Appendix 4.9
Energy Policy Compliance Report

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Energy Policy Compliance Report

Herbata Data Centre Campus

Naas, County Kildare
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P11	25/07/2024	Final Review	25/07/2024_RT	25/07/2024_UG	Minor policy wording changes

Contents

Tables

Figures

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1 Executive Summary

HDR has been commissioned by Herbata Ltd to undertake a review of their proposed data centre campus development at Jigginstown near Naas, Co. Kildare the subject of the application for planning permission to Kildare County Council (the Proposed Development), against Ireland's current national, and local energy, climate, and planning policies.

The Proposed Development is part of an overall data centre development which includes two main elements, namely:

(a) The Proposed Development, which as mentioned above is the subject of the application for planning permission to Kildare County Council; and,

(b) A proposed grid substation and 110kV transmission connection which are the subject of a separate application to An Bord Pleanála for approval under section 182A of the Planning and Development Act 2000 (as amended) (the Substation Application).

The Proposed Development and the Substation Application together constitute the "Project" for the purposes of Environmental Impact Assessment. The likely significant impacts of the Project on the environment, including on climate change, have been considered and assessed in the Environmental Impact Assessment Report (EIAR) submitted with the application for planning permission, climate change is considered in two parts:

- The impact of greenhouse gas (GHG) emissions caused directly or indirectly by the Project, which contribute to climate change; and
- The potential impact of changes in climate on the Project, which could affect it directly or could modify its other environmental impacts.

The report concluded that the whole life greenhouse gas emissions from the Project are not likely to have a significant effect on climate (see Chapter 16, titled Climate Change, Volume I (main text) and Volume II (appendices) of the EIAR). Further, the compliance of the Proposed Development with national and local planning policy is set out in the Planning Report submitted with the application for planning permission, which concludes that the Proposed Development aligns with national and local policy.

This report draws on the matters considered and assessed in those documents and sets out how the Proposed Development, and in particular the energy strategy developed to supply the power demands of the data centres, aligns with national and local climate, energy, and planning policies, including those specific to data centre development in Ireland. It is recognized that that these policies have evolved in recent years, reflecting the need to reduce greenhouse gas emissions and decarbonise our energy system.

Climate policy in Ireland, including as it relates to energy and decarbonisation of the electricity grid, stems from legal commitments made as a member state of the European Union to the Paris Agreement, known also as COP21, which came into force in November 2016 and is a legally binding international treaty on climate

change. In 2019 the EU overhauled its energy policy framework to move away from fossil fuels towards cleaner energy - and, more specifically, to deliver on the COP21 commitments. The COP21 and EU clean energy commitments are reflected in Ireland's energy and climate policy framework including the National Energy and Climate Plan (NECP) and the Climate Action Plan 2024 (CAP24).

Specifically in relation to data centres, the Irish Government has clearly set out its policy on the role of data centres going forward in Ireland's economy in its revised statement published in July 2022, titled "Government Statement on the Role of Data Centres in Ireland's Enterprise Strategy". The statement recognises that data centres are core digital infrastructure and play an indispensable role in our economy and society. Within the statement, there is a clear desire to ensure that the digital economy can still grow but at the same time decarbonise as it grows.

The statement sets out that the Government has agreed a set of national principles (six in total) that should inform and guide decisions on future data centre development. The statement makes clear that data centre development that is not consistent with these principles would not be in line with national policy, and therefore any data centre development being proposed now must be consistent with these principles. The six principles are:

1) Economic Impact
   Principle - The Government has a preference for data centre developments associated with strong economic activity and employment.
2) Grid Capacity and Efficiency
   Principle - The Government has a preference for data centre developments that make efficient use of our electricity grid, using available capacity and alleviating constraints.
3) Renewables Additionality
   Principle - The Government has a preference for data centre developments that can demonstrate the additionality of their renewable energy use in Ireland.
4) Co-Location or Proximity with Future-Proof Energy Supply Principle - The Government has a preference for data centre developments in locations where there is the potential to co-locate a renewable generation facility or advanced storage with the data centre, supported by a Corporate Power Purchase Agreements, private wire, or other arrangement.
5) Decarbonised Data Centres by Design
   Principle - The Government has a preference for data centres developments that can demonstrate a clear pathway to decarbonise and ultimately provide net zero data services.
6) SME Access and Community Benefits
   Principle - The Government has a preference for data centre developments that provide opportunities for community engagement and assist SMEs, both at the construction phase and throughout the data centre lifecycle.

As set out in detail in Section 5.1 below, the Proposed Development is fully consistent with each of the above principles, which have been integrated into the design of the Proposed Development from the earliest stage.

At a local level, the Kildare County Development Plan 2023-2029 includes policies and objectives in relation to energy and sustainability, which reflect National policy on same, including a number of policies and objectives specific to data centre developments. Each of these policies and objectives relevant to a data centre campus have been considered in sections 4 and 5 below, which set out how the Proposed Development aligns with each of these objectives and policies.

As described in more detail below, a number of key strategies have been developed as an integral part of the Proposed Development's energy strategy to manage energy demand and facilitate decarbonisation of energy usage and long-term sustainability, in summary these include:

- Adopt highly efficient cooling systems using direct air and exhaust arrangements for each building topped up with adiabatic elements for peak summer conditions.
- Provide high quantities of water storage, sufficient for a whole year or more, collected from rainwater only (not from mains water), to provide for the few weeks a year when the adiabatic cooling top up is needed. This has the benefit of not impacting the local area in terms of water demand and keeps the power demand to reasonable levels.
- A commitment to meet the Kildare County Council's policy of a minimum of 30% of the operational energy demand of the data centres being met by renewable sources, using Corporate Power Purchase Agreements (CPPAs) from wind and solar farm projects located within Ireland, supplemented by using on-site solar arrays. Herbata have been in advanced discussions with various solar and wind project developers with a view to sourcing capacity through CPPAs. It is clear that there is sufficient capacity available from renewable energy projects to provide electricity for all three development phases of the Proposed Development. Commitment to these CPPAs will not be possible until planning permission for the Proposed Development has been granted (along with a connection agreement with EirGrid); it is therefore suggested that Kildare County Council attach a condition to any grant of permission for the Proposed Development requiring the CPPAs to be secured in advance of the Proposed Development becoming operational. For further information refer to the Bos Energy Ltd document entitled Herbata: Energy Supply Strategy. Details of the exact text of the proposed planning condition in relation to CPPAs are set out in section 4.9.1 of the Planning Report submitted with the application for planning permission.

- The remaining 70% of the operational energy demands of the data centres is to be generated on-site using highly efficient gas turbines adjacent to each data centre building and linked directly to Battery Energy Storage Systems (BESS) located at each data centre building. This arrangement significantly reduces losses normally found in the transmission of power by ensuring that the energy required is generated at point of use, enabling the electricity generated from gas turbines to be stored and used on-site. Natural gas is considered a transitional fuel by the EU and one of the stated objectives of the Directive of the European Parliament and of the Council on common rules for the internal markets for renewable gas, natural gas and hydrogen, amending Directive (EU) 2023/1791 and repealing Directive 2009/73/EC (recast), which was adopted by the Council on 21 May 2024, is to ensure a gradual phase-out of natural gas, while noting that natural gas still plays a key role in energy supply. Gas Networks Ireland (GNI), Ireland's gas network operator, is working towards the decarbonisation of the gas network by replacing natural gas with renewable gases, such as biomethane and green hydrogen, with a goal of ultimately reducing to zero dependency on fossil fuel gasses by 2050. To support the decarbonisation of the gas network, a biomethane injection point is included as part of Gas Networks Ireland equipment which will be installed on the site as part of the Proposed Development.
- Provide a connection point for a district heating system, to harness the waste heat associated with the data centre campus to serve the area to the west of Naas. The provision of district heating in the local area would bring many benefits to the local community and businesses by decarbonising the heating of buildings and by increasing local energy security at reduced cost to households, community facilities and businesses.
- Each data centre building's gas turbines will have the capacity to produce electricity in excess of the 70% of the energy demand of the data centres which is proposed to be met from this energy source, in which case the BESS units will be charged from this excess electricity, meaning that the Proposed Development (i) will be able to feed excess electricity back into the Irish electricity grid and (ii) provide frequency stability support to the grid.

A Greenhouse Gas (GHG) emissions assessment has been carried out for the proposed campus development over an operational lifetime of 2027 to 2050, to predict the anticipated year of Net Zero Carbon (NZC) for the proposed development.

As outlined below, a conservative approach has been adopted on the basis of national policy and strategies, to assess the pathway to decarbonisation of the proposed development. The strategy below enables a NZC timeline of 2039. Should the relevant national strategies be implemented more quickly than the conservative estimate adopted for the purposes of this assessment, there is a potential for NZC to occur in the early 2030's.

The NZC assessment includes three scenarios which are compared to each other (full information is provided in Appendix A), in summary the scenarios considered are:

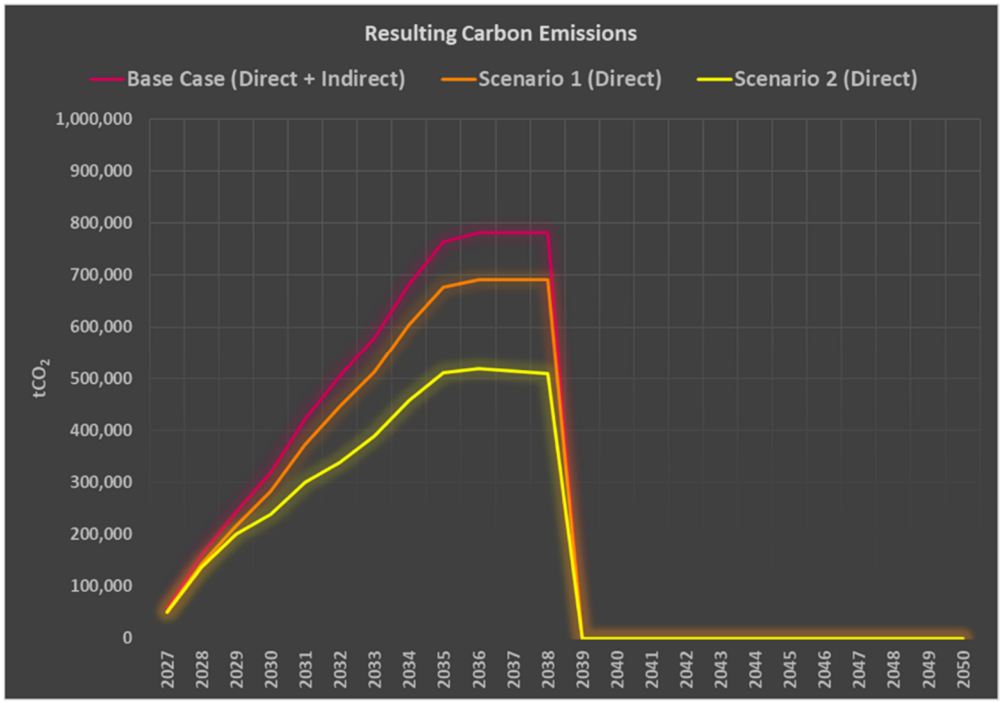
Base Case = 100% natural gas from 2027 to 2038, 100% green hydrogen from 2039 to 2050, no power drawn from the national electricity grid throughout.

Scenario 1 = 100% natural gas from 2027 to 2038, 100% green hydrogen from 2039 to 2050, with 30% (minus on-site PV) of the operational power demand of the data centre supplied by renewable energy drawn from the electricity grid via CPPAs throughout.

Scenario 2 = Blended natural gas with up to 20% green hydrogen and biomethane ramp-up from 2027 to 2038, 100% green hydrogen from 2039 to 2050, with 30% (minus on-site PV) of the operational power demand of the data centre supplied by renewable energy drawn from the electricity grid via CPPAs throughout.

The resulting GHG emissions are shown graphically below; the Base Case clearly has the worst emissions over the period although it does also reach a similar NZC position in 2039, but in the intervening years it has the worst emissions.

GHG Emissions Assessment



Scenario 1 is an improvement on the Base Case, with overall GHG emissions being around **11.6% lower** than the Base Case, but this only takes into account the input from electricity sourced from renewable sources via CPPAs.

Scenario 2 is clearly a significant step forward with a pathway to much lower GHG gas emissions, these being around **31.5% lower** than the Base Case. The provisioning of biomethane and partial hydrogen through to 2039 is key to achieving this lower level of emissions. In that regard, the Proposed Development has been designed in such a way that biomethane and green hydrogen can be used to power the Proposed Development as and when they become available, enabling the Proposed Development to take full advantage of the national roll out of biomethane and green hydrogen over the next 25 years or so, as described in the National Hydrogen Strategy and the National Biomethane Strategy, and ensuring that the Proposed Development will meet local and national energy policies.

Ultimately, all of the scenarios are projected to get to a NZC point in 2039, 100% green hydrogen will be available to fuel the gas turbines by this time as set out in the National Hydrogen Strategy (and as described in more detail in Section 6 below). As mentioned above, should the relevant national strategies be implemented more quickly than the conservative estimate adopted for the purposes of this assessment, there is a potential for NZC to occur in the early 2030's.

2 Introduction

HDR has been commissioned by Herbata Ltd to undertake a review of the Proposed Development against Ireland's current national, regional, and local energy, climate, and planning policies, including government policy in relation to data centre developments.

As mentioned above, the Proposed Development is part of an overall data centre development which includes two main elements, namely:

a) The Proposed Development, which as mentioned above is the subject of the application for planning permission to Kildare County Council; and,

b) A proposed grid substation and 110kV transmission connection which are the subject of a separate application to An Bord Pleanála for approval under section 182A of the Planning and Development Act 2000 (as amended) (the Substation Application).

The Proposed Development and the Substation Application together constitute the "Project" for the purposes of Environmental Impact Assessment. The likely significant impacts of the Project on the environment, including on climate change, have been considered and assessed in the Environmental Impact Assessment Report submitted with the application for planning permission, which concluded that the whole life greenhouse gas emissions from the Project are not likely to have a significant effect on climate. Further, the compliance of the Proposed Development with national, regional, and local planning policy is set out in the Planning Report submitted with the application for planning permission, which concludes that the Proposed Development aligns with national, regional and local policy.

This report draws on the matters considered and assessed in those documents and sets out how the Proposed Development, and in particular the energy strategy developed to supply the power demands of the data centres, aligns with national, regional, and local climate, energy, and planning policies, including those specific to data centre development in Ireland. It is recognized that that these policies have evolved in recent years, reflecting the need to reduce greenhouse gas emissions and decarbonise our energy system. This report describes the nature of the Proposed Development, its location, key elements and building arrangement. The report then sets out how the proposed data centres will be supported in terms of how its energy requirements will be met (through on-site generation and supply from the grid via CPPAs), and how the energy strategy developed complies with the relevant national and local policies.

Respecting the desire to manage energy demand and produce as much energy as possible from zero carbon sources and low carbon sources, the following key strategies have been developed and implemented as an integral part of the energy strategy for the Proposed Development:

- Adopt highly efficient cooling systems by the use of direct air and exhaust arrangements for each data centre building topped up with adiabatic elements for peak summer conditions.
- Provide high quantities of water storage, sufficient for a whole year or more, collected from rainwater only (not from mains water), to provide for the few weeks a year when the adiabatic cooling top up is needed. This has the benefit of not impacting the local area in terms of water demand and keeps the power demand to reasonable levels.
- A commitment to meet Kildare County Council's policy of a minimum of 30% of the operational energy demand of the data centres being met by renewable sources, by the use of Corporate Power Purchase Agreements (CPPAs) from wind and solar farm projects located within Ireland, supplemented by using on-site solar arrays.
- The remaining 70% of the operational energy demands of the data centres is to be generated on-site using highly efficient gas turbines adjacent to each data centre building and linked directly to BESSs located at each data centre building. This arrangement significantly reduces losses normally found in the transmission of power by ensuring that the energy required is generated at point of use, enabling the electricity generated from gas turbines to be stored and used on-site. Natural gas is considered a transitional fuel by the EU and one of the stated objectives of the Directive of the European Parliament and of the Council on common rules for the internal markets for renewable gas, natural gas and hydrogen, amending Directive (EU) 2023/1791 and repealing Directive 2009/73/EC (recast), which was adopted by the Council on 21 May 2024, is to ensure a gradual phase-out of natural gas, while noting that natural gas still plays a key role in energy supply. Gas Networks Ireland (GNI), Ireland's gas network operator, is working towards the decarbonisation of the gas network by replacing natural gas with renewable gases, such as biomethane and green hydrogen, with a goal of ultimately reducing to zero dependency on fossil fuel gasses by 2050. To support the decarbonisation of the gas network, a biomethane injection point is included as part of Gas Networks Ireland equipment which will be installed on the site as part of the Proposed Development.
- Each data centre building's gas turbines will have the capacity to produce electricity in excess of the 70% of the energy demand of the data centres which is proposed to be met from this energy source, in which case the BESS units will be charged from this excess electricity, meaning that the Proposed Development (i) will be able to feed excess electricity back into the Irish electricity grid (ii) and provide frequency stability support to the grid.

The combination of all the above strategies is both forward looking and in compliance with Ireland's current climate, energy, and planning policies. These strategies and how they align with, and support Ireland's current climate, energy, and planning policies are discussed further in the body of this report.

3 Nature of the Development

3.1 Site Location

The site is located approximately 2.5 km to the west of Naas town centre in County Kildare, 33 kilometers to the west of Dublin and 20km from Kildare Town. The travel time from Dublin city centre takes an estimated 45min and from Dublin Airport approximately 40-45 minutes. The site address is Jigginstown, Naas, Co Kildare, Ireland (Lat. 53°13'07'' N / Long. 6°42'00'' W) and is shown in *Figure **3-1*** below.

Figure 3-1. Site Location

Area the subject of the Substation Application to An Bord Pleanála

Area the subject of this application for planning permission to Kildare County Council

The site is 'green field' and has a gentle slope from North to South. The entire site measures 37.5ha (92.9 acres).

The Northern site boundary measures approximately 730m and runs along the regional R409 road which provides access to the site. This road starts in Naas and travels northwest to end at the intersection with the R403 road. There is a small area of farmland located at the north-east part of the site in the triangle formed between the M7 motorway and the R409. The boundary between the site and this small triangular area of farmland is formed by a line of scattered trees. The western site boundary measures approximately 380m and it is formed by a line of trees and hedges. To the East the site is facing the M7 Motorway, positioned between Junctions 9a and 10, with a line of trees and hedges located along the boundary. This eastern site boundary measures approximately 630m.

Since 1st December 2021 this site is zoned in the Naas Local Area Plan 2021-2027 for specific use as a Data Centre P (1).

The lands are located between the existing ‘M7 Business Park’ and ‘Osberstown Business Park’. The Osberstown Wastewater Treatment Plant is located nearby to the north. The site is bounded to the east by the M7 motorway and to the west by agricultural lands. The ‘Newhall Retail Park’ is located to the south of the site, on the east side of the M7 motorway. There has been significant development in the locality in recent years, particularly light industry, logistics and services.

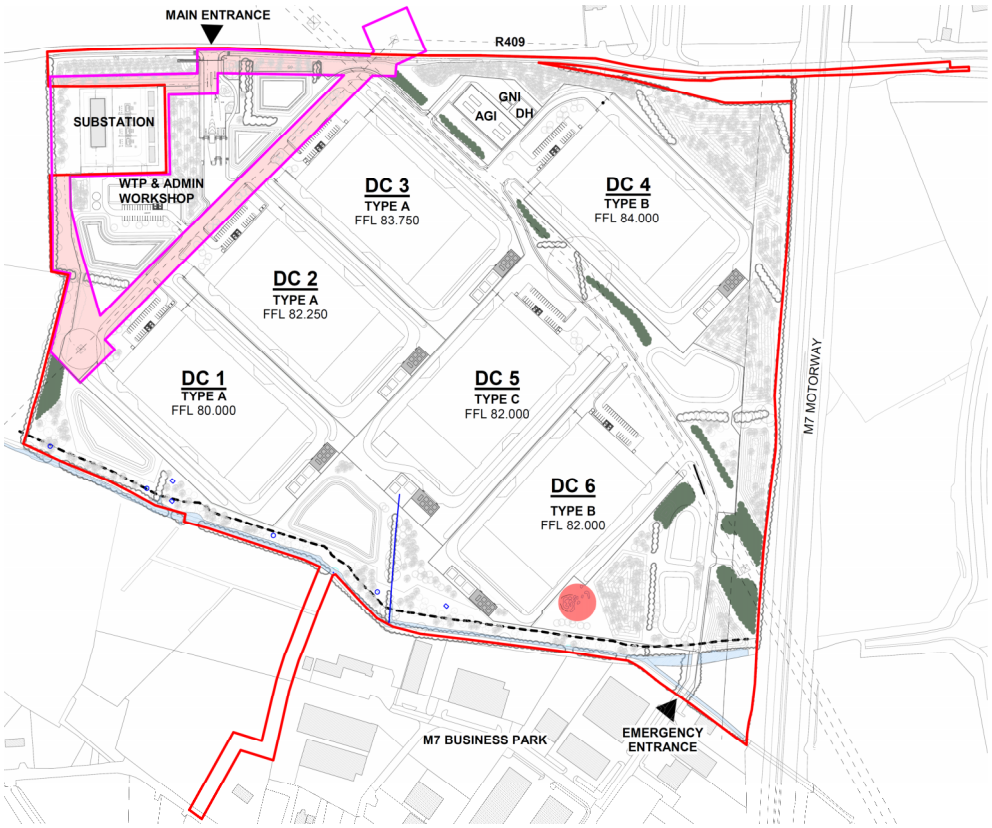
The site is currently in agricultural use and comprises a number of fields which are bounded by hedgerows. There is a cluster of farm buildings located within the site, accessed from the R409.

The proposed substation will be located to the North-West of the site as indicated on Figure 3-1 above. As mentioned above, the substation is not part of the Proposed Development, but is the subject of the Substation Application to An Bord Pleanála. The Proposed Development and the Substation Application together constitute the “Project” for the purposes of Environmental Impact Assessment.

3.2 Proposed Development

The Proposed Development will have six independent two-storey data centres, each with a 30MW ICT capacity. The buildings will each have their own secure boundaries encompassing the main building, ancillary facilities, data halls, power generation, fuel storage, BESS units, etc., together with dedicated parking including bicycle parking and electric vehicle charging facilities. This is shown in *Figure **3-2*** below, the proposed concept masterplan.

Figure 3-2. Proposed Concept Masterplan
Source: RKD Architecture



The site will have a secure boundary with security for the entire site including a transportation lock and rejection facility.

There are various ancillary buildings to be provided as part of the Proposed Development which include those dealing with incoming gas supplies from GNI using Above Ground Infrastructure (AGI) compounds as well as electrical and heat connections for the campus together with workshops and facilities for campus personnel.

Further, to the North-West of the site as indicated on Figure 3-2 above, a newly constructed substation will be provided, operated by EirGrid, to provide power connectivity for the Proposed Development. As mentioned above, the substation is not part of the Proposed Development, but is the subject of the Substation Application to An Bord Pleanála. The Proposed Development and the Substation Application together constitute the "Project" for the purposes of Environmental Impact Assessment

During construction, it is expected that operatives and managers will number up to 1100 people on site dependent on the construction schedule and phasing. Once constructed, it is expected that employment will come from both direct and indirect forms e.g., from 3rd party providers for ICT technicians to facilities maintenance engineers and general services.

3.3 On-Site Power Production

Power Generation

The Proposed Development's primary source of power will be on-site generation. Generation of electricity is proposed on-site using highly efficient gas turbines for the majority of the generation, supplemented by smaller gas engines used of load stepping. This is in line with recent EU direction (the Hydrogen and Decarbonised Gas Market Package, discussed further below) and consequently Irish Government direction on the use of gas for generation as a transitional fuel, also the CRU's policy position from November 2021 which was supported by EirGrid and the CRU's programme of work in September 2021 that discusses *"The delivery, through the all-island capacity auctions, of over 2,000 MW of enduring flexible gas fired generation capacity by 2030"* see link below:

https://cruie-live-96ca64acab2247eca8a850a7e54b-5b34f62.divio-media.com/documents/CRU202317_Electricity_Security_of_Supply_Programme_of_Work_Update_February_2023.pdf.

It also means that the Proposed Development will not add any additional demands to the grid and allows for any excess power generated on-site (in relation to 70% of the demand which will be met by the on-site generation) to be exported to the grid. The on-site electricity generation capacity will be in excess of that required for the operation of the data centres and will provide an opportunity for the export of electricity to the grid if and when required.

Source of Energy

Gas will be sourced from the gas network to provide primary energy supply to the gas turbines at each data centre building. GNI is the system operator of the gas network and currently transports gas mainly imported from the UK derived from the UK's or Norway's North Sea gas fields. GNI have clearly stated that it intends to decarbonise the gas network by 2050 by incorporating a series of changes, which in summary are:

- Introduction of bio-methane from agricultural sources injected into different parts of the gas network, primarily at high usage sites. GNI are already arranging for high usage sites to have bio-methane injection points, a bio-methane injection point is included within this project's proposals.
- Introduction of hydrogen in lieu of methane by up to 20% by volume. This will gradually increase over time, but tests and introduction of hydrogen in parts of the network have already started.

The use of gas supplied through the GNI network will therefore lead to a significant reduction in the carbon footprint of the power generated on site over the next 20-30 years, due to the ongoing decarbonisation of the GNI network.

Battery Energy Storage System (BESS)

Turbines operate at Medium Voltage (MV) level and are coupled with Battery Energy Storage Systems (BESS) to provide low emission 365/24/7 support to critical loads. Each gas turbine and BESS act as one together, they are independent of each other but will be linked to the connection point to the grid (via the proposed substation) to allow export of excess power to the grid.

The turbines (supplemented by engines for load stepping) will provide the primary energy supply to each data centre building. The running of the turbines will be continuous with the quantity of units operating at any one time dependent on the load demand in the data halls and the resilience required.

For the purposes of providing uninterrupted and conditioned power, each data centre building will have a dedicated battery energy storage system (BESS). This system will consist of individual modules connected in parallel, with the total quantity of modules for each building as required to match the load of the data centre. These modules will be housed in outdoor-rated enclosures and will be located in each building's exterior plant compound. The battery energy storage system will consist of rack mounted lithium iron phosphate battery modules connected to a DC bus. Rectification from AC to DC is achieved via an input inverter and conversion back to AC is achieved via an output inverter.

The inverters are contained within the BESS enclosures. Each BESS enclosure contains its own dedicated cooling and fire protection systems. The Proposed Development includes a significant energy storage component. An energy storage unit for each data centre building (six in total) is proposed. The storage capacity provides a backup energy source and in addition adds resilience to the wider grid, having the capacity to provide immediate export of energy to the national grid, or the capacity to import and store excess electricity generated externally, if required.

Electrical Grid Connection

An electrical grid substation is proposed to be located on site and will be formed from the breaking into and partially undergrounding EirGrid's existing 110kV overhead lines that currently cross the site. A full 8-bay EirGrid standard GIS substation will allow connectivity to the data centre campus for both import and export of electricity. The substation will also allow for development outside of the site to be enabled by having spare 110kV circuits if required.

The provision of the substation is crucial to the Proposed Development for multiple reasons, in summary they are:

1) As an Autoproducer, it enables the export of energy generated on-site to the grid.
2) To enable the energy storage facility to be connected to the grid and provide the ability to aid frequency stability of the grid.
3) To allow import and storage of electricity from the grid when available, particularly during periods where there is an over-supply of renewable energy.
4) To allow renewable energy sourced through CPPAs to be delivered to the site and combined with the on-site generation energy.

As noted above, the GIS substation and partial undergrounding of EirGrid's 110kV overhead lines will be subject of a separate Strategic Infrastructure Development (SID) planning application to An Bord Pleanála for approval under section 182A of the Planning and Development Act 2000 (as amended), as it involves changes to electricity transmission (the Substation Application). It should be noted that the Proposed Development and the Substation Application together constitute the "Project" for the purposes of the Environmental Impact Assessment and have been considered and assessment in the Environmental Impact Assessment Report submitted with the application for planning permission.

There is a 220kV overhead line also crosses the site. It is not proposed to make any alteration to the 220kV line, and the Proposed Development will not impact the line.

Heat Recovery and District Heating

Two of the gas turbines are proposed to have waste heat thermal boilers installed within their exhaust flues to recover the medium to high grade heat from the turbines. Each turbine has a nominal electrical output rating of 5MWe, the available maximum heat output is assumed at 10MWth per turbine, with a total capacity of 20MWth possible when both turbines are available and running. Both turbines will be prioritized in terms of running whenever possible.

The heat from the thermal boilers will then be pumped via heat exchangers to the perimeter of the data centre campus, to enable district heating pipework to be connected.

For the purpose of this study, it is assumed that the average electrical load of the site associated with ICT (information and communications technology) and cooling, when fully operational, is likely to max out at 230MW, however typically data centres don't achieve 100% utilization of the power, more normally they max out at 70-80% so in this case with all phases completed an annual power demand from the on-site generation of around 140MW is anticipated. It is acknowledged that this load is unlikely to be present on the first operational day, with a phased approach being employed by the data centre developer This will have to be considered in any detailed district heating assessment.

Having established the quantum and form of the heat that can be made available to the local area, a heat mapping assessment included within HDR's District Heat Report has been developed to identify where the heat could be best used in: existing facilities; significant facilities that have recently received planning; and areas of development that again would benefit from using a connection to a district heating system.

Renewable Energy Sources

Herbata's data centre campus is located In County Kildare and so has easy access to renewable generation in the form of wind and solar sources nearby. Initially, in order to achieve a minimum 30% renewable energy target, Corporate Power Purchase Agreements (CPPAs) will be entered into with a variety of renewable energy projects as the data centre load level increases over time. Herbata are in advanced discussions with various solar and wind project developers with a view to sourcing capacity through CPPAs. It is clear that there is sufficient capacity to provide for all of the development phases of the site Commitment to these CPPAs will not be possible until planning permission for the site has been granted (along with a connection agreement with EirGrid); it is therefore suggested that Kildare County Council attach a condition to any grant of permission for the Proposed Development requiring the CPPAs to be secured in advance of the proposed development becoming operational. For the latest Herbata specific strategy refer to the Herbata Energy Supply Strategy document by Bos Energy Ltd. Details of the exact text of the proposed planning condition in relation to CPPAs are set out in section 4.9.1 of the Planning Report submitted with the application for planning permission.

Further, following discussions with landowners immediately adjacent to the site, it may also be possible to locate a photovoltaic solar farm via a private wire agreement; once again it is intended that this is linked to the grid via the on-site substation developed with EirGrid's support to allow any spare capacity to be exported to the grid. Whilst this element is not part of this planning application, it is hoped that this can be added in the not-too-distant future making such consistent with Government's stated commitment in the Climate Action Plan to support design and implement a Private Wire policy proposition. Following the Department of the Environment, Climate and Communications (DECC)'s consultation in August 2023, the Irish Government published in July 2024 a memo on private wires with a view to establishing a new private wires framework.

4 National & Local Climate, Energy and Planning Policy

There is a cascading of policy on climate change and the need for decarbonisation of energy from a global level down to the local level. These are examined and discussed below.

4.1 Climate Policy and Decarbonisation of Energy

With Ireland being a member state of the European Union (EU), reference is needed to the commitments that the EU has made on behalf of all its member states. The key agreement is the Paris Agreement, referred to as COP21 (Conference of the Parties), which came into force in November 2016 and is a legally binding international treaty on climate change. The EU's response manifested itself into a comprehensive package of policy initiatives in the form of the European Green Deal in December 2019 which is designed to set the EU on a path to a green transition with the ultimate goal of achieving "Climate Neutrality" by 2050.

The key objective of COP21 is to ensure that "*the increase in the global average temperature to (kept) well below 2°C above pre-industrial levels*" and to pursue efforts "*to limit the temperature increase to 1.5°C above pre-industrial levels*".

Information on COP21 and its implementation by the EU can be found in the links below including the European Green Deal.

https://climate.ec.europa.eu/eu-action/climate-strategies-targets/2050-long-term-strategy_en#:~:text=The%20EU%20aims%20to%20be,AgreementEN%E2%80%A2%E2%80%A2%E2%80%A2

https://ec.europa.eu/clima/policies/strategies/2050_en

https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en

Since COP21, the EU has also had to consider the role of natural gas until its use is phased out by the end of 2050. In May 2024 the Council adopted a regulation and a directive establishing common internal market rules for renewable and natural gases and hydrogen and reforming the existing EU gas legislation which (the Hydrogen and Decarbonised Gas Market Package). The package recognises the transitional role of natural gas which will gradually be phased out.

https://www.consilium.europa.eu/en/press/press-releases/2024/05/21/fit-for-55-council-signs-off-on-gas-and-hydrogen-market-package

This is an important Directive, for Ireland in particular, as it recognises that power generation can, for the time being, be gas based whilst infrastructure is being put in place to decarbonise both the gas supply and electricity supply networks.

4.2 National Policy

As part of the Clean Energy Package (2019), each EU member state is required to provide a 10-year National Energy and Climate Plan (NECP), which is assessed as to how its goals and objectives are likely to fit with, inter alia, the commitments made by the EU to the Paris Agreement. This is an ongoing process; Ireland produced its first draft NECP in 2019 which was reviewed by the EU as shown in the link below.

https://energy.ec.europa.eu/system/files/2019-06/necp_factsheet_ie_final_0.pdf

In 2021, following the Climate Action and Low Carbon Development (Amendment) Act 2021, the Irish Government published the Climate Action Plan 2021 to show how it could significantly reduce its Greenhouse Gas (GHG) emissions by 2030 and be net zero by 2050, as stated in the Government's opening statement, as quoted below:

"The Climate Action Plan 2021 provides a detailed plan for taking decisive action to achieve a 51% reduction in overall greenhouse gas emissions by 2030 and setting us on a path to reach net-zero emissions by no later than 2050, as committed to in the Programme for Government and set out in the Climate Act 2021."

The full version of the Climate Action Plan 2021, 2023, & the latest 2024 iteration can be found in the links below:

https://www.gov.ie/en/publication/6223e-climate-action-plan-2021/
https://www.gov.ie/en/publication/7bd8c-climate-action-plan-2023/

https://www.gov.ie/en/publication/79659-climate-action-plan-2024/

Of relevance in this plan is the break-down of energy usage by sector, analysis of each sector and the targets set out to be achieved at a national level by each sector. Data centres are mentioned due to the likely growth in the sector and the need to decarbonise new and existing energy to these facilities. Within the Climate Action Plan 2021, the Government advised that it would be reviewing the data centre industry as a whole, this is now captured in the Climate Action Plan 2024 and is discussed in the Climate Chapter, Chapter 16 of the Environmental Impact Assessment Report (EIAR) submitted with this application for planning permission, in particular sections 16.1 and 16.2.

The EIAR submitted with this application for planning permission has considered the Climate Action Plan 2024, being the most recent approved Climate Action Plan for the purposes of section 15 of the Climate Action and Low Carbon Development Act 2015 (as amended), and concluded for the reasons set out in Chapter 16, Sections 16.5 to 16.10 of the submitted EIAR that Kildare County Council in granting planning permission for the Proposed Development would be performing its functions in a manner consistent with the Climate Action Plan 2024 and would therefore be complying with its obligations under section 15 of the Climate Action and Low Carbon Development Act 2015 (as amended).

