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Gas Networks Ireland

Biomethane Energy Report

September 2023

Table of contents

Foreword

To meet Ireland's climate and energy security ambitions, Ireland's gas network must transition to transport renewable gases at scale.

Gas is, and will remain, a key component of the energy mix, not least to balance the variable production of wind and solar energy but also for intensive heat users and hard to abate sectors in the battle against climate change. It is therefore essential for Irish society and industry that the gas used is displaced by renewable gases. This is now possible through a combination of biomethane and green hydrogen.

At Gas Networks Ireland, we are uniquely placed to facilitate this necessary change, and we're working hard to achieve it. Our consistency and reliability in transporting gas has spanned decades as we transitioned from town gas, which dates back to 1764, to natural gas since it was discovered off the coast of Kinsale in the 1970s. This experience and our expertise enable us to transform now once again, from transporting natural gas to renewable gases.

We first introduced domestically produced biomethane onto Ireland's gas network in 2020 and, the quantity, while small to begin with, is increasing in line with Government ambition. Biomethane is seamlessly replacing natural gas and is fully compatible with existing gas infrastructure, appliances and technology.

In October 2022, we asked Ireland's current and future biomethane producers for input to assist in developing a roadmap towards a renewable gas network to facilitate Ireland's biomethane ambition.

A total of 176 prospective biomethane producers responded to our Request for Information (RFI), identifying Ireland's potential for a 14.8 TWh per annum biomethane industry – a quantity of energy greater than that procured from Ireland's first offshore wind auction,

A total of 176 prospective biomethane producers responded, outlining Ireland's potential for a 14.8TWh per annum biomethane industry – a quantity of energy just greater than that of the successful offshore wind auction, which took place earlier this year.

ORESS 1, which took place earlier this year. This volume not only represents 26% of the total gas currently transported in Ireland's gas network, but it also represents the potential to reduce Ireland's emissions by 3.94 million tonnes of carbon dioxide (CO_2) per annum), which equates to 6.5% of Ireland's total 60.76 million tonnes of CO_2 equivalent (Mt CO_2 eq) emissions in 2022[1].

While the Irish biomethane industry might be just beginning, countries such as Germany, France, Italy and Denmark have been progressing their biomethane markets over the past decade, where biomethane is a critical tool in assisting hard to abate sectors such as intensive heat users, agriculture and transport to decarbonise. Ireland can learn from these countries experiences and given the success we have had with renewable wind energy and more recently solar energy Ireland can also become a leader in biomethane production.

The success in recent decades in the renewables sector has placed Ireland in a very healthy position to develop a renewable gas sector, as there are experienced developers and funders supported by key legal and supply chain operators to expand into this new industry.

In 2022, Ireland's gas network transported 57.1 TWh of energy to Irish industries and households almost twice the volume of energy transported in the electricity grid at 32 TWh[2] last year. If Ireland is to reach its climate action goals, it is essential that the same level of effort and support are applied to decarbonising the gas network as has been applied to decarbonise the electricity grid over the past 30 years.

In the early 1990s, Ireland embarked on the first steps to support renewable electricity inspired in part by the wind industry in Denmark. Notably, it took 25 years for Denmark to reach 38% of their electricity production from wind and solar energy. The same milestone was achieved by the Danish gas industry, reaching 38% of gas consumption from biomethane in just 8 years. This could once again prove to be an inspirational blueprint to us here in Ireland and the gas network will be central to this.

An indigenous biomethane industry would not only support the reduction of emissions of the agricultural sector, but it would also provide significant opportunities for rural communities, facilitate sustainable circular economies and significantly enhance security of energy supply. A new biomethane industry in Ireland, as with any emerging sector, will face challenges that must be overcome and while the first Irish policy support for biomethane is in development, it is essential that it provides a framework which delivers long-term price certainty for the biomethane producers and ensures that the planning and permitting process is aligned to the specific needs of the sector.

This report really sends out a strong signal that there is significant interest and demand for biomethane production in Ireland. It's a very flexible gas that contributes to the circular economy, as farm and food waste can be treated to produce renewable gas, and the by-products include a digestate that can be re-used as fertilizer and carbon dioxide, which other industries can utilise.

We at Gas Networks Ireland will continue working to replace natural gas with renewable gases, such as biomethane today, and hydrogen in the future, on Ireland's existing gas infrastructure, which will help to substantially reduce Ireland's carbon emissions while enhancing energy security, in the least disruptive most cost-effective manner.

We look forward to your continued support on our biomethane journey and will continue to keep you abreast of our developments.

Cathal Marley
Gas Networks Ireland, CEO

1 EPA, June 2023
2 https://www.seai.ie/data-and-insights/seai-statistics/monthly-energy-data/electricity/

Executive summary

On 24th October 2022, Gas Networks Ireland issued a Request for Information (RFI) to prospective biomethane producers to support the identification of new and feasible biomethane production projects and prepare for increased biomethane connections and injection. The purpose of this RFI was largely to assess the future infrastructure requirements for biomethane integration into the gas network.

Furthermore, against the backdrop of Ireland's increased biomethane ambitions, Gas Networks Ireland viewed the RFI as an important opportunity to gather information from producers on a biomethane market in a formal, structured manner and, thereby, to establish the status of prospective biomethane production in Ireland. To prepare for increased biomethane connections and injection, Gas Networks Ireland has developed a coordinated gas network plan, the Biomethane Energy Report, which will outline the development of the gas network to bring biomethane onto the network in the most efficient and effective manner. The Biomethane Energy Report has been compiled and published by Gas Networks Ireland based upon the responses received to this RFI.

Key facts and figures from the responses received to the RFI:

	176 prospective producer responses received.
	In volume terms, responses total to 14.8 TWh annual production.
	Median plant production capacity is 40 GWh per annum.
	Median distance from producers to the gas network is 5km.
	Annual emissions reductions from 14.8 TWh of biomethane production would total to 3.94 Mt CO_2eq per annum by 2030.

The RFI response in terms of production volumes is more than two and a half times that of Ireland's stated 2030 biomethane ambition. While the results represent an important indicator of the robustness of Ireland's biomethane production targets, it must be matched by new policies, regulatory support and initiatives to ultimately deliver an affordable and reliable clean energy transition to biomethane. Many submissions note that one of the continuing challenges to biomethane development in Ireland is the lack of a biomethane-specific policy support mechanism. It is, therefore, clear that any large-scale process to advance biomethane in Ireland would be well subscribed by a critical mass of experienced developers as well as smaller developers seeking to progress towards commercialisation. The further consultation on the Renewable Heat Obligation proposal, published in August 2023 in addition to the new Biomethane Strategy, which is currently being developed, is timely and welcome as the first steps in supporting biomethane market development.

Ireland's biomethane target of up to 5.7 TWh of biomethane by 2030 is ambitious given Ireland produced just 41 GWh of biomethane in 2022 and total Irish production of 62 GWh is projected for 2023. Scaling up to 5.7

In 1992, the first wind farm was connected to the Irish electricity grid while Gas Networks Ireland connected the first biomethane injection site to our network in 2020.

TWh will require investment in up to 150 new median sized biomethane production units. Based upon the responses received and considering trends across Europe, the likelihood is for a smaller number of larger plants to evolve as a biomethane market develops in Ireland.

The timing of this report is important to the transition of the gas network to renewable gas. In 1992, the first wind farm was connected to the Irish electricity grid while Gas Networks Ireland connected the first biomethane injection site to our network in 2020. While the gap is 28 years and the electricity sector has had many initiatives to support decarbonisation in the intervening years, the evidence from Denmark is particularly encouraging. In eight years, the gas industry in Denmark achieved what it took 25 years to achieve in the Danish electricity sector - sourcing 38% of their gas from indigenously produced biomethane. This year, Gas Networks Ireland has reached a further milestone in its biomethane journey, signing its first connection agreement to directly connect biomethane production to its network. Biomethane is one of the renewable gases of the future and is available today to decarbonise the energy system. It is Gas Networks Ireland's intention to work assiduously to progress the decarbonisation of its networks via biomethane and green hydrogen and the outcome from the RFI lays out a promising path in that regard.

1

Introduction

The Biomethane Energy Report presents and analyses the responses to a Request for Information (RFI) issued by Gas Networks Ireland to prospective Irish biomethane producers in the final quarter of 2022 on new and feasible biomethane production projects. The aim of the RFI was primarily to assess the future infrastructure requirements for biomethane integration into Ireland's gas network. Set against the backdrop of Ireland's accelerating biomethane ambitions, Gas Networks Ireland also views the RFI as an important opportunity to gather information from producers on a prospective biomethane market in a formal, structured manner and, thereby, to establish the scale and status of future biomethane production in Ireland.

1.1 Overview of Ireland's national gas network

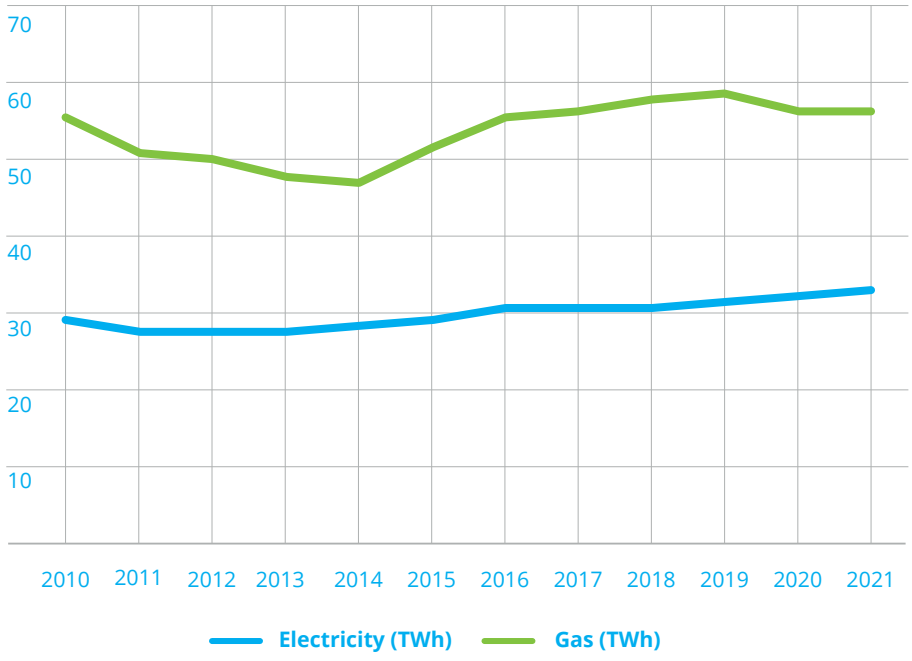
Gas Networks Ireland owns and operates Ireland's gas network. The national gas network is a €2.7 billion, state-owned asset, transporting energy solutions to 725,000 customers across 22 counties, consisting of over 12,000 km of distribution pipelines and almost 2,500 km of transmission pipelines. The gas network connects energy supply (gas entry points) with energy demand (end-users) and thereby, constitutes a key element of Ireland's energy system. The gas network also plays a key role in helping with balancing energy supply and energy demand, thereby ensuring that energy is available both where and when it is required.

Gas Networks Ireland is responsible for the safe, reliable and efficient transportation of Ireland's gas demand. Transporting over one third of Ireland's annual Total Primary Energy[3], the gas network meets significant portions of Ireland's industrial, commercial and residential energy demands together with generating circa. 50% of Ireland's electricity. The gas networks' contribution to Ireland is immense, not only in terms of the scale of energy transported but also in playing a vital role in providing resilience to the Irish energy system by supporting Ireland's intermittent wind and solar electricity supplies.

The gas network provides the flexibility to step in to generate electricity when intermittent renewable energy sources are not available and in addition, it plays a key role for many Irish industries that require high heat for their processes. It is noteworthy that, in Ireland, almost twice as much energy is transported in the gas network than is transported in the electricity grid – Ireland's gas network transported 57.1 TWh of energy in 2022; this compares with circa. 33 TWh of energy transported over the same period by the electricity network, as illustrated in Figure 1.1.

The energy transition to net zero will undoubtedly have a significant impact on Ireland's gas network and in the challenge to address the climate crisis, existing gas infrastructure and the gas network, in particular,

Figure 1.1: Volume of energy (TWh) transported by Ireland's gas network and electricity grid



Almost twice as much energy is transported in the gas network as the electricity grid – Ireland's gas network transported 57.1 TWh of energy in 2022.

3 Energy-in-Ireland-2022.pdf (seai.ie)

1. Introduction
(continued)

must be leveraged. This will only happen, however, if a technology-neutral approach to decarbonisation is adopted, with policy initiatives emerging that embrace and exploit the potential of the gas network to transform into a carbon neutral energy carrier. As Ireland's gas network operator, Gas Networks Ireland is responsible for complying with relevant national and European legislation. Gas Networks Ireland also has a role to play in both aligning with and helping to deliver national and EU climate policy frameworks and targets. In view of this and given the pivotal role of our gas network within Ireland's energy system, Gas Networks Ireland is intent on playing its part in delivering on Ireland's pathway to net zero. Ireland's gas network is, however, only at the outset of its transformation. Increasing the levels of indigenous renewable gas in the gas network and increasing integration and interoperability between the gas and electricity systems will be central to this transformation, enabling Ireland to achieve net zero by 2050 in the most cost effective and least disruptive manner while also enhancing energy security and diversity of supply. While the first renewable electricity wind farm was connected in 1992 in Bellacorick, Co. Mayo, the first renewable gas injected into the gas network was in 2020 in Cush, Co. Kildare. The electricity system has, however, had a range of support mechanisms in place to assist in directing and transforming electricity production and usage since the mid-1990s. It is anticipated that the gas network can achieve a similar transformation over a much shorter timeframe with the appropriate policy supports.

