peak day gas demand for Power Generation also occurred on this day, which was driven by lower than average wind speeds and because ROI was a net exporter of electricity to GB on this day.

Gas demand in the Power Generation sector, which represented 62% of the total gas demand on the peak day, increased by 7.7% in comparison to the 2020/21 peak day.

Gas demand in the residential sector, representing 16.7% of total peak day demand, decreased by 29% for the 2021/22 peak day vs. the previous year. Similarly, Industrial and Commercial demand on the peak day (representing 24% of total peak day demand) decreased by 16% in 2021/22, driven primarily by the decrease in NDM I/C demand of 27%. These differences are as a result of warmer temperatures on the 2021/22 peak day vs. 2020/21.

Figure 4-3: Historic peak day gas demand



4.0 Historic demand and supply
(continued)

Gas-fired power generation accounted for 59% of the Single Electricity Market fuel mix on the 2021/22 ROI peak day, while wind generation accounted for c. 16%. Electricity interconnectors operated as net exporters of electricity to GB, which when combined with high electricity demand in ROI, drove very high demand for gas-fired power generation.

The peak day demand in the NDM sector occurred on the 7th January 2022, with gas demand reaching 69.9 GWh/d. This is 16% lower than the corresponding NDM peak day in 2020/21, the difference being related to differing weather and temperature conditions.

The Gas Networks Ireland system 2021/22 peak day gas demand was 6% lower than the 2020/21 peak while the NI and IOM combined peak day gas demand were also lower, by 3.5% and 8.5% respectively compared to 2020/21.

4.4 Ireland's weather

Based on a Degree Day (DD) comparison, the most recent winter (October 2021 to March 2022) was approximately 8.5% warmer than the previous year. Relative to the long run degree day average, winter 2021/22 was approximately 7% warmer.

The coldest day in winter 2021/22, occurred on the 4th January, with an average temperature of 1.75°C, or a 13.75 DD. The corresponding coldest day in 2020/21 occurred on the 9th January with an average temperature of -1.35°C, or a 16.85 DD.

Gas demand on 4th January 2022 was not the peak gas demand day for winter 2021/22 as wind generation accounted for 38% of the SEM fuel mix on this day, displacing gas-fired generation. The average temperature on the 24th January 2022, i.e. the peak day for winter 2021/22, was 4.5°C or 11 DD.

4.5 Wind powered generation

The installed all-island wind generation capacity increased by 2% in 2021 from the previous year[16]. Wind powered generation output fell by 14.8% in 2021 compared to 2020, suggesting that wind generation load factors decreased in 2021 compared to the previous year.

On the peak day for wind generation in winter 2021/22, daily wind powered generation accounted for up to 77% of ROI daily electricity demand (26th November 2021). Wind accounted for only 1% of demand on the minimum day for wind generation (29th August 2022). On the 2021/22 peak day for gas demand (24th January 2022) wind accounted for c. 20% of all-island electricity generation.

4.6 Electricity interconnectors

There are two electrical interconnectors between the UK mainland and 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)[17] and its UK equivalent, BETTA (British Electricity Trading and Transmission Arrangements) resulted in a predominantly GB-IE flow on the EWIC, i.e. import of electricity from GB. Following this, the carbon price floor in GB was raised to £18 per ton CO_2 in April 2015 and this relationship, along with changing fuel price dynamics and tightening capacity margins in the UK, contributed to reversing the balance of electricity flows on the interconnectors, in favour of IE-GB exports.

Following the upgrade of the Single Electricity Market (SEM) via the Integrated Single Electricity Market (I-SEM) project in October 2018, electrical

16 System and Renewable Data Summary Report – EirGrid
17 The Single Electricity Market (SEM) is the wholesale electricity market operating in the Republic of Ireland and Northern Ireland.

interconnector behaviour has generally been efficient in that the interconnectors are generally importing to Ireland when SEM prices are higher than GB markets, and exporting at times of high wind when prices in the SEM are lower than in GB[18].

Carbon prices on the European Emission Trading Scheme (EU ETS) continue to rise in line with various projections[19].

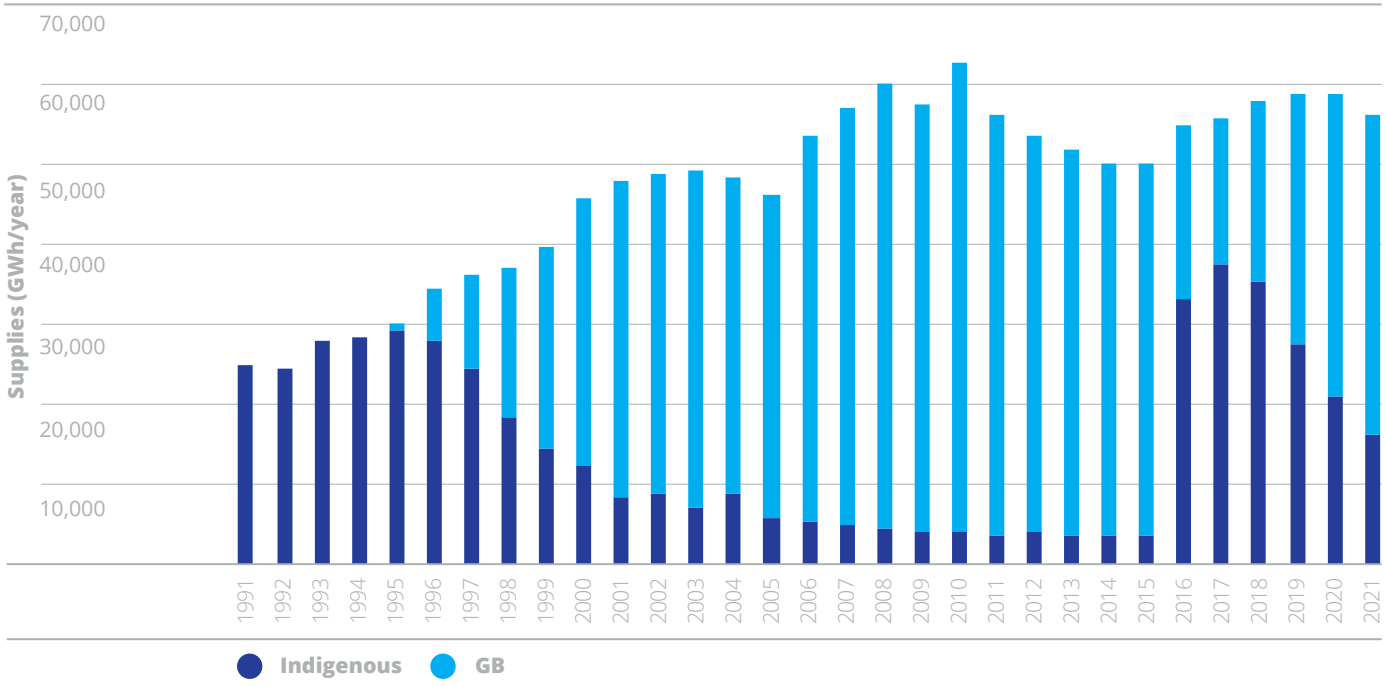
Following the withdrawal of the UK from the European Union, a UK Emissions Trading Scheme (UK ETS) replaced the UK's participation in the EU ETS on 1st January 2021. Similar to the EU ETS, the scheme applies to energy intensive industries, the Power Generation sector and Aviation. The first UK ETS auction was held on 19th May 2021; to date the UK ETS price has generally tracked the EU ETS price. It has been proposed that the UK ETS and EU ETS markets be linked in the future but a definitive plan for this link has yet to be announced.

There are several proposed electrical interconnector projects at various stages of development that are seeking to connect to the Ireland and Northern Ireland transmission networks. These include the Greenlink Interconnector, linking Ireland and Wales' electricity networks, which is currently projected to be commissioned in 2024, and the Celtic Interconnector, linking France's electricity network to Ireland, with a projected commissioning date in 2026.

4.7 Historic gas supply

In 2021 28.5% of Ireland's gas demand was supplied from indigenous sources (Corrib and small volumes of Biomethane). The balance of supply (71.5%) came through the subsea interconnectors via the Moffat Entry Point in Scotland.

Figure 4-5: Historic Annual Indigenous gas production and Great Britain (GB) imports



18 SEM committee Single Electricity Market Performance Quarterly Reports, available at https://www.semcommittee.com/publications

19 Gas Networks Ireland uses forecasts of carbon pricing from the International Energy Agency's World Energy Outlook.

5.0

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 and Commercial, Residential and Transport sectors.

In the Best Estimate demand scenario annual ROI gas demand is expected to decrease by 12% between 2021/22[20] and 2030/31.

The 1-in-50 ROI peak day forecast is expected to reach its highest point across the GFS horizon in 2024/25, which equates to 31% growth between 2021/22 and 2024/25. The peak day forecast is projected to grow by 17% between 2021/22 and 2030/31.

National policy targets a 70% renewable energy share in electricity generation (RES-E), such as from wind and solar, by 2030. While annual gas demand in the medium to long-term will be inversely related to the delivered level of RES-E on the Single Electricity Market, peak day gas demand will not be as significantly impacted as gas-fired power generation will be required to meet almost all of Ireland's electricity requirements on days of low wind. While electricity interconnectors may operate in the net import direction on such days, equally they may operate as net exporters of electricity on such high demand / low wind days. This will depend on the wider electricity market dynamics.

20 12 month forecast for 2021/22

This section presents an overview of the gas demand outlook for the period 2021/22 to 2030/31. The GFS forecasts future gas demands by examining the development of individual Power, Industrial & Commercial, Residential and Transport sector gas demands[21].

5.1 Gas demands

The demand forecasts presented in this section 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.

5.2 Gas demand forecasting

The demand forecast modelling methodology used in producing the GFS generates a ten-year forecast for the Power Generation, Industrial & Commercial, Residential & Transport sectors, based on a series of assumptions[22] which affect demand for each of these sectors. The primary forecasting inputs by sector are summarised in Figure 5-1.

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

Figure 5-1: Key demand forecasting assumptions

Power generation	Electricity demand	Available generation capacity	Energy/fuel prices
Industrial and commercial	Gross domestic product	New connections	Energy efficiency
Residential	Annual quantity	New connections	Energy efficiency
Transport	Fast fill stations	Heavy goods vehicles and buses	Usage profiles

21 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/docs/corporate/company/Gas-Forecasting-Methodology-Report.pdf

22 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.

5.0 Gas demand forecasts
(continued)

Table 5-1: 1-in-50 peak day forecasting assumptions

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

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.

5.3 Gas demand scenarios

In order to provide a comprehensive analysis Gas Networks Ireland has developed three gas demand scenarios for the period 2021/22 to 2030/31, 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 5-2: Gas demand scenarios overview[21]

Low demand	Best estimate	High demand
EirGrid's low electricity demand scenario	EirGrid's median demand scenario	EirGrid's high demand scenario
Emergency generation	Emergency generation	Emergency generation
New gas generation beyond T-3/T-4	New gas generation beyond T-3/T-4	New gas generation beyond T-3/T-4
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.	Blended short term GDP projections plus ESRI's economic outlook.
CAP 2021 targets	CAP 2021 targets	CAP 2021 targets
+ New connections low	**+ New connections best estimate**	**+ New connections high**
CNG low	**CNG best estimate**	**CNG high**

23 Bloomberg futures fuel pricing

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.

5.4 Demand forecast assumptions

This section presents an overview of the assumptions made for the gas demand outlook for the period 2021/22 to 2030/31.

5.4.1 Power generation sector

The Irish gas and electricity sectors are highly interdependent. Gas is a critical component of Ireland's electricity generation, producing 45.8%[24] of the country's annual electricity requirement in 2021. Gas-fired generators are the largest customer sector in the gas market, accounting for approximately 56% of the total ROI demand in 2021.

The following summarises the main assumptions regarding the changes in the SEM generation portfolio, as per the EirGrid / SONI All-Island Generation Capacity Statement (GCS) 2022-2031[25]:

- EirGrid has assumed the Moneypoint coal/HFO-fired power plant will not be available from October 2024 as none of the three generator units qualified for the 2024/2025 T-4 Capacity Auction. This follows the European Union Clean Energy Package decision to exclude generation emitting more than 550g/kWh from capacity markets such as the SEM. However, given current security of supply concerns as regards natural gas, and due to the deficit identified in EirGrid's adequacy assessment of the SEM, it is possible that the Moneypoint generators will remain available beyond 2024. Furthermore, the ESB has not provided a closure notice for these units. Therefore, Gas Networks Ireland has assumed that the Moneypoint units are still available in the Low and Best Estimate Gas Networks Ireland scenarios until 2027. On the other hand, in the High scenario, the three Moneypoint units retire as planned in 2024;
- The Kilroot[26] coal/HFO-fired power plant is assumed to close by the end of 2023 due to emissions restrictions resulting from the Industrial Emissions Directive (IED);
- Similar to the case of the Moneypoint units above, EirGrid assume that all Tarbert HFO-fired units (TB1, TB2, TB3, and TB4) and a gas-fired OCGT at Aghada (AT1) will close by the end of 2023. Three of the four Tarbert units (TB1, TB2 and TB4) are on extended forced outages in 2022 and Gas Networks Ireland assumes that they will close as scheduled. For security of supply and generation adequacy reasons, Gas Networks Ireland have taken the approach of keeping TB3 available beyond 2023 in its Low and Best Estimate Gas Networks Ireland scenarios. As regards AT1, this unit remains available in the Best Estimate Gas Networks Ireland and High scenarios;
- The peat and biomass co-firing plant at Edenderry has been granted an extension to their planning permission, allowing the plant to continue operation until 2030. The Edenderry plant will cease burning peat entirely by 2024 and will operate exclusively on biomass out to 2030. On this basis, Gas Networks Ireland assumes that Edenderry will be available in all GFS scenarios;
- In EirGrid's GCS, it is assumed that the new North-South interconnector is commissioned by the end of 2025 and is fully operational from 2026 onwards. Hence, Gas Networks

24 System and Renewable Data Summary Report – EirGrid
25 Refer to EirGrid All Island Generation Capacity Statement 2022-2031: https://www.eirgridgroup.com/site-files/library/EirGrid/EirGrid_SONI_Ireland_Capacity_Outlook_2022-2031.pdf
26 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

5.0 Gas demand forecasts
(continued)

Ireland have assumed that the North-South Interconnector is operational from 2026 in all but the High scenario where it is assumed that the commissioning of the interconnector is delayed by two years, resulting in the North-South Interconnector becoming fully operational in 2028;

- There are several proposed electrical interconnector projects involving Ireland, including the Greenlink Interconnector with GB and the Celtic Interconnector with France. In EirGrid's GCS, both Greenlink and Celtic interconnectors are assumed to be commissioned and fully operational by end-2024 and 2027 respectively. Hence, Gas Networks Ireland include the Greenlink interconnector on-time in all GFS scenarios and Celtic interconnector in all scenarios, on-time in the Low scenario and delayed by two years in both the Best Estimate and High scenarios, resulting in an operational start date of 2029;
- Gas Networks Ireland has included in its scenarios new entrant generators which were successful in the T-3 2024/2025 and T-4 2025/2026 capacity auctions run by EirGrid.[27] Due to the large volume of new entrants and the associated complexity in delivering this capacity to the electricity system, Gas Networks Ireland has engaged with EirGrid and individual gas generation developers in order to develop a timeline for delivery of the awarded capacity. In all three GFS scenarios, the contracted T-3 and T-4 capacity is anticipated to be delivered by the corresponding 18-month long stop date as defined in the Capacity Market Code;
- Gas Networks Ireland has also included a level of temporary emergency generation currently being procured as described in the CRU Electricity Security of Supply Programme of Work Update[28], comprising both gas turbines and distillate-fired engines, whose availability in the short- to medium-term will seek to address the shortfall in capacity identified in recent capacity assessments until additional capacity may be procured in the forthcoming T-4 2026/27 capacity auction; and
- To reflect the level of connection enquiries received by Gas Network Ireland in the Power Generation sector, and to meet the system adequacy shortfall as outlined in the 2021 EirGrid GCS Adequacy Analysis[29], further generation capacity in the form of a 450MW Open Cycle Gas Turbines (OCGTs) has been assumed to be in place from 2028 onwards in all GFS scenarios. The start date for this new gas-fired capacity reflects the projected end dates for the emergency generation previously mentioned.

The Irish Government's updated Climate Action Plan 2021 has set an ambitious target to achieve up to 80% RES-E by 2030. EirGrid have outlined in their GCS that their assumed build-out rate of renewables is compatible with a 70% RES-E target and that the more ambitious 80% target identified in the Climate Action Plan will be adopted in the next iteration of their Shaping Our Electricity Future (SOEF) v1.1 publication, due at the end of 2022. As a result, Gas Networks Ireland target a 70% RES-E target for 2030 in both Best Estimate and High scenarios of this GFS. To reflect the more ambitious 80% RES-E target, Gas Networks Ireland has incorporated additional measures to reach this target in the Low gas demand scenario, on the basis that increasing renewable generation will displace gas-fired generation. In contrast, in the High demand scenario, the actual 70% RES-E

27 As noted by EirGrid in its GCS, following certain capacity auctions, a number of awarded contracts have been terminated and are not progressing, and as such have been removed from the EirGrid studies. The associated new entrant generators have been excluded from the GFS base case scenarios also.
28 https://www.cru.ie/wp-content/uploads/2022/06/CRU202264-Electricity-Security-of-Supply-Programme-of-Work-Update.pdf
29 The adequacy analysis from the EirGrid/SONI GCS 2022-2031 was not yet published, or shared with Gas Networks Ireland in a draft format, at the time of writing and the analysis from the EirGrid/SONI GCS 2021-2030 has been used when estimating the expected electricity generation capacity shortfall

target is limited by the EirGrid Operational Policy Roadmap 2022-2023 but includes the same level of renewable generation build-out as the Low and Best Estimate scenarios. Onshore and Offshore Wind installed capacities are projected to increase to 5.85GW and 7.14GW respectively by end 2031.

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. locational constraint requiring a minimum number of generators in the Dublin area being on-load simultaneously).

- Technical parameters for generation plant have been modelled per Commission for Regulation of Utilities (CRU) published values[30]. Where technical parameters were unavailable for new generator entrants, Gas Network's Ireland used information made available directly from the plant developers and/or CRU published values for similar type and size plants
- Existing interconnectors have also been modelled per CRU published values, but with the added inclusion of the North-South tie-line between ROI and NI.
- Technical operational constraints on the EirGrid system have been modelled per the existing EirGrid operational constraints[31].

In order to achieve either a 70% or 80% RES-E target by 2030, it is recognised that in addition to the installed wind capacity development rates assumed in the GFS scenarios, additional measures will be required to address existing technical constraints on the power system. In order to facilitate the capacity buildout profiles of renewable generation and achieve the 70% RES-E target by 2030 (in particular in order to reduce the ensuing wind curtailment rates), EirGrid outline the measures they intend to undertake in their 2021 Shaping Our Electricity Future and EirGrid Operational Policy Roadmap 2022-2023 publications. These measures include:

30 Commissioned by the CRU and UREGas Networks Ireland, an update and validated model of the SEM has been produced and published by Economic Consulting Associates (ECA): https://www.semcommittee.com/publications/sem-19-044-sem-plexos-validation-2019-2025-information-note
31 https://www.sem-o.com/publications/general-publications/

5.0 Gas demand forecasts
(continued)

- Reduction or elimination of technical operational constraints on the transmission system;
- Reduction of thermal generator minimum-generation thresholds and the minimum inertia limit, in order to create sufficient headroom for renewable generation on days of high wind;
- Increasing the System Non-Synchronous Penetration (SNSP) level from existing 75% to 95% from 2030 in order to allow more penetration of non-synchronous resources (wind and solar) instantaneously that would otherwise need to be curtailed; and
- 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 measures have all been incorporated into the GFS scenarios in varying degrees in order to meet the different RES-E targets for 2030.