Supporting the Government and advising on progress against the Climate Action Plan 2021, 2023, and 2024, is the Sustainable Energy Authority of Ireland (SEAI). The SEAI have published many important reports on energy use and climate change, providing factual support and analysis. A key report was published by SEAI in 2022 which identified trends and achievements against targets within the Climate Action Plan 2021 for each sector and for each energy production type. For reference, data centres are considered as part of "commercial services" in this report. The full 2023 report published in 2024 is included in the link below and identifies progress against the Government energy policy to date.

https://www.seai.ie/publications/Energy-in-Ireland-2023.pdf

The Irish Government has also published a review of the role of data centres in Ireland, titled the "Government Statement on the Role of Data Centres in Ireland's Enterprise Strategy". The statement clearly recognizes the need for the digital economy and all that it brings to the overall Irish economy, and acknowledges that data centres are core digital infrastructure and play an indispensable role in our economy and society, but at the same time recognises the need for decarbonisation of our energy system in order to achieve the targets set out in the Climate Action Plan 2021 (which was the most recent Climate Action Plan at that time). This document sits alongside EirGrid's documents (two iterations) of "Shaping our Electricity Future" (see link below) which explicitly cater for significant increases in electricity demand (30-50%) up to 2030 whilst also providing for a power system which can deliver a substantial increase in RES-E (annual electricity from renewable energy sources) power systems by 2030. Within Ireland's 10-year NECP 2021-2031, a target is included for RES-E of 70% however since 2021, Ireland's Climate Action Plan has included a target to increase the share of electricity generated from renewable sources up to 80% in 2030 (see link below). Ireland achieved 40% RES-E in 2020.

https://www.eirgrid.ie/shaping-our-electricity-future

https://www.seai.ie/about/irelands-energy-targets/#:~:text=The%20renewable%20electricity%20target%20is,the%20coming%20decade%20and%20beyond.

These objectives had not until recently been considered alongside each other to the degree that they both must be addressed. The first paragraph from the Government statement, repeated below, summarises what the data centre industry is now faced with:

> *Government policy seeks to enable the 'twin transitions' of digitalization and decarbonization of our economy and society. These transitions can - and must be - complementary. For this to happen, digital and climate change policies need to move in tandem and this Statement sets out how this will be achieved in respect of data centres.*

The full statement can be found in the link below:

https://enterprise.gov.ie/en/publications/publication-files/government-statement-on-the-role-of-data-centres-in-irelands-enterprise-strategy.pdf

Within the Government's statement are six "Principles for Sustainable Data Centre Development", which the Government has agreed should inform and guide decisions on future data centre development, those six principles are: -

Economic Impact

Grid Capacity and Efficiency

Renewables Additionality

Co-Location or Proximity with Future-Proof Energy Supply

Decarbonised Data Centres by Design

SME Access and Community Benefits

Section 5.1 of this report sets out how the Proposed Development is fully consistent with each of these six guiding principles.

4.3 Electricity and Gas Policy

In response to National Policy on energy, climate change and sustainability, the Commission for Regulation of Utilities (CRU) and both the electricity and gas System Operators (SOs) have all published documents on their strategies for responding to the need to decarbonise the energy sector. These are summarized below:

The CRU

The CRU is Ireland's independent energy and water regulator and has responsibility for economic regulation and customer protection in the energy and water sectors and regulation of energy safety. Further information can be found at:

Energy | CRU.ie

The CRU have been highly focused on the capacity issues in the electricity market and now also the gas market. This is partially as a result of increasing demand by data centres and new facilities moving towards electrifying their activities, examples including using electric vehicles and heat pumps. In July 2021, the CRU published their direction to electricity system operators relating to data centre grid connections, requiring them to change their processes in response to capacity constraints, the link below relates:

CRU21060-CRU-consultation-on-Data-Centre-measures.pdf (divio-media.com)

The CRU's direction, entitled "Direction to the System Operators related to Data Centre grid connection processing (CRU/21/124), is the culmination of a CRU consultation published in June 2021 (Consultation). The Consultation identified the power consumption requirements of data centres as a growing threat to the security of Ireland's grid. The CRU put three proposals out to consultation, namely:

1. do nothing, i.e., leaving EirGrid's bespoke Data Centre Connection Offer Process & Policy protocol as the sole determinant of data centre connection. The CRU flagged in the direction its view that demand would swiftly outstrip supply if this option was taken;

2. impose a moratorium on the electrical connection of new data centres for several years; or
3. an intermediate approach requiring the electricity system operators, ESB Networks and EirGrid, to prioritize the processing of data centre connection applications based on:
    - location relative to existing levels of grid “constraint”
    - the level of dispatchable on-site electricity generation or storage that the data centre intends to install, and
    - the data centre’s flexibility to reduce its electricity demand, including by using its own generators or storage assets.

Option 3, the intermediate approach was selected as it recognized the value of allowing the data centre market to continue to develop and grow in Ireland, while also recognizing the role that it needs to play in the stabilization of Ireland’s grid.

In selecting Option 3, the CRU required that EirGrid (and ESBN where appropriate) apply the following assessment criteria on a case-by-case basis, in determining whether a connection offer should be made to an applicant data centre:

In selecting Option 3, the CRU requires that Eirgrid (and ESBN where appropriate) apply the following assessment criteria on a case-by-case basis, in determining whether a connection offer should be made to an applicant data centre:

- The location of the data centre applicant with respect to whether it is within a “constrained” or “unconstrained” region of the electricity system, and
- The ability of the data centre applicant to provide flexibility in their demand by reducing consumption when requested to do so by the relevant the System Operator (SO, in this case Eirgrid) in times of system constraint. This includes both with, and without, the use of dispatchable on-site generation and/or storage, which meets appropriate availability, and other technical requirements as may be specified by the SO.

Eirgrid – Electricity Systems Operator (SO)

EirGrid is responsible for operating the Irish electricity transmission system (i.e. the grid) along with its counterpart SONI, in Northern Ireland. The Irish grid is standalone as an All-Ireland grid with common power generation throughout plus two 350MW HVDC interconnectors to the UK with a planned additional 700kW interconnector between Cork and France (Celtic) due to come online in 2026. Typically, the Irish grid runs at between 4GW and 6GW but has topped 7GW during severe cold winter periods, during such times EirGrid was required to bring on additional generation capacity, increase the electricity flow from interconnectors (if available) or ultimately drop demand.

EirGrid, as the transmission system operator in Ireland pursuant to a license issued by the CRU, has a regulatory requirement to publish forecast information about the power system, including an assessment of the balance between supply and demand. EirGrid published the "All Island Generation Capacity Statement 2023-2032" which reports on the performance of the grid and assesses the likely capacity of the grid over a 10-year projection. In addition, EirGrid also published their 20 year lookahead on the Energy Scenarios that Ireland faces in 2019 and subsequently in 2023, which directly responds to the EU's policy statements and Ireland's Climate Action Plan, see links below. EirGrid's publications, amongst other things, speak to sustained strong growth in electricity demand driven by Government Policy, major investment in renewables generation technologies (Particularly offshore wind), increased interconnection, the need for market reform and the critical role of gas as a "backstop" for renewables as Ireland moves from 40% RES-E in 2020 to an 80% target for RES-E by 2030.

All-Island-Generation-Capacity-Statement-2020-2029.pdf (eirgridgroup.com)

https://cms.eirgrid.ie/sites/default/files/publications/TES-2023-Final-Full-Report.pdf

Gas Networks Ireland – Gas TSO & DSO

GNI are responsible for operating the Irish gas transmission and distribution systems along with its subsidiary GNI(UK) in Northern Ireland. The Irish gas network is highly reliant on interconnectors from Scotland via the Isle of Man. However, there are also proposals for import of shipped gas using Liquified Natural Gas (LNG) in the future.

In response to the Climate Action Plan, GNI published its Vision 2050 document which sets out its targets for decarbonizing the gas network fully by 2050. GNI make the following statement on their website:

> *"Our vision is for a net zero carbon gas network by 2050, by replacing natural gas with renewable gases, such as carbon neutral biomethane made from agricultural and food waste and carbon free green hydrogen."* and *"The European Union, through its 2021 Climate Target Plan Impact Assessment, concluded that gas will continue to provide 20% of Europe's energy in 2050."*

GNI have already set about looking at how it introduces bio-methane and hydrogen to its network. CCS is likely to take longer to introduce. GNI's Vision 2050 publication is included in Appendix B of this report.

The vision provided by GNI is for the Irish gas network to evolve to become net zero carbon by 2050 and to support emissions reductions across every sector of the Irish economy at the lowest cost possible. The vision requires that half of the projected 2050 gas demand will be met by net zero carbon gases or zero carbon gases and that Carbon Capture and Storage (CCS) will be in place to abate the emissions from the remaining use of natural gas. GNI has already begun to invest in new technologies to facilitate renewable gas injection into the gas network, and to transport Compressed Natural Gas (CNG) in the gas network as a fuel source for commercial vehicles.

Government of Ireland

Recently, the Government of Ireland have published two important and relevant strategy documents which describe how both biomethane and hydrogen will be developed and provided nationally to all sectors. These documents have been used to inform the calculation of how this Proposed Development can be made to have a Net Zero Carbon position as soon as reasonably possible, as they provide a robust and reasonable basis on which to calculate the availability of biomethane and green hydrogen into the future. The contents of these strategy documents, and the basis on which they have informed the Net Zero Carbon calculations, is set out in more detail in section 6 below and in Appendix A.

https://www.gov.ie/en/publication/d115e-national-biomethane-strategy/

https://www.gov.ie/en/publication/624ab-national-hydrogen-strategy/

4.4 Compliance with Energy Policy

The Herbata data centre project has carefully considered the current energy policy relevant to data centres. It is proposed that Herbata data centre will connect to both the grid and gas network. The energy strategy proposed, which aligns with the CRU's Direction to the System Operators related to Data Centre grid connection processing, can be summarized as follows:

- Herbata propose to generate power on-site using gas and to therefore not be dependent on the import of electricity from the Irish grid.
- A connection to the Irish grid via a new grid substation is proposed, to allow Herbata to:
    - Export spare electrical capacity to the grid.
    - Provide system frequency stability support.
    - Import renewable energy sourced through CPPAs.
- On instruction from EirGrid as the SO, Herbata will support their data centre demand using the on-site generation, as well as sourcing energy from renewable sources (via CPPAs) via the grid and make available to the grid excess capacity.
- By connecting to the gas network, Herbata will fully support the provision of a mixed gas / hydrogen supply. A bio-methane injection point will be installed on the site as part of the Proposed Development.

4.5 Local Planning Policy

The local authority, Kildare County Council (KCC), has adopted the Kildare County Development Plan 2023-2029 (the Development Plan), which is available at the following link: -

https://kildarecoco.ie/AllServices/Planning/DevelopmentPlans/KildareCountyDevelopmentPlan2023-2029/

As part of the Development Plan, Chapter 7 titled “Energy & Communications” sets out the policies and objectives in relation to energy production and how it relates to planning policy. This is contained in the link below. The Chapter follows carefully the International, National and Local planning and energy policies and lists the majority, and more, of them.

https://consult.kildarecoco.ie/sites/default/files/Ch%207%20final.pdf

Also within the Development Plan is Chapter 4 which supports Chapter 7 in terms of renewable energy targets. This can be viewed in the link below: -

https://consult.kildarecoco.ie/sites/default/files/Ch%204%20final.pdf

Within Chapter 7 are a series of Policies, Objectives and Actions. The key policies that relate to a data centre development and need to be addressed are listed in Table 4-1. These policies have been selected that are considered relevant to a data centre campus development of this type as proposed. Section 5 of this report sets out how the proposed development is fully consistent with all of these policies.

While this report has focused on the compliance of the Proposed Development with the policies set out in Chapter 7 of the Development Plan titled “Energy & Communications” (which is most relevant to Data Centres as it sets out the policies and objectives in relation to energy production and how it relates to planning policy), the other policies, objectives, and actions set out in the Development Plan which are relevant to the Proposed Development, including for example the policies and objectives set out in Chapter 4 as mentioned above, are considered in detail in section 4.4 of the Planning Report submitted with this application for planning permission. Further, how the Proposed Development is in compliance with the National Planning Framework is set out in section 4.2.2 of the Planning Report, and its compliance with the Regional Spatial and Economic Strategy for Eastern and Midlands Regional Assembly is set out in section 4.3 of the Planning Report.

As noted above, the Planning Report submitted with the application for planning permission, concludes that the Proposed Development fully aligns with national, regional and local policy supporting the ICT sector with data centres being a key component of this sector, and that it fully accords with sustainable development objectives and adopts an exemplary approach to data centre development within the State.

Table 4-1. Kildare Country Council Policies

Policy Reference	Policy Description
EC P2	Promote renewable energy use and generation at appropriate locations within the built environment and open countryside to meet national objectives towards achieving a net zero carbon economy by 2050.
EC O19	Promote the development of solar energy infrastructure for on-site energy use, including solar PV and solar thermal technologies. On-site battery storage projects shall be considered subject to fire safety, environmental safeguards, and the protection of natural or built heritage features, biodiversity views and prospects.
EC O23	Support the installation of solar collectors and panels for the production of heat or electricity in commercial and industrial buildings in line with relevant design criteria, building regulations and technical guidance documents.
EC O24	Require the submission of a Glint and Glare Assessment as part of any solar energy development proposal where there is likely to be any impact on neighbouring uses, transportation, and aviation safety.
EC P11	Support Ireland's renewable energy commitments outlinedin national policy.
EC P12	Facilitate air to water heat developments at appropriate location and scale.
EC P13	Promote the appropriate development of waste heat technologies and the utilisation and sharing of waste heat in areas where feasibility is demonstrated for its use in the delivery of low carbon district heating technology.
EC P14	Require high levels of energy conservation, energy efficiencyand the use of sustainable and renewable energy sources in new and existing buildings.
EC P15	Promote the necessary infrastructure to support the continued roll out of electric vehicles.
EC P18	Support the accommodation of Data Centres at appropriate locations in line with the objectives of the National Planning Framework and the Government Statement on the Role of Data Centres in Ireland subject to appropriate Transport and Environmental Impact Assessments.
EC P19	Support the development, reinforcement, renewal and expansion of the electricity transmission and distribution grid to provide for the future physical and economic development of Kildare.
EC P21	Support the infrastructural renewal and development of thegas networks in the county, subject to proper planning, heritage, environmental and amenity requirements.

5 Compliance with Data Centre Policy

This section of the report looks at how the proposed Herbata Data Centre campus project responds and complies with the relevant parts of data centre policy at national and local levels including in relation to energy use.

5.1 The Six Principles

As noted earlier, the Irish Government reviewed the contribution of data centres to the Irish economy and issued a statement in July 2022 titled “Government Statement on the Role of Data Centres in Ireland’s Enterprise Strategy”. Within the statement are six guiding principles for the data centre industry as set out above. This report has considered each of these guiding principles in turn below, and set out how the Herbata data centre project, including its energy strategy, is fully consistent with all six of these guiding principles: -

Economic Impact

Principle - The Government prefers data centre developments associated with strong economic activity and employment.

Response – The Herbata data centre project will have strong economic activity and employment during construction and operation. The construction period is projected to be phased over 8-years where the number employed on site will vary from around 150 up to 1100 people. This refers to direct employment on site, however there will also be high levels of equipment that will need to be procured over the 8-years. Irish companies have a very good track record in providing much of this equipment to data centres constructed in Ireland and in the rest of Europe.

Equipment and systems will include switchgear, battery systems, and air handling plant, all of which are of a high and critical value to the Proposed Development. These would typically be procured through mechanical and electrical sub-contractors; again, Ireland is rich in highly qualified sub-contractors of this type who have very good track records in the data centre industry.

Once the data centres are in operation, they will need to be maintained to a high level necessary for critical facilities of this type. There will be a significant number of people employed on site either directly or via third party contractors, increasing as the site is built out. The quantum of engineering and technical staff required on site is expected to be much higher than most data centre projects due to the nature of the power systems proposed. As noted in earlier sections, energy is to be generated on site and so will require a high level of maintenance and monitoring throughout the life of the data centres. It is further expected that as the site is built out it will become a centre of excellence for engineering and technology and attract other companies and organisations to locate nearby.

Grid Capacity and Efficiency

Principle - The Government has a preference for data centre developments that make efficient use of our electricity grid, using available capacity and alleviating constraints.

Response - It is well documented by both the CRU and EirGrid that the Irish electricity grid is constrained in the near to medium horizon in terms of capacity and distribution to varying degrees across Ireland. Ireland has also experienced a security of supply generation constraint (predicated on a failure of the capacity market to secure the required investment in new generation) which has been alleviated by EirGrid's procurement of temporary emergency generation in 2023. The Herbata Data Centre proposes to not take any power from the grid unless excess renewable energy capacity is available, instead, it proposes to generate its own power on-site using gas turbines connected to each data centre building gradually installed as the load increases. To facilitate this, a new 110kV grid substation is proposed, which is the subject of a separate Strategic Infrastructure Development (SID) application to An Bord Pleanála for approval under section 182A of the Planning and Development Act 2000 (as amended), and which will allow the site to export to the Irish grid and to allow import from renewable energy sources covered by CPPAs.

This is a highly effective and efficient format linked also to the ability for the electrical systems to provide capacity back to the grid and/or provide fast acting short term grid frequency response services. This ability has come about from a key electrical design format change, by moving the battery elements out of traditional UPS systems and locating them alongside the generating turbines at a higher voltage.

Renewables Additionality

Principle - The Government has a preference for data centre developments that can demonstrate the additionality of their renewable energy use in Ireland.

Response - The Herbata data centre project proposes three ways to incorporate renewable energy use for the project:

On-site – Solar PV panels are to be located on the roofs of each data centre building with a minimum peak output of 500kW for supporting the technology elements and a further 20kW for supporting the admin/support functions.

Off-site – Herbata have been actively negotiating and seeking agreements with solar and wind farm developers within Ireland and intend to enter into CPPAs on a phased basis to support the construction and operational build out.

Decarbonisation of gas – as part of Gas Networks Ireland Vision 2050 for decarbonising the gas network, GNI intend to facilitate the provision of a mix of hydrogen within the gas network up to 20% and bio-methane in lieu of fossil fuel-based gas. To facilitate the use of additional bio-methane in the network, a bio-methane injection point will be installed on the site as part of the Proposed Development, which has been agreed with GNI.

It is the intention to provide sufficient capacity from on-site solar PV and off-site generation from renewable sources via CPPAs to support at least 30% of the operational energy demand of the data centres.

These three methods will fully support this particular guiding principle.

Co-Location or Proximity with Future-Proof Energy Supply

Principle - The Government has a preference for data centre developments in locations where there is the potential to co-locate a renewable generation facility or advanced storage with the data centre, supported by a Corporate Power Purchase Agreements, private wire, or other arrangement.

Response - Herbata's data centre campus is located on West side of Naas in County Kildare and so has easy access to renewable generation in the form of wind and solar nearby, either by CPPAs or directly by private wire. To achieve a minimum 30% renewable energy target, Corporate Power Purchase Agreements (CPPAs) will be used from a variety of sources as the data centre load level increases over time, and there may be potential to use private wire agreements to secure a further supply of renewable energy from sites adjacent to the Proposed Development.

In addition, the Herbata data centre buildings will incorporate battery energy storage systems to protect the technology loads but also to facilitate fast acting frequency response support to the Irish grid.

Decarbonised Data Centres by Design

Principle – The Government has a preference for data centres developments that can demonstrate a clear pathway to decarbonize and ultimately provide net zero data services.

Response – The Herbata data centre project has incorporated pathways to decarbonise through to net zero in three ways, as outlined below:

- The energy to be produced on site in each data centre building will be generated using gas imported from GNI's network to supply the gas turbines. GNI, in their Vision 2050 document (see Appendix B), have clearly shown how they intend to decarbonise the gas network through to net zero by 2050. This objective clearly mirrors the Government's Climate Action Plan and allows this project to benefit from a fuel source that will gradually be decarbonised over the coming years; it is projected that the gas network will reduce its carbon emissions by as much as 40% over the next decade alone.
- The project has already had a request from GNI to include a bio-methane injection point to aid the decarbonisation of the energy usage at the site, which is now included as part of the Proposed Development. This is a valuable and direct method of decarbonisation.
- As noted earlier, it is the intention of Herbata Ltd to enter into CPPAs and potentially private wire agreements with renewable energy providers, along with the on-site renewable energy provision identified above, to a minimum level of 30% of the total operational energy used on site. Clearly these will all be zero carbon sources and directly decarbonise the energy use on-site.

The combination of all the above will provide a very high level of decarbonisation from the start of the project, and gradually increase through to a net zero position.

SME Access and Community Benefits

Principle - The Government has a preference for data centre developments that provide opportunities for community engagement and assist SMEs, both at the construction phase and throughout the data centre lifecycle.

Response - The Herbata Data Centre project will result in several long-term planning gains to the local community and businesses in the Naas area, and will include the following:

- A connection point for a district heating system, to harness the waste heat associated with the Data Centre, will be provided on site to serve the area to the west of Naas. Such provision has been fully investigated and has been shown to be feasible, subject to the installation of the required local infrastructure. The provision of district heating in the local area would bring many benefits to the community and businesses by decarbonising the heating of buildings and by increasing local energy security at reduced cost to households, community facilities, and businesses.
- The provision of a substation at the Herbata Data Centre campus will enhance the local electricity grid and will include the provision of an 8-bay format grid substation. Two of these bays will be used for incoming and outgoing feeders to the existing transmission line, two further bays will be allocated to the Herbata Data Centre, leaving 4 bays as spare for future development in and around the Naas area. This additional future capacity will benefit the local area and help ensure future energy provision in the Naas area. In addition, spare capacity from the on-site generation can be made available to the local area and wider Irish grid when available and as required.
- As part of the development of the Herbata Data Centre it is proposed to upgrade the local road network (R409) serving the site and provide new footpath and cycling infrastructure along with a new Bus Stop on the R409. These improvements will not only help promote active travel among the workforce of the Data Centre but will also provide improved infrastructure for the local population living, working, and doing business in the vicinity of the Data Centre and Naas.
- The construction and operational phases of the Herbata Data Centre will result in a substantial increase in employment opportunities in the local area, with a focus on the employment of the local population especially during the construction phase.

It is therefore evident that the construction of the Herbata Data Centre in Naas will bring many benefits to the local community and local businesses during the construction phase and during the lifecycle of the Data Centre.

5.2 Compliance with Planning Policy

Earlier in Section 4 it has been shown how International and National policies on climate change and energy flow down to local planning policy. Again, in Section 4.4, the relevant local planning policies which apply to the Proposed Development and its energy demands were listed; these are repeated below, and each is responded to with the proposed projects actions as shown in Table 5-1 below.

Further, as also set out in section 4.4 above, the other policies, objectives, and actions set out in the Development Plan which are relevant to the Proposed Development, are considered in detail in section 4.4 of the Planning Report submitted with this application for planning permission. Further, how the Proposed Development is in compliance with the National Planning Framework is set out in section 4.2.2 of the Planning Report, and its compliance with the Regional Spatial and Economic Strategy for Eastern and Midlands Regional Assembly is set out in section 4.3 of the Planning Report.

Table 5-1. Responses to KCC Planning Policies

Policy Reference	Policy Description	Responses and Actions against policies
EC P2	Promote renewable energy use and generation at appropriate locations within the built environment and open countryside to meet national objectives towards achieving a net zero carbon economy by 2050.	It is proposed to enter into CPPA renewable energy agreements with solar and wind farm developers within Ireland to meet the minimum requirement of 30% of energy from renewable sources as set out in Objective RE O72.[1] This will be on a phased deployment basis. **Status: Compliant with policy**
EC O19	Promote the development of solar energy infrastructure for on-site energy use, including solar PV and solar thermal technologies. On-site battery storage projects shall be considered subject to fire safety, environmental safeguards, and the protection of natural or built heritage features, biodiversity views and prospects.	All the data centre buildings are to be provided with a minimum of 500kW of solar PV roof mounted. In addition, each gas turbine will have 5 x 1MW battery energy storage system (BESS) to support the power systems and allow for grid support in the form of frequency stabilisation e.g. DS3. **Status: Compliant with policy**

[1] Objective RE O72 of the Development Plan is set out in Chapter 4 of the Development Plan and is "*Require data centres to consider the use of sustainable renewable sources of energy to fuel their operations in whole in the first instance or in part (minimum of 30%) where this is not possible and where it has been satisfactorily demonstrated not to be possible, subject to all relevant and cumulative environmental assessments and planning conditions.*" As set out in section 4.4.1.1 of the Planning Report submitted with this application for planning permission, the Proposed Development fully complies with Objective RE O72 of the Development Plan.

EC O23	Support the installation of solar collectors and panels to produce heat or electricity in commercial and industrial buildings in line with relevant design criteria, building regulations and technical guidance documents.	In addition to the Solar PV noted against policy EC O19 above, it is also proposed to provide 20kW of solar PV to support non-data/technology production areas to meet building regulations. **Status: Compliant with policy**
EC O24	Require the submission of a Glint and Glare Assessment as part of any solar energy development proposal where there is likely to be any impact on neighbouring uses, transportation & aviation safety.	A Glint and Glare assessment report has been provided as part of the planning submission with no impact on local or transport systems. **Status: Compliant with policy**
EC P11	Support Ireland's renewable energy commitments outlined in national policy.	As well as the adoption of solar PV on the roofs of the data centre buildings, power generated on site will be from natural gas sourced from the GNI network. GNI have a programme to decarbonise the gas grid fully by 2050 in line with Ireland's national policy on energy. In addition, there is a commitment to source renewable energy from external sources via CPPAs. This will support the development of different forms of renewable energy throughout Ireland. **Status: Compliant with policy**
EC P12	Facilitate air to water heat developments at appropriate location and scale.	Heat pumps are to be provided to the admin areas of each data centre building to provide heating and cooling from electrical sources with the lowest carbon impact. **Status: Compliant with policy**
EC P13	Promote the appropriate development of waste heat technologies and the utilisation and sharing of waste heat in areas where feasibility is demonstrated for its use in the delivery of low carbon district heating technology.	It is proposed to provide heat exchangers on two of the gas turbines to provide medium to high grade heat to the local community. A district heating assessment report has been provided to identify potential uses of the heat to the west of Naas. **Status: Compliant with policy**

EC P14	Require high levels of energy conservation, energy efficiency & the use of sustainable & renewable energy sources in new and existing buildings.	A full building control assessment has been carried and reported upon. This gives full compliance. In addition, using further solar arrays on the roof of the data centre buildings and the provision of CPPAs to meet the 30% minimum renewable energy target. **Status: Compliant with policy**
EC P15	Promote the necessary infrastructure to support the continued roll out of electric vehicles.	Infrastructure will be provided for all EVs including staff owned vehicles, visiting cars, small vans, and large lorries. Chargers will be sized for quick charging at each car park and lorry loading bay area. **Status: Compliant with policy**
EC P18	Support the accommodation of Data Centres at appropriate locations in line with the objectives of the National Planning Framework and the Government Statement on the Role of Data Centres in Ireland subject to appropriate Transport and Environmental Impact Assessments.	The site in Jigginstown has already been zoned for data centre use, it is not within Dublin and its regions and so meets the objectives of the National Planning Framework. As set out above, section 4.2.2 of the Planning Report submitted with the application for planning permission sets out how the Proposed Development complies with the relevant provisions of the National Planning Framework. Section 5.1 above demonstrates how the proposed development is fully consistent with each of the six guiding principles set out in the Government's Statement on the Role of Data Centres in Ireland. **Status: Compliant with policy**
EC P19	Support the development, reinforcement, renewal and expansion of the electricity transmission and distribution grid to provide for the future physical and economic development of Kildare.	It is proposed to provide a new grid 110kV substation, which is the subject of a separate Strategic Infrastructure Deployment (SID) application to an Bord Pleanála for approval pursuant to section 182A of the Planning and Development Act 2000 (as amended). This will enable EirGrid & KCC to facilitate easier distribution of power to the local area. **Status: Compliant with policy**

EC P21	Support the infrastructural renewal and development of the gas networks in the county, subject to proper planning, heritage, environmental and amenity requirements.	In discussion with GNI, a new connection to their gas network will be provided via an AGI. This will also include the facility to allow for injection of bio-methane into the gas network. **Status: Compliant with policy**

As can be seen from Table 5-1 above, it is clear that the proposed data centre development is fully consistent with all relevant local planning policies.

6 GHG Emissions Assessment / NZC

6.1 Introduction

A Greenhouse Gas (GHG) emissions assessment has been carried out for the proposed campus development over an operational lifetime of 2027 to 2050, to predict the anticipated year of Net Zero Carbon (NZC) for the proposed development.

As outlined below, a conservative approach has been adopted on the basis of national policy and strategies, to assess the pathway to decarbonisation of the proposed development. The strategy below enables a NZC timeline of 2039. Should the relevant national strategies be implemented more quickly than the conservative estimate adopted for the purposes of this assessment, there is a potential for NZC to occur in the early 2030's. The NZC calculations are set out in more detail in Appendix A.

The assessment's timeline pathway to NZC has been informed by the following documents:

- **Ireland's National Biomethane Strategy | May 2024 publication** by Government of Ireland, Department of Agriculture, Food and the Marine, in partnership with the Department of the Environment, Climate and Communications.
- **Climate Action Plan 2024 | publication** by Government of Ireland
- **Climate Action Plan 2023 | publication** by Government of Ireland
- **National Hydrogen Strategy | July 2023 publication** by Government of Ireland, Department of the Environment, Climate and Communications.
- **Injecting green hydrogen blends into Ireland's gas network, Technical and safety feasibility study | December 2022 publication** by Gas Networks Ireland

Government of Ireland's Data Centre Strategy

The above strategy documents include summaries of key policy statements, including the 'Government Statement on the Role of Data Centre in Ireland's Enterprise Strategy', as per the insert below from Section 1.1 of the National Hydrogen Strategy:

Major Policy Statements 2020-2023 *(continued)*	
Government Statement on the Role of Data Centre in Ireland's Enterprise Strategy	• This Statement seeks to enable the 'twin transitions' of digitalisation and decarbonisation of our economy and society. These transitions can – and must be – complementary. For this to happen, digital and climate change policies need to move in tandem and this Statement sets out how this will be achieved in respect of data centres. • The Statement highlights the CRU Decision (CRU/21/124) that new data centre connections are required to have on-site generation (and/or battery storage) that is sufficient to meet their own demand and, to assist in full decarbonisation of the power system, this generation should also be capable of running on renewably sourced fuels (such as renewable gas or hydrogen) when supplies become more readily available.

The policy defines the need for a complementary transition of digitalisation and decarbonisation supported by high-level expectations, summarised as:

- On-site generation to meet demand, and/or
- On-site battery storage, and
- Power generation capable of running on renewably sourced fuels (such as renewable gas or green hydrogen), when supplies become more readily available.

6.2 Pathway to Decarbonisation

In light of these strategies, the proposed development has been designed so that it can take full advantage of the national roll out of biomethane and green hydrogen as part of its pathway to decarbonisation, and includes on-site:

- Electricity generation via Photovoltaic arrays
- Fuel adaptable gas-powered electricity generation
- Mains Gas supply, complete with:
- Green Hydrogen injection point, and
- Biomethane injection point
- Battery storage for charging and discharging of electrical energy
- Electrical grid connection to deliver the remaining 30% CPPA requirement.

As such, the decarbonisation to NZC by 2050 transition, in conjunction with policy strategies, focuses on the proposed developments fuel supply opportunities, namely:

- Green Hydrogen injection % mix to on-site gas supply
- Biomethane injection % mix to on-site gas supply
- 100% Green Hydrogen via local network / cluster and/or national network connection

With a desire to promote transition, the opportunity to inject a combination of green hydrogen and biomethane has been adopted for the purposes of this assessment.

With grid connected electricity required to enable delivery of the indirect 30% CPPA electrical demand, less the on-site PV, the remaining 70% is provided via the proposed on-site gas turbines, which also supply the on-site battery storage facility.

This assessment focuses on pathways to decarbonise the 70% of the electricity demand for the data centres which is to be generated by the gas turbines, via renewable fuel supply(s), to achieve a Net Zero Carbon outcome.

Anticipated Green Hydrogen Consumption

Due to the properties of hydrogen and in accordance with GNI's 'Injecting green hydrogen blends into Ireland's gas network', December 2022, the maximum amount of 20% green hydrogen mix has been adopted for on-site injection into the gas supply pipeline:

1.1.1 Objective one - Conclusions

This report has considered the pilot hydrogen blending projects undertaken in both the UK and Europe. In particular, the HyDeploy project (undertaken on two discrete networks in the UK) has successfully demonstrated that hydrogen blends can be safely introduced on the distribution network with no negative impact on either the network itself, or domestic and commercial customers. The evidence generated from HyDeploy, particularly in the area of materials assessment where a significant evidence base has been developed, can be used to support hydrogen blending projects in Ireland. This evidence indicates that up to 20% hydrogen blends will not impact existing materials found on the British gas distribution network.

Source: GNI's 'Injecting green hydrogen blends into Ireland's gas network', December 2022, section 1.1.1 Objective one - Conclusions, page 9.

As green hydrogen ("GH") production is being developed with a target in place for 2030 of 4TWh, for the purposes of this assessment, the ramp up of GH has been based on an exponential curve from 2023 to 2030, then linear to 2050 representing 35.6 TWh based on GNI's national non-domestic demand prediction of 74.6TWh minus 39TWh/annum domestic.

In accordance with Government of Ireland's National Hydrogen Strategy July 2023, from 2038 onwards it is anticipated a National Hydrogen Network will be in place. Based on this, the proposed development has been designed so that a switch over to 100% green hydrogen is anticipated to occur in 2039. In addition, local networks' / clusters also provide the proposed development with the opportunity to accelerate the NZC programme, subject to development in the local area.

The hydrogen approach is further supported by the relatively close proximity of the proposed development to GNI's Renewable gas entry point (Green) and Interconnector 2 (Blue) which indicates the opportunity for hydrogen availability for injection and / or a form of network, as per extracted in *Figure **6-1*** below:

Figure 6-1. Extract from Hydrogen Gas Network
Source: GNI's 'Injecting green hydrogen blends into Ireland's gas network', December 2022, Figure 2-2-1 Overview of Gas Networks Ireland's Transmission System, page 13

Furthermore, the Government of Ireland's National Hydrogen Strategy July 2023 sets out a strategic development timeline roadmap which identifies a route to utilise hydrogen through to anticipated 100% green hydrogen niche national network connection from as early as 2033, or local network/cluster from as early as 2028. The considered routes for incorporating green hydrogen within these assessments is as follows:

- **2023-28:** Renewable hydrogen produced from curtailed grid electricity or onshore renewables, hydrogen blends across the interconnectors for a small number of niche applications either via network bending or trucked (non-pipeline) complemented by the option of large-scale deployment of small-scale storage applications.
- **2028-33:** Renewable hydrogen produced from curtailed grid electricity and/or onshore/offshore wind, including blends across niche interconnectors either via network blending, trucked (non-pipeline) for on-site use, or local networks/clusters, complete with large scale deployment of small-scale storage applications and niche network blending.
- **2033-38:** Renewable hydrogen from offshore wind at large scale deployment with continued blends across interconnectors, large scale local networks/clusters, niche national hydrogen network and small-scale storage applications.
- **2038-50:** Large-scale deployment of national hydrogen network complete with import/export routes established complemented by large-scale storage solutions of geographical scale and maintained niche networks/clusters.