1.2 Ireland's pathway to net zero

Ireland has committed to an average 7 per cent per annum reduction in overall greenhouse gas (GHG) emissions from 2021 to 2030, a 51 per cent reduction over the decade, relative to 2018 levels, and further to achieve net zero emissions by 2050. The transition to a net zero carbon economy presents significant challenges for Ireland. Meeting these GHG emissions reduction targets, among the most ambitious in the world, will be challenging and will require fundamental changes to how our energy system and indeed our wider economy and society operate, with the need for a just transition and sustainable, secure and cost-effective solutions.

If Ireland is to meet its 2030 climate targets and ultimately transition to a clean energy system by 2050, a diverse range of low-carbon and net-zero energy technologies will be required. While the early focus has been upon wind and solar developments, and most recently, offshore wind, Ireland needs to embrace all renewable energies, particularly those that are already available and quickly scalable such as biomethane in the build-up to 2030. Renewable gases, with minimum carbon intensity such as biomethane and green hydrogen, can be employed as a further means of displacing natural gas, thereby, contributing to the transition towards a future net zero energy system. Given both the urgency to deliver on targets in the build-up to 2030 and the availability of biomethane technology and infrastructure, it is important to develop existing potential for biomethane production within circular economy, energy, and environmental systems.

Moreover, there has been rapid change in the energy sector since 24th February 2022 following the Russian invasion of Ukraine, with geopolitical developments heavily influencing energy decarbonisation, security, affordability and demand. Via biomethane, the security of energy supply can be enhanced helping to protect against price volatility in international markets. Furthermore, with biomethane, the total cost of ownership of the energy system is also minimised as the infrastructure for distribution and use is already in place. All of this has served to accelerate the ambitions around the role biomethane will play in displacing imported natural gas across Europe. The increasing prominence of biomethane in the energy transition, has been clearly recognised by the European Commission in the REPowerEU plan, with an increased annual biomethane production target of 35 billion cubic metres (bcm) by 2030. Anaerobic

While the early focus in Ireland and elsewhere has been upon wind and solar developments, and most recently, offshore wind, Ireland needs to embrace all renewable energies, particularly those that are already available and quickly scalable such as biomethane in the build-up to 2030.

Digestion (AD) is a proven and well-established technology in Europe, as evidenced by the continued steady growth observed in AD biomethane production facilities. Almost 70 new facilities were delivered in Europe in 2022, bringing the total number operational to 1,137, with a maximum installed capacity of more than 196 TWh of annual production. Biomethane also has the potential to yield energy security benefits where biomethane displaces imported natural gas, as well as bringing price stability benefits to customers alongside decarbonisation benefits.

1.3 Report outline

This report is structured as follows: Section 2 provides some insight into the role of biomethane in decarbonising Ireland's energy system together with an overview of the policy position of biomethane both at a national and EU level. Section 3 presents a detailed analysis of the responses received by Gas Networks Ireland to the RFI from prospective biomethane producers including in-depth analysis of the gas infrastructure requirements arising from the RFI. Biomethane market arrangements from an EU and national perspective are detailed in the next section. Sections 4, 5 and 6, respectively, consider the implications for gas demand and the gas supply benefit of biomethane. Finally, the decarbonisation potential of biomethane out to 2030, based upon the results of the biomethane RFI, are quantified in section 7 of the report while section 8 concludes.

2

The role of biomethane in decarbonising Ireland's energy system

Biomethane as a renewable gas, is already firmly established and available on the European market, and it has the potential to progressively replace natural gas supplies both at a European and national level. The role of biomethane in the energy transition process, facilitating a secure and decarbonised energy future, has been highlighted by the EU Commission in the REPowerEU plan, with an increased annual indigenous production target of 35 bcm by 2030. This report illustrates that in a future energy scenario biomethane can make a substantial contribution to Ireland's renewable gas demand where the balance of Ireland's renewable or zero-carbon gas requirements will migrate to other technologies such as green hydrogen.

2.1 Understanding biomethane

Biogas is produced as the main product of the AD of biological feedstocks including food waste and agricultural feedstocks (such as animal manures, grass, grass silage, etc.). The AD process produces biogas from feedstocks, through the breaking down of organic material by micro-organisms in large oxygen-free tanks. Biogas is typically comprised of 60% methane and 40% CO_2, and it can be used locally for heat purposes or for power and heat production. As an alternative, biogas can be upgraded to biomethane to replace natural gas. When biogas is upgraded to greater than 97% methane, it is termed biomethane. Biomethane satisfies the Renewable Energy Directive II's (RED II) life cycle analysis (emissions created and avoided are accounted for and sustainability criteria met) and can be classified as "renewable gas". Biomethane can, therefore, assist in meeting Ireland's decarbonisation targets.

Biomethane production plants are hubs of the circular economy - streams of materials previously regarded as waste, from agriculture, industrial processes and water management can be channelled through anaerobic digesters and converted into:

1. renewable energy in the form of biomethane.
2. nutrient-rich organic fertiliser or digestate (which can be used locally as a renewable bio-fertiliser).
3. pure biogenic CO_2 (which can be used as a feedstock in multiple industrial applications).

The separate collection and digestion of organic waste in biomethane plants results in threefold GHG emission savings:

- avoided emissions from decomposing wastes.
- production of renewable energy in the form of biomethane, which replaces natural gas.
- production of organic fertilisers/ digestate - after AD, all key nutrients and micro-nutrients can be directly used on soil as a fertiliser, thereby, substituting fossil fuel based mineral fertilisers.

A biomethane plant can result in a net reduction of GHG emissions, capturing the naturally occurring emissions to produce biomethane. While both biomethane and natural gas release CO_2 upon combustion, biomethane can be net zero provided the process has captured emissions equal to or greater than those from the combustion of biomethane. Methane is the most significant GHG emission from agriculture at present and biomethane plants provide the opportunity to reduce this significantly. Biomethane production also significantly reduces the net emissions of nitrous oxide, which is the second most significant GHG emission from agriculture. This saving will result from the displacement of chemical fertilisers and raw slurry land spreading, with more stable and efficient digestate derived bio-fertiliser.

While both biomethane and natural gas release CO_2 upon combustion, biomethane can be net zero provided the process has captured emissions equal to or greater than those from the combustion of biomethane.

2. The role of biomethane in decarbonising Ireland's energy system (continued)

2.2 The role of biomethane

Biomethane is a renewable gas, structurally identical to natural gas that can be used as a direct substitute for natural gas. Biomethane is fully compatible with the national gas network and existing appliances, technologies and vehicles, and can seamlessly replace natural gas to reduce emissions in industrial heating, transport and power generation. As such, it is one of the means to reduce the consumption of fossil fuels and, thereby, contribute to the transition towards a net zero energy system.

Replacing natural gas with biomethane, represents an essential step in the decarbonisation of Ireland's energy system. Biomethane will play an important role in this future system, representing an opportunity to enable Ireland to transition to a climate neutral economy by being a zero-carbon substitute for natural gas. Sustainable and indigenously produced biomethane can help Ireland meet its 2030 emissions reduction target and sectoral emissions ceilings, also, play a role in sustainably delivering a net zero energy system to meet its 2050 net-zero emissions targets, diversify and strengthen its security of supply, and provide a pathway to energy independence.

Gas Networks Ireland is working towards the decarbonisation of Ireland's energy system by replacing natural gas with renewable gases - biomethane initially and green hydrogen in the future - ensuring a secure and diverse energy supply for Ireland. While there is currently much discussion, in Ireland and elsewhere, on the prospects for hydrogen, this will take some time to reach significant scale, with hydrogen technology advancement the long-term carbon neutral solution in the gas industry. The more immediate and localised opportunity for renewable gas is advancing the production and utilisation of indigenously produced biomethane. Delivering on Ireland's increased ambition for biomethane production, as set out in Climate Action Plan (CAP) 2023 and REPowerEU, is, as a result, one of Gas Networks Ireland's key priorities.

Figure 2.1: Rationale for accelerating biomethane production

Security of supply	Domestically produced biomethane, dispersed throughout the country, boosts security of supply and can displace fossil gas from Corrib as it declines.
Cost-competitive	Similar to the early years of the wind industry, the biomethane gate price is currently more expensive than natural gas. However, when the full system decarbonisation alternatives are considered, biomethane represents a cost competitive solution.
Rapid climate action	Biomethane could rapidly reduce climate emissions across hard to abate energy demand sectors and can create negative emissions.
Sustainable agriculture	Biomethane production boosts employment in rural areas, promotes circular economy in agriculture, and can improve soil health. Digestate, a byproduct of biomethane production can displace fossil produced fertilizer.
Energy system services	Biomethane can deliver highly valuable energy, which is dispatchable, suitable for intensive heat industries, transport and other hard to abate sectors.
Technology and infrastructure ready	Biomethane is produced with existing technology and can therefore be rapidly scaled up. It can also be transported, stored and distributed through existing gas grids.

The injection of biomethane into the gas network is aligned with both EU and individual Member State decarbonisation strategies across Europe. Several EU Member States are incentivising a move away from the use of biogas at AD sites for electricity production towards the injection of biomethane into the gas network. Italy has subsidies for existing AD plants to direct their biogas to biomethane production and subsequent injection into the gas network. Other countries, such as the United Kingdom and France, have also developed policies to similarly target biomethane production for injection into the gas network. An alliance has been established amongst the French gas network companies to promote the decarbonisation of the gas network, with a 100% renewable gas target now in place for 2050. Denmark has committed to fully displacing natural gas on their gas distribution network with biomethane by 2035.

Biomethane is receiving a lot of attention in recent times from a policy perspective. The development of an indigenous biomethane industry demonstrates strong alignment with key European and national environmental and energy policies.

The rationale for accelerating Ireland's biomethane ambition is set out in Figure 2.1.

2.3 Biomethane policy

Biomethane is receiving a lot of attention in recent times from a policy perspective. The development of an indigenous biomethane industry demonstrates strong alignment with key EU and national environmental and energy policies.

EU policy

At an EU level, energy policies have signalled a strong biomethane-specific support for emissions reductions, with several policy frameworks supportive of biomethane introduced over recent years. A sustainable biomethane industry in Ireland would therefore directly contribute to the aims of several EU climate policy objectives and frameworks.

REPowerEU published by the EU Commission in 2022 is a joint European action plan, REPowerEU which aims to phase out the EU's dependence on fossil fuels from Russia, via higher liquified natural gas (LNG) and pipeline imports from non-Russian suppliers together with increased use of biomethane and renewable hydrogen. The overarching goal of REPowerEU in terms of biomethane is to support the achievement of an EU-wide target on biomethane production of 35 bcm in 2030 and to create the preconditions for a further ramp up of its potential towards 2050, in order to increase EU energy security. Biomethane measures set out within REPowerEU are very supportive of creating the preconditions for sustainable and safe injection of biomethane into the gas grid. In this context, REPowerEU is in favour of an expanded role for gas network operators in facilitating biomethane injection. One of the key action areas specified is the requirement to provide incentives for biomethane injection, with a specific reference to the costs of upgrading biogas, grid connection and grid injection acting as a barrier of entry for individual operators thereby, preventing biomethane injection. To assist with the implementation of the REPowerEU plan, the EU Commission published a Biomethane Action Plan setting out measures to be taken at both national and European levels to scale up biomethane production and consumption.

Europe aims to be net zero by 2050, as set out in the EU's Green Deal. The development of a biomethane industry can directly contribute to this net-zero target, displacing emissions from natural gas, slurry and chemical fertiliser production. Integrating slurry as feedstock to AD biomethane plants avoids the emissions from slurry storage and spreading and instead captures them for use in energy production – simultaneously supporting farmers in complying with the Nitrates Directive.

Furthermore, a sustainable biomethane industry would directly contribute to the aims of the EU Methane Strategy. While the uptake of improved waste management practices and the displacement of chemical fertiliser with digestate bio-fertiliser each contributes to a number of the key goals set out in the EU Farm to Fork Strategy, the EU Circular Economy Action Plan and the EU Biodiversity Strategy.

2. The role of biomethane in decarbonising Ireland's energy system (continued)

National policy

At a national level, an indigenous biomethane industry could support some high-level climate targets introduced over recent years including:

Climate Action Plan (CAP) 2023

Includes the following key actions relevant to the development of a biomethane industry in Ireland, including:

- Promote indigenous, agri-based biomethane production.
  - By 2025 – Production of up to 1 TWh of Biomethane by 2025; Construction of up to 20 AD plants of scale.
  - By 2030 – Production of up to 5.7 TWh of Biomethane by 2030; Construction of up to 200 AD plants of scale.
- DAFM & DECC to establish a Biomethane Working Group to develop a National Biomethane Strategy.
- Introduce a Renewable Heat Obligation Scheme by 2024 (introduce obligation in the heat sector, incentivising the production of indigenously produced biomethane).