The outlook to 2030/31 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 dispatch.
- Peat fired capacity has fallen significantly since the end of 2020 due to the closures of West Offaly and Lough Ree power stations. Edenderry peat fired power station remains high in the merit order due to priority dispatch associated with the co-firing of biomass at the plant.
- It is expected that net interconnector flows for ROI will be relatively neutral for the first three years of the GFS horizon in all three scenarios. During this time, it is anticipated that EWIC will continue to export to GB and that the North-South tie-line will also continue to facilitate imports from NI. With the expansion of the North-South tie-line in 2026, the commissioning of two gas-fired CCGTs in Kilroot and with the forecast increase in electricity demand, it is anticipated that imports to ROI will increase considerably in the second half of the GFS horizon in all three demand scenarios such that ROI is strongly net importing in this period. This net import position will continue with the commissioning of the Celtic interconnector in 2027 in the Low scenario and in 2029 in the Best Estimate and High scenarios. Finally, with the exponential increase in the projected levels of offshore wind deployment in the final two years of the GFS horizon, ROI moves to being a net exporter of electricity in the Low scenario while in both the Best Estimate and High scenarios ROI is anticipated to have a neutral import/export position.
- Coal, heavy fuel oil (HFO) and gas prices have continued to increase in 2021/22; the cost of both coal- and HFO-fired generation vs. gas-fired generation during this period has promoted coal and HFO to a higher position relative to previous years, despite an increase in carbon prices. This trend is anticipated to continue over the short-term, however the split in gas and coal/HFO prices is expected to narrow in the medium-term.
- Gas fired plant is anticipated to meet the balance of electricity demand.

Figure 5-3 illustrates the anticipated level of generation by fuel for thermal plant in the SEM, based on the EirGrid / SONI All-Island Generation Capacity Statement 2022-2031. This is based on thermal plant capacities given for 2022 with anticipated commissioning/ decommissioning dates as set out in the GCS and discussions with CRU on Security of Supply.

The EirGrid / SONI low, median and high electricity demand scenarios are illustrated in Figure 5-4. 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.

Figure 5-3: Forecast Single Electricity Market (SEM) thermal generation mix and interconnection capacity

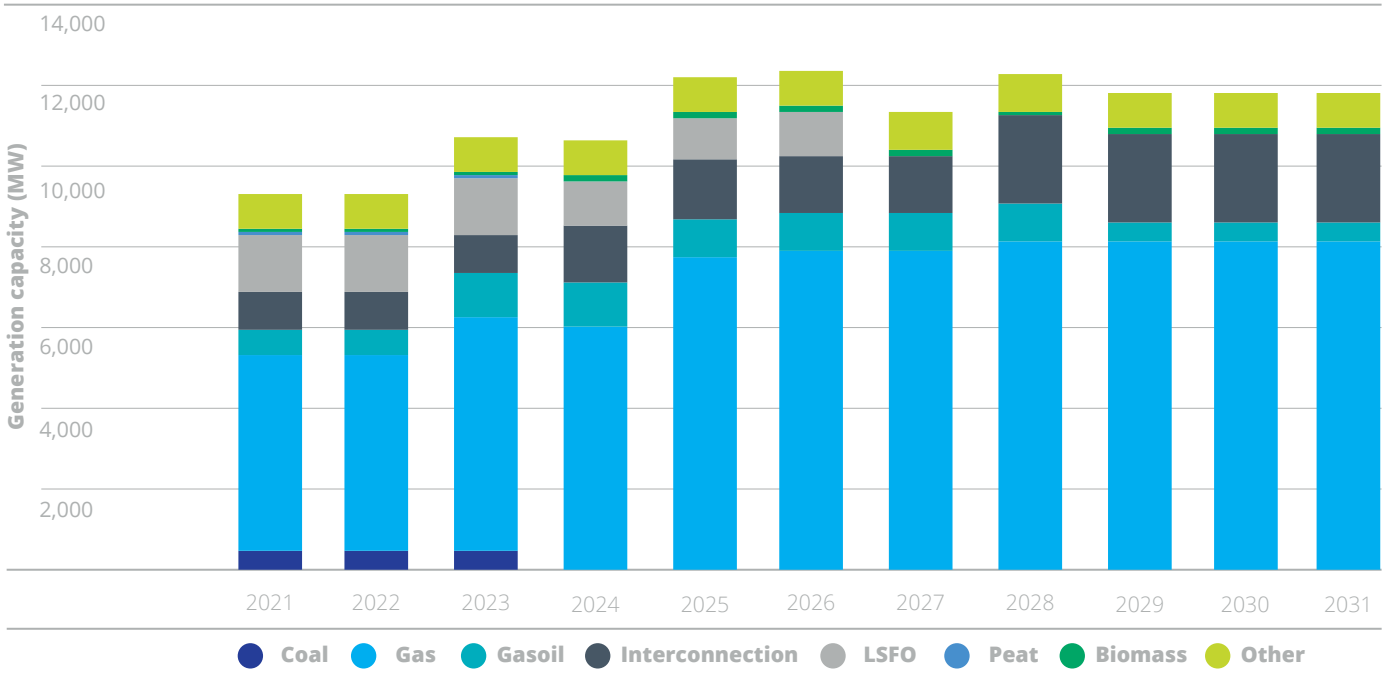
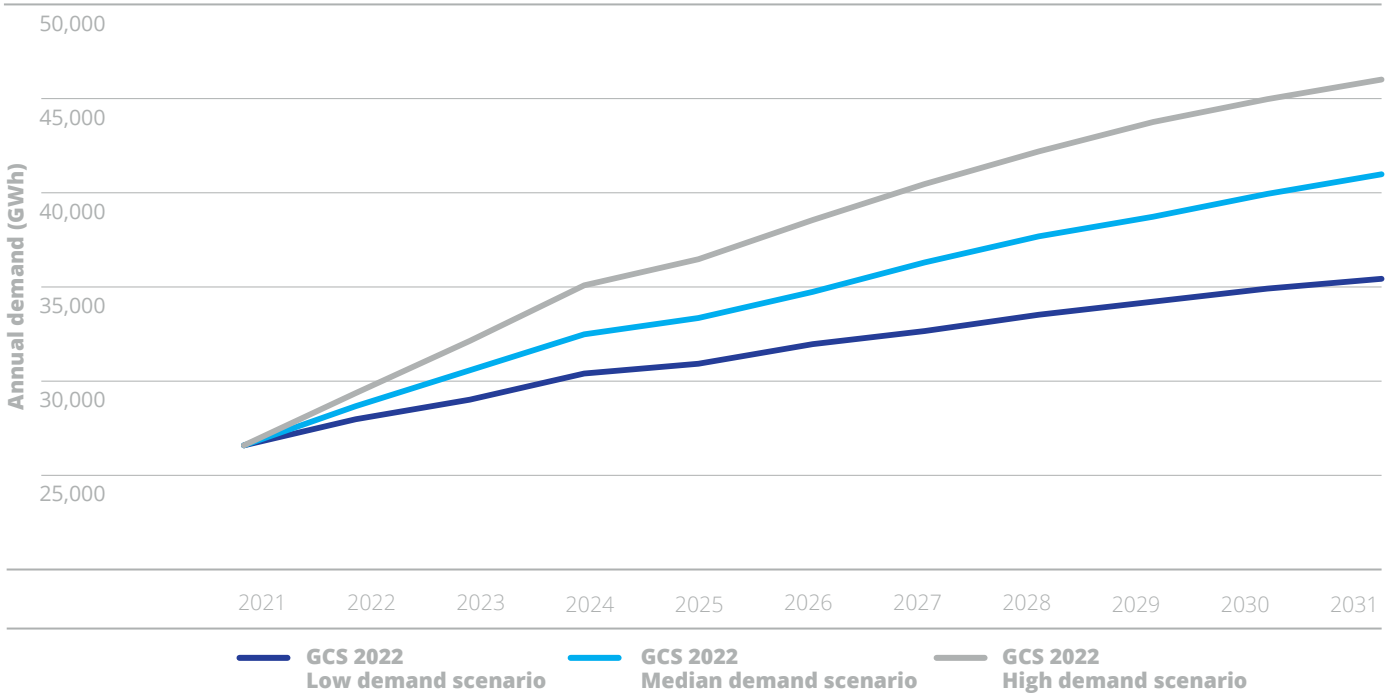


Figure 5-4: Electricity demand forecasts for ROI



5.0 Gas demand forecasts
(continued)

The peak day electricity demand assumption for the average winter peak day projection is taken directly from the EirGrid / SONI All-Island Generation Capacity Statement (GCS) 2022-2031. For the 1-in-50 severe winter peak day projection, a calculated 1-in-50 year electricity demand is used, which considers the actual '1-in-50' electricity peak of 5,090 MW, which occurred in 2010, the intervening peak day electricity growth rates, and the projected peak day electricity growth rates. This results in a factor being calculated, which when applied to the average winter peak day projection, gives a forecasted 1-in-50 peak electricity demand.

5.4.2 Industrial and commercial sector

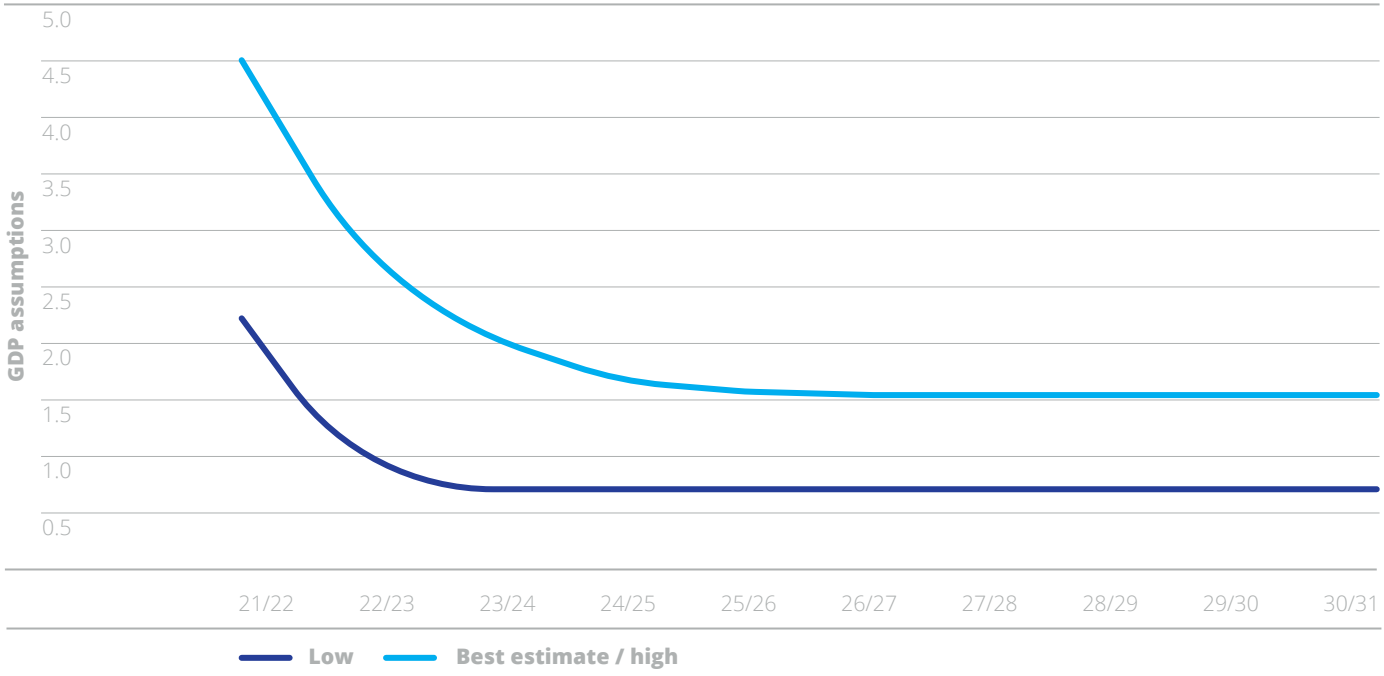
Industrial & Commercial sector gas demand is assumed to continue to increase in line with anticipated new connection numbers and in proportion with Gross Domestic Product (GDP)[32]. Figure 5-5 presents the GDP growth rate assumptions over the forecast period.

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

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 and the IMF's Article IV Consultation with Ireland[33] in July 2022.

The Data Centre market continues to grow, and new demands cannot be met by the current electricity grid, leading to some Data Centres taking the decision to generate electricity on-site themselves, using natural gas to complement flexible electrical connections to the electrical grid. Based on a recent Commission for

Figure 5-5: GDP growth assumptions



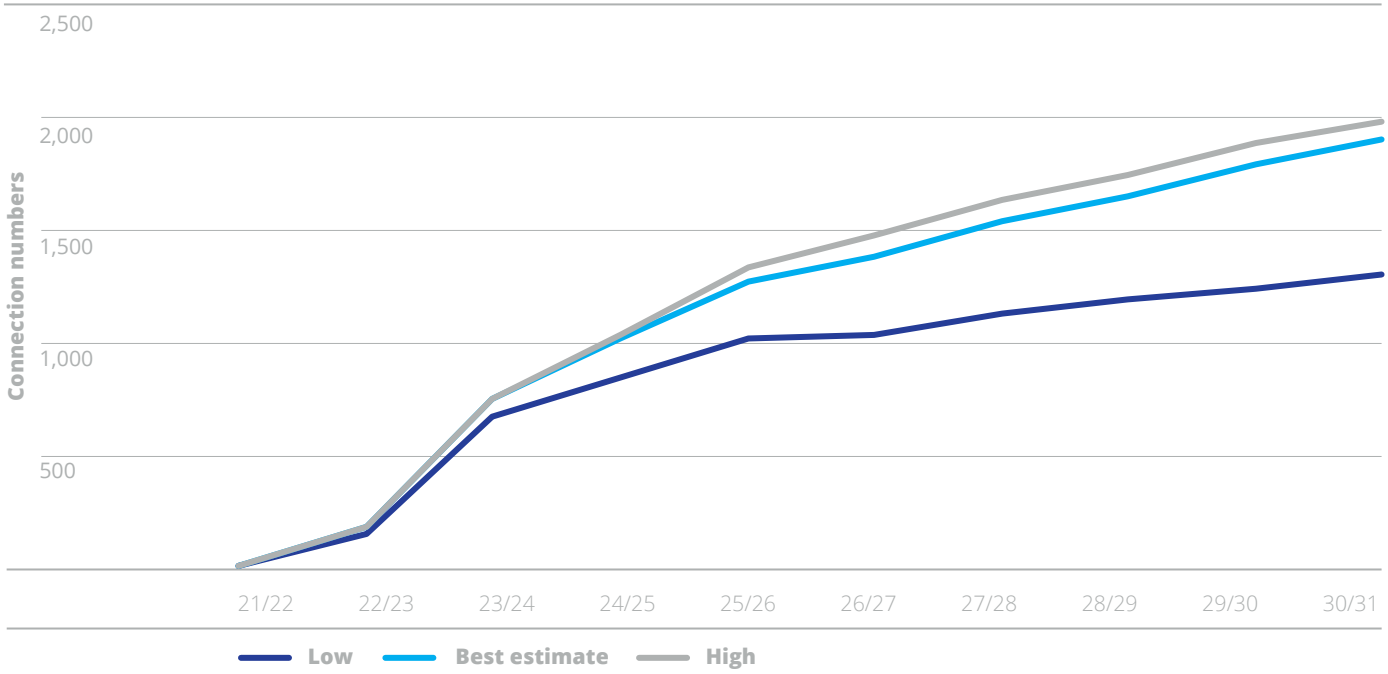
32 Industrial & Commercial sector growth rate is assumed to be 80% of GDP based on observed historical trends.
33 https://www.imf.org/en/News/Articles/2022/07/07/pr22249-imf-executive-board-concludes-2022-article-iv-consultation-with-ireland

Regulation of Utilities (CRU) decision, Data Centres with their own independent electricity generators may get priority for grid connections in the future, adding further potential demand for natural gas power generation in this sector. In addition, new regulations on fuel storage for back-up facilities, combined with the sector's desire to invest in low carbon fuel sources with a pathway to decarbonisation, are driving Data Centres to select natural gas as the source of back-up fuel, displacing higher carbon fuels like diesel/kerosene. The recent Government Statement on the Role of Data Centres in Ireland's Enterprise Strategy sets out a series of principles to inform and guide decisions on future Data Centre development. There is a clear preference for Data Centre developments that can demonstrate the additionality of their renewable energy use in Ireland and can demonstrate a clear pathway to decarbonise and ultimately provide net zero data services. Gas Networks Ireland believe that Data Centres connecting to the gas network could meet these principles through the increased use of biomethane and hydrogen and are currently assessing the statement impacts and consulting with Government. For the purposes of this GFS horizon, the Low and Best Estimate scenarios have been limited to Data Centre customers with connection agreements already in place. Figure 5-6 presents the additional annual demand for large new connections in the Industrial & Commercial sector over the forecast period.

5.4.3 Residential sector

The forecast for new residential connections is shown in Figure 5-7[34]. The Government's Climate Action Plan 2021 proposed an effective ban on the installation of natural gas boilers in new homes from 2023, however retrofits to the mature housing stock are exempt from this ban. Gas Networks Ireland has already experienced a significant reduction in demand for natural gas connections for newly built homes accelerated by the Climate Action Plan 2019 which proposed

Figure 5-6: Annual large new industrial & commercial loads demand forecasts



34 On average a central boiler will service 90 apartment units. The connection numbers shown in Figure 5-8 include new houses, mature houses and apartment units.