As such the basis of this assessment utilises green hydrogen as a proportion of the targeted ramp-up using a total national production opportunity of 35.6TWh by 2050 on a linear scale until 2039 when transition to 100% green hydrogen supply is anticipated for the proposed development.

Three NZC routes were identified from 2027 to 2039 as illustrated below, with the most conservative approach forming the basis of this assessment to utilise 100% green hydrogen from 2039 onwards:

Figure 6-2. Potential NZC Routes
Source: Government of Ireland's National Hydrogen Strategy – Timeline Roadmap July 2023

The above NZC route graphic is supported by Table1 extracted below:

Table 6-1. Table 1: Ireland's strategic hydrogen development timeline roadmap, p7
Source: Government of Ireland's 'National Hydrogen Strategy', July 2023

Table 1: Ireland's strategic hydrogen development timeline roadmap

	2023-28	2028-33	2033-38	2038-50
Production				
Renewable hydrogen produced from curtailed grid electricity or onshore renewables where available	Large scale deployment envisioned	Large scale deployment envisioned	Large scale deployment envisioned	Large scale deployment envisioned
Hydrogen blends across the interconnectors	Small number of niche applications	Small number of niche applications	Small number of niche applications	Unlikely to exist
Renewable hydrogen from Offshore Wind	Unlikely to exist	Small number of niche applications	Large scale deployment envisioned	Large scale deployment envisioned
Transportation				
Trucked (non-pipeline) or onsite use	Large scale deployment envisioned	Large scale deployment envisioned	Small number of niche applications	Small number of niche applications
Network blending	Small number of niche applications	Small number of niche applications	Unlikely to exist	Unlikely to exist
Local networks/clusters	Unlikely to exist	Large scale deployment envisioned	Large scale deployment envisioned	Small number of niche applications
National hydrogen network	Unlikely to exist	Unlikely to exist	Small number of niche applications	Large scale deployment envisioned
Import/Export Routes established	Unlikely to exist	Unlikely to exist	Small number of niche applications	Large scale deployment envisioned
Storage				
Network blending	Small number of niche applications	Small number of niche applications	Unlikely to exist	Unlikely to exist
Small scale storage applications	Large scale deployment envisioned	Large scale deployment envisioned	Small number of niche applications	Small number of niche applications
Large scale storage solutions of geological scale	Unlikely to exist	Small number of niche applications	Large scale deployment envisioned	Large scale deployment envisioned
End Uses				
Existing Large Energy Users on gas network using GOs	Small number of niche applications	Small number of niche applications	Unlikely to exist	Unlikely to exist
Heavy Land Transport	Small number of niche applications	Large scale deployment envisioned	Large scale deployment envisioned	Small number of niche applications
Power Generation	Unlikely to exist	Small number of niche applications	Large scale deployment envisioned	Large scale deployment envisioned
Industrial Heating	Unlikely to exist	Small number of niche applications	Large scale deployment envisioned	Large scale deployment envisioned
Aviation and Shipping	Unlikely to exist	Unlikely to exist	Small number of niche applications	Large scale deployment envisioned
Exports	Unlikely to exist	Unlikely to exist	Small number of niche applications	Large scale deployment envisioned

Unlikely to exist | Small number of niche applications | Large scale deployment envisioned

Anticipated Biomethane Consumption

The Government of Ireland's latest Biomethane Strategy, May 2024, considers a limit of 2% biomethane mix per supplier for heat across an initial 3-year period. From year 4, this percentage annually increases to a final target level of 10% by 2030. Whilst this statement is not directly linked to Data Centre's and / or the biomethane production industry, it forms the basis of the biomethane injection strategy for this assessment by way of a conservative approach using a single supplier. We have also based the maximum biomethane national production value on 14.8TWh, as per GNI's Biomethane Energy Report, September 2023, page 2, as a target achieved by 2050 via linear ramp-up from the 2030 target of 5.7TWh (CAP24, page 230).

GNI's Biomethane Energy Report, September 2023, also states a production rate of 41GWh in 2022 and projected 62GWh production rate for 2023, scaling up to the 2030 target. Therefore, for the purposes of this assessment this scaling has been considered alongside the single supplier approach outlined above to inform the single supplier strategy from 2027 onwards. In addition, consideration was given to the sectoral demands which identified the remaining sectoral biomethane opportunity for comparison of non-targeted TWh vs predicted site-wide consumption.

6.3 Net Zero Carbon (NZC) Basis of Calculations

The following summarises data input to the operational GHG assessment for the proposed development:

- Part L Ireland Regulated Energy Report for Herbata Jigginstown
- Use of a representative Part L UK data hall and services model, extrapolated to represent the proposed development's data halls.
- EIAR chapter 16 and its Appendices for the proposed development in relation to associated system operational data inputs (including PV and BESS).
- Desktop analysis of the ramping up of the loading to the data halls based on anticipated operational programme to a maximum 80% loading across the proposed development.
- Carbon factors according to the following table:

Table 6-2. Fuel Carbon Factors
Source: Various, see notes below table

Fuel Carbon Factors		
Natural Gas*	0.204	kgCO2/kWh
Hydrogen**	0.000	kgCO2/kWh
Biomethane***	0.050	kgCO2/kWh
Electricity****	0.332	kgCO2/kWh

* Value taken from SEAI emission factors excel for 2022
** Based on hydrogen supply being 100% Green Hydrogen + 0% network losses
*** Average of Ave. 'Default' & Ave. 'Typical' GHG values from Department for Energy Security & Net Zero 'Methods of calculating greenhouse gas emissions: "actual value method" and default value method".
**** Digest of UK Energy Statistics, 'SEAI conversion and emission factors excel', for electricity in 2022

6.4 NZC Assessment

The NZC assessment includes three scenarios which are compared to each other (full information is provided in Appendix A), in summary the scenarios considered are:

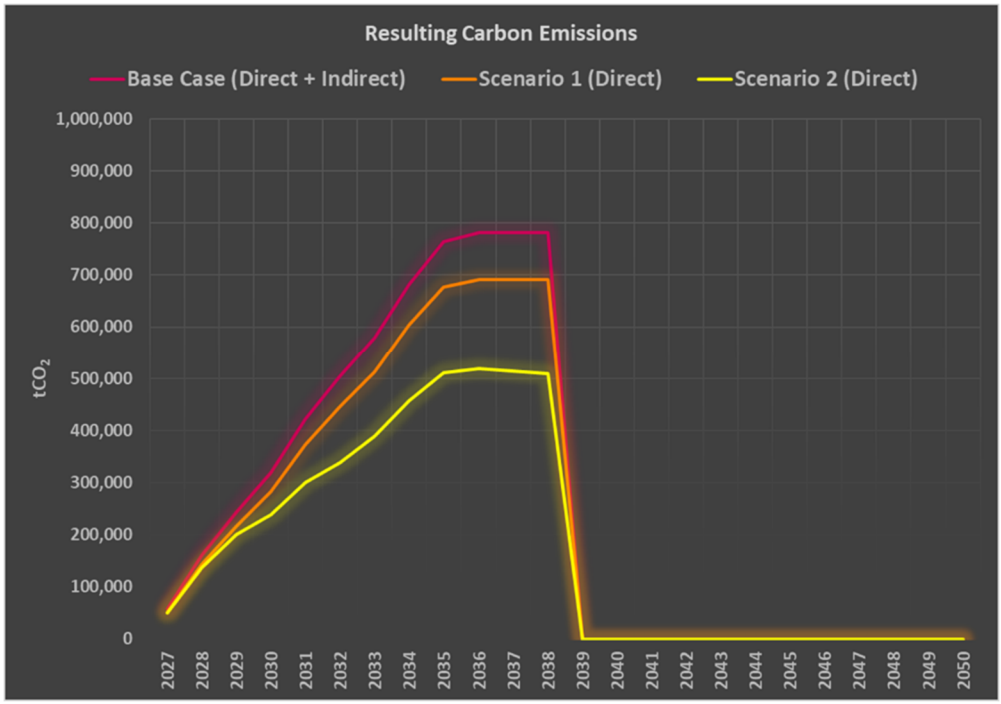
Base Case = 100% natural gas from 2027 to 2038, 100% green hydrogen from 2039 to 2050, no power drawn from the national electricity grid throughout.

Scenario 1 = 100% natural gas from 2027 to 2038, 100% green hydrogen from 2039 to 2050, with 30% (minus on-site PV) of the operational power demand of the data centre supplied by renewable energy drawn from the electricity grid via CPPAs throughout.

Scenario 2 = Blended natural gas with up to 20% green hydrogen and biomethane ramp-up from 2027 to 2038, 100% green hydrogen from 2039 to 2050, with 30% (minus on-site PV) of the operational power demand of the data centre supplied by renewable energy drawn from the electricity grid via CPPAs throughout.

The resulting GHG emissions are shown graphically in Figure 6-1 below; the Base Case clearly has the worst emissions over the period although it does also reach a similar NZC position in 2039, but in the intervening years it has the worst emissions.

Figure 6-3. GHG Emissions Assessment



Scenario 1 is an improvement on the Base Case, with overall GHG emissions being around **11.6% lower** than the Base Case, but this only takes into account the input from electricity sourced from renewable sources via CPPAs.

Scenario 2 is clearly a significant step forward with a pathway to much lower GHG gas emissions, these being around **31.5% lower** than the Base Case. The provisioning of biomethane and partial hydrogen through to 2039 is key to achieving this lower level of emissions. In that regard, the Proposed Development has been designed in such a way that biomethane and green hydrogen can be used to power the Proposed Development as and when they become available, enabling the Proposed Development to take full advantage of the national roll out of biomethane and green hydrogen over the next 25 years or so, as described in the National Hydrogen Strategy and the National Biomethane Strategy, and ensuring that the Proposed Development will meet local and national energy policies.

Ultimately, all scenarios are projected to get to a NZC point in 2039, 100% green hydrogen will be available to fuel the gas turbines by this time as set out in the National Hydrogen Strategy (and as described in more detail above and in Appendix A).

6.5 NZC Assessment Conclusions

As outlined above, a conservative approach has been adopted on the basis of national policy and strategies, to assess the pathway to decarbonisation of the proposed development. The strategy below enables a NZC timeline of 2039. Should the relevant national strategies be implemented more quickly than the conservative estimate adopted for the purposes of this assessment, there is a potential for NZC to occur in the early 2030's.

Appendix A

GHG Emissions Prediction, and Pathway to Net Zero Study

Herbata Data Centre Campus

GHG Emissions Prediction, and Pathway to Net Zero Study

07th June 2024 Rev 3

1. Introduction

Herbata Ltd. are proposing to develop a data centre campus to the west of Naas, with six data centre buildings each with an IT capacity of 30MW. The development is in support of Ireland's digital economy and commerce, however Herbata are acutely aware of the need to keep Greenhouse Gas (GHG) Emissions to a minimum and to show how and when they will achieve Net Zero Carbon ("NZC") in order to complement the digital economy alongside decarbonisation.

The following NZC study demonstrates the opportunities available for Herbata to reduce GHG emissions achieving a predicted NZC target date prior to 2040, as addressed in the following sections. For supporting information and further explanation of the assessment please refer to Herbata – Data Centre Campus, Energy Policy Compliance Report, Section 6**:**

2. **Potential National Renewable Energy Projection** – this explains how renewable energy sources for electricity and gas are expected to develop in Ireland through to 2050, including key production targets for biomethane and green hydrogen production, based on Government and Gas Network publications at the time of writing (further details contained in Section 4), including assumptions made to enable a projection through to National 2050 NZC target.

3. **Anticipated Project Renewable Energy Pathway** – graphical illustrations of the anticipated NZC pathway using renewable energy sources in-line with 'Potential National Renewable Energy' expectations of Section 2 above. Including maximum potential renewable energy source mix in to the on-site gas supply

4. **Fuel Blend Scenarios Explanation** – Explanation of Scenarios that are considered and reported on in the following sections

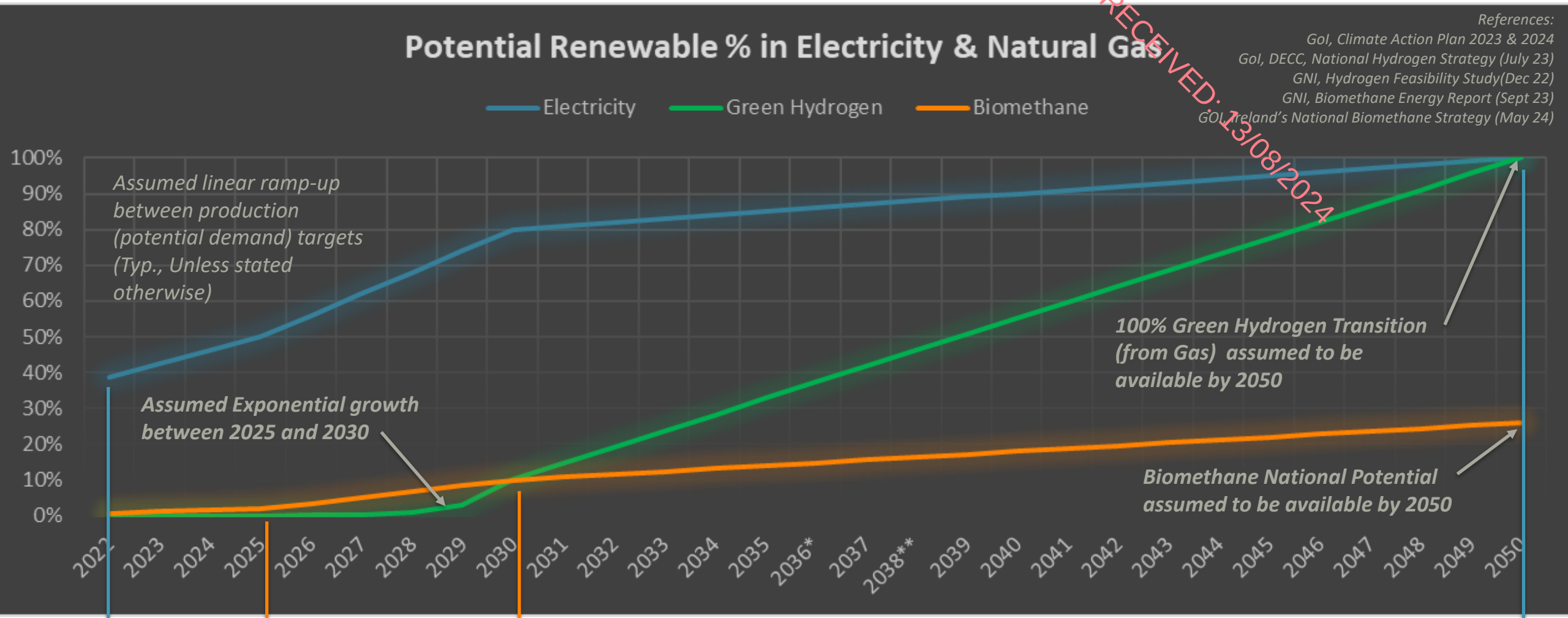
5. **Data Centre Campus Consumption** – the campus is planned to be constructed in three phases, with each building gradually loaded up with IT equipment. An assessment has been made on the likely ramping-up of IT load from 2027 to end of 2035, complete with predicted demand and consumption breakdown through to 2050.

6. **Fuel Blending Scenarios** - comparison of the Base Case, Scenario 1, and Scenario 2 in tabular format

7. **GHG CO_2 Emissions** – comparison of the Base Case, Scenario 1 and Scenario 2 in graphical representation

8. **GHG Emissions Conclusion** – this summarises the output of this study

2. Potential National Renewable Energy Projection



38.6%

~1.8% (Target: 1TWh)

Target: 50%

~10% (Target: 5.7TWh)

~10.3% (Target 4TWh)

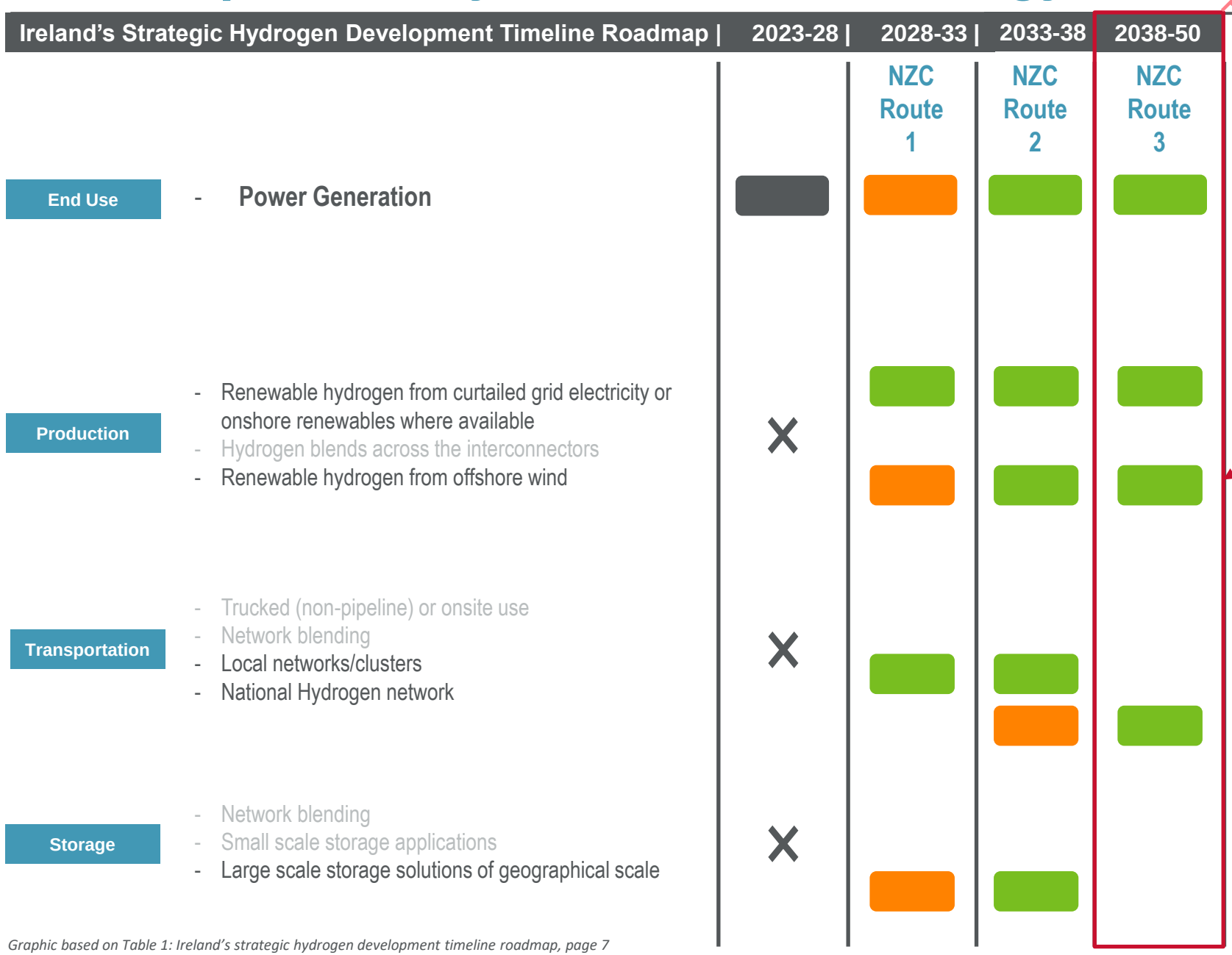
Target: 80%

Assumed Net Zero Target

Assumed 100% (Potential 74.6TWh)

~26% (National Potential 14.8TWh)

3. Anticipated Project Renewable Energy Pathway



Graphic based on Table 1: Ireland's strategic hydrogen development timeline roadmap, page 7

Route to NZC using 100% Hydrogen assumes that Data Centres can be classified as a 'Power Generation' end use, by virtue of them being power generators despite them also being the primary power consumer.

'NZC Route 3' indicates the basis of this assessment to utilise 100% green hydrogen from 2039 onwards

Key:

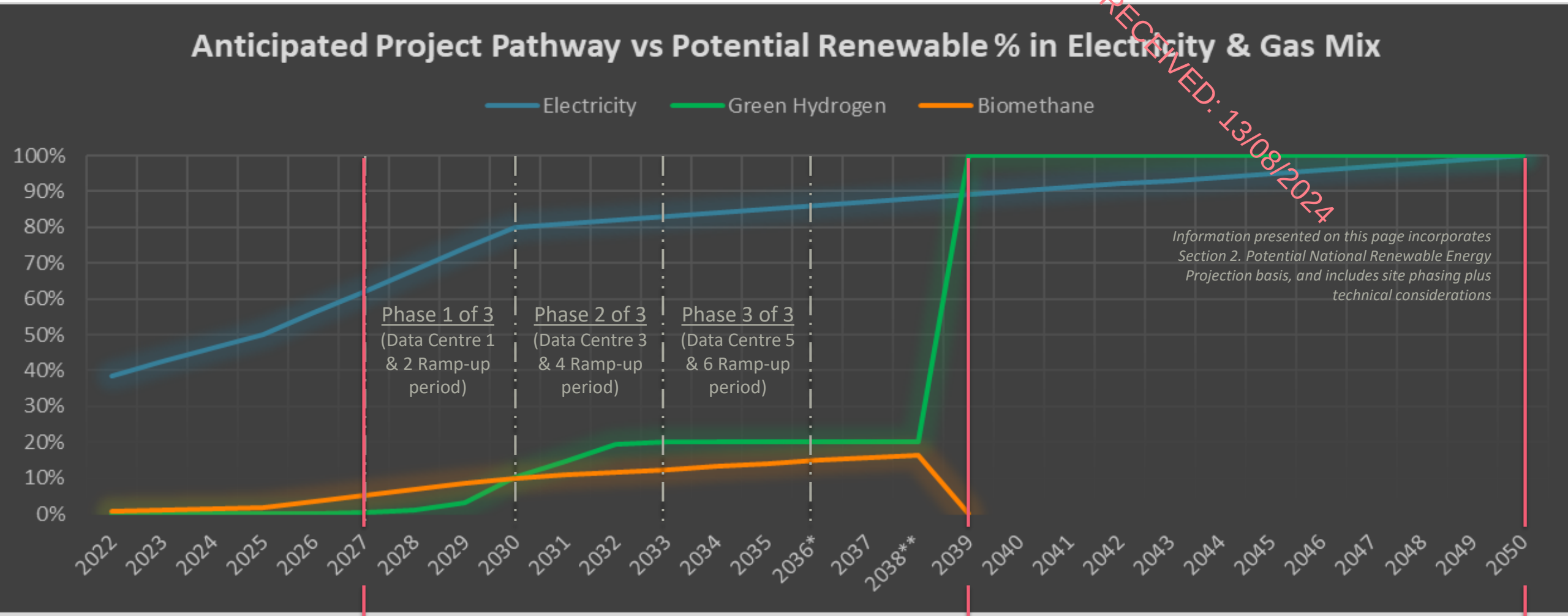
Unlikely to exist

Small number of niche applications

Large scale deployment envisioned

Unlikely to be available to end use

3. Anticipated Project Renewable Energy Pathway



Pathway Step 1 – Ramp-up to Full Operation:

***1) Ramp-up of renewable gases in-line with phasing**, via:*

i) On-site Biomethane Injection (Trucked), and

ii) On-site Green Hydrogen Injection (Trucked), or direct connection to Local Network / Cluster

***2) Ramp-up of on-site PV & Batteries** in-line with phasing*

***3) Ramp-up of 30% CPPAs** in-line with phasing*

Pathway Step 2 – Net Zero Carbon Full Operation:

***1) Transfer to 100% Hydrogen**, via either:*

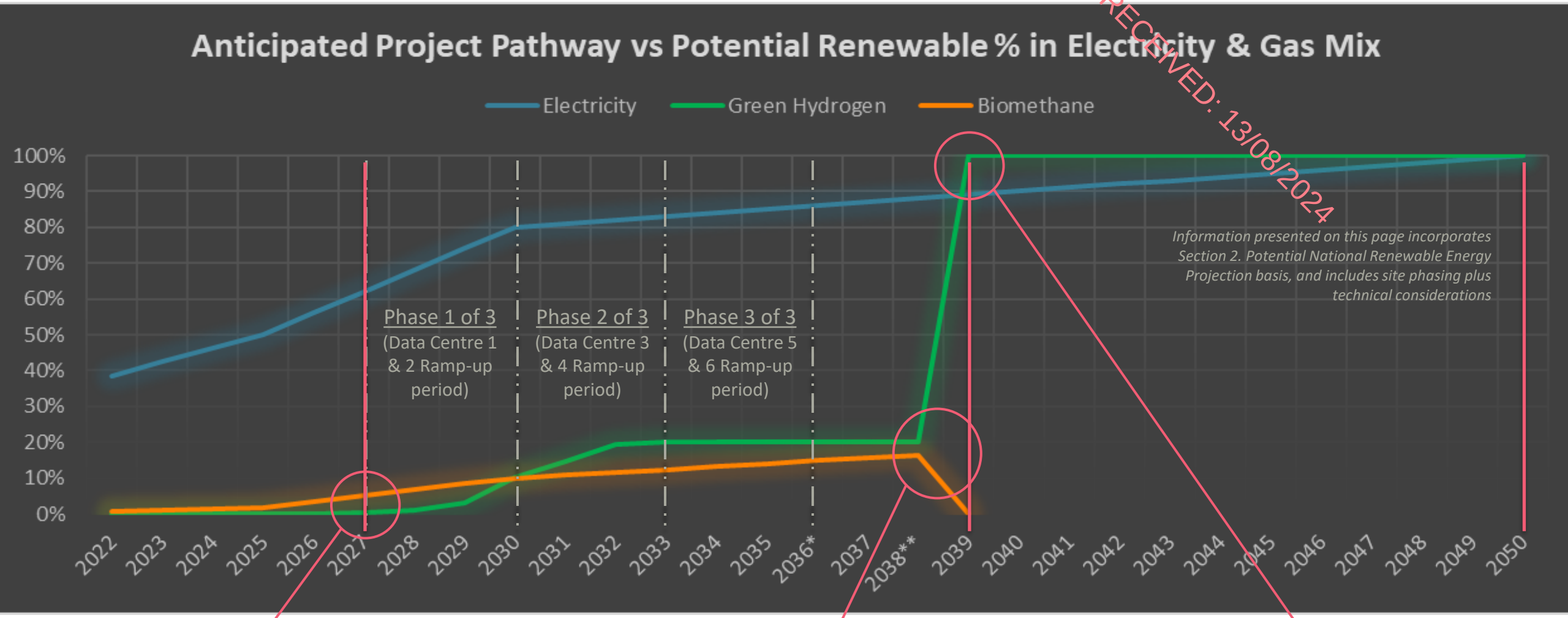
i) National Hydrogen Network, or

ii) Local Network / Cluster

***2) 30% CPPAs** Maintained*

***3) On-site PV & Batteries** Maintained*

3. Anticipated Project Renewable Energy Pathway



1) Operation Start-up Year: Max. Potential Gas Mix

0.3% Injected green hydrogen
Up to 5.1% Injected biomethane availability
94.6% Natural gas

2) Full Operation Transition Year: Max. Potential Gas Mix

20% Injected green hydrogen
Up to 16.4% Injected biomethane
63.6% Natural gas

3) Transition to Hydrogen: No Gas Mix

100% green hydrogen via national network or local network / cluster

4. Fuel Blend Scenarios Explanation

Using collated, interpolated, and extrapolated information from Government of Ireland, Department of the Environment, Climate and Communications (DECC) and Gas Networks Ireland (GNI) as well as other key bodies such as Eirgrid and SEAI, it has been possible to develop various energy blend scenarios. To get to a NZC position, it is essential that ultimately all energy sources are provided by zero carbon / renewable sources. The main three low-and-zero carbon sources considered for this project are as follows:

1. **Electricity generated off-site** from solar and wind farms, connected through the grid to the site via commercial power purchase agreements (CPPAs)

2. **Biomethane** either injected directly on-site into the gas supply or via a wider area arrangement with certificates

3. **Green Hydrogen** either mixed into the general gas network or locally injected on-site, as it becomes available

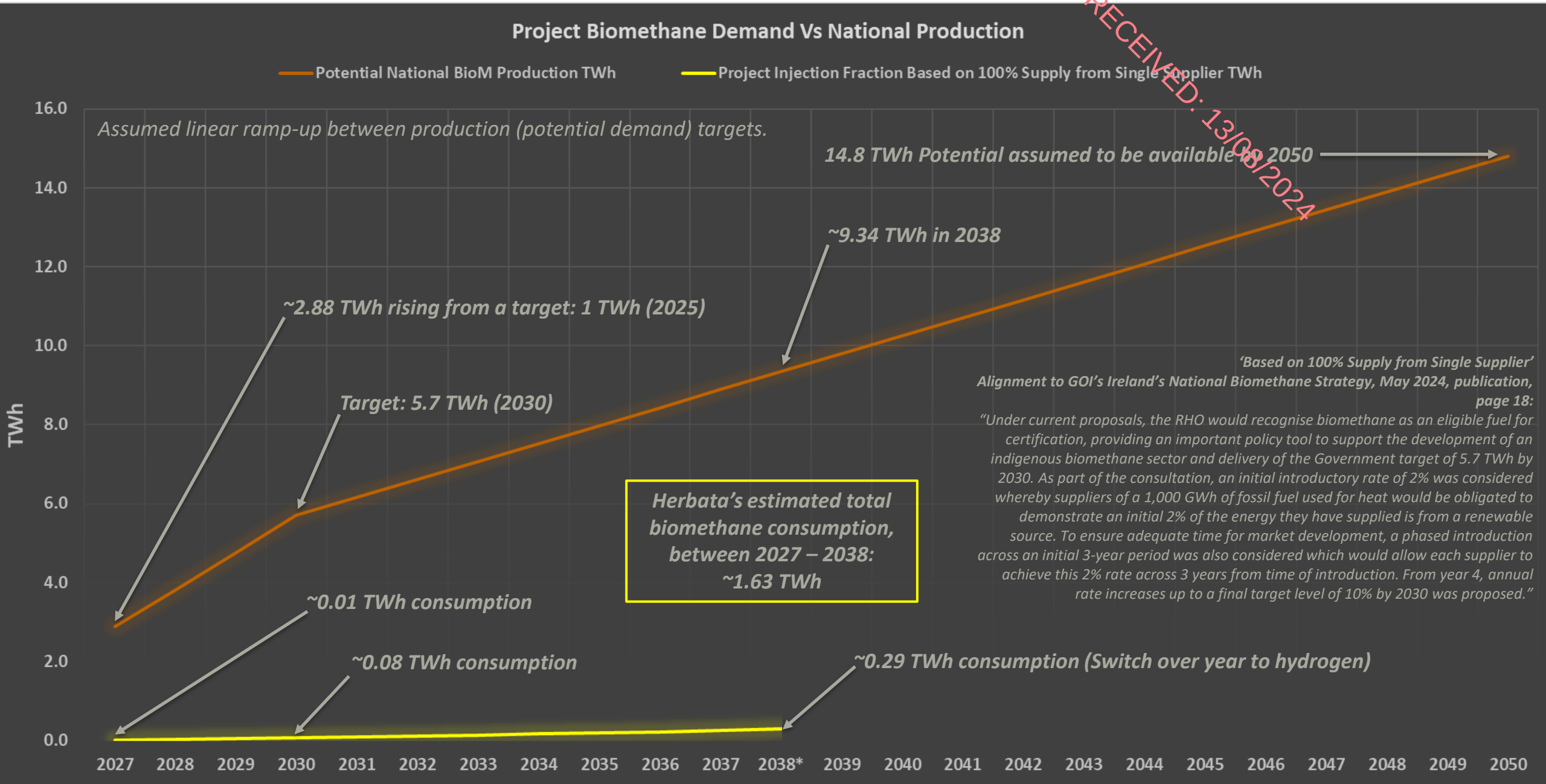
All of the above sources are being developed currently, and all have forecasted production rates through to 2050. There has to be some concern about the rate at which these fuel source developments occur as well as what proportion of the production can be assumed for this project. The more ambitious forecasts considered have therefore not been used and a more conservative approach adopted to develop three main scenarios, these are described in more detail on the following slide, and summarised below:

1. **Base Case** – this is the 'business-as-usual' approach with all energy being sourced from current natural gas pipelines and used in the on-site turbines to produce all electricity demand, until green hydrogen switchover to national network or local network / cluster in 2039

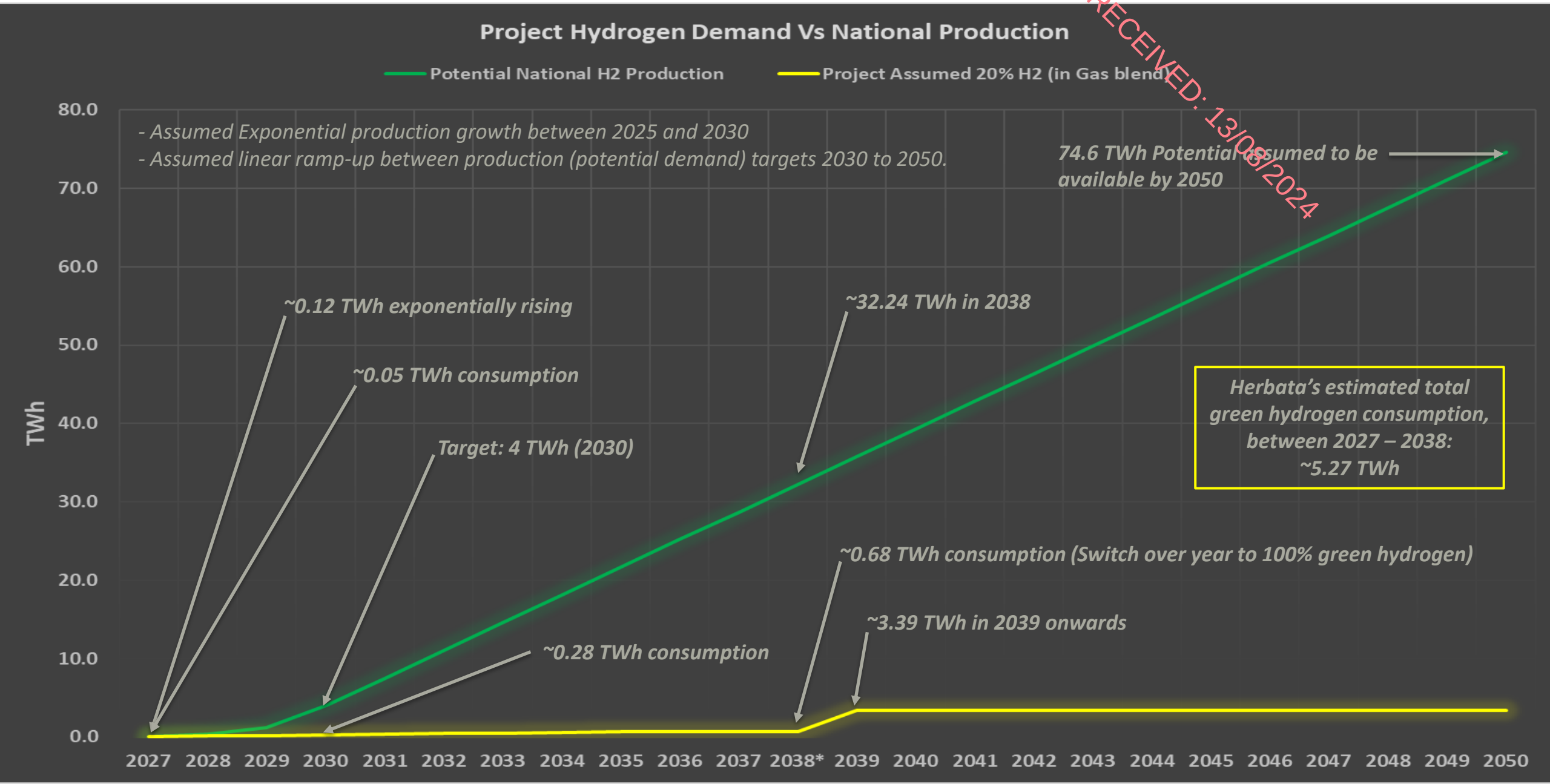
2. **Scenario 1** – As Base Scenario, albeit with 30% (minus on-site PV) of the electrical energy sourced from grid connected CPPAs

