KPMG

Supporting a renewable gas sector in Northern Ireland

2022

Contents

1,400 Jobs
that could be supported by an indigenous biomethane industry in NI by meeting a 2030 target of 1.4 TWh.

The Biomethane Opportunity in numbers

20,000	The number of AD plants already operating across Europe, demonstrating the established and proven nature of this technology.
90	The number of AD plants already successfully operating across NI. These plants primarily use their gas to generate electricity under the Renewable Obligation Certificate scheme.
6.3 TWh	The volume of biomethane which could be generated from indigenous feedstocks located within 10km of the existing NI gas network
1.4 TWh	A proposed NI 2030 biomethane target, which would displace 8.75% of NI's current natural gas consumption. This equates to 15% of natural gas usage excluding power generation in 2030.
1,400	Jobs that could be supported by an indigenous biomethane industry in NI by meeting a 2030 target of 1.4 TWh.
1.2 MT	The amount of CO_2 savings a biomethane industry could deliver for NI between 2024-2030.
6%	The percentage of savings a biomethane target of 1.4 TWh could deliver for the NI Energy Strategy's goal of reducing energy emissions from 12.6MT to 7MT by 2030.
200,000 tonnes	Of CO_2eq savings would be attributed to the agriculture sector in NI.
6,247 km	The length of the modern NI gas network which can be used to deliver renewable gases to homes and businesses to support decarbonisation.
Over £1bn	Level of historic investment in the NI gas grid, which now has the opportunity to be used as a distribution network for low carbon gases.
67%	The gas network could reach 67% of homes in NI, which offers them the potential to immediately reduce emissions and the opportunity to further decarbonise once the grid transports significant volumes of renewable gases.
20%	The amount of hydrogen that currently could be blended into the distribution grid without significant impact to consumers or infrastructure.

Foreword by Action Renewables

In just two years' time Action Renewables will come of age. Back in 2003 very few people had heard about renewable energy, let alone climate change. Action Renewables spent the first four to five years trying to upskill the necessary statutory bodies, the wider public, and school children about what was coming down the road. Astonishingly I have now met some of those very school children who now work in the industry.

There is an even greater need for Action Renewables, and others who share similar goals, than ever before. While climate change is happening at a frightening pace (it is likely that 2022 will be the eighth year in succession when temperatures have exceeded 1.0°C above pre-industrial levels) there can now be few people who are not aware of it and what needs to be done to avert crisis.

We are delighted that Northern Ireland now has an ambitious vision to transform into a low carbon society and economy by 2050 and of course the recently launched Energy Strategy - The Path to Net Zero Energy[1] sets key targets for energy efficiency, renewable energy, and the green economy to tackle climate change. Energy accounts for approximately two-thirds of all greenhouse gas emissions in Northern Ireland and heat accounts for approximately half of Northern Ireland's total energy consumption. Raising awareness about climate change, encouraging and supporting renewable energy, and focussing on what needs to be done to help deliver decarbonisation has always been and remains the central focus of what this charity does.

Concentrating on energy, and on gas in particular, we tasked KPMG with examining what support mechanisms could be employed to drive decarbonisation within the gas networks and deliver renewable heat to customers. We recognise that the existing pipeline and boiler infrastructure is an asset, and a recent, modern one at that. Northern Ireland has already shown considerable leadership, pragmatism, and willingness to rise to the challenge by generating approximately 50% of electricity from renewable sources. The challenge now is to do the same for the gas sector. This report has examined all the details and facts available against a difficult background of a global pandemic, a war in Europe and simply unprecedented energy price rises. If this report prompts the same conversations, both in terms of quality and quantity, which have been taking place between the key stakeholders participating in its creation, then it will achieve its purpose.

Terry Waugh

Chief Executive Officer
Action Renewables

Executive Summary

Northern Ireland ("NI") has an ambitious vision to transform into a low-carbon society and economy by 2050 and the recently launched Energy Strategy - The Path to Net Zero Energy[1] sets out the actions NI will take to tackle climate change. As part of the transition to a low-carbon economy, the Northern Ireland Assembly recently passed the Climate Change (No.2) Bill[2], targeting Net Zero by 2050.

Energy accounts for approximately two-thirds of all greenhouse gas emissions in NI, while heat accounts for over half of NI's total energy consumption and is responsible for 38% of energy-related emissions in NI.

Given the significance of both energy and heat emissions, Action Renewables ("AR"), a registered charity that aims to support a world which recognises the serious impacts of climate change, has commissioned KPMG to examine the potential role that renewable gases (focused principally on biomethane gas, but acknowledging the future role of green hydrogen) can have in NI's decarbonisation pathways, and potential government policy mechanisms that could be introduced to stimulate its production and uptake. This report has been developed with the co-operation of the NI Distribution Network Operators as they are likely to have a significant role in the enablement of the sector, as well as transportation and displacement of natural gas in their networks with renewable gas.

While electrification and energy efficiency will play a significant role in the decarbonisation of heat (e.g. heat pumps), there has been increasing policy consensus across Ireland, Northern Ireland and Great Britain ("GB") that the energy transition will need diversity and that renewable gas has a vital and significant role to play.

At present, the UK and Ireland have among the lowest levels of renewable heat across Europe (6.3% and 7.8% respectively, vs 22% European Union average[3]), relying heavily on natural gas and oil. As such, each of these jurisdictions require significant investment in energy efficiency and all forms of renewable heat such as biomethane, hydrogen and heat pumps to achieve Net Zero targets and meet carbon budgets.

The gas network in Northern Ireland transported 17.2 TWh of natural gas in 2020/21, with 9.2 TWh used in the power sector and 8 TWh used on the distribution grid by approximately 320,000 residential and commercial customers. According to the Transmission System Operators, demand for gas is to reduce to approximately 16 TWh in 2030, with a small reduction in the power sector's demand (due to increased renewables on the system), but an increase in demand on the distribution network, up to 9.1 TWh in 2030[4].

This report outlines an ambition to support a renewable gas sector in Northern Ireland with an initial target of 1.4 TWh of gas supply coming from biomethane by 2030 (displacing 8.75% of natural gas demand) and explores potential financial support mechanisms to bolster the deployment of new indigenous production facilities for biomethane. This volume target has been suggested as it is broadly in-line with the capacity roll-out profile which was achieved for the existing AD capacity in NI, is well within the feedstock capacity available in NI, and could comfortably be accommodated in the NI gas network with limited infrastructure investment.

1 The Path to Net Zero Energy
2 Climate Change (No.2) Bill
3 Eurostat
4 Northern Ireland Gas Capacity Statement

What is Biomethane Gas?

Biomethane is a renewable gas which can act as a direct replacement for natural gas. It has similar properties to natural gas and can be transported using the existing gas network, used by existing gas appliances, and blended with hydrogen. Biomethane is produced using anaerobic digestion, which is a natural process, involving the breakdown (digestion) of biomass (organic matter from plants and animals) by bacteria, in the absence of oxygen (anaerobic). Biogas is produced through this process, which is collected in a gas membrane. This biogas is then upgraded and cleaned to become biomethane, ready for grid injection or transportation to its end use. AD plants typically use a combination of slurry, silage, energy crops, food waste and animal by-products (collectively called 'feedstock') which are digested in a large concrete or steel tank.

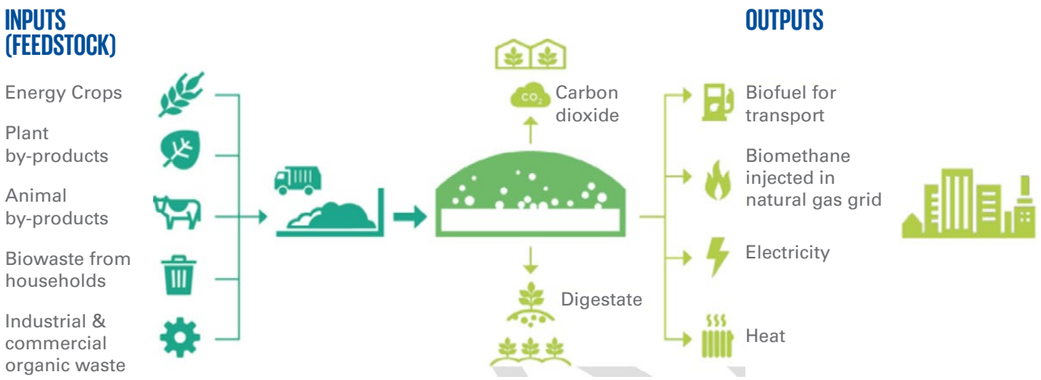

Figure 1

Biomethane is a renewable gas, and as such its production and subsequent displacement of natural gas can assist in NI's decarbonisation ambitions. Furthermore, since it is produced exclusively using domestic inputs, it further increases NI's energy security through reduced reliance on imported natural gas.

A 2030 biomethane target of 1.4 TWh would equate to a CO_2eq emission reduction of 340,000 tonnes in 2030 and a cumulative reduction of 1.2 million tonnes from 2024 to 2030, using an assumed development profile.

Cumulative CO^2eq savings

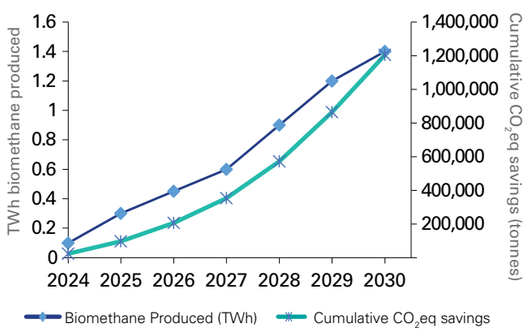

Figure 2

With the majority of the biomass feedstock expected to be sourced from the agriculture sector, the 1.2 million tonnes of CO_2eq savings would be split between the energy sector and the agriculture sector. Approximately 1 million tonnes of CO_2eq savings would be attributed to the energy sector with the remaining c. 200,000 tonnes attributed to the agricultural sector between 2024 and 2030. The NI Energy Strategy outlines a plan to reduce energy emissions from 12.6MT in 2018 to 7MT in 2030 and a 1.4 TWh target for biomethane could represent 6% of all emissions savings needed in the energy sector.

Feedstock Potential

Biomethane can be produced from a broad range of biomass materials including agricultural wastes, food waste and crops.

As outlined in the graph below, agricultural sources represent the single largest source of feedstock for AD across Europe, with crops and agricultural wastes representing 66%[5] of all input material.

5 Feedstocks applied for biogas production in the EU (Wouters et al. 2020)

Feedstocks applied for biogas production in the EU

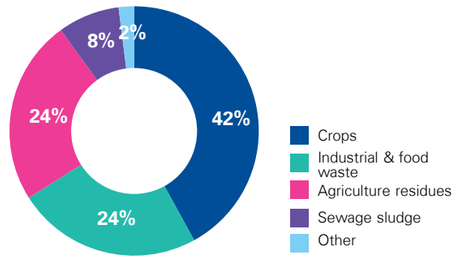

Figure 3

While food waste is often considered the optimum feedstock, as it is typically easier to process in the digestor, has a high energy content, and provides an environmentally better outcome than landfilling such material, its overall volume is limited and finite and the majority of available food waste resource in NI is currently utilised in existing AD plants. Food waste should be an important component of any national AD scheme, but it isn't sufficiently scalable on its own.

Accordingly, in order to develop a long-term, scalable and sustainable biomethane industry, it is vital to work in partnership with the agriculture sector to establish a mutually beneficial model which provides new economic opportunities for rural communities and an outlet for agricultural wastes, all while producing an indigenous fuel which can play a vital role in the national decarbonisation journey.

According to a Queen's University Belfast authored report for the Centre for Advanced Sustainable Energy, ("CASE") Northern Ireland has the potential to produce 6.3 TWh[6] of biomethane using agricultural-led facilities (under a scenario where all housed livestock manure and underutilised grass silage is used for biomethane production via anaerobic digestion), highlighting the potential agricultural feedstocks available in NI.

Renewable Gas Potential

Producing biogas from AD is a mature technology already operating in Northern Ireland across approximately 90 facilities[7], as well as 20,000 plants across Europe[8]. While these existing NI facilities all use the biogas to produce electricity, it is a straightforward process to upgrade the biogas to biomethane gas, which can then be injected straight into the grid. NI is expected to inject its first biomethane in 2023.

6 Centre for Advanced Sustainable Energy – Northern Ireland Case Study
7 NI Audit Office – Generating electricity from renewable energy
8 European Biogas Association

The fact that NI already has c.90 operational AD plants provides a significant head start over other jurisdictions, such as Ireland, which is seeking to mobilise its biomethane sector from a very low base. In particular, it means that NI already has over a decade of experience in developing, permitting, operating and integrating AD into the NI ecosystem and means that the proposed biomethane strategy is about scaling an existing industry, rather than establishing a new one.

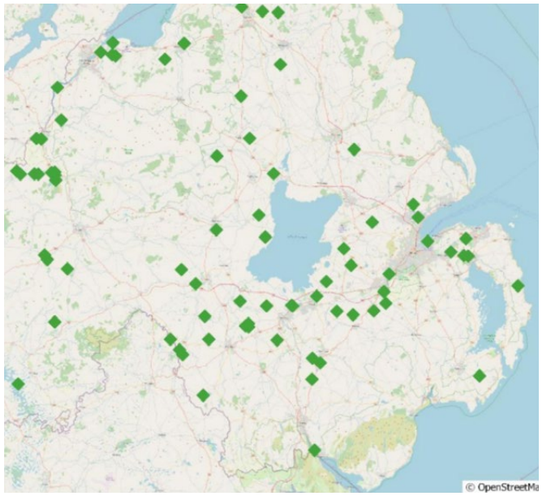

Figure 4

In March 2022, the European Commission announced a target to produce 35 billion cubic metres (342 TWh) of biomethane within the EU by 2030 as part of its REPowerEU plan. This is a doubling of the original 2030 target, set out in the Fit for 55 communication. Currently in Europe, production of biomethane is approx. 30 TWh which means the industry needs to grow greater than tenfold by 2030 to meet new targets.

Biomethane Production in Europe from 2011 until 2020 (EBA)

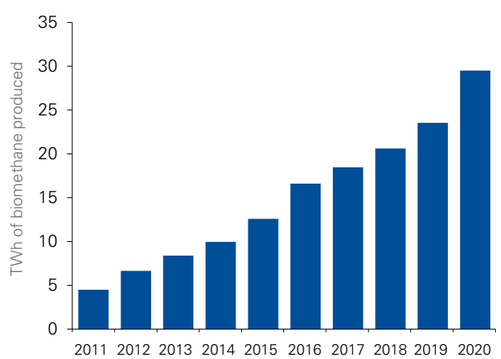

Figure 5

20,000

The number of AD plants already operating across Europe, demonstrating the established and proven nature of this technology.

Support Mechanism Required

In normal market conditions (i.e. pre-2022 macroeconomic factors) biomethane is more expensive to produce than natural gas. While industry / consumers may be willing to pay some element of a 'green' premium for biomethane, the current gap is too great to see widespread adoption of the fuel.

To ensure necessary private sector investments and encourage industry uptake, a support mechanism will be required to stimulate the production of biomethane in Northern Ireland. Based on our analysis across Europe, no jurisdiction has been able to stimulate an indigenous biomethane sector without the introduction of a government-mandated support or regulatory mechanism.

Calculating the levelized cost of energy ("LCOE") of biomethane production remains challenging, as the cost is heavily dependant on scale, technology and feedstock source.

Based on the CASE analysis (refer to page 27 for further details), we assume that the majority of NI biomethane plants will utilise agricultural feedstocks including crop silage, slurry and other agricultural wastes. While we would expect a combination of large and small AD plants to be developed, for the purposes of this paper we are assuming the average plant will produce 20GWh of biomethane output, which is twice the size of the majority of existing AD plants in NI. Such a scale of plant will typically utilise around 20,000 tonnes of silage, along with 10,000 tonnes of slurry and other agricultural wastes per annum.

In research conducted by KPMG in 2019 in Ireland, based on real-world quotes from technology suppliers and AD operators, we estimate the LCOE of a 20GWh agri-led biomethane AD plant to be approximately 7.6p per kWh.

Notwithstanding recent LCOE pressure driven by global inflation, the general market expectation is that in the long term, biomethane LCOE can be reduced. A Navigant[9] study estimated that the average LCOE today (7c per kwh) could fall to 5.7c per kWh (4.9p per kWh) by 2050, driven by economies of scale, feedstock valorisation, improved operations and higher operating hours, which represents a 29% reduction.