5.0 Gas demand forecasts
(continued)

Figure 5-7: Residential new connection numbers

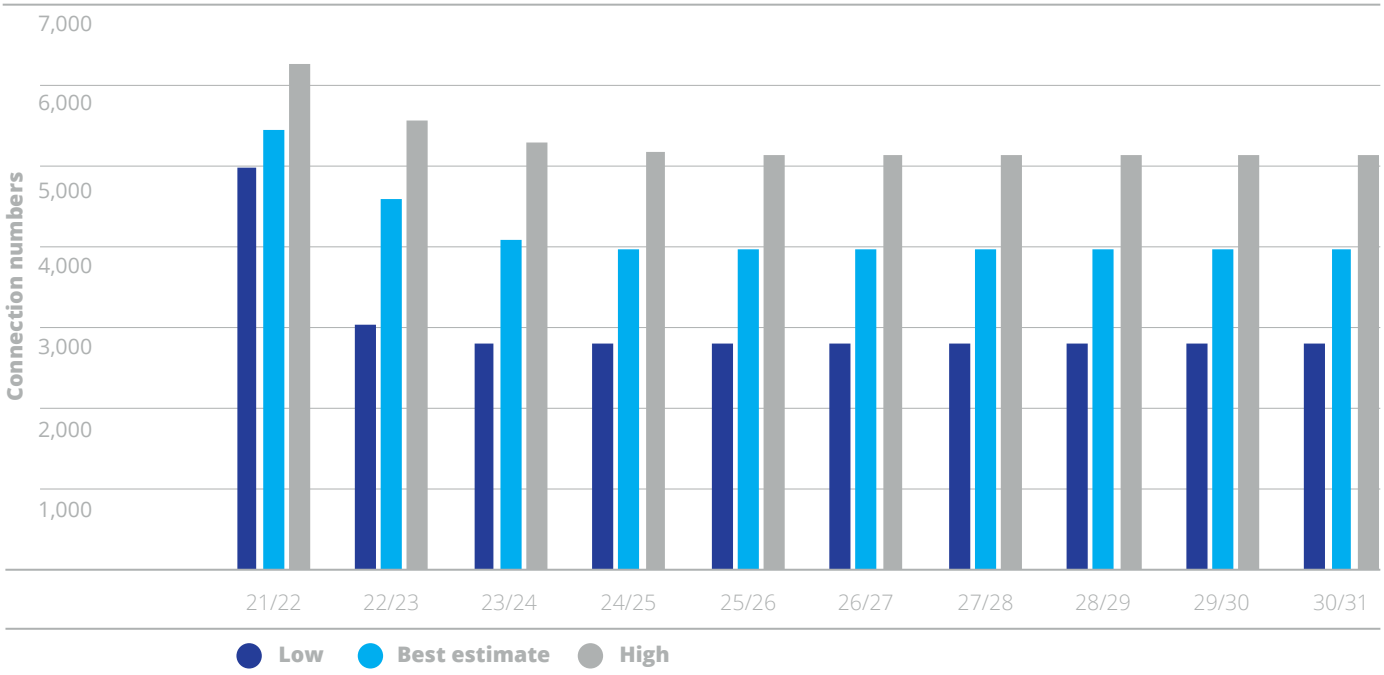
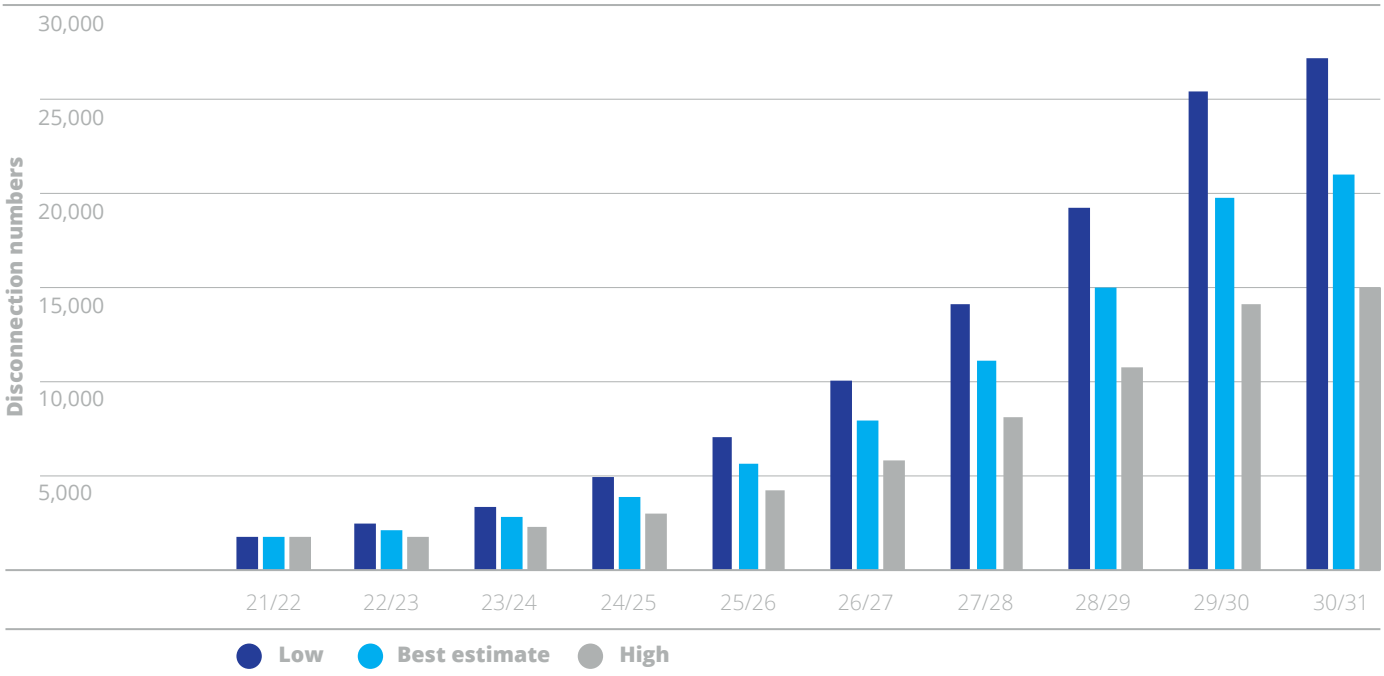


Figure 5-8: Residential disconnection numbers



an effective ban on the installation of natural gas boilers in new homes from 2025. This is a natural reaction from builders, developers, architects and M&E (Mechanical and Electrical) consultants to a government paper recommending an effective ban on natural gas boilers, albeit 5 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. 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 gases as a pathway for new and existing homes to decarbonise.

In addition to considering the measures in the Climate Action Plan 2021 on new residential connections, Gas Networks Ireland has incorporated the plan's electrification of residential heat targets on existing customers. The plan targets an additional 680,000 heat pumps in residential buildings (of which 400,000 to be installed in existing buildings). Currently gas boilers represent approximately a 28% share of primary energy source by building stock. Gas Networks Ireland advocate the prioritisation of comparatively less clean conventional fuels such as electricity (non-heat pump), oil and solid fuel for replacement with heat pumps and to replace gas boilers as they come towards the end of their useful life which will maximise the reduction in cumulative CO_2 emissions incurred by 2030. The Best Estimate scenario assumes that by 2030, 100% of the CAP 21 targets related to installation of heat pumps in existing houses will be met, 17% of which will replace gas boilers and translates to 81,524 disconnections by 2030/31 assuming that the heat pump adoption rate continues beyond 2030. The forecast for total non-cumulative residential disconnections i.e. including an estimation for non-CAP related disconnections, is shown in Figure 5-8.

Energy efficiency

Energy efficiency savings impacting on industrial & commercial and residential gas demands are derived from the SEAI National Heat Study[35] .

5.4.4 Transport 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 biomethane as alternative fuels. This ambition will help meet Ireland's requirements under the EU's Alternative Fuels Infrastructure Directive.

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.

Four public and three private CNG stations are now operational, a further five public access Causeway stations, currently at various stages of development, will be delivered over the next two years. Two further public access CNG stations, co-located at existing forecourts or new build sites, are also planned by Gas Networks Ireland as part of the GRAZE Project, partly funded by Climate Action Fund grant funding. Six further public stations are targeted along the comprehensive road network helping to develop the CNG station network across the country.

35 https://www.seai.ie/publications/Heating-and-Cooling-in-Ireland-Today.pdf

5.0 Gas demand forecasts
(continued)

The delivery of private CNG refuelling stations represents another element of Gas Networks Ireland's wider CNG strategy. Gas Networks Ireland delivers CNG infrastructure to private fleet operators and hauliers, allowing those who require more control over their refuelling patterns to do so in their own locations. There are currently three medium-sized private CNG stations operational in Ireland - located at Gas Networks Ireland's Gas Works Road site, Clean Ireland Recycling's Shannon operation and Virginia International Logistics in Dublin. Last year, Gas Networks Ireland also installed a second CNG refuelling station for Virginia International Logistics, a public access station, in Virginia Co. Cavan.

Looking ahead, the potential for CNG vehicles to be fuelled by biomethane, specifically indigenously produced biomethane, offers a significant opportunity to fully decarbonise HGV transport, widely recognised as one of the hardest to abate sectors. Biomethane in transport will also contribute to the achievement of Ireland's emissions reduction targets and targets for the use of renewable energy. Climate Action Plan 2021 supports the development of a renewable gas in transport industry in Ireland via Action 287, "Support the development of renewable gas, such as biomethane, as a transport fuel in the transport sector". Progress on this action is already evident, with CNG vehicles on the road, refuelling infrastructure operational and indigenous biomethane being injected into the national gas network.

For the GFS Best Estimate scenario Gas Networks Ireland plans to install 25 CNG refueling stations, a mix of 13 public and 12 private stations by 2026/27. By the end of the current GFS horizon, in the Best Estimate scenario, Gas Networks Ireland is expecting to see annual CNG demand of circa 506 GWh/yr, when the CNG station portfolio has reached anticipated operating capacity, equivalent to meeting the annual fuel requirement of approximately 1,012 HGVs. Utilising CNG with biomethane, bio-CNG, to power HGVs, offers a real solution to decarbonising the HGV fleet. When powered 100% by bio-CNG, this equates to circa 103kTCO_2-eq annual savings when the CNG stations reach their anticipated capacity. Table 5-2 gives the projected transport sector demand for each scenario.

5.5 The demand outlook

This section presents an overview of the gas demand outlook for the period 2021/22 to 2030/31.

5.5.1 Power generation sector gas demand

As described in Section 4.2, Power Generation sector gas demand has risen substantially since 2015 as a result of growing electricity demand, outages at coal- and oil-fired generators, the retirement of peat-fired units, and, up to gas year 2019/20, carbon and fuel prices favouring gas-fired generation ahead of coal in the merit order for electricity generation. 2020/21 diverged from this trend due to increasing gas prices and as a direct result of several large CCGTs being on extended outages during 2021. Despite even higher gas prices in 2021/22 owing

Table 5-2: Annual CNG demand forecasts

GWh/yr	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29	29/30	30/31
Low	22	32	53	96	155	245	321	368	380	380
Best estimate	22	43	71	129	207	326	429	491	506	506
High	22	53	88	161	259	408	536	613	633	633

to gas supply constraints as a result of the Russian invasion of Ukraine, gas demand for power generation is set to recover for 2021/22 with more gas-fired units available to run compared to 2020/21.

Electrical interconnector behaviour generally operates efficiently in that the interconnectors are mainly importing to Ireland when Irish electricity prices are higher than GB markets and exporting at times of high wind when prices in the SEM are lower than in GB[36]. It is expected that this trend will continue in the short to medium-term in all scenarios. With the addition of two new interconnectors, connecting Ireland to France via the Celtic interconnector and Ireland to Wales via the Greenlink interconnector, it is more difficult to predict future electricity import/export trends. However, with the increased penetration of wind power on the island and offshore toward the end of the GFS horizon, it is envisaged that the SEM will be net exporting by 2030/31.

In the Best Estimate demand scenario, in a divergence from forecasts from previous years, Power Generation sector gas demand is expected to decrease overall across the GFS horizon. There are a number of drivers of this projected decrease:

- A RES-E target of 70% is considered in the modelling and it is achieved by 2030
  - In order to reach this target, some operational constraints on the electricity grid have been relaxed resulting in less gas-fired generation being constrained on
  - The model includes EirGrid's latest forecast of wind and solar generation build-out rates where, in particular, offshore wind installed capacities are more ambitious than in 2021. In addition, it is assumed that onshore wind capacity factors increase over the second half of the GFS horizon with the repowering of older turbines and due to the continual increase in the size of new turbines.

36 SEM committee Single Electricity Market Performance Quarterly Reports, available at https://www.semcommittee.com/publications

5.0 Gas demand forecasts
(continued)

- The increased level of interconnection with France and GB with the construction of the Celtic and Greenlink Interconnectors, coupled with the build-out of the North-South Interconnector, is driving more imports into the SEM, particularly at times of low wind generation. This results in the displacement of some gas-fired generation.

Initially however, there is some growth expected in first half of the GFS horizon. This is driven by the anticipated recovery of gas prices vs. coal and oil prices by 2023/24, resulting in favouring base load gas plant in the merit order, and by forecast growth in the electricity demand in accordance with EirGrid's GCS 2022-2031.

Overall, across the forecast horizon, a decrease in demand of 27% is predicted in the Power Generation sector in the Best Estimate scenario.

This fall in demand is in spite of the strong growth in electricity demand with EirGrid predicting growth of 45% in their median electricity demand scenario. As previously mentioned, the penetration of renewable generation and relaxation of operational constraints to meet 70% RES-E target, coupled with the impact of increased interconnection with GB and France, is eliminating any growth in gas demand for Power Generation due to this increased electricity demand.

The High demand scenario uses similar inputs and assumptions, with the exception of the following:

- taking EirGrid High electricity demand forecast,
- Moneypoint and Tarbert both closing by Oct-2024 and Dec-2023 respectively,
- the RES-E target of 70% not being met due to operational constraints being limited by the EirGrid Operational Policy Roadmap 2022-2023 and;
- the completion of the North-South Interconnector is delayed by two years until January 2028.

Power generation gas demand in the High demand scenario is projected to decrease by 2% across the GFS horizon.

The Low demand scenario inputs and assumptions deviate from the Best Estimate scenario as follows:

- taking EirGrid Low electricity demand forecast,
- achieving 80% RES-E target in 2030,
- Aghada AT1 OCGT closing by Dec-2023 as scheduled in EirGrid's GCS 2022 and;
- All new interconnectors, i.e. Greenlink, Celtic and North-South, operational in accordance with the timelines set out in EirGrid's GCS 2022.

Hence, power generation gas demand in the Low demand scenario is projected to decrease by 34% across the GFS horizon.

Across all three demand scenarios a step change in demand is observed between 2024/25 and 2025/26 due to a number of reasons:

- The North-South interconnector essentially removes any electricity capacity flow constraint between NI and ROI at the start of 2026 in both the Best Estimate and Low scenarios,
- Kilroot CCGTs become available in January 2026 which displaces older, less efficient gas-fired units on the system.

A second step change is seen from 2027/28 onwards in all scenarios due to the commissioning of the Celtic interconnector in late-2028. Finally, the Best Estimate and Low scenarios hit RES-E targets of 70% and 80% respectively in 2030 while the High Scenario falls 6% short of the 70% RES-E target due to some operational constraints still being in place.

5.2.2 Industrial and commercial sector gas demand

In the Industrial and Commercial sector, the Best Estimate demand scenario profile shows strong growth of 14% over the period of interest. In the High demand scenario, Industrial & Commercial sector gas demand is also expected to grow 16%

Figure 5-9: Power generation sector gas demand

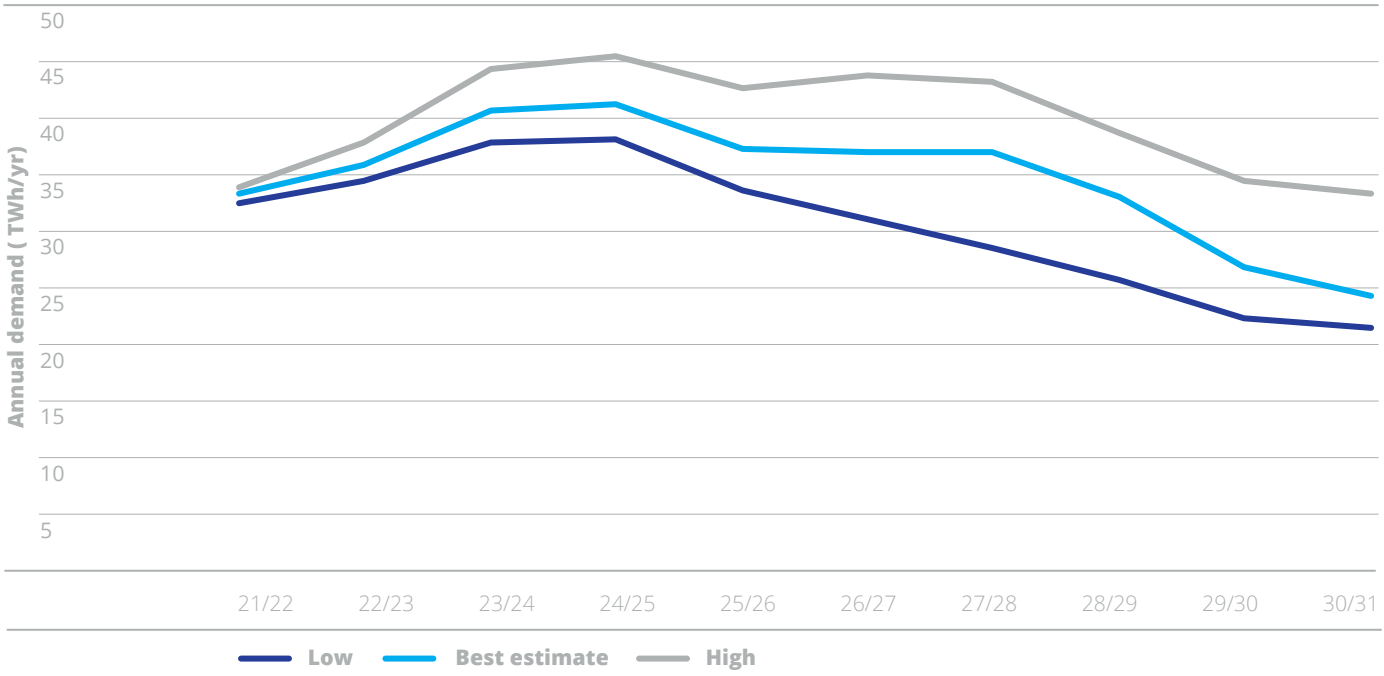
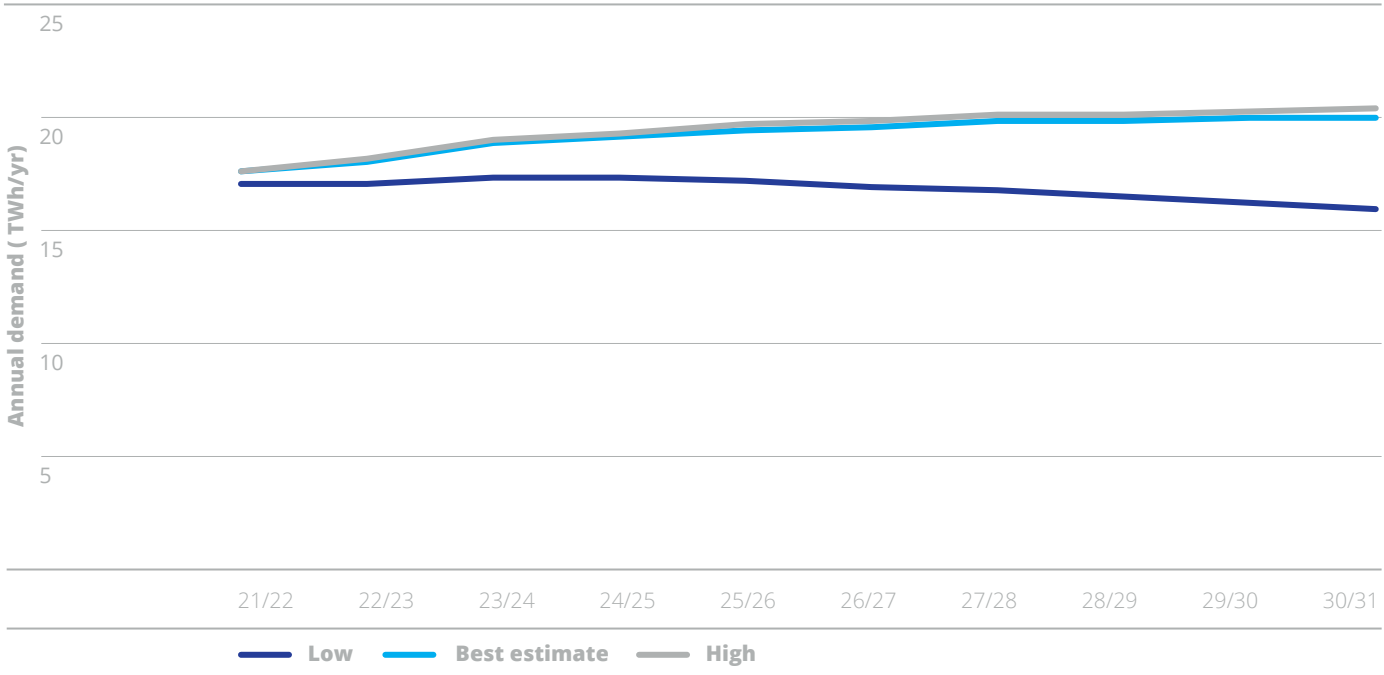


Figure 5-10: Industrial & commercial sector gas demand



5.0 Gas demand forecasts
(continued)

whereas in the Low demand scenario, Industrial & Commercial sector gas demand is expected to fall by 7% by 2030/31.