3. **Scenario 2** – As Scenario 1, with biomethane and hydrogen injected on-site on a gradual uplift (refer to following pages), then linear to anticipated projected consumption (usage)

4. Fuel Blend Scenarios Explanation - Biomethane



4. Fuel Blend Scenarios Explanation



5. Data Centre Campus Consumption - Modelling

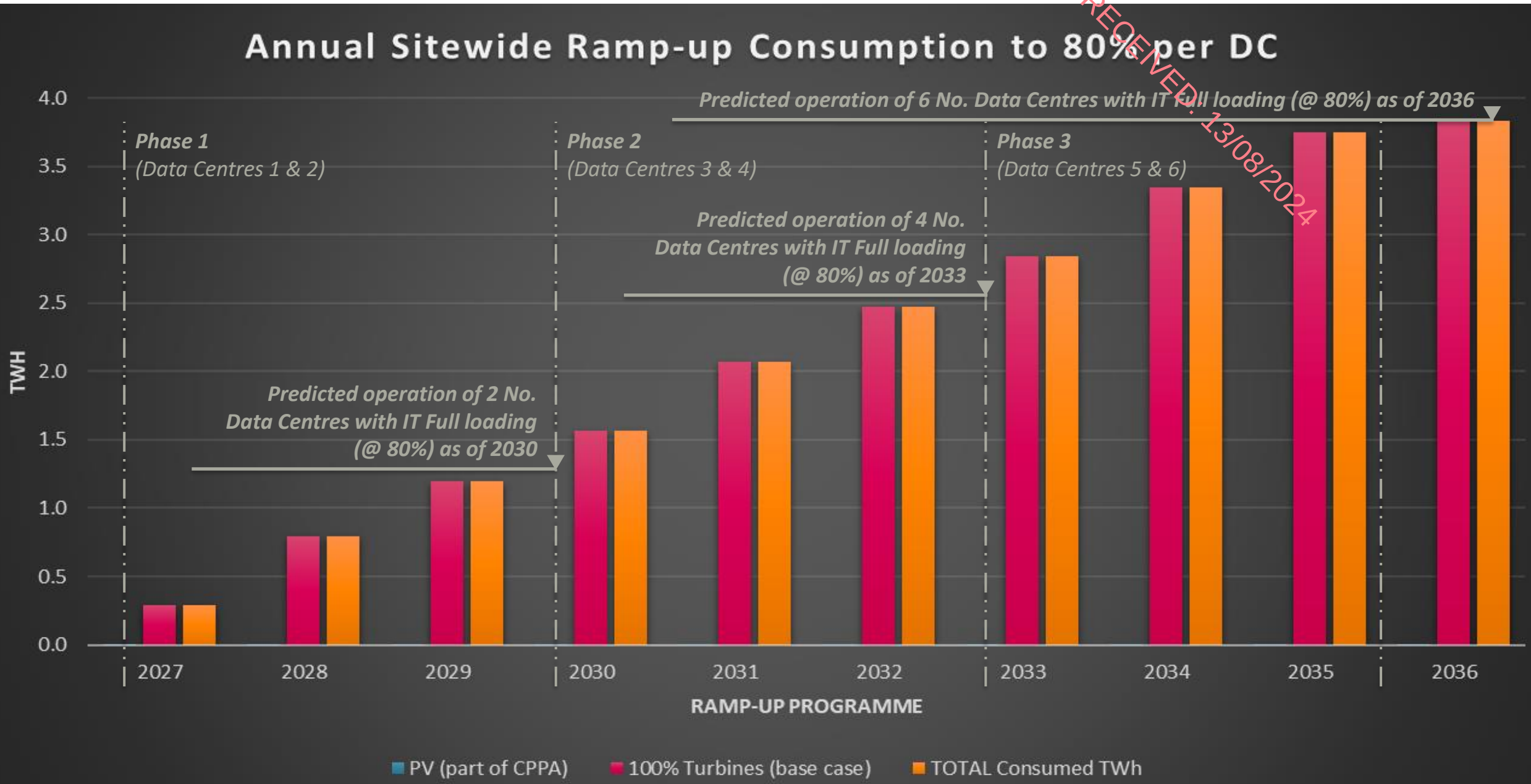
The following summarises data input to the operational GHG assessment for the proposed development. For supporting information and further explanation of the assessment, please refer to Herbata Data Centre Campus, Energy Policy Compliance Report, Section 6:

- Part L Ireland Regulated Energy Report for Herbata Jigginstown
- Use of a representative Part L UK data hall and services model, extrapolated to represent the proposed development's data halls.
- EIAR chapter 16 Appendices for the proposed development in relation to associated system operational data inputs (including PV and BESS).
- Desktop analysis of the ramping up of the loading to the data halls based on anticipated operational programme to a maximum 80% loading across the proposed development.
- Carbon factors according to the following table:

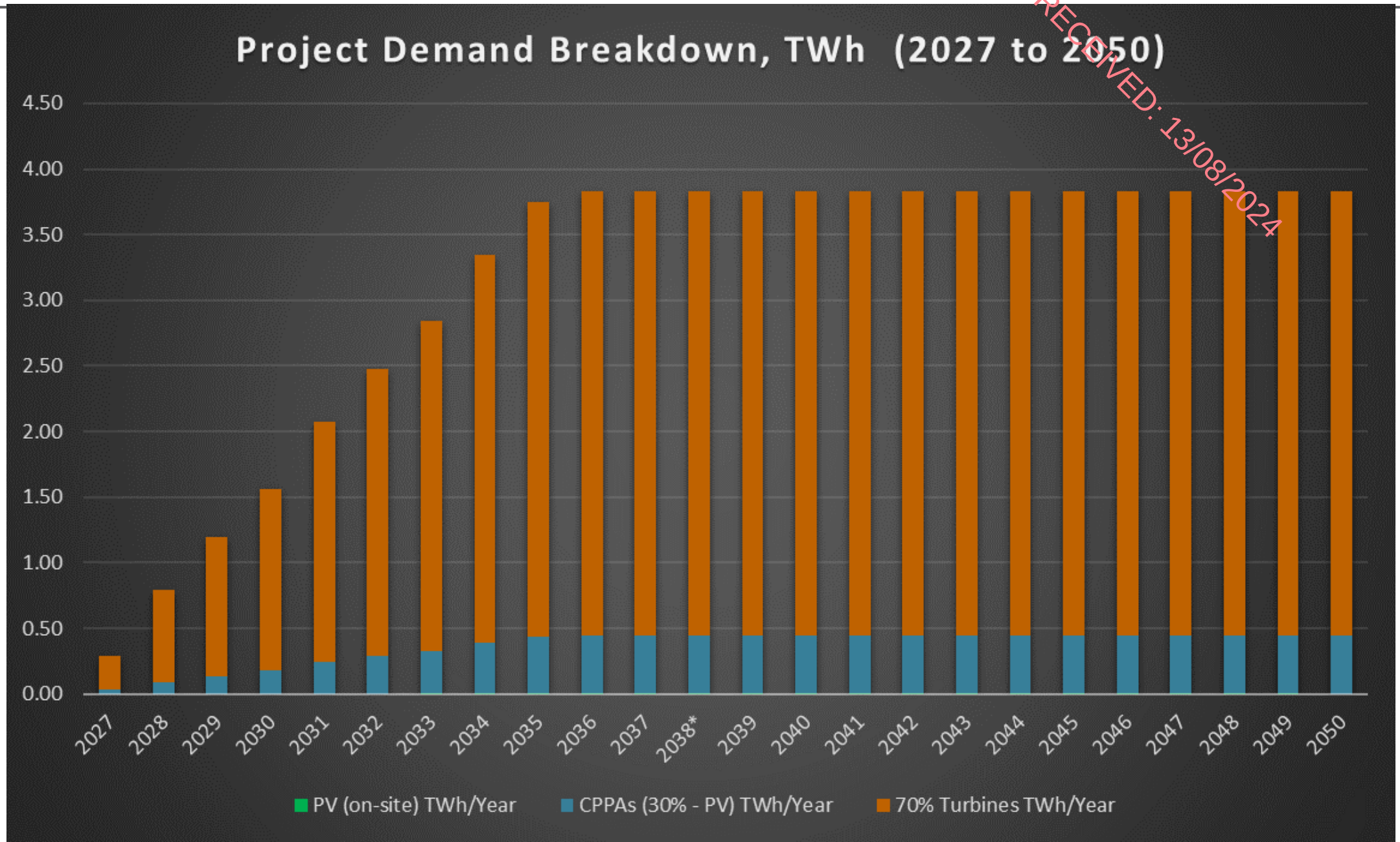
Fuel Carbon Factors		
Natural Gas*	0.204	kgCO2/kWh
Hydrogen**	0.000	kgCO2/kWh
Biomethane***	0.050	kgCO2/kWh
Electricity****	0.332	kgCO2/kWh

* Value taken from SEAI emission factors excel for 2022
** Based on hydrogen supply being 100% Green Hydrogen + 0% network losses
*** Average of Ave. 'Default' & Ave. 'Typical' GHG values from Department for Energy Security & Net Zero 'Methods of calculating greenhouse gas emissions: "actual value method" and "default value method".
**** Digest of UK Energy Statistics, 'SEAI conversion and emission factors excel', for electricity in 2022

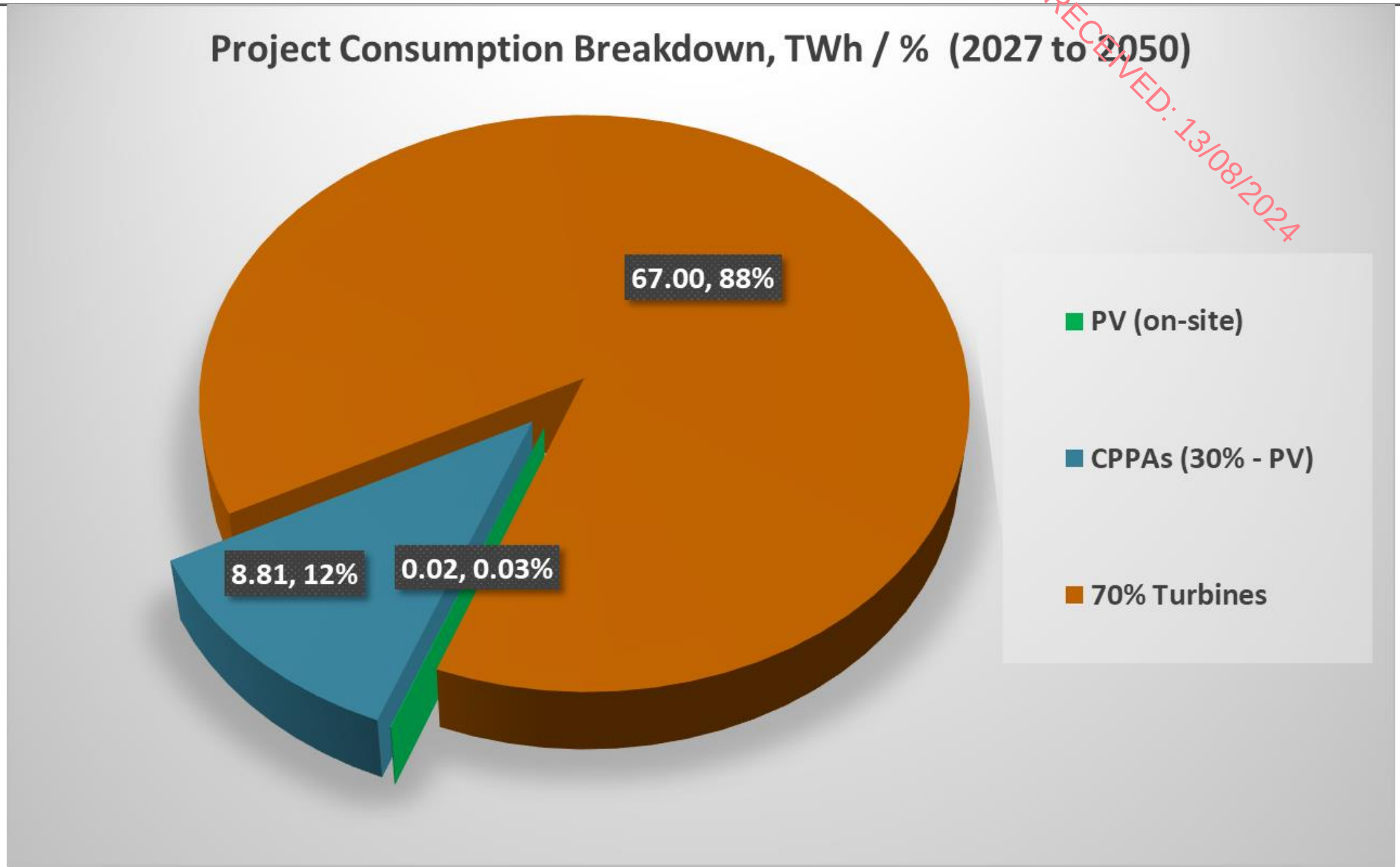
5. Data Centre Campus Consumption - Ramp-up



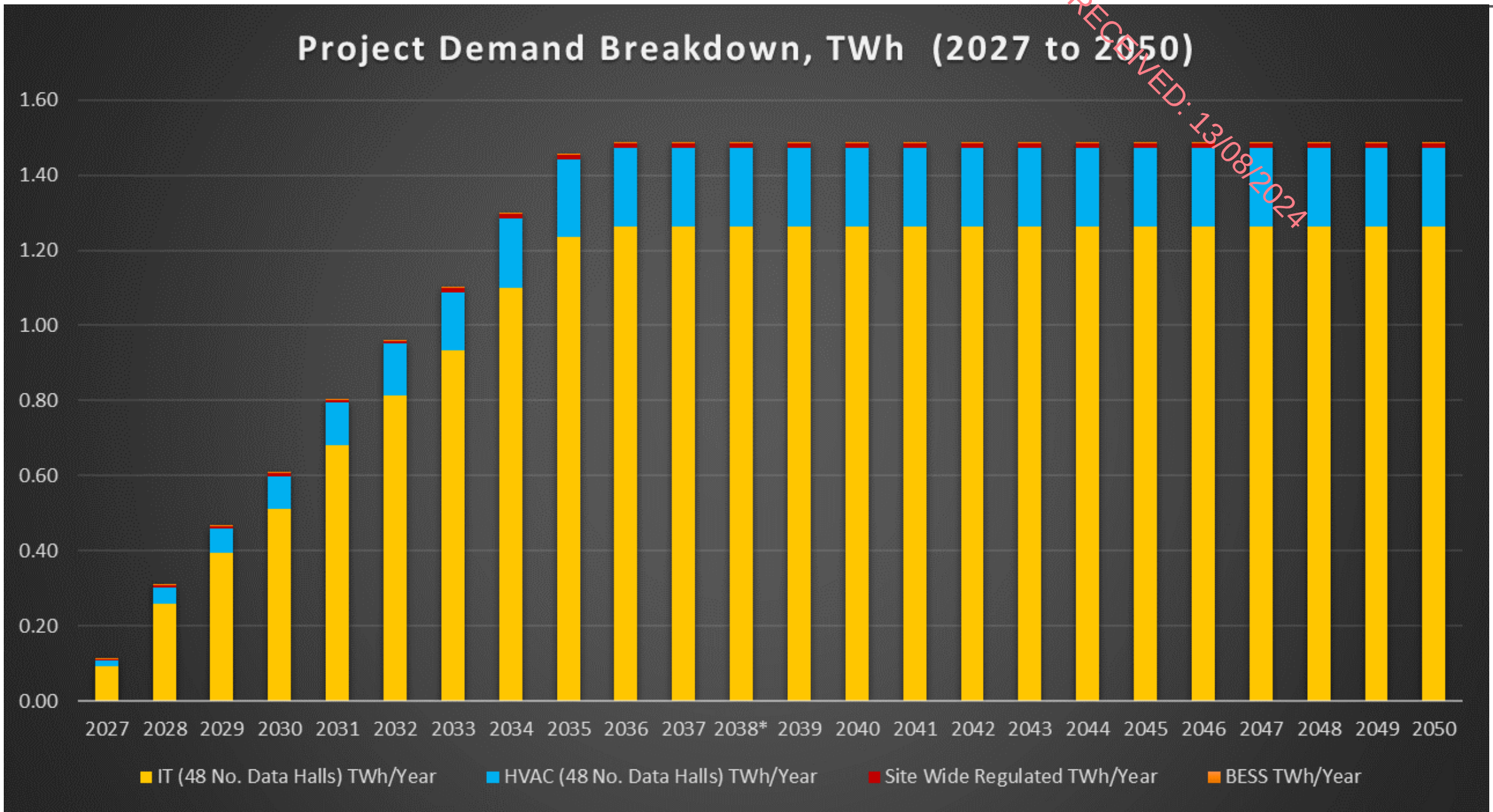
5. Data Centre Campus Consumption - to 2050



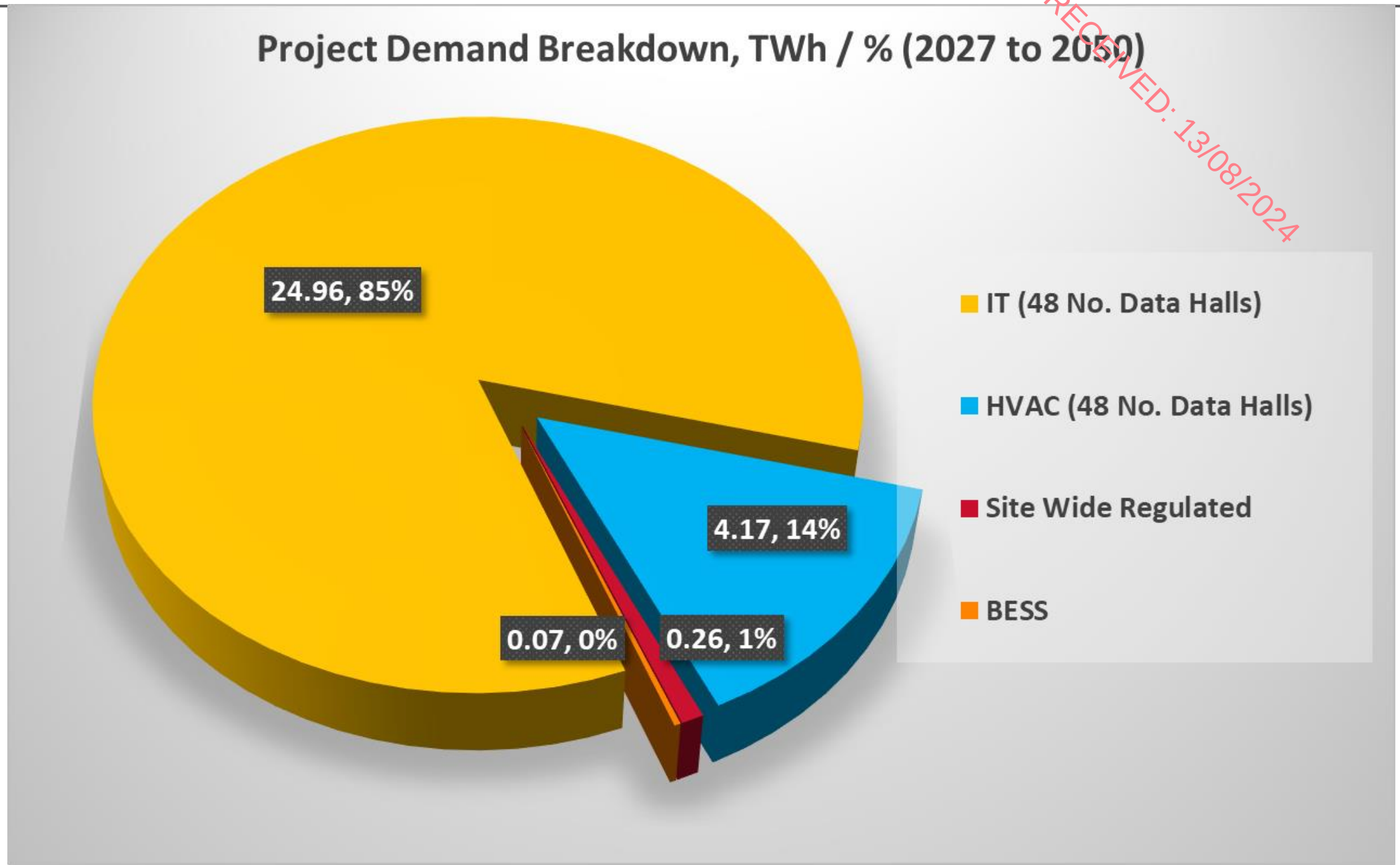
5. Data Centre Campus Consumption - to 2050



5. Data Centre Campus Consumption - to 2050



5. Data Centre Campus Consumption - to 2050



6. Fuel Blend Scenarios – Base Case, Scenarios 1 & 2

Year	Sitewide Demand & Energy Usage				
	Direct - Peak Gas Load (MW)	Indirect - Peak Electricity Load (MW)	Direct - Gas Usage (GWh/yr)	Indirect - Electricity Usage (GWh/yr)	
2027	29.0	3.7	254	32	Phase 1 IT @ 80%
2028	79.9	10.4	701	91	
2029	120.6	15.8	1,058	138	
2030	157.8	20.5	1,383	180	Phase 2 IT @ 80%
2031	208.7	27.3	1,830	239	
2032	249.4	32.6	2,187	286	
2033	286.6	37.4	2,512	328	Phase 3 IT @ 80%
2034	337.5	44.1	2,959	387	
2035	378.2	49.5	3,315	434	
2036	386.4	50.6	3,387	443	Sitewide IT load @ 80%
2037	386.4	50.6	3,387	443	
2038	386.4	50.6	3,387	443	
2039	386.4	50.6	3,387	443	
2040	386.4	50.6	3,387	444	
2041	386.4	50.6	3,387	444	
2042	386.4	50.6	3,387	444	
2043	386.4	50.6	3,387	444	
2044	386.4	50.6	3,387	444	
2045	386.4	50.6	3,387	444	
2046	386.4	50.6	3,387	444	
2047	386.4	50.6	3,387	444	
2048	386.4	50.6	3,387	444	
2049	386.4	50.6	3,387	444	
2050	386.4	50.6	3,387	444	

Scenarios of GHG Emissions predictions:

Base Case = 100% natural gas from 2027 to 2038, 100% green hydrogen from 2039 to 2050, no power drawn from the national electricity grid throughout.

Scenario 1 = 100% natural gas from 2027 to 2038, 100% green hydrogen from 2039 to 2050, with 30% (minus on-site PV) of the operational power demand of the data centre supplied by renewable energy drawn from the electricity grid via CPPAs throughout.

Scenario 2 = Blended natural gas with up to 20% green hydrogen and biomethane ramp-up from 2027 to 2038, 100% green hydrogen from 2039 to 2050, with 30% (minus on-site PV) of the operational power demand of the data centre supplied by renewable energy drawn from the electricity grid via CPPAs throughout.

Year	GHG Emissions (tCO_2/yr)		
	Base Case (Direct + Indirect)	Scenario 1 (Direct + CPPA)	Scenario 2 (Direct + CPPA)
2027	58,415	51,315	49,678
2028	161,559	142,938	136,883
2029	243,931	215,711	200,498
2030	318,822	282,079	238,673
2031	421,967	373,203	300,089
2032	504,341	445,975	338,436
2033	579,233	512,344	388,484
2034	682,380	603,467	457,514
2035	764,756	676,240	511,541
2036	781,235	690,794	518,673
2037	781,239	690,794	513,840
2038	781,244	690,794	508,685
2039	0	0	0
2040	0	0	0
2041	0	0	0
2042	0	0	0
2043	0	0	0
2044	0	0	0
2045	0	0	0
2046	0	0	0
2047	0	0	0
2048	0	0	0
2049	0	0	0
2050	0	0	0
Total	6,079,123	5,376,153	4,162,993
% Saving		11.6%	31.5%

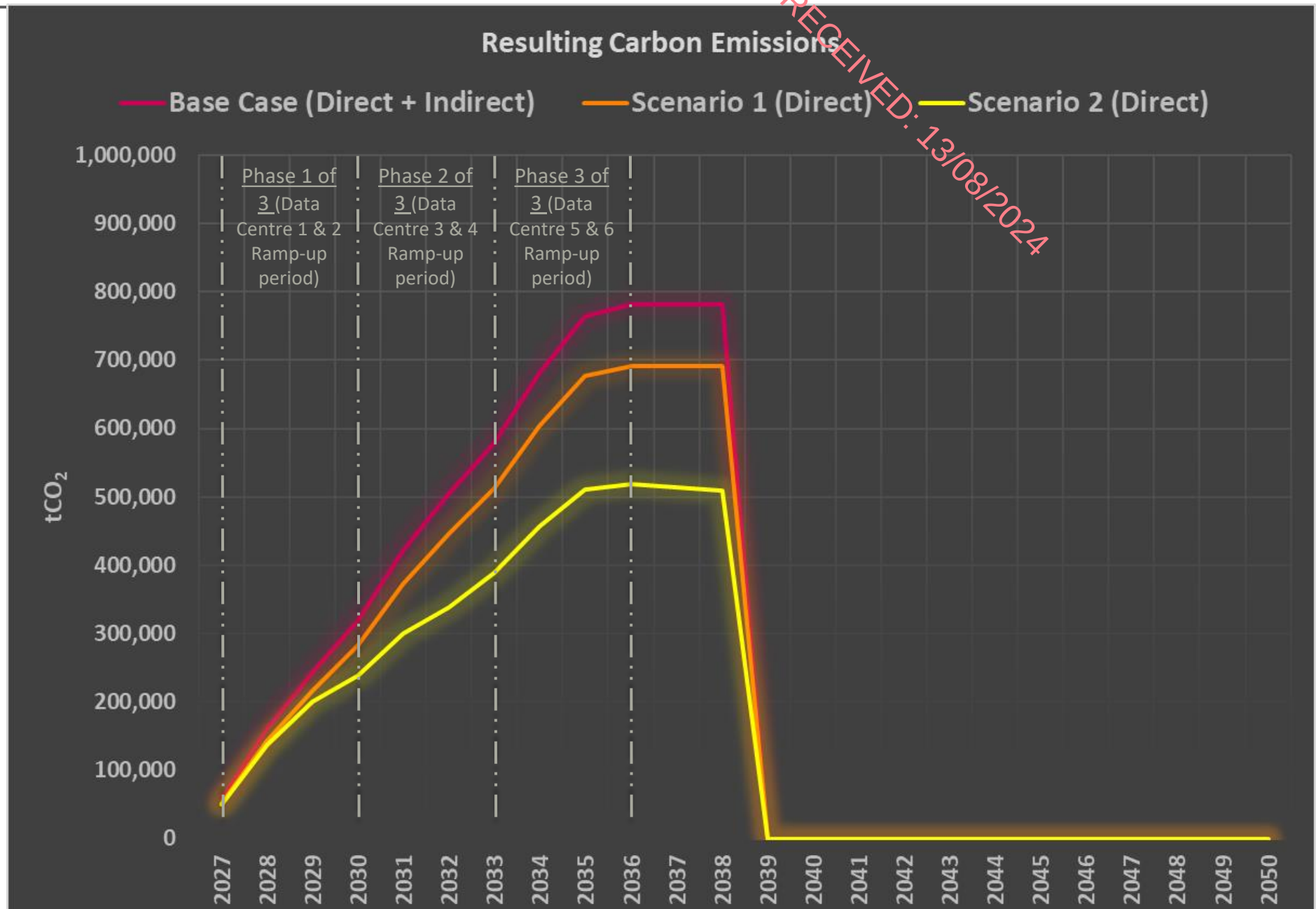
7. GHG CO_2 Emissions

Scenarios of GHG Emissions predictions:

Base Case = 100% natural gas from 2027 to 2038, 100% green hydrogen from 2039 to 2050, no power drawn from the national electricity grid throughout.

Scenario 1 = 100% natural gas from 2027 to 2038, 100% green hydrogen from 2039 to 2050, with 30% (minus on-site PV) of the operational power demand of the data centre supplied by renewable energy drawn from the electricity grid via CPPAs throughout.

Scenario 2 = Blended natural gas with up to 20% green hydrogen and biomethane ramp-up from 2027 to 2038, 100% green hydrogen from 2039 to 2050, with 30% (minus on-site PV) of the operational power demand of the data centre supplied by renewable energy drawn from the electricity grid via CPPAs throughout.



8. GHG Emissions Conclusion

As outlined above, a conservative approach has been adopted on the basis of national policy and strategies, to assess the pathway to decarbonisation of the proposed development. The strategy below enables a NZC timeline of 2039. Should the relevant national strategies be implemented more quickly than the conservative estimate adopted for the purposes of this assessment, there is a potential for NZC to occur in the early 2030's.

Three different energy mix scenarios have been considered for the Herbata Data Centre Campus, proposed to be constructed on a phased basis from 2027 through to 2036. The NZC pathway study results shown in Sections 6 & 7 above are summarised as follows:

1. **Base Scenario** – worst case predicted GHG emissions using natural gas only

2. **Scenario 1** – the total emissions are predicted to reduce by **11.6%** compared to the Base Case

3. **Scenario 2** - the total emissions are predicted to reduce by **31.5%** compared to the Base Case

Scenarios 1 & 2 predict being NZC in 2039 subject to successful rollout of the 100% green hydrogen national network.

The scenarios developed have been based on current available information and predicted production of renewable energy. It is possible that these scenarios will be bettered as production methods and development of these renewable energy sources comes to market over the next 5 to 10 years.

For supporting information and further explanation of the assessment, please refer to Herbata Data Centre Campus, Energy Policy Compliance Report, Section 6.

Appendix B

Gas Networks Ireland – Vision 2050 Document

Gas Networks Ireland

Vision 2050

A Net Zero Carbon Gas Network for Ireland

ervia

The solution to Ireland's energy and climate challenge will require the successful deployment of many technologies. Electrification, natural gas (with Carbon Capture and Storage (CCS)), renewable gas and renewable electricity sources will all play significant roles in the energy system in 2050.

Ireland's gas network is a valuable national asset which will play a major role in achieving a clean energy future in a least cost, safe and secure manner.

This document outlines how our vision can be achieved.

Gases and gas technologies to deliver Ireland's net zero carbon network by 2050:

Natural Gas
It emits 40% less CO_2 than coal and 22% less CO_2 than oil.

Renewable Gas
It is net zero carbon, extremely versatile and fully compatible with the existing gas network infrastructure.

Compressed Natural Gas (CNG) and Bio-CNG
Compressed Natural Gas (CNG) is natural gas used in transport. Bio-CNG is compressed renewable gas used in transport.

Carbon Capture and Storage (CCS)
Captures the emissions from natural gas power plants and large industry preventing emissions entering the atmosphere – the **'abated'** natural gas is net zero carbon.

Hydrogen
Produces zero CO_2 emissions when combusted and can be blended with natural gas or used in its pure form.

Power to Gas (P2G)
Uses renewable electricity to split water into hydrogen and oxygen.

Foreword

Climate change is one of our greatest and most urgent global challenges. This challenge is man-made and the implications of not solving it are catastrophic. Global warming is having far reaching and profound impacts on communities, human health and the world's climate. Major economies are falling short of climate change targets and Ireland is no exception.

Ireland is experiencing significant population growth with projections forecasting a population of 6.7 million in 2051 in the Republic of Ireland[1]. Ireland's economy is growing and is out-performing many other European economies. The growth in our population and economic activity will create even higher energy demands.

Heat and transport account for 80% of Ireland's energy use while electricity accounts for the remaining 20%[2]. While the country has made huge strides in creating renewable electricity, this remains a relatively small part of Ireland's overall required energy mix. We urgently need to come up with solutions to address the remaining energy requirements and to ensure we are all more efficient in our use of energy.

Ireland's Climate Action Plan (CAP) sets out an ambitious trajectory to address climate disruption over the coming years[3]. The CAP also sets out clear governance arrangements which will significantly enhance accountability and purpose in implementing the proposals. Gas Networks Ireland and Ervia welcome the strength of the ambition and the associated governance set out in the CAP. We recognise that Ireland must significantly increase its commitments to tacking climate disruption, and we are delighted to share our vision for the significant role that the gas network can play in supporting Ireland's climate commitments. We welcome the CAP as a living document which will be updated annually. As we achieve progress toward our vision we will periodically refresh this document to chart our progress and potential, and to share critical developments in new and emerging clean gas technologies. The gas network plays a critical role in Ireland's economy today, delivering 30% of the country's primary energy needs; serving homes, businesses and electricity generation. In 2017 over half of all electricity produced in Ireland was generated using natural gas[4].

Our vision is for the gas network to evolve to become net zero carbon by 2050 and to support emissions reductions across every sector of the Irish economy at the lowest cost possible. We will realise this vision by meeting half the projected 2050 gas demand with net zero carbon and zero carbon gases and by using Carbon Capture and Storage (CCS) to abate the emissions from the remaining natural gas. Gas Networks Ireland has already begun to invest in new technologies to facilitate renewable gas injection into the gas network, and to supply Compressed Natural Gas (CNG) from the gas network as a fuel source for commercial vehicles. Ervia is also assessing the feasibility of CCS and hydrogen solutions as part of a wider long-term ambition to pursue net zero carbon and zero carbon solutions.