Sectoral emissions ceilings

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. Achieving the Climate Action Plan biomethane production ambition of 5.7 TWh, replacing natural gas with biomethane in the national gas network would result in a carbon abatement of 1.5 Mt CO_2eq[4]. These emissions savings could support the achievement of sectoral emissions targets.

Climate Action and Low Carbon Development (Amendment) Bill

In July 2021, the Climate Action and Low Carbon Development (Amendment) Bill was signed into law and Ireland is now on a legally binding path to net-Zero emissions no later than 2050, and to a 51% reduction in emissions by the end of this decade.

2.4 Biomethane connection to the gas network

Biomethane is structurally identical to natural gas and can therefore be injected into the existing gas network and used interchangeably with natural gas. Biomethane production plants can be connected at the distribution or transmission level, or, alternatively, biomethane producers may opt to operate without a direct connection to the gas network and transport their gas by road to a central grid injection (CGI) point on the gas network. The choice of network connection option is driven primarily by distance from the gas network and the size of the plant. Under the Connections Policy[5] for biomethane connections, the customer contribution to the cost of connection includes two components:

- A standard contribution of 30% of the estimated costs for the connection assets.
- A supplemental "economic test" contribution to provide for any shortfall in the capital costs of the connection not recovered through attributable tariff payments. Further detail in this is provided in Section 3.2.3.

The connections policy also incentivises connecting parties to the 'least cost' or most efficient solution - for instance, a transmission connection is only viable for a very large customer. When the cost of connecting fully meets the economic test a producer pays 30% of the upfront capital cost of connecting infrastructure. If, however, the biomethane plant is a significant distance from the existing gas network the producer pays an amount in excess of 30% increasing with distance and associated connection cost.

Based on analysis of the RFI responses, most biomethane production, by volume, will be connected to the low-pressure distribution network. In a minority of instances, the proximity to the high-pressure transmission system together with the size of the plant mean that it is more economical for the producer to connect to the transmission network.

If the production site is too far from the existing gas network or the biomethane production plant is too small in size, it may not warrant an economic connection to the gas network. In this case, a viable alternative is to compress the biomethane to a higher pressure and transport it by trailer to a point where it can be injected into the gas network. These injection points are referred to as CGI sites. Currently, there is one CGI facility at Cush, Co. Kildare, which was constructed with the assistance of innovation funding from Gas Networks Ireland.

CGIs will represent a critical aspect of biomethane injection, facilitating the exploitation of continuous biomethane production regardless of a biomethane producers' geographical location and proximity to the gas network. Led by

4 The "Marginal Abatement Cost Curve" report recently published by Teagasc concludes that the achievement of the Government's 5.7 TWh of biomethane production ambition by 2030 would deliver 1,518 kt CO_2eq in year one. Cumulatively over the 2021 to 2030 period, 4.1 Mt CO_2eq savings would be delivered assuming the 5.7 TWh biomethane ambition is achieved

5 Gas-Networks-Ireland-Connections-Policy-Document-Revision-5.0.pdf (gasnetworks.ie)

Gas Networks Ireland, the GRAZE (Green Renewable Agricultural Zero Emissions) project will deliver the first large scale CGI facility in Ireland near Mitchelstown, Co. Cork and will collect biomethane from plants in its catchment area, transport it by road to the CGI facility and inject it into Ireland's gas network.

2.5 Readiness of the gas network for transport of biomethane

While our network is already seamlessly transporting biomethane, albeit small in volume, there is nevertheless a need to prepare for a pronounced ramp-up in biomethane production in the build-up to 2030 and an associated increase in biomethane injection into the gas network. With increasing volumes of biomethane injection, it will be necessary to undertake more extensive capacity planning to ensure that all biomethane is utilised in the network.

Significant biomethane development could change the existing flows in the gas system, most notably due to more decentralised gas supply. Solutions already exist in some countries to address the decentralised supply challenge arising from biomethane injection. For instance, reverse compression facilities now exist in a number of European countries to support the gas network to distribute decentralised biomethane production by implementing bi-directional flow from the distribution network to the transmission network. This is necessary, as a high percentage of biomethane plants, circa. 60% of European plants[6], are connected to the distribution network. If significant volumes of biomethane are injected into the low-pressure distribution network, the biomethane can be compressed and injected into the high-pressure transport network, a reversal of conventional design. This issue is addressed more fully in Section 3.3.5.

The connections policy also incentivises connecting parties to the 'least cost' or most efficient solution.

2. The role of biomethane in decarbonising Ireland's energy system (continued)

While our network is already seamlessly transporting biomethane, albeit small in volume, there is nevertheless a need to prepare for a pronounced ramp-up in biomethane production and an associated increase in biomethane injection into the gas network.

It is noteworthy that the investment challenges faced are significantly lower than those experienced in the electricity sector, where wind and solar are the major renewable sources. Gas infrastructure has the key advantage, relative to the electricity sector, of being already able to accommodate huge volumes of biomethane, moving it towards consumption centres and storing it with limited incremental costs. The required changes will necessitate gas network operators to provide bottom-up designs and a more flexible management and operation of their networks, which is achievable. In most EU jurisdictions, the cost of reverse compression is borne by the network operator and socialised via the tariffs to avoid step changes in developments whereby an individual producer may be burdened with the additional cost of reverse compression, which may subsequently benefit other developments. In this respect, the EU-wide practice is akin to the treatment of deep reinforcement costs in the electricity network.

2.6 Green Certs and Guarantees of Origin

Renewable gas certificates (sometime referred to as "Green Certs" or Guarantees of Origin can be issued to producers of biomethane who are injecting into gas grids. The EU has approved a number of schemes (EU Voluntary Schemes) such as ISCC[7] or Red Cert that are authorised to verify if the biomethane produced qualifies as a renewable fuel. These schemes perform a lifecycle assessment of the biomethane, including all elements of how the gas is produced including transportation of waste feedstocks right through to delivery of gas to customers. Producers that meet the necessary requirement can be issued with proofs of sustainability, which record and declare their production of biomethane as being renewable. The Scheme is fully compliant with the EU Renewable Energy Regulations, more commonly referred to as RED II, the Conference of the Parties 21 (Paris Agreement) and associated IPCC processes and guidelines, providing reassurance and confidence to the consumer, regulator and Government.

The key financial benefit of buying Green Certs is that it will obviate the need to pay carbon tax or if a customer falls under the EU Emissions Trading System (ETS) system it obviates the need to acquire carbon credits to the degree that renewable gas is used in replacement of natural gas.

Following the EU's RED II regulations, the Minister for the Environment, Climate and Communications passed into Irish law the Statutory Instrument number 350 of 2022 on 12th July 2022. This legislation appointed Gas Networks Ireland as the Issuing Body for Guarantees of Origin for Gas, produced from renewable sources. In addition to this, the Commission for Regulation of Utilities (CRU) is set to establish a supervisory framework, against which a guarantee of origin can be issued. At present, the Supervisory Framework governing the operation of the Registry is being prepared by the CRU. When this step is concluded, arrangements for the import and export of Guarantees of Origin will be developed.

Gas Networks Ireland now issue Guarantee of Origin certificates to producers of renewable gas for every megawatt hour of renewable gas injected into Ireland's national gas network, with the aim of providing certainty for customers as to the origin of renewable gas purchases and a mechanism for gas producers to monetise the renewable value of their product including biomethane.

By providing an objective means of tracking the commercial transactions of renewable gas through the supply chain, Ireland's Renewable Gas Registry helps establish trust in the market and confidence in the renewable gas sector. This certificate will disclose the origin of the gas to the end consumer via a book and claim system. Each certificate represents a guarantee that the equivalent amount of renewable gas has been injected into the gas network.

Many energy users wish to procure renewable gas because they recognise the importance of reducing their carbon footprint and moving towards a more sustainable future for their company and customers. This demand has created the requirement for a European-wide market of renewable gas certificates. Renewable gas certificates have been administered by registries in several European countries to meet the need for title-tracking of the green value of renewable origins injected into national gas networks.

To date, most certificates have found their way to the transport market to meet the Renewable Transport Fuel Obligation (RTFO) targets. Biomethane used to fuel Compressed Natural Gas (CNG), or LNG vehicles is now recognised by the RTFO, which is operated by the National Oil Reserves Agency (NORA). Once the biomethane has been supplied to the transport fuel market, the NORA scheme issues RTFO certificates for the biomethane. The volume of renewable gas used in the transport market is counted towards Ireland's transport targets set out in RED II.

Biomethane injected into the gas network can be transported to forecourts, which have a CNG refilling station. This renewable gas is a zero-emissions fuel in the transport sector and qualifies for the RTFO. Gas Networks Ireland's Renewable Gas Registry tracks the allocation of the biomethane from the point of injection into the network to the point of withdrawal at individual refuelling stations. A Proof of Origin certificate issued by the Registry completes a mass-balance check, tracking the volume claimed from the point of injection to withdrawal from the network. To complete this, Gas Networks Ireland checks that both injection and withdrawal have taken place by the claiming parties and then assigns the production amount to the withdrawn amount. With the respective cancellation statement, RTFO certs may be claimed. NORA has published a guidance document describing this process.

Import of natural gas into Ireland occurs daily at the Moffat Interconnection Point. Therefore, the physical import of biomethane is also possible.

Gas Networks Ireland aims to recognise mass-balance certificates from other European registries transferred to Ireland on a pilot basis. For imported amounts, Gas Networks Ireland may issue a Proof of Origin in the Registry.

The EU Commission is in the process of establishing the 'Union Database', which aims to ensure the tracing of liquid and gaseous fuels that are eligible for being counted towards the share of renewable energy in any Member State. This project will introduce processes to simplify and standardise arrangements for the flow of renewable gas between Member States.

Renewable gas certificates may be traded by account holders in the registry prior to the final allocation of renewable gas to a consumer. When an account holder sells renewable gas certificates to a consumer, Gas Networks Ireland cancels the associated certificates in the registry and issues a cancellation statement. This ensures a direct link from producer to consumer and proof of the origin of the renewable energy.

3

Biomethane Request for Information (RFI)

Against the backdrop of Ireland's biomethane ambitions and Gas Networks Ireland's focus upon delivering on this ambition, Gas Networks Ireland issued a RFI[8] to prospective biomethane producers in the final quarter of 2022 to support the identification of new and feasible biomethane production projects.

8 https://www.gasnetworks.ie/docs/business/renewable-gas/Biomethane-RFI-Overview.pdf

3.1 RFI from prospective biomethane producers

The RFI was an opportunity to establish the current potential of biomethane production in Ireland by gathering information from prospective biomethane producers in a formal, structured manner. The RFI was open for approximately two months, with the RFI issued on 24th October 2022, and submissions invited in response by December 19th, 2022. The timeline for the RFI process is set out in Figure 3.1 below.

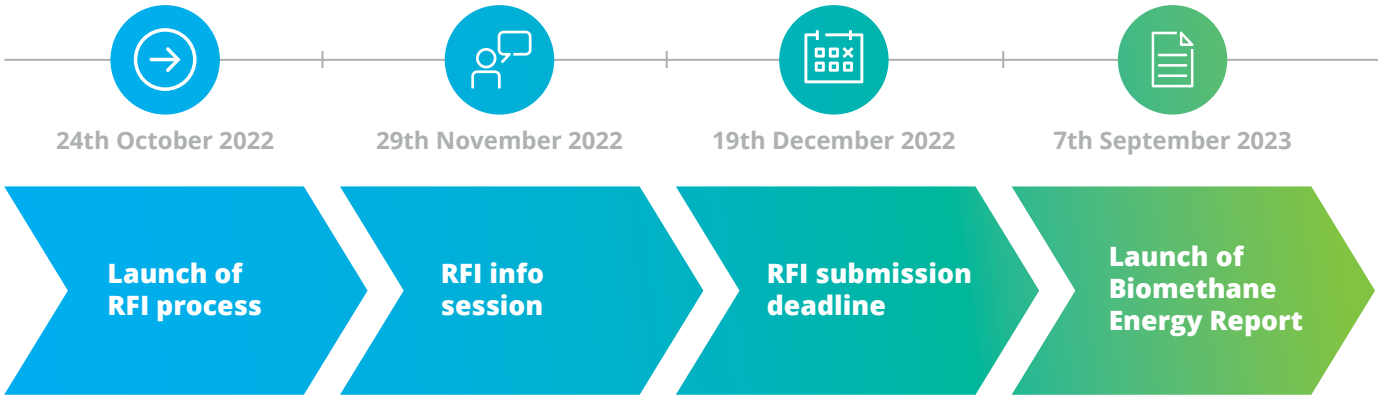
The purpose of the RFI on biomethane production was twofold:

1. Use RFI biomethane production data to assess the future infrastructure requirements for biomethane integration into the gas network by comparing the current gas network infrastructure to the mapping of biomethane production potential from the RFI.
2. Gas network operators are key stakeholders in relation to the development of a biomethane industry and, most notably, the planning of biomethane integration into the gas network. In view of this and given the need to rapidly scale up biomethane production in Ireland by 2030 up to the 5.7 TWh stated ambition, the findings from this RFI will provide Gas Networks Ireland with detailed information to pro-actively engage with Irish policymakers to plan a gas network fit for future needs.