Anticipated growth in this sector is strongly linked to economic performance; as noted in Section 5.4.2, moderate GDP growth is assumed in the short to medium-term in both the Best Estimate and High scenarios. In the Low scenario, strong GDP growth is projected for 2021/22 but this is anticipated to decrease to 1.4% for the remainder of the GFS horizon. In addition to GDP growth, an increase in the projected number of additional (one-off) connections is also driving growth in the Industrial and Commercial sector driven largely by interest from Data Centres and large FDI Multi-National organisations setting up operations in Ireland.

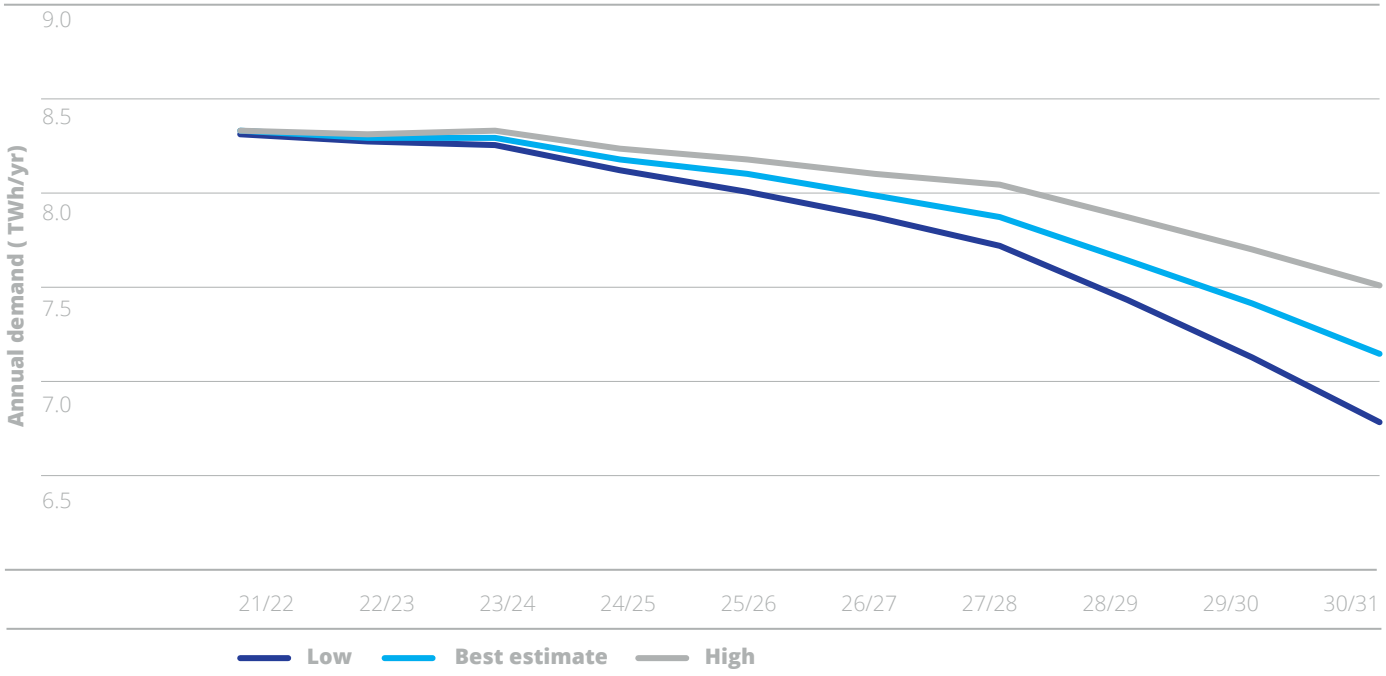
Industrial and Commercial sector projections take account of SEAI National Heat Study measures in the sector.

5.5.3 Residential sector gas demand
In the Residential sector, taking account of the targets announced in the 2021 Climate Action Plan, negative growth is projected across all scenarios; this is as a result of reduced new connections, coupled with an anticipated increase in disconnection rates in this sector as a result of gas boiler replacement with heat pumps. Increasing energy efficiency is also taken into account across the GFS horizon in all scenarios.

The Best Estimate scenario projects a reduction of 12% in the Residential gas demand sector across the forecast horizon. In the High and Low demand scenarios, 9% and 16% reductions in demand are predicted respectively.

5.5.4 Transport sector gas demand
In the Transport sector, growth is projected across all scenarios. Gas Networks Ireland has successfully developed both public and private CNG stations on the distribution gas network with new connections expected to continue

Figure 5-11: Residential sector gas demand



and increase across the ten-year GFS period. The Best Estimate demand scenario projects that 506 GWh/yr is in place by 2030/31, while the High and Low demand scenarios assume demands of 633 GWh/yr and 380 GWh/yr respectively.

5.5.5 Total annual gas demand

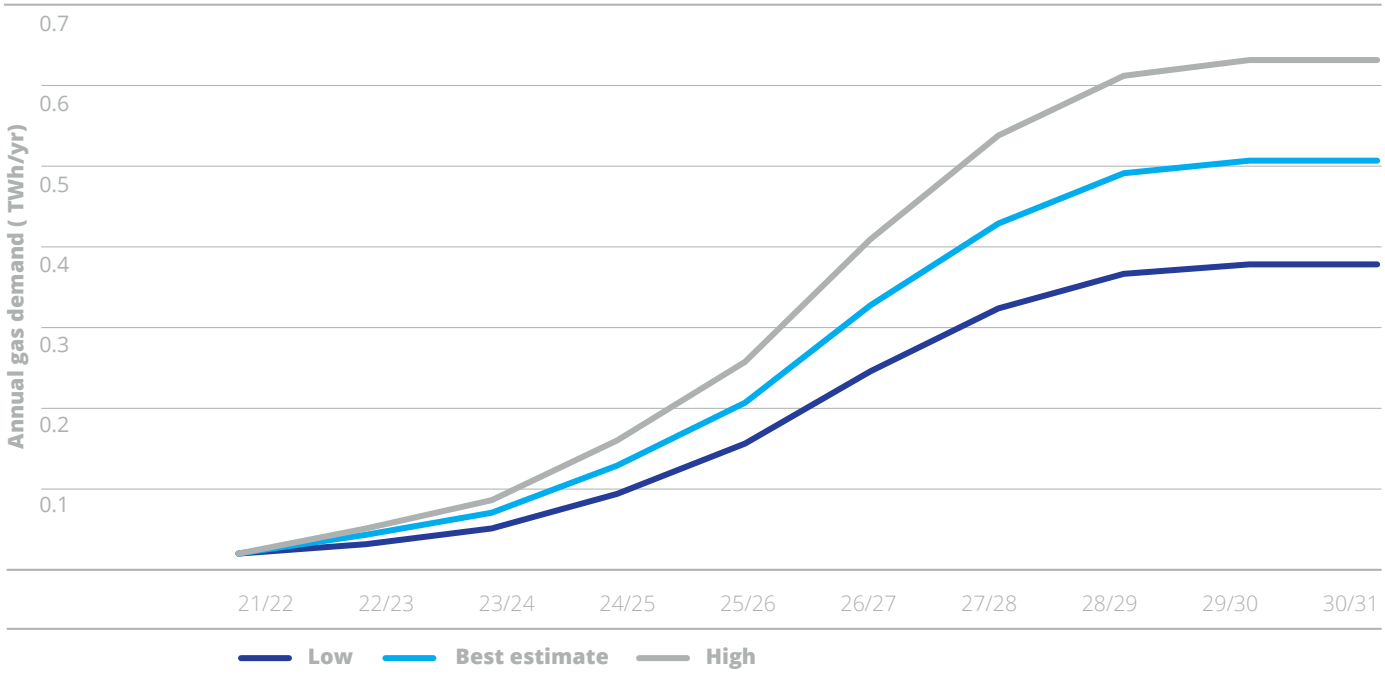
Annual ROI gas demand is expected to increase in the early years of the period, with a peak in 2024/25 and then decline for the remaining years of the period. In the Best Estimate demand scenario, annual ROI gas demand is expected to fall by 12% between 2021/22 and 2030/31. Similarly, in the Low demand scenario, a decrease in ROI gas demand is predicted over the same horizon of 22% while a slight increase in annual gas demand of 3% is projected in the High demand scenario. The decrease in both the Best Estimate and Low scenarios is primarily driven by the anticipated fall in both Power Generation and Residential sector gas demands. In contrast, Industrial & Commercial demand is set to increase in the Best Estimate and High gas demand scenarios whereas the Low scenario is projecting a fall in Industrial & Commercial demand across the GFS horizon. Hence, an increase in the number of additional (one-off) connections in the Industrial and Commercial sector, coupled with moderate projected economic growth, negates the fall in gas demand to a degree in the Best Estimate and High demand scenarios. The slight growth in the High demand scenario is driven by the assumption that the 70% RES-E target will not be met in 2030, falling short by 6%.

The aggregate ROI demands for the three GFS scenarios are presented in Figure 5-13. Figure 5-14 gives the relative weightings of each sector over the forecast period for the Best Estimate demand scenario.

5.5.6 Peak day gas demand

The 1-in-50 and average year peak day gas demands for ROI are given in Figure 5-15. The 1-in-50 peak is expected to grow by 17% in the Best Estimate and 29% in the High demand

Figure 5-12: Transport sector gas demand



5.0 Gas demand forecasts
(continued)

Figure 5-13: Total annual ROI gas demands

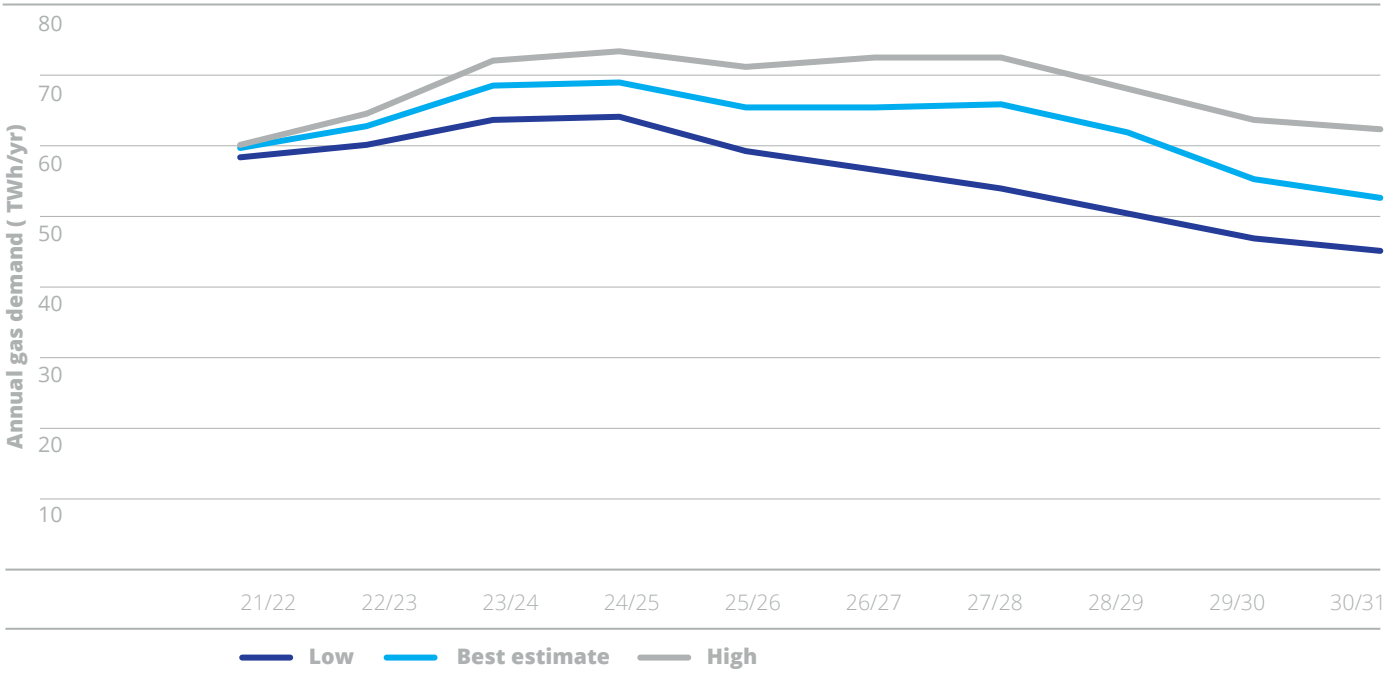


Figure 5-14: Best estimate scenario annual ROI demand by sector

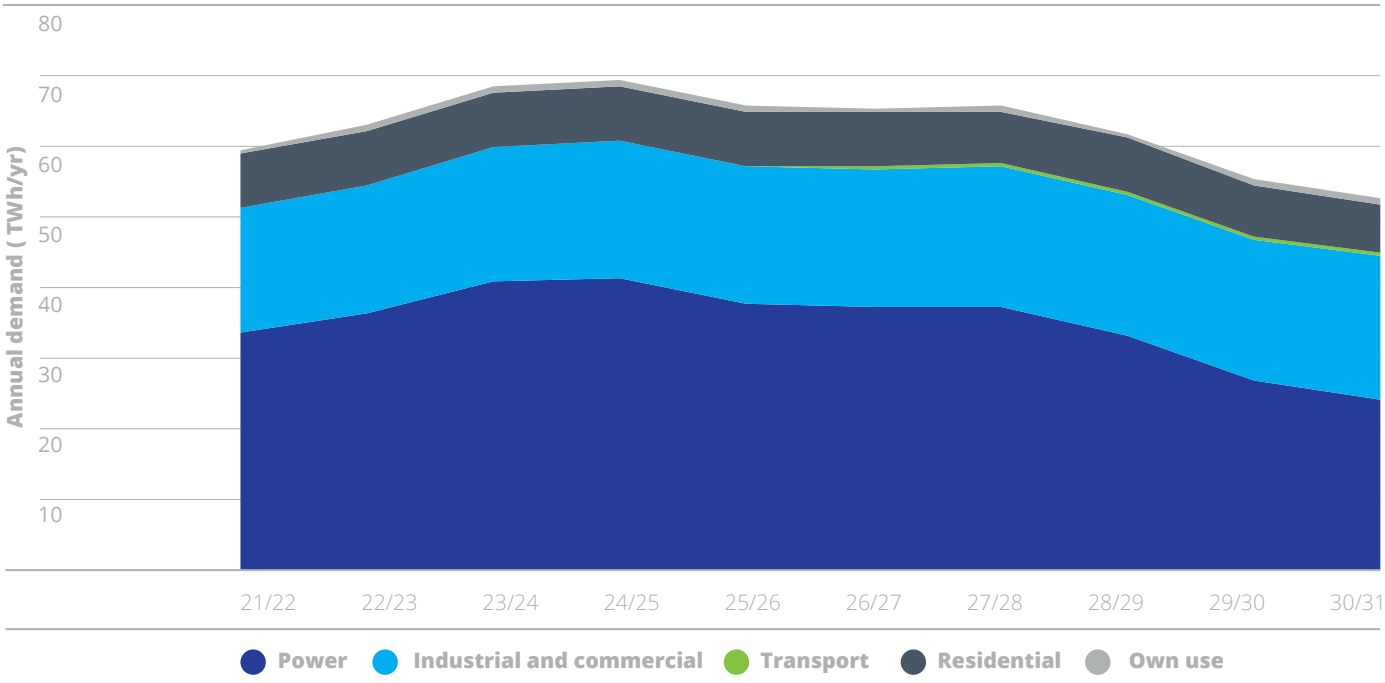
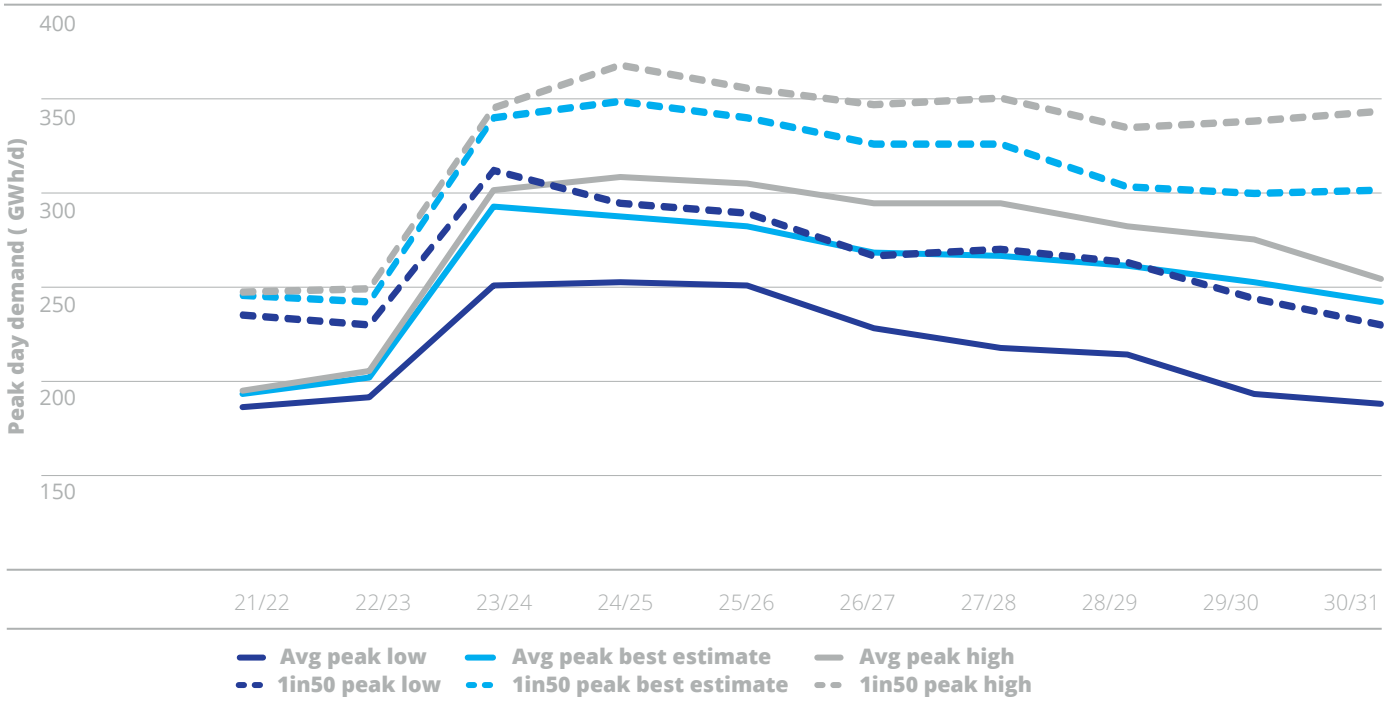


Figure 5-15: ROI peak day gas demand forecast



scenarios, while the Low is expected to fall by 1%. Average year peaks are expected to grow by 18% in the Best Estimate scenario and by approximately 1% and 22% in the Low and High demand scenarios respectively.

There is decoupling of peak day and annual gas demand in the power generation sector 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.

The increasing penetration of renewable generation, particularly of offshore wind and solar PV, does have a slight dampening effect on the peak day gas demand, with installed wind capacity assumed to double over the final four years of the GFS forecast horizon. The high level of electrical interconnection achieved by the final three years of the GFS horizon also has an impact on the power generation peak day gas demand; in the forecast it is assumed that the SEM will be net importing on these days, thereby displacing some of the OCGTs that would have been the marginal plants in the merit order. It is noted that the direction of interconnector flow changes regularly based on market conditions at a given time, and the modelled behaviour is no indication of what may actually transpire on the system at this level of daily granularity i.e. depending on market conditions at a point in time, interconnectors may operate as net exporters, thus increasing the peak day gas requirement over and above that shown in Figure 5-15.