Our vision for the existing gas network is exciting and ambitious. We are committed to working with government and policy makers across all sectors, to ensure we maximise the contribution this asset owned by the people of Ireland can make to help reduce emissions at least cost. We must all take responsibility and act to address climate change in order to preserve and protect Ireland for future generations.

Cathal Marley

Interim CEO,
Ervia

Denis O'Sullivan

Managing Director,
Gas Networks Ireland

Key drivers to deliver Ireland's net zero carbon gas network:

Renewable gas (Biomethane)

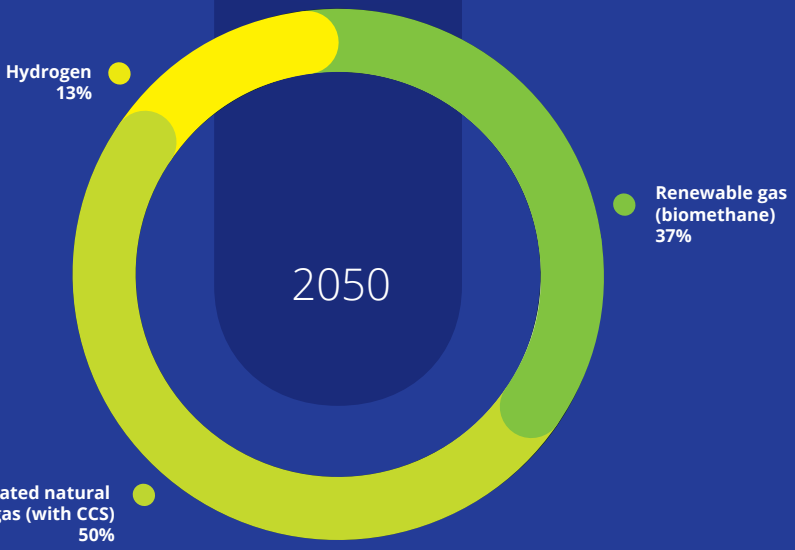
Abated natural gas (with CCS)

Hydrogen

The gas network will provide a sustainable, secure and cost-effective decarbonisation pathway

A net zero carbon gas network will deliver at least 18.7Mt/ annum CO_2 emissions savings by 2050 (31% of Ireland's overall current emissions).

- **Electricity 8.2Mt**
- **Industry 2.7Mt**
- **Heat 2.6Mt**
- **Transport 2.8Mt**
- **Agriculture 2.4Mt**



1. Introduction and Key Messages

The Challenge and Opportunity

Urgent action is required to reduce Ireland's emissions

Climate change is one of the greatest global challenges facing this generation and it is widely recognised that "rapid, far reaching, and unprecedented changes" are required to limit harmful greenhouse gas (GHG) emissions to avoid a global climate disaster[5]. In recognition of the urgent and far reaching action required, the European Commission has set out its vision to achieve net zero emissions by 2050[6]. Ireland has committed to radically decarbonising its energy system by 2050, however the country is not on course to achieve its short or long-term climate ambitions.

The transition to a low carbon economy presents significant challenges for Ireland. Energy demand is forecast to increase, driven by a rising population and a growing economy. Agriculture is a key sector of the Irish economy and it is the largest source of Ireland's emissions. The agri-food sector is forecast to continue to grow and decarbonising it is very difficult. The heating and transport sectors are also challenging to decarbonise.

Ireland's Climate Action Plan (CAP) is a welcome development which sets out clear targets for emissions savings per sector to 2030 along with clear governance and accountability. It highlights the need for, and benefits of, early action: "The earlier we act, the less dramatic and costly it will ultimately be for Ireland. Acting now reduces our long-term transition costs, and brings additional benefits such as better air quality and reduced fuel poverty"[3]. Ireland's gas network can play a vital role in delivering early and sustained action.

Networked gas is a key component of Ireland's energy mix

Ireland's gas network is among the most modern gas networks in Europe and it provides a safe, secure and reliable energy supply. The gas network plays an important role in Ireland's economy, delivering 30% of the country's primary energy needs serving homes, businesses and electricity generation[4]. In 2017 over half of total electricity produced was generated using natural gas[3]. In total there are over 700,000 gas customers in Ireland, including 30,000 businesses. Ireland's national gas network infrastructure, which is valued at €2.6 billion, is 14,390km long and connects towns and villages in 21 counties across the country.

The gas network also provides essential back-up and flexibility for the electricity grid when wind levels drop, an increasingly important feature as intermittent renewable electricity generation continues to grow. The large energy storage capacity of the gas network means it can deliver heat to homes and businesses and can still provide fuel for electricity generation when there is no wind.

Ireland's gas network can deliver early and significant emissions savings

Natural gas provides a cleaner alternative to coal, peat and oil today. Replacing these fuels with natural gas in electricity generation and heating will ensure early action and provide immediate emissions reductions. Similarly converting Ireland's Heavy Goods Vehicles (HGVs) from diesel to Compressed Natural Gas (CNG) can yield near-term emissions reductions in the transport sector.

Ireland's gas network can evolve for even greater, sustainable emissions savings

By transporting renewable gas (biomethane) in the network now, and by developing technologies such as hydrogen and CCS, we will play a critical role in transforming Ireland's energy economy. A total emissions saving of at least 18.7Mt CO_2 per annum can be achieved by using gas and the gas network to decarbonise every sector of the economy. Based on total emissions of 61Mt CO_2[7], this represents a reduction of 31% of Ireland's total emissions, or the equivalent of 58% of the emissions from transport, electricity generation and the built environment. This analysis draws on collaborative research between Gas Networks Ireland and MaREI, the Science Foundation Ireland (SFI) Research Centre for Energy, Climate and Marine.

Our Vision

A net zero carbon gas network

Our vision is for Ireland's gas network to be net zero carbon by 2050.

This ambition will be achieved by progressing two core aims, each contributing approximately half of the emissions savings required to completely decarbonise the network.

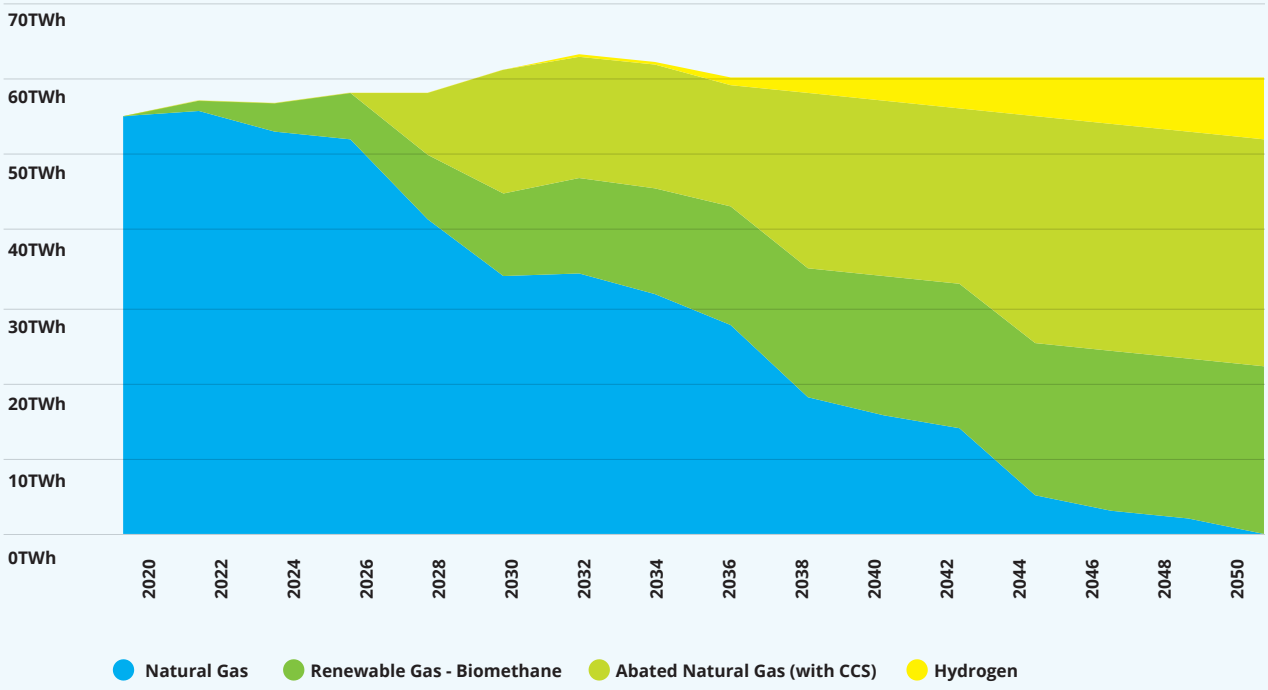
Injecting 50% net zero carbon and zero carbon gases into the network to displace half of the natural gas required to meet consumer demand. Renewable gas will be injected into the gas network now, and over time, hydrogen will also be added. Gas Networks Ireland is targeting 11TWh/annum renewable gas in the network by 2030 (20% of current demand). The volume of renewable gas and hydrogen in the gas network will increase over time to 50% by 2050. The evolution of technology between now and 2050 will determine the ultimate split between renewable gas and hydrogen in the network in 2050. A variety of scenarios may arise over this timeframe which may result in more or less hydrogen or renewable gas, but with the combination of these gases still meeting 50% of gas demand.

'Abating' the 50% natural gas still required to meet overall demand. CCS technologies will increasingly capture and store the CO_2 emissions from natural gas used for power generation and large industry.

By 2050 the combination of renewable gas, hydrogen and natural gas in combination with CCS will deliver net zero carbon gas for home heating, transport, industry and electricity generation.

Our vision for Ireland's gas network is aligned with other European gas networks of which six have committed to net zero carbon by 2050.

Figure 1: Our vision for a net zero carbon gas network by 2050



Benefits of a Net Zero Carbon Gas Network

Transitioning to a clean energy economy will be challenging as a balance between sustainability, security and affordability must be achieved. Using existing energy assets and capabilities will achieve these aims earlier, offering the potential to achieve a smoother and more sustainable transition.

Immediate emissions savings

These will be achieved by moving to replace peat, coal and oil with natural gas in electricity generation, heating and transport. Making early progress ensures savings accumulate and grow year after year as we move toward 2030 and 2050. Longer-term, as the gas network evolves to become net zero carbon, **a total emissions saving of at least 18.7Mt CO_2 annually will be achieved economy wide**.

Least cost and least disruptive transformation

Supplying renewable gas through the gas network is the least cost and least disruptive way to decarbonise home heating for those on or near the gas network. An analysis carried out by KPMG has demonstrated that the cost of **decarbonising heating for the one million homes on or close to the gas network is three times more expensive via electrification** compared with renewable gas[8]. Poyry have concluded that achieving a decarbonised energy sector in 2050 will be significantly cheaper by including natural gas with CCS, renewable gas and hydrogen[9]. The European Commission has reported that it will **cost the EU an additional €1.2 trillion to reach its CO_2 reduction target for the power sector** without CCS[10].

Energy security and flexibility

The large storage capability of the gas network is unique and cannot be economically provided by other energy sources. The **flexibility and energy storage capacity of the gas network ensures that heat is always available**, and high levels of renewable energy can be reliably accommodated on Ireland's electricity grid. Gas together with CCS will ensure that existing and new gas power plants can be securely accommodated to provide flexible, secure and cost effective electricity generation.

Other benefits

CNG provides an **immediate pathway to decarbonisation of HGVs and bus transport** and even greater benefits as renewable gas displaces natural gas. The use of gas in transport also significantly improves air quality compared to diesel, reducing serious health effects associated with poor air quality. The EU requires Member States to achieve 3.5% advanced biofuels in transport by 2030, and renewable gas from grass (Bio-CNG) offers a commercially viable advanced biofuel which is cheaper than other advanced biofuels. CNG and Bio-CNG are particularly important options for heavy duty transport such as HGVs and buses where viable options to decarbonise are limited.[11]

Delivering renewable gas, primarily from grass, agricultural wastes and other sustainable feedstocks, will provide clean energy while also helping to reduce agricultural emissions through better land and agricultural waste management. A renewable gas industry will help **stimulate the rural economy by introducing an additional income stream to farms** and developing new, skilled and sustainable jobs in rural areas.

The availability of competitive renewable and net zero carbon gas supplies will enable businesses who favour gas, or require it for high temperature processes, to locate or remain in Ireland.

Maximising the use of existing state energy infrastructure will deliver a least cost approach to achieve a clean energy future, ensuring energy affordability and a just and fair transition for all energy consumers.

In total there are over 700,000 gas customers in Ireland, including 30,000 businesses. Ireland's national gas network infrastructure, which is valued at €2.6 billion, is 14,390km long and connects towns and villages in 21 counties across the country.

Realising Our Vision

Supports are required to unlock this opportunity for Ireland

Supportive policy and regulations will be critical

Energy investments are typically sizeable and long-term and consequently are ideally made under conditions of relative certainty, typically in response to encouraging policy signals from Government. Gas network connection and network utilisation can be enabled or disabled by policy. Energy policy should support the potential for networked gases with a net zero carbon gas network as a key component of Ireland's clean energy future.

Investment support will also be critical

Emerging and new clean energy technologies in Ireland will require support to become economically mature and self-sustaining. Similar to other clean energy technologies, a variety of measures will be required to enable the gas network and networked gases to maximise their contribution towards meeting the decarbonisation challenge.

Supporting renewable gas – the inclusion of renewable gas in an appropriate support scheme is critical to kick-start the development of renewable gas projects in Ireland.

A detailed policy roadmap will be required to set out the measures required from demand side to supply side to successfully develop Ireland's renewable gas industry. Gas Networks Ireland would welcome the development of a detailed policy roadmap in support of renewable gas and would work in partnership with industry stakeholders, researchers and relevant Government Departments to develop this.

Revising building regulations – Part L of the building regulations currently excludes renewable gas as a renewable energy technology despite the capability of gas boilers to operate on both renewable gas and natural gas. To create a level playing field for renewable gas, Part L should be amended to include appliances that are fuelled by a gas blend inclusive of a renewable gas element, and for the renewable element within the blend to be calculated toward the minimum renewable energy contribution[12]. Similarly, the option to select renewable gas is not on the default settings for Building Energy Rating (BER) Certification for the domestic sector. All other technologies are listed in the default settings and renewable gas should be recognised on the same basis.

Committing to transition Ireland's HGVs from diesel – the Accelerated Capital Allowance (ACA scheme) for gas vehicles and refuelling equipment and the excise duty treatment for CNG should be retained beyond their expiry in December 2021 and 2024 respectively, and until such time as the HGV population is 30% gas powered.

Integrating energy systems planning - The gas network and electricity grid are complementary and co-dependent. 'Sector coupling' between gas and electricity has been recognised at European policy level as key to supporting decarbonisation efforts. Coupled policy and regulations are required for electricity and gas to achieve an integrated systems approach. Energy planning should adopt a technology neutral approach with the focus on achieving required decarbonisation at least cost and least disruption.

Supporting CCS development in Ireland – Gas fired power plants in combination with CCS could introduce a new product in the Irish electricity market. This combination could provide zero emission electricity that is dispatchable on-demand. Ireland already has Combined Cycle Gas Turbine (CCGT) plants and Open Cycle Gas Turbine (OCGT) plants, and more are likely to be built over the coming 15 years. To ensure this energy option is developed, CCS should therefore be recognised and incentivised in a similar way to other technologies which provide the same benefits.

Facilitating hydrogen trials – Gas Networks Ireland will introduce hydrogen into the network in the longer-term but only following extensive testing and safety case development. Investment in these activities will be required through the 2020's to enable the development of appropriate standards and codes. Shareholder and Regulator support will be required to introduce safe but pragmatic regulations and incentives that will facilitate the introduction of new gases onto the network.

A Clean Energy Future for Ireland

Ireland's gas network provides a major opportunity to achieve significant and enduring emissions savings, sooner rather than later, across every sector of the economy, in a least cost and least disruptive manner; while retaining energy sector security and flexibility.

Ervia and Gas Networks Ireland are committed to developing the gas network so that this opportunity can be realised. Policy and other supports will be required to achieve our vision and as we work towards it, we will partner with key energy stakeholders, industry bodies, researchers and communities to ensure a least cost and fair transformation to a clean energy economy.

Realising a net zero carbon gas network will help to ensure that Ireland plays its part in the global effort to tackle climate change, becoming a sustainable clean energy economy now and for future generations.

Components of Our Vision

Natural Gas is the earth's cleanest fossil fuel. It emits 40% less CO_2 than coal and 22% less CO_2 than oil[3]. It also produces negligible levels of nitrogen dioxide (NOx) and sulphur dioxide (SOx) compared to oil or coal. Switching from these higher carbon fuels to natural gas can deliver immediate emissions benefits. The existing gas network is already capable of taking on significant new energy demands.

Compressed Natural Gas (CNG) is natural gas stored under high pressure. Replacing diesel in HGVs and buses with CNG would deliver immediate emissions reductions, air quality improvement (by eliminating particulate matter) and noise reduction. CNG is particularly well suited to deliver the high power and distance requirements of heavy-duty transport such as HGVs, buses and ships. Bio-CNG is renewable gas stored under high pressure. It can be used as a renewable transport fuel in the same way as CNG but delivers even greater emissions savings. We are already investing in CNG refuelling solutions for HGVs and buses. In 2018 the first public CNG refuelling station at Dublin Port became operational as part of our ambition to develop, in partnership with others, a 170-station CNG refuelling network.

Renewable Gas is biomethane (purified biogas) produced from existing waste streams and a variety of sustainable biomass sources, including grass, animal waste, crop residues and food waste. It is net zero carbon, extremely versatile and fully compatible with existing gas network infrastructure. It is identical in standard to natural gas and can be used for all the same applications, using the same machinery (boilers, appliances). It can be blended with, or can act as a substitute for, natural gas. Gas Networks Ireland is targeting 11TWh/annum renewable gas in the network by 2030 (20% of current demand). We are already active in facilitating the emergence and uptake of this new energy source via the existing gas network. A network of renewable gas injection points is under development with the first commissioned in 2019. We are working with Teagasc, MaREI and other key stakeholders to develop plans for a renewable gas industry for Ireland in partnership with farmers and communities. We are developing certification for renewable gas for Ireland (Green Gas Certificates) to assure the origin and sustainability of renewable gas sources which will stimulate the use of renewable gas by industry and other sectors.

Hydrogen produces zero CO_2 emissions when combusted. Much like natural gas, hydrogen can be used for heating, transport, and power generation. Currently most hydrogen is produced by separating it out from methane. This involves separating out the hydrogen in natural gas through a process called Steam Methane Reforming (SMR). This process produces CO_2 emissions which can be stored via CCS. Hydrogen may also be produced by an entirely carbon free process called electrolysis, this can use renewable electricity to split water into hydrogen and oxygen. The process is commonly referred to as Power to Gas (P2G). Electrolyser technology is developing rapidly, becoming larger scale and lower cost. Given the scale of the ambition for increased renewable energy generation for Ireland, this approach offers significant potential.

Gas Networks Ireland participates in a number of Irish and European gas forums and research initiatives, which are assessing how hydrogen could be transported using existing gas networks. We are also closely monitoring developments in the UK where hydrogen use in the gas network is being trialled by Northern Gas Networks.

Carbon Capture and Storage (CCS) involves capturing CO_2 from large point sources, such as power plants, and transporting it by pipeline or shipping, and securely storing it underground in depleted gas fields, thus preventing the CO_2 from entering the atmosphere (CO_2 "abatement"). Abated Natural Gas is natural gas supplied in conjunction with CCS to provide the benefits of natural gas without the emissions. Together with Ervia, we are already examining the feasibility of CCS solutions for Ireland with CO_2 being stored off-shore of Ireland or with CO_2 being exported (piped or transported by tanker to foreign storage facilities).

2. Ireland's Decarbonisation Challenge

Ireland is not on course to meet its EU 2020 Greenhouse Gas (GHG) emissions and renewable energy targets. Heating and transport emissions targets are proving particularly challenging. Emissions and renewable energy targets will increase in 2030 and 2050. Ireland will also have to manage the impact of a rising population, a growing economy leading to increased energy demand, and a growing agriculture sector. Natural gas will play an immediate role in reducing emissions in the residential, transport, electricity generation, and industrial and commercial sectors by replacing more CO_2 intensive fossil fuels such as oil, coal and peat. There are significant further opportunities for the gas network to support the achievement of targets in electricity generation, heat and transport.

Ireland's Current Position

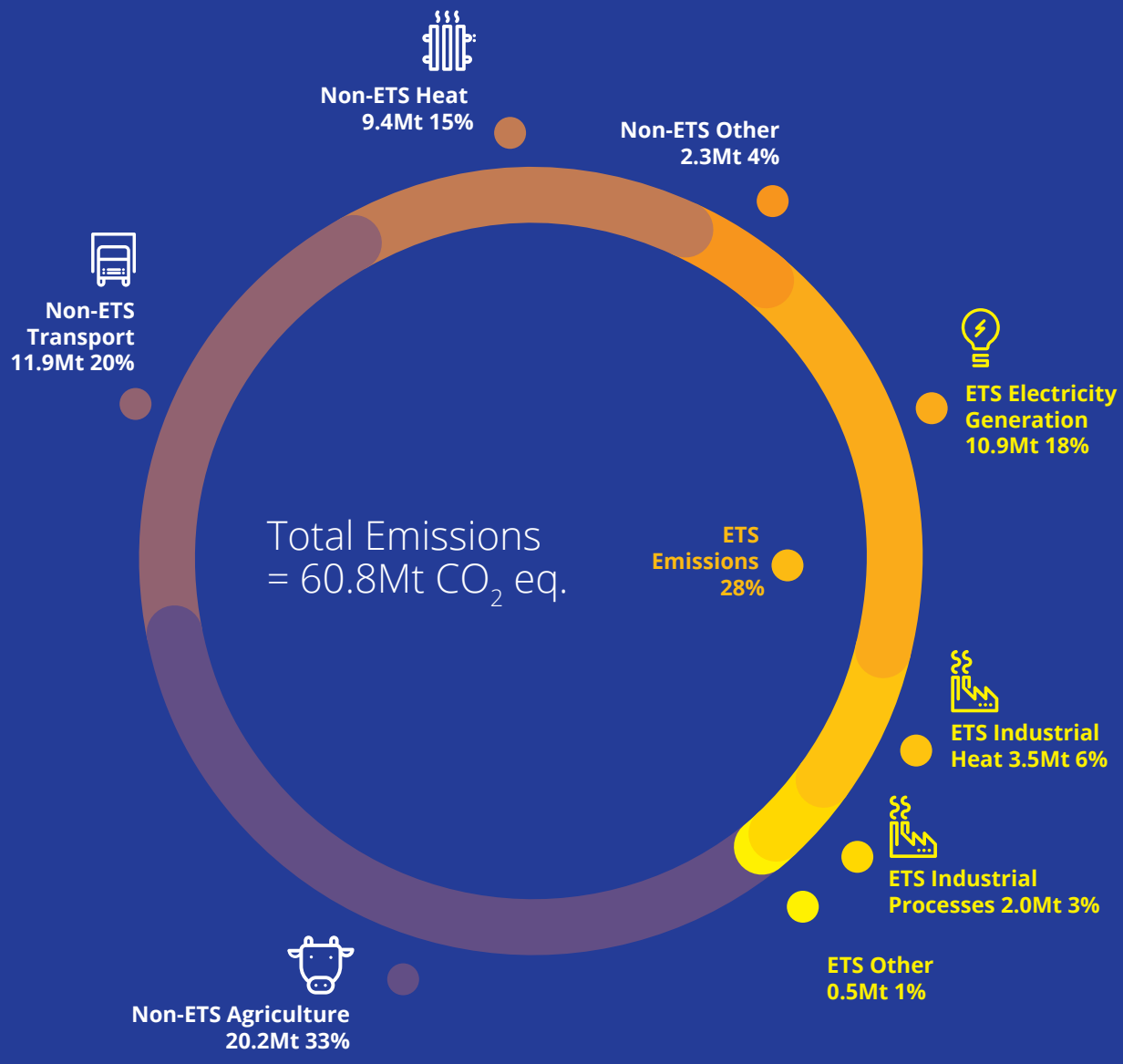
Emissions reductions are not on course to meet EU targets

Ireland must achieve mandatory national emissions reductions in the EU Non-Emissions Trading Scheme (Non-ETS) sector which includes agriculture, transport, residential and commercial sectors. Large emitters in the power generation, industrial and aviation sectors must achieve targets in the EU Emissions Trading Scheme (ETS) sector.

Ireland's emissions profile is set out in Figure 2. This shows that agriculture is the biggest source of overall emissions, currently at 33%, followed by transport at 20% and electricity generation at 18%. The nature of its agriculture-based economy means Ireland has the highest portion of overall emissions from agriculture against an EU average of circa 10%[13]. Decarbonising the agriculture sector is challenging, particularly as agri-food output is forecast to increase.

Ireland is not projected to meet its EU 2020 emissions targets and is not on the right path to meet longer-term EU and national targets. Non-ETS emissions are projected to be only 0-1% below 2005 levels by 2020 compared to a 20% reduction target[14]. Ireland's CAP is a welcome development which sets out clear targets for emissions savings per sector to 2030 along with clear governance and accountability.

Figure 2: Ireland's GHG Emissions 2017 (based on EPA 2017 Inventory)[7]



ETS = Emissions Trading Sector
Non-ETS = Non Emissions Trading Sector

Emissions targets will increase for 2030

EU targets will increase by 2030 and will rise further in line with the EU's ambition to achieve climate neutrality (net zero emissions) by 2050. Failure to achieve these targets will result in substantial fines levied on EU/Irish taxpayers.

The EU has set out more challenging emissions targets for 2030 as follows:

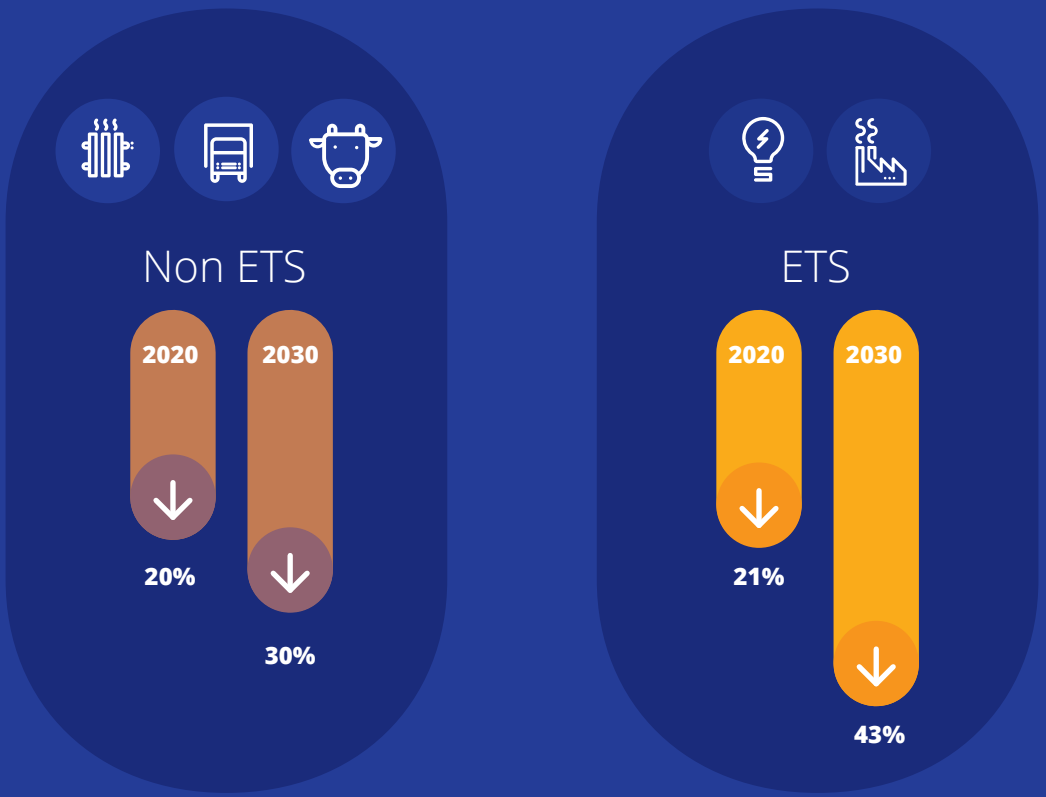
- Non-ETS sector[15] – 30% emissions reduction by 2030 compared to 2005 levels
- ETS sector[14] – 43% emissions reduction by 2030 compared to 2005 levels

The Non-ETS sector target is a mandatory national target and compliance is achieved by staying within allocated carbon budgets. Ireland's next carbon budget will be for the period 2021–2030. Emissions savings achieved early and maintained over the period can be accumulated toward the 2030 target. Early action is therefore important to ensuring the best possible chance of achieving Ireland's targets.

At a national level, Ireland's Climate Action and Low Carbon Development Act 2015 requires "an aggregate reduction of at least 80% CO_2 emissions (compared to 1990 levels) by 2050 across the electricity generation, built environment and transport sectors; and in parallel, an approach to carbon neutrality in the agriculture and land-use sector"[14].

To achieve this target, Ireland must reduce emissions across the electricity generation, built environment and transport sectors from 31.8Mt CO_2 today to 5Mt CO_2 in 2050[15]. Emissions from transport alone are double this target which highlights the scale of the challenge. Over this time, it is estimated that Ireland's population may reach 6.7 million (an increase of almost 2 million) which will further escalate the emissions challenge[1]. Ireland's ambition to reduce emissions will likely increase even further in line with the European Commission's vision to achieve climate neutrality by 2050.

Figure 3: EU Non-ETS and ETS Emissions Reduction Targets



Ireland's Renewable Energy Challenge

Renewable energy is growing significantly in the electricity sector but Ireland is not on course to meet overall EU targets

In 2017, Ireland met 10% of energy use from renewable energy[14]. Significant progress has been made in increasing renewable energy in electricity generation, however Ireland looks set to miss its EU 2020 overall target of 16% energy use from renewables (Renewable Energy Share – 'RES'). This 16% target is made up of individual targets for electricity, heat and transport as set out in Figure 4. In 2017, renewable energy accounted for 30% of electricity generation, 7% of heat, and 7% of transport[14].

Renewable energy targets will increase for 2030 and heat and transport must play an increasing role

The EU has made it clear that more demanding targets will be implemented in the decades ahead. European agreement has been reached for an even more challenging target of 32% RES for the EU for 2030, with a clause for an upwards revision by 2023[17]. This target will be split across electricity generation, heat and transport.

Electricity generation is the area which has seen most success to date. Electricity however only accounts for 20% of overall energy use in Ireland, meaning the 30% renewable electricity share in 2017 equates to just 6% of overall energy use from renewable sources[2]. Ireland has made significant progress towards its 40% target for electricity generation from renewable sources given the successful investment in onshore wind generation. The government has also set out an ambition to generate 70% of electricity from renewable sources (which will include offshore wind and solar) by 2030[18]. However, even at Ireland's target of 70% renewable electricity, only 14% of overall energy use would come from renewables, against a target of 32% in 2030[2] (assuming electricity remains at circa 20% of overall energy use). Heat and transport account for 80% of energy use, and Ireland must also achieve a much higher share of renewable energy in these sectors in order to meet its 2030 targets.

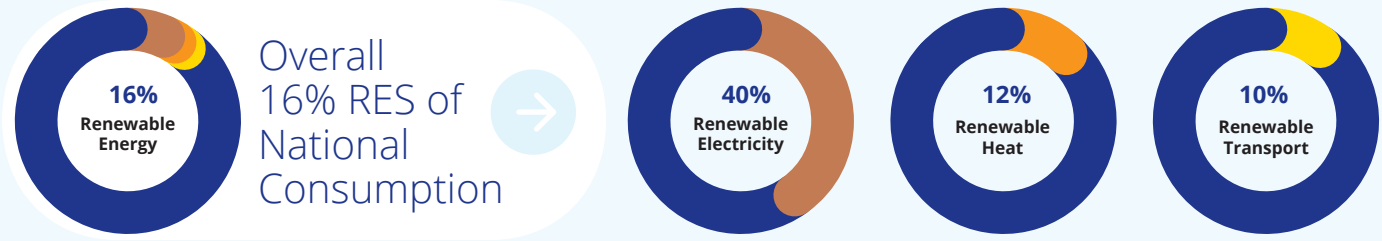
Meeting Ireland's Emissions and Renewables Challenges

Natural gas is a cleaner alternative to coal, peat, and oil, and replacing these fuels with natural gas in electricity generation, heating and transport will provide immediate emissions reductions. As the gas network evolves to become a net zero carbon network by introducing renewable gas, hydrogen and CCS, continued progress will be made toward Ireland's long-term climate goals.

Renewable gas in heat and transport offers a vital opportunity for Ireland to increase its overall renewable energy share while also contributing to Ireland's mandatory non-ETS emissions targets. Emissions reductions from renewable electricity do not count toward Ireland's mandatory EU emissions targets as they are counted toward ETS sector targets. Renewable electricity and renewable gas therefore can play complementary roles in reaching both emissions and renewable energy targets.

Ireland's CAP is a welcome development which sets out a significant ambition for the increased deployment of renewable energy in the country's overall energy mix. If all the targets in the CAP are met, it is estimated that approximately 30% of Ireland's energy requirements will be met by renewable sources by 2030. The current CAP does not reflect Gas Networks Ireland's target for 11TWh/annum renewable gas in the network by 2030 (20% of current demand). This represents approximately 10% of Ireland's projected energy use in 2030 and its implementation would increase Ireland's renewable energy usage to 40% by 2030.

Figure 4: Ireland's 2020 Renewable Energy Targets[16]



3. Unlocking a Clean Energy Future Using the Gas Network

Ireland's existing gas network is a critical €2.6 billion asset owned by the people of Ireland. The gas network underpins Irish economic growth and competitiveness, and this valuable national asset can be used to transform the country's energy economy. The gas network will provide a sustainable, secure and cost-effective decarbonisation pathway for Ireland in partnership with renewable electricity.

Meeting Ireland's targets and transitioning to a clean energy future will require a variety of low carbon and renewable energy options to be explored and integrated across every sector of society. Early action is essential for Ireland to have the best possible chance of achieving its climate goals. By waiting for future technology solutions and behaviour change, Ireland risks being left with too much to deliver too late, and ultimately missing its targets.

To have the best chance of achieving its targets, Ireland must consider how it can use its existing electricity and gas networks to make progress sooner rather than later. Both systems can play a complementary role in a clean energy future. Using the existing gas network will ensure that immediate progress can be achieved in a manner which balances sustainability with affordability and energy security.

Sustainable:

Gas (in all its forms – natural, renewable, abated, hydrogen) is an essential part of Ireland's pathway to 2050 and beyond. The gas network will deliver immediate emissions reductions, and over time the network will evolve to become net zero carbon, in the same way that the electricity grid is progressively decarbonising.

The gas network plays a crucial role in the Irish economy today, providing heat to homes, businesses and industry and providing the fuel for over half of Ireland's electricity generation. The demand for gas to provide heat and fuel is growing, driven by an expanding population and continued economic growth. Gas demand is expected to grow significantly between now and 2030[19], and both natural gas and renewable gas will be part of the Irish energy mix beyond 2050[20,21].