Based on this potential LCOE improvement, the graphic below outlines a potential trajectory for LCOE for biomethane production in NI, assuming variation optimisations and market factors are delivered. We would suggest that further work is undertaken on analysing LCOE at the appropriate time once inflationary pressures have reduced.

The green shading represents the LCOE funding gap which Government policy must bridge. As can be seen below, this gap can be expected to reduce over time:

- Assuming a linear 29% LCOE improvement as forecast by Navigant (technical efficiency, economies of scale etc through to 2050).
- Increased Climate Change Levy on natural gas.
- Monetisation of the digestate output. At present digestate management is generally a cost, or at least revenue neutral output. However, if it can be processed sufficiently, it would be able to directly replace fossil-based fertilisers and generate an income for the plant.
- In the first few years of injection into the gas grid there is likely to be some additional costs for the blending of propane to increase the calorific value of the renewable gas. This may be mitigated through grid management improvements and updated billing modelling, which could be location specific. Based on conversations with the Distribution Network Operators, these could be in place at the latter end of the decade.
- Combining these various factors suggests that the support premium required to stimulate biomethane production is approximately 6p per kWh in 2022, reducing to 4p per kWh by 2030.

Cost of biomethane production is forecasted to fall

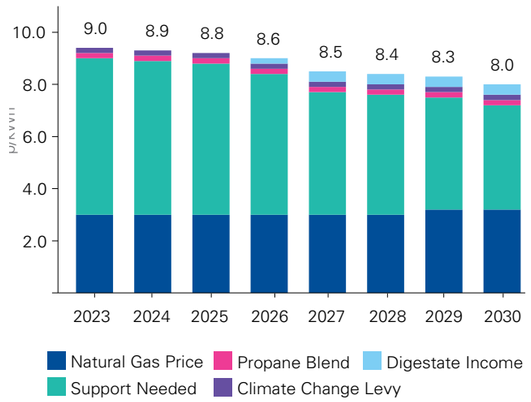

Figure 6

9 Navigant – The optimal role for gas in a net-zero emissions energy system

Supporting the development of the Biomethane sector

All European jurisdictions with an active Biomethane industry have supported the development of the sector with government subsidy, support or legislation.

In Great Britain, the Government recently introduced a new biomethane support scheme, the Green Gas Support Scheme, while Ireland has now set a 1.6 TWh biomethane target and recently consulted on the introduction of a Renewable Heat Obligation scheme to support the establishment of the sector.

Since the closure of the Northern Ireland Renewables Obligation ("NIRO") in 2017, there have been no NI-based support mechanisms for AD in NI. Additionally, there has never been a support scheme in place for biomethane production in NI.

Accordingly, if NI is to have its own indigenous biomethane industry, government policy supports similar to those in place in GB and Ireland will be required.

KPMG has considered potential support mechanisms from other jurisdictions, including GB and Ireland, and has set out the analysis in the body of this paper, including a review of the Green Gas Support Scheme, the Renewable Heat Obligation and Contracts for Difference.

KPMG is aware of the challenges currently faced by households in terms of rising energy costs and propose that the mechanism introduced must be spread across the entire heating sector to limit the impact on individual bills. This approach is consistent with the Energy Strategy which seeks to make the transition to Net Zero affordable for all.

The Important Link to Agriculture

Agriculture accounts for approx. 26%[10] of Northern Ireland's greenhouse gas emissions. AD plants provide farmers with opportunities to capture methane from slurry, which helps to reduce emissions in the agriculture sector, while the use of digestate would reduce water pollution and displace artificial fertilisers, as well as enhancing soil, air and water quality and improving biodiversity.

Emissions by sector 2019

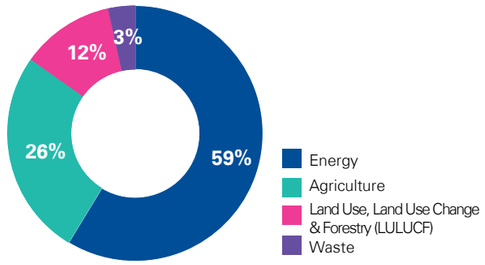

Figure 7

While the use of agricultural crops for AD can be controversial, with concerns that it will compete with animal feed volumes, as the CASE study highlights, Northern Ireland has the capacity to produce material quantities of biomethane without impacting on current agricultural output levels. In particular, the CASE study focuses only on incremental feedstock production, not existing silage volumes, by increasing grass silage productivity on under-utilised land.

Furthermore, a case study carried out in a recent KPMG and Devenish report notes that "Despite the AD plants (in NI) consuming an incremental c.700,000 tonnes of grass silage annually (c.8% of historic silage production), over the same period the number of dairy cattle grew by c.12%, while overall cattle numbers increased by 4%. This would suggest that the AD sector did not lead to a constraint on cattle expansion".

AD sector in NI did not lead to a constraint on cattle expansion

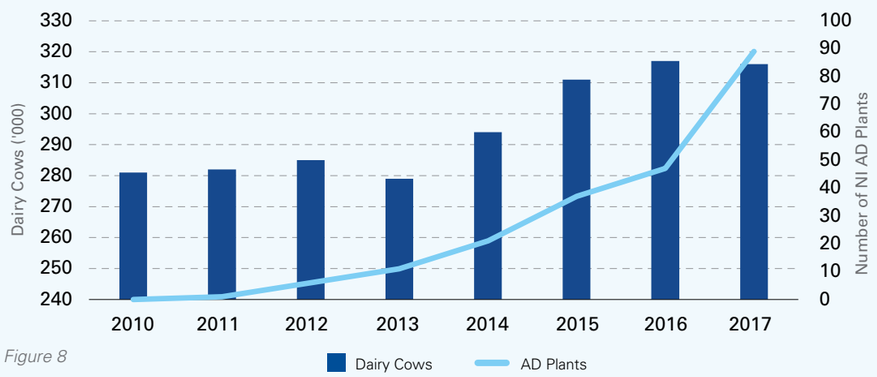

Figure 8

10 Northern Ireland's GHG Inventory by source (1990-2019)

There is also the opportunity to introduce innovation into the agricultural feedstock production system.

A recently published report carried out in Ireland by KPMG and Devenish 'Exploring how Ireland can deliver a sustainable, agriculture-led biomethane industry', shows that the use of Multi-Species Swards can be a viable pathway to grow incremental forages to act as a feedstock for AD plants, rather than mono-culture ryegrass which has historically been considered[11].

Biomethane production also provides a significant benefit to the agriculture sector through the creation of jobs such as operating new AD facilities while also helping to secure jobs in the industry through feedstock supply to the new plants. This also helps promote rural economies through the creation of skilled jobs for local people. If 1.4 TWh of biomethane production is achieved in NI, up to 1,400 jobs could be created by 2030. A biomethane industry also offers an opportunity for current farmers to diversify their income streams, through the supply of feedstocks, and a biomethane industry could act as driver to secure farming jobs in NI.

Enablement Policies

To deliver a renewable gas sector in Northern Ireland, several enablement policies will be required, some of which will necessitate cross-departmental working groups. KPMG welcomes the inclusion in the Energy Strategy Action Plan 2022 of an action point to set up one such group in respect of biomethane.

In terms of key policies required, below is a summary of the most critical enablement factors to achieving material progress:

- Biomethane grid injection needs to be facilitated in Northern Ireland. KPMG acknowledges this is a current focus of the Utility Regulator in collaboration with the gas industry and is a necessary first step.
- The Utility Regulator's mandate should be broadened so as to allow it to better support the development of a renewable gas sector in NI.
- Planning for energy infrastructure can be difficult, and if as many as 70 AD plants are to be built by 2030 to meet an interim target of 1.4 TWh of biomethane, a streamlined process for strategic energy infrastructure should be considered.
- A consultation on an appropriate support mechanism should take place this year to ensure a mechanism can be in place by 2023/24.
- In consultation with the Utility Regulator and other Stakeholders, the Distribution Network Operators should consider the additional infrastructure required to facilitate the movement of gas from the west of Northern Ireland to the east post 2030 – the opposite of today's normal gas flow.

Green Hydrogen Potential

Hydrogen is the most abundant element in the universe but does not exist naturally in its pure form. It can be created in several ways, including from water (using electrolysis) that can be used in a similar manner to natural gas. At low level blends (<20% by volume) with natural gas, appliance replacement is not required (modern appliances are already capable of a 20% hydrogen blend). Hydrogen can be transported using the existing gas distribution networks which are modern polyethylene type, unlike some of the network in GB.

Green hydrogen will be critical for meeting NI's commitment to Net-Zero by 2050. It has the potential to play a role in decarbonising vital industry sectors and provide flexible deployment across heat, power, and transport. There are uncertainties around the exact role of hydrogen in 2030 and out to 2050, and scale of demand and deployment in different sectors, but it is a key component in the Power-to-X concept, which aims to use surplus renewable electricity in the most efficient manner (whether through conversion to other forms such as hydrogen, energy storage or energy conversion techniques).

Northern Ireland has a significant wind resource and storage capability and can use both to produce and store green hydrogen. Green Hydrogen can support the decarbonisation of industry, domestic homes, power and transport.

This report mainly focuses on the immediate opportunity presented by biomethane, but briefly covers NI's hydrogen potential in Section 6. Further work and analysis of the green hydrogen opportunity for NI should progress in parallel with the biomethane workstream as there are many overlaps, such as support mechanisms, policy, regulation and safety frameworks, for policy makers to progress.

Next Steps

KPMG's engagement with the Distribution Network Operators and wider industry has revealed that there is a strong desire to work alongside the necessary government departments, most notably DfE, DAERA, the Department for Infrastructure (DfI), the Utility Regulator and the Health and Safety Executive for Northern Ireland (and all other relevant stakeholders) to deliver on the current level of ambition.

The gas network plays a vital role in Northern Ireland's energy mix and economic progress. It is responsible for supplying energy for heat in a safe, reliable, and controlled manner to customers on an on-demand basis, 24 hours a day, 365 days a year. The gas network transported 17 TWh of natural gas in 2020/21, with 9.2 TWh used in the power sector and 8 TWh used on the distribution grid by approximately 320,000 residential and commercial customers.

11 Sustainability of Biomethane Production in Ireland

90

The number of AD plants already successfully operating across NI. These plants use their gas to generate electricity under the Renewable Obligation Certificate scheme.

Section 1 - Introduction and Policy Background

Action Renewables ("AR") is a registered charity that aims to support a world which recognises the serious impacts of climate change and to take measures to prevent and mitigate against those impacts, through using renewable energy, energy efficiency, renewable transport, and renewable products. AR commissioned KPMG to produce this report with the support and cooperation of the Distribution Network Operators in Northern Ireland.

Natural gas is a key energy source for NI

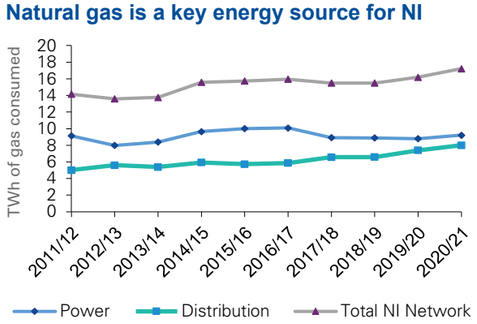

Figure 9

According to the Transmission System Operators[12], demand for gas is to reduce to approximately 16 TWh in 2030, with a reduction in power sector demand (due to increased renewables on the system), but an increase in demand on the distribution network, up to 9.1 TWh in 2030. A 1.4 TWh interim 2030 target represents 15% of 2030 forecasted distribution demand. It is important to note that these assessments were carried out before the launch of the NI Energy Strategy and the 80% renewable electricity target by 2030 being adopted in the NI Climate Change Act, meaning demand in the power sector is likely to decrease further.

Transmission System Operators - Forecasted gas demand

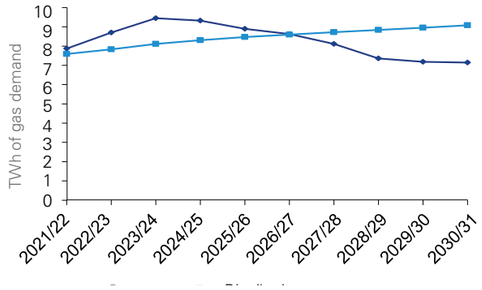

Figure 10

Northern Ireland has an ambitious vision to transform into a low-carbon society and economy by 2050 and the recently launched 'Energy Strategy - The Path to Net Zero Energy' sets out the actions NI will take to tackle climate change. While significant progress has been made to date in decarbonisation, particularly in electricity generation, there is a recognition that more can and must be done to address other areas such as heating and transport, which also generate significant volumes of greenhouse gases. To meet Net-Zero ambitions, Northern Ireland must phase out fossil fuels and transition to a lower-carbon economy while protecting the consumer and ensuring the lowest cost options are delivered in an affordable manner.

Energy accounts for almost 60% of Northern Ireland's greenhouse gas emissions[13]. The heat sector consumes 56% (29.4 TWh) of all energy used in NI (52.5 TWh) and is responsible for 38% (4.8 $MTCO_2eq$) of emissions produced by energy related sectors (12.6$MTCO_2eq$).

Total energy consumption by sector

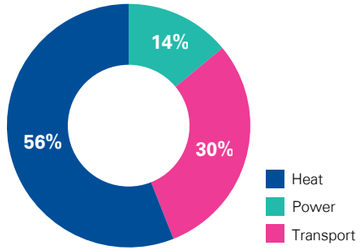

Figure 11

Emissions produced by energy releated sectors

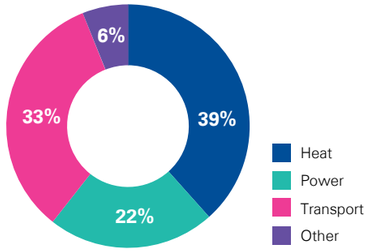

Figure 12

The decarbonisation of heat is a critical component of the Energy Strategy and the gas network can play a substantial role in achieving this through the displacement of natural gas with biomethane. A study carried out by KPMG in 2018 for Ervia 'Decarbonising Domestic Heating in Ireland'[14] showed that although heat pumps offer lower ongoing costs - in deep retrofitted homes compared to renewable gases, there is still an economic role for biomethane in existing dwellings in the residential sector and biomethane offers substantial CO_2 savings when displacing natural gas in the heating sector.

Biomethane is considered a carbon-neutral fuel, once it meets strict ongoing sustainability criteria set out under regulations of individual support schemes in the UK and under the Renewable Energy Directive II[15] or equivalent. The annual savings of CO_2eq from a 2030 biomethane target of 1.4 TWh equates to a CO_2 emission reduction of 340,000 tonnes in 2030 and a cumulative reduction of 1.2 million tonnes from 2024 to 2030, using an assumed development profile.

The approx. 1.2 million tonnes of CO_2 savings would be split between the energy sector and the agriculture sector. Approximately 1 million tonnes of CO_2 savings would be attributed to the energy sector (from the displacement of natural gas) with the remaining c. 200,000 tonnes attributed to the agricultural sector (from soil sequestration and methane capture from slurry)[16] between 2024 and 2030. The NI Energy Strategy outlines a plan to reduce energy emissions from 12.6MT in 2018 to 7MT in 2030 and a 1.4 TWh target for biomethane could represent 6% of all savings needed in the energy sector.

Cumulative CO^2eq savings

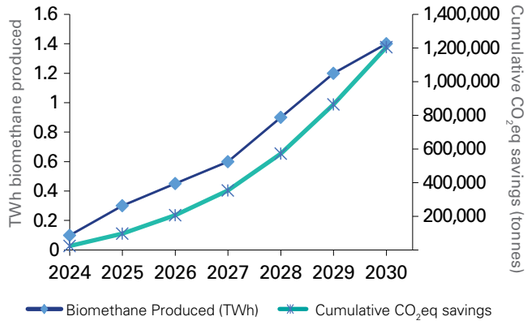

Figure 13

This report outlines an ambition to support a renewable gas sector in Northern Ireland with an interim 2030 target of 1.4 TWh coming from biomethane and explores potential financial support mechanisms to bolster the deployment of new production facilities for biomethane.

