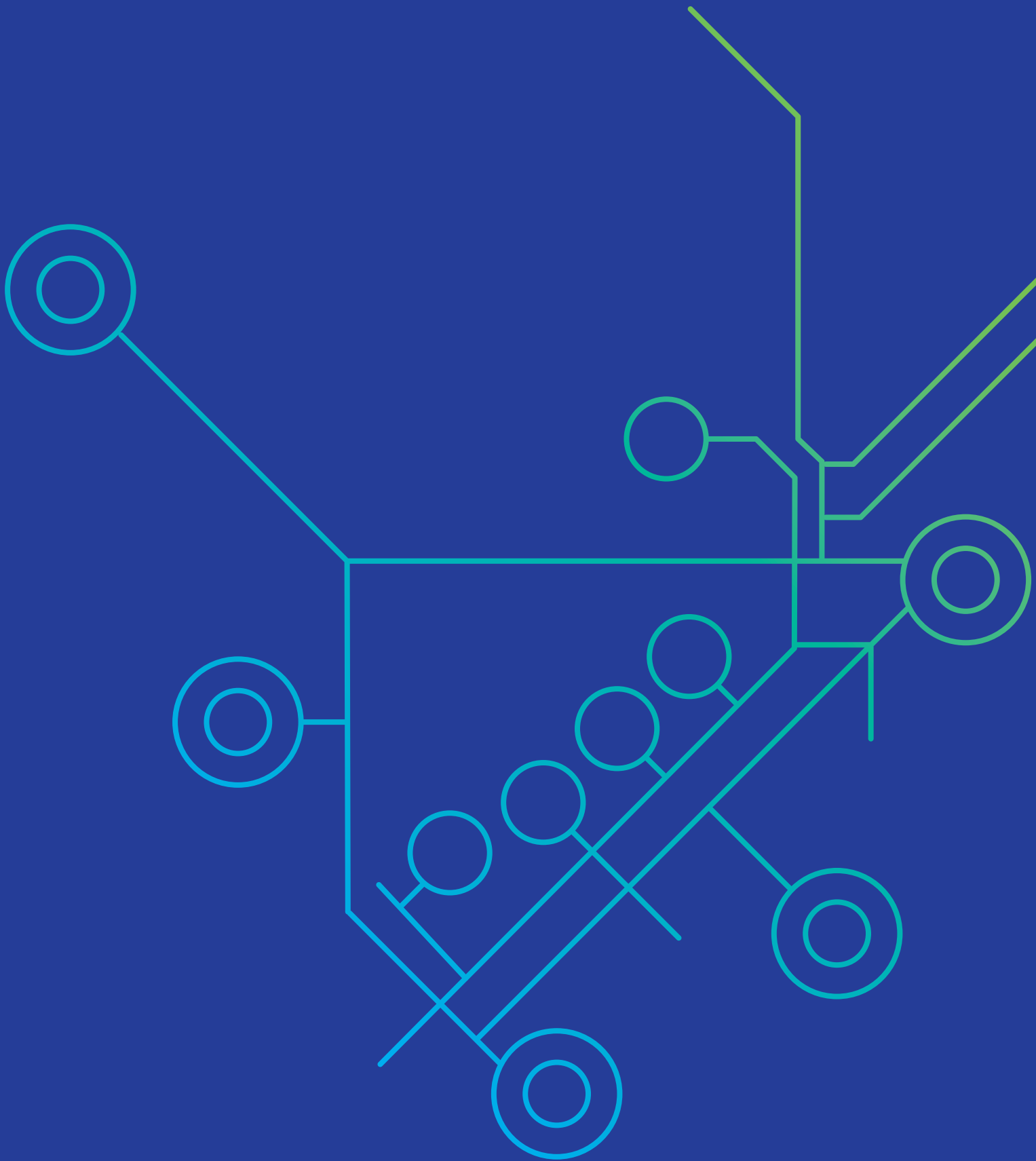
Pathway to a Net Zero Carbon Network

Gas Networks Ireland



1. Introduction

I am excited to share with you a transformation pathway for Ireland's gas network as we prepare to deliver a repurposed, resized, and fully decarbonised network by 2045. The Irish Government has ambitious climate and energy targets to successfully transition to a carbon-neutral economy by 2050. Our transformation pathway reflects this same imperative to reduce greenhouse gas emissions by transporting renewable gases only, while simultaneously ensuring Ireland has a secure and reliable energy supply in an increasingly integrated energy system.

Currently transporting over 30% of Ireland's total primary energy and generating almost 50% of Ireland's electricity, our network makes a key contribution to our economy, and it makes sense to continue to use this vital State asset to transport renewable energy across the country in the future.

This document outlines one pathway by which the gas network can evolve and continue to play a key role at the heart of Ireland's future energy system. Our pathway is consistent with current energy policy and targets, and reflective of wider energy system needs. It is dependent on the timely progression and realisation of key energy policy developments and the emergence and necessary scaling of enabling energy technologies, renewable gases – biomethane and hydrogen and supporting economics. The actual basis and timing for the full decarbonisation of our network will become clearer as energy policy and new energy sources and technologies progress, but we know that by embracing innovation in these areas, leveraging our expertise, and collaborating with stakeholders, we can realise this ambition. The flexible deployment of the pathway can be adapted in response to greater certainty of future supply and demand, and other factors impacting the gas network. Most importantly, with the right combination of developments, our flexible network is capable of being carbon-neutral by 2045.

Future decarbonised energy systems will still need an appropriate mix of electrons and molecules, and Ireland will be no different in this to countries across Europe where gas transporters are preparing to repurpose their networks for renewable gases. Electricity systems, that can produce renewable hydrogen at scale and integrate with gas systems, that can transport, import, export and store it at scale, will provide the core integrated basis for approaching and achieving net zero carbon economies.