The gas network provides a way to achieve immediate progress on emissions. Natural gas is a cleaner alternative to coal, peat and oil and replacing these fuels with natural gas in electricity generation, heating and transport will ensure early action and provide immediate emissions reductions. As the gas network evolves to become a net zero carbon network by introducing renewable gas, hydrogen and CCS, continued progress will be made toward Ireland's long-term climate goals.

The nature of Ireland's agricultural economy also means that the country is uniquely positioned to develop a renewable gas industry which will provide a productive use of agricultural wastes, reduce agricultural emissions, and contribute to meeting Ireland's renewable energy targets.

Secure:

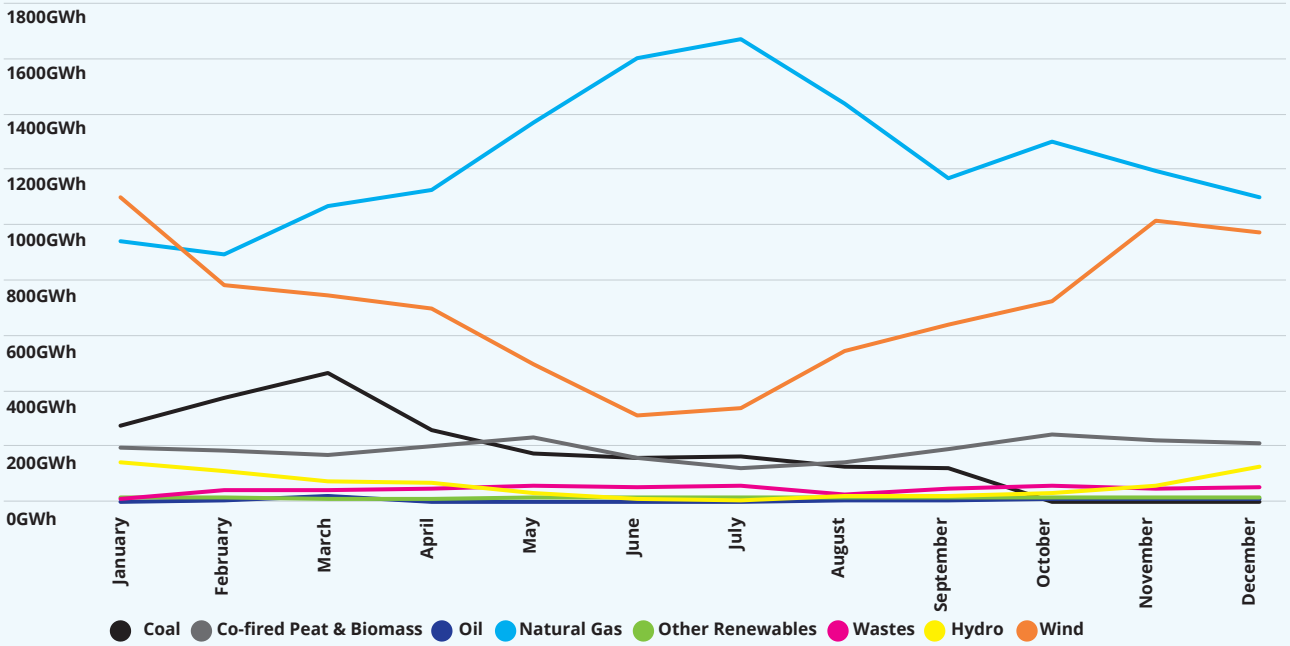
The unique large storage capacity and flexibility of the gas network provides low cost energy storage, enhances security of supply and enables high levels of renewable energy such as wind on the electricity grid.

The large energy delivery and storage capability of the gas network plays a significant role in Ireland's energy system. In 2017, the gas network transported over double the energy transported by the electricity grid[22,23]. The gas network is a vital part of Ireland's energy system providing 30% of Ireland's total primary energy needs and the fuel required for more than half of all electricity generation[4]. The gas network has also consistently proven its resilience through extreme weather events, with no loss of gas supply to households, businesses or the power generation sector.

Ireland has significantly increased its renewable electricity share to 30% in 2017[14]. This is a very positive development, and Ireland has set an ambition to reach 70% renewable electricity by 2030[18]. The gas network enables high levels of renewable energy by providing quick ramp up and flexibility when there is very low wind. The large storage capacity of the network can be used to flexibly meet short-term energy demand fluctuations and high seasonal winter peaks. This was evidenced in summer 2018, when up to 90% of electricity was generated using natural gas due to very low winds[24] (Figure 5). The flexibility and large storage capability of the gas network is unique and cannot be economically provided by other energy sources.

The gas network will continue to provide a safe and secure energy supply to the Irish economy. It will also continue to provide the flexibility to support high and increasing levels of intermittent (not always available) wind and solar energy on the electricity grid, ensuring that the stability of the grid is maintained. Renewable gas and hydrogen will play significant roles in the future gas supply, which will provide indigenous, renewable, and diverse gas sources, enhancing security of supply. Imports of renewable gas or hydrogen could also supplement indigenous production in the future, providing a further option to diversify the gas supply.

Figure 5: Electricity Generation Mix 2018 (SEAI)[25]



Cost effective:

Gas and the gas network will provide a least cost pathway to decarbonise home heating and power generation (with CCS), and will provide cost effective solutions for other sectors supporting a competitive economy and ensuring energy affordability.

MaREI has carried out an analysis of Ireland's energy system which has shown that electrification, natural gas with CCS, renewable gas and hydrogen will all play significant roles in 2050[20]. Poyry have similarly concluded that achieving a decarbonised energy sector in 2050 will be significantly cheaper by including natural gas with CCS, renewable gas and hydrogen[9]. The European Commission's analysis on a carbon neutral Europe by 2050 also indicates significant roles for bioenergy/renewable gas, CCS and hydrogen in the future energy mix.[26]

Using the existing gas network to transport renewable gas is the least cost and least disruptive way to decarbonise home heating. An analysis carried out by KPMG has demonstrated that the cost of decarbonising heating for the one million homes on or close to the gas network is three times more expensive via electrification compared with renewable gas[8]. Economic levels of energy efficiency (i.e. insulation) should underpin every solution, however, placing a high cost burden on households will not deliver the rapid change required. Using the gas network to transport renewable gas is a practical way to decarbonise home heating which avoids 'carbon lock in' as the consumer does not have to make an active choice to invest and adopt new technology. This means that progress can be achieved sooner rather than later and en masse. Emissions savings achieved early can be accumulated year on year toward meeting Ireland's targets.

Ireland's CAP estimates that the Marginal Abatement Cost (MAC) associated with agricultural renewable gas (agricultural biomethane) is €377 per tCO_2eq (MAC is the cost of reducing emissions measured per unit). Analysis by KPMG has demonstrated that the MAC in respect of renewable gas from agricultural sources is estimated to be €128 to €207 per tCO_2eq. The CAP estimate is therefore approximately 82% to 195% higher than KPMG's estimates. Renewable gas can be produced from a wide variety of sources and using a wide range of technologies. As a result, the MAC varies accordingly. The analysis contained in the CAP assumes a single cost estimate using worst case assumptions, the costly use of seaweed as a feedstock. Gas Networks Ireland's target to reach 20% renewable gas in the network in 2030 is based on agricultural waste and grass, a significantly cheaper source. The gas network also requires significantly less investment to facilitate renewable gas injection in comparison with the electricity grid reinforcement costs required for high levels of electrification. The total system costs should be evaluated when comparing technologies to ensure the lowest overall cost to the Irish citizen.[27]

Natural gas and the gas network will also continue to play a key role in keeping electricity generation costs down, particularly as the level of intermittent (not always available i.e. wind and solar) renewables increases. The gas network provides large energy storage today at a much lower cost than battery storage. Combining CCS with the large storage and flexibility characteristics of the gas network will be key to a cost effective transformation. The International Energy Agency (IEA) has stated that without CCS, the transformation of the power sector will be at least $3.5 trillion (USD) more expensive[28]. The European Commission has similarly reported that it will cost the EU an additional €1.2 trillion to reach its CO_2 reduction target for the power sector without CCS[10].

The gas network will also provide cost effective solutions to reduce emissions in heavy transport. CNG (and Bio-CNG) provides an attractive solution for HGVs and bus fleet owners to displace diesel, resulting in reduced emissions and operating costs, and enhanced air quality for Ireland.

The gas network will continue to provide cost effective solutions for industry. Natural gas is a vital input and heat source for many multi-national industrial customers with high temperature heat requirements. The availability of secure and cost competitive natural gas, and increasingly renewable gas, is a key requirement for many of these companies in choosing to locate or expand in Ireland.

Maximising the use of the existing gas network will facilitate a cost-effective transformation, avoiding significant new capital investment, and ensuring a fair and just energy transition for all citizens, especially those most vulnerable to energy poverty.

Ireland's Future Energy System and Complementarity:

Electricity and gas can play complementary roles to decarbonise Ireland's energy system in a least cost manner while ensuring energy security.

'Sector coupling' between gas and electricity has been recognised at European policy level as key to supporting decarbonisation efforts. This means that gas and electricity infrastructure should be planned and operated in an integrated manner. Combining the virtues of the electricity and gas systems can deliver early emissions savings, allow more renewables, lower costs to consumers, enhance energy storage and increase system resilience. European gas system operators are actively working on sector coupling initiatives with electricity system operators.

Ireland's electricity and gas networks already play complementary roles. Gas produces substantial amounts of Ireland's electricity and can ramp up and down depending on the level of intermittent renewable energy (i.e. wind) available to the electricity grid. Gas and electricity also meet customer energy needs for heat and power in a complementary way. EU studies have shown that electricity use may reach up to 40% of total final energy consumption by 2050[29]. Net zero carbon gas networks will therefore play an important complementary role for Europe and for Ireland. Recognising this, six European gas networks have already committed to net zero carbon by 2050. As Ireland seeks to deliver on its climate ambitions, integrated planning and operation of the electricity grid and gas network will ensure emissions savings are achieved in a secure and affordable manner. This approach will deliver a fair transition for all energy users.

In electricity, increasing levels of renewable energy will be required to meet Ireland's targets and decarbonise the electricity sector. The gas network will continue to provide large energy storage and flexibility for the electricity grid particularly as the level of intermittent renewables increases. This will optimise the use of Ireland's existing state assets and avoid significant and unnecessary electricity grid reinforcement costs.

The use of CCS will also extend the use of gas fired electricity generation plants with the benefit of reducing the overall cost of the energy transition for the state, and ultimately for the energy consumer.

In heating, it will be less costly and less disruptive to decarbonise heating for those consumers already connected to and within reach of the network by using the existing gas network than by electrification. The CAP sets out a significant ambition for electrification of heat in the existing residential sector by 2030. It also calls for a target to be set for renewable gas use for 2030. Both electrification and renewable gas will play key roles in decarbonising the existing residential heating sector. Renewable gas can be used in existing gas boilers today and its use will ensure redundancy, security and affordability in our path to 2030. Existing boilers are also understood to be compatible with small percentage blends of hydrogen.

The CAP signals an effective ban on the installation of gas boilers from 2025 in all new dwellings through the introduction of new regulatory standards for home heating systems. As the gas network evolves to become net zero carbon, transporting renewable gas and hydrogen, it will offer a viable alternative clean heat source for new dwellings which can be delivered through renewable heating systems such as renewable gas and hydrogen boilers.

District heating could also potentially offer another viable option as a heat source for new dwellings.

In transport, electric vehicles provide a suitable solution for cars and light vehicles while CNG and Bio-CNG provide a suitable solution for heavy-duty transport including HGVs, buses and ships.

4. A Net Zero Carbon Gas Network by 2050

Gas technologies available today will deliver immediate emissions savings for Ireland and will provide a pathway for future clean technologies to be adopted. Longer-term, emerging technologies will become cost competitive and suitable for adoption. Gas and the gas network will deliver significant emissions savings for Ireland as the gas network progressively decarbonises and becomes net zero carbon. A net zero carbon gas network will complement the role of renewable electricity and ensure Ireland delivers on its climate goals in a practical and cost-effective manner.

Our Vision

Our vision is for Ireland's gas network to be net zero carbon by 2050 (Figure 6).

In 2050, net zero carbon gas will be available for use in home heating, transport, industry and electricity generation. This ambition will be achieved by progressing two core aims, each contributing approximately half of the emissions savings required to completely decarbonise the network.

Injecting 50% net zero carbon and zero carbon gases into the network to displace half of the natural gas required to meet consumer demand. Renewable gas will be injected into the network now, and over time, hydrogen will also be added. Gas Networks Ireland is targeting 11TWh/annum renewable gas in the network by 2030 (20% of current demand). The volume of renewable gas and hydrogen in the gas network will increase to 50% by 2050. The evolution of technology between now and 2050 will determine the ultimate split between renewable gas and hydrogen in the network in 2050. A variety of scenarios may arise over this timeframe which may result in more or less hydrogen or renewable gas, but with the combination of these gases still meeting 50% of gas demand.

'Abating' the 50% natural gas still required to meet overall demand. Abated natural gas is natural gas used in conjunction with CCS to capture and store the CO_2 emissions from power generation and large industry.

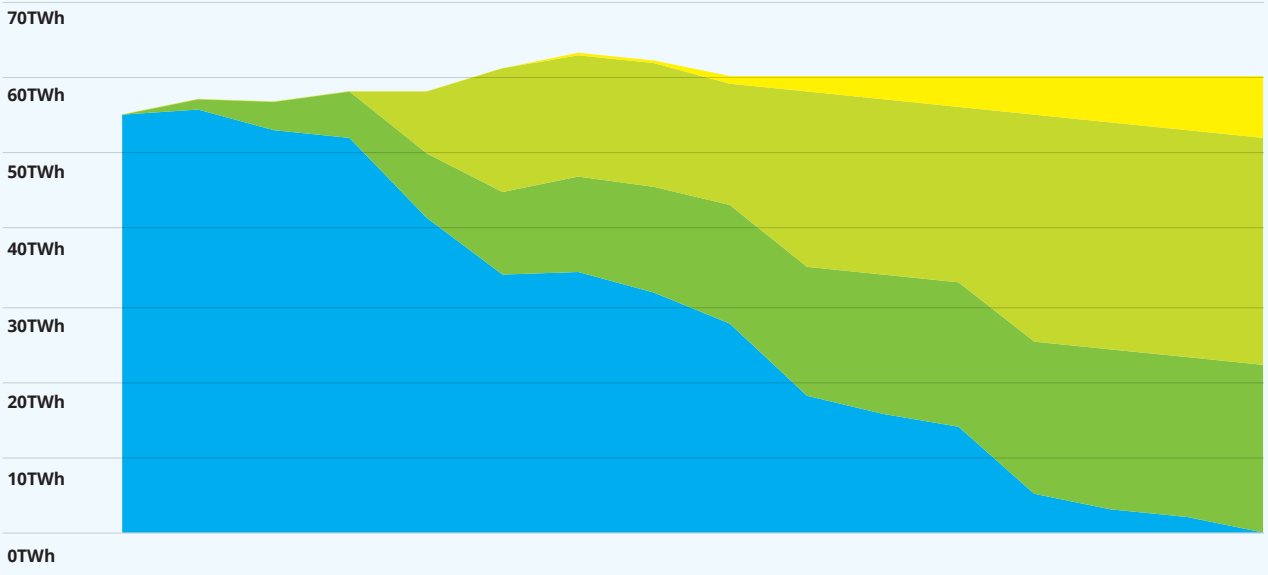
Our vision for Ireland's gas network is aligned with other European gas networks of which six have committed to net zero carbon by 2050.

Our vision for the short to medium-term is based on currently available and mature technologies (natural gas, CNG in transport, and renewable gas) which will deliver immediate emissions savings for Ireland. Making early progress ensures savings accumulate and grow year after year as we move toward 2050. Our vision for the longer-term is underpinned by technologies which are already being piloted and adopted in other parts of the world (CCS and hydrogen). Our vision is also underpinned by collaborative research between Gas Networks Ireland and MaREI on renewable gas, power to gas and the future of gas.

Our vision is for half of Ireland's heating sector to decarbonise seamlessly and 'en masse' as the gas delivered to customers via their existing gas connections is increasingly decarbonised. Electrification will also play an important role in the energy system as we progress toward 2050, with electrification offering a way to decarbonise existing 'one-off' and rural housing that is not located within practical reach of the existing gas network.

Our vision is that CNG (and Bio-CNG from renewable gas) will play an important role in decarbonising the heavy-duty transport sector including HGVs and buses, while electrification will play a key role in decarbonising the passenger car fleet.

Figure 6: Our vision for a net zero carbon gas network by 2050



Gas constitution percentage %	2020	2022	2024	2026	2028	2030	2032	2034	2036	2038	2040	2042	2044	2046	2048	2050
Natural Gas	100	97	94	90	72	56	54	51	46	30	26	23	8	5	3	0
Renewable Gas (Biomethane)	0	3	6	10	15	18	20	23	26	28	31	32	33	35	35	37
Abated Natural Gas (with CCS)	0	0	0	0	14	26	25	26	27	38	38	38	50	50	50	50
Hydrogen	0	0	0	0	0	0	0	1	2	3	5	7	8	10	12	13

Our vision also accommodates Ireland's electricity sector continuing to evolve to include two-way energy flows (where customers deliver energy back to the grid), higher demand, and greater demand volatility. The electricity grid will need to meet these complex requirements with an increasingly high level of intermittent renewable energy. The gas network will play a complementary and important role in supporting high levels of intermittent renewable energy on the grid and in providing flexibility to ramp up and down to meet the evolving needs of the electricity grid.

Our Vision Components

The gases and technologies which underpin our vision are as follows:

Renewable gas

Renewable gas is a clean, sustainable and net zero carbon fuel for heat, electricity and transport. It works in the same way as natural gas, coming into homes and businesses through the existing gas infrastructure. Ireland is uniquely positioned to benefit from renewable gas. Not only will renewable gas reduce energy related emissions, it will also help to reduce those from the hard to tackle agriculture sector, the biggest source of Ireland's emissions.

Ireland has the highest potential for renewable gas production per capita within the EU, with a potential of 13TWh/annum forecast by 2030[30]. Gas Networks Ireland is targeting 11TWh/annum renewable gas production by 2030 (20% of current demand). Various studies indicate that Ireland has the potential to sustainably produce over 42TWh/annum renewable gas[31]. We forecast that 22TWh/annum could be produced in Ireland by 2050.

Renewable gas is produced from a wide variety of sources including existing waste streams and a variety of sustainable biomass sources, including grass, animal waste, crop residue and food waste. Renewable gas can be produced through a variety of techniques, including the most widely used process 'anaerobic digestion'. This is where microorganisms break down the waste and biomass sources in the absence of air, producing gas. Anaerobic digestion is a well-established mature technology with over 17,000 plants in operation across Europe including Ireland and Northern Ireland[32].

The re-cast EU Renewable Energy Directive (RED II) comes into legal effect from 2021 and its sets out the minimum compliance requirements for all renewable energy fuels. Key among these requirements for liquid, gaseous, and solid fuels is the sustainability criteria. RED II sets out a list of fuel and feedstock types that can be classified as sustainable and also sets out carbon intensity thresholds. In addition, RED II recognises certain improvements in agriculture production which should be encouraged and assigns bonus carbon rating measures to assist in stimulating these. Ireland will use a life cycle assessment calculation formula to determine compliance with the sustainability criteria set out in the Directive. Gas Networks Ireland has partnered on an industry project to develop a robust calculation methodology and independent certification scheme for Ireland. Ireland's Green Gas Certification (GGC) scheme will ensure a reliable method of tracing and verifying renewable gas origin and will ensure the sustainability criteria set out under RED II are met.

In order to achieve our 2030 ambition, a network of 340 anaerobic digestion plants will be required. These plants will deliver renewable gas to the gas network either by direct connection or through a network of transmission connected Central Grid Injection (CGI) points. The first CGI facility is planned for Mitchelstown in Co. Cork and will enable the output of 590GWh/annum renewable gas, which is enough for 56,000 homes, avoiding over 170,000 tonnes of CO_2 per annum.

Gas Networks Ireland's role will be as facilitator of the roll-out of renewable gas. We will be an advocate for change and we will put in place the network to transport the renewable gas. A partnership of Government, investors, local producers and large energy users will ultimately ensure the successful delivery of this vital new indigenous resource.

CCS and abated natural gas

CCS is a technology which captures up to 100% of the CO_2 from electricity generation and large industrial emitters and transports it by pipeline or shipping and securely stores it underground in depleted gas fields ensuring that it is not emitted into the atmosphere[33]. The nearly depleted Kinsale gas field, off the coast of Cork, offers a potentially ideal storage facility for CO_2 and this is being investigated by Ervia and Gas Networks Ireland. Developing CCS in Ireland would allow us to continue to enjoy the benefits of natural gas and support the penetration of increasing levels of renewable energy in electricity generation, while largely eliminating the CO_2 emissions. Natural gas used in conjunction with CCS in this way is known as 'Abated Natural Gas'.

CCS will become available from the late 2020s and will ramp up in phases as gas fired power plants (or large industry) adopt this technology, enabling emissions to be abated. CCS also provides the option to export CO_2 to other jurisdictions outside Ireland.

CCS is not a new technology; 18 large-scale facilities are operating successfully around the world and further facilities are planned across Europe, the US and Canada[34].

A CCS project in Ireland could capture CO_2 from a number of gas-fired power plants enabling the provision low-carbon electricity. It would also provide a pathway for CO_2 intensive heavy industry to decarbonise. Ireland needs essential products like cement and aluminium to build homes and grow our economy. These industrial processes produce CO_2 which can only be removed using CCS.

Hydrogen

Hydrogen produces zero CO_2 when combusted and has the potential to play an increasing role in Ireland's decarbonisation strategy. Much like natural gas, hydrogen can be used for heating, transport, industry and power generation. Hydrogen can be mixed with natural gas or renewable gas in small percentages to form a blended gas or it can also be used on its own (100% hydrogen). Gas Networks Ireland and Ervia are investigating the potential for hydrogen production and transportation using the gas network. Ireland's gas network has the potential to transport large volumes of hydrogen. The low-pressure distribution network has polyethylene pipework which is understood to be compatible with 100% hydrogen. Work is also underway to evaluate the compatibility of the high-pressure steel transmission pipelines with hydrogen.

Currently hydrogen is primarily produced by separating it out from methane. This involves separating out the hydrogen in natural gas through a process called 'steam methane reforming' (SMR). This process produces CO_2 emissions which can be stored via CCS. Hydrogen may also be produced by an entirely carbon free process called 'electrolysis'. This process uses renewable electricity to split water into hydrogen and oxygen. Producing hydrogen in this way is known as 'power to gas' (P2G). Electrolyser technology is developing rapidly, becoming larger scale and lower cost. Given the scale of the ambition for increased renewable energy generation for Ireland, this approach offers significant potential. Hydrogen from P2G can complement electrification by acting as a source of energy storage for intermittent renewable energy generation which would otherwise be wasted.

The production of hydrogen will give rise to the need for additional gas storage capacity. As Ireland's geology precludes some of the preferred methods of storing hydrogen at scale currently in use internationally, Gas Networks Ireland is focussing on assessing developments in man-made storage methods. One such approach is to use hydrogen rich liquids such as ammonia. Ammonia, which is a combination of nitrogen and hydrogen can be produced when there is a surplus of hydrogen. Hydrogen is then separated out as required. Ammonia can also be shipped internationally potentially forming part of a future international trade in hydrogen.

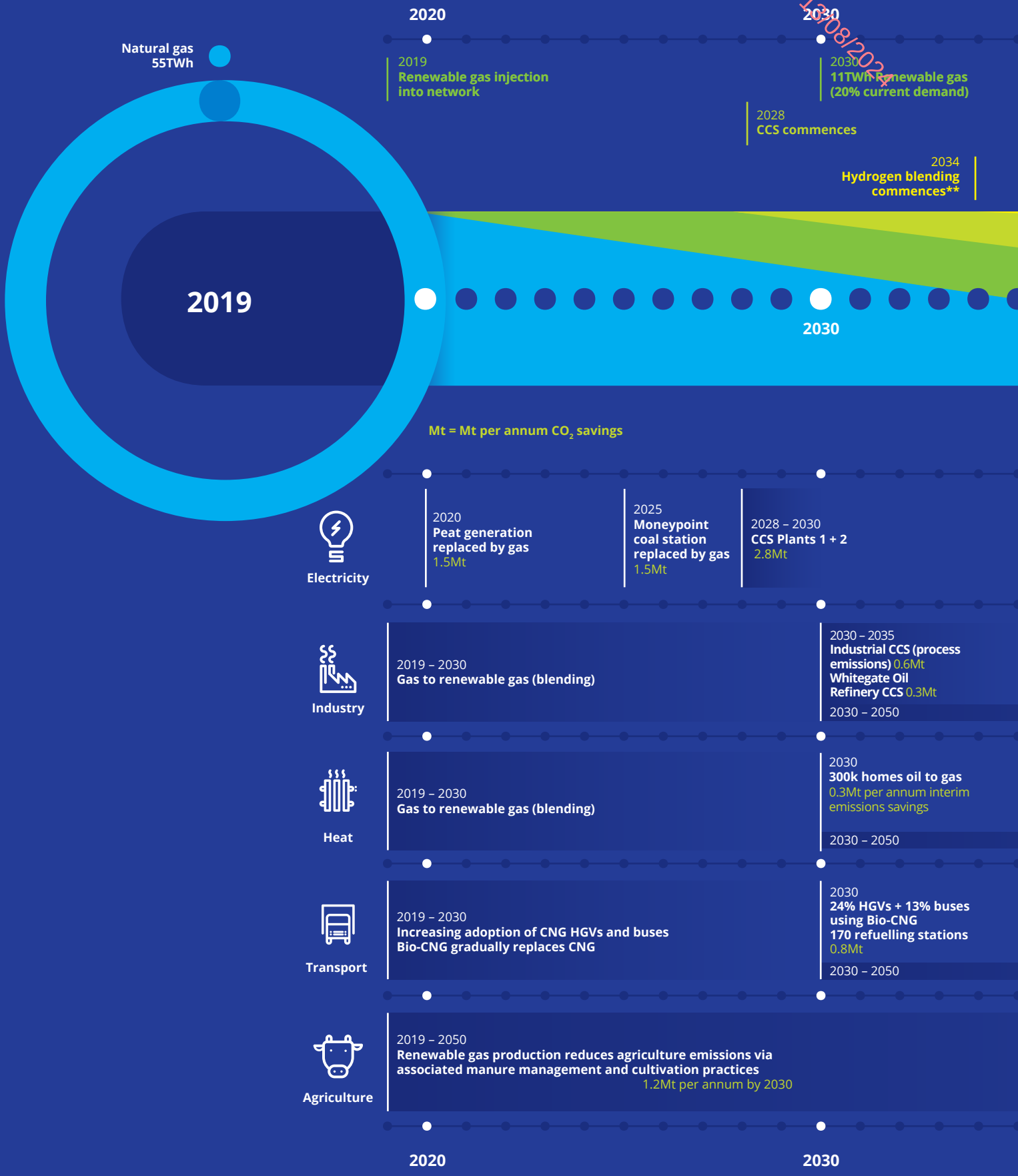
Gas Networks Ireland participates in a number of European gas forums, which are assessing how hydrogen could be transported using existing gas networks. In Ireland, Gas Networks Ireland and Ervia are actively collaborating with a variety of hydrogen research initiatives and bodies including GENCOMM (GENerating Energy Secure COMMunities through Smart Renewable Hydrogen), Hydrogen Mobility Ireland and Hydrogen Ireland Association. Hydrogen has the potential to provide Ireland with a highly versatile energy source which can be used in gas network injection, electricity generation, heat, transport and industry. Its storage capability also provides a potential additional source of energy security for the country. Gas Networks Ireland and Ervia have collaborated with peer semi-state companies to investigate hydrogen production and associated costs for Ireland.

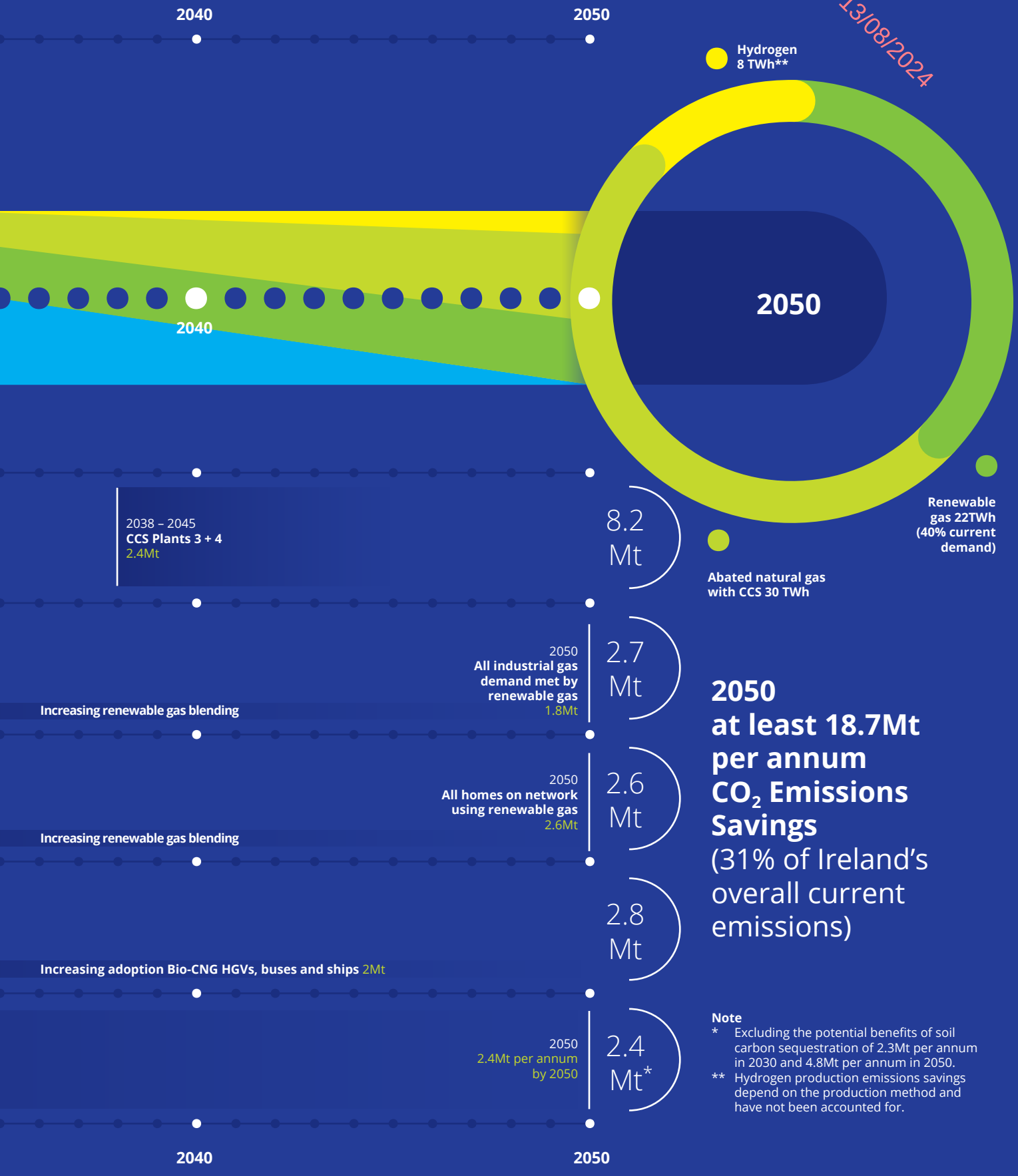
Hydrogen is being piloted and evaluated for use in heating and transport in many countries worldwide. In the UK, the Northern Gas Networks H21 North of England project is examining the feasibility, from both a technical and economic viewpoint, of converting the existing natural gas network to 100% hydrogen. We are closely monitoring developments in the UK.

Imports and exports

Emerging global markets in traded renewable gases will mean that import of renewable gas and hydrogen is likely to be available from 2030 onwards. Similarly, it is expected that CO_2 export to foreign storage facilities (e.g. Norway, UK) by ship or by pipeline will be available in the 2030s. These facilities could supplement, or substitute for, indigenous facilities if required in the future.

Our Vision Roadmap





2050
at least 18.7Mt per annum CO_2 Emissions Savings
(31% of Ireland's overall current emissions)

Note
* Excluding the potential benefits of soil carbon sequestration of 2.3Mt per annum in 2030 and 4.8Mt per annum in 2050.
** Hydrogen production emissions savings depend on the production method and have not been accounted for.

A Net Zero Carbon Gas Network by 2050

Our vision for a net zero carbon gas network in 2050 will be achieved in stages. As the gas network evolves and transports increasing volumes of net zero carbon and zero carbon gases, increasing emissions savings directly related to networked gas will be achieved. Figure 7, shows how the emissions profile of the gas network itself will evolve over time to become net zero carbon by 2050.

Our vision for a net zero carbon gas network will directly deliver significant emissions savings for Ireland as outlined in Figure 7, but it will also deliver wider emissions savings. A total emissions saving of at least 18.7Mt CO_2 per annum can be achieved by using gas and the gas network to decarbonise every sector of the economy. Based on total current emissions of 61Mt CO_2[7], this represents a reduction of 31% of Ireland's total emissions, or the equivalent of 58% of the emissions from transport, electricity generation and the built environment (against a target of 80% by 2050). Figure 8, outlines the economy wide decarbonisation potential of the gas network to 2050.

One of the key benefits of decarbonising the gas network is that it will not only help to achieve Ireland's ultimate renewable energy and decarbonisation targets in 2050, but in making early and continuous progress it will significantly contribute to meeting Ireland's interim milestone targets.