In terms of the type of information that Gas Networks Ireland was seeking in the RFI, there were a number of key themes, with questions classified in relation to biomethane production plant details (location, size of the plant), planning permission and feedstock type. The RFI was open to both private and public sector respondents, and a broad range of responses encompassing different sources of feedstock supply from within the Republic of Ireland was also encouraged.

Gas Networks Ireland continues to monitor ongoing energy policy development and will incorporate all further policy measures and ambitions into the NDP Best Estimate scenario as these measures and ambitions become known.

Figure 3.1: RFI process timeline



3. Biomethane Request for Information (continued)

3.2 RFI results – analysis

3.2.1 Aggregate

The RFI provides a snapshot of prospective biomethane production in Ireland and thereby is an opportunity to better understand the status of Ireland's nascent biomethane market. In aggregate, the RFI from biomethane producers yielded 176 responses. In volume terms, these responses total to 14.8 TWh of biomethane production by the end of the assessment horizon 2030. Aggregate RFI results are presented in Figure 3.2 below.

A comparison of this aggregate RFI volume response with Ireland's recently accelerated biomethane production ambition reveals that the RFI response outturn compares very favourably with, and comfortably exceeds by more than two and a half times, the 5.7 TWh 2030 ambition stated in Climate Action Plan 2023. RFI responses, both in number and volume terms, therefore, serve to underline the robustness of the Government's 2030 biomethane ambition. Further analysis of current domestic consumption of natural gas relative to the estimates for the national biomethane production potential in 2030 from the RFI indicates that 26% of total gas demand could be met by biomethane.

In terms of annual production capacity, the median sized plant based upon RFI responses is 40 GWh per annum. The EU is relied upon throughout this report as a benchmark given that it is the world's largest producer of biogas and biomethane. Such a finding compares with an average production capacity of 35 GWh per annum[9] at an EU level. Europe's biomethane market includes many smaller biomethane plants, as well as plants with large production capacities. Although there is an increase in smaller biomethane plants, the average yearly biomethane production per plant in Europe has remained stable at around 35 to 36 GWh yearly production per plant for the last six years. This demonstrates the increasing uptime and performance of both new and existing biomethane plants in Europe.

Of the 176 responses received, almost 60% or 105 responses, in absolute terms, were sized between 40 GWh to 55 GWh in annual capacity. The relevance of this beyond the simple fact that the prospective plants coincide with the EU average is that this size of plant would fit well with equipment suppliers' expectations around the EU suggesting that the nascent Irish market is already centring around economic and technical norms. The median distance of RFI biomethane plants is 5km from the network. Based on current cost profiles, such a distance is slightly higher than the key threshold for the median plant size when undertaking the "economic test" approved by the CRU that is applied to all connections. This "economic test" will be further addressed later in this report.

Figure 3.2: RFI aggregate results

14.8 TWh
Volume

176
Number of projects

5 km
Median distance from network

40 GWh
Median plant size

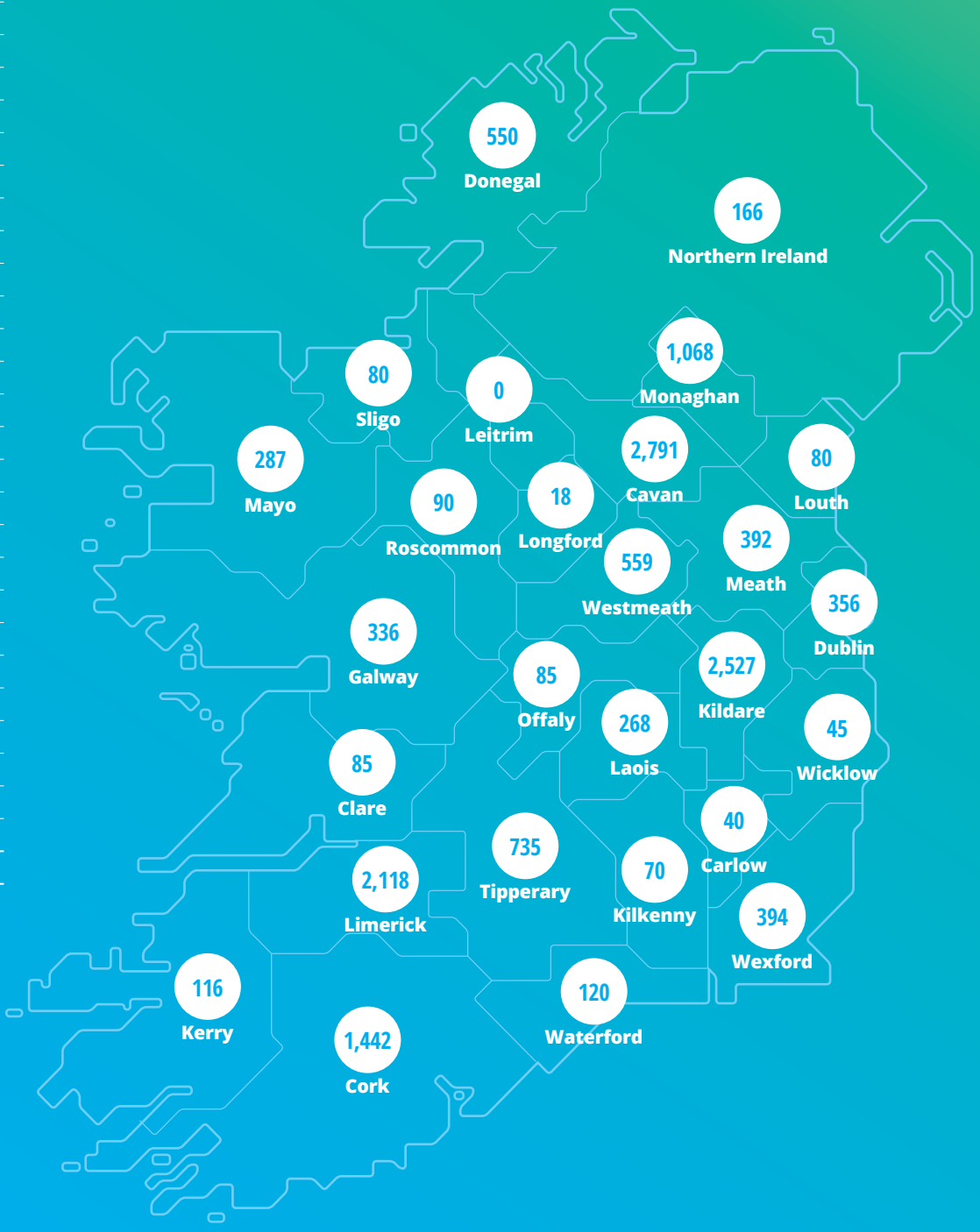
3.2.2 Geographic analysis

Figure 3.3 presents RFI responses on a county–by-county basis and clearly illustrates that biomethane production projects may be developed (with the exception of Leitrim with no RFI responses received from this county) in all counties. Other counties such as Longford, Carlow and Wicklow, however, have a comparatively low response rate,

9 In 2021, the average production per biomethane plant was 34.7 GWh (EBA Statistical Report 2022).

County	GWh
Carlow	40
Cavan	2,791
Clare	85
Cork	1442
Donegal	550
Dublin	356
Galway	336
Kerry	116
Kildare	2,527
Kilkenny	70
Laois	268
Leitrim	0
Limerick	2,118
Longford	18
Louth	80
Mayo	287
Meath	392
Monaghan	1,068
Northern Ireland	166
Offaly	85
Roscommon	90
Sligo	80
Tipperary	735
Waterford	120
Westmeath	559
Wexford	394
Wicklow	45
Total	**14,818**

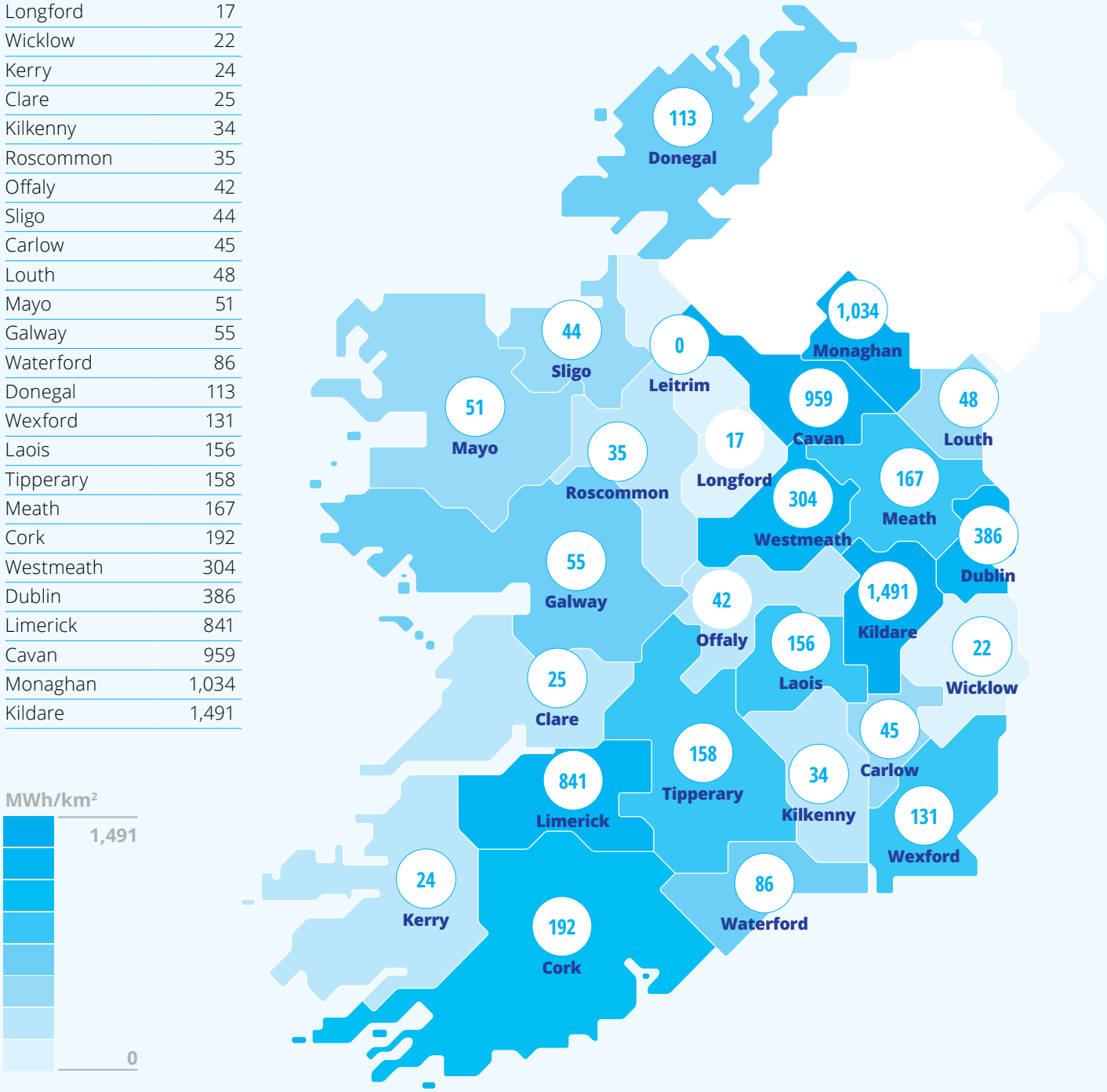
Figure 3.3: RFI biomethane production responses by county



3. Biomethane Request for Information
(continued)

County	MWh/km²
Leitrim	-
Longford	17
Wicklow	22
Kerry	24
Clare	25
Kilkenny	34
Roscommon	35
Offaly	42
Sligo	44
Carlow	45
Louth	48
Mayo	51
Galway	55
Waterford	86
Donegal	113
Wexford	131
Laois	156
Tipperary	158
Meath	167
Cork	192
Westmeath	304
Dublin	386
Limerick	841
Cavan	959
Monaghan	1,034
Kildare	1,491

Figure 3.4: RFI biomethane production – MWh per km²



with nine counties having responses totalling to less than 100 GWh per annum. This indicates that there is clear scope within these counties to expand biomethane production and further underlines that the overall prospects for biomethane production may even exceed those detailed within this report.

RFI responses from biomethane producers outside of the Republic of Ireland, yet within Northern Ireland, were also welcomed, albeit subject to additional requirements – specifically, the need to demonstrate that the project is in close proximity to the Gas Networks Ireland network or capable of being transported by road into the Republic of Ireland for injection into the Irish gas network system. Responses received from Northern Ireland relate to a number of projects, located close-by to Gas Networks Ireland's transmission network in Northern Ireland, albeit small as a share of total volume, amounting to 0.166 TWh.

Analysis of the density of biomethane production, measured in MWh per km², as illustrated in Figure 3.4, further highlights the variation by geographical location. A number of counties with a high density of production may, however, be heavily influenced by the availability of feedstock. For instance, Kildare represents the single largest county in terms of density of production and this may reflect relatively good availability of feedstock from both agriculture as well as domestic and commercial organic waste from the Greater Dublin Area. Furthermore, the counties of Monaghan and Cavan rank highly owing to a range of agricultural practices in these two counties, which represent very good prospective feedstock options. As a result, it is difficult to make a definitive assessment of the true potential of biomethane production from the dataset. Nevertheless, it is reasonable to conclude that those counties with low levels of production may understate their biomethane production potential within this study.