5.0 Gas demand forecasts
(continued)

Table 5-3: Indicative carbon emissions by fuel type[35]

Generator type	Plant efficiency	tCO_2/MWh generated
Gas fired	55%	0.37
Coal fired	36%	0.94
Peat fired	38%	1.10
Oil fired	29%	0.96

In the final year of the GFS forecast horizon, peak day gas demand in certain scenarios demonstrates a slightly negative growth trend against year six (gas year 2025/26). A significant portion of this, however, is simply down to the assumed market dynamics between ROI and GB as modelled, with assumed long-term fuel and carbon pricing shifting to favour peak day imports from GB, displacing some gas generation from OCGT units.

5.5.7 Role of gas in power generation
Ireland's portfolio of CCGT power plants are significantly more efficient than other thermal generator types 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 5-3).[37]

Gas-fired generation accounted for 45.8% of Ireland's electricity generation in 2021[38]. 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 716,000 customers in Ireland, including some of Ireland's largest multinational and indigenous industries.

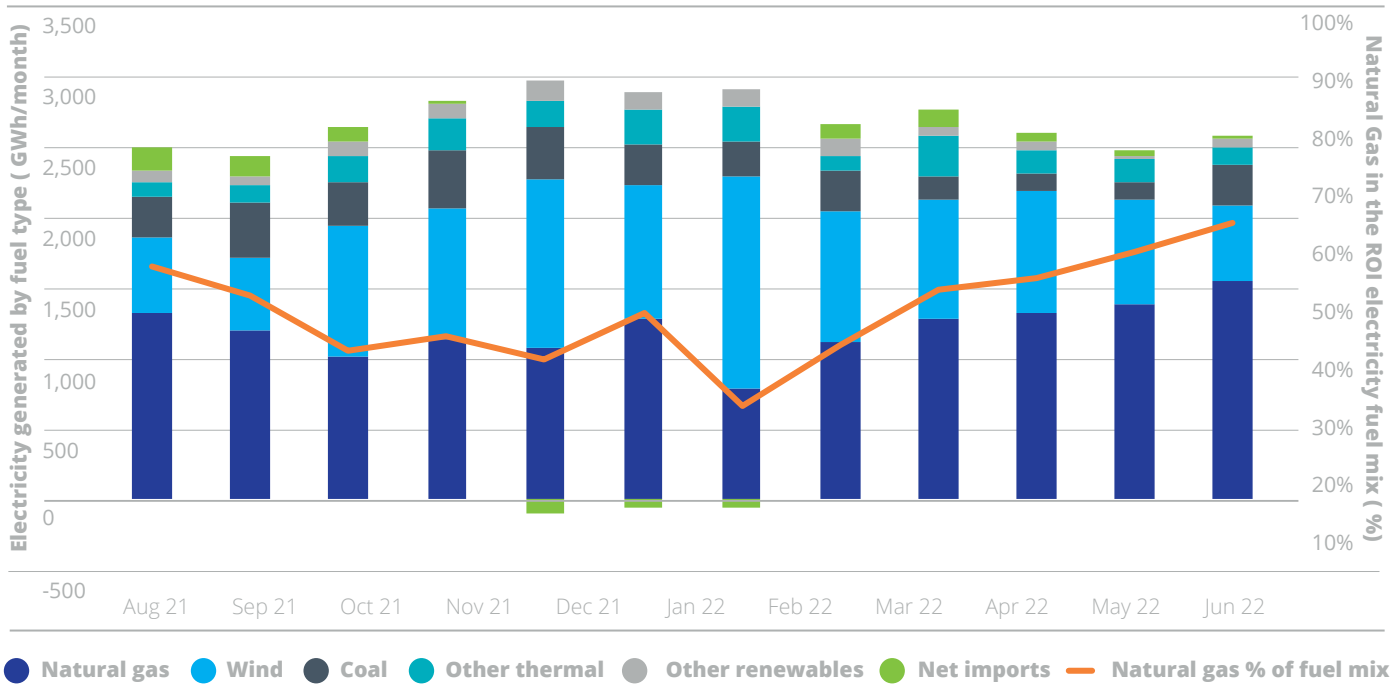
The strong relationship between gas and electricity has already proven to be very beneficial to Ireland; it has provided and maintained competitive energy prices and a secure and reliable supply of energy. Figure 5-16 demonstrates the contribution of natural gas fired generation to the ROI electricity fuel mix for the 12 months up to July 2022. This figure demonstrates how the gas network continues to complement renewable generation. The partnership between flexible gas-fired power generation and intermittent renewable generation is key to enabling Ireland's renewable integration ambition into the future.

As noted in Section 5.4.1, the dynamics which influence gas demand in the power generation sector continue to evolve. In addition to future electricity demand growth, among the key factors set to influence the trajectory for gas demand in the medium-term are:

- future operation of Moneypoint and Tarbert power stations;
- target commissioning dates of the North-South, Celtic and Greenlink interconnectors
- continued build-out of Wind Generation towards the 70% by 2030 RES-E target, and potentially towards an 80% RES-E target;
- new generator entrants to the SEM (both gas-fired and other energy sources), coming online between 2023 and 2026 aligning to T-3 and T-4 capacity auction results;
- fuel and carbon prices;
- role of temporary emergency generation;
- operational constraints on the electricity network, for example inertia and SNSP restrictions.

37 Based on carbon emission factors published in the SEM Plexos validation model.
38 System and Renewable Data Summary Report – EirGrid

Figure 5-16: Natural gas in the electricity fuel mix[37]



Gas Networks Ireland welcomes the opportunity to examine the future role of gas and of the gas network in contributing towards Ireland's transition to a low carbon energy future.

All the above considerations have been factored into GFS 2022 modelling assumptions as part of the base case scenarios. Two sensitivities were then identified and carried out on the Best Estimate scenario as follows:

1. Considering the Low Electricity Demand from EirGrid's GCS with all other parameters unchanged for the Gas Network's Ireland Best Estimate scenario
2. Examining the case where some electricity interconnectors are not available on the peak day, i.e. both Greenlink and Celtic interconnectors were considered unavailable for imports/exports in this sensitivity

Table 5-4 shows the results of Sensitivity 1 (S1) in terms of growth in the ROI annual gas demand and Gas Networks Ireland System 1-in-50 peak day demand across the GFS horizon while it also includes growth in Gas Networks Ireland System 1-in-50 peak day demand across the GFS horizon for Sensitivity 2 (S2).

Table 5-4: Sensitivity analysis results vs. best estimate (base case)

Scenario	2021/22 -> 2030/31 % growth (ROI annual)	vs. base case	2021/22 -> 2030/31 % growth (Gas Networks Ireland 1-in-50 peak day)	vs. base case
Base case: best estimate	- 12%		+17%	
S1: best estimate + EirGrid low electricity demand	- 16%	↓	+17%	—
S2: best estimate with limited interconnection	N/A		+27%	↑

39 Based on SEAI Monthly Electricity Data https://www.seai.ie/data-and-insights/seai-statistics/monthly-energy-data/electricity/

5.0 Gas demand forecasts
(continued)

The results of the sensitivity assessments are described in further detail in the following sections.

5.5.8 Best estimate with low electricity demand

Figure 5-17 below shows the forecast trajectory of electricity demand as included in EirGrid's GCS 2021 vs. GCS 2022. There has been a significant uplift made to the projected electricity demands between these two years; the trajectory of the Low demand from GCS 2022 is approximately the same as that for the Median demand in GCS 2021.

As regards the peak electricity demand, in GCS 2022 it is projected to increase by 24% by 2030 whereas in GCS 2021 the forecast increase was 16%.

Due to this significant revision in the electricity demand forecast between EirGrid's previous two GCS publications, it was decided to consider the case where the GCS 2022 Low Electricity demand was run in the Gas Networks Ireland Best Estimate scenario with all other inputs and assumptions remaining unchanged.

Figure 5-18 below shows the annual ROI gas demand for the base case Best Estimate vs. the case where low electricity demand is considered. The impact is direct and is consistent throughout the horizon, resulting in a decrease of 16% in gas demand across the horizon in the Best Estimate case with low electricity demand whereas in the base case best estimate case this decrease is 12%.

The 1-in-50 Gas Networks Ireland system peak day demand for the Best Estimate scenario vs. the Best Estimate scenario with low electricity demand is shown in Figure 5-19 below. From 23/24 to 28/29, a gap of approximately 20GWh opens between the peak day gas demand in each scenario which is directly driven by the difference in electricity demand. From 28/29

Figure 5-17: ROI annual electricity demand – GCS 2021 vs. GCS 2022

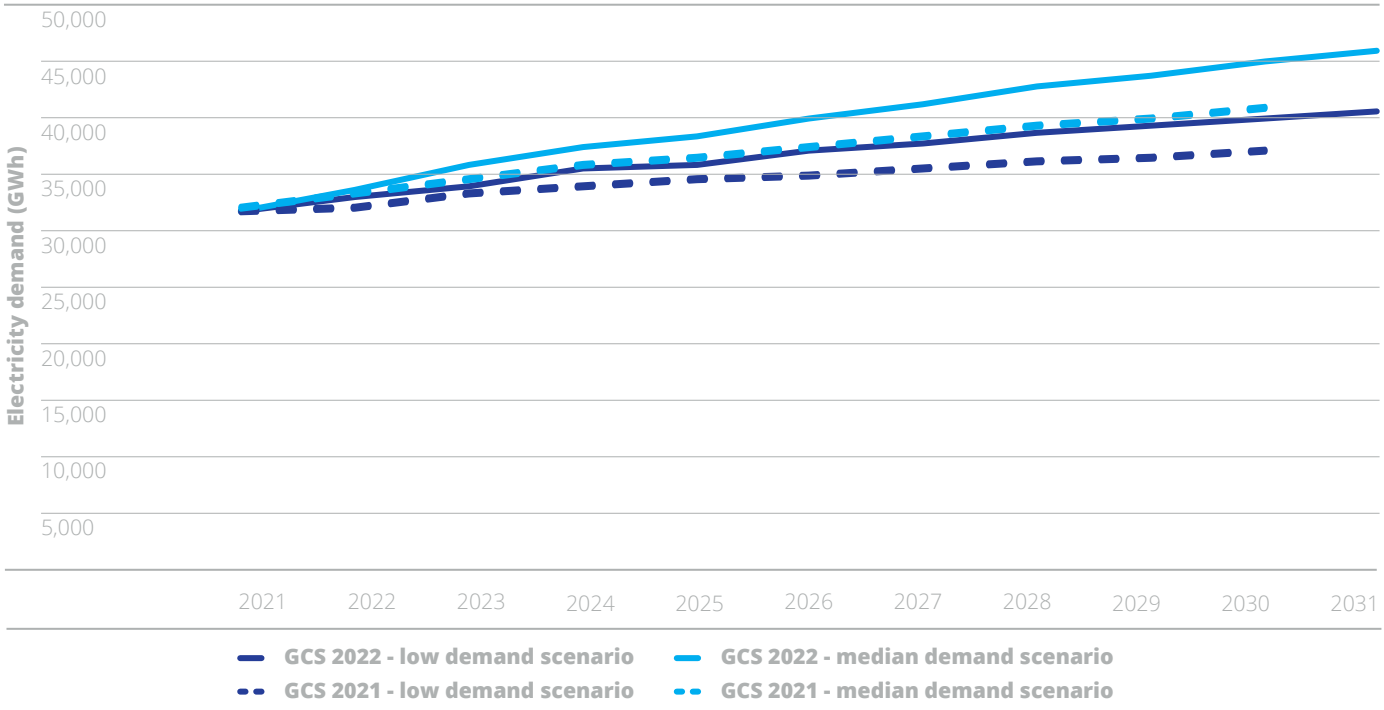


Figure 5-18: ROI annual gas demand for base case best estimate vs. best estimate with low electricity demand (sensitivity 1)

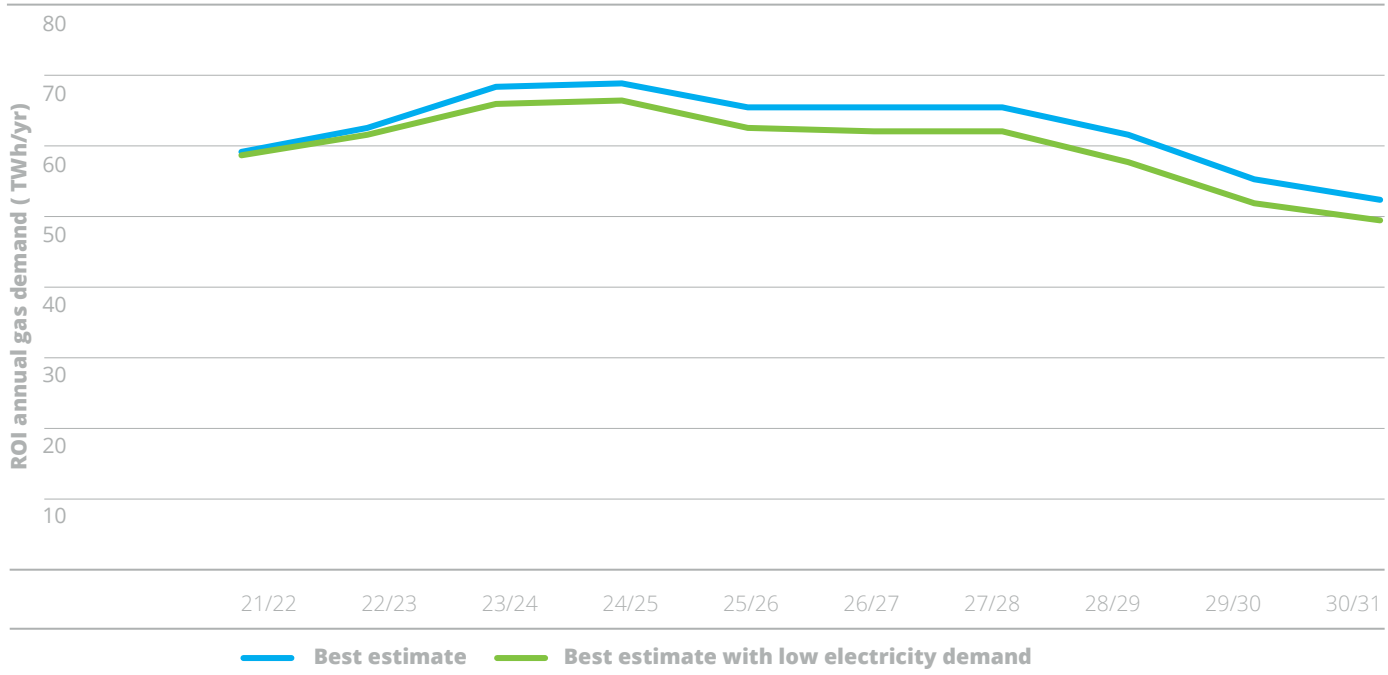
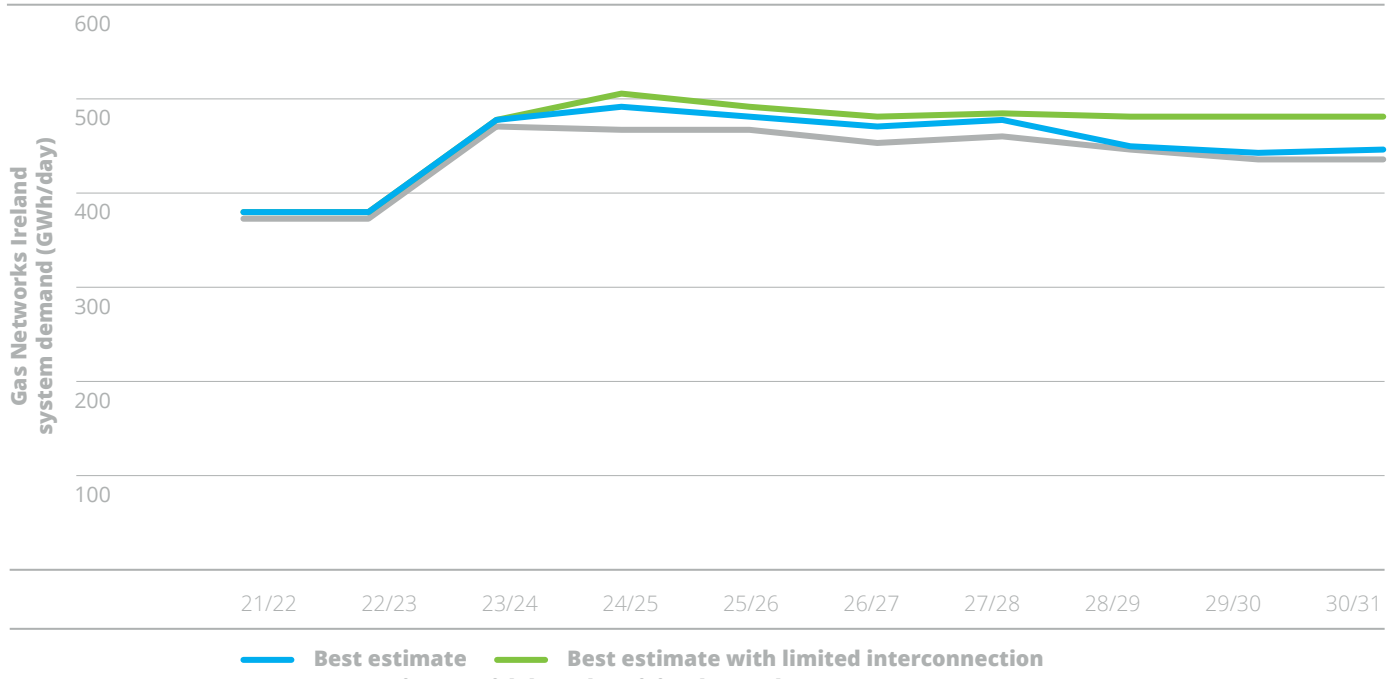


Figure 5-19: Gas Networks Ireland system 1-in-50 peak day demand for the base case best estimate vs. sensitivities 1 and 2



5.0 Gas demand forecasts
(continued)

onwards, the marginal gas plant is competing with imports via interconnectors, particularly the Celtic interconnector, and so the gap between the Best Estimate scenarios with EirGrid's low and median electricity demands decreases to 5-10 GWh due to imports from France via Celtic.

5.5.9 Best estimate with limited interconnection

This sensitivity considers the case where neither the Greenlink nor the Celtic interconnector are available for imports on the peak day. In the base case Best Estimate 1-in-50 peak day forecast, there are considerable imports on the peak day; as gas-fired generators are typically the marginal plant, these electricity imports have a direct dampening effect on gas demand for power generation on the peak day.

As previously mentioned, Greenlink is anticipated to be operational by the end of 2024 while Celtic is forecast to be available from 2029 in the Best Estimate scenario. Figure 5-19 above illustrates the impact of not having these interconnectors available to import power on the peak day resulting in a direct increase to gas demand from gas year 24/25 onwards. The Gas Networks Ireland system demand for the Best Estimate with limited interconnection scenario is 10-15GWh higher on the 1-in-50 peak day vs. the base case Best Estimate for gas years 24/25 to 27/28 inclusive, showing the impact of Greenlink not being available. From gas year 28/29 onwards, the impact of not having both Greenlink and Celtic available is equal to a 30GWh uplift on the Gas Networks Ireland system 1-in-50 peak day demand in the Best Estimate with limited interconnection scenario vs. the base case Best Estimate scenario.

Overall, across the GFS horizon, Gas Networks Ireland system 1-in-50 peak day gas demand grows by 27% in this sensitivity with limited interconnection in comparison to growth of 17% in the base case Best Estimate scenario. Finally, available supply capacity is exceeded within the Gas Networks Ireland system on the 1-in-50 peak day from 23/24 onwards throughout the GFS horizon in the case with limited interconnection.

"Overall, across the GFS horizon, Gas Networks Ireland system 1-in-50 peak day gas demand grows by 27% in this sensitivity with limited interconnection in comparison to growth of 17% in the base case Best Estimate scenario."