Figure 7: Gas network emissions reduction pathway

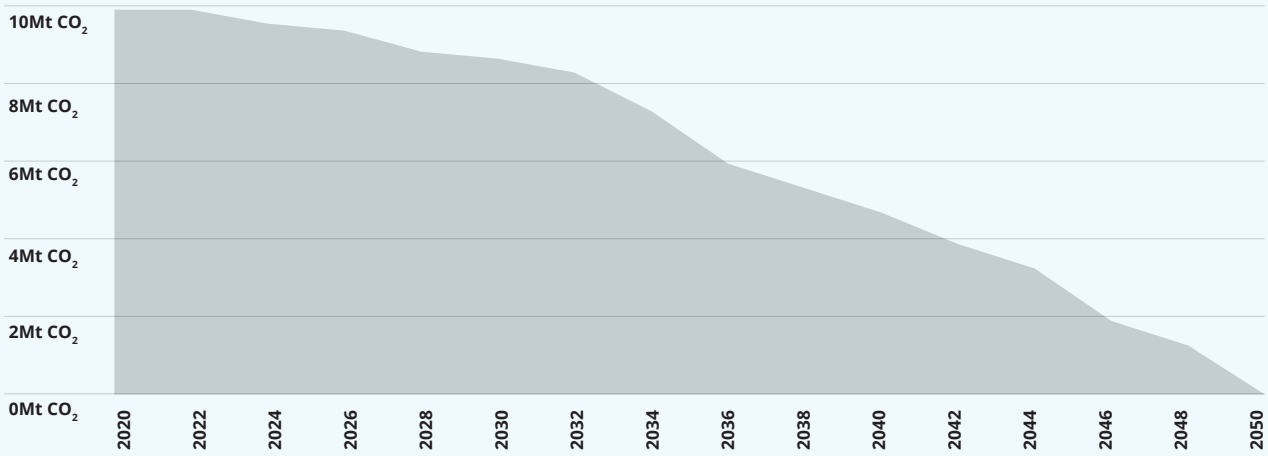
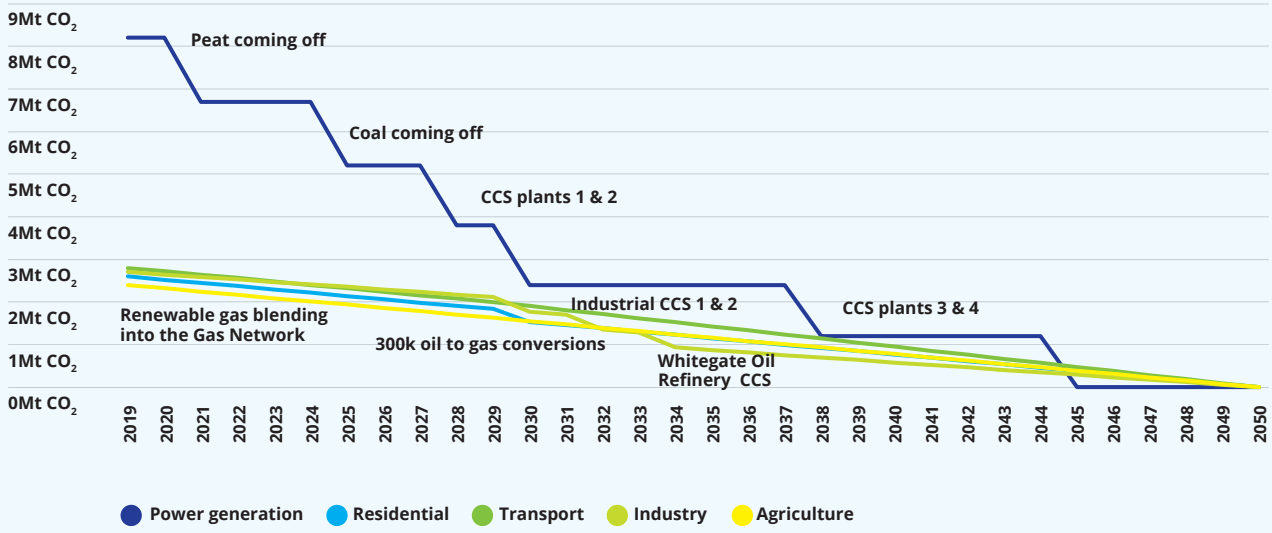


Figure 8: Economy wide decarbonisation potential



Our Vision in Summary

Our vision is for the gas network to evolve to become net zero carbon by 2050.

Natural gas and renewable gas in the network, together with CNG and Bio-CNG in transport, will deliver immediate emissions savings for Ireland. In the longer-term, hydrogen and CCS will play a significant role in achieving a net zero carbon gas network.

Our vision for the gas network will deliver decarbonisation sooner rather than later, and it will enable significant society wide emissions savings of at least 18.7Mt CO_2 /annum by 2050. Our vision for 2050 is one in which the gas network plays a key role in a decarbonised energy system, delivering net zero carbon gas and continuing to provide the critical large energy storage and flexibility which it provides today.

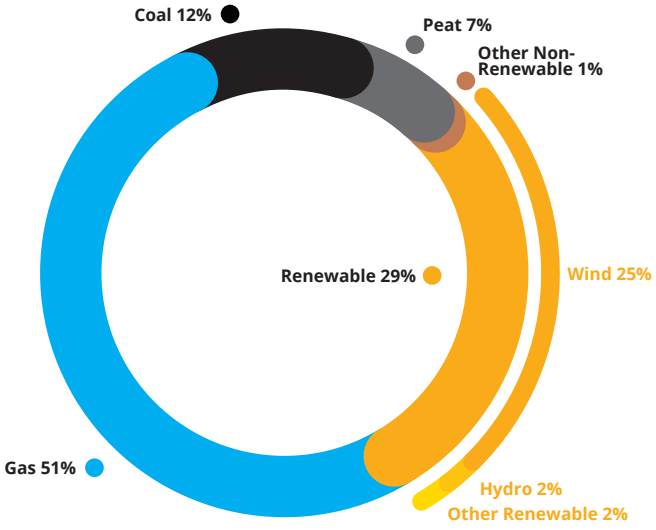
Using the gas network, a reduction of at least 8.2Mt CO_2/annum in electricity generation can be achieved by 2050.

5. Decarbonising Electricity

Electricity generation represents 18% (10.9Mt CO_2) of Ireland's emissions[7]. For Ireland to meet its long-term decarbonisation targets, low carbon electricity generation must be achieved. The carbon intensity of Ireland's electricity generation sector has fallen significantly over the last ten years; as the share of renewable energy in the generation mix has continued to increase, and as natural gas has replaced coal and oil. The responsive, flexible generation provided by natural gas will play an increasingly important role in supporting the volatility of intermittent renewable energy sources. Using the gas network, a reduction of at least 8.2Mt CO_2/annum can be achieved by 2050. Combining renewable gas with CCS offers the prospect of net negative emissions for Ireland and could be used to offset emissions in other sectors.

Ireland has set out an ambition to meet 70% of electricity generation from renewable energy[18]. Technologies such as wind and solar are 'intermittent' energy sources which means they are not always available to match demand and can drop off very quickly. As the share of intermittent renewables increases, the challenge of maintaining electricity grid stability and matching supply and demand grows. The responsive, flexible generation provided by natural gas plays an important role in supporting the volatility of intermittent renewables. In 2017, natural gas fuelled 51% of electricity generation requirements[22] (Figure 9).

Figure 9: Ireland's electricity generation fuel mix in 2017[22]



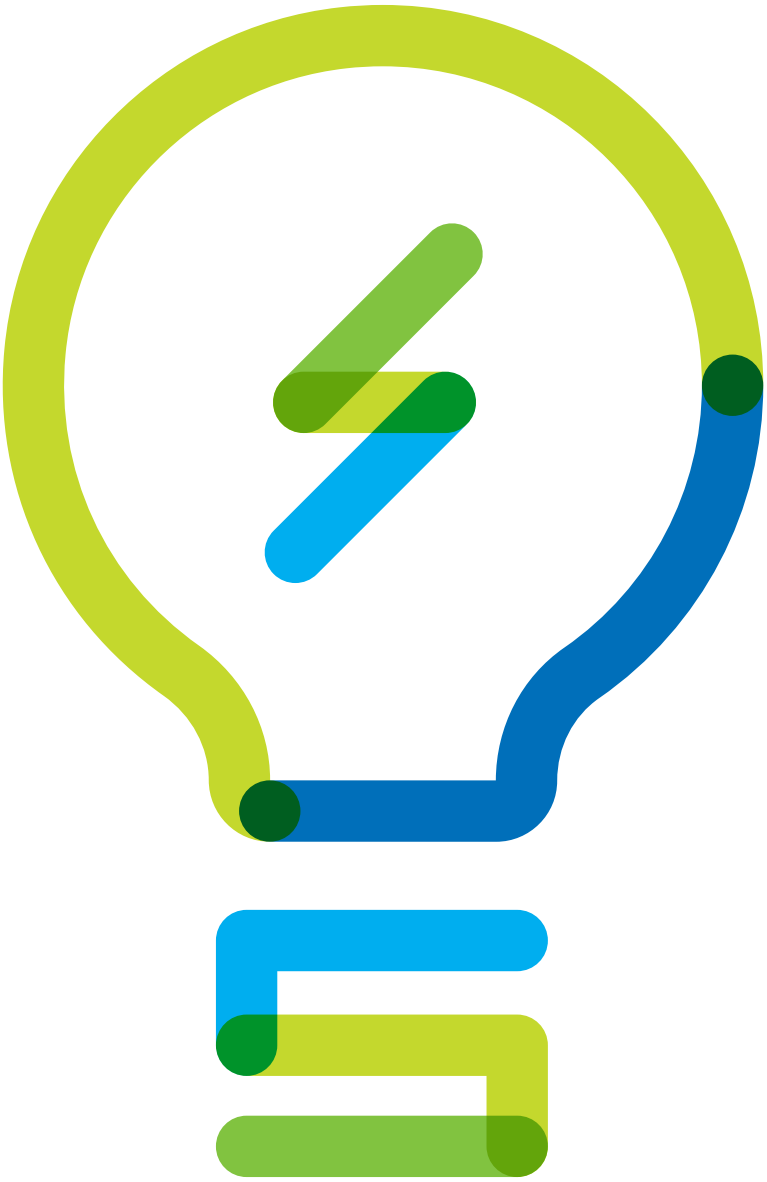
The CAP recognises the challenge Ireland will face in moving to higher penetrations of renewable electricity given its intermittent and often unpredictable nature and references the need for a range of technology solutions including interconnection, storage and dispatchable capacity such as gas plants. The electricity and gas systems are highly interdependent, and an integrated systems approach to both electricity and gas can deliver smart solutions and synergies for Ireland.

Why gas and the gas network provides a smart solution

Natural gas fired generation provides flexibility and stability to the electricity grid, allowing a high level of intermittent renewable electricity.

Ireland's electricity system has been designed to operate within very tight tolerances. If these tolerances are not met, the grid may become unstable with the risk of power outages[35]. Natural gas fired power generation provides flexibility and electricity grid stability, which complements the high level of intermittent renewable generation on the system.

The gas network provides critical inter-seasonal flexibility through its capability to supply large volumes of energy. This means that even on the coldest winter days with low wind availability, the gas network can ramp-up to provide gas for peak electricity generation, while also meeting peak heating demand.



Similarly, wind generation can be very low during summer periods. Natural gas demand for power generation hit an all-time high in June and July of 2018, with up to 90% of the country's electricity supply generated from natural gas, and an average of 70% over this period[24]. Even in winter, when demand is greatest, intermittent renewables such as wind and solar will fluctuate and there is no guarantee of the levels of electricity they will deliver.

As the penetration of intermittent renewables increases, the role of natural gas fired generation in providing system stability and security will become even more critical. No other power generation technology that is available on demand (dispatchable) provides the flexibility of gas.

The gas network provides large scale and cost-effective energy storage for Ireland

The gas network possesses significant energy storage capabilities, playing an important role in Ireland's energy security. In 2017 the gas network transported over 56,000GWh of energy, almost double that conveyed by the electricity grid at approx. 28,000GWh[22,23]. With the increasing use of intermittent renewable electricity generation, the need for back up capacity will continue to grow. Battery technology continues to improve and while it can play an important role, batteries can only store "a fraction of the energy that the gas system provides today at a far lower cost than even the lowest cost electricity storage"[36].

In 2017, approximately 4% of wind generation in Ireland was curtailed[37]. The level of curtailed wind and other renewables will increase as their penetration on the grid increases. P2G can harness this curtailed electricity and convert it to hydrogen or methane, which can be stored and injected into the gas network. Batteries are a suitable option for short-term peak storage, but they are more expensive per unit of energy stored versus P2G (by up to a factor of 1,000)[38].

High efficiency gas power plants can provide significantly cleaner electricity than coal and peat

Natural gas provides significant emissions savings over peat and coal fired generation. Replacing peat and coal with natural gas, would result in a saving of at least 3Mt CO_2/annum. Renewable gas could also be used in electricity generation in gas fired power plants (if sufficient volumes were available in future). This would have the effect of maintaining the critical flexibility and stability that gas generation provides, while progressively lowering CO_2 emissions and increasing renewable generation. Combining renewable gas with CCS in gas fired power plants offers the prospect of net negative emissions for Ireland. Negative emissions through CCS is one of the only ways to take emissions out of the atmosphere and could offset emissions in other sectors.

CCS is a proven technology which can be used together with natural gas to provide clean, dispatchable electricity

CCS can capture up to 100% of the CO_2 from the exhaust stream of existing gas power plants in Ireland[33]. This means the benefits of gas fired power generation such as flexibility and stability can be retained while eliminating CO_2 emissions. The use of CCS will also reduce the cost of reducing emissions for Ireland. The European Commission has reported that it will cost the EU an additional €1.2 trillion to reach its CO_2 reduction target for the power sector without CCS[10].

Progress in decarbonising electricity

Ervia and Gas Networks Ireland are investigating the potential for CCS at the nearly depleted Kinsale gas field off the coast of Co. Cork. This would provide the potential to capture the CO_2 from a number of gas fired power plants in the area, enabling them to provide low-carbon electricity.

Recommendations to decarbonise electricity

Convert Moneypoint to natural gas:

Moneypoint is Ireland's largest power plant. It is currently operating on coal, one of the heaviest carbon emitting fuels. Conversion to natural gas would deliver significant immediate emissions reductions of circa 1.5 Mt CO_2/annum. Ireland's CAP supports an end to the burning of coal in ESB's Moneypoint generation plant by 2025, and the replacement with low-carbon and renewable technologies.

Invest in developing CCS solutions for Ireland:

Investing in CCS solutions will ensure that the flexibility and security of gas fired power generation can be retained while eliminating CO_2 emissions. CCS will be key to a cost effective transformation for the power sector. Ireland's CAP sets out an action for the establishment of a steering group to examine and oversee the feasibility of CCS in Ireland.

Ensure coupled regulations for electricity and gas to deliver an integrated systems approach to decarbonisation:

'Sector coupling' between gas and electricity has been recognised at European policy level as key to supporting decarbonisation efforts. This means that the development of gas and electricity infrastructure should be planned in an integrated manner. A joint approach will optimise the delivery of energy to consumers and increase the capacity to store renewable energy efficiently and effectively. European gas system operators are actively working on sector coupling initiatives with electricity system operators.

Electricity and gas can play complementary roles in decarbonising Ireland's energy system. Policy development should be linked across these sectors to ensure an integrated systems approach which will deliver synergies for Ireland.

Investigate P2G solutions to store curtailed renewable energy generation:

P2G can harness curtailed electricity and convert it to hydrogen or methane, which can be stored and injected into the gas network. This could avoid wasting this clean energy resource and could provide a more cost-effective means of energy storage than batteries.

Using the gas network, a reduction of at least 2.7Mt CO_2/annum in industry can be achieved by 2050.

6. Decarbonising Industry

Large industrial ETS emissions accounts for 9% (5.5Mt CO_2) of Ireland's emissions[7]. Using the gas network, a reduction of at least 2.7Mt CO_2/annum can be achieved by 2050. The large Industrial and Commercial (I&C) companies in the ETS sector are required to reduce their emissions under the EU 'cap and trade' mechanism. Companies must either reach their targets or pay for credits by auction. These companies are expressing greater need for clean solutions as targets continue to reduce allowable emissions, and as investors continue to ramp up their demand for green credentials. Natural gas and renewable gas are particularly valued by companies to produce heat and energy solutions.

Why gas and the gas network provides a smart solution

The I&C sector is of vital economic importance for Ireland. Gas and the gas network can contribute to reducing emissions by working in partnership with industry.

Attract and retain industry and multi-national investment

Many industries require gas for high temperature processes. Industry has a limited number of technically feasible solutions for many high temperature processes. Multi-national and large I&C companies are increasingly seeking to procure renewable gas to meet their Corporate Social Responsibility (CSR) commitments to reduce their carbon footprint. Over 40 companies, including large manufacturing and agri-food companies in Ireland, have recently signed a carbon pledge to significantly reduce their emissions footprint between now and 2030.

Many I&C customers with thermal heat requirements are actively looking to natural gas and renewable gas as a means of decarbonising. A clear roadmap for the availability of renewable gas is thus becoming a key requirement for many of these companies in choosing to locate or expand in Ireland. In 2016, the Renewable Gas Forum of Ireland (RGFI), of which Gas Networks Ireland is a member, surveyed large manufacturing companies in Ireland about their thermal energy needs. The results highlighted that 75% of the companies surveyed have specific targets to reduce their carbon footprint. Natural gas and renewable gas are particularly valued by many of these companies, especially those in the pharmaceutical and food or beverage processing sectors. Renewable gas is emerging as an important factor in terms of securing ongoing and future investment in Ireland.

Provide industry with attractive renewable gas solutions available in other global locations

There is a growing demand for renewable gas and carbon abatement solutions amongst major I&C companies globally, with an increasing number of large brands committing to carbon neutrality. In the US, the world's largest cosmetics company, L'Oreal, has committed to becoming carbon neutral. As part of that ambition it has diversified its energy portfolio to include renewable gas, signing a 15-year power purchase agreement for 40% of the renewable gas produced from one renewable gas plant[39].

Green Gas Certificates (GGCs) are essential to supporting the growth of a renewable gas industry in Ireland. GGCs enable companies to verify renewable gas origin and sustainability credentials in order to claim use of a renewable energy source.

As CCS solutions become available for Ireland, CO_2 intensive heavy industries will have the option to avail of CCS to further reduce their carbon footprint, while benefiting from the continued use of natural gas to meet their operational requirements. Hydrogen may also offer a potential future solution for industry.

Provide cost effective gas CHP options for industry

Natural gas delivered by the network can be used for onsite energy generation, offering I&C customers substantial energy cost savings. This provides an attractive solution and Gas Networks Ireland has contracted with numerous I&C customers who wish to avail of onsite generation options. Data centres in particular have a large demand for electricity. There are approximately 46 data centres in operation in Ireland with substantial future growth predicted[19]. Gas Networks Ireland has developed a combined offering of natural gas, renewable gas and dark fibre (through Ervia's telecoms business Aurora Telecoms) for its data centre customers.

Progress in decarbonising industry

The EU Renewable Energy Directive Re-cast (RED II), provides for clear recognition of renewable gas and associated Guarantees of Origin for supply of renewable gas, via gas network systems. A key requirement that comes with this recognition is a robust GGC scheme and service.

Ireland's GGC scheme will allow end users to purchase renewable gas with confidence, as well as giving government and regulators the certainty that sales of renewable gas are transparent and accounted for. The scheme will be the first of its kind in Ireland.

Recommendations to decarbonise industry

Convert I&C businesses near the gas network from oil and coal to natural gas:

Replacing coal and oil with natural gas provides an immediate emissions reduction. These businesses will then continue to be decarbonised as the gas network ultimately becomes net zero carbon.

Green Gas Certification (GGC):

A reliable method of tracing and verifying renewable gas origin is vital to providing confidence to consumers that the gas delivered is renewable and can be counted against their emission reduction targets. Gas Networks Ireland, in partnership with other Irish and European agencies, is developing a GGC scheme for Ireland. The successful implementation of Ireland's GGC scheme will support the growth of a market for renewable gas in Ireland. This scheme also aligns with European goals to develop an EU wide Guarantee of Origin scheme.

Using the gas network, a reduction of at least 2.6Mt CO_2/annum in heat (non ETS) can be achieved by 2050.

7. Decarbonising Heat

Domestic heating accounts for 9% of Ireland's emissions or almost 6Mt CO_2 emissions[7]. Using the gas network, a reduction of at least 2.6Mt CO_2/annum can be achieved by 2050. The primary domestic heating sources in Ireland are oil and gas. Of the 2 million[40] residential dwellings in Ireland, there are currently over 700,000 (35%) connected to the gas network with a further 300,000 (15%) in urban areas located close to the network. The gas network provides a smart, cost effective means of immediately delivering significant emissions reductions in heat, with further improvements over time as renewable gas is introduced.

Why gas and the gas network provides a smart solution

Decarbonising the heating sector is challenging. However, the gas network provides a smart, cost effective pathway to deliver significant emissions reduction, while also increasing Ireland's renewable energy share.

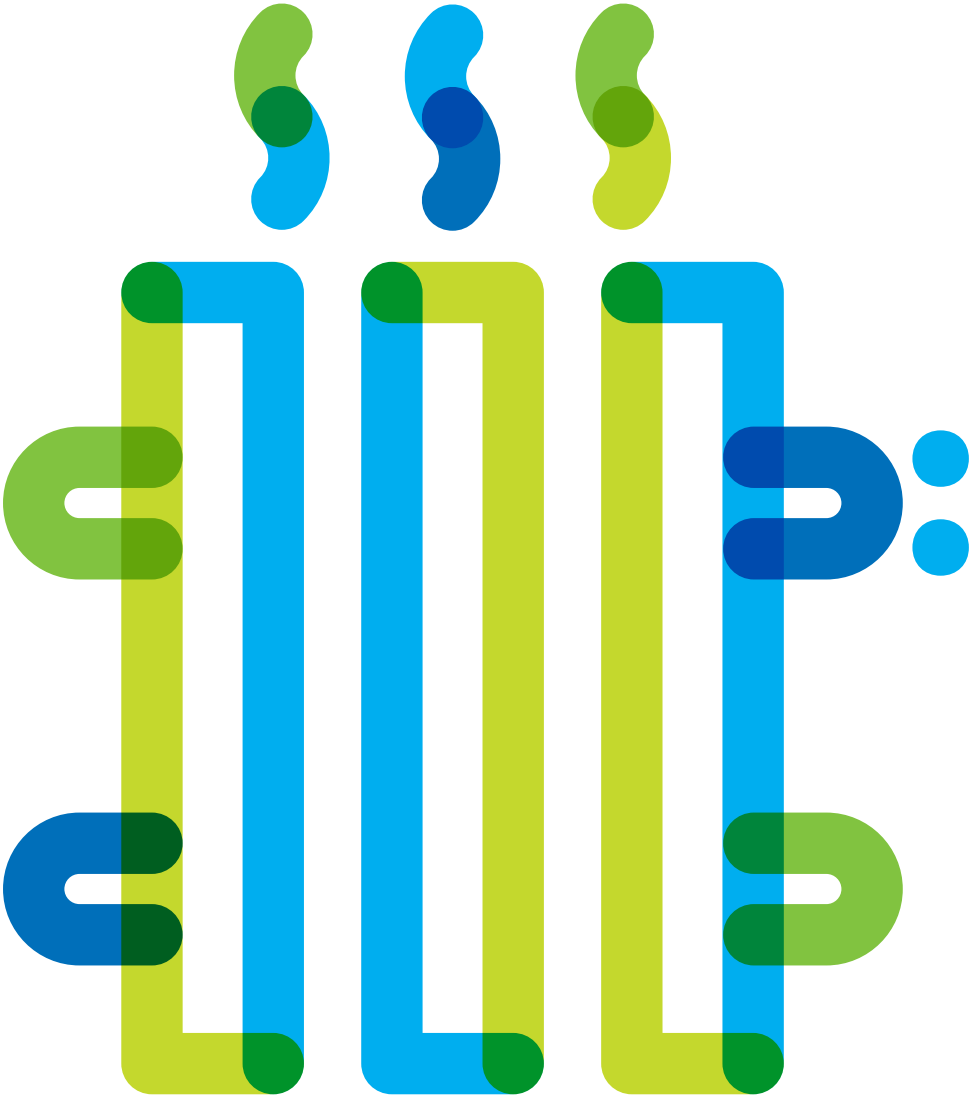
Least cost and least disruption to decarbonise home heating

Investment will be required to transform to a low carbon society. Using the existing gas network offers a practical and effective pathway to minimise the investment required. Economic levels of energy efficiency (i.e. insulation) must form a basis for any pathway. It will be less costly and less disruptive to decarbonise heating for those consumers already connected to and within reach of the network by using the existing gas network than by electrification. The CAP sets out a significant ambition for electrification of heat in the existing residential sector by 2030. It also calls for a target to be set for renewable gas use for 2030. Both electrification and renewable gas will play key roles in decarbonising the existing residential heating sector. Renewable gas can be used in existing gas boilers today, and its use will ensure redundancy, security and affordability in our path to 2030. Existing boilers are also understood to be compatible with small percentage blends of hydrogen.

The CAP signals an effective ban on the installation of gas boilers from 2025 in all new dwellings through the introduction of new regulatory standards for home heating systems. As the gas network evolves to become net zero carbon, transporting renewable gas and hydrogen, it will offer a viable alternative clean heat source for new dwellings which can be delivered through renewable heating systems such as renewable gas and hydrogen boilers.

By converting the 300,000 homes close to the gas network from oil heating to natural gas, the carbon intensity of heating these homes would reduce by 30%[19]. As renewable gas is injected into the network, the heating sector can be decarbonised at scale and without relying on customer behaviour change.

Analysis conducted by KPMG has shown that the cost of decarbonising heating for the one million homes on, or close to, the gas network is three times more expensive via electrification than by using renewable gas in the gas network[8]. Electric heat pumps are emerging as a favoured option for electrification of heat. The installation of heat pump technology requires significant adaptation of the heating system relative to gas. Optimal use of heat pump technology requires high levels of insulation which typically requires significant building fabric upgrades. The cost of deep retrofitting Ireland's existing housing stock would be in the region of €60bn - €80bn based on an average cost of €35,000 - €50,000 per house[41]. A similar study by Wales and West Utility in the UK finds the cost could be up to £60,000 per household[42]. Where heat pump solutions are considered suitable, hybrid heat pumps which combine high efficiency gas condensing boilers with air source heat pumps offer a more practical solution than heat pump only solutions. Hybrid heat pumps select the most efficient heating system depending on outdoor temperatures and require less disruptive changes for the homeowner compared with a heat pump only solution. The lower the disruption the greater the likelihood of widespread early adoption.



There is a very clear consensus amongst policy makers and climate experts globally that immediate action is required to avoid dangerous levels of global warming. Simply placing the burden of cost and disruption on the customer and relying on behaviour change will not deliver the transformational and immediate action required. By using the existing gas network to deliver renewable gas, there is a clear opportunity to achieve significant progress towards emissions targets in a practical, least cost, and least disruptive manner. By making it easier for consumers, we are likely to see greater uptake of low carbon solutions.

Renewable gas can be produced from a wide variety of sources and using a wide range of technologies. As a result, the MAC varies accordingly (MAC is the cost of reducing emissions measured per unit). Analysis by KPMG has demonstrated that the MAC in respect of renewable gas from agricultural sources is estimated to be €128 to €207 per tCO_2eq. The gas network also requires significantly less investment to facilitate renewable gas injection in comparison with the electricity grid reinforcement costs required for high levels of electrification. It is important that the total system cost is evaluated when comparing technologies to ensure the lowest overall cost to the Irish citizen.[27]

Maximise investment in the existing gas network infrastructure and avoid unnecessary investment

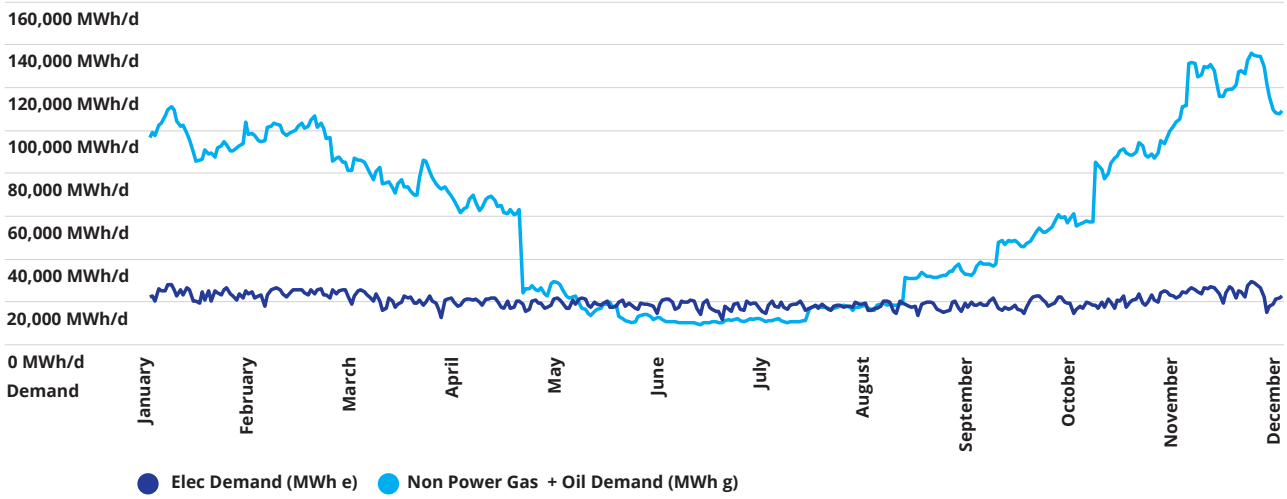
The gas network is built to accommodate 1 in 50 winter peak demand (i.e. a severe winter peak day that is statistically likely to occur once every 50 years). If this additional heating demand was to be met by electrification, it would place significant strain on the electricity system. Substantial reinforcement would be required to ensure that enough capacity would be available to meet peak heating and electricity demand occurring together. Building new infrastructure with the capability to meet an infrequent 1 in 50 heating event is inefficient when the gas network already delivers this capacity.

In 2010, Ireland experienced a severely cold winter, Figure 10 shows residential gas and oil demand versus residential electricity demand over the course of 2010. This shows that significant extra electricity infrastructure would be required at distribution level to meet the addition of heating demand. Utilising the existing gas network avoids the additional costs that would be required to reinforce the electricity network and avoids stranding the significant capital already invested in Ireland's gas network infrastructure.

Progress in decarbonising heat

Natural gas provides a significantly cleaner alternative to coal, oil and peat heating today and as renewable gas is introduced, the homes and businesses connected to the gas network will decarbonise. The first renewable gas injection facility in Cush, Co. Kildare was commissioned in 2019. The network entry facility for this project is designed to inject up to 108GWh/annum renewable gas, enough gas for 9,000 homes[19].

Figure 10: Electricity vs gas + oil heating demand profiles showing winter 2010 '1 in 50' peak demand (based on Eirgrid, Gas Networks Ireland, NORA data)



Recommendations for decarbonising heat

Convert homes near the gas network from oil and coal to gas:

Replacing coal and oil with natural gas provides an immediate emissions reduction. These homes will then continue to be decarbonised in a least cost and least disruptive manner as the gas network introduces renewable gas.

Ensure that there is a level playing field for all renewable energy technologies:

Part L of the building regulations does not provide a level playing field. It excludes renewable gas as a renewable energy technology because the appliance (gas boiler) can operate on both renewable gas and natural gas. Part L should allow the blending of fuels in appliances, subject to robust supporting verification such as the GGC scheme. A reasonable solution would allow appliances that are fuelled by a blend, and for the renewable element within the blend to be calculated toward the minimum renewable energy contribution[12]. Similarly, the option to select renewable gas is not on the default settings for Building Energy Rating (BER) Certification for the domestic sector. All other technologies are listed in the default settings and renewable gas should be recognised on the same basis.

Given the high level of uncertainty over the technologies which will deliver long-term decarbonisation for Ireland, it is important that all technologies are allowed to compete on an equal basis. Renewable gas is already well developed and available at competitive rates in other European countries and a renewable gas support scheme is vital to establishing the industry in Ireland. State support is required to cover the price gap between wholesale natural gas and the cost of producing renewable gas.

The Department of Communications, Climate Action and Environment (DCCAE) has implemented the Support Scheme for Renewable Heat (SSRH) for air, ground and water source heat pump technology. An appropriate support scheme for renewable gas is critical for the development of renewable gas projects in Ireland.

Ensure a technology neutral approach to future energy solution planning:

As technologies mature, more solutions will become viable and economic to adopt. All technologies must be allowed to compete for future adoption to ensure that viable solutions are not ruled out now. Gas and the gas network can deliver "rapid and far reaching" emissions reductions for Ireland now using currently available technologies, and in the longer-term using early stage technologies. Limiting the choice of pathways now, such as planning for an electrification only future, could have far reaching implications in terms of the long-term 'cost' to the country.

It has been demonstrated by KPMG that the cost of decarbonising heating for the one million homes on, or close to, the gas network is three times more expensive via electrification than by using renewable gas in the gas network[8]. Gas and the gas network therefore provide a cost effective and minimally disruptive way of decarbonising heat and must not be ruled out in favour of an electrification only future.

Using the gas network, a reduction of at least 2.8Mt CO_2/annum in transport can be achieved by 2050.

8. Decarbonising Transport

The transport sector is a large energy consumer and is the source of 20% of Ireland's emissions or almost 11.9Mt CO_2[7]. Using the gas network, a reduction of at least 2.8Mt CO_2/annum can be achieved by 2050. While HGVs and buses account for only 4% of vehicles on the road, they account for 30% of all emissions in the road transport sector[43]. CNG is a cleaner, affordable and proven alternative fuel to diesel or petrol. CNG as a fuel significantly reduces particulate matter emissions and, when renewable gas is introduced, it offers HGVs and buses a pathway to net zero carbon transport.

Emissions from the transport sector are a key contributor to air pollution in Ireland. High levels of particulate matter are a growing concern, with an estimated 1,100 premature deaths every year as a result of poor air quality[44].

Ireland's CAP sets out a number of welcome measures to support the decarbonisation of the transport sector including the development of a CNG fuelling network to support the uptake of CNG vehicles.

Why gas and the gas network provides a smart solution

CNG solutions for HGVs and buses can immediately reduce emissions from the transport sector and can provide a pathway for renewable gas use in these vehicles.

CNG provides an immediate lower carbon solution for HGVs which will improve air quality and health

CNG is a proven technology with over 26 million CNG vehicles in use worldwide[45]. The use of CNG in HGVs and buses can provide an immediate and significant emissions reduction, including harmful emissions such as particular matter, SO_x and NO_x, compared to diesel. The fine nature of particulate matter means it can get deep into the lungs and bloodstream causing harmful health effects[46]. The use of CNG will therefore significantly enhance Ireland's air quality and reduce serious illnesses.

CNG is an attractive solution for fleet owners, offering cheaper running costs

HGV and bus fleet owners are showing increased interest in CNG solutions as they recognise the dual benefit of reducing emissions while making significant cost savings. CNG can generate savings of up to 35% for fleet owners compared to diesel and offers comparable re-fuelling times[47]. The payback period for HGV trucks is in the region of 2-2.5 years which is a very attractive proposition for fleet owners[47].

CNG is a pathway for renewable gas transport (Bio-CNG) which can further eliminate emissions

Moving the HGV and bus sector to CNG will provide a pathway for the use of Bio-CNG, as an increasing level of renewable gas is transported by the gas network. In the UK, CNG Fuel's Leyland CNG filling station has been supplied with 100% renewable gas (Bio-CNG) since September 2016. Transitioning Dublin Bus and Bus Eireann fleets to CNG and Bio-CNG could deliver a substantial reduction in overall emissions and make a powerful statement of intent regarding Ireland's commitment to a low carbon economy.

Hydrogen may provide a future solution and CNG/ Bio-CNG provides a pathway

The application of hydrogen in the transport sector is being explored and trialled in the US, Japan, Europe and other global locations. CNG and Bio-CNG gas transport provide a pathway for hydrogen powered HGVs and buses in the future. Gas Networks Ireland and Ervia are actively collaborating with a variety of hydrogen research initiatives and bodies including GENCOMM, Hydrogen Mobility Ireland and Hydrogen Ireland Association to assess applications for hydrogen,including its use in transport.