Policy Background

European, UK and Irish renewable energy policies have historically focused on decarbonising the electricity supply system, with c. 43% of Ireland's electricity and 40% of the UK's electricity now produced from renewables. More recent Net Zero targets however, mean the policy focus is increasingly shifting to decarbonising heat and transport systems, as previous targets in these sectors were missed due to lack of financial support mechanisms.

Northern Ireland has its part to play in meeting global climate targets and recently the Northern Ireland Assembly passed the Climate Change Act (Northern Ireland) 2022 Bill, which sets a Net Zero target for NI by 2050. This is a milestone piece of legislation for Northern Ireland, being the first dedicated and indigenous legislative tool to tackle climate change. As part of the Energy Strategy Action Plan 2022, the Department for Economy has set up a cross-departmental working group on biomethane production and is developing a business case for a hydrogen centre of excellence.

As part of their Nationally Determined Contribution to the United Nation's process, the UK government has committed to reduce emissions by 68% from 1990 levels by 2030. Northern Ireland's new Energy Strategy aims to deliver a 56% reduction in energy emissions by 2030 relative to 1990 levels. Ireland is aiming to reduce their national emissions by 51% from 2018 levels in the same timeframe.

While electrification will play a significant role in the decarbonisation of heat (e.g. heat pumps), there has been increasing policy consensus across Ireland, Northern Ireland and United Kingdom that the energy transition will need diversity and that renewable gases have a vital and significant role to play.

At present, the UK and Ireland have among the lowest levels of renewable heat across Europe (6.3% and 7.6% respectively, vs 22% EU average)[17], relying heavily on natural gas and oil. As such, each of these jurisdictions require significant investment in all forms of renewable heat such as biomethane, heat pumps, and hydrogen to achieve Net Zero targets and carbon budgets.

Renewable heat performance - Eurostat

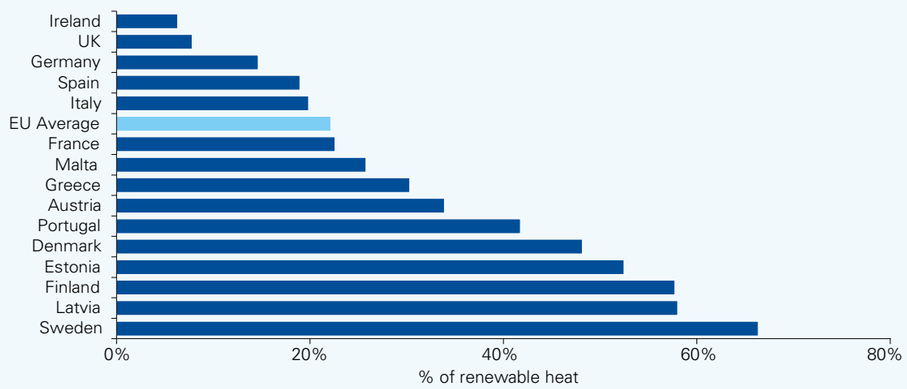

Figure 14

12 Northern Ireland Gas Capacity Statement
13 Energy Strategy – The Path to Net Zero Energy
14 Decarbonising Domestic Heating in Ireland
15 RED II

16 Based on research by Teagasc Ireland
17 Eurostat

To support and encourage this investment, the UK has recently introduced a new Green Gas Support Scheme[18], while Ireland recently consulted on the introduction of a new Renewable Heat Obligation scheme[19].

Great Britain – Biomethane Policy Support

Biomethane in GB has been primarily supported through the Non-Domestic Renewable Heat Incentive (RHI). This has recently changed, with the announcement of the closure of the non-domestic RHI and the development of the Green Gas Support Scheme as a replacement. Existing RHI recipients will continue to receive tariff payments over the lifetime of the RHI agreement (20 years).

The GGSS provides tariff support for plants producing biomethane via anaerobic digestion which is injected into the gas grid. It is funded by the Green Gas Levy which is applied to all licenced fossil fuel gas suppliers. The GGSS opened on 30 November 2021. It will be open to applications for 4 years and registered participants will receive tariff payments for 15 years. The scheme will help decarbonise Great Britain's gas supplies by increasing the proportion of 'green' gas in the grid.

During peak years of production, biomethane plants incentivised by the GGSS will produce enough green gas to heat around 200,000 homes. The GGSS is expected to contribute 8.2 million tons of CO_2 equivalent of carbon savings over its lifetime.

The Green Gas Levy[20] (GGL) applies to licensed fossil fuel gas suppliers in Great Britain from 30 November 2021 and funds the GGSS. The levy is charged on a per meter basis to all gas suppliers who supply less than 95% renewable gas.

The government has committed to transition the GGL from its current meter point design to a volumetric levy as soon as possible, subject to overcoming feasibility issues, so that costs better align with gas consumption. It is important to note these schemes only apply to England, Scotland, and Wales and not to Northern Ireland.

The Committee on Climate Change UK[21] estimates that biogas/biomethane will replace c. 10% of natural gas demand and biomethane grid injection is forecasted to treble by 2030.

In the transport sector a Renewable Transport Fuel Obligation[22] is in place which supports the development and use of renewable transport fuels such as biomethane. AD operators in NI are eligible to apply for support under this scheme. While this provides NI plants with a potential route to market for their output, it will take up capacity on the NI gas network while primarily decarbonising the GB transport sector, rather than the NI economy.

Ireland – Biomethane Policy Support

There is a wide range of government policy objectives influencing the development of anaerobic digestion facilities in Ireland including decarbonisation, the Government's Action Plan for Rural Development, the Nitrates Action Plan, the Climate Action Plan, the Department of Agriculture, Food and Marine's Code of Good Agricultural Practice and the Government's Waste Action Plan for a Circular Economy. These are further complimented by EU policies such as EU Green Deal, Farm to Fork and the EU Methane Strategy.

The Climate Action Plan (2019)[23] outlined the need to set a 2030 target for the level of energy to be supplied by indigenous biomethane injected into the gas grid and consider how necessary supports would be funded. The Marginal Abatement Cost Curve developed for the Climate Action Plan estimated that c 1.6 TWh was considered part of the most cost-effective pathway to reduce emissions in line with Ireland's decarbonisation targets out to 2030.

The Department of the Environment, Climate and Communications assessed a few different funding methods for biomethane and progressed two:

- a Renewable Heat Obligation (Consultation stage); and
- an option to include it in the existing Biofuels Obligation Scheme operating in the transport sector.

The updated (2021) Climate Action Plan[24] outlined several actions to support the development of a biomethane industry in Ireland, including:

- Support the development of a pilot cluster of anaerobic digesters through the Ireland Strategic Investment Fund by Q4 2024; and
- A review of the 2030 grid injection target (1.6 TWh) will take place in 2023.

In 2021, the Government launched its Renewable Heat Obligation Consultation document which is looking to place an obligation on energy suppliers to procure between 3% and 10% of their heat energy from renewable sources by 2030. This will stimulate a demand for biomethane from 2023 when a lower-level obligation will be introduced. The cost of procuring biomethane will be apportioned across all heat energy users rather than being Government funded. As there is no exchequer funding required, no State Aid application is needed, which means the scheme can be implemented without delay. The price of biomethane will be determined by market forces at a level to support the construction of new anaerobic digestion facilities.

Also in 2021, the Department of Transport released its Renewable Fuels for Transport Policy Statement[25]. The policy states the Government is committed to developing a new investment framework for the growth of sustainable forms of gas and as a transport fuel in the transport sector. From 2023, biomethane will receive 1.5x credits under the Biofuels Obligation Scheme.

The Department of the Environment, Climate and Communications has made capital grant funding available from the Climate Action Fund[26] and recently awarded funding to 'GRAZE', a project developing a biomethane transmission grid injection infrastructure hub.

Northern Ireland – Biomethane Policy Support

Northern Ireland has experience in developing anaerobic digestion facilities, having incentivised construction up to 2017 under the Renewable Obligation Certification (ROC) scheme. These facilities are currently used to generate approx. 50MW of electricity, using the biogas to fuel combined heat and power plants. This experience of building c. 90[27] plants provides a platform for the further development of a biomethane industry in the province.

AD plant capacity	Number of accredited generating stations in
<500kWh	80
501kWh - 5MWh	8
>5MWh	0

Figure 15

The existing anaerobic digestion plants in Northern Ireland have the capacity to produce c. 0.9 TWh of biomethane, which is equivalent to 65% of the proposed target for 2030. To switch to biomethane production, these plants would require capital expenditure to install equipment to clean the biogas to become biomethane, as well as access to grid injection points or alternative transport methods. Although these plants may be required on the electricity grid post-ROC support, their running time could be reduced as the NI electricity grid further decarbonises with cheaper technologies such as wind and solar. There may be an opportunity in the future for these existing plants to develop biomethane upgrading facilities if the need for these plants on the electricity system is reduced. The ROC support scheme will end for some of these AD plants around 2035 and small capital grants could be offered to upgrade excess biogas to biomethane and transport it to the grid or end users.

Currently there is no support scheme in place for biomethane, however the recently published Energy Strategy outlines the importance of renewable gases for Northern Ireland to successfully meet its climate goals. In the 'flexible fit' scenario of the Energy Strategy, biofuels account for 29% of total energy demand, 'due to proposed biomethane use in the gas network and biofuels replacing some heating oil'.

As part of the Energy Strategy Action Plan 2022, the Department for Economy is setting up a cross-departmental working group on biomethane production.

Biomethane in Europe

The expansion of AD throughout Europe is highlighted in the EBA's 'Statistical Report 2021'[28] which shows a c. 80% increase in Biomethane Plants in two years. This represents an increase from the 483 plants in 2018 to 880 plants in 2020. This contrasts with biogas (used for electricity generation), which is growing now at a smaller rate, showing the switch to a more efficient use of a limited bioenergy resource.

18 Green Gas Support Scheme
19 Renewable Heat Obligatio
20 Green Gas Levy
21 The CCC UK – Sixth Carbon Budget
22 Renewable Transport Fuel Obligation
23 Climate Action Plan 2019
24 Climate Action Plan 2021
25 Renewable Fuels for Transport – Policy Statement
26 Climate Action Fund
27 Northern Ireland Audit Office – Generating Electricity from renewable energy
28 EBA 2021

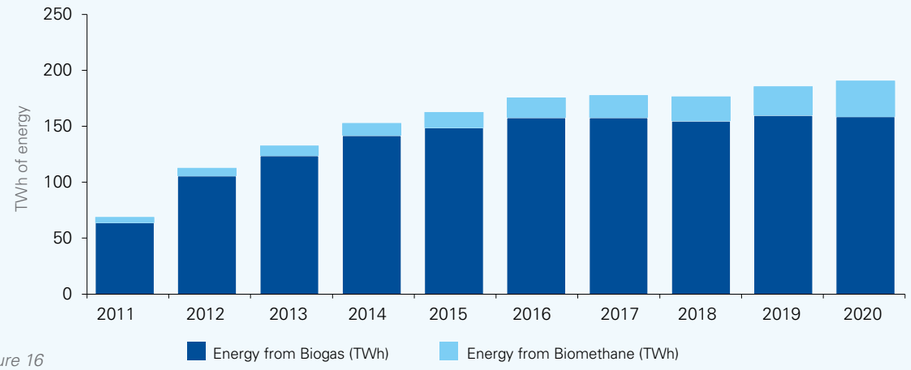

Figure 16

Countries such as France are adopting aggressive rollout strategies and installing plants at a rate close to one installation every two weeks.

There are currently 18 countries producing biomethane, collectively producing 32 TWh[29] of biomethane in 2020 (+25% on 2019), in Europe.

In light of ongoing price volatility and supply concerns of natural gas, the EU has outlined a plan (RePowerEU[30]) which will see Europe independent of Russian gas well before 2030. Several measures are proposed including a doubling of the 2030 EU ambition for production of biomethane. The target has been increased from c.171 TWh to c.342 TWh.

A snapshot of the leading biomethane producing European Countries is depicted below:

Country	Number of Biomethane Plants 2020	2020 Biomethane Production
Germany	242	11 TWh
France	214	2.2 TWh
United Kingdom	107	7 TWh
Sweden	70	1.4 TWh
Netherlands	60	2.1 TWh
Denmark	52	4 TWh
Italy	23	2.1 TWh

Figure 17

Country Spotlight

France

France is Europe's fastest growing biomethane sector with approx. 172 new projects being commissioned in the last two years (2020 & 2019). There are over 950 projects at different stages of development with a combined production capacity of 22.6 TWh. There were 214 total plants operational in 2020, with a combined production capacity of 2.2 TWh.

France owes the spectacular growth of its biomethane market in large part to the French Act on Energy Transition for Green Growth, effective from August 2015, which fully committed France to the transition to a renewable energy system. The Act included the goal of 10% biomethane in the gas grid by 2030. Biomethane plants in France receive a fixed Feed in Tariff (FiT), which is guaranteed for 20 years.

29 EBA 2021
30 RePowerEU

Strengths of the French biomethane sector:

- Policies are embedded in France's agricultural development policy framework and perspective directly linked to rural jobs, increasing productivity and competitiveness.
- Leveraged natural supply of feedstock availability from the agricultural sector to aid rapid expansion of plants.
- The costs of the Feed in Tariff for biomethane are borne by gas and other energy consumers via state taxes: the Domestic Consumption Tax on Natural Gas paid by French gas consumers, and the Domestic Consumption Tax on Energy Products which is levied for the most part on petroleum products.

Denmark

Denmark has grown its biomethane production from 1 plant in 2012 to 52 plants in 2020, producing over 4 TWh of biomethane in 2020. With an increase of 1.3 TWh in Danish biomethane production in 2020, Denmark has seen more growth (in overall energy terms) in this sector than any European country except the UK.

The Parliament in Denmark in 2020 agreed on a new support scheme based on tenders which only apply for biomethane production. Denmark previously offered attractive FiTs at a cost of €134m in 2016 and €215m in 2017) but in 2018 a new subsidy scheme was presented in direct response to the increasing cost of subsidies, and has operated from 2021.

Non-financial policies:

- A target for 50% of manure from Danish livestock to be converted to energy by 2020 (only about 10% was achieved by 2018).
- Organic waste is banned from landfill and if possible, must be 'treated' in an AD plant.

Strengths:

- The tender system provides a solution to the increasing costs associated with a FiT scheme while still providing a fixed annual stimulus of €32m to the Biomethane sector.
- Use of financial and non-financial policies to enable growth of the Biomethane sector.

The Northern Ireland Gas Network – Overview

The NI gas transmission system, for commercial and regulatory purposes, begins at Moffat in Scotland, at the point which connects the GNI (UK) network to National Grid's National Transmission System in Great Britain. This connection allows for the seamless importation of gas to NI.

The NI transmission network is connected to Ireland via the South-North Pipeline (operated by GNI UK) and to Scotland via the Scotland to Northern Ireland Pipeline (operated by Mutual Energy).

Northern Ireland Gas Transmission Network Overview

Figure 18

The NI gas network is over 6,200km and delivers energy to c. 320,000[31] customers. It is one of the most modern networks in operation, built mainly in the late 1990's and 2000's.

The network is currently in a growth phase and can play a greater role in the supply of energy to homes and businesses while also helping to reduce emissions through the introduction of biomethane. It is estimated that the gas network can reach 67% of homes in the country and an opportunity to reduce emissions immediately by connecting homes currently burning higher carbon intensive fuels to the gas network is in line with the Energy Strategy.

"Our focus to 2030 will be ensuring that certain low-regret pathways remain open while focusing on removing the most carbon intensive sources of heating"[32].

Growth on the gas network

2020/21 saw the largest consumption of natural gas on the NI network, potentially influenced by the pandemic. Demand for gas has been growing steadily over the past 10 years, increasing from 14 TWh in 2011/12 to 17 TWh in 2020/21. This reflects total gas usage, with approx. 8 TWh being used on the distribution network (i.e. the network which serves residential and commercial customers) and the balance (9.2 TWh) used by the gas-fired power stations and large energy consumers.

31 Data provided by the Distribution Network Operators
32 Energy Strategy – The Path to Net Zero Energy

Natural gas is a key energy source for NI

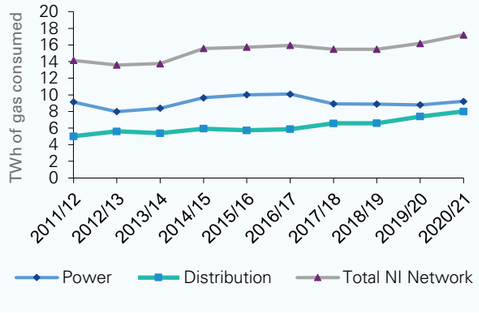

Figure 19

Demand for natural gas on the distribution network has seen a 26% increase in the last 5 years, with connections to the grid rising from 223,000 in 2015 to c. 320,000 in 2022.