6.0

Gas supply

Key messages:

The Corrib gas field is expected to meet 21% of annual Gas Networks Ireland system demands (28% of ROI demand) in 2021/22[40], with the Moffat Entry Point providing the remaining 79%.

The Corrib gas field supplied approximately 14% of Gas Networks Ireland peak day system demand (19% of ROI demand) in 2021/22.

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

Moffat is anticipated to meet 95% and 94% of Gas Networks Ireland system and ROI peak day demands respectively in 2030/31.

Biomethane is forecast to meet 1% and 1.5% of Gas Networks Ireland system and ROI peak day demands respectively in 2030/31. This is based on achieving 3.2 TWh/year of indigenous biomethane by 2030/31. This is ahead of the base case volume of biomethane deployment developed in the Government's National Energy and Climate Plan 2021-2030 and CAP 2021, which set the target for indigenous biomethane at 1.6 TWh by 2030.

Biomethane is forecast to meet 4.4% and 6.1% of Gas Networks Ireland system and ROI annual demands respectively in 2030/31.

The GFS forecasts includes low level blends of hydrogen in the network equating to 2% of annual system demand by 2030/31, supplied both indigenously and through the interconnectors from the UK.

40 Actual consumption up to and including the month of August, estimation for September

This section presents an overview of the gas supply outlook for the period 2021/22 to 2030/31.

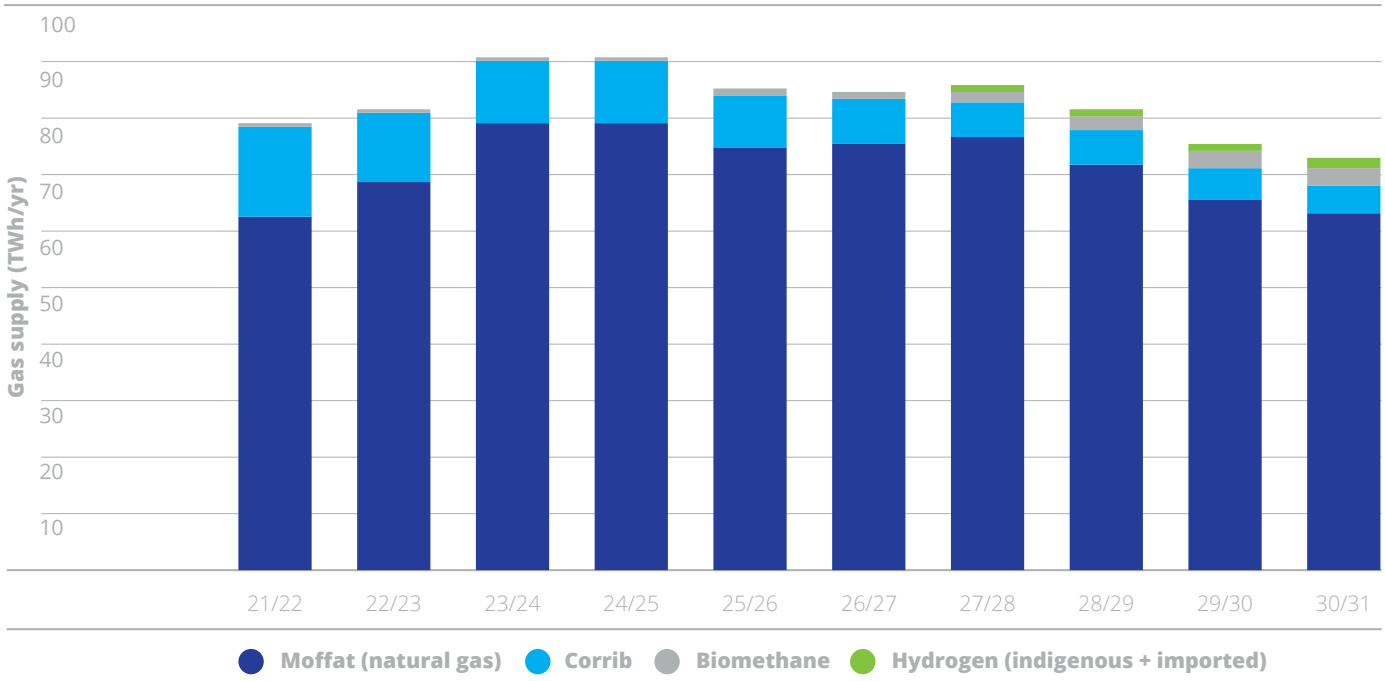
For 2021/22, the Corrib gas field is expected to meet 21% of annual Gas Networks Ireland system demands (28% of ROI demand), with the Moffat Entry Point providing the remaining 79%.

Looking forward, Corrib is projected to decline in its share of supply; in 2022/23 Corrib is anticipated to meet up to 15% of annual Gas Networks Ireland system[41] demands (19% of ROI demand), with the Moffat Entry Point providing the remaining 85%. By 2030/31 Corrib gas supplies will have declined to less than 14% of initial peak production levels. By the end of the forecast horizon Moffat will account for approximately 88% of annual Gas Networks Ireland system demands (approximately 83% of ROI demand, of which 0.9% is a blend of hydrogen). Renewable gases are anticipated to play a larger role in system supply by 2030/31, with biomethane forecast to meet 4.4% of system demand (6.1% of ROI demand) and hydrogen forecast to meet 2% of system demand, 50% of which is supplied through Moffat (2.3% of ROI demand, 40% of which through Moffat). The balance of supply is forecast to be met by Corrib.

Figure 6-1 presents the forecast Gas Networks Ireland system annual gas supply for the period to 2030/31 for the Best Estimate demand scenario.

The Corrib gas field supplied approximately 14% of Gas Networks Ireland peak system demand (19% of ROI demand) in 2021/22 with the balance of system demand of 86% from Moffat (82% of ROI). Moffat is anticipated to meet 95% of Gas Networks Ireland system peak day demand in 2030/31 (94% of ROI peak day demand, of which 0.5% is a blend of hydrogen). Renewable gases

Figure 6-1: Annual Gas Networks Ireland system gas supply forecasts– best estimate scenario



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

6.0 Gas supply
(continued)

are anticipated to play a larger role in peak day system supply by 2030/31 with biomethane forecast to meet 1% of system demand (1.5% of ROI demand) and hydrogen forecast to meet 0.9% of system demand, 50% of which is supplied through Moffat (1.1% of ROI demand, 41% of which through Moffat). The balance of peak day supply is forecast to be met by Corrib.

Figure 6-2 presents the forecast 1-in-50 peak day Gas Networks Ireland system gas supply for the period to 2030/31 for the Best Estimate demand scenario.

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 would be exceeded on a 1-in-50 peak day in the last eight years of the forecast horizon, and for a single year of the average peak day forecast. This is described in further detail within Section 8.

6.1 Moffat entry point

The Moffat entry point in south west Scotland 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 with upstream counterparties. The UK wholesale gas market is extremely liquid with diverse supply sources from the UK, Norway, mainland Europe and further afield. Wholesale supply contracts into the ROI market are for variable duration and volumes because much of the demand in ROI is related to the Power Generation market. The current technical capacity at the Moffat Entry Point is 35 mscm/d (386.9 GWh/d). National Grid considers a hydrogen blend at Moffat a distinct possibility before 2030 pending a decision by the

Figure 6-2: 1-in-50 peak day Gas Networks Ireland system gas supply forecast– best estimate scenario

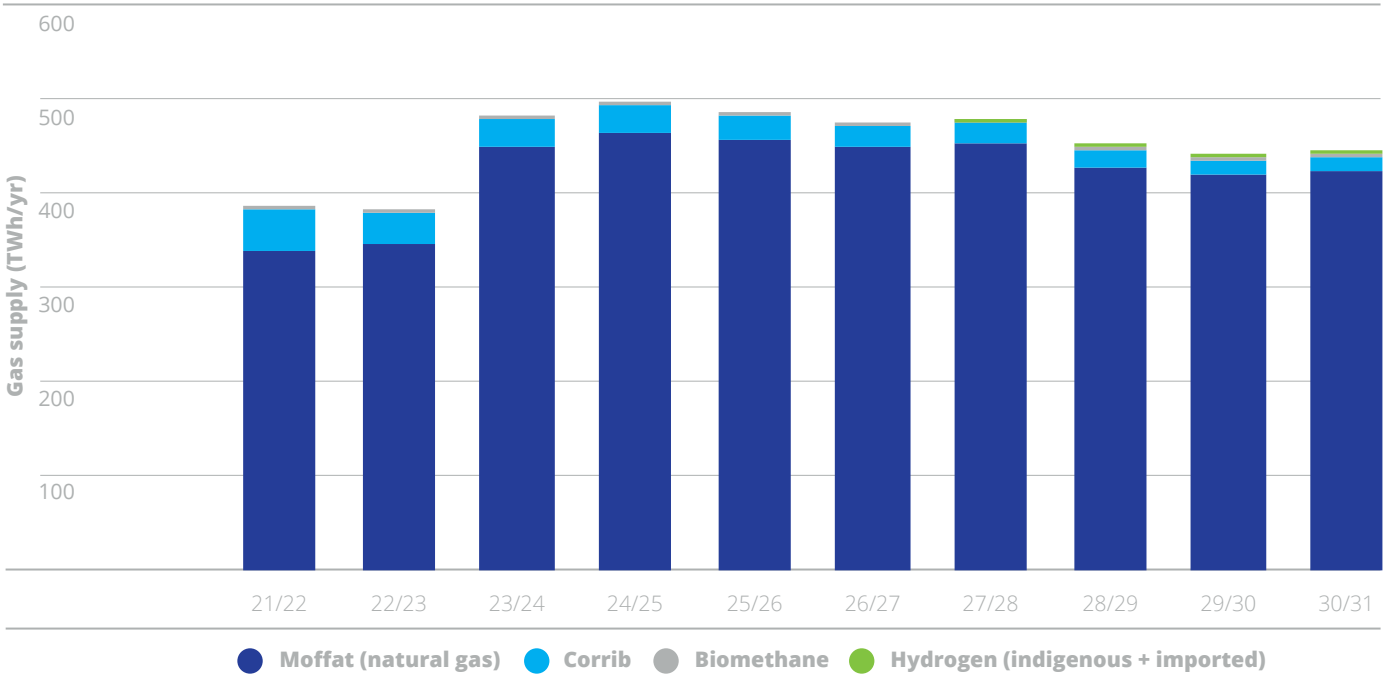


Table 6-1: Corrib forecasts maximum daily supply

	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29	29/30	30/31
Daily supply (mscm/d)	4.7	3.7	3.1	3.0	2.6	2.3	2.0	1.7	1.5	1.4
Daily supply (GWh/d)	49.0	38.7	32.3	31.4	27.4	23.5	20.5	18.0	15.9	14.2

UK government on the UK hydrogen business model, the supply forecasts include a blend of 0.5% hydrogen at Moffat in 2027/28 growing to a 1% blend by 2030/31.

6.2 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 6-1 shows the forecast maximum daily supplies from Corrib received in June 2022.

6.3 Biomethane

Energy from biomethane has the potential to contribute significantly to Ireland's renewable energy targets. In particular, biomethane 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, biomethane production can also deliver significant greenhouse gas mitigations for the Agriculture sector, with elimination of greenhouse gas emissions from current slurry storage, slurry land spreading practices, and crop residue emissions.

As with other renewable energy technologies, biomethane requires National policy and incentive supports to allow this industry to develop and grow to a long-term competitive fuel. With the pending implementation of an appropriate support mechanism, Gas Networks Ireland has produced three biomethane gas production scenarios (Low, Best Estimate and High).

The GFS Low biomethane scenario is aligned in the Government's National Energy and Climate Plan (NECP) 2021-2030 and Climate Action Plan (CAP) 2021, which set the target for indigenous biomethane at 1.6 TWh by 2030.

The recent Government announcement on sectoral greenhouse gas emissions ceilings and, in particular, the commitment to deliver a 25 per cent reduction from the agriculture sector by 2030 and agro-forestry and anaerobic digestion up to 5.7 TWh of biomethane mean that the rollout of biomethane production is highly likely to increase even faster than projected volumes in the Best Estimate scenario. Such a view is further highlighted by the following:

- Action 169 in CAP 2021 commits to a further review in 2023 of the 1.6 TWh target set for the level of biomethane in the gas grid by 2030; this could see a more ambitious 2030 target for biomethane being set next year;
- The Renewable Heat Obligation consultation contemplated a range of renewable heat energy targets up to 5.5 TWh, which is significantly more ambitious than the current 1.6 TWh; and
- The SEAI National Heat Study, published earlier this year, provides a comprehensive assessment of the options available to reduce CO_2 emissions associated with heating in Ireland. The Heat Study estimates a maximum potential of 5TWh of biomethane could be supplied in Ireland by 2030. Further opportunity may be sought to increase the production of biomethane above 1.6 TWh building on the output of the National Heat Study.

6.0 Gas supply
(continued)

Table 6-2: Biomethane gas supply forecast

TWh/yr	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29	29/30	30/31
Low	< 0.1	< 0.1	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6
Best estimate	< 0.1	< 0.1	0.2	0.6	1.1	1.6	2.0	2.4	2.8	3.2
High	< 0.1	0.1	0.3	0.7	1.2	1.8	2.7	3.7	4.7	5.7

Furthermore, recent rising interest in biomethane following the publication of REPowerEU also points to the number of biomethane operating plants and connections in Ireland rising further. One of the key actions to accelerate biomethane production proposed within REPowerEU is to support biomethane production to a sustainable maximum potential volume of biogas with the aim to further upgrade it to biomethane, as well as direct biomethane production from waste and residues. In this respect, the REPowerEU plan sets an EU-wide target of 35 billion cubic meters (bcm) of biomethane production by 2030, doubling the current EU ambition of 17 bcm in the 'Fit for 55' package. If prorate member state targets were implemented, the new target for Ireland would be approximately 10.2% of gas consumption - based on 2021 figures, this would amount to a target of circa 5.7 TWh per annum for Ireland by 2030. While the REPowerEU plan is not legally binding on Member States, it is noteworthy that recent analysis by Gas for Climate estimated the sustainable supply potential of biomethane in the EU-27 at 41 bcm in 2030 and 151 bcm by 2050, highlighting the achievability of 2030 and 2050 targets set within REPowerEU. Following the renewed biomethane ambition within REPowerEU, it is widely anticipated that the 35 bcm target may be translated by EU Member States into National targets by incorporating into their National Climate and Energy Plans and appropriate measures (e.g. permitting, financing, certification, etc.) enacted to scale up national biomethane industries. The GFS High biomethane scenario is aligned to the RePowerEU target of 5.7 TWh by 2030. The GFS Best Estimate scenario is based on achieving an intermediate level of 3.2 TWh/year of indigenous biomethane by 2030/31.

Table 6-2 shows Gas Networks Ireland's biomethane production forecast.

6.4 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.

Gas Networks Ireland is working with prospective renewable hydrogen producers on their connection enquiries and is actively engaging with these producers in answering

"Gas Networks Ireland will continue to engage with renewable energy developers to explore the opportunities and challenges presented by future injection of hydrogen into the gas network. "

enquiries. Gas Networks Ireland will continue to engage with renewable energy developers to explore the opportunities and challenges presented by future injection of hydrogen into the gas network.

As outlined in Section 3, looking beyond 2030, the gas network can be fully decarbonised by utilising biomethane and hydrogen. In the interim it is likely that hydrogen will begin to enter the network within the forecast horizon of the GFS, in low blended volumes on the Transmission gas network and with the potential for higher blends in parts of the Distribution gas network.

The recent Government announcement on sectoral greenhouse gas emissions ceilings commits additional resources for 2000 MW of green hydrogen by 2030, a level of which is anticipated to be injected into the gas network. Furthermore, the publication of the REPowerEU Plan in May 2022 confirmed the EU's plans to end its dependency on Russian fossil fuels through energy saving and diversification of supplies and to accelerate the roll-out of renewable energy. Building on the Fit for 55 package, the Plan included a proposal to increase the headline 2030 renewables target from 40% to 45% under the Fit for 55 package, including a target of producing 10 million tonnes of domestic renewable hydrogen plus 10 million tonnes of hydrogen imports by 2030. The GFS forecasts include low level blends of hydrogen in the network of up to 2% of annual system demand by 2030/31 supplied indigenously and through the interconnectors from the UK.

7.0

Commercial market arrangements

Key messages:

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

At EU level, full implementation by Gas Networks Ireland of the EU Network Codes has been completed.

The focus has moved to the European Green Deal, finalising the Hydrogen and Gas Markets Decarbonisation Package and most recently the REPowerEU Plan, which seeks to accelerate the move away from Russian fossil fuels with increased targets for biomethane and hydrogen production as part of the path to net zero.

"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."

7.1 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;
- maintain, and enhance where necessary, market rules which are included in the Code of Operations;
- 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;
- manage the contracts of the companies licensed to ship gas through the transportation system; and
- drive market change initiatives to deliver on decarbonisation targets.

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. Our role in this regard has never been more important following Brexit which resulted in ROI no longer being directly connected to another EU Member State. As a result, strong collaboration and engagement is required to minimise any issues that may arise as a result of ROI being directly connected to a third country (GB) and the potential for divergence in legislative and regulatory regimes. Against this backdrop and the challenges it may give rise to, Gas Networks Ireland will continue to ensure that a resilient, robust and safe gas network is maintained to customers through appropriate and efficient investment.

7.2 European developments

The EU Green Deal (published in December 2019) presented a high-level roadmap of key policies and measures to frame the EU's plans for decarbonisation and its ambition to become net zero by 2050. It has resulted in more ambitious targets and increased pressure to decarbonise, at both EU and national levels. Of particular interest to Gas Networks Ireland and the European energy industry were the 2020 publication of the EU strategies for Energy System Integration and Hydrogen (July 2020) and Reducing Methane Emissions (October 2020). These three strategies collectively pave the way towards a "fully decarbonised, more efficient and interconnected energy sector".

As a key step in delivering on the Green Deal, the European Commission's 'Fit for 55 Package', published on 14th July 2021, set binding targets of achieving climate neutrality by 2050 and a commitment to cut carbon emissions by at least 55% by 2030 (compared to 1990 levels). This series of 13 cross-cutting legislative proposals included eight revisions of existing legislation and five brand new proposals. The proposed amendments most relevant to Gas Networks Ireland, relate to the EU Emissions Trading System (ETS), Renewable Energy Directive,

7.0 Commercial market arrangements (continued)

Energy Efficiency Directive, and Alternative Fuels Infrastructure Directive. This Package is the starting point for Member States, the European Parliament and the Commission to debate and decide on a complete overhaul of EU energy and climate legislation over the coming years. These proposed changes will, in turn, have a major impact on national policies.

The proposed 'Hydrogen and gas markets decarbonisation package' (revising Directive 2009/73/EU and Regulation 715/2009/EU) was published in December 2021. This revision aims to redesign a competitive, decarbonised gas market, fit for renewable gases including hydrogen and biomethane. Gas Networks Ireland actively fed into this review via direct consultation input and representation through its various EU gas association memberships. Agreement on the final text of the revised directive is expected in late 2022 or early 2023. Since the Russian invasion of Ukraine in February 2022, the volume of new energy initiatives from the European Union has continued to accelerate:

- The revision of the Regulation on Trans-European Networks in Energy (TEN-E), which was adopted in May 2022 and which governs the PCI process, sought to ensure consistency with the ambition set out in the Green Deal by ending support for new natural gas and oil projects.
- The publication of the REPowerEU Plan in May 2022 confirmed the EU's plans to end its dependency on Russian fossil fuels through energy saving and diversification of supplies and to accelerate the roll-out of renewable energy. Building on the Fit for 55 package, the Plan included a proposal to increase the headline 2030 renewables target from 40% to 45% under the Fit for 55 package, including a goal to increase biomethane production to 35bcm by 2030 as well as a target of producing 10 million tonnes of domestic renewable hydrogen plus 10 million tonnes of hydrogen imports by 2030.
- New gas storage rules which elevate the status of gas storage facilities to critical infrastructure and put in place requirements on member states with underground gas storage facilities (Ireland is not included) to fill 80% of their storage capacity by 01 November in 2022 and 90% in the years after. These rules were adopted on 27 June 2022 in an effort to improve energy security amid Russia's invasion of Ukraine.