3.2.3 "Economic test" and connection distance

Before analysing connection options for RFI responses, it is important to address the process of applying the "economic test" to new biomethane connections. For biomethane connections, both transmission and distribution, the customer contribution in relation to a connection includes two components:

- A standard 30% contribution.
- A supplemental "economic test" contribution.

Gas network connections have always been subject to an "economic test". At its simplest, an "economic test" ensures that the cost of connecting new customers or new towns is evaluated relative to the revenues that will be generated from these connections over prescribed timeframes, with these timeframes varying by category of customer. This approach is overseen by the CRU. The economic appraisal will consider the projected revenues recovered over 10 years, together with the forecast of capital costs (excluding the 30% mandatory contribution) and any ongoing operational costs, in order to ascertain whether a project returns a positive or negative Net Present Value (NPV) in aggregate.

In the case of biomethane connections, a new connection that meets the "economic test" means that the connecting party will solely pay the standard 30% contribution to the capital cost of connection.

If the economic assessment is negative, the customer or producer contribution will increase above the 30% until a break-even position is reached. This then becomes the cost of connection to the producer. A longer time-period for the economic appraisal of a biomethane connection will lead to additional revenue being generated across this period, which is incorporated into the appraisal itself.

Given that the priority of the energy regulator is to ensure stability in annual gas tariffs, it is reasonable to assume that future gas tariffs would be maintained at a stable level. The gas tariffs would then be applied to projected biomethane demand profiles. While each appraisal would be specific to the relevant project, generally, the commitments already made at Government level to ensure increased biomethane production should result in strong demand profiles for the economic periods of review. Assuming other costs remain relatively stable over the period, the additional revenue that is generated through a longer appraisal period, benefiting from a potentially increasing demand profile, could contribute to more projects returning a positive NPV in the period of review, while ensuring committed capacity in the gas network.

3. Biomethane Request for Information (continued)

The implication of the "economic test" in the analysis of the responses to the RFI is significant. For example, the current "economic test" applied over 10 years indicates that biomethane plants under 20GWh per annum would not have a positive NPV and as a result are deemed to be connected to a CGI instead of distribution network. Notably there are 32 respondents to the RFI below 20 GWH. Similarly, biomethane production sites, which are 40 GWh, meet the "economic test" as long as the distance from the network is circa 3.5Km from the network. (Note; this is not a fixed figure and can increase or decrease as a result of inflationary costs being out of line with tariff changes).

This analysis highlights an issue in relation to the appropriate timeframe for the "economic test" of biomethane connections. The lifetime of a biomethane plant is generally held to be 20 years or more. If a longer timeframe were to be used in the "economic test", the threshold in terms of both the size of biomethane plant connected to the gas network would reduce and the distance from the network that a biomethane plant could still meet the threshold for 30% connection cost would increase.

In conclusion, the "economic test" has a bearing on the outcome of this analysis. In the analysis of all projects submitted to the RFI, each project is assessed to see if it passes the "economic test" and with a slight margin for error. If it does not pass the "economic test" it is assumed that the project will not be connected by pipeline and instead would be directed to a road transportation option to a CGI.

3.3 Network connections

One of the key purposes of the RFI, from a Gas Networks Ireland perspective, was to assess the future infrastructure requirements for biomethane integration into the gas network by comparing the current gas infrastructure to the mapping of biomethane production potential.

Accordingly, all responses have been analysed and mapped using the Geographical Information System (GIS). The mapping of projects relative to the gas networks illustrates that 50% of project are within 5.6Km from the network and 64% of projects are within 10km of the existing networks. The mapping of projects onto GIS allows us to assess the location of each of these projects in terms of:

- their distance from the gas network.
- the clustering of sites in proximity to the gas network.

This mapping of biomethane production from the RFI can then be used for future planning by anticipating potential needs for network updates and build an ongoing dialogue with policymakers and the regulator to plan a gas network fit for future needs.

3.3.1 Network connections analysis – methodology

Gas Networks Ireland has undertaken a network connection assessment of the 176 responses received whereby the current gas network infrastructure is examined in the context of the mapped biomethane production potential from the RFI responses. This connection assessment incorporates an analysis of the potential need for gas network upgrades including capacities, injection points, gas flows, pressure levels etc. Additional network equipment installation (pipes and compression) and reverse compression capacities are also considered within the context of this network connections analysis.

Four elements of each of the 176 responses has been analysed as part of this network analysis including:

1. Length of pipeline or distance of the plant from the gas network.
2. Pipeline size determined by flow velocity or the speed with which the biomethane will flow from the plant onto the gas network.
3. Transmission or distribution network connection.
4. Expected level of constraint faced, whereby, for instance, there is not enough demand on a distribution network at periods of low demand during the summer months or alternatively, a large plant seeking a connection to a small distribution network may lead to constraints in winter months.[10]

This network analysis, underpinned by RFI responses, is combined with a set of indicative project costs for connection to the gas network associated with biomethane injection projects. The project costs have been compiled using data sourced from distribution network reinforcement projects and mains laying activities undertaken as new connection projects over the 2018 to 2023 period. It is, however, important to highlight that the final costs of biomethane connections are subject to change as the cost of each individual injection facility will vary

10 A map of the expected level of curtailment for each of the distribution networks has also been compiled. Detailed network analysis of RFI biomethane responses has also been undertaken to inform the requirement for within grid compression, CGI locations.

Figure 3.5: Overview of Gas Networks Ireland's transmission system

3. Biomethane Request for Information (continued)

depending on proximity from the existing gas network, requirement for compression equipment and whether the project is connecting to the distribution or transmission network.

The applicable standard distribution project costs were categorised based upon the following:

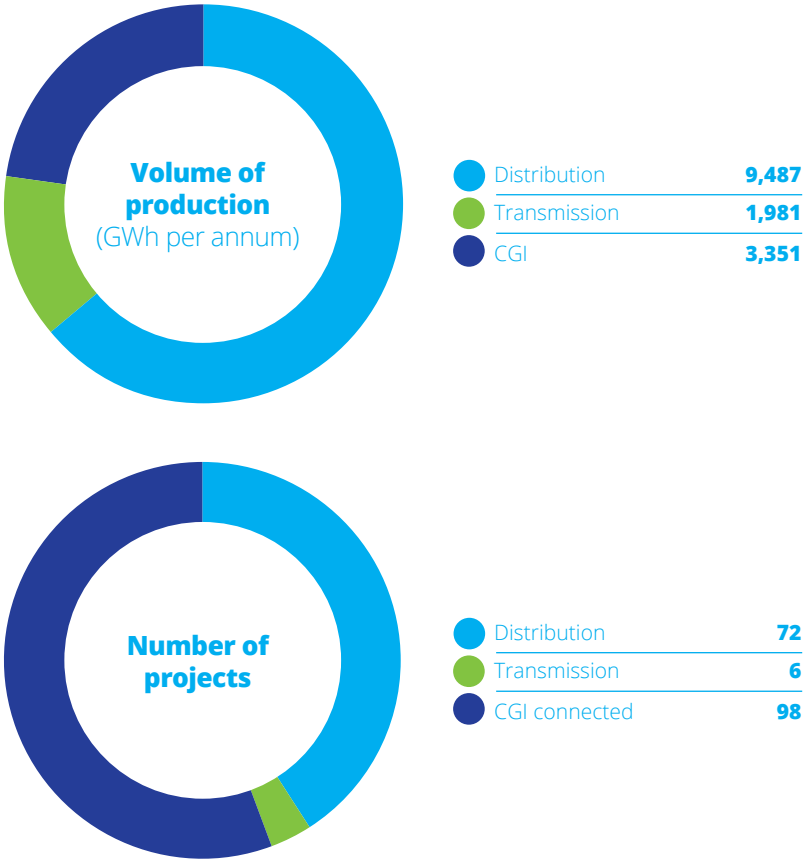
- Pipe diameter.
- General location (rural, semi urban, urban).
- Budget complexity (low, medium, upper).
- These project costs were utilised to determine the indicative costs for each category.

Additional non-standard costs were also incorporated to include the following:

- Special engineering difficulties (e.g., rail or river crossings).
- Wayleaves.
- Environmental allowances.
- Inflation allowances.
- Overheads and contingency.

These costs were, in turn, combined with biomethane injection specific equipment assumptions, specifically, relating to biomethane network entry facility (BNEF) and reverse compression costs. BNEF describes a range of equipment and facilities, which ensure that the biomethane is compliant with all necessary standards and regulations before it enters the gas network. The BNEF unit incorporates equipment such as gas analysis metering, sampling equipment, odorant injection system, pressure regulation/ pressure reduction system, divertor valve, telemetry unit and a remotely operated entry valve.

Figure 3.6: Biomethane connections by connection type



3.3.2 Direct connection to transmission and distribution networks

In the case of a direct connection, producers directly connect their biomethane production site to the gas network via a pipeline. At each direct connection entry point for biomethane, there is a BNEF, which becomes the entry point on the gas network.

Connection of a biomethane plant to the distribution or the transmission network is largely determined by two key factors:

1. Distance of the plant from the existing network, which largely determines the cost of network connection.
2. Scale or size of plant, which has a significant impact on the "economic test" parameters, which ultimately determine the connection cost for the customer.

Generally, biomethane plants are expected to be connected to the distribution system, largely due to the lower cost of distribution assets.

Some biomethane production is, however, so close to the transmission network infrastructure that it is more cost efficient to connect directly to the transmission system.

For the purposes of this report, the "economic test" has been employed to assess whether RFI projects are likely to be connected to the gas network directly or not. As addressed in Section 3.6.2, projects that meet the "economic test" will be charged the standard contribution of 30% of the capital cost of connection. It should, however, be noted that this is not a pass/fail test and as such failure to meet the pass level means that a connection charge will exceed the 30% stated in the policy. We have allowed a 10% leeway in assessing direct connection. While this is arbitrary, and some customers may be prepared to pay above a 10% threshold beyond the 30% connection charge for a direct connection it was felt that it is a reasonable assumption at this early stage in the industry development.

The analysis determined the connection types to be as follows:

- 72 projects are connected to the distribution network, with an aggregate volume of 9,487 GWh of biomethane per annum.
- 6 projects are connected to the transmission network, with a total biomethane volume of 1,981 GWh per annum.
- 98 projects are connected via a CGI facility, with volume totalling to 3,351 GWh per annum (excluding any clustered connections further discussed in Section 3.3.4).

These results are also presented in Figure 3.6.

It is noteworthy that such a profile of distribution and transmission connections for biomethane plants is broadly similar to that at a European level.

3.3.3 Central grid injection (CGI) facilities

Biomethane producers can opt to produce biomethane on-site and transport it via road, known as a "virtual pipeline", to a CGI facility, as outlined in Section 2.4. In this instance, the biomethane produced by the plant operator is compressed, collected in a bank of high-pressure containers on a trailer and transported by road to a CGI facility where the biomethane is injected into the gas network.

For the purposes of this report, a producer is connected to the network via a CGI facility where they are located too far from the gas network to be economically viable for a direct connection to the distribution or transmission network. The assumption in relation to economic viability is that CGI connections are required when a customer contribution to the pipeline connection cost exceeds 40%. The mandatory minimum contribution is 30% is in accordance with the "economic test" of the Connections Policy. A threshold of an additional 10% is relied upon to incorporate those producers who are only marginally outside the "economic test" 30% threshold. It is reasonable to assume that such producers would be willing to pay for the convenience of a pipeline connection over transporting by road.

3. Biomethane Request for Information
(continued)

It is clearly cost-effective to aggregate the output of multiple neighbouring biomethane producers and therefore, clustering warrants consideration.

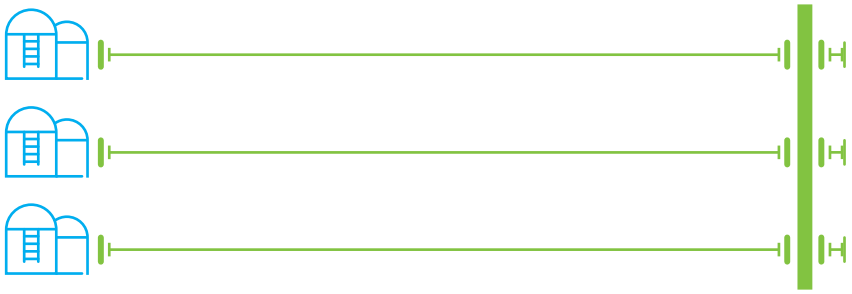
Based on this approach, more than half the RFI responses in number but less than one quarter in volume terms fall into the category of CGI connected producers. Analysis of this category of responses points to a requirement for, in aggregate (including the planned site near Mitchelstown), five CGI facilities of similar size to the Mitchelstown facility, which can accommodate circa. 700 GWh of capacity per annum at peak capacity.