Overall gas demand is forecast to increase marginally to 2030 with distribution demand forecast to increase from 8 TWh to 9.1 TWh in 2030. The amount of gas used by the power stations is forecast to reduce by 2030 as the proportion of electricity from renewable sources increases. These forecasts are based on historic growth and published before the new Energy Strategy.

Transmission System Operators - Forecasted gas demand

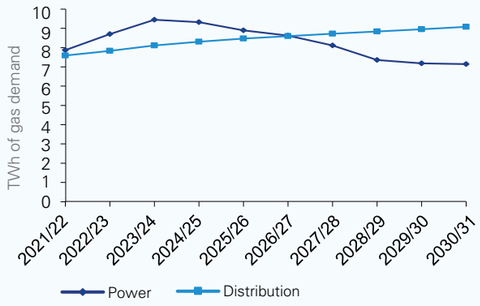

Figure 20

Emissions associated with natural gas

Natural gas is a fossil fuel and emits carbon dioxide emissions upon consumption. In 2020/21 with approximately 17 TWh of natural gas used in the NI network it is estimated that natural gas was responsible for c.3.5 million tonnes of CO_2 emissions[33]. The gas network can immediately reduce emissions through the introduction of biomethane, with potential savings quantified in this report. The gas network has already played a role in reducing NI's emissions by displacing higher carbon intensive fuels such as oil in the heating sector and coal in the power generation sector. It is important to note that with a Net Zero 2050 target, these emissions must get to zero.

2020/21 gas consumption and associated emissions

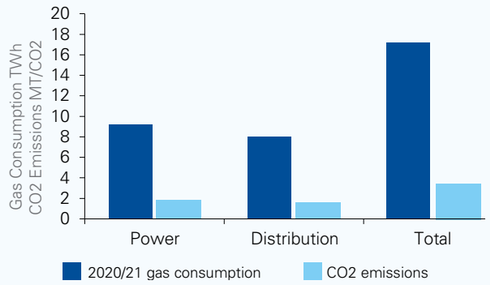

Figure 21

33 Carbon intensity of 204gCO2/kWh is used for analysis

Supporting a renewable gas sector in Northern Ireland

Section 2 – The opportunity for renewable gas in Northern Ireland

Use Cases of Renewable Gas – Background

According to Northern Ireland's GHG Inventory by source (2019) emissions from agriculture accounted for 26%, transport accounted for 20%, the residential sector accounted for 13.5%, power generation 13% and business accounted for 11% of NI's emissions.

NI's Emissions by sector

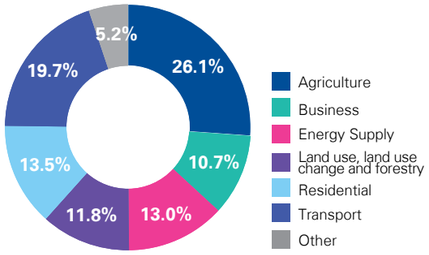

Figure 22

While renewable gas can be used to decarbonise a wide range of sectors such as electricity, heat, and transport, given that demand for its use is likely to exceed production volume, it is important that it is targeted at the sectors where it has the most impact. The production of biomethane from AD is more expensive than its natural gas alternative. However, it is a mature, proven, and well-established technology and if optimised and utilised for the right purposes, can represent the lowest cost solution, or in some instances, the only solution for decarbonising heat demand for some of the most challenging carbon emission points.

We believe the optimal use of biomethane is in thermal decarbonisation, and in particular high temperature industrial processes that have limited alternative options to decarbonise. To encourage and scale the development of the sector and to realise immediate emissions savings in the heat sector, it may be sensible to initially deploy biomethane across the wider heating sector (residential and commercial/industry) in the first instance, with further targeted deployment into hard-to-abate sectors once scale has been achieved. This is a low regrets option that is in line with the Energy Strategy.

The production of renewable gas in Northern Ireland can also help reduce import dependency, which in turn increases NI's security of energy supply and can help protect against recent volatile pricing on the international markets.

Biomethane is not the only solution and other decarbonisation solutions such as electrification, energy efficiency, demand reduction and green hydrogen should progress at pace in all sectors. If NI is to hit its Net Zero targets, all available technologies will be required to decarbonise the heating sector.

Electricity

Decarbonising NI's electricity supply has progressed significantly over the past decade and has been a significant success story for NI, mainly through the deployment of wind energy. This will progress further as wind and solar prices continue to reduce and become the cheapest sources of new electricity capacity, with SONI forecasting approx. 1.4GW of new wind and solar development by 2030. Given that wind and solar generation is significantly cheaper than generating electricity from AD, it makes absolute sense to instead focus finite biomethane resources into decarbonising sectors with fewer economic alternatives.

Electricity Generation Emissions

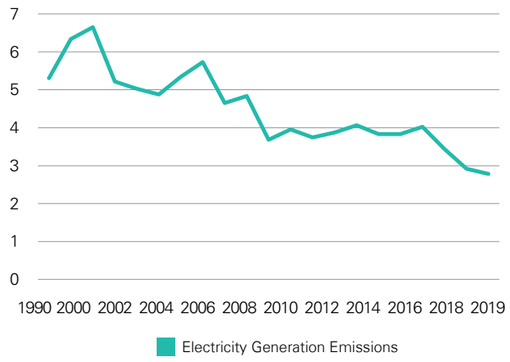

Figure 23

The European growth trend for biomethane versus the plateau of biogas indicates that European Countries are also moving away from supporting biogas for electricity generation (mainly due to cheaper alternatives) and moving towards using the scarce biomethane resource for heating and transport purposes.

Heating

Heating in NI accounts for 56% of all energy used and is responsible for 38% of energy emissions. Historically heating has been a difficult to decarbonise sector as there were limited technologies available.

Total energy consumption by sector

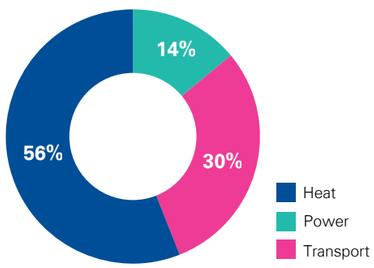

Figure 24

Domestic heating

The NI Energy Strategy outlines the use of a range of technologies to decarbonise domestic heating, which accounts for 13% of all NI GHG emissions. In particular the strategy will look to move homes away from higher carbon intensive heating fuels such as oil and solid fuels to electric heatpumps or to the gas network to take advantage of the decarbonisation potential of renewable gases.

"There are a number of potential transition pathways available to consumers currently using heating oil. These include a switch to zero carbon heating technologies such as a heat pump or connection to the gas network (where possible) to take advantage of the plan to fully decarbonise the gas used in the network[34]."

Analysis carried out by KPMG for Northern Ireland Electricity Networks[35] (NIE) shows that under an 'electrification scenario' it is expected that 40% of homes will be heated by a heat pump in NI by 2040.

"The Electrification scenario considered in this report would see heat pumps in c.350k dwellings by 2040, which is equivalent to a heat pump in 40% of homes in NI"[36].

As such, while heat pumps are expected to be an important component of domestic decarbonisation, they are only going to part of the solution, will take time to deploy, and as of 2040, 60% of homes will still be utilising fossil heating solutions.

Accordingly, it makes sense to complement heat pump decarbonisation by utilising the existing gas network to deliver renewable gas into the balance of homes where they have gas grid access.

As highlighted in a report commissioned by Gas Networks Ireland ("GNI"), KPMG's Decarbonising Domestic Heating (2018)[37] it concluded that:

"Utilising low carbon biomethane within the existing gas network is the lowest cost way of decarbonising heat for homes connected to or in close proximity to the gas network".

In one scenario of the GNI report, KPMG looked at 'infilling' the network to reach 300,000 more homes that are located within close proximity to the network that currently use other fossil fuels, such as oil.

"Our analysis also suggests that extending the gas network to the c.300,000 homes in close proximity to the existing gas network ('network infilling') represents a lower cost option than electrification for these homes. Our estimate of the cost per household of creating a low-carbon gas distribution network serving one million customers is roughly one-third of converting these properties to electric heat".

Carbon emission savings associated with oil to natural gas switching alone can be more than 30%[38] due to lower carbon intensity of gas and the higher efficiency of gas boilers. Fuel switching alongside energy efficiency measures would further decrease carbon emissions by reducing demand. It is estimated that the carbon emissions savings could be as high as 48%[39] - 52%[40] for oil to gas switches when efficiency measures are undertaken alongside the fuel switch.

Although heat pumps offer the lowest operation costs for new build homes, installation costs and energy efficiency measures required on older homes can be prohibitive. The scale of the challenge to reduce emissions means every low carbon option needs to be utilised.

However it is worth highlighting that decarbonising the domestic heating sector will require significant investment regardless of the approach taken or technology chosen, relative to a do-nothing scenario where heat demand continues to be met by fossil fuels.

Commercial/Industrial heating

High thermal industrial processes should also follow the heat decarbonisation template above and move from higher carbon intensive fossil fuels to gas or electric (if a suitable technology can meet their requirements), and then fully decarbonise with renewable gas or through renewable electricity.

Off gas grid industrial consumers can also avail of biomethane as a decarbonisation solution, with alternative transport options such as a 'virtual pipeline' or 'truck and trailer' models becoming available. This is currently operating at a small scale in NI in the biogas sector.

Based on analysis carried out by KPMG in Ireland for various high temperature thermal industrial users[41], biomethane is currently one of the lowest cost options for industrial decarbonisation, and it is vital for economic development that industry in NI has access to decarbonised energy supply. Although biomass is marginally cheaper than biomethane, burning solid fuel in stoves and boilers brings particulate and air quality concerns, as well as operational challenges for the industrial user. Biomass also needs an on-site storage solution, where biomethane can be delivered on demand via the gas network infrastructure.

Alternative Thermal Options (p/kWh)

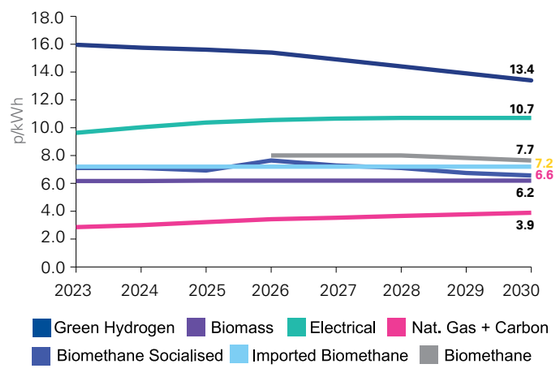

Figure 25

34 Energy Strategy – The Path to Net Zero Energy
35 Electrification: Economic Opportunity for Northern Ireland – Report for NIE
36 Electrification: Economic Opportunity for Northern Ireland – Report for NIE
37 Decarbonising Domestic Heating in Ireland
38 Gas Networks Ireland
39 Analysis by Phoenix Natural Gas – based on data from BEIS, SEDBUK and Carbon Trust
40 Analysis by Firmus Energy
41 Project Clover (original analysis carried out in € and converted to £ for the purposes of this report)

Transport Sector

Transport decarbonisation is likely to be dominated by the electrification of passenger vehicles, but for Heavy Goods Vehicles (HGVs) and buses Compressed Natural Gas (CNG) vehicles can play a crucial role in what remains a difficult to decarbonise sector. Natural gas vehicles are fully compatible with biomethane, and this readily available technology can help reduce emissions immediately.

Transport emissions by mode

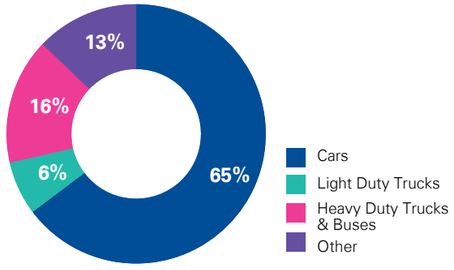

Figure 26

Heavy-Duty Trucks and buses account for 16% (660,000 tonnes) of Greenhouse Gas emissions in the transport sector. It is unlikely that electric or hydrogen Heavy-Duty Trucks will be available in the NI market at scale before 2030 so a role for CNG vehicles with biomethane fuel is seen as a realistic option for decarbonisation of this sector. CNG vehicles are available now and offer immediate benefits in terms of emissions reductions and air quality.

Utilising the existing gas network for decarbonisation

The NI gas network plays a hugely significant role in NI's energy supply mix through reliably, safely, and efficiently providing over 17 TWh of energy during 2020/21, which is forecast to fall slightly to 16 TWh in 2030.

The modern network of pipes is an asset that can be used to help decarbonise the NI economy through the injection of biomethane. Utilising an existing asset to help on the decarbonisation journey can reduce the overall cost of the transition to a Net-Zero economy.

Gas storage

One of the key challenges in any energy system is ensuring that supply can match demand. Biomethane is typically produced by AD plants on a consistent, 24/7 basis. Therefore, the importance of flexibility offered by the substantial usable energy storage capability inherent in the gas network is of real value in meeting diurnal and seasonal variability in energy demand and supporting intermittency in renewable electricity generation supply.

There is a project in planning at Islandmagee, Co. Antrim to construct a large underground gas storage facility. Confirmation of the potential operational commencement date is presently not available, but it plans to store 500 Mm3 (c. 5 TWh biomethane) of renewable gas. Having a gas storage facility operating in NI will be crucial to the development of an indigenous renewable gas industry. The storage potential will depend on what renewable gas is stored at the facility.

In the short term the distribution networks will be able to handle quantities of biomethane injection of at least 1.4 TWh with network planning and locational spread of AD facilities in line with demand. As the penetration increases there will be a need to store this gas in the transmission network via in-grid compression or centralised grid injection facilities. As the renewable gas industry grows and eventually produces more gas than required in summer months when demand is low, an underground storage facility (or above ground storage) will become crucial.

Biomethane potential in Northern Ireland - CASE Report Summary

Northern Ireland benefits from an existing high degree of farming activity (driven largely by the high demand for agricultural products produced in Northern Ireland and exported around the world). The province also has a relatively low but growing gas demand per capita (3.8 MWh compared to 7.5 MWh per person in the United Kingdom). This places Northern Ireland in a unique position to decarbonise the gas grid through the increased utilisation of existing agricultural biomass to produce biomethane.

Such a transition from natural gas to biomethane links with Common Agricultural Policy Strategic Plans to promote biomethane production from livestock manures, residues, and underutilised grassland. In Northern Ireland, consideration of post-Brexit financial support mechanisms in the agriculture sector have recently been open to a consultation by DAERA (Consultation on Future Agricultural Policy Proposal for Northern Ireland) with a new Agricultural Policy expected in 2024. Environmental sustainability and improved resilience were key themes of the consultation which was carried out just before agreement was reached on Climate Change (No. 2) Bill, which sets a Net Zero target for NI by 2050. This is a milestone piece of legislation for Northern Ireland, being the first dedicated and indigenous legislative tool to tackle climate change.

A recent study by the Centre for Advanced Sustainable Energy ("CASE") at Queen's University examined the potential for biomethane production in NI and the results of the study are summarised here:

- The energy potential from manure biomethane equates to 33% of the total gas distribution network energy demand for 2020/21 (being 7.6TWh). The energy potential from underutilised grass silage biomethane represents 65.3% of the energy demand for the same period.
- The biomethane potential from both manure and underutilised silage biomethane combined is equivalent to 98.3% of the total current gas distribution network energy demand.
- CASE also considered the proximity of the areas where the manure and underutilised grass silage are located to the gas network.
- Within the boundary of the 15 current network distribution zones (used for the CASE project only), i.e. 10 km from the gas distribution network, the total biomethane potential is as follows:
  - Manure was 209 million Nm3 of biomethane which is 83% of the total biomethane potential value from all housed manure material in Northern Ireland.
  - Grass silage was 418 million Nm3, which is 84% of the total biomethane value estimated to come from all underutilised silage.
  - The sum of 627 million Nm3 of biomethane from both manure and silage equates to an energy potential of 6.3 TWh, which is 82% of the total natural gas distribution network demand in 2020/21.
- It is clear that biomethane from the anaerobic digestion of manure and underutilised grass silage material, if added to the gas distribution network, can displace a significant proportion of the current annual demand in Northern Ireland. Of the 15 gas network zones (used for the CASE project only), 11 have excess production capacity to export gas to other zones. Only the Belfast, Derry/Londonderry, Fermanagh, and Larne areas would be net importers of biomethane.