We believe that the realisation of a decarbonised gas network is in the best interests of Ireland's energy customer, offering a least cost and least disruptive means of decarbonising energy use for many, and a vital alternative decarbonisation path for those consumers for whom electrification is very challenging.

Gas Networks Ireland is committed to working with government, policymakers, regulators, and key stakeholders to develop and invest in a more integrated, resilient, and flexible Irish gas network. We are committed to making a vital contribution to Ireland's net zero carbon future by displacing all the natural gas on our network with renewable gases.

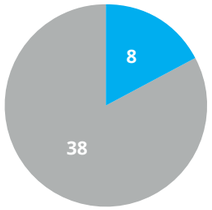
Cathal Marley
Chief Executive Officer

2. Overview

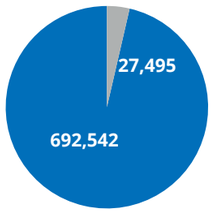
Connected customers

- Power Generation
- Industrial and Commercial
- Residential

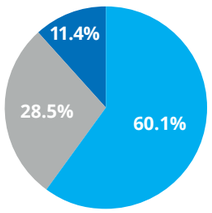
Transmission connected
c. 39 TWh p.a



Distribution connected
c. 19 TWh p.a.



% overall annual segmented consumption



The gas network, serving Ireland today

The gas network, while serving Ireland's energy needs today, is also focused on transforming into a fully decarbonised network that transports renewable gases.

Ireland's gas network transports almost twice the energy transported by Ireland's electricity network, and it also provides a safeguard for the intermittent nature of renewable generation forms in the electricity market, such as wind and solar. The gas network is capable of being fully repurposed and fully decarbonised in the future by displacing natural gas with renewable gases (biomethane and hydrogen), and it can help realise a net zero integrated energy system through the targeted deployment of renewable gases at scale.

Ireland's gas network is among the most modern in Europe and provides a safe, secure, and reliable energy supply. Every year this c. €3 billion national asset transports almost a third of national primary energy requirement through 14,725 km of pipelines to towns and villages in 22 counties. In total, there are over 720,000 gas customers connected to our network across the country, including over 27,000 businesses. The network currently comprises a unitary 'transmission' (national, high-pressure) ring main and spur lines supporting distinct 'distribution' (local, low-pressure) networks. While most gas consumption (c. 67%) occurs on the transmission network, most consumers (99%+) are served from the distribution networks. Our gas interconnectors with the UK are Ireland's most vital energy assets, importing c. 80% of the State's annual gas demand and c. 25% of Ireland's annual total primary energy requirement. Today, networked gas is the primary dispatchable fuel source in Ireland's electricity generation mix, fuelling about 50% of all electricity generated each year, and up to 90% of electricity in peak periods. The network also serves the needs of industry, particularly those with high heat and energy reliability requirements, while also meeting the heating and cooking needs of about 30% of Irish businesses and 40% of Irish homes.

Power Generation, now and near-term

Gas is currently the primary means of maintaining electricity supply against the backdrop of increasing intermittent renewable electricity sources. While natural gas demand for power generation is expected to fall by c. 33% between 2023 and 2030, peak day power demand is expected to grow by c. 30% in the same period. This pattern shift between overall and peak demand will continue, with Ireland's electricity generators and system operators increasingly reliant on the capacity, resilience, and responsiveness of the gas network to complement the intermittency of renewable generation sources.

Growing renewables

Networked gas is a vital energy source for many businesses, particularly those engaged in power generation or with high-heat or high reliability process needs, and for many such businesses renewable gas is the only viable decarbonisation solution. Gas Networks Ireland's current focus is on readying the network for the transportation of renewable gases as they become available. Ireland's National Hydrogen Strategy and Biomethane Strategy will enable the further scaling of both renewable gases over time, and we are actively working to have the network ready to transport whatever volumes of each will seek the benefits of a pipelined route to market. The remainder of this decade will see the establishment and growth of initial gas injection and transportation capabilities and capacities for both renewable gases. The gas network is currently biomethane ready, and biomethane is already being transported on the network in small but growing volumes. As biomethane scales to meet the Government's current annual target of 5.7 TWh by 2030, it will by then account for c.12% of projected networked gas. Ireland has significant biomethane production potential, and we anticipate that the decade beyond 2030 will likely see further growth in networked biomethane volumes. Hydrogen at any scale on the network, whether produced domestically or imported via the gas interconnectors, is likely to be a post-2030 development. Our focus for the period to 2030 is to complete the necessary testing, trialling, and safety case development to demonstrate and prove network readiness for hydrogen.

The gas network, serving Ireland in the future

By 2040, annual networked gas volume is anticipated to reach its lowest level, as natural gas is almost fully displaced, biomethane reaches its full potential and hydrogen continues to grow.

As the indigenous green hydrogen economy matures by the mid-2040s, entirely renewable networked gas volumes are anticipated to rebound to c. 45 to 50 TWh, supplying a key renewable and fully decarbonised component of Ireland's annual total primary energy requirement. As part of the overall transition to a carbon-neutral economy, electricity demand is anticipated to more than double by 2050. Green hydrogen has the potential to support this transition by quickly and reliably producing electricity when needed, to complement wind and solar in meeting electricity demand. A fully repurposed gas network can continue to play the role it does today, providing Ireland's broader energy system with the benefits of flexibility, resilience, and reliability.