3.3.4 Clusters

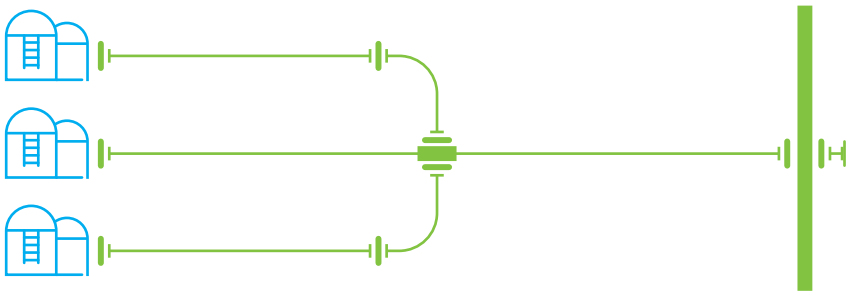
There is a further opportunity when considering the possible solutions for biomethane producers seeking to access the market. A number of locations in Ireland have limited or no gas network infrastructure in place.

Figure 3.7: Direct vs clustered connections

Direct connection model



Cluster connection model



The Border regions are particularly relevant in this respect as they have exceptionally low or, in the case of Donegal, no gas network infrastructure. When considering how biomethane producers in these areas can deliver their product to market, it raises the issue of how best to facilitate these projects - should CGI facilities be employed to inject this biomethane into the gas network or should extending gas networks be considered grouping a number of biomethane sites together.

The initial analysis completed for each of the 176 RFI responses was undertaken on an individual basis, with no consideration given to clusters or the amalgamation of plants for network connection purposes. Taking a clustering approach to biomethane is a new concept for the gas industry, with all gas connections to the network, to date, assessed on a singular or standalone basis. In locations where plants are small in terms of biomethane production capacity, they can be clustered and connected to the network via a single pipeline connection. This would serve to both reduce the overall number of CGIs and increase either distribution or transmission directly connected plants and volumes. Moreover, it is more economic and cost-effective to aggregate the output of multiple neighbouring biomethane producers and consider on a grouped basis whereby the connection assets required to access the network are shared. Therefore, clustering warrants consideration. Before this analysis is considered, further clarity would be required in relation to the appropriate “economic test” to be applied.

Given the experience with directly connected biomethane production in our analysis and in other EU Member

States, it is likely that the development of clustered connections would result in an increase in connections on the low-pressure distribution system. It would also result in a reduction in the number of CGI facilities required nationally. The geographical dispersal of such plants across five geographical areas stand out, namely, Donegal, Monaghan, Sligo, Tipperary and Wexford. The specific locations in these counties have limited or no existing gas network. Based upon RFI responses received, these five counties have a concentration of biomethane production that warrants further consideration for cluster connections.

If these production sites were amalgamated it would reduce the number of biomethane producers being facilitated by CGI by 38, from 98 to 60. In volume terms, these 38 sites account for 1,453 GWh of biomethane annually, thereby, reducing the volume of CGI connected production from 3,351 GWh per annum to 1,898 GWh per annum. Ultimately, this would serve to reduce the number of CGI facilities nationally from 5 to 3 (including Mitchelstown). Assessing the most appropriate long-term solution for such regions of the country warrants careful consideration from a Gas Networks Ireland perspective.

3.3.5 Reverse compression

With increased biomethane production, investment in the gas network will be required to accommodate the decentralised supply or injection of biomethane. As a solution to such decentralised supply, reverse compression facilities are adopted to facilitate the bi-directional flow from the distribution to the transmission network. This involves installing a compressor station at the interface point between the distribution and transmission networks. The concept of reverse compression is that during times of low local demand for gas, which results in the biomethane facility being constrained, a compressor will operate to flow gas out of the distribution network and inject it into the transmission network. This effectively creates a new demand source on the distribution network, which will enable the biomethane producer to continue injecting gas.

Reverse compression will only be relied upon as a solution for low capacity on the distribution network after alternative solutions[11] have been deployed. For instance, low level constraints can be alleviated by seasonal adjustment in Above Ground Installation (AGI) setpoint[12] pressure. By reducing the pressure setpoint, the input of gas from the transmission network is reduced allowing local biomethane production priority access to the system. Further solutions include more dynamic change of the setpoint and automation. Alternatively, interconnection with other adjacent distribution networks and the last step would involve installing reverse compression to inject gas into the transmission system.

Reverse compression is now common practice across several European countries[13] including Denmark, France, the Netherlands, and Germany. According to the Gas for Climate consortium, there were 15 reverse flow facilities in operation across Europe in 2021 and a further 25 under development.

The RFI responses clearly highlight the need to address the issue of reverse compression, with pockets of prospective biomethane production clustered across some locations in Ireland. Analysis of all proposed RFI projects has identified constraints in 13 local distribution networks.

11 Such alternatives include the permitting of low level or short duration curtailment, the active management of pressure at AGIs and interconnection between adjacent distribution networks to alleviate constraints.
12 These are the intersections between the high-pressure transmission system and the low-pressure distribution networks.
13 Reverse compression facilities are not always necessary in continental Europe depending on the degree of interconnection in a country's gas network, which can reduce the need for compression.

3. Biomethane Request for Information (continued)

The estimated cost of the reverse compression infrastructure to address the level of congestion identified to accommodate 14.8 TWh of biomethane injection is in the order of €41m[14]. With this level of reverse compression installed, some constraints remain. For the purposes of this report, it has been assumed that constraints below 20 GWh annually would not economically justify installing reverse compression solutions.

3.3.6 Connection infrastructure investment

Understanding both the implications of Ireland's biomethane ambition for the gas network and the ways in which the gas transportation infrastructure needs to adapt to facilitate biomethane injection represents a key aspect of our RFI analysis. Biomethane is a perfect substitute for natural gas, with no further investment in terms of dedicated pipelines and storage infrastructures required. Nevertheless, some adjustments may be required to the existing gas network to accommodate a high number of smaller decentralised injection facilities.

Setting a binding target for the production of biomethane, as set out in REPowerEU in 2022, is and will continue to help to drive investments, with the REPowerEU objectives for biomethane expected to attract capital flows into the biomethane sector. The EBA[15] estimate[16] that the overall level of investment required to reach the REPowerEU's 35 bcm sustainable biomethane production by 2030 to be €83 billion. Ireland's corresponding 2030 ambition is 5.7 TWh, which equates to circa. 0.58 bcm of biomethane. A pro-rata investment for Ireland would, on the basis of the EBA's estimates, total to €1.4 billion. It is noteworthy that this €1.4 billion investment cost would, however, relate to both investment in the biomethane production plants and the associated network infrastructure.

In terms of the "attendant" infrastructure, Gas Networks Ireland has used the RFI dataset to conduct a network assessment of what level of investment in network infrastructure would be necessary to facilitate the injection of 14.8 TWh of biomethane by 2030. This network connection assessment included analysis of the potential need for gas network upgrades including capacities, injection points, gas flows, pressure levels etc. Additional network equipment installation (pipes and compression) and reverse compression capacities were also considered within the scope of this network connections analysis.

The network analysis for all 176 projects produced an indictive distance from the network, pipeline size required and, in some instances, options for connecting to the distribution and transmission gas network. Network analysis also identified any seasonal constraints that may arise due to local production on distribution networks exceeding demand requiring reverse compression.

These initial outputs were then assessed to ascertain if plants would be connected to either the distribution or transmission network with respect to the "economic test" or if, in the case of biomethane production sites small in size or too far away from the network to be economically connected by pipeline were assumed to be connected by CGI.

The outcome of this network analysis and applying the current higher risk costs to the total number of connections and lengths of network, assuming semi-urban terrain, results in the network investment requirements presented in Figure 3.8.

The network analysis for all 176 projects produced an indictive distance from the network, pipeline size required and, in some instances, options for connecting to the distribution and transmission gas network.

14 A Gas Innovation Funded feasibility study estimated the capital cost for Gas Networks Ireland to install and operate this technology would be in the region of €1.6 million

15 "Investment Outlook on Biomethane", European Biogas Association, 2023.

16 According to the 1st EBA Investment Outlook in Biomethane, there is currently an investment pipeline of €18 billion to scale up biomethane production | European Biogas Association.

Figure 3.8: Network investment required to facilitate 14.8 TWh of biomethane injection in Ireland

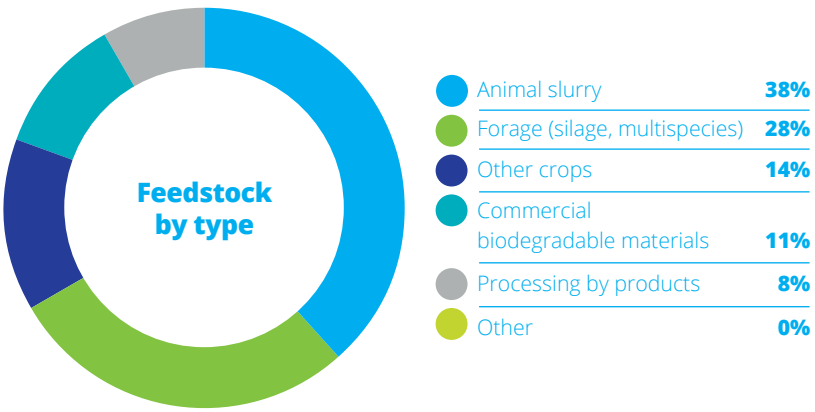
Biomethane injection requirement	Number of connections	Connection cost
Distribution connections (excluding reverse compression)	72	€372m
Reverse compression	13	€41m
Transmission connections	6	€23m
CGI	5	€149m
Total		**€586m**

3.4 Feedstock

AD produced biomethane can rely upon a wide variety of organic feedstocks including municipal or industrial organic waste and wastewater, industry residues, agricultural residues (such as manures and straw) or plant materials. Agriculture-based biomethane plants make up the largest share of biomethane production in Europe, with 64% of biomethane in Europe produced by agricultural plants. Other important feedstock sources include organic municipal solid waste (11%) and industrial waste (11%). A clear trend towards agricultural residues, organic municipal solid waste and sewage sludge is evident amongst newly installed biomethane plants in Europe, with a limited number of new biomethane plants established to run on monocrops since 2017. Such a change partly reflects the fact that the growth in biomethane production is no longer dominated by Germany, with an increasing number of plants being built in France, Italy, the Netherlands, and Denmark. Whereas a large share of biomethane plants in Germany run on monocrops, plants in the countries currently leading growth in the biomethane sector run principally on agricultural residues and to a lesser extent also on organic municipal solid waste and sewage sludge.

In Denmark, three-quarters of its AD biomethane feedstock now comes from agriculture waste[17]. Given that Ireland has a similarly sizable agriculture sector and is circa 60% bigger in area relative to Denmark, bodes well for the prospects that Ireland should have significant available feedstock in support of biomethane production. The nature of Ireland's agricultural sector means that it is uniquely positioned to develop a biomethane industry. The key feedstock potential for AD in Ireland comes from manure, agricultural residues such as straw, sequential cropping and industrial wastewater, which will provide a productive use of agricultural wastes, reduce agricultural emissions and contribute to meeting Ireland's renewable energy targets. Based upon responses in relation to feedstock in the RFI, feedstock types in Ireland seem set to be largely agri-based. As illustrated in Figure 3.9, almost 80% of feedstock, according to RFI responses, seem set to be sourced from agricultural feedstocks. Such a share is broadly in line with Denmark where circa. 75% of biomethane production is agri-based.

Figure 3.9: Feedstock by type based on RFI responses



17 Presentation by Henrik V. Laursen from Bigadan - RFI information event (29th November 2022).

4

Biomethane market arrangements

Biomethane plays an important role in ensuring the development of the future energy system. Together with other low carbon and renewable gases, biomethane has the potential to progressively replace a share of natural gas supplies in the medium to long run and can serve as a dependable supplement to other renewable energy sources. It is, therefore, useful to consider biomethane market arrangements, essentially progress to date, at both a cross-country and national level.

4.1 Biomethane developments at a European level

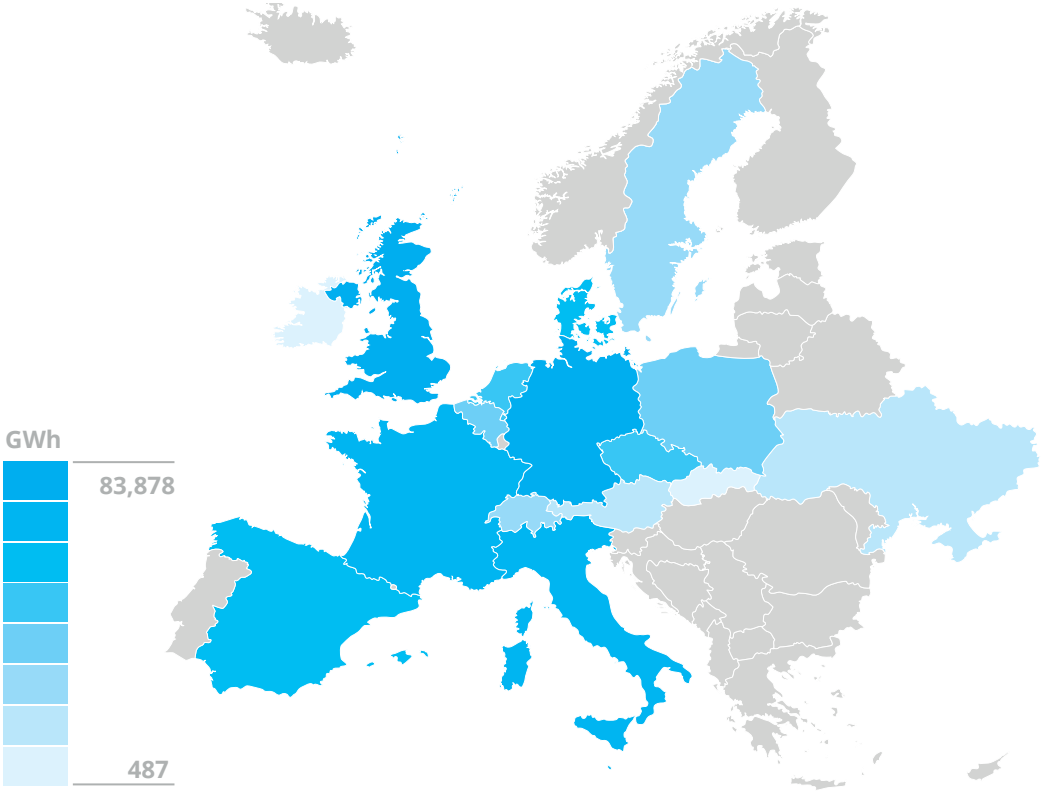
The biomethane sector is already supporting European countries in the achievement of climate goals and energy security, with biomethane being produced in increasing quantities across Europe.