Progress in decarbonising transport

Gas Networks Ireland plans to facilitate the development of a 170-station CNG fuelling network including 40 public access forecourts, on major routes, and/or close to urban centres. We are building partnerships with forecourt operators and haulage companies to make this possible. This ambition will help meet Ireland's requirements under the EU's Alternative Fuels Infrastructure Directive. Gas Networks Ireland is targeting the conversion of 24% of HGVs and 13% of buses to CNG or Bio-CNG by 2030.

Gas Networks Ireland is leading a project called the Causeway Study, which is funded by the Commission for Regulation of Utilities (CRU) and the Connecting Europe Facility (CEF) Transport Fund, under which it is intended to deliver 14 high capacity fast fill CNG stations and a single renewable gas network injection point. The fast fill stations provide quick, efficient and safe refuelling. The normal fill time for a CNG HGV is 3-5 minutes from empty which is comparable to diesel. The first public access station has been constructed at the Circle K Service Station in Dublin Port, one of the busiest HGV refuelling stations in the country. The station is currently operational and has capacity to refuel up to 70 HGVs per day.

In 2017 Gas Networks Ireland launched its CNG Vehicle Fund, making up to €20,000 available to businesses towards the purchase of a new CNG vehicle.

Recommendations for decarbonising transport

Maintain policies which support the transition of HGVs and buses from diesel to CNG/Bio-CNG:

The existing excise duty treatment should be maintained at the current level after expiry in December 2024. The Accelerated Capital Allowance scheme for gas vehicles and refuelling equipment should be maintained after expiry in December 2021. Both incentives should be retained until such time as the HGV population is 30% gas powered (circa 5,000 trucks).

Introduce further supports to stimulate the CNG/Bio-CNG market for HGVs and buses:

Technology Adoption: Transition the public transport fleet away from diesel to CNG/Bio-CNG

Planning Permission: Provide planning support for CNG re-fuelling stations. On strategic corridors, planning permission should require CNG refuelling in forecourt design

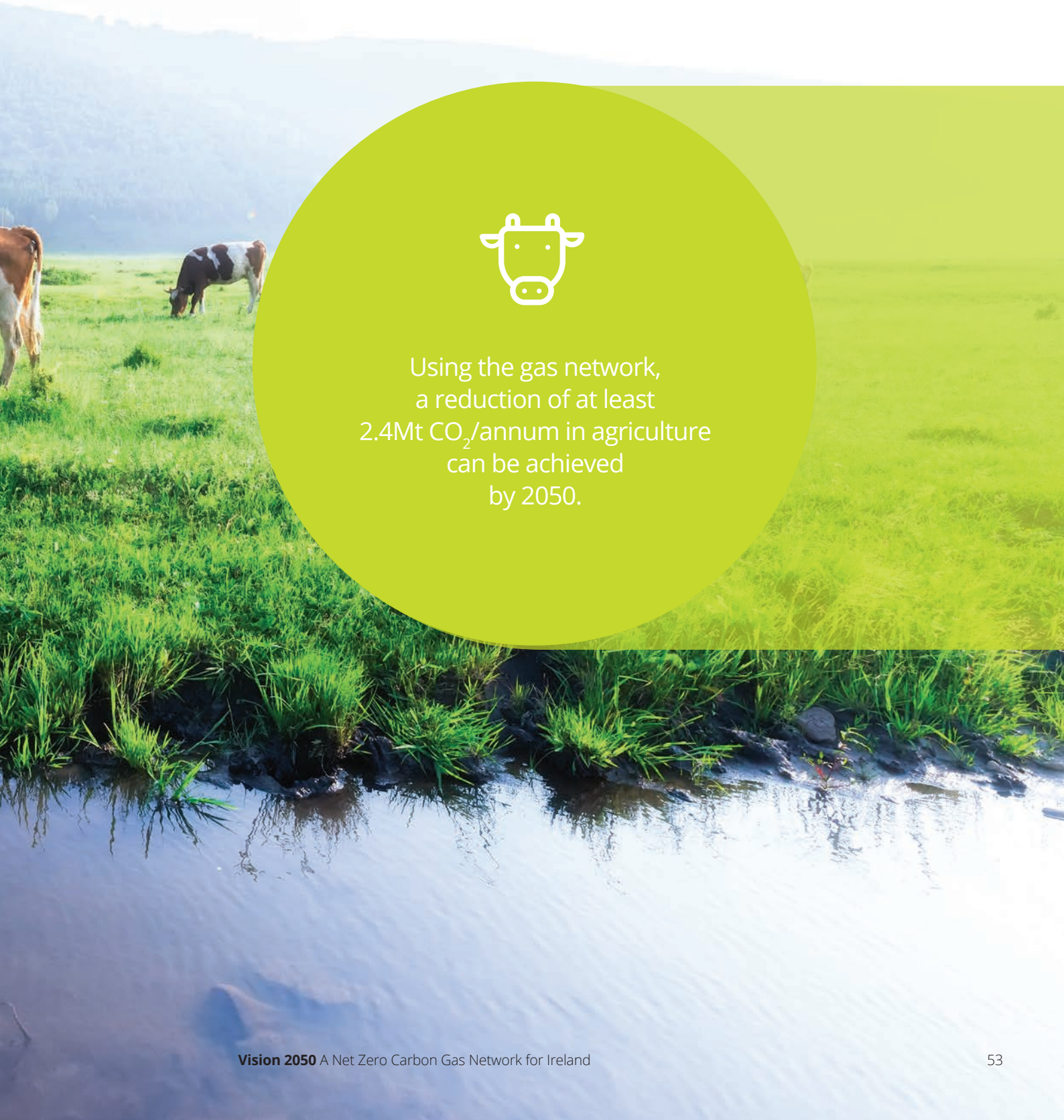
Toll Charges: Exempt gas-powered HGVs and buses from toll charges

Vehicle Purchase: Introduce a grant scheme or tax relief for trucks to accelerate uptake and support early adopters

Ireland must also advocate for European support for renewable gas in transport. By implementing the right supports, the European Union could boost Bio-CNG in transport and significantly reduce emissions from heavy duty transport, a challenging sector to decarbonise.

Green Gas Certification (GGC):

A reliable method of tracing and verifying renewable gas origin is vital to providing confidence to consumers that the gas delivered is renewable and can be counted against their emission reduction targets. Gas Networks Ireland, in partnership with other Irish and European agencies, is developing a GGC scheme for Ireland. The successful implementation of Ireland's GGC scheme will support the growth of a market for renewable gas in Ireland. This scheme also aligns with European goals to develop an EU wide Guarantee of Origin scheme.



Using the gas network, a reduction of at least 2.4Mt CO_2/annum in agriculture can be achieved by 2050.

9. Decarbonising Agriculture

At 33% (20Mt CO_2)[7], the agriculture sector is the biggest source of Ireland's emissions against an EU average of circa 10%[13]. Using the gas network, a reduction of at least 2.4Mt CO_2/annum can be achieved by 2050. Agriculture and the agri-food sector is of vital importance to Ireland and the Irish economy. Total agriculture sector employment in 2016 was 173,000 and output from the sector was valued at €6.92 billion[48]. Decarbonising agriculture is challenging, particularly as agri-food output is growing. Gas and the gas network can contribute to a reduction in agriculture emissions by supporting and enabling a renewable gas economy which captures methane and waste emissions. A renewable gas industry provides Ireland with a unique opportunity to stimulate the rural economy, enhance farm incomes and create jobs.

Why gas and the gas network provides a smart solution

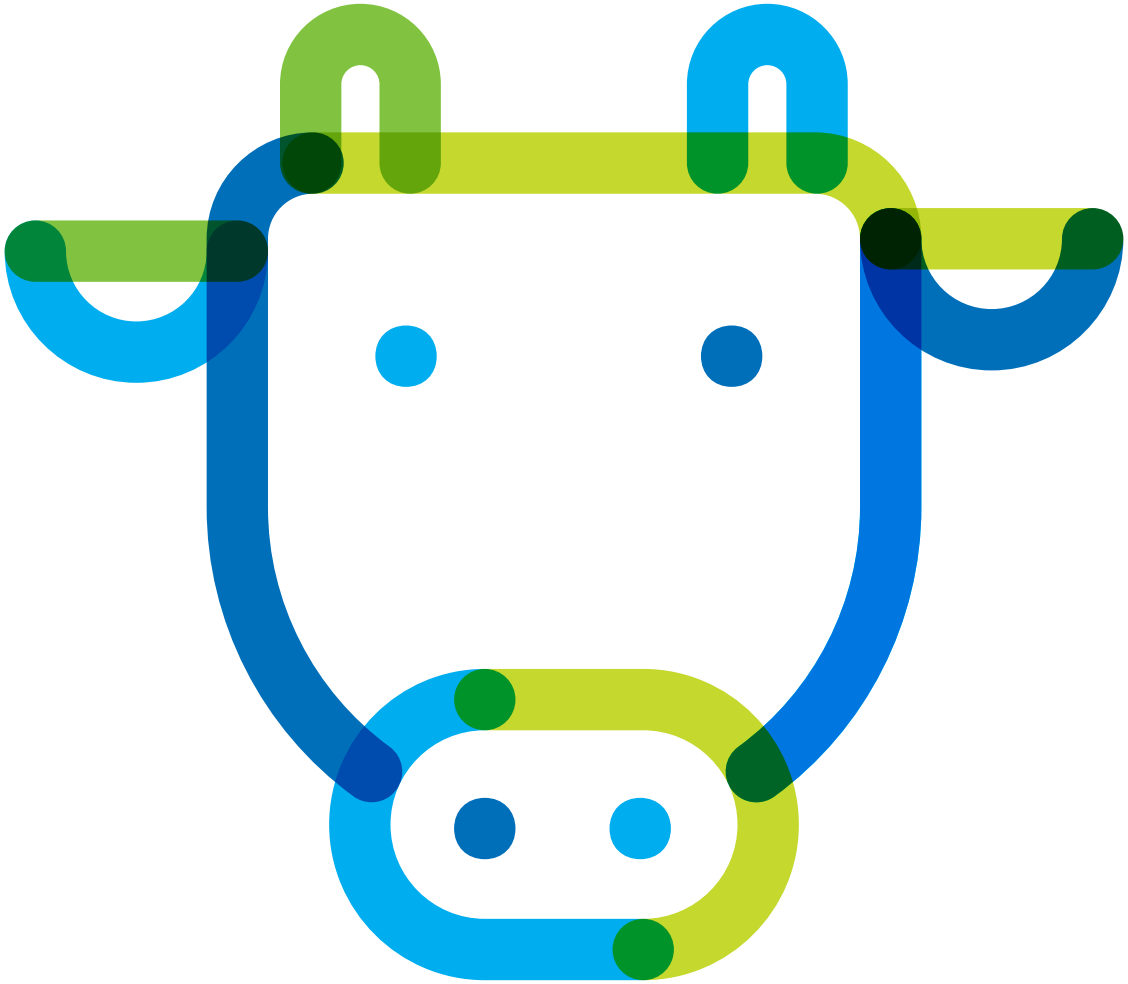
Ireland must find solutions to tackle agricultural emissions whilst meeting the needs of its agri economy. Developing a renewable gas industry can contribute to tackling agricultural emissions while supporting the development objectives of Government and the farming industry.

Gas and the gas network can contribute to emissions savings by supporting a renewable gas economy which would also boost farm incomes and stimulate rural Ireland. Ireland has the highest potential within the EU for renewable gas production per capita by 2030, at 13TWh/annum[30]. Gas Networks Ireland is targeting 11TWh/annum renewable gas production by 2030 (20% of current demand). This renewable gas will be produced through a process called 'anaerobic digestion', by which wastes and biomass (i.e. grass and slurry) are broken down by microorganisms in the absence of air. The process produces renewable gas and a by-product called 'digestate' or 'bio-fertiliser' which can be applied instead of chemical fertilisers. Even accounting for the energy and emissions in the production process and the emissions from combustion, the net output is at a minimum net zero carbon and can often be carbon negative (this means that renewable gas can have a net effect of removing CO_2 from the atmosphere).

Reduce CO_2 and potent methane emissions from agriculture

Methane is 28-36 times more harmful than CO_2 in terms of its global warming potential[49]. The use of fresh slurry in renewable gas production can reduce emissions from manure storage on farms, particularly potent methane emissions. The replacement of open slurry storage with anaerobic digestion can potentially deliver 17% methane emissions savings[50]. Slurry biogas systems are therefore very favourable as they can be carbon negative. The digestate produced as a by-product of the anaerobic digestion process can also be used as a bio-fertiliser, reducing emissions from energy intensive chemical fertiliser production.

Since the elimination of the milk quota system in 2015, the dairy industry has seen substantial growth and this is expected to continue with increased energy usage from the dairy sector. This poses a challenge for Ireland in terms of reducing agricultural and energy emissions. Renewable gas can provide a viable solution for the dairy industry to meet increasing energy demands in a sustainable and economic manner.



Contribute to a circular economy and improve waste management practices

The CAP expresses a need for Ireland to transform its approach to waste and apply circular economy principles.

Renewable gas can contribute to a circular economy. The anaerobic digestion of slurry and food waste produces renewable gas and contributes to significant emission reductions. Combining grass and other sustainable feedstocks with slurry increases the yields of renewable gas. Anaerobic digestion of food and agricultural wastes is the most environmentally friendly and economical means of processing such wastes in comparison with Ireland's current practices, including composting, landfill, exporting, land spreading and incineration. Applying the treated digestate or bio-fertiliser from agricultural anaerobic digestion as fertiliser is also more environmentally friendly as it reduces emissions and produces less odours than slurry spreading.

Increase farm incomes and stimulate the rural economy

The National Farm Survey 2017 found that 30% of farms were economically vulnerable, while another 27% were only viable due to the presence of another income source outside the farm[51]. It is estimated that approximately 33% of grassland in Ireland is making a financial loss for farmers[52]. Irish dairy farms are producing approximately 7.1 tonnes of grass dry matter per hectare (DM/ha), while more efficient farms produce 12-14 tonnes DM/ha[53]. The development of a renewable gas industry would provide farmers with an incentive to improve output and providing sustainable feedstocks such as grass or red clover would attract an additional source of income with no capital investment costs for farmers. Using the digestate or bio-fertiliser from anaerobic digestion could also reduce costs for farmers by reducing the need to purchase chemically manufactured fertilisers.

The development of an indigenous renewable gas industry and supply chain provides Ireland with a unique opportunity to stimulate the rural economy, enhance farm incomes, and create jobs. While Gas Networks Ireland will facilitate the development of infrastructure, local entrepreneurs, local communities and private sector investors will develop the production. The renewable gas industry has created over 35,000 jobs in Germany, 8,000 jobs in Italy and 11,000 jobs in the UK[54]. Our target of reaching 11TWh (20%) of indigenous renewable gas production will create an estimated 4,000 new direct jobs and secure a further 2,500 indirect jobs in rural communities. GDP contribution is estimated at over €2bn from the construction of biogas plants to 2050, and over €400m from the operation of the plants in 2050[55]. By displacing imported gas, Ireland also benefits from a positive balance of trade contribution of €25m/annum for every 1TWh.

Ireland has the grassland potential to develop a renewable gas industry sustainably while meeting livestock and food harvest requirements

Various studies have reported that Ireland can produce more than enough grass to meet the demands of both agriculture and a renewable gas industry[31,56]. It is estimated that circa 2.8 million tonnes of dry matter (produced from 11.1 million tonnes of grass silage) and 9.9 million tonnes of slurry will be required to produce the targeted 11TWh/annum (c.20% of Ireland's current gas demand)[53]. By improving grassland management and production practices, it is estimated that the average surplus grassland resource could be increased to 12.2 million tonnes DM/annum, even when allowing for food harvest 2020 targets[31]. This is more than sufficient to meet Gas Networks Ireland's renewable gas target for 2030.

Bio-fertiliser will be used to enhance grassland production. Under the EU RED II Directive (which is legally binding from 2021), use of bio-fertiliser is mandatory for any farmer supplying feedstock such as grass silage to anaerobic digesters. RED II compliance is ensured through independent auditing under the GGC scheme for Ireland. The emissions Life Cycle Assessment (LCA) must equate to the zero carbon requirements of the Directive or better. Chemical fertiliser can be used at the very beginning, when bio-fertiliser is not available, but this still forms part of the LCA calculation, and thus its use is limited to an application of lime or other limited applications, depending on soil deficiencies. In the case of a grass silage source, this would be confined to the first application of fertiliser on the first annual cut, but all subsequent cuts (cuts 2, 3, and 4) will have sufficient supply of bio-fertiliser, which must be used. All subsequent use of chemical fertiliser is prohibited, and in the longer-term, the increased availability of bio-fertiliser will displace chemical fertilisers across other farming operations.

RED II sets out a list of fuel and feedstock types that can be classified as sustainable and also sets out carbon intensity thresholds. In addition, RED II recognises certain improvements in agriculture production which should be encouraged and assigns bonus carbon rating measures to assist in stimulating these. Ireland will use an LCA calculation formula to determine compliance with the sustainability criteria set out in the Directive. Gas Networks Ireland have partnered on an industry project to develop a robust calculation methodology and independent certification scheme for Ireland. Ireland's GGC scheme will ensure a reliable method of tracing and verifying renewable gas origin and will ensure the sustainability criteria set out under RED II are met.

Progress in decarbonising agriculture

Gas Networks Ireland is working with Teagasc and other key stakeholders to develop plans for a renewable gas industry in partnership with farmers and rural communities.

Recommendations for decarbonising agriculture

Seek whole system carbon accounting for Ireland at European level:

RED II sets out strict carbon accounting criteria which will become tighter from 2026 onwards. The emissions reductions which can be counted from renewable gas are limited under the current calculation methods. RED II allows member states to seek further emissions reductions to be counted. For instance, there are additional savings which can be achieved from better land use management and the use of bio-fertiliser when renewable gas is produced from agricultural sources. At present these savings are not counted as part of emissions savings. As Ireland's renewable gas industry develops, these additional savings must be measured and demonstrated in order to benefit from whole system carbon accounting of renewable gas at European level.

Develop an industry standard for biofertiliser:

The development of a standard for digestate, as in the UK, is critical to ensuring the circular economy which Gas Networks Ireland envisages for the renewable gas industry in Ireland. This means that the by-product of the renewable gas production process can be used as a bio-fertiliser by farmers, further reducing the emissions impact of the life cycle renewable gas production process.

10. Supporting a Cleaner Energy Future

Policy and supports are required to unlock the significant decarbonisation potential of the gas network. Similar to other renewable technologies, policy, regulation and investment supports are needed to stimulate renewable gas production and develop CCS. A combination of technologies will be required to achieve Ireland's climate goals. A level playing field is necessary to ensure that all clean energy technologies can compete for future adoption, and to ensure that viable future solutions are not ruled out too early and regretted later. An integrated policy development approach for gas and electricity would deliver valuable synergies for Ireland and deliver a least cost and least disruptive transition for Irish citizens and businesses.

Making Early Progress

The decarbonisation agenda tends to focus on absolute transition, getting off fossil fuels and straight on to zero-carbon alternatives. But absolute transition to clean alternatives is not always readily available or immediately achievable. Waiting for absolute transition and a perfect future means the opportunity to bank immediate and cumulative emissions savings will be missed and Ireland will continue to miss its interim emissions targets. Making early progress ensures savings accumulate and grow year after year as we move toward 2050.

Waiting on technologies to mature, costs to decline, and consumer behaviours to change, risks leaving too much to deliver far too late.

The gas network can deliver "rapid and far reaching" emissions reductions for Ireland now using currently available technologies. In the longer-term, as the gas network evolves to become net zero carbon, it will deliver significant emissions savings across every sector of the economy. The gas network will provide a platform to achieve progress at scale by delivering net zero carbon gas to customers using their existing gas connection.

Policy measures required to achieve early progress

There are six key policy areas in which action is required to stimulate immediate progress toward Ireland's climate goals:

Timing **Immediate**

Develop coupled policy and regulations for electricity and gas to achieve an integrated systems approach

Electricity and gas can play complementary roles as part of a whole system solution to decarbonise Ireland's energy system. Policy development should be linked across these sectors to ensure an integrated systems approach, which will deliver synergies for Ireland. Sector coupling between gas and electricity has been recognised at European policy level as key to supporting decarbonisation efforts and European gas system operators are actively working on sector coupling initiatives with electricity system operators. This means that the development of gas and electricity infrastructure should be planned and operated in an integrated manner. A joint approach will optimise the delivery of energy to consumers and increase the capacity to store renewable energy efficiently and effectively.

Timing **Immediate**

Introduce policy measures to support the development of CCS facilities for Ireland

CCS is recognised globally by the IPCC, IEA, European Commission and others as critical to delivering a cost-effective transition for the electricity generation sector. There are a number of supports that would stimulate the development of CCS in Ireland.

An essential first step is fair and reasonable consideration of the CCS offering. CCS enables the combined benefits of both renewables and unabated gas fired power plants i.e. zero emission electricity that is dispatchable on-demand and provides inertia to the electricity grid. It should therefore be rewarded and recognised in a similar way to other technologies which provide the same benefits. Cost comparisons for CCGT and CCS against wind or solar should be based on the full system cost. A study by the UK Energy Research Centre suggests that the extra reserve and network costs are in the range of £15-£45/ MWh for high levels of wind and solar penetration[57].

Timing **Immediate**

Beyond affording fair comparison of the technology, securing acknowledgement in national policy of the critical role CCS can play in decarbonising Ireland's electricity and industry sectors is key. This would provide a necessary signal to potential investors. This must also be backed up with support at Government level for EU grant applications, which will form a further key funding element.

Timing **Mid 2020s**

Ultimately there is a need for clear economic signalling. The electricity market must recognise that operating gas power plants in combination with CCS effectively represents the introduction of a new product with all the combined benefits of both renewables and unabated gas power plants; this should be rewarded using the electricity Public Service Obligation (PSO).

Timing **Immediate**

Implement a support scheme for renewable gas

State support is required to cover the price gap between wholesale natural gas and the cost of producing renewable gas. DCCAE has implemented the SSRH for air, ground and water source heat pump technology. An appropriate support scheme for renewable gas is critical for the development of renewable gas projects in Ireland.

Timing **Immediate**

Revise Part L of the Building Regulations to create a level playing field for renewable gas

Part L of the building regulations does not currently provide a level playing field. It excludes renewable gas as a renewable energy technology because the appliance (gas boiler) can operate on both renewable gas and natural gas. Part L should allow the blending of fuels in appliances, subject to robust supporting verification, such as the GGC scheme. A reasonable solution would allow appliances that are fuelled by a blend, and for the renewable element within the blend to be calculated toward the minimum renewable energy contribution[12]. Similarly, the option to select renewable gas is not on the default settings for Building Energy Rating (BER) Certification for the domestic sector. All other technologies are listed in the default settings and renewable gas should be recognised on the same basis.

Maintain and introduce policies which will support the transition of larger vehicles from diesel to CNG and Bio-CNG

In order to support the transition of larger vehicles away from diesel and towards CNG, and ultimately Bio-CNG, the following policy supports should be considered:

Timing **2021**

Accelerated Capital Allowance (ACA): Maintain the ACA scheme for gas vehicles and refuelling equipment after expiry in December 2021 until such time as the HGV population is 30% gas powered (circa 5,000 trucks)

Timing **2024**

Excise duty: Maintain the excise duty treatment for CNG at the current level (due to expire in December 2024) until such time as the HGV population is 30% gas powered (circa 5,000 trucks)

Introducing the following policy measures would further support the adoption of CNG / Bio-CNG:

Timing **Immediate**

Toll charges: Exempt gas-powered HGVs from toll charges for main routes

Timing **Immediate**

Vehicle purchase: Introduce a vehicle grant scheme or tax relief of €15,000 - €20,000 per truck to accelerate uptake and support early adopters

Timing **Immediate**

Develop a detailed policy roadmap for renewable gas

A detailed policy roadmap will be required to set out the measures required from demand to supply side to successfully develop Ireland's renewable gas industry. Gas Networks Ireland would welcome the development of a detailed policy roadmap in support of renewable gas and would work in partnership with industry stakeholders, researchers and relevant Government Departments to develop this.

Supporting early progress

There are six key initiatives which will deliver immediate progress toward Ireland's climate goals:

Timing **Early to Mid 2020s**

Convert coal and peat power plants to gas

Moneypoint is Ireland's largest power plant. It is currently operating on coal, one of the heaviest emitting fuels. Conversion of Ireland's coal and peat power plants to natural gas would deliver immediate emissions reductions of at least 3Mt CO_2 per annum, and longer-term adoption of CCS would almost eliminate emissions.

Timing **Immediate**

Implement a robust Green Gas Certification (GGC) scheme

Gas Networks Ireland, in partnership with other Irish and European agencies, is developing a GGC scheme for Ireland. This will ensure that renewable gas origin can be verified and traced so that it can be counted against emissions reduction targets. Support for the implementation of Ireland's GGC scheme will be required to stimulate the growth of a market for renewable gas in Ireland across heat and transport.

Timing **Immediate**

Convert 300,000 homes and businesses near the gas network from oil and coal to gas

Extending the gas network to the 300,000 homes and businesses close to the network offers a practical way to achieve immediate emissions reductions by displacing oil and coal. These homes will then continue to be decarbonised in a least cost and least disruptive manner as the gas network decarbonises and ultimately becomes net zero carbon. The gas network already has the capacity to meet this extra heating demand. Extending the network to regional towns will also enable inward investment in these regions as many industrial companies require natural gas and increasingly renewable gas solutions.

Timing **Immediate**

Convert HGV and bus transport sector from diesel to CNG initially and ultimately to Bio-CNG

The following initiatives would stimulate the adoption of CNG / Bio-CNG and provide immediate emissions reductions in the transport sector. This would significantly improve air quality for Ireland by almost eliminating particulate matter emissions from converted vehicles:

Technology adoption: Transition the public transport fleet away from diesel to CNG/Bio-CNG

Planning permission: Provide planning support for CNG re-fuelling stations i.e. specify a planning requirement for CNG refuelling facilities for forecourts located on strategic corridors

Ireland must also advocate for European support for renewable gas in transport. By implementing the right supports, the European Union could boost Bio-CNG in transport and significantly reduce emissions from heavy-duty transport; a challenging sector to decarbonise.

Timing **Immediate**

Develop a standard for biofertiliser

The development of a standard for digestate is critical to ensuring the circular economy which Gas Networks Ireland envisages for the renewable gas industry in Ireland. This means that the by-product of the renewable gas production process can be used as a biofertiliser by farmers, further reducing the emissions impact of the life cycle renewable gas production process.

Timing **Immediate**

Support the development of renewable gas network injection facilities

The addition of renewable gas to the network requires the development of CGI facilities at strategic locations throughout the country. Gas Networks Ireland has planned a network of transmission connected facilities. The first renewable gas injection facility in Cush, Co. Kildare was commissioned in early 2019. This is a very welcome development which will support renewable gas in Ireland's gas network. Continued support for the development of renewable gas infrastructure will be required to grow an industry of scale which will deliver significant emissions savings.

Keeping Options Open and Supporting Emerging Technologies

There are five key initiatives which will help ensure a successful long-term trajectory towards Ireland's climate goals and which will keep options open:

Timing **Immediate**

Ensure technology neutral energy planning

As technologies mature, more solutions will become viable and economic to adopt. All technologies must be allowed to compete for future adoption to ensure that viable solutions are not ruled out now and regretted later. Technologies must be evaluated not only on their emissions reduction potential but also on their relative affordability, adoptability, security, and potential to support the needs of Ireland's future energy system. Limiting the choice of pathways now, such as planning for an electrification only future, could have far reaching implications in terms of the long-term 'cost' to the country.

Timing **Early to mid 2020s**

Investigate CCS and hydrogen demonstration in Ireland

The UK and other European countries have made significant investments in investigating and demonstrating future gas technologies at scale, for example the H21 North of England Project. The H21 project is examining the feasibility, from both a technical and economic viewpoint, of converting the existing natural gas network to 100% hydrogen. Similarly, large scale CCS facilities are already operating successfully in other global locations with further facilities planned across Europe, the US and Canada. Investing in R&D and pilot projects to demonstrate future renewable gas technologies at scale is vital to ensuring that Ireland is positioned to adopt suitable emerging clean technologies at pace with Europe.

Timing **Early to Mid 2020s**

Support for P2G technology

P2G, using renewable electricity to produce carbon free hydrogen, is increasingly seen as a key decarbonisation pathway for electricity through sector coupling. Hydrogen can complement electrification by providing the large-scale energy storage necessary to overcome intermittency and make use of excess renewable energy generation. Commercial and academic organisations in Ireland are becoming active in the area of hydrogen and need policy makers to create conditions that provide for the trialling and potential commercialisation of hydrogen and P2G technologies.

Timing **Late 2020s**

Upgrade Ireland's natural gas power stations to use CCS technology

Installing CCS will allow for further reductions in emissions from natural gas fired power stations. This would maintain the flexibility and security of gas fired power generation while largely eliminating the CO_2 emissions.

Timing **Immediate**

Promote education and engagement regarding renewable and net zero carbon gas technologies

Rolling out promotion and educational programmes on clean energy technologies such as renewable gas, hydrogen and CCS is important to ensuring that communities and the general public are engaged. Given the currently low level of anaerobic digestion facilities in Ireland, the general public may have concerns over the adoption of the technology. Promotion and educational programmes relating to new clean energy technologies will help to ensure their successful adoption. These solutions should be progressed in collaboration with industry stakeholders, researchers and communities.

11. Conclusion

Ireland has committed to radical decarbonisation of its energy system by 2050. The gas network will deliver immediate emissions savings, increasing year on year, by transporting an evolving mix of gases in combination with CCS. The gas network will be net zero carbon by 2050, delivering economy wide emissions savings of at least 18.7Mt CO_2/annum, equivalent to 31% of Ireland's total current emissions. The gas network will deliver these savings in a least cost and least disruptive manner, while sustaining the security and resilience of Ireland's energy system.

Ireland's gas network provides a safe, secure and reliable energy supply. The gas network delivers 30% of the country's primary energy needs and transports twice as much energy as the electricity network to serve homes, businesses and electricity generation[4]. In 2017 over half of total electricity generated was powered by natural gas[4], and much higher proportions at times of peak demand or in the absence of intermittent renewables. The flexibility and energy storage capacity of the gas network ensures that heat is always available, and high levels of renewable energy can be accommodated on Ireland's electricity grid. The gas network will continue to play this critical role for Ireland, and it will also deliver a clean energy future in a least cost, safe, and secure manner. By transporting natural gas and renewable gas in our network now, and by developing future technologies such as hydrogen and CCS, we will play a critical role in transforming Ireland's energy economy.

Progress toward a net zero carbon gas network is already underway:

Natural gas will continue to be a significant component of the gas mix transported by the network between now and 2050. CCS will provide a means to remove or 'abate' the CO_2 emissions from large point emitters such as electricity generation plants and large industry. CCS technology is already available and used across the world. Together with Ervia, we are examining the potential for CCS solutions for Ireland at the depleted Kinsale gas field. Ireland could also avail of CCS solutions in other countries.

Investment in CNG refuelling solutions for HGVs and buses is underway. In 2018 the first public CNG refuelling station was completed at Dublin Port as part of our ambition to develop, in partnership with others, a 170-station CNG refuelling network. Replacing diesel with CNG will deliver immediate emissions reductions for Ireland and will significantly enhance air quality. As the network decarbonises, Bio-CNG will be available, further reducing transport emissions.

The development of a network of renewable gas injection points is underway. This now enables low carbon and net zero carbon gases to be transported by the gas network, serving homes, businesses and electricity generation. Gas Networks Ireland is also actively developing a GGC scheme. This scheme will certify the origin and sustainability of renewable gas, providing sustainability assurance to gas consumers, stimulating the use of renewable gas by industry and other sectors. Work is ongoing with Teagasc, farmers, their representative bodies and rural communities to develop plans for a renewable gas industry which will stimulate the rural economy, create jobs and enhance farm incomes. Renewable gas will play a significant role in delivering a net zero carbon gas network, not only delivering substantial emissions reductions, but also contributing to meeting Ireland's renewable energy targets in heat and transport. It is our ambition that 11TWh of gas demand (20% of current demand) will be met by renewable gas by 2030, and 22TWh (40% of current demand) by 2050, enhancing energy security through a new indigenous renewable energy source.

We are examining hydrogen solutions for Ireland, including the potential to blend hydrogen into the network. Ireland's gas network once carried 'town gas' which included a significant portion of hydrogen. Hydrogen has the potential to again play an important role in the future energy system.

The gas network has begun to decarbonise and will continue to deliver increasing emissions savings as the network evolves to ultimately become net zero carbon by 2050. The gas network will help meet Ireland's decarbonisation milestones in a least cost and least disruptive manner, while sustaining the security and resilience of Ireland's energy system. Achieving this will require that the role of the gas network in maintaining whole energy system stability in Ireland is recognised and that equitable supports are made available for net zero carbon gases (i.e. renewable gas) and CCS.

Gas Networks Ireland is committed to a clean energy future for Ireland. A whole energy system approach will deliver Ireland's climate ambitions in the most practical and least cost manner. To achieve this, we will partner with key energy stakeholders, industry bodies, research institutes and communities to ensure a least cost and fair transformation to a clean energy society. Our ambition to deliver a net zero carbon gas network will help to ensure that Ireland plays its part in the global effort to tackle climate change, supporting a clean energy society now and for generations to come.

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Abbreviations

Term	Definition
ACA	Accelerated Capital Allowance
AD	Anaerobic Digestion
Bio-CNG	Bio Compressed Natural Gas
CAP	Climate Action Plan
CCGT	Combined Cycle Gas Turbine
CCS	Carbon Capture & Storage
CEF	Connecting Europe Facility
CNG	Compressed Natural Gas
CO_2	Carbon Dioxide
CRU	Commission for Regulation of Utilities
CSR	Corporate Social Responsibility
DCCAE	Department of Communications, Climate Action and Environment
DM	Dry Matter
EPA	Environmental Protection Agency
ETS	Emission Trading Scheme
EU	European Union
GDP	Gross Domestic Product
GENCOMM	GENerating Energy Secure COMMunities through Smart Renewable Hydrogen
GGC	Green Gas Certificate
GHG	Greenhouse Gas
GWh	Giga Watt Hour
Ha	Hectare
HGV	Heavy Goods Vehicle
I&C	Industrial & Commercial
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
LCA	Life Cycle Assessment
MAC	Marginal Abatement Cost
MaREI	Marine and Renewable Energy Research and Development Centre
Mt	Mega Tonne
MWh	Mega Watt Hour
Non–ETS	Non Emissions Trading Scheme
NOx	Nitrogen Oxides
OCGT	Open Cycle Gas Turbine
P2G	Power to Gas
PSO	Public Service Obligation
RED	Renewable Energy Directive
RED II	Renewable Energy Directive Re-cast
RGFI	Renewable Gas Forum of Ireland
RHI	Renewable Heat Incentive
SFI	Science Foundation Ireland
SMR	Steam Methane Reforming
SOx	Sulphur Oxides
SSRH	Support Scheme for Renewable Heat
tCO2eq	Tonnes of Carbon Dioxide Equivalent
TWh	Tera Watt Hour