A repurposed gas network can also benefit Ireland by facilitating a least cost and least disruption transition to decarbonised energy, while retaining the enduring utilisation and value realisation of an established national asset. Our post-2045 fully repurposed gas network is anticipated to still include both transmission and distribution gas transportation tiers. We anticipate both losses (e.g. residential and built environment gas heating – although some of this may be displaced by renewable gas-fired district heating) and gains (e.g. gas for transport) in different customer and demand segments over time, and we will continually review, resize and adjust the extent of our network tiers accordingly. A repurposed gas network will not only provide an economical approach to decarbonising some of Ireland's energy consumption, but will also provide the Irish State with valuable options for future energy ambitions, such as greater energy security and independence, including energy self-sufficiency or even net energy export via the existing gas interconnectors.

Decarbonisation now and long-term

In 2022, according to the Environmental Protection Agency, Ireland's green house gas emissions were estimated to be 60.76 MTon CO_2 equivalent of which natural gas consumption and transportation accounted for 10.58 MTon CO_2 equivalent or c.17% of national CO_2. Annual emissions from gas will reduce gradually over time, and with the repurposing of the network to transport only renewable gases, they will ultimately be eliminated. Gas transportation emissions will begin to reduce as natural gas use is displaced by increased electrification and renewable electricity, and as the natural gas currently transported on our network is displaced by renewable gases. In the period to 2035, increasing volumes of biomethane and hydrogen blended with and displacing natural gas volumes will deliver partial gas decarbonisation. Beyond 2035, as renewable gases reach their respective production (biomethane) or blend (hydrogen) limits, network conversion will deliver accelerated and ultimately full gas decarbonisation. Fully renewable networks will help to decarbonise every sector of the economy that uses networked gas, and present further opportunities to decarbonise the wider economy, through the scaling up of existing demand sectors and adoption of renewable gases for new sectors, such as aviation and shipping (as outlined in the National Hydrogen Strategy 2023). The inclusion of these new sectors, and the further potential for hydrogen export, would increase our projected overall 2045 gas transportation volumes.

Systems integration

Presently, Irish electricity grid limitations and system constraints result in the occasional curtailment of renewable energy, and in 2023 c. 9% of Irish wind generation was curtailed. Ireland has ambitious targets to expand wind and solar electricity generation and through the 2020s renewable generation is projected to increasingly exceed the electricity grid's capacity to absorb and/or export it. In the absence of energy sector developments to utilise surplus renewable electricity, c. 20% of renewable electricity could be curtailed by 2030.

Energy storage can play a role in utilising renewable electricity surplus. Batteries can store electricity but are best suited to meeting short-term peak demands (hours /days). In a renewable-dependent electricity system, seasonal and multi-seasonal storage will be required to complement short-duration storage. The gas network has the capacity to store and transport energy at volumes and for periods significantly beyond current battery technology, and much more cost-effectively. 'Power to Gas' (or P2G) processes, such as electrolysis, can maximise utilisation of surplus and dedicated renewable electricity by producing green hydrogen which can be stored in, distributed by, or even in the longer-term future exported through the gas network, with pipeline transportation proven to be the safest and most cost-effective means of scale energy transportation, whether for use in Ireland or exporting. Utilising the existing gas network, including the interconnectors for these purposes, could maximise the utility of our renewable resources and optimise the build-out of electricity interconnectors or hydrogen storage facilities.

3. Renewable gases

Ireland has significant potential for producing both biomethane and green hydrogen and Gas Networks Ireland aims to fully decarbonise the gas network by 2045 by replacing natural gas with these renewable gases. The network can already transport 100% biomethane and can be repurposed to transport 100% hydrogen.

Ireland's latest Climate Action Plan 2024 highlights that "*decarbonised gases such as green hydrogen and biomethane can provide a decarbonisation pathway for reducing emissions arising from medium and high-temperature processes*" and reaffirms the *"need to diversify our renewable electricity generation and increase our gas-fired generation capacity*". It also highlights that the "*use of zero-emissions biomethane in heating*" may also be necessary to achieve our targets *to "decarbonise the built environment across the residential, commercial and public subsectors*". Ireland's National Hydrogen Strategy 2023 and National Biomethane Strategy 2024 both make clear that networked hydrogen and biomethane have key roles to play in Ireland's energy future.

Biomethane

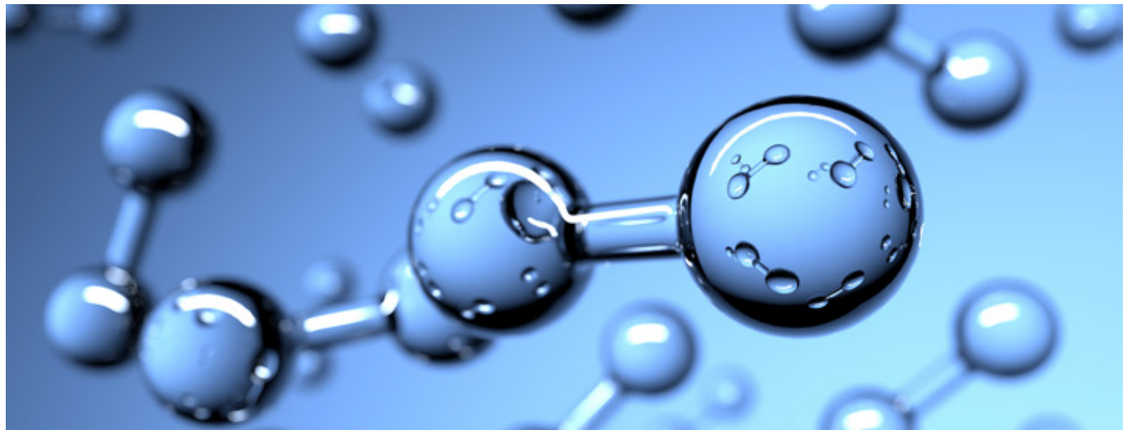
Biomethane meets the same technical standards as natural gas, and as such is fully compatible with existing gas infrastructure and installations e.g., boilers and appliances. Biomethane can function as a direct substitute for natural gas. Ireland's National Biomethane Strategy states that "*Without biomethane, Ireland is unlikely to meet its legally binding climate targets"*.

