HYDROGEN PROJECTS IN IRELAND

Case Studies

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DUBLIN HYDROGEN ‘WHRIGHTBUS’ PILOT SCHEME

The first hydrogen buses were purchased in the summer of 2021; the world’s first double decker hydrogen buses found themselves in Ireland’s capital city of Dublin. The project saw joint efforts between the Bus Éireann and the National Transport Authority, as well as the company Wrightbus which created the buses. The buses were the first hydrogen fuel-cell buses to be used on Irish public transport, marking a significant advancement towards a fleet of zero-emission vehicles, with the investment totalling more than €2 million (approximately €2.4m) to purchase three zero emissions vehicles. The bus models used are the ‘Wrightbus Streetdeck H2 FCEV’ manufactured by the Bamford Bus Company, and assembled in Galgorm, in Northern Ireland.

As part of a pilot programme for alternative fuel technology, the NTA and Bus Éireann evaluated the buses while they were in operation. BOC Gases Ireland initially provided the hydrogen for the buses, which was refuelled at its Bluebell facility in Dublin.

The Hydrogen Whrightbus in collaboration with TFI

Source: https://council.ie/new-hydrogen-buses-for-initial-use-on-commuter-route-105x/

The minister of transport at the time of unveiling, Eamon Ryan TD, explained that “Reducing carbon emissions from transport is critical to reaching our climate goals and will also improve air quality for all… other technologies such as battery-electric, are very well suited to bus services in urban areas, but on longer commuter and inter-urban routes, hydrogen fuel cell technology is an innovative zero pipe emission alternative to diesel… I’m especially pleased that the Wrightbus Streetdeck, which is the first such bus in the world, is assembled in Northern Ireland and that Bus Eireann are piloting these buses on their commuter route between Dublin to Ratoath.”

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Three of the above-mentioned zero-emission buses entered service on Bus Éireann Route 105x between Dublin and Ratoath, County Meath in July 2022. Following its launch, just after one year the buses completed over 60,000 kilometres of emission-free travel, saving over 50 tonnes of CO2 from tailpipe emissions and 20,000 litres of fuel. It is comparable to making three and a half trips from Dublin to Sydney, to put things into perspective.

The hydrogen buses function similarly to battery-electric buses in that the vehicle can travel farther than conventional EVs thanks to the electricity produced by the fuel cell and hydrogen storage tanks on board. These buses only emit water vapour, released from the exhaust at the back of the vehicle. This has a great environmental benefit as it reduces city pollution. Traditional diesel buses expel pollutant gases, which only increase in traffic. Water vapour, although a greenhouse gas, only stays in the atmosphere a couple of days, compared to carbon dioxide or methane and is less damaging to public health.

Source: https://www.irishexaminer.com/news/arid-40336385.html

Apart from the eco-friendliness of the vehicles, Dublin Bus Éireann consumers have greeted the models with great enthusiasm. A single bus is capable of carrying up to 79 passengers, and the vehicles are fully accessible to individuals with mobility impairments. Moreover, the absence of a conventional combustion engine in the diesel models results in significantly lower noise pollution in both urban and suburban areas.

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HYDROGEN IRELAND NATIONAL ASSOCIATION

A national association known as HydrogenIreland (H2IRL) serves as a platform for the island of Ireland's hydrogen community in both the Republic of Ireland and Northern Ireland. H2IRL aims to increase awareness of hydrogen and influence policy changes under the general purview of the European Hydrogen Association and Hydrogen Europe, assisting in securing sustainable, renewable energy across both the north and south of the island of Ireland.

Together, company operations, academic institutions, research centres, and policymakers constitute H2IRL, which serves as a forum and voice for the hydrogen community. It offers a hub for hydrogen knowledge on the island, encourages the production and sale of hydrogen and associated technologies, and establishes hydrogen as a sustainable energy source going forward. Increasing the widespread use of clean energy and renewables through connecting organisations together is a key aspect of H2IRL.

The Association acts on behalf of its members to deliver help and expertise so that hydrogen and fuel cells become a key component of a low carbon economy on the whole island; therefore communication and organisational expertise is crucial.

Hydrogen Ireland

The H2IRL exists to provide value to its members by:

1. **Advocating strongly for a positive social, political and economic environment:** developing renewable hydrogen energy and fuel cells on as the island of Ireland developing a zero and low carbon economy.
2. **Representing the shared interests of its members:** a collective approach to maximise impact and effectiveness.
3. **Providing a common voice:** addressing concerns about hydrogen energy and fuel cells.
4. **Sharing non-commercially sensitive information:** facilitating knowledge transfer.
5. **Promoting the development of best practice:** developing safety guidance and standards in the deployment of fuel cells and hydrogen.
6. **Influencing government and company policies in Ireland:** supporting hydrogen energy and fuel cell development, demonstration and procurement.
7. **Influencing the policies of public and private sector organisations:** supporting hydrogen energy and fuel cell deployment on the island of Ireland.
8. **Representing members' interests:** within European and International organisations.