The injection of biomethane into the gas network is aligned with both EU and individual Member State strategies. The role of biomethane in Europe's energy transition process has been ramped up by the EU Commission following the publication of the REPowerEU plan, with an increased annual production target of 35 bcm by 2030. In 2021, the most recent year for which annual data is available, 3.5 bcm of biomethane and 15 bcm of biogas was produced in the EU-27. The REPowerEU target is, therefore, equivalent to roughly ten times current annual EU biomethane production. While the level of current biomethane production in Europe is low, the number of AD biomethane plants across Europe has risen by 30% in the last two years pointing to increased future production.

As the biogas industry has slowed over the past decade, biomethane production has grown markedly, with 2021 recording the largest annual increase to date. An additional 6.1 TWh of biomethane production was recorded in 2021, which represents an annual growth rate of 20%. An aggregate of 1,322 AD plants were producing biomethane in April 2023; this compares with 1,023 in 2021. It is expected that this increased prominence of biomethane production relative to biogas will continue and is set to become more pronounced. Each year, an increasing number of EU countries are shifting incentives from biogas production to biomethane production, resulting in sustained rapid growth of the biomethane industry. Italy has subsidies for existing AD plants to direct their biogas to biomethane production and subsequent injection into the gas network. Other countries, such as the United Kingdom and France, have also developed policies to similarly target biomethane production for injection into the gas network.

Figure 4.1: European biomethane production, 2021

Country	GWh
Germany	83,878
UK	26,224
Italy	25,763
France	10,390
Spain	8,329
Denmark	7,277
Czech Republic	6,840
The Netherlands	4,826
Poland	3,407
Belgium	2,965
Sweden	2,265
Switzerland	1,779
Austria	1,622
Ukraine	1,366
Slovakia	1,214
Ireland	487



4. Biomethane market arrangements
(continued)

Gas Networks Ireland has delivered and is progressing several initiatives to assist in Ireland attaining the stated biomethane production ambition of 5.7 TWh ambition by 2030.

At an individual country level, there are varying stages of advancement in terms of biomethane market development. While Germany led the development of Europe's market for almost a decade, it was overtaken as Europe's fastest growing in terms of biomethane production by France in 2017. Some countries such as Denmark and Sweden already have significant biomethane production, with Denmark on course to replace 100% of its natural gas consumption with biomethane.

Figure 4.1 presents the split in biomethane production between the EU-27 and the UK, Norway, Switzerland, and Iceland).

4.2 Biomethane in the Irish gas market

While biomethane production has been rolled-out over recent decades across Europe at significant scale, biomethane is at a nascent stage of development in Ireland. Biomethane deployment in Ireland has been very limited to date, with only a handful of commercial scale AD plants developed.

4.2.1 Progress to date in Ireland

Gas Networks Ireland has delivered and is progressing several initiatives to assist in Ireland attaining the stated biomethane production ambition of 5.7 TWh ambition by 2030. The following are some key milestone dates that have been reached or are underway in relation to biomethane in Ireland:

Ireland's first biomethane injection facility

Gas Networks Ireland commissioned Ireland's first biomethane injection facility in Cush in Co. Kildare and it was officially declared an entry point in May 2020. This injection facility is now fully operational. In cumulative terms, 84,111 MWh of biomethane has been injected into the network up to end-July 2023. The biomethane injected is produced in Nurney, Co. Kildare and transported via road in trailers. This facility may be converted to a directly connected site in the future. In April 2022, a second biomethane producer was approved for the injection of biomethane into the network. More recently, Gas Networks Ireland has signed its first connection agreement to directly connect biomethane production to the gas network.

Green Gas Certification Scheme

In 2020, Gas Networks Ireland voluntarily established a renewable gas registry to certify the origin of renewable gas entering the gas network. Establishing this scheme represented a key step in the development of a renewable gas industry in Ireland as it provides an objective means of tracking the commercial transactions of renewable gas through the supply chain, thereby, boosting confidence. Furthermore, the scheme may support the expansion of production, provide certainty for consumers who buy the renewable gas and provide an incentive for producers to inject renewable gas into the network. An aggregate of 84,111 certs, each 1 MWh, has been issued to date.

GRAZE Gas Project

The GRAZE gas project will deliver Ireland's first large scale CGI facility, located in Mitchelstown, Co. Cork. This project, which also includes six trucks with 36 trailers, two CNG refuelling stations and a vehicle fund, has been approved for €8.47m funding under the Climate Action Fund administered by DECC (Department of the

Environment and Climate Change). The CGI facility will facilitate biomethane being collected from AD plants in the catchment area, transported by road to the CGI facility and injected into the gas network. At peak, this CGI facility will have the technical capacity to inject up to 700 GWh of biomethane per annum (equivalent to the heating requirements of approximately 64,000 homes).

Price control 5 (PC5)
Gas Networks Ireland is subject to regulation by the CRU. A key responsibility of the CRU is approving the level of revenue which Gas Networks Ireland can charge its customers. Every five years, the revenues that Gas Networks Ireland can collect from customers via network tariffs and charges are re-evaluated in a price control (PC) process. PC5, which will set the revenues that Gas Networks Ireland can collect across the period from October 2022 to September 2027, is currently underway. As part of PC5, Gas Networks Ireland has made a submission in relation to biomethane, with proposed infrastructure investment that will align with the Government's target for indigenous biomethane production.

4.2.2 Biomethane in transport

Decarbonising Ireland's transport sector, the second most energy intensive sector within the economy, accounting for 19.1 per cent of GHG emissions in Ireland in 2022[18], is particularly challenging. Transport, therefore, has an important role to play in meeting the targeted 7 per cent annual reduction in emissions over the 2021 to 2030 period. Within transport, the Heavy Duty Vehicle (HDV) category, namely, Heavy Goods Vehicles and buses, warrants particular attention given the potentially high positive environmental impact of HDVs switching from traditional transport fuels to alternative fuels - 4% of registered vehicles were classified as HDVs in 2021 yet SEAI estimates indicate that this category of vehicles alone was responsible for 20% of total transport CO_2 emissions.

The solutions to the HDV decarbonisation challenge necessitates the successful deployment of new technologies. While electrification and hydrogen-powered trucks represent a substantial opportunity to accelerate HDV transport decarbonisation, most distance requirements for HDVs are beyond the capabilities of hydrogen and battery electric models currently available. CNG is natural gas that has been compressed and stored at high pressures (over 200 bar) and used as a transport fuel. The potential for CNG vehicles to be fuelled by biomethane offers an opportunity to fully decarbonise HDV transport in Ireland[19], contributing to the achievement of both Ireland's emissions reduction targets and targets for the use of renewable energy. Examples from Sweden clearly illustrate the important role biomethane can play in the transport sector for both light- and heavy-duty vehicles. Furthermore, biomethane already accounts for in excess of 90% of the gas supplied for road transport in the UK.

The Causeway Project was developed by Gas Networks Ireland to kick-start the gas in transport or CNG market in Ireland. There are currently four public access CNG refuelling stations[20], delivered as part of the Causeway Project, supplying CNG to Irish hauliers. Gas Networks Ireland is working to expand the number of CNG stations in Ireland, with a pipeline of additional public CNG stations progressing through the design, planning and construction project phases. Gas Networks Ireland expects to have five more public access CNG stations operational by 2024.

4.2.3 Biomethane for shrinkage – future plans

Gas Networks Ireland is seeking to procure a portion of its shrinkage gas requirement from indigenous biomethane from October 2025. Shrinkage gas is defined as own use gas (OUG) and natural gas required to replace unaccounted for gas (UAG). OUG is gas that is consumed by Gas Networks Ireland in operating its network – for instance, gas required to run compressors. UAG is gas whose use is not accounted for - examples include theft and leakages. Gas Networks Ireland is required to procure shrinkage gas in anticipation of the volumes expected to be utilised as fuel gas on the transmission system and to replace transmission and distribution unaccounted for gas. The biomethane for shrinkage procurement project is being undertaken to stimulate the development of the biomethane market in Ireland and, also, to help reduce the emissions associated with the transportation of gas through the network and represents an important opportunity for Gas Networks Ireland to demonstrate leadership in a meaningful way in support of its decarbonisation strategy.

18 https://www.epa.ie/our-services/monitoring--assessment/climate-change/ghg/transport/, EPA, 2012.
19 Bio-CNG would save up to 8.5 times as much CO_2 as CNG based upon natural gas supplied, based upon Department of Transport estimates.
20 Located in Ballysimon Road, Limerick, Cashel, Co Tipperary and Clonshaugh and Dublin Port in Dublin.

5

Demand outlook for biomethane

5.1 Gas demand

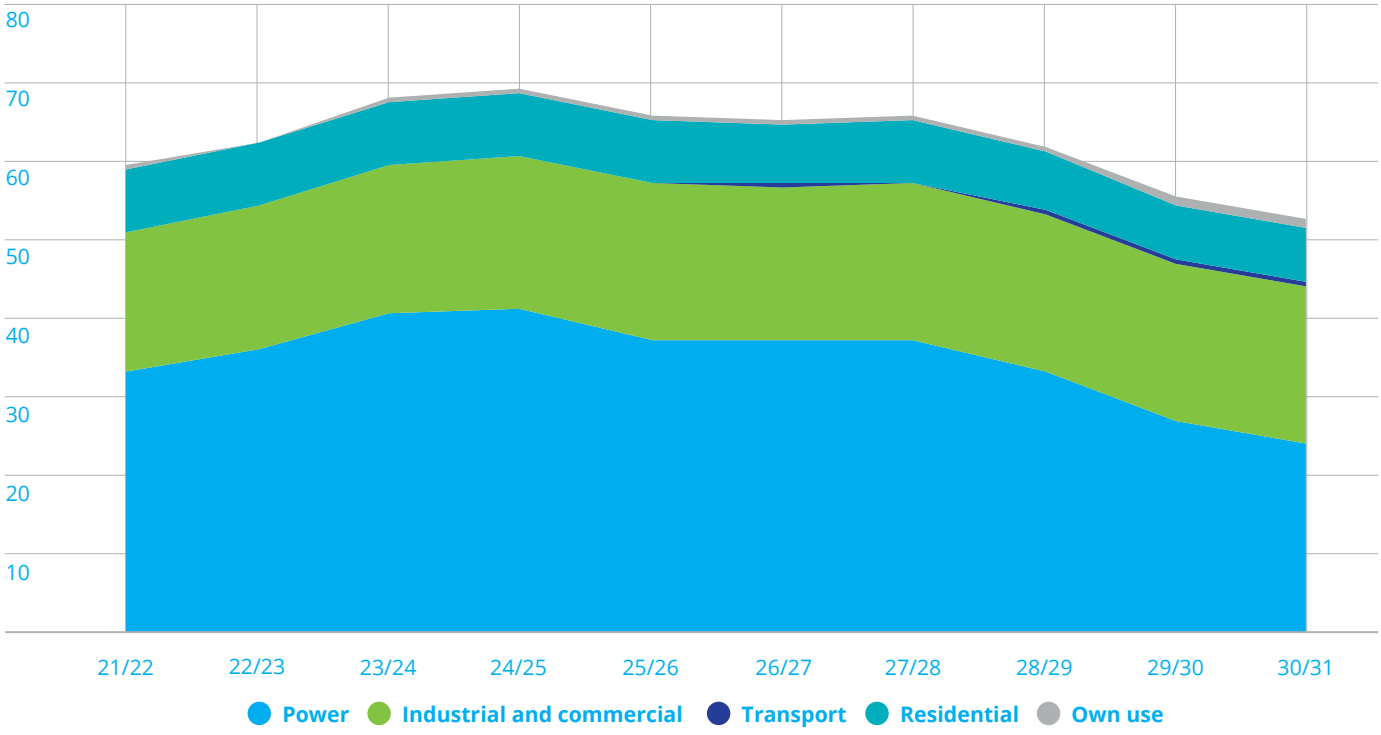
Gas Networks Ireland's "Gas Forecast Statement" (GFS)[21] sets out how the gas network may develop over the coming ten-year period. This assessment is based upon current supply and demand for gas, as well as projections for growth in gas consumption and the development of infrastructure. Ireland's consumption of natural gas has increased over recent years, largely due to both increased demand for electricity and some increases in industrial load. The GFS indicates that the overall annual demand for gas is expected to peak in the coming years, most likely in gas year 2024/2025 (i.e., between October 2024 and September 2025), as illustrated in Figure 5.1 below.