Gas Networks Ireland is already facilitating biomethane injection on the gas network. We began our net zero carbon journey in 2019, with the introduction of domestically produced biomethane, through Ireland's first purpose-built injection facility in Cush, Co. Kildare, with biomethane producers transporting their gas by road to the injection site. A central grid injection site will be operational in Mitchelstown by 2025. Ireland's National Biomethane Strategy highlights that *"More than 75% of biomethane plants in Europe are grid connected"* and that *"Transporting biomethane via gas pipeline is the most efficient, sustainable, and cost-effective method of transporting to end users"*.

The European Commission's REPowerEU Plan, in recognising biomethane's potential, aims to increase the production and use of biomethane throughout Europe to 35 BCM (350 TWh) by 2030 and Ireland's stated ambition of 5.7 TWh biomethane production by 2030 reflects this. Ireland's National Biomethane Strategy asserts that *"The substantial contribution that biomethane could make to gas supply in Ireland (i.e., 5.7 TWh by 2030) will help to diversify sources of gas, improve energy security, and help shield against possible price instability or volatility in international energy markets"*.

It is reasonable to expect that both EU and national ambitions for biomethane beyond 2030 will increase. Biomethane will play an increasingly vital role in the decarbonisation of the gas network, with production and networked transportation of the gas likely to grow substantially across the phases of our outlined transformation pathway. Gas Networks Ireland's Biomethane Energy Report, published in 2023, indicates that currently, Ireland has a prospective 14.8 TWh of annual biomethane production with over 75% of potential projects within 'economic' direct connection to the gas network under the existing connections policy. It is critical to ensure biomethane is produced in an environmentally sustainable manner, achieving high standards for the protection of water, soil, biodiversity, and ecosystem services. Gas Networks Ireland recognises that the ultimate biomethane volume generated on the island will also be determined by biodiversity and sustainable limits.

A biomethane sector with the momentum and conditions to reach 5.7 TWh annual production by 2030 would reasonably be expected to approach realisation of its currently identified potential by 2040. At that time and at such volumes, biomethane would potentially be transported in a dedicated network, serving consumers, for whom electrification is very challenging, along a Cork-Dublin regional corridor, and including substantial portions of the existing distribution networks in Munster and Leinster.



Hydrogen

Hydrogen can be combusted to generate heat or mechanical power, with zero CO_2 emissions, and it produces only water vapour as a byproduct. Hydrogen can be stored indefinitely and can be transported, in existing natural gas networks.

Ireland's National Hydrogen Strategy confirms that *"Where feasible, repurposing existing natural gas pipeline infrastructure to hydrogen is favourable"* and that *"As production expands, hydrogen pipelines (are) envisioned to become the dominant transportation option"*. A 2021 ACER (Agency for the Cooperation of Energy Regulators) report 'Transporting Pure Hydrogen by Repurposing Existing Gas Infrastructure' estimated that the cost of repurposing existing gas pipelines to transport hydrogen is a fraction (10% to 35%) of the cost of building new dedicated hydrogen pipelines. Gas Networks Ireland's own study in 2022 'Hydrogen technical and safety feasibility study' makes clear that our network can be repurposed to transport hydrogen.

Ireland's preferred option for indigenous hydrogen production is electrolysis, whereby electricity splits water into hydrogen and oxygen. When renewable energy sources, like wind or solar, power this process it produces green or renewable hydrogen. In anticipation of the emergence of both indigenous green hydrogen and hydrogen via our UK interconnectors, Gas Networks Ireland is engaged in an extensive programme of work to enable the phased introduction of hydrogen into the gas network and its blending with natural gas via both interconnection and direct connection.

Ireland's Climate Action Plan 2024 reaffirms Ireland's offshore wind targets of 7 GW to be operational by 2030, including 2 GW dedicated for electrolysis. The Government's National Hydrogen Strategy includes a green hydrogen production ambition for Ireland to produce up to 150 TWh of green hydrogen per annum by 2050 (c. 58 TWh was the total gas demand in Ireland in 2023). Importantly, the National Hydrogen Strategy recognises that the existing gas network can be repurposed to transport hydrogen by stating that *"Promising results in terms of the technical capability of the gas network to transport hydrogen blends up to 100% and repurposing parts of the gas network makes sense"*.

Indigenous production potential and interconnector import opportunities mean hydrogen will emerge from 2030 onwards to scale rapidly through the 2030s to volumes (c. 15 to 20 TWh and beyond) enabling sections of the national network to become 100% hydrogen, with hydrogen becoming the dominant networked gas in Ireland by 2040. These developments will create the opportunity for the existing gas transmission ring main converting to transport hydrogen nationally, facilitating the transition of Ireland's gas-fired power generation fleet and largest industrial customers to hydrogen. Conversion to hydrogen of a minority of the distribution networks supplied from the ring main will also allow consumers, for whom electrification is very challenging, to decarbonise via hydrogen. The conversion to hydrogen of one interconnector (the smaller interconnector - IC1), possible from the mid-2030s onwards (including reverse flow capability) will enable cost-efficient and scale hydrogen export to the UK and beyond. Furthermore, the National Hydrogen Strategy acknowledges that *"Interconnection import/export routes, will play a key role in ensuring security and price resilience of supply"*.