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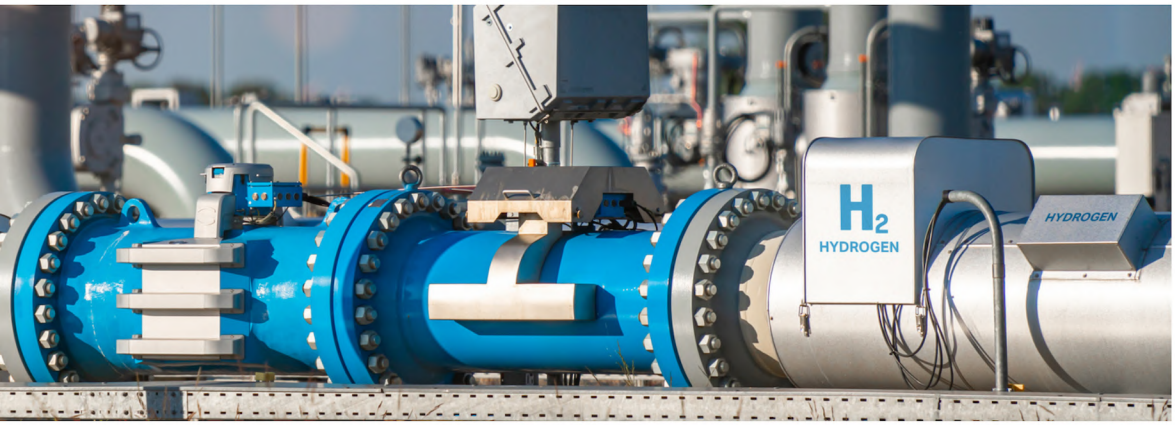
Hydrogen Ireland: GENCOMM Project Summary

The GENCOMM project, carried out between 2017-2023 aimed to address the energy sustainability challenges of North-West Europe through the implementation of smart hydrogen-based energy matrixes. The project aimed to implement three pilot plants that link the three main northwest European renewable sources (Solar Power, Wind Power, and Bioenergy) with forms of energetic demand (Heat, Power and Transportation fuels). Belfast Metropolitan College, as the lead organisation, worked with the National University of Ireland Galway, as well as other organisations from the UK, Ireland, Denmark, Luxemburg, France, and Belgium, utilising € 7.07M of EU funding, to a total budget of € 11.79M for the three pilot plants.

Based on the above pilot plants, GENCOMM integrated technical and financial simulation models into developed. These models helped to form the Decision Support Tool (DST) which provides a roadmap for communities to transition to renewable, hydrogen-based energy matrixes. The DST gives hydrogen stronger future market viability.



Interreg North-West Europe GENCOMM

Specific Objectives of the GENCOMM project:

1. **Empower communities** to implement hydrogen-based energy matrixes to sustainably satisfy their energy demand.
2. **Stimulate the uptake of renewable hydrogen-based technologies** by successfully running three demonstration facilities.
3. **Establish a strong group of energy stakeholders** devoted to, through the use of hydrogen, “sustainabilise” the energy matrix of the NWE region.

Two years after the project end, throughout 2023–2025, more research is planned to evaluate the potential role integrated energy parks might play in the Irish energy system, as well as any potential drawbacks or obstacles. Additionally, as part of the plan, an early hydrogen innovation fund will be established to co-finance demonstration initiatives along the hydrogen value chain.

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GAS NETWORKS IRELAND PARTNER AND RESEARCH PROJECTS

Green hydrogen is produced by using renewable electricity to split water into hydrogen and oxygen using electrolysis, meaning its production does not involve the release of carbon dioxide. It is therefore a clean and renewable gas. Gas Networks Ireland sees itself as a focal point in solidifying Ireland's clean energy future by working on projects with various stakeholders to conduct thorough research. The goal of this kind of research is to guarantee that green hydrogen can be used to safely operate gas appliances and networks in order to satisfy consumer demands. Increasing the usage of green hydrogen will require connecting end consumers, storage, and generation of hydrogen within hydrogen clusters.

Gas Networks Ireland maintains strong connections to the government and key players in the energy industry both in Ireland and throughout Europe, as evidenced by its close engagement with the University College Dublin's Energy Institute (UCDEI) and other related institutions. To fulfill the requirements and recommendations of the National Hydrogen Strategy and the Irish Government's Climate Action Plan, stakeholders across Ireland must work together in order to decarbonise its gas network and achieve net-zero emissions by 2050.