Gas Networks Ireland continues to proactively engage with our European and national stakeholders in the context of considerations and implications of these developments for our business and the wider Irish gas and energy market.

8.0

Gas network capacity

Key messages:

As part of the forecast modelling, Gas Networks Ireland compares the forecasted demands in Section 5 and the forecasted supplies in Section 6. The 2022 GFS highlights that the Best Estimate 1-in-50 peak demand is forecasted to surpass the combined system entry capacity over the GFS period.

Gas Networks Ireland will keep this potential constraint under review in subsequent Gas Forecast Statements and Network Development Plans.

Temporary operational measures have been identified to mitigate the constraint while the permanent capacity upgrades are put in place. Such measures, which include management of gas inventory storage in the subsea interconnectors, and changes to the operating regimes at the compressor stations will be sufficient to mitigate the constraint in the short to medium term while the permanent capacity upgrades are put in place.

Gas Networks Ireland is in the fifth and final year of its fourth regulatory Price Control Period (PC4)

Gas Networks Ireland is currently finalising a business plan for the next price control period (PC5) which will be submitted to the CRU in September 2022.

In 2021, twelve projects were completed including 1 AGI Capacity Upgrade, and 11 Reinforcements of the Distribution Network.

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

8.1 Investment planning

Gas Networks Ireland's planning and design 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 projects is on matters of proper planning and sustainable development having due regard for the environment. This process has been outlined in Section 2, 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.

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 2. System operator requirements continue to evolve and both environmental and European legislative requirements will impact on future system operation.

Gas Networks Ireland 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 ISO55001 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 detail 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); and
- **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.

8.2 Regulatory capital allowance

The CRU approves capital allowance for Gas Networks Ireland which fund the required investment on the network. Gas Networks Ireland is in the fifth and final year of its fourth regulatory Price Control period (PC4).

Gas Networks Ireland's business plan for the next price control period (PC5) will be submitted to the CRU in September 2022. This plan sets out the investment requirements for a five-year period to September 2027 to ensure the provision of a safe high-quality service for all gas customers, a continued focus on efficient spend, efficiently facilitating the energy transition and maintaining a safe and resilient network. The process was delayed due to the changed economic landscape that prevailed at the start of 2022, however determination is due for completion in 2023.

8.0 Gas network capacity
(continued)

Capacity constraints projects, refurbishments and new connections are funded by the Price Control Capital Allowance and form part of the Regulated Asset Base ("RAB"). A portion of the cost of new connections and capacity upgrades related to large new connections may be funded directly by the customer in accordance with the New Connections Policy.

Future investment proposals outside of the initial determination are subject to approval from the Commission for Regulation of Utilities and the relevant consents and permissions. System operator requirements continue to evolve and both environmental and European legislative requirements will impact on future system operations.

In addition to RAB-funded regulated investments, the Causeway Project is a regulated project funded by a combination of regulatory OPEX allowances (Innovation fund), cofunded from a grant from the CEF Transport Fund and upfront customer contributions. The Causeway project represents a significant step forward in delivering a sustainable alternative fuel for Irish transport.

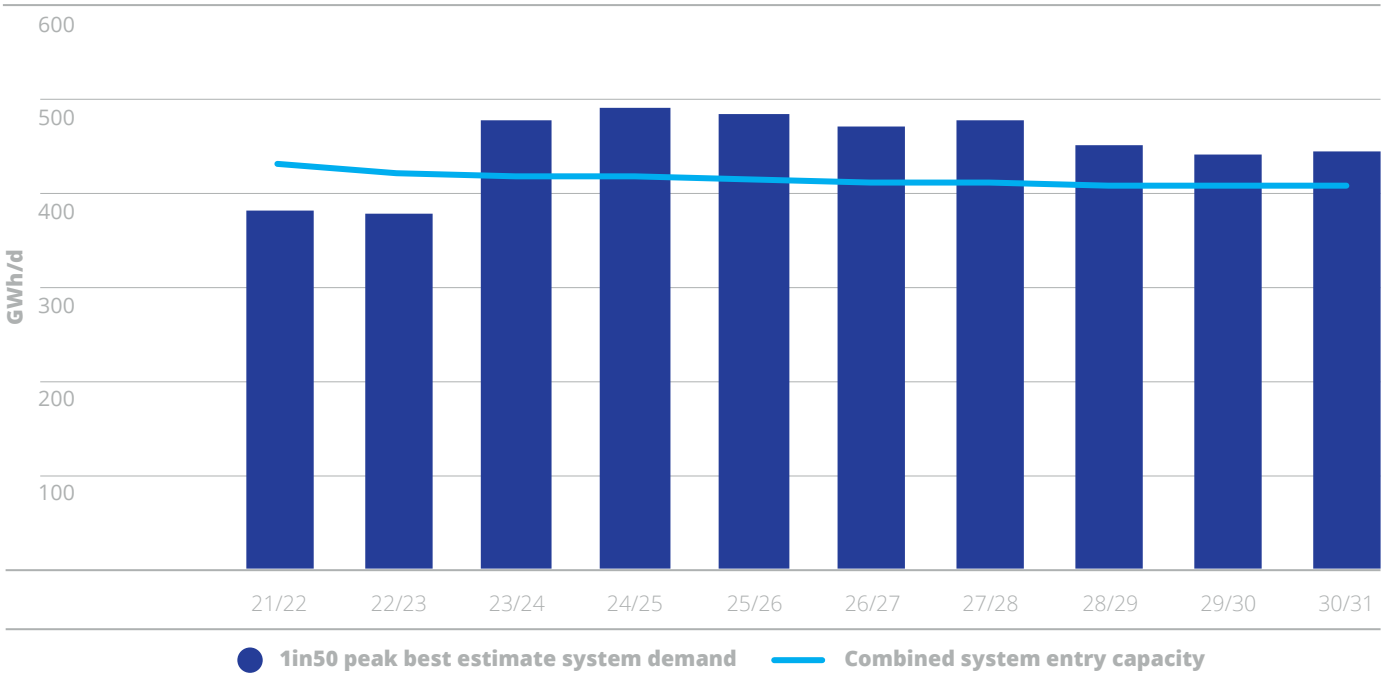
8.3 Completed capital programmes

Capacity limitations are identified on the network and addressed through appropriate capital investment programmes in order to ensure continuity of supply to all customers. In 2021, twelve projects were completed including 1 AGI Capacity Upgrade, and 11 Reinforcements of the Distribution Network. These projects were subject to the appropriate consenting and planning regimes as set out in Section 2.

8.4 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

Figure 8-1: Combined system entry capacity versus peak day gas demand



Section 5 is modelled to identify any potential capacity constraints. These constraints are typically capacity upgrades to Above Ground Installations (AGIs) and reinforcement of the distribution network. These works are completed under a capital investment programme.

As part of the forecast modelling, Gas Networks Ireland compares the forecasted demands in Section 5 and the forecasted supplies in Section 6. The GFS 2022 highlights that the Best Estimate 1-in-50 peak demand is forecasted to surpass the combined system entry capacity over the GFS period as shown in Figure 8-1.

Capacity on the interconnector pipelines is adequate to meet all gas demand projections over the ten-year horizon, the potential constraint would arise at the associated compressor station installations in Scotland. Gas Networks Ireland is progressing and proposing a series of short, medium and to long-term solutions to the Moffat constraint. These solutions will provide incremental increases in capacity at both compressor stations. Gas Networks Ireland will keep this potential constraint under review in subsequent Gas Forecast Statements and Network Development Plans. Temporary operational measures have been identified to mitigate the constraint while the permanent capacity upgrades are put in place. Such measures, which include management of gas inventory storage in the subsea interconnectors, and changes to the operating regimes at the compressor stations will be sufficient to mitigate the constraint in the short to medium term while the permanent capacity upgrades are put in place.

Appendices

Appendix 1: historic demand

Historic daily demand by metering type

The historic demand data in Section 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 Industrial and Commercial sites.
- Daily Metered (DM) sites with an annual demand greater than 5.55 GWh and less than 57 GWh, and includes the medium Industrial and Commercial, hospitals and large colleges etc.
- Non-Daily Metered (NDM) with an annual demand of 5.55 GWh or less, and includes the small Industrial and Commercial 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 Industrial and Commercial components:

- **Power sector**: The individual power stations are separated out from the LDM total.
- **The industrial and commercial sector**: Which is comprised of the demand from the remaining LDM sites, the DM sector and the NDM Industrial and Commercial 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 Industrial and Commercial demand combined into the TX DM Industrial and Commercial category; and
- Distribution demand has been subdivided into the DX NDM demand, with all of the remaining LDM and DM Industrial and Commercial demand combined into the DX DM Industrial and Commercial category

The transmission connected demand, Figure A1-1, does not appear to be particularly weather sensitive. The gas demand of the power sector 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.

Appendix 1: historic demand
(continued)

Figure A1-1: Historic ROI daily demand of transmission connected sites

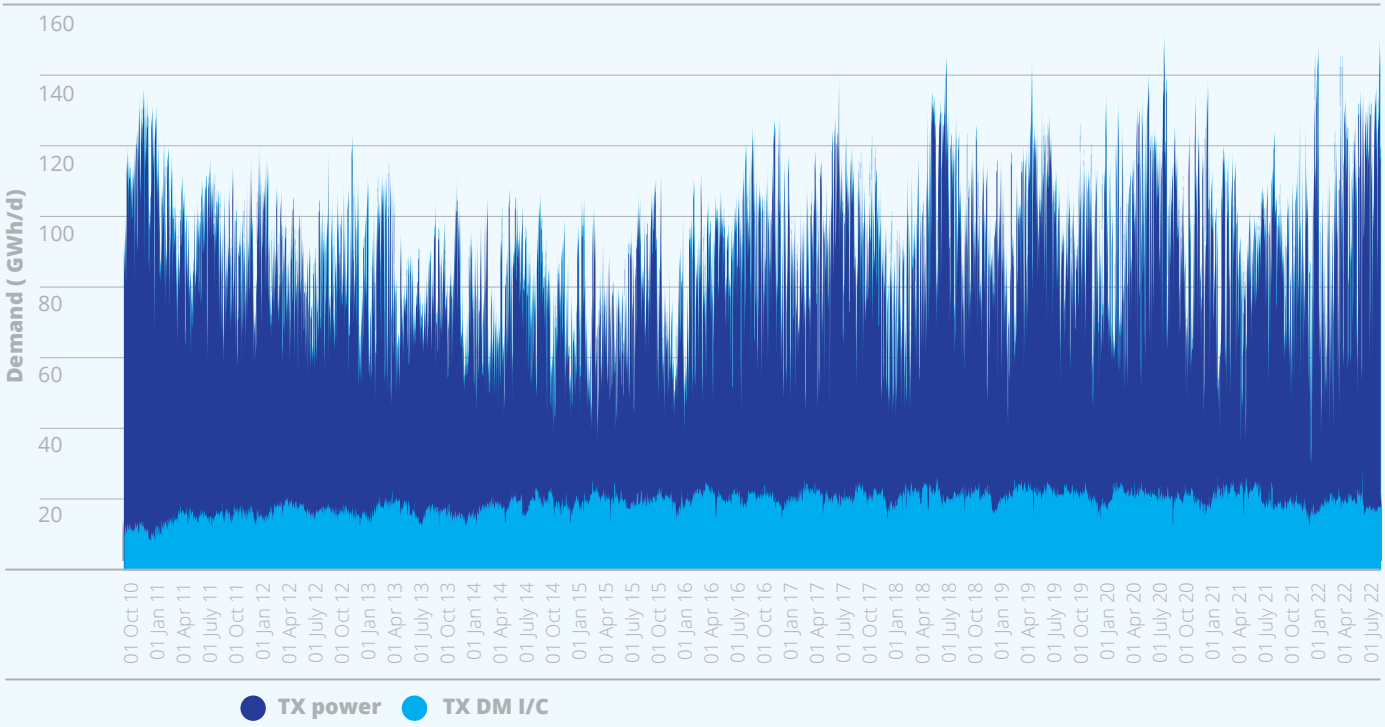


Figure A1-2: Historic ROI daily demand of distribution connected sites

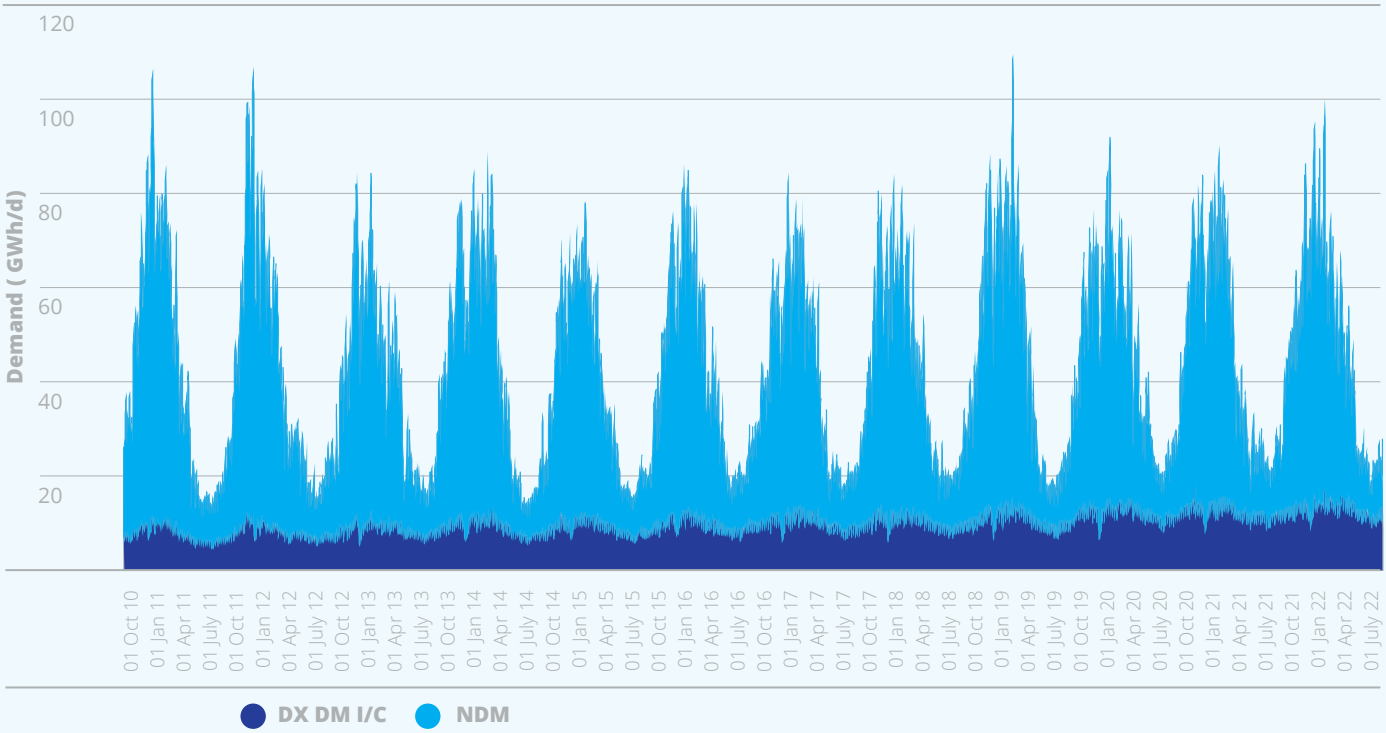


Table A1-1: Historic Gas Networks Ireland annual gas demands (actual) [42]

GWh/yr	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22
ROI	55,726	50,435	50,072	47,582	47,136	51,478	55,070	56,348	57,481	58,344	56,052	55,900
NI & IOM	17,852	15,142	15,031	15,132	16,970	16,992	18,168	16,984	17,005	17,693	18,798	17,748
Total	**73,578**	**65,577**	**65,103**	**62,714**	**64,106**	**68,470**	**73,237**	**73,332**	**74,485**	**76,036**	**74,849**	**73,647**

Table A1-2: Historic Gas Networks Ireland peak day gas demands (actual)

GWh/d	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22
ROI	244.1	211.7	213.2	187	203.8	199.4	221.8	215.9	218.5	225.4	248.5	233.0
NI & IOM	79.3	74.1	62.7	68.2	72.8	69.9	70.1	63.1	75.9	70.6	82.3	79.1
Total	**323.4**	**285.8**	**275.9**	**255.2**	**276.6**	**269.2**	**291.9**	**279**	**294.4**	**295.9**	**330.9**	**312.1**

Table A1-3: Historic ROI annual gas demands (actual)

GWh/yr	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22
Power[43]	35,365	29,864	28,156	26,910	24,708	29,061	32,181	31,936	33,050	33,772	31,349	33,071
I/C	12,021	13,244	13,700	13,682	15,013	15,581	15,835	16,485	17,149	16,879	16,797	15,750
Residential	8,340	7,326	8,216	6,991	7,414	6,835	7,054	7,927	7,282	7,693	7,905	7,078
Total	**55,726**	**50,435**	**50,072**	**47,582**	**47,136**	**51,478**	**55,070**	**56,348**	**57,481**	**58,344**	**56,052**	**55,900**

Table A1-4: Historic ROI peak day gas demands (actual)

GWh/d	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22
Power	132.2	114.1	119.9	102	102.4	104.7	121.6	110.1	113	129.4	134.3	144.7
I/C	49.6	49.4	50.4	46.8	54.8	54.9	56.6	61	60.2	58.8	59.3	49.7
Residential	64.2	48.2	44.2	39.9	46.6	40.1	43.6	44.8	45.3	37.2	55	39.0
Total	**246**	**211.7**	**214.4**	**188.7**	**203.8**	**199.7**	**221.8**	**215.9**	**218.5**	**225.4**	**248.5**	**233.5**

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

Table A1-5: Historic annual supplies through Moffat, Inch and Corrib

GWh/yr	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22
Moffat[44]	72,320	64,103	64,148	62,549	63,132	45,731	35,494	39,060	46,544	54,216	59,417	59,188
Inch	3,765	3,952	4,014	3,339	3,724	3,674	3,872	3,696	2,784	1,571	3	0
Corrib	-	-	-	-	-	20,470	34,659	32,612	26,747	21,217	16,520	15,494
Total	**76,086**	**68,055**	**68,162**	**65,888**	**66,856**	**69,876**	**74,025**	**75,368**	**76,074**	**77,004**	**75,940**	**74,682**

Table A1-6: Historic peak day supplies through Moffat, Inch and Corrib

GWh/d	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22
Moffat	303.9	255.7	251.2	232.7	248.3	189.5	172.9	171.4	213.2	233.9	280.8	261.8
Inch	33.7	32	26.7	26.4	28	19.6	16.8	11.2	9.7	5.7	-	-
Corrib	-	-	-	-	-	60.1	103.7	97.1	78.5	61.9	52.3	45.4
Total	**337.6**	**287.6**	**277.9**	**259.1**	**276.3**	**269.3**	**293.4**	**279.7**	**301.4**	**301.4**	**333.1**	**307.2**

42 Actual demands shown (not weather corrected) with residential estimated as % of NDM
43 Power sector gas demand is amended to account for those I/C connections which generate electricity for their own use less process gas
44 Table shows total Moffat supplies including ROI, NI and IOM

Appendix 1: historic demand
(continued)

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

Table A1-7: Historic coincident peak day and annual ROI demands

GWh/d Peak day	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22
TX power	132.2	114.1	119.9	102	102.4	104.7	123.8	106.1	113	129.4	134.3	144.7
TX DM I/C	12	17.7	17.8	16.1	18.8	21.1	20	21.7	20.3	23.1	18.7	16.8
DX DM I/C	12.3	11.9	12.2	12.6	13.3	13.5	13.6	14	15.5	15.5	15.8	14.8
DX NDM	89.5	68	64.6	57.9	69.4	60.4	61.2	68.4	69.7	57.4	79.8	57.2
Total ROI	**246**	**211.7**	**214.4**	**188.7**	**203.8**	**199.7**	**218.6**	**210.1**	**218.5**	**225.4**	**248.5**	**233.5**
Annual												
TX power	35,365	29,864	28,156	26,910	24,708	29,061	32,181	31,936	33,050	33,772	32,389	33,071
TX DM I/C	4,978	6,147	6,088	6,439	7,085	7,455	7,562	7,642	7,888	7,659	7,699	6,760
DX DM I/C	3,020	3,235	3,419	3,432	3,593	3,776	3,842	4,038	4,494	4,570	4,754	4,926
DX NDM	12,363	11,188	12,409	10,802	11,749	11,184	11,485	12,733	12,049	12,343	12,563	11,143
Total ROI	**55,726**	**50,435**	**50,072**	**47,582**	**47,136**	**51,478**	**55,070**	**56,348**	**57,481**	**58,344**	**57,405**	**55,900**

Table A1-8: Historic non-coincident peak ROI demand by sector

GWh/d Peak day	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22
TX power	133	117.4	119.9	108.7	103.2	123.2	127.3	142.2	141.5	148.4	136.5	147.7
TX DM I/C	18.4	20.4	22.9	23.1	25.1	25.4	26.3	26.4	26	25.2	26.5	28.7
DX DM I/C	12.3	12.7	13.7	12.8	13.8	14.1	14	15.8	15.9	18.7	17.3	17.7
DX NDM	94.9	73	75.5	65.8	73.5	71.5	71	97.2	76.4	74.8	83.2	69.9
Total ROI	**258.5**	**223.5**	**231.9**	**210.4**	**215.6**	**234.1**	**238.6**	**281.7**	**259.8**	**267.1**	**263.5**	**264.0**
Power	133	117.4	119.9	108.7	103.2	123.2	127.3	142.2	141.5	148.4	136.5	147.7
I/C	57.5	53.7	59.1	56.5	62.7	63.4	64.3	74.4	68.6	69.2	70.4	68.5
Residential	68	52.4	52.9	45.2	49.7	47.6	47	65	49.6	49.5	56.6	47.8
Total ROI	**258.5**	**223.5**	**231.9**	**210.4**	**215.6**	**234.1**	**238.6**	**281.7**	**259.8**	**267.1**	**263.5**	**264.0**

Appendix 2: demand forecasts

Assumptions

As outlined in Section 5 assumptions are made regarding a number of key demand drivers. These are summarised in Table A2-1 to Table A2-3.