4. Network reconfiguration

Our decarbonisation pathway, consistent with current energy and climate action policy, focuses on ultimate network repurposing to transport only renewable gases. The evolution of the gas network will take place over the next 20 years, at first gradually as biomethane and hydrogen are blended with natural gas, and then more rapidly, as portions of the network are fully converted to one or other renewable gas to the point of full decarbonisation. While the precise timing of the network transformation is uncertain, what is clear is that it will occur in four distinct phases. Throughout the period to 2050, significant developments in domestic, U.K., E.U. and international energy will shape the actual timing and precise nature of the network reconfiguration that emerges. Ultimately the pace at which our network can transform will be determined by the timing and scale of renewable gases availability.

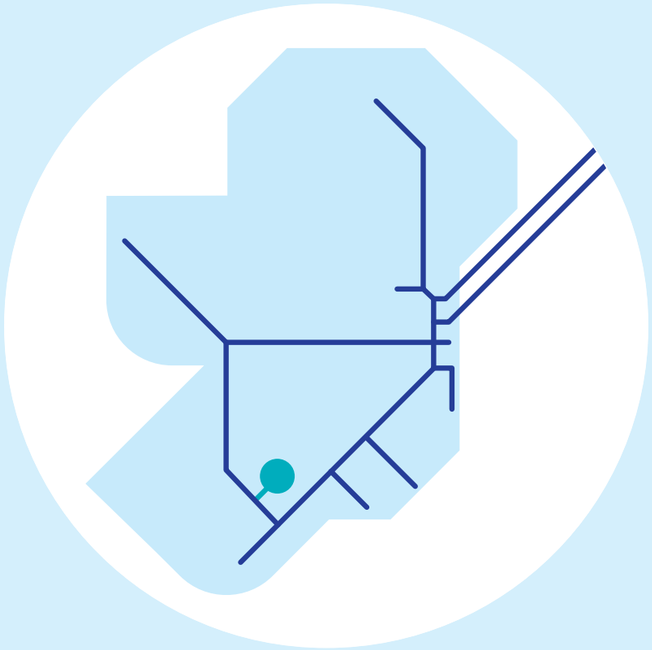
Over the next 12 to 15 years our gas system will likely remain a unitary network predominantly transporting natural gas but including increasing volumes of renewable gases. It is during the late 2030s and through the 2040s that complete network repurposing will be progressed. The storage requirements of the network will also change over the period. Initially, storage will focus on backing up natural gas supply, however, as segments of biomethane and hydrogen networks emerge and expand, it will be necessary to establish appropriate stores of each of those gases, that can cater for seasonal and inter-seasonal demand peaks and provide cover in periods of potentially constrained supply.

4. Network reconfiguration

Foundation

Now – end 2027

Schematic of network by end of 2027



This phase of development will be focused on readying the network for the emergence and initial scaling of renewable gases. The period will be one of planning, testing, trialling, safety case development, and initial injection sites establishment. By the end of this phase, the network will have enhanced its security and resilience capabilities and proven its ability to safely inject and transport renewable gases.

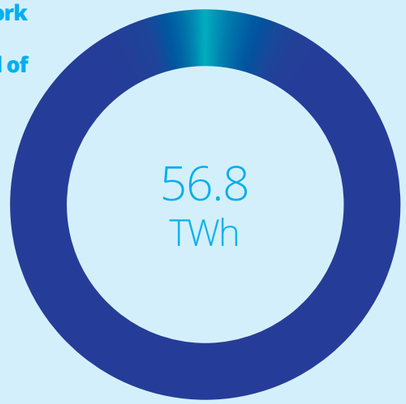
Foundation – Gas source estimates by end of 2027

Hydrogen
0 TWh

Biomethane
0.7 TWh

Natural gas
56.1 TWh

Annual network demand/gas source by end of 2027



Schematic Legend

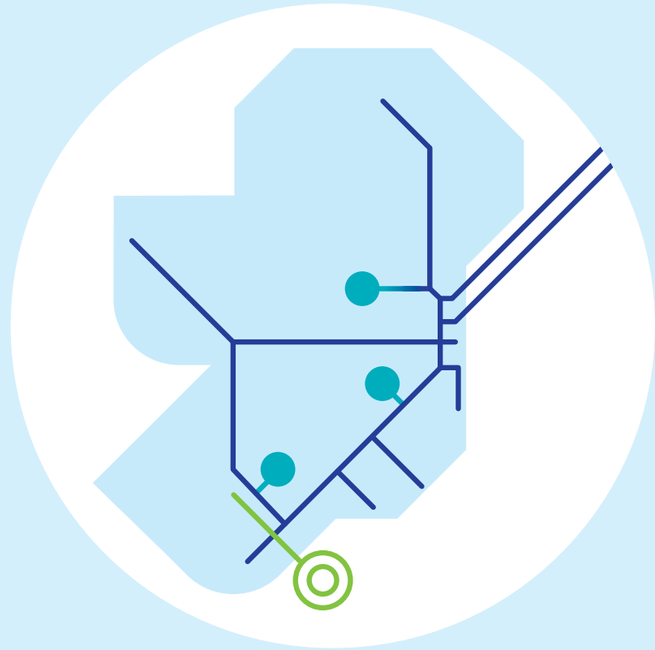
- Natural gas pipeline
- Hydrogen pipeline
- Biomethane pipeline
- Hydrogen pipeline under construction
- Hydrogen cluster
- Biomethane central grid injection point

Direct biomethane and hydrogen connections not included

Development

2028 – 2032

Schematic of network by end of 2032



During this period, renewable gas volumes will scale-up. Our pathway anticipates that the national biomethane target of 5.7 TWh by 2030 is achieved and that the biomethane sector which is solidly established by this point continues to grow towards sustainable limits.

It is expected that hydrogen blending will commence either locally and/or via the gas interconnectors and an initial hydrogen cluster will emerge likely involving some repurposing of the existing gas network to distribute indigenous green hydrogen to local large gas consumers. It is also likely other such projects, most likely at port locations, will be under development in this period.