Gas Networks Ireland

The National Hydrogen Startegy and Climate Action Plan of the Irish Government clearly follow the 17 Sustainable Development Goals; a commitment of all UN countries.

Gas Networks Ireland established the **Network Innovation Centre** in Dublin with this goal in mind. The centre's experts and innovation team have been working on projects with external research partners from Europe to fully grasp hydrogen's potential and make sure the Irish gas network can safely transport and store hydrogen to homes and public entities.

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The Network Innovation Centre aims to provide stakeholders with the necessary data to understand how green hydrogen will impact the gas network and help ensure a smooth transition; considering any costs and potential disruption to Ireland's energy system and the general population. As one of the first projects, the centre worked with UCDEI on the 'Testing of Blends of Hydrogen and Natural Gas' (HyTest). The research found that householders using natural gas blended with up to 20% hydrogen will not need to make any change to their existing domestic appliances or notice any difference. There was also a substantial emissions reduction obtained by blending hydrogen with natural gas. These outcomes are important from a network safety and end user perspective, in terms of gas pressure and leakage identification, and also to support plans to fully convert the network to renewable gas over time.

Summary of outcomes:

- The domestic gas appliances tested **operated safely and effectively** with various hydrogen blends tested **ranging from 2% to 20% hydrogen by volume.**
- There was a **substantial emissions reduction** obtained by blending hydrogen with natural gas.
- The average emission reduction found was a **12% reduction in CO2 , a 37% reduction in CO, a 43% reduction in the CO:CO2 ratio, and a 40% reduction in NOx emissions.**
- There were **no changes observed in the minimum operating pressure** of appliances while burning the hydrogen gas blends.
- **No leakage was detected** during pre-testing or during operations for all pipework, connections, fittings, and valves at operating pressure.
- The domestic **gas flow meter was consistently accurate** when used for measuring gas volume flows containing **up to 20% hydrogen** compared to natural gas.
- The **flame motion and colour** of the hydrogen gas mixtures **stayed similar to natural gas.**

Sources:
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GAS NETWORKS IRELAND
TECHNICAL AND SAFETY FEASIBILITY STUDY

Gas Networks Ireland builds, develops, and operates Ireland's natural gas infrastructure, maintaining over 14,664 km of gas pipelines and two sub-sea interconnectors. The Gas Networks Ireland transmission network includes onshore pipelines, any interconnectors, as well as offshore and onshore Scotland pipelines and assets; highlighting the importance of collaboration between countries to maintain energy safety and security. Gas Networks Ireland began with an initial 31km of transmission pipeline in 1978. Today, it continues to grow to a network covering 2,476 km high-pressure steel transmission pipelines and 12,188 km lower pressure polyethylene distribution pipelines. Furthermore, Gas Networks Ireland holds ownership to various Above Ground Installations (AGIs), District Regulating Installations (DRIs) and compressor stations.

To maintain safety and a high-standard of work and tech use, Gas Networks Ireland assembled an internal cross-functional technical and safety working group assisted by global energy consultancy DNV. In the year 2022, the DNV conducted many technical evaluations of Gas Networks Ireland's assets, policies, practices, and installations, in addition to a survey of global research and experiments, creating a report presenting the findings and suggestions that resulted from the above research. The report is based on the 'Technical and Safety Feasibility Study': a high-level assessment of the readiness of Gas Networks Ireland technology and assets for transporting hydrogen/natural gas blends.

This work included the following objectives:

1. To evaluate the potential impacts of hydrogen and natural gas blends on Ireland's distribution and transmission network (in Ireland, subsea interconnectors and Gas Networks Ireland's assets in Northern Ireland, Scotland and the Isle of Man).

2. To assess the impacts of hydrogen blends on current network operations and the integrity of the gas networks.

3. To determine the impacts of hydrogen blends on downstream end-user appliances.

The findings were very positive and **indicate that it will be both safe and feasible to utilise the existing gas network to transport blended hydrogen. H**owever, the report states that **further detailed research will be required before commencing with the commercialisation of hydrogen in the network,** for example in relation to the high pressure transmission network and large industrial, commercial and power generation users. The report, provides next steps including an assessment of the impact on end-users. **It was recommended that developing the safety assessment strategy for hydrogen/ natural gas blends should commence immediately before the start of any hydrogen blending demonstration pilot studies/schemes.**

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The findings of the Gas Networks Ireland technical and safety feasibility study on 'Injecting green hydrogen blends into Ireland's gas network', were very positive, showing that Ireland's gas distribution network is compatible with hydrogen blends of up to 20% and even 100% hydrogen with only some modifications required.