To ensure necessary private sector investments and encourage new developments, a support mechanism will be required to stimulate the production of biomethane in Northern Ireland

Section 3 – Potential Support Mechanisms for Biomethane

In normal market conditions (i.e. pre-2022 macroeconomic factors) biomethane is more expensive to produce than natural gas. While KPMG expect industry / consumers may be willing to pay some element of a 'green' premium for biomethane, the gap has historically been too great to see widespread adoption of the fuel without a subsidy.

Composition of LCOE of agri-biomethane AD Plane (KPMG 2019)

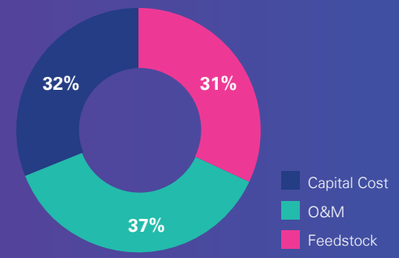

Figure 27

To ensure the necessary private sector investment and encourage new developments, a support mechanism will be required to stimulate the production of biomethane in Northern Ireland. While wholesale gas prices have risen significantly in 2022 it is unlikely that they will remain at such high levels for long enough to encourage the development of a biomethane industry in NI. In addition, current inflationary pressures in 2022 have increased both the capital and operational costs of producing biomethane. Based on our analysis across Europe, no jurisdiction has been able to stimulate an indigenous biomethane sector without the introduction of a government-mandated support or regulatory mechanism. Calculating the LCOE of biomethane production remains challenging, as the cost is heavily dependent on scale, technology, and feedstock source.

Based on the CASE analysis, we are assuming that the majority of NI biomethane plants will utilise agricultural feedstocks including crop silage, slurry and other agricultural wastes. While we would expect a range of AD plants to be developed, for the purposes of this paper we are assuming the average plant will produce 20GWh of biomethane output, which is twice the size of the majority of existing AD plants in NI. The larger scale AD plant helps cover the cost of the additional gas clean up equipment required for biomethane production. Such a scale of plant will typically utilise around 20,000 tonnes of silage, along with 10,000 tonnes of slurry and other agricultural wastes per annum.

Based on research conducted by KPMG in 2019 in Ireland which relied on real-world quotations from technology suppliers and AD operators, we estimated that the LCOE of a 20GWh agri-led biomethane AD plant to be approximately 7.6p per kWh.

NI-based AD plants will have a broadly similar cost base to Ireland, with the exception of gas grid connection costs, which are partially socialised in Ireland. Under current proposals for connecting AD plants to the gas network in NI, plants are expected to have to bear the full cost of a grid connection and we would expect such plants to have a slighter higher LCOE. As outlined in the graphic above, this LCOE is fairly evenly split between capital, operating and feedstock costs in this analysis.

This is broadly consistent with a separate 2019 European study by Navigant, which calculated the average LCOE for a biomethane plant to be 5.9p – 7.6p per kWh, with agricultural AD plants at the upper end of this range, and larger, waste-led plants at the lower end of the range.

While not directly comparable, NI's existing AD plants, which utilise their biogas to generate electricity rather than thermal biomethane, are supported by the historic ROC subsidy regime. The majority of plants receive four ROCs per MWhe (electricity) of output. If one was to consider the average energy income earned by these plants and divide this income by the thermal biomethane content of their biogas output, they earn the equivalent of 9p per kWhth (thermal), which is broadly in line with the assessments noted above although the levels of investment returns would differ due to differences in capital and operating costs.

It is worth noting that these LCOE studies were conducted in 2019. Based on more recent anecdotal evidence, current inflationary pressures on construction materials, operating costs, feedstock and fertiliser prices are likely to have increased this LCOE, at least in the short-term. This is consistent with both solar and onshore wind LCOE, which have also risen during 2021/22 due to technology cost rises, against a general downward trend over recent decades.

For the purposes of our analysis, we have used longer-term historic average prices for both AD plant economics, as well as natural gas prices. While both are inflated at this time, we expect the differential between the required biomethane price and natural gas prices will return to the historic average in the coming years. We are therefore assuming an average LCOE for a NI-based agri-fed 20GWh biomethane plant of 9p / kWhth. We would suggest that further work is undertaken on analysing LCOE at the appropriate time once inflationary pressures have stabilised.

Notwithstanding this recent LCOE pressure, the general market expectation is that in the long-term, biomethane LCOE can be reduced. The same Navigant study referenced above estimated that the average LCOE today could fall to 5.7c per kWh (4.9p per kWh) by 2050, driven by economies of scale, feedstock valorisation, improved operations and higher operating hours, which represents a 29% reduction.

Based on this potential LCOE improvement, the graphic opposite outlines a potential trajectory for LCOE for biomethane production in NI, assuming variation optimisations, wholesale natural gas prices returning to pre-2022 levels, and market factors are delivered.

Green shading represents the LCOE funding gap which Government policy must bridge. As can be seen below, this gap can be expected to reduce over time:

- Assuming a linear 29% LCOE improvement as forecast by Navigant (technical efficiency, economies of scale etc through to 2050).
- Increased Climate Change Levy on natural gas.
- Monetisation of the digestate output. At present digestate management is generally a cost, or at least revenue neutral output. However, if it can be processed sufficiently, it would be able to directly replace fossil-based fertilisers and generate an income for the plant.
- In the first few years of injection into the gas grid there is likely to be some additional costs for the blending of propane to increase the calorific value of the renewable gas.
- This may be mitigated through grid management improvements and updated billing modelling, which could be location specific. Based on conversations with the Distribution Network Operators, these are expected to be in place at the latter end of the decade.
- Combining these various factors suggests that the support premium required to stimulate biomethane production is approximately 6p per kWh in 2022, reducing to 4p per kWh by 2030.

Cost of biomethane is forecast to fall

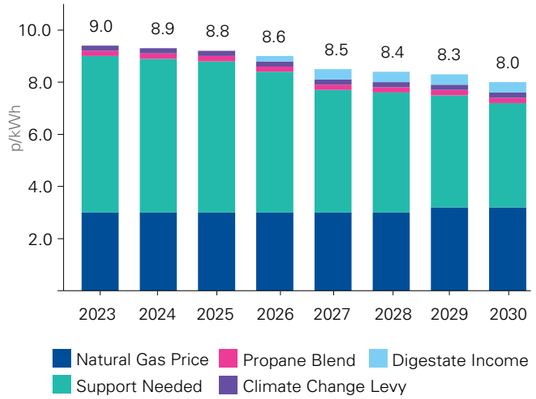

Figure 28

Assuming 1.4 TWh demand in 2030 will be met from biomethane, annual support needed in 2030 will be approximately £67m based on an assumed development profile of AD generation facilities and pre-2022 gas prices.

Funding required under all support mechanisms

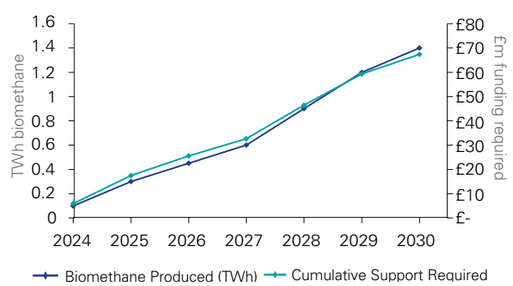

Figure 29

The support level required for biomethane in 2030 will depend significantly on the price of natural gas throughout the rest of the decade, as seen in the graphic below. The higher the price of natural gas the lower the support level required by the operators to ensure their AD plants are viable. A flexible support mechanism that accounts for these movements in gas prices offers the best value for the consumers.

Support needed (2030) will depend on wholesale gas price

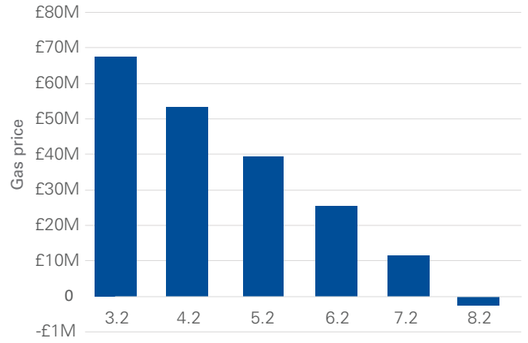

Figure 30

Funding required under all support mechanisms

From analysis carried out on other jurisdictions and support schemes they have operating or propose to operate, the following are the current available support schemes reviewed for this report, some of which are more suited than others to help support a biomethane industry in Northern Ireland.

1. Green Gas Support Scheme (GB)

Introduction:

The Green Gas Support Scheme (GGSS) is a UK government environmental scheme that provides financial incentives for new anaerobic digestion biomethane plants to increase the proportion of green gas in the gas grid. With the heating of industry, businesses and homes being responsible for a third of the UK's greenhouse gas emissions, the scheme aims to reduce these emissions by replacing natural gas, on the grid with green gas through supporting biomethane production and injection.

The scheme is open to applicants in England, Scotland, and Wales for four years from 30 November 2021.

How it works:

Registered participants receive quarterly payments over a period of 15 years. Payments are based on the amount of eligible biomethane that a participant injects into the gas grid and allow for a 10% return for the investors. For 2022, the subsidy level set by Department of Business, Energy & Industrial Strategy (BEIS) is 5.51p/kwh (+ income from gas sales) for up to 60GWh.

The GB scheme is funded by the Green Gas Levy, initially on a meter point basis and moving to a volumetric based approach by 2028.

Where else is it used?

- Similar schemes operate across Europe that offer a set subsidy level like the GGSS. In France, biomethane grid injection plants receive a fixed subsidy over a 20-year period. The tariff varies depending on the size of the plant and feedstock used, similar to GB.

Advantages:

- The GGSS offers a guaranteed price for developers which gives the private sector certainty and reduces financing costs.
- The scheme is easily administered and could be replicated quickly in any jurisdiction.

Disadvantages:

- A support price must be set by policy which could lead to an overly generous subsidy or an unattractive subsidy that doesn't encourage development. Detailed analysis on the level of support required would need to be undertaken, specific to NI.
- A fixed subsidy does not consider the extreme movements in wholesale prices currently seen in the market. Consumers aren't protected under a mechanism that pays a fixed price to producers.

2. Heat Obligation Scheme

Introduction:

Ireland recently consulted on a new potential support scheme for renewable heat. This obligation, if introduced, would require the suppliers of energy used in the heat sector in Ireland to ensure a certain proportion of their annual energy supplied is renewable.

This differs from the support schemes in GB as it seeks to spread the additional cost of supporting renewable heat across the entire heat sector rather than just on gas consumers. For Ireland, which like NI has a limited number of gas connections, this presents significant advantages.

How it works:

An obligation scheme is usually technology neutral and market forces will determine the price paid for each unit of renewable heat, without the involvement of government departments, who will determine the level of obligation through policy.

Supply of all non-renewable fuels (excluding electricity) would be liable under the obligation. This obligation would be paid by all users of fossil fuels in the heat sector and the suppliers operating in the heat sector would be responsible for recovering the costs they incur through the consumer's bill.

An obligation offers energy suppliers flexibility to procure any renewable fuel that meets strict sustainability criteria. This will encourage the lowest cost options to be procured by the market, which in turn will keep costs to a minimum for consumers. For example, if biomethane was the lowest cost renewable fuel, oil suppliers could purchase credits for biomethane blended into the gas network to meet their obligation. The oil consumers would still consume oil but would be charged a slightly higher price to cover the cost of heat sector decarbonisation.

A heat obligation rate would be set on an annual basis. This would be the portion or percentage that suppliers must source from renewable sources. For example, if the obligation rate was set at 1% and a supplier sold 100 GWh of energy per annum, they would be required to source 1 GWh of renewable fuel for the heat sector.

To obtain price certainty for the development of new facilities, KPMG would expect producers and energy suppliers to agree a fixed price per unit of gas through a long-term contract, inclusive of the support premium so that the project, consumer, and supplier are not exposed to movements in the wholesale price.

Where else is it used?

- The Renewable Heat Obligation scheme proposed in Ireland is very similar in design to the Biofuels Obligation Scheme operating in Ireland's transport sector and the Renewable Transport Fuel Obligation in the UK, which obligates transport fuel suppliers to blend renewable oil products into road transport fuels.

Advantages:

- KPMG analysis suggests that biomethane and biomass will be the lowest cost options for suppliers. The gas network in NI offers suppliers immediate access to over 320,000 customers using gas, which gives suppliers an immediate market to target to meet their obligation.
- Socialises the cost across a wider customer base to reduce the impact on individual bills.
- Establishes a demand for renewables in the heating sector.
- Reduced government administration.

Disadvantages:

- Does not offer commercial certainty to investors as government policy can change.
- Limited regulatory oversight.
- Limited production of biomethane in the early years of the scheme could lead to higher prices being paid to secure the output of the AD facilities. These prices could be passed onto consumers. It will be critical that the planning system facilitates the development of AD in NI.

3. Contracts for Difference

Introduction:

Contracts for Difference (CfD) incentivise investment in renewable energy by providing developers of projects with high upfront costs and long lifetimes with direct protection from volatile wholesale prices, and they protect consumers from paying increased support costs when prices are high.

CFD Illustration example of - compensation payments relative to strike price

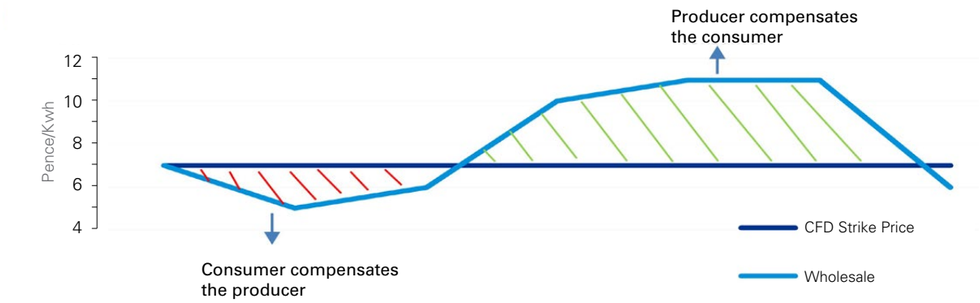

Figure 31

How it works:

By implementing a CfD for biomethane support, producers of renewable gas are given 'price certainty' at the strike price rate. Should the price fall below this strike price, the consumers would compensate the producer for the difference between the strike price and the prevailing lower wholesale rate to always maintain the strike price for the producer. Conversely, should the wholesale price rise above the strike price, the producer would compensate the consumer by the amount of the differential (as illustrated in figure 30). Thereby, consumers are protected at times when gas prices rise as the level of support paid varies based on carbon prices (if applicable) and natural gas prices.

A CfD fixes the level of income at the price required to make AD plants economic, so when gas prices rise, the premium required from the biomethane support shrinks. This offers a level of protection for consumers who will be guarded against potential future price rises.

CfD contracts are generally awarded via a competitive auction and successful applicants receive a guaranteed revenue stream for the duration of the contract (normally 15 years). The output from AD plants could be sold to a central aggregator who would then enter into supply contracts with suppliers.

Where else is it used?

- A CfD scheme is the UK government's current main mechanism for supporting low-carbon electricity generation in GB and is likely to be the support mechanism chosen for future hydrogen support. Italy have recently announced a CfD style support mechanism to increase biomethane production[42].

Advantages:

- Due to the commercial certainty of a CfD and the ability of the operators to access lower cost finance, this could reduce the premium required and the funding needed to be paid by consumers.
- CfD schemes offer consumers protection against price rises and volatility in the fossil fuel market.
- If the price of natural gas is above the price of biomethane, money would be refunded to the scheme from developers. In Q4 2021, the CfD scheme operating in the electricity sector in GB paid money back (£39m) to suppliers due to higher market prices[43].

Disadvantages:

- A CfD scheme requires a dedicated body, new or existing, to operate it as it requires a lot of administration to run the scheme and the auctions.