Detailed planning for key network repositioning projects will be completed and the planning and piloting for future network conversion to hydrogen will commence.

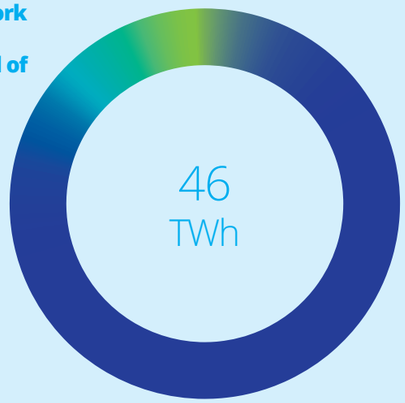
Development – Gas source estimates by end of 2032

Hydrogen
1.3 TWh

Biomethane
6.3 TWh

Natural gas
38.4 TWh

Annual network demand/gas source by end of 2032



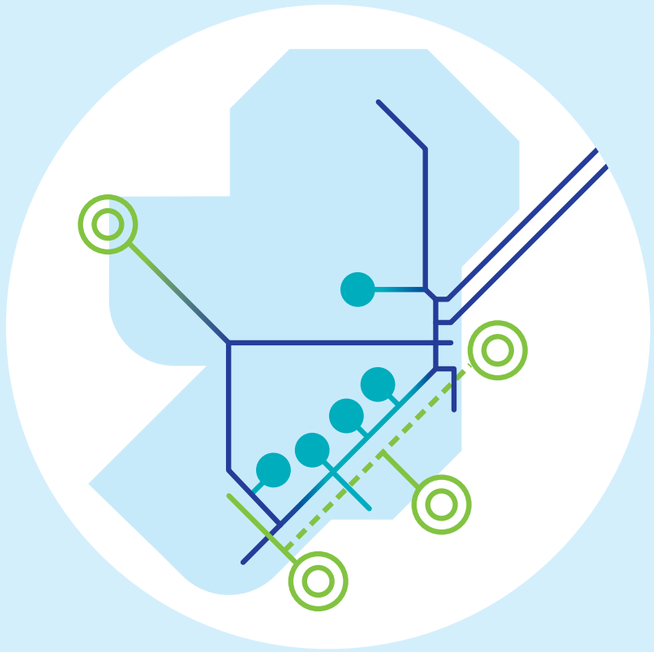
4. Network reconfiguration

Repositioning
2033 - 2040

As hydrogen volumes available to the gas network continue to grow, the focus will turn to more wholesale gas network repurposing. Hydrogen clustering opportunities will become exhausted (there are likely only c. 5 or 6 potential clusters nationally) and will require connection to each other for resilience, and volumes of hydrogen on the gas network will approach levels beyond which conversion to 100% hydrogen would be necessary. Key network flexibility projects will now need to be undertaken to ready the network for full repurposing to transport renewable gases only.

During this phase, our infrastructure will be reviewed on a case-by-case basis to determine if gas assets are to be repurposed or to be decommissioned if they are no longer in use. We will also consider reinforcement and network development.

Phase 1: 2033 - 2036
Schematic of network by end of 2036



Schematic Legend
- Natural gas pipeline
- Hydrogen pipeline
- Biomethane pipeline
- Hydrogen pipeline under construction
- Hydrogen cluster
- Biomethane central grid injection point

Direct biomethane and hydrogen connections not included

Some network compression and reinforcement work will be undertaken to adjust for the difference in transporting 100% hydrogen, a less energy dense gas than natural gas. Some parallel network development (most likely twinning of the Cork-Dublin transmission pipeline) will be necessary to create the flexibility for introducing 100% renewable gases on distinct networks and to connect hydrogen clusters.

In the mid to late 2030s, subject to scaling of hydrogen production, 100% UK hydrogen could become available through the Moffat Entry Point along with the emergence of a Dublin hydrogen power generation cluster. Initially one interconnector (IC1) would convert to hydrogen, providing resilience and security of supply to the emerging hydrogen gas system. This development will facilitate and underpin future ring main conversion and the integration of the hydrogen clusters to the national network. This would also provide Northern Ireland with the option to convert the Scotland to Northern Ireland Pipeline (SNIP) to hydrogen or remain on natural gas supplied by the second interconnector (IC2). By the end of this period, the focus will have shifted to designing the future hydrogen conversion programme and supporting customer and stakeholder communications programmes.

Phase 2: 2037 - 2040
Schematic of network by end of 2040

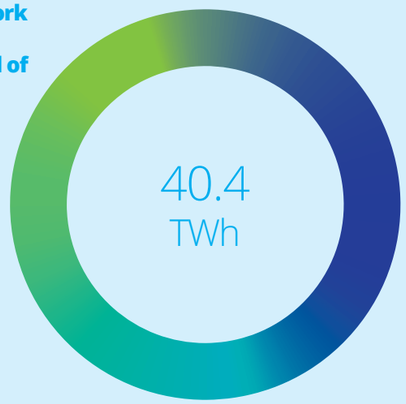
Phase 1 – Gas source estimates by end of 2036

Hydrogen
6 TWh

Biomethane
10 TWh

Natural gas
24.4 TWh

Annual network demand/gas source by end of 2036



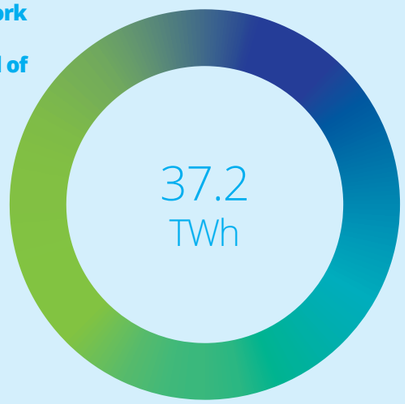
Phase 2 – Gas source estimates by end of 2040

Hydrogen
17.1 TWh

Biomethane
14 TWh

Natural gas
6.1 TWh

Annual network demand/gas source by end of 2040



4. Network reconfiguration

Conversion

2041 – 2045

Assuming sustainable biomethane production has scaled to levels that would support a dedicated network, the national gas network will be split into two distinct renewable gas networks. National biomethane potential suggests that it may be ultimately capable of meeting c. 25%-30% of national gas needs. As such, hydrogen will need to cater for the remaining c. 70%-75% of enduring gas demand, resulting in a larger national zero carbon hydrogen network and a smaller regional net zero carbon biomethane network.