As part of next steps in the utilisation of hydrogen in the network, Gas Networks Ireland will undertake a programme of materials testing for around 50% of transmission pipelines to maintain the current operating pressures when operating with hydrogen blends above 10%.

Gas Networks Ireland will also undertake targeted research on certain equipment contained within transmission gas installations and compressor stations to support the adaptation of large industrial, commercial power generation. The Technical and Safety feasibility study outlines a proposed Safety and Technical Roadmap for Gas Networks Ireland and its stakeholders to follow in future hydrogen-related pilot projects.

The risk assessment and safety demonstration summary states that hydrogen injection requires careful consideration of flows, pressures, hydrogen quality, control of the mixing process and accurate measurement and monitoring of the blend and its energy content.

The research concluded with the recommendation that the start of a pilot hydrogen blending project on the Irish gas network will aid in demonstrating the network's safe functioning as well as the safety of any appliances used by end users, for example in homes or power plants. The pilot studies and further implementation of hydrogen blending into the network will require cooperation from every stakeholder associated with Gas Networks Ireland and support from the appropriate regulatory bodies.

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5 HYDROGEN MOBILITY IRELAND: DEVELOPING THE USE OF HYDROGEN FOR TRANSPORT

The 'Hydrogen Mobility Ireland' (HMI) is a cross-sector partnership bringing together leading companies, research institutions and government agencies that are working together to develop infrastructure related to hydrogen mobility technologies and promote hydrogen technologies in the country. These include organisations such as ESB (Irish electricity supplier), Gas Networks Ireland (gas network operator), motor/car distributors such as Toyota Ireland, Hyundai Ireland, and Honda Ireland, as well as University College Dublin. These entities and more are working together to develop and promote hydrocarbon technologies in Ireland.

The main goals of the partnership are:

1. **Introduction and development of infrastructure for the production, distribution and supply of hydrogen:** creating a network of hydrogen refueling stations that will enable users of hydrogen cars to have easy access to fuel.

2. **Encouraging the increased use of hydrogen vehicles:** promoting the benefits of hydrogen vehicles, such as zero emissions and lower operating costs.

3. **Supporting research and technological development in the field of hydrogen:** working with universities and research institutes to promote innovation and technological development related to hydrogen.

4. **Building international partnerships and collaborating with other entities operating in the hydrogen sector:** establishing collaborations with similar initiatives and organizations around the world to exchange knowledge and experiences and promote the global development of hydrogen technologies.

By working towards these objectives, Hydrogen Mobility Ireland hopes to expedite the shift in Ireland towards a more environmentally friendly and sustainable transportation system and encourage the advancement of hydro-related technologies in various domains, such as the construction of infrastructure for hydrogen production, distribution, and supply, and the creation of a network of hydrogen refuelling stations to facilitate the easy access of fuel for drivers of hydrogen-powered vehicles, such as buses.

In addition, the partnership actively promotes technical advancement and research by facilitating the sharing of expertise and knowledge among partners and participating organisations. The planning of conferences, seminars, and workshops where professionals in the field of hydrogen are able to share their expertise and experience facilitates the sharing of best practices, helps identify problems in the hydrogen industry, and establishes a centre for creative solutions.

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A report from Hydrogen Mobility Ireland, published in May 2023, explains the role of hydrogen derived e-fuels in aviation and maritime, as well as the opportunities for Ireland, to make recommendations on how the development of a domestic hydrogen ecosystem can facilitate the production of sustainable e-fuels for use in aviation and shipping transport. The research examined e-fuels, which are created when CO2 and electrolytic hydrogen combine to form hydrocarbon liquids or oxygenated (methanol or ethanol) by chemical or biological synthesis. **It was found that the amount of hydrogen that will be required to cover the projected demand when considering proposed EU policies ranges from 0.25-0.35 kt in 2025, up to 7-11 kt in 2030, finally reaching 230-330 kt in 2050.**

E-fuels, produced from hydrogen and captured CO2, can produce drop-in fuels chemically identical to fossil fuels. At the date of writing, the production of e-methanol is at commercial scale, while e-kerosene production is at pilot scale. **The report further states that through developing the Irish hydrogen economy further, expanding into e-fuels, could result in:**

- **Gross Value Added of €11m/year in 2030**
- **Gross Value Added of up to €300m/year in 2050**
- **10,500 associated jobs by 2050**

A wide range of fuel types and technologies will be needed to decarbonise the transportation industry in Ireland and Europe as a whole. The industry will continue to rely heavily on liquid carbon fuels due to unique operational needs and variations in journey length (for example, national compared to international shipping). Furthermore, the cost of producing e-fuels is currently higher than that of fossil fuels, which makes it difficult for producers to commercialise these technologies. The scaling up of these technologies hence requires immediate financial backing as well as clear and precise national and EU policy.

Sources:
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