The advent of this peak is primarily driven by the anticipated fall in annual gas demand amongst both the larger users of gas, mainly power generation, and to a somewhat lesser extent, residential users. The downward trend in power generation annual 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.

Naturally, a peak in gas usage raises questions for both industries and the gas industry in Ireland as well as many other EU countries who have been considering this for a number of years now. In reality, an enduring role for the gas network will continue. Nevertheless this role will clearly require change, transitioning to the transport of renewable energy.

This report is helpful in providing some insights into this transition. Until now, there has been a belief, in the absence of real data from the market, that there is a high level of interest relating to the production of biomethane. There is extensive discussion on the subject of hydrogen, and it is anticipated that Ireland is well placed to become a significant producer of hydrogen. Biomethane in the meantime can offer a more realistic short-term promise but ultimately will be limited in the longer

Figure 5.1: GFS best estimate scenario annual ROI demand by sector



21 GNI-2022-Gas-Forecast-Statement.pdf (gasnetworks.ie)

5. Demand outlook for biomethane
(continued)

term as it is does not have the almost endless potential of green hydrogen that is predicted for Ireland.

Taking an objective view of gas demand and assuming that peak annual gas demand occurs in approximately early 2025 (after which electricity production demand for natural gas dwindles and residential properties adopt alternative technologies to gas heating), then overall gas demand, as predicted by Gas Networks Ireland, will fall. The advent of biomethane in line with the Government's plans for 5.7 TWh by 2030 will start to accelerate the displacement of natural gas.

These two factors are the central tenets of forecasting the end of natural gas in the Irish gas grid and displacing this gas with renewable gas. The RFI aggregate volume of 14.8 TWh is 26% of Irelands current gas demand. It also coincides with the average biogas production per square km in Germany currently, who have been developing their industry for fifteen years or so. It is not unreasonable to assume that there is more potential biomethane production available and that current gas demand could be substantially displaced with indigenous biomethane as is reflected in the current plans in Denmark who aim to displace all natural gas with biomethane by 2035. Taking into account the reduction of natural gas use in electricity production (which currently stands at 60% of total gas use) and domestic heating (which in 2022 was 12% of total gas demand) this would leave Ireland well placed to meet its remaining gas demand substantially from biomethane in the not-too-distant future.

While we are too early in the process to be setting target dates for this, we are aware that at least one EU Member State is claiming that they will end the use of natural gas by 2035. The period between now and 2030 is, therefore, essential to set us on the right trajectory for both biomethane and green hydrogen gas use and more particularly to provide viable alternatives for our customers to transition to net zero solutions.

5.2 End uses for biomethane

Biomethane is a highly versatile energy resource and can be used for a variety of end-use applications, as it can seamlessly replace all the end-uses of natural gas. Biogas is, however, only suitable for on-site use in specialised gas boilers or combined heat and power units designed explicitly to run on gas of its quality to generate both electricity and heat.

On-site upgrading of biogas to biomethane prior to injection into the gas network is therefore now viewed as the most efficient use of biogas. Biomethane is chemically identical to natural gas and can, therefore, displace any volume of natural gas without impact or cost to the existing consumer. Hence, the increasing

number of European countries shifting incentives from biogas production to biomethane production, resulting in sustained rapid growth of the biomethane industry, as highlighted in Section 4.1.

One of the core benefits of biomethane is its versatility as an energy source - biomethane can be used in a variety of end-use applications, as it can replace all of the end-uses of natural gas, across some of the most challenging to decarbonise sectors including:

- Transport (biomethane is suitable for transport as it is a certifiable fuel and is compatible with CNG vehicles).
- Industrial heat.
- Synchronous dispatchable power generation.

Furthermore, injecting biomethane into the gas network also facilitates the efficient transportation of biomethane directly to a number of these hard to decarbonise end-use sectors. The decarbonisation of heat and transport pose significant climate target challenges for Ireland, with industrial heat and heavy goods transport being the two most difficult areas within these categories. Sustainable biomethane transported through the gas network to where it is needed most and used more efficiently is critical to achieving emission reduction goals. SEAI's National Heat Study finds that the optimal application for biomethane is in the decarbonisation of operations with high direct heat demands for which alternatives such as electrification is somewhat more challenging.

Biomethane is chemically identical to natural gas and can, therefore, displace any volume of natural gas without impact or cost to the existing consumer.

6

Gas supply impact of biomethane

The Russian invasion of Ukraine has led to new challenges for the security of energy supplies across Europe together with an associated dramatic increase in energy prices. In view of this and given that the energy system in Ireland and elsewhere is undergoing a period of unique transformational change, as set out in Section 1.2, it is of key importance to ensure the pathway of decarbonisation is underpinned by affordable and secure clean energy sources. Having a reliable source of energy is vital for consumers to have confidence in the transition to a net zero emissions future. Therefore, Ireland must ensure that security of energy supply is maintained as Ireland transitions to a net-zero emissions future.

Biomethane is structurally identical to natural gas and can therefore be injected into the existing gas network and used interchangeably with natural gas. Biomethane can directly replace natural gas. Where biomethane displaces imported natural gas, biomethane also yields energy security benefits in addition to the system benefits of natural gas such as storage and flexibility. Biomethane, therefore, provides Ireland with a valuable opportunity to improve energy independence via reduced imports, dispersed local production and as a result improved security of supply.

Energy import dependency is a widely relied upon as an indicator of a country's energy security, with indigenous or locally sourced energy held to be more secure than imported sources. Ireland currently imports almost 75% of our gas from the UK via our interconnectors with Scotland, with the remaining 25% sourced from indigenous supplies from the Corrib gas field in Mayo. Ireland's dependency on imported natural gas is expected to rise to 90% by 2030 as natural gas sourced indigenously from the Corrib gas field depletes. A biomethane production industry could replace the declining Corrib gas field so that Ireland is not solely reliant on a single source of gas from the UK in the future. As a result, it is vital that Ireland diversifies its energy supplies and develops locally sourced biomethane, thereby, introducing an indigenous, sustainable and renewable source of energy.

The development of an indigenous biomethane industry has a further beneficial impact upon security of supply, namely, diversity of supply. Diversity of supply essentially refers to the number of different sources of gas supply available. Domestically produced biomethane, dispersed throughout the country, would serve to boost diversity of gas supply. In addition to displacing natural gas from Corrib as it declines, the dispersed nature of biomethane production and the fact that it will be predominantly injected into the local distribution network can address diversity of supply concerns, with less single points of failure than is presently the case.

Learning from international experience and developing an industry with the appropriate scale for Ireland can also contribute to the security of price in the energy market. It is, therefore, important that due consideration be given to the mechanisms that have both worked well in other countries and those which have resulted in less than satisfactory outcomes.

Where biomethane displaces imported natural gas, biomethane also yields energy security benefits in addition to the system benefits of natural gas such as storage and flexibility.

7

Biomethane RFI results – decarbonisation role

Biomethane satisfies the Renewable Energy Directive II's (RED II) life cycle analysis whereby emissions created and avoided are accounted for and sustainability criteria met and can, therefore, be classified as "renewable gas". Biomethane can, therefore, assist in meeting Ireland's decarbonisation targets.

The development of a biomethane industry in Ireland would directly contribute to the achievement of emissions reduction targets. In addition to displacing emissions from the displacement of natural gas, biomethane also avoids emissions from slurry and chemical fertiliser production. Integrating slurry as feedstock to AD biomethane plants avoids the emissions from slurry storage and spreading and instead captures them for use in energy production – simultaneously supporting farmers in complying with the Nitrates Directive. In addition, digestate, a by-product of the AD biomethane process, can be a key ingredient for the production of organic fertilisers, which have the ability to displace chemical fertiliser, thereby, avoiding emissions associated with chemical fertiliser production. When all of these other external benefits are taken into account, it is likely that great emissions reduction benefits will accrue from a developed Irish biomethane industry.

The solutions to Ireland's decarbonisation challenge necessitates the successful deployment of new technologies or solutions. There are two key aspects to climate mitigation to be considered with any new solution. The first is the CO_2 reduction that can be achieved by any such technology and the second, albeit often overlooked, is the speed of deployment as reflected in the cumulative impact of emissions reductions over a particular period of time.

Biomethane production represents a significant opportunity in terms of both of these metrics i.e., the scale that can be achieved and the speed of implementation, provided the correct model or approach is adopted. As previously highlighted within this report, Denmark at the end of 2022 was producing 38% of their total gas consumption in the form of renewable biomethane. This milestone was achieved by Denmark over a relatively short eight-year period. To deliver the same level of renewable electricity production from wind and solar in Denmark, it took 25 years, thereby, highlighting the prospects for a scalable solution delivering cumulative benefits for biomethane in Ireland.

The "Marginal Abatement Cost Curve" report recently published by Teagasc[22] concludes that the achievement of the Government's 5.7 TWh of biomethane production ambition by 2030 would deliver 1,518 kt CO_2eq in year one. Cumulatively over the 2021 to 2030 period, 4.1 Mt CO_2 eq. savings would be delivered assuming the 5.7 TWh biomethane ambition is achieved.

Assuming the aggregate biomethane production identified in the RFI were agri-based, the equivalent pro-rata annual production of 14.8 TWh of biomethane would equate to 3.94 Mt CO_2eq per annum. The annual emissions in agriculture in 2022 was 23.34 Mt CO_2 eq. and 3.94 Mt CO_2eq per annum equates to 16.9% of last year's agriculture emissions. In 2022, Ireland's total GHG emissions were estimated to be 60.76 Mt CO_2eq. The 3.94 Mt CO_2eq abated, based upon the RFI, would represent 6.5% of Ireland's total 2022 emissions. Unfortunately, it is not possible to provide a definitive view of cumulative annual emissions savings arising from RFI responses owing to uncertainties faced by prospective biomethane producers in Ireland. Nevertheless, it is important to highlight that the quicker measures are taken up, the more cumulative mitigation can occur over the run up to the 2030 "commitment period".

Assuming the aggregate biomethane production identified in the RFI were agri-based, the equivalent pro-rata annual displacement of the 14.8 TWh of potential biomethane production identified in the RFI would equate to 3.94 million tonnes of CO_2 per annum (Mt CO_2eq) by 2030.

22 https://www.teagasc.ie/publications/2023/marginal-abatement-cost-curve-2023---executive-summary.php

8

Conclusion

Until now, there has been a belief, in the absence of real data from the market, that there is a high level of interest in the production of biomethane in Ireland. The results of the RFI issued by Gas Networks Ireland to prospective biomethane producers strongly supports this belief and clearly highlights the opportunity that exists for Ireland to develop indigenously produced biomethane.

The RFI confirms the appetite is there amongst prospective biomethane producers in Ireland, with an aggregate production totalling to 26% of current gas consumption, which could enter Ireland's gas network by 2030. It is not unreasonable to assume that there is further potential biomethane production available in Ireland and that current gas demand could be even more substantially displaced with indigenous biomethane such as in Denmark, which aims to displace 100% of their natural gas demand with biomethane by 2035. The development of a biomethane industry in Ireland would directly contribute to the achievement of emissions reduction targets, with potential emissions reductions in line with the RFI response equating to 3.94 Mt CO_2eq. This could be of significant assistance to hard to abate industries that are challenged in addressing climate change.

Ireland has stated its ambition is to produce up to 5.7 TWh of biomethane by 2030 amounting to approximately 10% of Ireland's current gas demand. The RFI response is very encouraging in this regard, with a result in terms of production volumes more than two and a half times that of Ireland's stated 2030 biomethane ambition.

Ireland has already been successful in supporting the development of renewable wind and solar energy and we need to leverage lessons from this to support the development of a biomethane industry. Learning from this experience and developing a biomethane industry with the appropriate scale for Ireland is of key importance. Furthermore, it is important that due consideration be given to the biomethane-specific market mechanisms that have both worked well in other European countries such as Denmark and those which have resulted in less than satisfactory outcomes.

The build-up to 2030 will prove a critical period for Ireland in delivering on its biomethane potential. While the results represent an important indicator of the robustness of Ireland's biomethane production targets, it must be matched by new biomethane-specific policies, regulatory support and initiatives to ultimately deliver an affordable and reliable clean energy transition to biomethane. In order to deliver these benefits, we need a comprehensive biomethane strategy that provides clarity on appropriately balanced feedstocks, maximizing waste to energy options, ensuring community engagement and introducing appropriate market structures to ensure the industry grows in a sustainable manner. Gas Networks Ireland is ready to play its role in providing connections and injection facilities to support biomethane producers and suppliers in meeting Ireland's biomethane production ambition.

In conclusion, Ireland has a real opportunity to develop a biomethane industry at scale, which will offer multiple benefits for our agricultural economy, assist in the decarbonisation of Ireland's economy more generally, enhance our security of energy supply and lead to the development of a key renewable indigenous energy resource in the build-up to 2030.

Gas Networks Ireland

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