By the end of the period, the gas transmission system in Northern Ireland can be converted to hydrogen, transporting indigenous hydrogen production and/or hydrogen via the South North Pipeline and the Scotland to Northern Ireland Pipeline (SNIP), however, stakeholders in Northern Ireland will determine the transition pathway and its timing.

Biomethane may also emerge as the dominant gas within distribution networks in Northern Ireland. The current transmission ring main in the Republic of Ireland will begin converting to hydrogen transportation, and will ultimately supply all gas-fired power generation and very large industrial customers, with a new 'parallel' biomethane transmission backbone supplying consumers along the existing Cork-Dublin pipeline, and the majority of connected distribution networks.

This allows existing consumers for whom electrification will be very challenging to quickly and easily decarbonise as equipment conversion is not required in switching from natural gas to biomethane.

The biomethane distribution networks will continue to supply consumers directly in the main conurbations in Cork, Limerick, Tipperary, Waterford, Kilkenny, Carlow, Laois, Kildare, Dublin, Meath, Louth, Cavan, and Wicklow. Biomethane-fuelled district heating schemes may emerge as an alternative in some areas.

The hydrogen transmission network will also support a distribution tier (portions of a limited number of current distribution networks now supplied from the hydrogen ring main also 'converted' for hydrogen). These distribution networks will continue to directly supply large consumers for whom electrification ultimately proves very challenging. Finally, the second (and higher capacity) interconnector also converts to hydrogen, providing significant additional security of supply back-up to indigenous green hydrogen production via the UK and European Hydrogen Backbone. This provides an efficient means of scale hydrogen export, in the event of hydrogen production surplus to national needs and/or to take advantage of international premiums for green hydrogen.

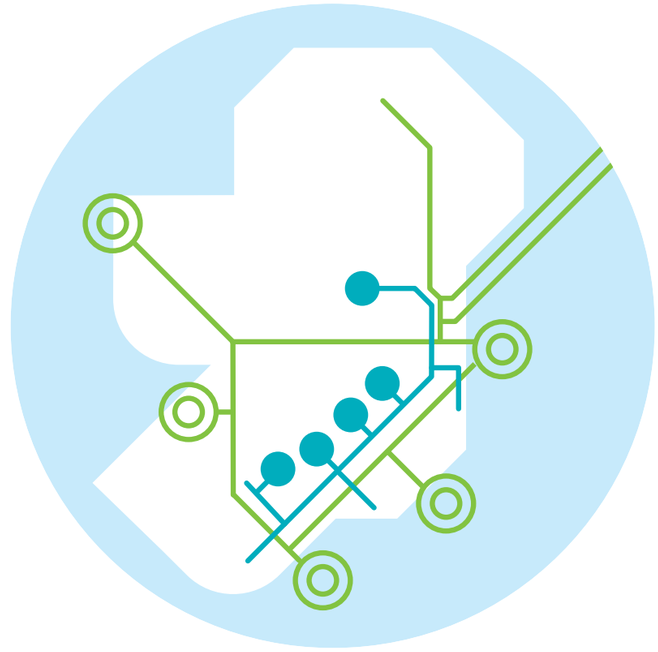
Post-conversion, and with our two networks supplying only renewable gases, our infrastructure will have been reviewed on a case-by-case basis to determine if gas assets were to be repurposed or to be decommissioned if they were no longer in use. Demand for sustainable networked gas is anticipated to recover somewhat. A maturing hydrogen economy will increasingly look to the national hydrogen ring main for supply and as an efficient means of moving hydrogen between points of production and centres of consumption. As electricity demand continues to increase, hydrogen-fired generation is likely to experience higher levels of utilisation, and with networked hydrogen widely available across the country, hydrogen will be a more accessible solution for heavy transport.

Schematic Legend

- Natural gas pipeline
- Hydrogen pipeline
- Biomethane pipeline
- Hydrogen pipeline under construction
- Hydrogen cluster
- Biomethane central grid injection point

Direct biomethane and hydrogen connections not included

Schematic of network by end of 2045



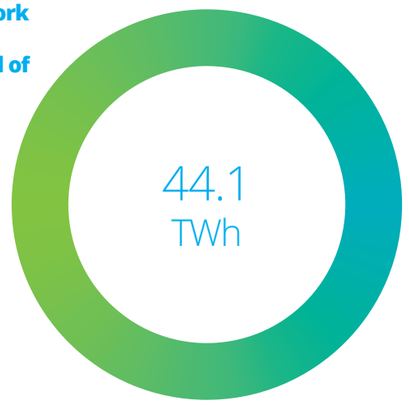
Conversion – Gas source estimates by end of 2045