4. Auction Scheme

A competitive auction for supporting biomethane production is a relatively new concept which has been adopted in Denmark. A fund is put in place and developers bid in their support cost and the best projects gain funding until the budget for the auction is assigned. This new scheme was set up in direct response to concerns about the increasing costs of previous support mechanisms.

Advantages:

- Lowest cost developments will be selected for support, which ensures the lowest price renewables for consumers is procured.
- A budget cap for the auction mitigates the risk of over subsidisation.

Disadvantages:

- Like CfD auctions, a dedicated body would be required to operate it as there is a lot of administration to run the scheme and auctions.
- There is no consumer protection built into the auction mechanism if the gas price rises above the support level.

5. Grant Funding

Anaerobic Digestors are capital intensive projects and grant funding could reduce the premium needed to make them economic, which in turn reduces the impact on consumers. However, due to feedstock costs and the ongoing operational costs of AD plants, even with 50% or 100% capital grants, a support mechanism would still be required to operate the plants, albeit at a lower level.

For instance, if a capital grant at a rate of 50% was provided to cover the build costs of an AD plant, KPMG analysis indicates that the level of support could be reduced by approx. 1.5p/kWh (i.e. reduced from 5p/kWh to 3.5p/kWh). If the level of a capital grant is increased to 100%, the level of support could be reduced by up to approx. 3p/kWh (i.e. reduced from 5p/kWh to 2p/kWh).

Grants could be given directly to the private sector operators or through subsidised grid connections from the network operator, which could be recovered through their regulated asset base. Grants and capital funding could come from UK ETS auction revenue or other sources of exchequer funding. Similar proposals have been made in other jurisdictions such as Ireland for capital grant funding.

Conclusion on potential support mechanism

Support mechanisms for biomethane vary across jurisdictions to allow for specific local factors, such as feedstock inputs and the level of gas consumers compared to other technologies. It is clear from our analysis that to develop a renewable gas industry, a support mechanism is required. KPMG couldn't find one example of a successful biomethane industry operating in a country that didn't have a suitable support mechanism.

42 World Biogas Association
43 Low Carbon Contract Company

Section 3B

Funding options for a potential support mechanism in Northern Ireland

How a potential support mechanism for renewable gas is funded in NI is the main determining factor in how much the scheme would cost an individual consumer. As detailed in the Appendix, c.£67m would be required in 2030 to fund a 1.4 TWh target of biomethane, based on pre-2022 wholesale natural gas prices, and this quantum of support will be required annually to maintain the level of biomethane output (or increase in line with higher biomethane targets).

From our analysis of existing and proposed support mechanisms there are several methods to consider for funding a biomethane support mechanism:

1. Levy on gas meter points:

Under a simple levy of gas meter points, the additional cost of biomethane would be spread equally across the number of meter points connected to the grid, regardless of sector or consumption level. Based on projections using historic connection rates carried out by the Distribution Network Operators, it is expected 421,000 meter points will be connected to the NI network in 2030.

Assumptions	
Biomethane Demand	1.4 TWh
Total biomethane support required (2030)	c.£67m
Meter Points	2030

Based on the above assumptions, a basic meter point levy to support 1.4 TWh of biomethane by 2030 could add £160 to each gas meter point bill in NI in 2030.

Advantages:

- A very simple to administer mechanism which could be implemented without any delays.

Disadvantages:

- As the levy is charged on having a meter point, it does not distinguish between different demand levels such as large industry or domestic users or consider wider implications such as fuel poverty.
- Only focuses on gas consumers, which will raise bills of individual gas consumers considerably.
- A levy on gas consumers only will discourage oil-to-gas switches which is a key component of the Energy Strategy.

2. Levy based on volume of gas consumed:

A volume-based approach represents a fairer charge on consumers than a meter point charge and better aligns to climate policy as it rewards consumers who are more energy efficient and undertake measures to reduce their demand.

It also distinguishes between domestic and commercial customers as they are charged on a per kWh basis and not simply based on having a meter connection.

A volume-based scheme takes the support required and spreads it across the demand in the sector. A 1.4 TWh demand for biomethane spread across 9.2[44] TWh of demand would add 0.7p to every kWh consumed by a business or domestic household. Based on assumed 2030 average demand in the domestic sector and wholesale gas prices returning to pre-2022 levels (c.3p/kWh), this would add £72 to annual bills in 2030. If gas prices were to remain higher, the level of support required would be smaller per bill as shown above, the overall level of support required would be less.

Assumptions	
Biomethane Demand	1.4 TWh
Demand on distribution grid (2030)	9.2 TWh
Total biomethane support required (2030)	c.£67m
Additional cost per kWh consumption	0.7p/kWh
Current average domestic consumption	11,140 kWh per annum
2030 assumed domestic demand due to energy efficiency upgrades	10,000 kWh
Commercial consumption (Band 1)	25,000 kWh
Commercial consumption (Band 2)	50,000 kWh
Commercial consumption (Band 3)	73,200 kWh

For commercial and industrial customers on the consumption bands shown, it would add between £181 and £530 to their annual gas bills, if wholesale natural gas prices return to pre-2022 levels. This would reduce if gas prices were to remain higher than pre-2022 levels.

The UK government has committed to transition the Green Gas Levy from its current meter point design to a volumetric levy as soon as possible, subject to overcoming feasibility issues, so that costs better align with gas consumption.

Advantages:

- Fairer mechanism than a levy based on meter point connection.
- Rewards energy efficiency as lower demand equates to lower additional cost.

Disadvantages:

- Only focuses on gas consumers, which will raise bills of individual gas consumers considerably if wholesale gas prices return to pre-2022 levels.
- A levy on gas consumers only will discourage oil-to-gas switches which is a key component of the Energy Strategy.

3. Obligation on all heat consumers:

If all consumers of fossil fuels for heat are included in an obligation to support the introduction of renewable fuels in the heat sector, it would reduce the impact on individual bills. A levy/obligation could be placed on all heat users, in a similar manner to the way renewable electricity is funded through a charge on all electricity consumers bills.

Suppliers of oil, solid fuels and gas could collect the levy from their consumers based on the volume of energy they sell to consumers for example, which could in turn fund a suitable support mechanism, such as a CfD.

As all consumers in the heat sector would benefit from the introduction of renewables it would be seen as a fair way to fund a support mechanism that was technology neutral.

If a target of 5% additional renewable heat by 2030 was set in local government policy this would equate to approx. 1.5 TWh of additional renewables in the heat sector. It is anticipated that biomethane would meet 1.4 TWh of this, with additional renewable heat sources such as biomass contributing to the rest up to 2030.

To assess the potential impact on consumers bills it is assumed, for the purposes of the estimates below, that the lowest cost fuel available at scale would be the production of biomethane with injection into the distribution gas grid.

The potential impact on consumer bills is calculated by taking the 2030 average demand 10,000 kWh, multiplying it by the obligation/levy rate of 5% and then multiplying this by the average premium required to support biomethane from 2024-2030 of 5p/kWh. This results in £25 being added to the average domestic bill in NI in 2030 based on wholesale gas prices returning to pre-2022 levels.

Assumptions	
Heat Demand in NI (2019)	29.4 TWh
Biomethane target	1.4 TWh
2030 Renewable Obligation/Levy	5%
2030 Residential gas demand	10,000 kWh p/a
Support required (2030)	£67m

For commercial and industrial customers on the consumption bands shown above, it would add between £62 and £181 to their annual bills, if wholesale natural gas prices return to pre-2022 levels.

Advantages:

- The additional cost of renewable heat / biomethane is spread among the widest possible consumer base, which reduces the impact on individual bills.
- Larger volumes of renewable heat / biomethane can be supported.
- The lowest cost sustainably sourced renewables will be favoured by suppliers, meaning the best value for consumers is chosen. This also gives an opportunity for other sustainable sources of indigenous fuels to be developed.
- Rewards energy efficiency as lower demand equates to lower additional cost.

Disadvantages:

- More complex to administer than a levy focused only on the gas sector.

44 Demand level in 2030 assumed by the Gas Distribution Operators at current growth rates

Summary Table

Potential support schemes				
Subsidy	Green Gas Support Scheme	Renewable Heat Obligation Scheme	Contracts for Difference	Auction Scheme
Overview	Support for new AD biomethane plants injecting green gas to the grid	Policy mechanism to establish demand for renewable heat fuels	Price certainty offered to producers of renewable gas through strike price	Producers bid in a price needed to generate biomethane + economic return
Introduced	2021	Consultation Stage	Active in electricity markets	2021
Subsidy Type	Feed in tariff	Guaranteed price with supplier	Guaranteed price	Guaranteed price
Scheme Length	2021	Determined by policy	15 years	15 years
Advantages	Guaranteed price for developers which provides certainty	Establishes demand for renewable heat fuels	Offers consumers protection against high gas prices	Ensures lowest cost developments are supported
Disadvantages	Fixed subsidy doesn't offer consumer protection against high gas prices	Doesn't offer commercial certainty as policy can change	High administration burden	No consumer protection built in
Suitability in current form to NI market	Low	High	High	Medium

Funding mechanisms for potential support scheme			
Mechanism	Meter point levy	Volume based levy	Heat levy
Overview	Charge on all gas meters to support biomethane	A charge based on gas volume purchased to support biomethane	A levy on all fossil fuel heat users to support the introduction of renewables in the heat sector
Administrative Burden	Low	Medium	Medium
Advantages	Easy to implement with limited administration	Rewards energy efficiency and lower consumption of gas	Spreads the additional cost among a wide consumer base
Disadvantages	Low penetration of gas meters in the heat sector in NI	Low penetration of gas meters in the heat sector in NI	More complex to administer than a gas only levy
Suitability to NI market	Low	Low	High

Conclusion

The KPMG analysis shows that a number of support schemes in operation or proposed to be implemented in other jurisdictions could be suitable for the NI market, especially a CfD or heat obligation scheme. Due to the low penetration of gas in the heat sector in NI, KPMG recommend that the additional cost of the chosen support scheme is spread among the widest consumer base possible, ideally the entire heating sector. This would be in line with the NI Energy Strategy as it would encourage oil-to-gas switches, while decarbonising the gas network and limit the additional cost paid by consumers.

Section 4 – Benefits to the NI Agriculture Sector

The current NI biogas industry provides a strong validation of the proven technology and suitability of feedstocks to produce biogas. NI AD plants mainly use grass silage and slurry as feedstock. NI has developed a mature AD sector with c. 90 plants in operation to date. Many, if not all, of these plants were primarily constructed under the ROC subsidy scheme. The average AD plant size in NI is 10 GWh (0.5 MWe) whereas the optimum plant size for biomethane injection to benefit from economies of scale is approx. twice the size at 20 GWh (1MWe.).

KPMG would expect a combination of large and small plants to be developed depending on location, local gas network injection capacity, availability of feedstock, proximity to the gas network and that the market / project developers will chose the optimum solution for their site.

NI provides a strong case for the expansion of renewable gas due to its natural supply of feedstock, high thermal loads, lack of renewable heat energy and opportunities to stimulate the rural economy.

Alleviating concerns on Cattle Constraint & Feedstock Availability

A Northern Ireland Case Study compiled for the 'Sustainability of Biomethane Production in Ireland', commissioned by Gas Networks Ireland and Devenish[45], noted that NI deployed c.90 AD plants between 2011-2017.

During this period, the number of dairy cattle grew by 12% and overall cattle numbers by 4%, highlighting that the AD sector did not lead to a constraint in cattle expansion. It's noted that there was also an increase in cattle feed utilisation over the period, indicating that the increased cattle numbers were supported by a combination of increased grass production and grain feed.

AD sector in NI did not lead to a constraint on cattle expansion

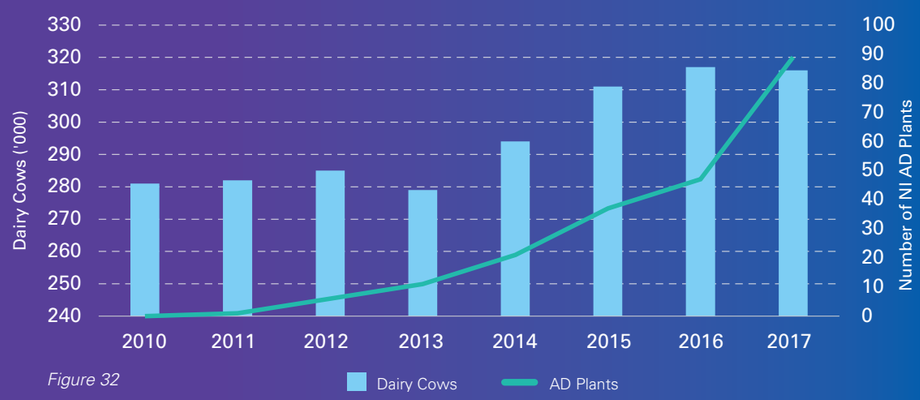

Figure 32

45 Sustainability of Biomethane Production in Ireland

While there have been some examples of very localised competitive disruption, overall silage pricing doesn't appear to have been impacted by the development of the AD sector. We do note that average conacre prices have risen over the period, although this appears to have been driven primarily by an increase in demand for grazing land (presumably for the increased cattle numbers), since overall land utilised for grass silage production did not increase over the period. This indicates and validates the hypothesis that increased grass silage yields can be obtained as part of a well-ran grassland system.

Further, Department of Agriculture, Environment and Rural Affairs (DAERA) statistics show that the amount of farmland dedicated to grass increased by over 25,000 ha over the same period, including an 18% increase in land with grass less than 5 years old. This suggests a material programme of reseeding and land optimisation, which is in line with anecdotal evidence of AD plant owners achieving increased grass yield through improved crop management.

The emergence of Multi-Species Swards (MSS) as a promising feedstock for AD production is gaining traction on the island of Ireland given their high yields with lower fertiliser requirements, in addition to co-benefits relating to biodiversity and carbon sequestration. Studies undertaken in Ireland show the advantages of MSS compared to Perennial Ryegrasses (PRG).

"In 2020, both MSS mixes out yielded the control PRG sward by approximately 2 tnDM/ha. This was achieved with 100 kg/ha less artificial nitrogen application. The reason for this is the legumes (nitrogen-fixing plants) in the sward. In conjunction with bacteria in their roots, these plants can make their own nitrogen to feed themselves and the plants around them"[46].

If production on land utilised for farming and underutilised land can be increased by 2tnDM/ha, while using less artificial fertilisers, the ability for farmers to produce feedstock for AD above their own needs could be significant in NI.

Stimulation of the Rural Economy

According to the DAERA Farm Incomes in Northern Ireland 2019/20, the average business income per farm fell to £26k from £27k previous year. 63% of farms had an off-farm income of above £10k per annum and in 2019/20 17% of farms incurred a loss. This suggests that farms in Northern Ireland would be receptive to additional revenue sources.

A Sustainable Energy Authority Ireland report identified that in terms of employment, between construction and operation of AD plants in an 'Increased Biomethane' scenario, c.2,700 jobs could be created in the rural economy in Ireland[47].

Similarly, an RGFI and KPMG report noted that in achieving 6.8 TWh from renewable gas by 2030, 3,000+ jobs could be created for rural Ireland. This equates to c.0.44 jobs / GWh[48].

The European Biogas Association conducted in-depth analysis on job generation across the European Biogas sector and calculated the European weighted average direct and indirect jobs/GWh at 0.32/GWh and 0.77/GWh respectively[49].

Applying these findings to Northern Ireland, in conjunction with the total potential biomethane production as outlined in the Queen's CASE report of 6,268 GWh, indicates the potential to generate up to 2,000 direct jobs and 4,800 indirect jobs across the rural economy in Northern Ireland, helping to stimulate and sustain rural communities. Achieving the 1.4 TWh 2030 target set out in this report could generate over 1,400 jobs mainly for rural NI.

Agricultural-led Feedstock Supply

Agriculture accounts for approx. 26% of Northern Ireland's greenhouse gas emissions. AD plants would provide farmers with opportunities to capture methane from slurry feedstock which will help to decarbonise the dairy & beef sectors, while the use of Organic Soil Improver (digestate) will reduce water pollution and the use of artificial fertilisers, as well as enhancing soil, air and water quality and improved biodiversity.

If a target of 1.4 TWh biomethane in 2030 is achieved, a total of 200,000 tonnes of CO_2eq would be reduced in the agriculture sector from 2024-2030 and annual savings of 55,000 tonnes of CO_2eq would be obtained in 2030.