Table A2-1: Future GDP annual growth

GDP growth (%)	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29	29/30	30/31
Low	4.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Best estimate	9.1	5.3	4.1	3.3	3.1	3.1	3.1	3.1	3.1	3.1
High	9.1	5.3	4.1	3.3	3.1	3.1	3.1	3.1	3.1	3.1

Table A2-2: Residential new connections

	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29	29/30	30/31
Low	5,000	3,033	2,833	2,833	2,833	2,833	2,833	2,833	2,833	2,833
Best estimate	5,467	4,600	4,117	3,992	3,967	3,967	3,967	3,967	3,967	3,967
High	6,267	5,592	5,317	5,192	5,167	5,167	5,167	5,167	5,167	5,167

Table A2-3: Residential new disconnections

	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29	29/30	30/31
Low	1,765	2,377	3,328	4,823	7,024	10,067	14,144	19,307	25,557	27,188
Best Eestimate	1,765	2,033	2,766	3,916	5,611	7,955	11,094	15,069	19,882	21,138
High	1,765	1,689	2,203	3,010	4,199	5,842	8,044	10,832	14,207	15,088

Forecast

The demand forecasts are summarised in Tables A2-4 to A2-12. Table A2-13 presents the various supply sources by entry point, both existing and proposed. The values represent the maximum supply volume each source could potentially provide.

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

- Tables A2-4, A2-5 & A2-6: 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 A2-7, A2-8 & A2-9: Peak-day gas demand under 'average year' weather conditions, i.e. the weather conditions that typically occur each year; and
- Tables A2-10, A2-11 & A2-12: 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).

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 power generation peak-day gas demand forecast assumes that all 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.

Appendix 2: demand forecasts
(continued)

Table A2-4: 1-in-50 peak day demand – low demand scenario

GWh/d	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29	29/30	30/31
Power	121.8	118.9	165.8	150.4	147.5	142.0	146.3	143.5	132.2	124.7
IC	74.1	73.1	93.9	95.6	94.9	81.8	81.1	79.7	78.3	76.7
Residential	63.7	63.5	63.0	62.4	61.7	60.7	59.4	57.8	55.7	53.5
Transport	0.1	0.1	0.1	0.3	0.4	0.7	0.9	1.0	1.0	1.0
Own use	3.0	3.0	3.4	3.4	3.4	3.2	3.2	3.1	3.0	2.9
Sub total	**262.6**	**258.5**	**326.3**	**312.1**	**307.9**	**288.3**	**291.0**	**285.2**	**270.2**	**258.8**
IOM	6.7	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9
NI	102.7	105.1	122.6	129.8	127.5	127.1	132.8	125.5	119.9	121.1
Total	**372.1**	**370.5**	**455.8**	**448.8**	**442.3**	**422.2**	**430.6**	**417.5**	**396.9**	**386.8**

Table A2-5: 1-in-50 peak day demand – best estimate demand scenario

GWh/d	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29	29/30	30/31
Power	129.7	124.4	171.2	175.5	168.4	168.8	168.7	150.3	149.2	153.2
IC	77.1	78.6	113.3	116.5	117.1	105.5	106.3	106.2	106.2	105.9
Residential	62.0	61.8	61.6	61.1	60.6	59.8	58.9	57.6	56.1	54.4
Transport	0.1	0.1	0.2	0.4	0.6	0.9	1.2	1.3	1.4	1.4
Own use	2.8	3.0	3.2	3.2	3.2	3.2	3.3	3.3	3.3	3.3
Sub total	**271.7**	**267.9**	**349.4**	**356.6**	**349.8**	**338.2**	**338.3**	**318.7**	**316.1**	**318.2**
IOM	6.7	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9
NI	102.7	105.1	122.6	129.8	127.5	127.1	132.8	125.5	119.9	121.1
Total	**381.2**	**379.9**	**478.8**	**493.2**	**484.2**	**472.2**	**478.0**	**451.1**	**442.8**	**446.2**

Table A2-6: 1-in-50 peak day demand – high demand scenario

GWh/d	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29	29/30	30/31
Power	130.5	130.6	173.5	188.9	177.4	181.6	183.4	171.2	176.2	180.9
IC	77.1	78.9	113.8	117.9	118.9	108.2	109.0	109.0	109.1	108.9
Residential	62.0	61.9	61.7	61.5	61.1	60.5	59.9	59.0	57.9	56.7
Transport	0.1	0.1	0.2	0.4	0.7	1.1	1.5	1.7	1.7	1.7
Own use	3.0	3.2	3.8	3.9	3.9	3.8	3.8	3.8	3.7	3.7
Sub total	**272.7**	**274.7**	**353.2**	**372.6**	**362.0**	**355.2**	**357.5**	**344.7**	**348.7**	**351.9**
IOM	6.7	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9
NI	102.7	105.1	122.6	129.8	127.5	127.1	132.8	125.5	119.9	121.1
Total	**382.2**	**386.6**	**482.6**	**509.2**	**496.3**	**489.2**	**497.2**	**477.0**	**475.4**	**479.9**

Table A2-7: Average year peak day demand – low demand scenario

GWh/d	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29	29/30	30/31
Power	112.8	143.0	151.0	145.2	149.5	141.5	136.1	135.0	114.0	118.4
IC	61.2	58.1	79.3	86.6	83.4	69.0	70.8	70.1	72.2	64.6
Residential	46.0	23.8	43.5	43.1	40.0	43.6	38.5	37.4	38.5	37.5
Transport	0.1	0.1	0.1	0.3	0.4	0.7	0.9	1.0	1.0	1.0
Own use	2.2	1.5	2.2	2.3	2.2	2.3	2.2	2.1	2.2	2.0
Sub total	**222.2**	**226.4**	**276.2**	**277.5**	**275.5**	**257.1**	**248.5**	**245.7**	**227.8**	**223.6**
IOM	6.5	6.5	6.6	6.1	5.4	5.4	5.3	5.0	5.3	5.3
NI	85.5	80.0	105.7	105.4	103.2	103.0	108.6	101.5	95.6	97.1
Total	**314.2**	**312.9**	**388.4**	**389.0**	**384.0**	**365.4**	**362.5**	**352.1**	**328.8**	**326.0**

Table A2-8: Average year peak day demand – best estimate demand scenario

GWh/d	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29	29/30	30/31
Power	141.3	140.8	162.6	158.8	149.6	150.1	148.0	144.3	137.7	144.1
IC	55.8	61.8	98.1	98.0	103.5	92.2	93.2	92.0	92.3	89.2
Residential	28.6	30.1	47.2	45.7	45.0	44.4	43.7	44.2	43.6	32.1
Transport	0.1	0.1	0.2	0.4	0.6	0.9	1.2	1.3	1.4	1.4
Own use	1.6	1.8	2.6	2.4	2.5	2.6	2.6	2.6	2.6	2.2
Sub total	**227.4**	**234.5**	**310.7**	**305.4**	**301.2**	**290.2**	**288.6**	**284.4**	**277.6**	**268.9**
IOM	6.5	6.5	6.6	6.1	5.4	5.4	5.3	5.0	5.3	5.3
NI	85.5	80.0	105.7	105.4	103.2	103.0	108.6	101.5	95.6	97.1
Total	**319.3**	**321.0**	**422.9**	**416.9**	**409.7**	**398.6**	**402.6**	**390.8**	**378.6**	**371.4**

Table A2-9: Average year peak day demand – high demand scenario

GWh/d	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29	29/30	30/31
Power	117.9	123.3	168.2	174.5	165.7	167.1	172.1	167.1	145.0	135.1
IC	63.3	67.6	98.8	99.3	107.1	97.6	93.1	90.1	100.1	99.7
Residential	46.1	44.0	48.0	46.0	44.1	43.0	42.5	41.1	46.7	40.3
Transport	0.1	0.1	0.2	0.4	0.7	1.1	1.5	1.7	1.7	1.7
Own use	2.2	2.4	2.6	2.5	2.5	2.6	2.5	2.4	2.9	2.4
Sub total	**229.6**	**237.4**	**317.8**	**322.7**	**320.0**	**311.4**	**311.7**	**302.3**	**296.4**	**279.3**
IOM	6.5	6.5	6.6	6.1	5.4	5.4	5.3	5.0	5.3	5.3
NI	85.5	80.0	105.7	105.4	103.2	103.0	108.6	101.5	95.6	97.1
Total	**321.5**	**323.9**	**430.0**	**434.2**	**428.6**	**419.8**	**425.6**	**408.8**	**397.4**	**381.7**

Appendix 2: demand forecasts
(continued)

Table A2-10: Annual demand – low demand scenario

TWh/yr	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29	29/30	30/31
Power	32.8	34.6	38.0	38.2	33.8	31.1	28.6	25.7	22.5	21.7
IC	17.1	17.0	17.4	17.3	17.2	16.9	16.8	16.5	16.2	15.9
Residential	7.9	7.9	7.9	7.8	7.7	7.6	7.4	7.2	6.9	6.7
Transport	0.0	0.0	0.1	0.1	0.2	0.2	0.3	0.4	0.4	0.4
Own use	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Sub total	**58.2**	**60.1**	**63.8**	**63.9**	**59.4**	**56.4**	**53.6**	**50.3**	**46.6**	**45.1**
IOM	1.6	1.6	1.6	1.5	1.3	1.3	1.3	1.2	1.3	1.3
NI	17.6	16.6	20.5	20.3	18.8	18.4	18.8	18.7	18.8	19.2
Total	**77.4**	**78.3**	**85.9**	**85.6**	**79.4**	**76.1**	**73.8**	**70.3**	**66.7**	**65.6**

Table A2-11: Annual demand – best estimate demand scenario

TWh/yr	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29	29/30	30/31
Power	33.4	36.1	40.8	41.4	37.5	37.1	37.2	33.2	26.9	24.3
IC	17.6	18.1	18.9	19.2	19.5	19.6	19.9	19.9	20.0	20.0
Residential	7.9	7.9	7.9	7.8	7.8	7.7	7.6	7.4	7.2	7.0
Transport	0.0	0.0	0.1	0.1	0.2	0.3	0.4	0.5	0.5	0.5
Own use	0.5	0.5	0.6	0.6	0.6	0.6	0.7	0.6	0.7	0.7
Sub total	**59.4**	**62.8**	**68.3**	**69.1**	**65.5**	**65.3**	**65.7**	**61.6**	**55.2**	**52.4**
IOM	1.6	1.6	1.6	1.5	1.3	1.3	1.3	1.2	1.3	1.3
NI	17.6	16.6	20.5	20.3	18.8	18.4	18.8	18.7	18.8	19.2
Total	**78.6**	**81.0**	**90.4**	**90.9**	**85.6**	**85.1**	**85.8**	**81.6**	**75.3**	**72.9**

Table A2-12: Annual demand – high demand scenario

TWh/yr	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29	29/30	30/31
Power	34.1	37.9	44.5	45.6	42.9	44.0	43.3	39.0	34.7	33.4
IC	17.6	18.2	19.0	19.3	19.7	19.9	20.1	20.2	20.3	20.4
Residential	7.9	7.9	7.9	7.9	7.8	7.8	7.7	7.6	7.4	7.3
Transport	0.0	0.1	0.1	0.2	0.3	0.4	0.5	0.6	0.6	0.6
Own use	0.4	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.5
Sub total	**60.1**	**64.6**	**72.1**	**73.5**	**71.2**	**72.6**	**72.3**	**67.9**	**63.6**	**62.2**
IOM	1.6	1.6	1.6	1.5	1.3	1.3	1.3	1.2	1.3	1.3
NI	17.6	16.6	20.5	20.3	18.8	18.4	18.8	18.7	18.8	19.2
Total	**79.3**	**82.8**	**94.2**	**95.3**	**91.3**	**92.4**	**92.4**	**87.9**	**83.7**	**82.6**

Table A2-13: Maximum daily supply volumes[45]

GWh/d	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29	29/30	30/31
Corrib	49.0	38.7	32.3	31.4	27.4	23.5	20.5	18.0	15.9	14.2
Moffat	386.9	386.9	386.9	386.9	386.9	386.9	386.9	386.9	386.9	386.9

45 Figures shown for Moffat are the current maximum daily supply volumes. Gas Networks Ireland is progressing and proposing a series of short-, medium- and long-term measures to increase the maximum daily supply volumes available from Moffat. These measures will provide incremental increases in capacity at both Compressor stations. Detailed engineering studies are ongoing to determine the potential increase to Moffat supply volumes over the time period presented.

Appendix 3: 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 section summarises the results of the network analysis carried out for this GFS.

Network analysis was carried out using hydraulic network modelling software, Pipeline Studio®. A single hydraulic model of the interconnector and ROI transmission systems[46] 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 2030/31;

- 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 A3-1: Entry point assumptions

	Moffat	Corrib
Pressure (barg)	47.047	Up to 85.0
Gross calorific value (MJ/scm)	39.848	37.7
Max supply (mscm/day)	35	4.7

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 mscm/d. 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).

46 NI transmission system is not included in the modelling. NI is treated as a demand at Twynholm, Scotland.
47 Anticipated Normal Off-take Pressure (ANOP).
48 Figure based on average historic values.

Glossary

AA	Appropriate Assessment
AD	Anaerobic Digester
AGI	Above Ground Installation
ALARP	As Low as Reasonably Practicable
ANOP	Anticipated Normal Offtake Pressure
BER	Building Energy Rating
BETTA	British Electricity Trading and Transmission Arrangements
CAM	Capacity Allocation Mechanism
CAP	Climate Action Plan
CCGT	Combined cycle gas turbine
CCS	Carbon Capture & Storage
CCUS	Carbon Capture Utilisation& Storage
CEF	Connecting Europe Facility
CGI	Central Gas Injection
CHP	Combined heat and power
CNG	Compressed Natural Gas
CO_2	Carbon dioxide
CPS	Carbon Price Support
CRU	Commission for Regulation of Utilities
DD	Degree Day
DECC	Department of the Environment, Climate and Communications
DM	Daily Metered
DRI	District Regulating Installation
EC	European Commission
ENTSOG	European Network of Transmission System Operators for Gas
ENTSO-E	European Network of Transmission System Operators for Electricity
ESRI	The Economic & Social Research Institute
ESIPP	Energy Systems Integration Partnership Programme
EU ETS	European Emission Trading Scheme
EWIC	East West Interconnector
EU	European Union
FDI	Foreign Direct Investment
FSR	Functional Specification and Requirements
GB	Great Britain
GCS	Generation Capacity Statement
GDP	Gross Domestic Product
GFS	Gas Forecast Statement
GHG	Greenhouse Gas
GRAZE	Green Renewable Agricultural & Zero Emissions
GTMS	Gas Transportation Management System
GTSC	Gas Technical Standards Committee
GWh	Gigawatt hour
GWhe	Gigawatt hour (electric energy)
GWh/d	Gigawatt hours per day
GWh/yr	Gigawatt hours per year
GWhe/yr	Gigawatt hours of electric energy per year
HGV	Heavy Goods Vehicle
HUGE	Hydrogen Utilisation Green Energy
I-SEM	Integrated Single Electricity Market Project
I/C	Industrial & Commercial
IC	Interconnector
ICT	Information & Communications Technology
IDA	Industrial Development Agency
IE	Ireland

IED	Industrial Emissions Directive
IMF	International Monetary Fund
IP	Interconnection Point
IOM	Isle of Man
ISCC	International Sustainability and Carbon Certification
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
NECP	National Energy & Climate Plan
NEEAP	National Energy Efficiency Action Plan
NGV	Natural Gas Vehicle
NI	Northern Ireland
NOx	Nitrogen Dioxide
NSAI	National Standards Authority of Ireland
NTS	National Transmission System
NUIG	National University of Ireland Galway
NZEB	Nearly Zero Energy Buildings
OCGT	Open Cycle Gas Turbine
OECD	The Organisation for Economic Co-operation and Development
PC4	Fourth Price Control
PC5	Fifth Price Control
PCI	Project of Common Interest
PfG	Programme for Government
PMA	Pressure Maintenance Agreement
PSO	Public Service Obligation
RAB	Regulated Asset Base
RED	Renewable Energy Directive
RES	Renewable Energy Source
RES-E	Renewable Energy Source use in Electricity
RES-T	Renewable Energy Source use in Transport
RGFI	Renewable Gas Forum Ireland
ROI	Republic of Ireland
SEA	Strategic Environmental Assessment
SEAI	Sustainable Energy Authority of Ireland
SEM	Single Electricity Market
SLGN	Sligo Local Gas Network
SME	Small and Medium Enterprise
SNSP	System Non-Synchronous Penetration
SOx	Sulphur Dioxide
TEN-E	Trans-European Networks in Energy
TEN-T	Trans-European Networks in Transport
TES	Tomorrow's Energy Scenarios
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
UK ETS	UK Emission Trading Scheme
UCD	University College Dublin
UNFCCC	United Nations Framework Convention on Climate Change


Gas
Networks
Ireland

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