Hydrogen
30.1 TWh

Biomethane
14 TWh

Natural gas
0 TWh

Annual network demand/ gas source by end of 2045



5. A pathway to decarbonisation

Schematic Legend
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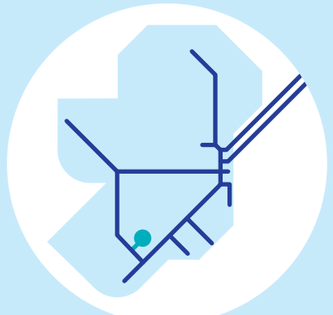
- Hydrogen pipeline under construction
- Hydrogen cluster
- Biomethane central grid injection point

Direct biomethane and hydrogen connections not included

Foundation
Now - 2027

Network demand/gas source: **56.8** TWh



Development
2028 - 2032

Network demand/gas source: **46** TWh

Repositioning
2033 - 2040

Phase 1
2033 - 2036
Network demand/gas source: **40.4** TWh

Phase 2
2037 - 2040
Network demand/gas source: **37.2** TWh

Conversion
2041 - 2045

Parallel hydrogen and biomethane networks: **44.1** TWh

Net zero carbon network by 2045

	By end-2027	By end-2032	By end-2036	By end-2040	By end-2045
Biomethane	• Transporting 0.7 TWh p.a. • Mitchelstown Central Grid Injection (CGI) & connections	• Transporting 6.3 TWh p.a. • 1 more CGI plus connections	• Transporting 10 TWh p.a. • 3 more CGIs plus connections	• Transporting 14 TWh p.a. • Further direct connections	• Transporting 14 TWh p.a.
Hydrogen	• Transporting 0 TWh p.a. • Small pilot projects initiated	• Transporting 1.3 TWh p.a. • Interconnection hydrogen @ 2-5%	• Transporting 6 TWh p.a. • Interconnector hydrogen @ 5-10%	• Transporting 17.1 TWh p.a. • Interconnector 1 (IC1) converted to 100% hydrogen	• Transporting 30.1 TWh p.a. • Interconnector 2 (IC2) also converted to hydrogen
Network	• Detailed transition plan completed	• Hydrogen cluster @ Cork • Initial hydrogen network expansion • Hydrogen conversion pilots developed	• Hydrogen cluster @ Dublin, Mayo/Galway & Southeast • Parallel hydrogen Dublin/Cork TX main under construction • Preparatory IC1 work (both ends) • Hydrogen supply to Scotland Northern Ireland Pipeline (SNIP) enabled	• Dublin & Cork hydrogen clusters linked • Hydrogen cluster @ Shannon • Hydrogen ring main conversion commences • Independent biomethane network	• South North pipeline converted to hydrogen • Export capability developed on Interconnectors
Storage	• Strategic gas emergency store in development	• Strategic storage in place	• Initial renewable storage in place and additional options developing	• Biomethane storage increases • Hydrogen storage scaling	• Biomethane seasonal storage • Hydrogen seasonal storage
Consumers			• Initial Powergen/Large energy users on hydrogen	• Majority Powergen/Large energy users on hydrogen • Hydrogen ring main towns conversion commences	• Powergen/Large energy users on hydrogen • Dx networks on biomethane • Hydrogen ring main town conversion complete

6. A better energy future

Our national gas network plays a critical role in Ireland's energy system. The flexibility, responsiveness, and storage capability of networked gas means that our energy system will still need gas molecules in the future energy mix, but our national decarbonisation imperative means that ultimately this cannot be natural gas.

Ireland's gas network is a flexible, modern asset that can evolve and repurpose to enable the displacement of natural gas with emerging renewable gases - gases that Ireland is ideally positioned to produce at scale.

Developing our gas network to be a fully net zero carbon energy transporter over the coming 20 years can retain the current benefits of networked gas, but can also yield the added benefits of enabling a significant portion of national energy consumption to be decarbonised at least cost and with least disruption. In addition, gas network repurposing will enable the State to maximise its indigenous renewable energy production and utilisation, while optimising its storage and interconnection investment commitments in realising a fully decarbonised energy sector.

In making this transition, our future decarbonised gas network can enable Ireland to not only achieve its climate action ambitions, but to also reshape energy consumption across different segments of the economy. By repurposing the gas network, Ireland will fulfil its potential to become self-sufficient in energy and could ultimately even become a net exporter of renewable energy, with all the energy security and affordability benefits this would offer both the Irish State and Irish energy consumers.

While we are confident that the network transformation pathway we have outlined can be achieved, and across the timeline indicated, this can only be realised in the context of scale renewable gases, whether produced in Ireland or imported in the case of hydrogen, becoming available to displace natural gas. Similarly, the network transformation we have outlined, even in the context of scale renewable gases being available, can only be embarked upon and delivered with necessary supporting energy policy, renewable energy economics, and energy market regulations. Our pathway outlines a central, adaptable case view reflective of the timely realisation of all currently known policy targets and enablers and a credible optimistic outlook on how these will evolve through the 2030s and 2040s, all consistent with realising net zero carbon by 2045. If any of these key dependencies were delayed, our transformation pathway would necessarily extend out or energy sector evolution might involve the deployment of additional or interim energy technologies, such as Carbon Capture and Storage (CCS). There is also the possibility that some developments could realise earlier than currently seems likely and the pathway could accelerate interconnector (IC1) conversion for example.

Critically, Ireland's gas network can be a net zero carbon component at the heart of our national 2050 energy system, continuing to play the key role it does today and more, but fully decarbonised. Gas Networks Ireland is committed to realising our network's potential to make this transition. We are committed to readying and ultimately repurposing our network to transport only renewable gases for the benefit of the country and its energy consumers.

Gas Networks Ireland

The main contact details for
Gas Networks Ireland are:

General enquiries
1800 464 464
Lines open Monday to Friday 8am – 8pm and Saturday 9am – 5.30pm

24 Hour emergency service
1800 20 50 50

networksinfo@gasnetworks.ie

@GasNetIRL
gasnetworks.ie

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