Cumulative CO2 savings - agricultural sector

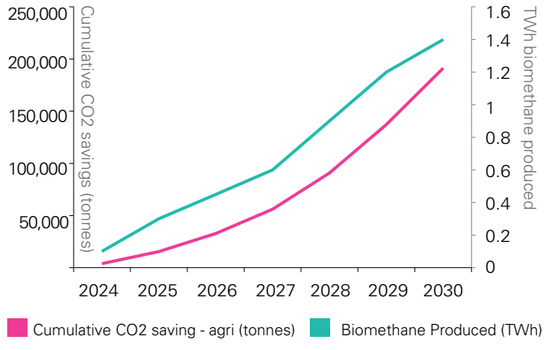

Figure 33

46 Sustainability of Biomethane Production in Ireland
47 Assessment of Cost and Benefits of Biogas and Biomethane in Ireland
48 An Integrated Business Case for Biomethane
49 EBA 2022

Agricultural-based anaerobic digestion to produce biomethane is often positioned as a key technology to decarbonise both industry and the broader agricultural sector, whilst providing several potential ancillary benefits in terms of sustainability and wider rural development.

While it is feasible to produce biomethane from a wide variety of feedstocks, including municipal and commercial waste, organic materials and agricultural crops, KPMG analysis suggests that the establishment of an agricultural industry led approach represents the scenario most capable of supporting the development of a robust, scalable, and sustainable industry which has the capacity to make a meaningful impact on Northern Ireland's decarbonisation goals.

Additionally, the utilisation of animal slurry as a co-feedstock would provide one of the few options available for farms to reduce their carbon emissions and improve their overall sustainability. Recent analysis also carried out by KPMG in Ireland[50] showed that a 20GWh AD plant would reduce CO_2eq emissions by c.4,100 tonnes per annum through the displacement of natural gas, and c.750 tonnes per annum for the agricultural sector[51] through soil sequestration. Further studies on soil sequestration in NI should be carried out to calculate an NI specific figure as it may slightly differ from Ireland. There is also the opportunity to reduce emissions even further by capturing the CO_2 from the AD facility. This CO_2 could be used in the food/beverage sector and would reduce the need for other sources of CO_2 in those sectors.

While the business case for AD remains supportive of the utilisation of other commercial and food waste materials where available, the increased costs of operating and maintaining waste plants, as well as the relatively limited volume of suitable materials available in NI, means overall economics are not significantly lower, while the volume would remain a fraction of that achievable using the more scalable agriculture feedstock.

Benefits of developing an agriculture-led biomethane industry

- Air Quality - Slurry arising from livestock rearing is usually utilised by spreading to land. A storage facility is required for when spreading is not allowed. Slurry storage and spreading to land can lead to strong odours, and surveys, carried out by the Sustainable Energy Authority of Ireland, of farmers have identified that they often receive complaints from people living in the immediate neighbourhood. While low emission techniques such as trailing-shoe or injector, can help to reduce odours, so can the AD process. This is due to the digestate output from the AD process containing a lower concentration of volatile fatty acids than the raw slurry input.
- Biodiversity - Digestate has a reduced pathogen loading compared to raw slurry. It can act as a more effective fertiliser than raw slurry, which could lead to farmers being able to reduce mineral fertiliser applications.
- Rural Economy – By their nature AD plants tend to be in rural areas and can bring significant economic benefits to the rural economy in NI, including job creation/retention.
- Waste Management – AD presents an opportunity to divert organic wastes away from traditional management methods, such as landfill and composting, and to improve the management of slurries. A key benefit of this improved management is a reduction in the greenhouse gas emissions associated with the management of the wastes.
- Income diversification – AD offers farmers an additional market and potential revenue stream for excess grass and agriculture waste. It will give them an opportunity to earn additional income and not be solely reliant on livestock or crops.
- Digestate - Digestate in its raw form is comparable to cattle slurry, hence it is nutrient rich and remains a challenge in nutrient-dense regions, where it can impact water, land and biodiversity. However, transforming digestate into a biofertiliser enables this 'waste' problem to be converted into an economic opportunity. Digestate biofertilisers can enhance grass growth beyond expectations of the nutrient performance. An Irish study comparing the efficacy of biofertilisers in comparison to undigested cattle slurry found a wide variation in quality dependent on the feedstock used. The development of biofertilisers from digestate has become increasingly relevant to AD plants to meet regulatory requirements and to provide an alternative source of income for AD operators.

50 Project Clover
51 Based on analysis from Teagasc Ireland

- Improved security of supply of gas – By replacing natural gas demand with biomethane, NI can become less reliant on fossil fuel imports and develop its own supply of energy. This will leave the economy less vulnerable to supply shocks and international market prices in the future. Price volatility impacts consumers and can lead to higher levels of fuel poverty which directly affects communities.
- Organic food producers - Organic farmers can benefit from biomethane production through improved nutrient recycling. The conversion of slurry to digestate in the AD process improves the value of the material as a fertiliser, increasing the availability of nitrogen. This is particularly important in organic farming where inorganic fertilisers are not used and recycling of nutrients in farm waste materials is therefore at a premium.
- Capture of CO_2 – A by-product of the biogas to biomethane upgrading is a near pure stream of CO_2, which can be captured and sold to multiple markets. This can increase revenue for AD operators and reduce the support needed to produce biomethane. It is also a green source of CO_2 and can reduce the need for alternative sources.
- Reduced usage of chemical fertilisers – The chemical fertiliser replacement value of digestate varies in the literature and can range between 15-100%, with nutrient availability increasing with simple processing techniques such as solid-liquid separation. Anecdotal evidence suggests that over time, with repeated applications and improved soil quality, digestate can displace up to 80-90% of chemical fertiliser use and can enhance soil biological activity. According to the Anaerobic Digestion and Bioresources Association, "1 tonne of artificial fertiliser replaced with digestate, saves 1 tonne of oil, 108 tonnes of water and 7 tonnes of CO_2eq emissions[52]".
- Soil Nutrient Management - The rerouting of manure to AD facilities, along with the opportunity to support nutrient recovery and collection, provides a route of increased control and more efficient redistribution of nutrients from surplus to deficit areas or further afield. This would be valuable for sustainable agriculture development due to the surplus phosphorus pool that exists in Northern Ireland at present and the legacy effect of this, which has resulted in a high proportion of soils with levels of crop-available phosphorus which are above the agronomic optimum recommended for grassland.

Sustainability of Agriculture Biomethane

Sustainable production of biomethane is well proven and as shown in this report biomethane production is happening at scale across Europe.

For biomethane gas from AD plants to be classified as a zero carbon, renewable fuel, plants must be able to achieve increasingly strict sustainability criteria as outlined within the EU Renewable Energy Directive II ("REDII") and future RED III criteria (or equivalent), sustainability criteria guidelines are also outlined in support schemes operating in the UK. While RED II is a European directive, it will have implications for NI, while an alternative scheme is likely to be introduced, potentially as part of the new Agricultural Policy expected in 2024.

The RED II criteria stipulate that biomass fuels produced from agricultural biomass cannot be derived from raw material obtained from (1) land that was formerly peatland; (2) lands with a high biodiversity value; and (3) lands with a high carbon stock. In addition, RED II requires that all biomass fuels used for electricity, heating and cooling must achieve at least a 70% GHG emission saving, increasing to 80% for installations that start operating from 2026.

Accordingly, it is vital to ensure that any future AD deployment is undertaken in full compliance with RED requirements and that it is developed in a manner that ensures it doesn't create any unintended negative consequences.

Slurry would be required as co-feedstock with grass to meet the RED II sustainability criteria. The inclusion of slurry is required because harvesting the methane from slurry prevents it from being released to the atmosphere, thereby having the effect of being carbon negative and improving the overall GHG savings of the AD facility. The proportion of slurry required ranges from 40-55% to meet the 2026 (80% GHG emission savings) RED II criteria.

Additional measures can be undertaken to improve the sustainability of production and have been highlighted in studies undertaken by Devenish and Gas Networks Ireland. Utilising Multi-Species Swards instead of monoculture grasses and enhancing rules to ensure biodiverse land is not utilised for AD feedstock production can help with the overall sustainability of biomethane production.

52 Sustainability of Biomethane Production in Ireland

Section 5 – Barriers to a renewable gas sector in NI

It is clear renewable gas will play a crucial role in the overall decarbonisation of the NI economy, not only in the energy sector but also the agriculture sector. To benefit from the resource potential outlined in this report it is critically important that, as outlined in the Energy Strategy, biomethane grid injection is facilitated in NI as soon as possible. Alternative transport measures for off-grid industry should also be investigated further. Based on KPMG's analysis of other jurisdictions and their biomethane industry, the following barriers also need to be overcome to ensure the successful development of a renewable gas industry in Northern Ireland.

A role for the Utility Regulator

There needs to be a clear mandate for the Utility Regulator to have a role in the decarbonisation of our energy system. Similar mandates have been given to the Commission for Regulation of Utilities in Ireland and OFGEM in the UK.

"The CRU is committed to playing our role to help deliver a secure, low carbon future at least cost".

OFGEM "work to protect energy consumers, especially vulnerable people, by ensuring they are treated fairly and benefit from a cleaner, greener environment".

The Utility Regulator is currently considering the process to allow grid injection of biomethane onto the NI network and this work should continue and be expanded to include renewable gas storage. This will also necessitate input from the Health & Safety Executive for Northern Ireland.

The Utility Regulator, in conjunction with the gas industry and consumer stakeholders, should also consider developing a workstream to assess the future of billing on the NI gas network with the introduction of renewable gases. The current billing framework was designed to operate in conjunction with 100% natural gas, which can act as a barrier to the introduction of renewable gases. This is because renewable gases must meet the exact billing standard currently in operation for natural gas which involves pre-processing them before injection, which is costly and can involve the use of fossil fuels.

Ask:

The Utility Regulator's mandate should be broadened so as to be more supportive of the development of a renewable gas sector in NI.

Current and proposed grid connection charge structure

GNOs and the Utility Regulator will need to ensure that an aligned approach is in place for AD plants to connect to the gas network, in NI regardless of their geographical location. If NI is to achieve its ambition of decarbonising the gas network, a similar connection agreement needs to be put in place across the NI network. This work which is ongoing, will help streamline the process for AD plant operators, who will need a view on costs of connections depending on their distance to the network and geographic location of development.

A scheme to help reduce the cost of connection could also be implemented, where the generator pays 70% of the cost for example and the network operator could add 30% of the cost to their asset base or the 30% cost could be covered by a capital grant. Other countries have successfully implemented these alternative financial mechanisms to support grid-injected biomethane.

To maximise the supply of biomethane across all sections of the network, in-grid compression would be required to ensure biomethane could get onto the transmission network and be utilised across NI, not only in the area it was generated. This incurs an additional cost to cover the compression fee. How this fee is recovered also needs to be resolved as some areas would be affected more than others.

The 2030 target of 1.4 TWh mitigates against the need for in-grid compression or a renewable gas injection hub, as based on analysis of historic summer baseload demand levels the distribution grid has capacity to absorb the full 1.4 TWh[53].

Ask:

Assess the potential option to implement a scheme to reduce the grid connection costs for AD plants in NI.

Assess the options for cost recovery of in-grid compression for levels of biomethane, particularly relevant when production levels rise above 1.4 TWh post 2030.

Planning impediments

Planning for energy infrastructure can be difficult in NI and if c. 70 AD plants are required to be built by 2030 to meet an ambition of 1.4 TWh of biomethane by 2030, a streamlined process for strategic energy infrastructure should be considered.

The planning system should be further resourced as the scale of applications required to meet NI's decarbonisation goals will be substantial. With plans for 1.4 GW capacity of wind and solar and the potential for 70+ AD plants by 2030, the scale of planning applications will put pressure on current resources. Delays need to be minimised and with wind farms currently spending more than twice as long in planning in NI than in Great Britain[54] already it is clear more resources will be required out to 2030.

A recent Public Accounts Committee assessing Planning in Northern Ireland[55] highlighted the failures of the planning system in NI.

"The planning system in Northern Ireland is not working. The Committee recommends that a Commission is established to undertake a fundamental review to ascertain the long term, strategic changes that are needed to make the system fit for purpose. This should be led by someone independent from the Department".

53 KPMG analysed historic gas demand data on the distribution network to estimate the minimum summer baseload demand on the network to ensure excess storage of renewable gas wouldn't be required to meet the 1.4TWh target.
54 Renewable NI – Review of Planning Act
55 Planning in Northern Ireland – Public Accounts Committee

"The Committee is appalled by the performance statistics. It is simply unacceptable that almost one-fifth of the most important planning applications aren't processed within three years. Such poor performance has an impact on applicants, developers and communities and is risking investment in Northern Ireland".

The report provides 12 recommendations including ensuring the planning system is properly funded, an independent fundamental review is carried out and that planning authorities carry out regular reviews of past decisions to understand their real-world outcomes.

KPMG would highlight the importance of a properly functioning planning system in achieving a renewable gas sector by 2030 in NI and would echo the Public Accounts Committee recommendations.

Support mechanism

As discussed in this report, it is clear that a support mechanism for the production of biomethane is required in NI. To gather feedback from interested parties and to ensure the scheme is designed to meet the needs of the NI market, a consultation on an appropriate support mechanism should take place in 2022 to ensure a mechanism can be in place as soon as possible.

Ask:

Hold a public consultation on a potential support scheme for biomethane in NI.

Long-term preparation

As the scale of biomethane production surpasses the current ambition of 1.4 TWh by 2030, storage of biomethane in the transmission network or dedicated storage facilities will be required. Storage will smooth out the production and demand profile of renewable gases, for example, renewable gas is produced at a constant rate during summer when heating demand is low, this gas will need to be stored and used at an alternative time. This requires Utility Regulator support and will also require specific planning and health and safety regulation as storage may take place on-farm, within the gas network or in specialist storage facilities, above or below ground level. To ensure this does not act as a blocker to growth of renewable gas post 2030, work should progress on this in the coming years.

Ask:

Assess the potential for storage of renewable gases in NI, including any legal, regulatory and safety issues that need to be resolved before storage of biomethane or hydrogen can occur.

Digestate

Digestate has typically been viewed as a waste product and burden for AD plants, with operators commonly paying farmers to act as off-takers. However, transforming digestate into a more usable and valuable fertiliser can shift this 'waste' material into a potential revenue stream for plant operators. As NI already has c.90 AD plants in operation, there is already regulations and responsibilities in place around anaerobic digestate. The role of DAERA in this aspect will be important.

Ask:

These regulations should be reviewed to ensure they capture the latest developments in processing digestate into a biofertiliser. A public consultation to gather the latest research and developments in this area could take place while the AD industry develops.

UK-wide schemes

DfE should consider the appropriateness of extending the Green Gas Support Scheme or the GB CfD scheme to include Northern Ireland alongside Great Britain, in a similar manner to which the ROC scheme operates on a UK-wide basis and the expected Hydrogen Business Model and CfDs for wind are likely to be deployed.

Ask:

Assess the potential for including NI in an extended UK wide biomethane support scheme.

6%

The percentage of savings a biomethane target of 1.4 TWh could deliver for the NI Energy Strategy's goal of reducing energy emissions from 12.6MT to 7MT by 2030.

Section 6 – Longer-term potential for green hydrogen

Hydrogen is the most abundant element in the universe but does not exist naturally in its pure form. It can be created in several ways, including from water (using electrolysis) that can be used in a similar manner to natural gas. At low level blends (<20% by volume) with natural gas, appliance replacement is not required (many new appliances are already capable of a 20% hydrogen blend). Hydrogen can be transported using the majority of the existing gas distribution networks which are of modern polyethylene type, unlike some of the network in the UK.

Policy Support for hydrogen

United Kingdom

In 2021, BEIS published the UK's first hydrogen strategy[56]. The strategy details how the UK will look to capture the economic benefits of growing the UK hydrogen economy, supporting innovation, and stimulating investment to develop the supply chains and skills needed and create jobs and export opportunities for the UK.

It also sets out a twin-track approach to supporting both electrolytic 'green' and carbon capture-enabled 'blue' hydrogen production, alongside other potential production routes, which will enable the rapid growth of the sector while bringing down costs.

As set out in the 10-point plan[57] for a green industrial revolution, government, working with industry, initially aimed for 5GW of low carbon hydrogen production capacity by 2030. This level of hydrogen production could be equivalent to the amount of gas consumed by over 3 million households in the UK each year. In a Hydrogen Investor Roadmap[58] published in April 2022, the government has now doubled the target of green hydrogen production capacity to 10GW by 2030 (with at least half from green hydrogen), with the first milestone of 2GW to be reached by 2025.

To stimulate investment in hydrogen production, the UK government has made funding available, including:

- Net Zero Hydrogen Fund[59] of £240m to support capital and development expenditure.
- H2[60] Business Model to provide an initial £100m for green hydrogen projects.

The longer-term support scheme, known as the Hydrogen Business Model, has recently been consulted on and the government have issued a number of details in their response to the consultation.

"The primary objective of the business model is to incentivise the production and use of low carbon hydrogen through the provision of ongoing revenue support in order to overcome the cost gap between low carbon hydrogen and cheaper higher carbon counterfactual fuels".

A value for money case for blending of hydrogen onto the gas network and a neighbourhood sized trial of 100% hydrogen are both expected to be completed during 2023. A village sized trial is expected to commence in 2025 and a town sized hydrogen project is targeted by 2030.

Ireland

Ireland has recently (July 2022) launched a public consultation to gather the views of stakeholders and interested parties, in order to inform the development of a hydrogen strategy for Ireland[61].

The Renewable Heat Obligation consultation set out the Department's intended position in relation to hydrogen as a heat fuel.

"It is intended that green hydrogen produced from additional renewable electricity would be given a double credit".

Ireland's updated Renewable Fuels for Transport policy statement also shows government policy support for hydrogen in the transport sector from 2023[62].

Northern Ireland

The NI Energy Strategy states *"We can continue to be world leaders in integrating renewable electricity generation and we can become world leaders in the new hydrogen economy".*

The strategy also discusses creating a centre of excellence in research and innovation for hydrogen and to ensure Northern Ireland can maximise the potential use of hydrogen in the gas network, the Department for Economy plans to review existing legislative provision by 2025.

Modelling carried out for the Energy Strategy shows that hydrogen contributes between 19-24% of energy requirements across the transport, heat, and industrial sectors. This is significant growth from today's position, and it is important that legal, safety and regulatory frameworks are progressed to ensure development.

In terms of dedicated financial support mechanisms, projects in Northern Ireland can apply for funding under the UK-wide schemes as outlined under the UK hydrogen policy background.

Green hydrogen potential in Northern Ireland

Under both scenarios modelled in the NI Energy Strategy, hydrogen plays a significant role in meeting NI's future energy scenarios with 2050 ambitions of between 19% and 24% (c.3.5 TWh – c. 6 TWh) of final energy demand supplied by hydrogen. The analysis accompanying the Energy Strategy shows very low levels of hydrogen produced from electricity and most of the hydrogen being generated via Steam Methane Reforming and Carbon Capture.

56 UK hydrogen strategy
57 The Ten Point Plan for a Green Industrial Revolution
58 Hydrogen Investor Roadmap
59 Net Zero hydrogen fund
60 Hydrogen Business Model
61 DEC
62 Renewable Fuels for Transport Policy

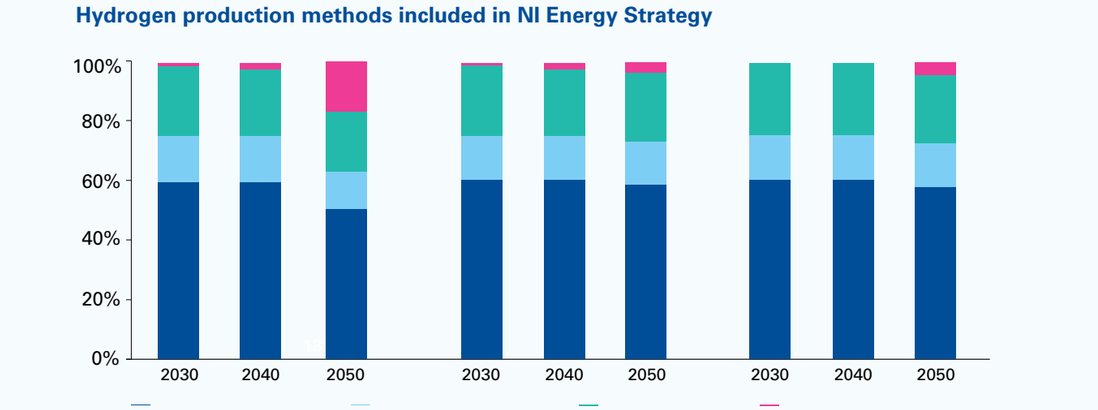

Figure 34

Green hydrogen has several potential benefits compared to other methods of production:

- In the first instance it can help the electricity system by utilising excess generation from renewables at times of curtailment.
- This in turn can help with the feasibility of new wind farm development by improving the routes to market for the electricity produced.
- Alongside green hydrogen, oxygen is produced which can be of use in many scenarios, such as the use of oxygen by NI Water to improve wastewater treatment efficiency levels.
- At the point of installation of the electrolyser, a quantum of high-grade heat is available.
- The green hydrogen itself is then available for use in the heat and transport sectors.
- Green hydrogen can offer a route to market for renewable developments that can't access the grid, which in turn can help NI realise its potential for offshore wind.
- Green hydrogen is expected to be the lowest cost method of production for hydrogen by 2030[63].

When an existing ROC accredited wind farm is curtailed, they could receive ROCs for the electricity used in electrolysers when they are unable to export. If these developments could be targeted for small electrolysers pilots to prove the concept before 2030, it would be an opportunity to test different components of a future hydrogen production system and network injection at a lower cost than if non-ROC accredited wind farms are used.

In 2020, the level of curtailment in Northern Ireland was approx. 14% of the installed generating capacity of 1.3 GW, spread across NI. SONI are forecasting a further 1.6 GW of generating capacity being installed on the grid by 2030 although curtailment is likely to decrease as the quality of the network improves and technological solutions improve energy efficiency and demand management.

To illustrate the potential green hydrogen output in NI by 2030, we have worked through a potential scenario below:

Assumptions

- The UK government's ambitions to install 2GW of installed capacityaccross the UK by 2025. We have assumed 10% of this is installed in Northern Ireland: 0.2 GW.
- The load factor of the electrolysers is 50%.
- The efficiency of the electrolysers is 65%.
- All of the hydrogen produced is available to the gas network and not used for other purposes (such as transport).

Outcome

- Based on the assumptions, the amount ofgreen hydrogen potential by 2025 would be 0.6 TWh.
- At the UK government's level of ambition of 5GW of green hydrogen potential by 2030 (holding all of the other assumptions steady) would be 1.4 TWh.

63 Green hydrogen to outcompete blue hydrogen everywhere by 2030 - BNEF

As can be demonstrated from the illustrative example, the amount of green hydrogen that could be available in 2030 is modest (accepting that the assumptions are subject to change) and is equivalent to the level of ambition in relation to biomethane (1.4 TWh). To produce green hydrogen on an economic and at such a level, dedicated renewable capacity will need to be built for hydrogen production post-2030 as demand will come from the heat and electricity generation and transport sectors. 1.4 TWh of green hydrogen by 2030 would be between 23%-40% of the hydrogen needed in the Energy Strategy's 2050 scenarios.

There are also many policies, safety and regulation frameworks and support mechanisms required, to develop a green hydrogen sector in NI. The extent of these requirements to get close to the level of green hydrogen illustrated above are much more challenging than the requirements to achieve the same biomethane target.

Green hydrogen potential

Green hydrogen will be critical for meeting NI's commitment to Net-Zero by 2050. It has the potential to play a role in decarbonising vital industry sectors and provide flexible deployment across heat, power, and transport. There are uncertainties around the exact role of hydrogen in 2030 and out to 2050, and scale of demand and deployment in different sectors but it is a key component in the Power-to-X concept, which aims to use surplus renewable electricity in the most efficient manner (whether through conversion to other forms such hydrogen, energy storage or energy conversion techniques).

Northern Ireland has a significant wind resource and storage capability and can utilise this to produce green hydrogen to help decarbonise difficult to decarbonise sectors, such as high temperature heat and heavy good vehicles transport.

As Northern Ireland progresses to 80% renewable electricity by 2030, there will be significant portions of curtailed electricity due to supply exceeding demand. Green hydrogen production can help alleviate some of this excess wind generation, as well as expected improvements in the electricity network. Some level of storage will be provided by the gas network, but to shift hydrogen produced from renewable electricity in the winter months and convert it back to heat or electricity in the summer months for example when wind generation is low, will require large scale storage solutions, one of which Northern Ireland has access to and is discussed in detail earlier in the report.

Green hydrogen production works best with dedicated renewables, running at maximum capacity, not just on curtailed generation. Green hydrogen production can offer a route to market for large scale offshore wind developers, who instead of solely connecting to the electricity grid, can develop large electrolysers to produce vast amounts of green hydrogen. This is the more likely route to large-scale hydrogen production in Northern Ireland, albeit the Energy Strategy does not foresee large scale offshore development until after 2030. The scale of offshore ambition in Northern Ireland is currently 1GW.

Costs of green hydrogen

Currently green hydrogen production is uneconomic as costs of electrolysers and electricity inputs are too high. These are expected to fall substantially by 2030.

It is predicted that green hydrogen production will become the cheapest source of hydrogen by 2030[64], outcompeting blue hydrogen which requires Carbon Capture and Storage. Due to recent price volatility and concerns about supply of natural gas, green hydrogen may become the cheapest source of hydrogen pre-2030.

Green hydrogen production costs are very dependent on electricity costs and can vary from region to region. As wind and solar further develop in NI it is expected the cost of electricity will fall, which in turn will lead to cheaper green hydrogen.

Bloomberg New Energy Finance recently published analysis[65] which shows the expected cost of green hydrogen in the UK region (2030) to be between $1.50kg - $2.00kg of hydrogen. This equates to a cost of production of approx. $4.5c - $6c per kWh or 3.5p-4.5p per kWh. There are other costs to consider like transport and storage and these can be substantial (2x to 3x), depending on project specific factors.

Benefits of developing a hydrogen economy

Developing a hydrogen economy in NI can increase energy security by reducing reliance on imported fossil fuels and help take full advantage of NI's renewable resources.

Alongside biomethane, it can offer the NI economy and consumers a level of protection against international price shocks for fossil fuels.

NI can benefit significantly from potential job creation related to a hydrogen economy. A recent article[66] in Ireland produced by a leading hydrogen expert suggested that almost 50,000 jobs could be created in the industry in Ireland and a similar study should be carried out for NI to assess the benefits to the economy that green hydrogen would bring. DfE are to prepare a business case in relation to a hydrogen centre of excellence as part of the Energy Strategy and this could be considered as part of that exercise.

64 Green hydrogen will be cheaper than blue by 2030 - BNEF
65 Green hydrogen to outcompete blue hydrogen everywhere by 2030
66 Irish Times article – Government is warned State could miss opportunity if strategy not published

Supporting a renewable gas sector in Northern Ireland

There is potential to store vast quantities of hydrogen below ground, which can be produced when there is excess renewables and low demand and then utilised in the power generation sector during periods of low renewables and high demand. Northern Ireland is uniquely placed in terms of below ground storage capability, due to the salt caverns at Islandmagee, Co. Antrim.

To facilitate the blending of hydrogen onto the gas network, similar legislative and regulatory frameworks are required as are currently in place for natural gas. In addition, hydrogen has a different calorific value to natural gas and biomethane, meaning that in instances where blending takes place, changes to the metering and billing processes in Northern Ireland will have to be made and the Utility Regulator's input will be required to facilitate this.

Hydrogen business models

In 2021, as part of the UK Hydrogen strategy, the Department for Business, Energy & Industrial Strategy ("BEIS") launched a consultation on a business model establishing the financial support framework for low-carbon hydrogen. In April 2022, the response to the consultation from BEIS was published which revealed the latest details about the proposed hydrogen business model for the UK.

BEIS intends to proceed with the intended positions set out in the Business Model Consultation to support new Hydrogen production capacity through a combination of price support and volume support.

BEIS proposed hydrogen support mechanism

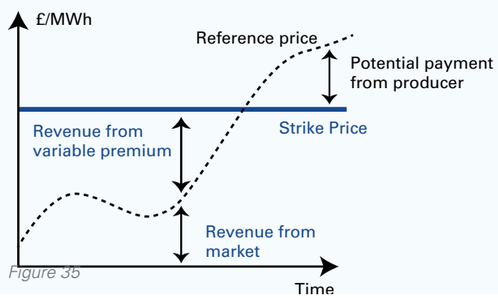

Figure 35

European Hydrogen Backbone (EHB)

The EHB initiative aims to accelerate Europe's decarbonisation journey by defining the critical role of hydrogen infrastructure – based on existing and new pipelines – in enabling the development of a competitive, liquid, pan-European renewable and low-carbon hydrogen market. Gas Networks Ireland and National Grid are partners of the project[67].

The initiative seeks to foster market competition, security of supply, security of demand, and cross-border collaboration between European countries and their neighbours. Europe has defined a bolder and more ambitious hydrogen target of 20 MT by 2030 in response to the RePowerEU plan to phase out Russian fossil fuel imports well before 2030. This includes a 10 MT target of domestic EU hydrogen supply, as well as a 10 MT target of hydrogen imports from outside the EU. These targets are strengthened by accelerated national climate ambitions as well as the accelerated development of the European hydrogen market.

Actions that can be taken now to advance green hydrogen policy

Develop a dedicated NI hydrogen action plan, which could outline actions that need to be taken to support the development of a hydrogen economy, a position on hydrogen production, research, and development and where NI see hydrogen being used in NI as our use cases may vary from the UK.

Investigate potential support mechanisms for different end uses of hydrogen. It is likely that a different mechanism will be needed for the transport and heat sector, for example as transport will benefit from the existing RTFO (or as amended in due course).

Future-proof infrastructure by mandating the installation of hydrogen ready boilers by 2026. Boilers currently on the market are hydrogen blend (20%) ready, but the building regulations have not yet caught up with the future direction of travel on renewable energy.

Identify areas on the network that would be first movers in terms of a full network changeover to hydrogen or areas best suited to hydrogen blends. Initially these areas could be used for the trials noted above and should use relevant learnings from the trials taking place in GB to improve the efficiency of the trials.

Time and resources should be dedicated to investigating potential sites suitable for hydrogen storage in NI, both above ground and below ground.

Working with the Health and Safety Executive and Utility Regulator, the development of safety protocols for the storage, transport and injection of hydrogen should commence. While much is known about natural gas and biomethane, there may be a nuance with respect to hydrogen, particularly in relation to storage (whether above or below ground level).

67 European Hydrogen Backbone

Appendix

Analysis on biomethane development profile and annual support required							
	2024	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
TWh biomethane produced	0.1	0.3	0.45	0.6	0.9	1.2	1.4
Support level required for biomethane (p/kWh)	5.9p	5.8p	5.4p	4.7p	4.6p	4.3p	4p
Incremental support required	£5.9m	£11.6m	£8.1m	£7m	£13.8m	£12.9m	£8m
Total annual support required	£5.9m	£17.5m	£25.6m	£32.6m	£46.5m	£59.3m	£67.3m

Supporting a renewable gas sector in Northern Ireland

Contact us

Russell Smyth
Partner
KPMG Sustainable Futures
e: russell.smyth@kpmg.ie

Gary Borland
Director
KPMG Sustainable Futures
e: gary.borland@kpmg.ie

Philip Connolly
Manager
KPMG Sustainable Futures
e: philip.connolly@kpmg.ie

kpmg.ie

© 2022 KPMG, an Irish partnership and a member firm of the KPMG global organization of independent member firms affiliated with KPMG International Limited, a private English company limited by guarantee. All rights reserved.

The information contained herein is of a general nature and is not intended to address the circumstances of any particular individual or entity. Although we endeavour to provide accurate and timely information, there can be no guarantee that such information is accurate as of the date it is received or that it will continue to be accurate in the future. No one should act on such information without appropriate professional advice after a thorough examination of the particular situation.

The KPMG name and logo are registered trademarks of KPMG International Limited ("KPMG International"), a private English company limited by guarantee.

If you've received this communication directly from KPMG, it is because we hold your name and company details for the purpose of keeping you informed on a range of business issues and the services we provide. If you would like us to delete this information from our records and would prefer not to receive any further updates from us please contact unsubscribe@kpmg.ie.

Produced by: KPMG's Creative Services **Publication Date:** September 2022 (8287)