



Ballylumford P2X
Phase One



Background

The challenge

Northern Ireland has the highest instantaneous penetration of grid connected wind generation in the world today. However, the wind industry here is subject to curtailment. This is when carbon free energy production is turned off for system security reasons.

At certain times Northern Ireland has the capacity to produce more renewable energy than can be consumed. This limits the decarbonisation benefits delivered by existing wind and solar generators, and unless a solution can be found, it will create a barrier to future renewable investment, as curtailment will continue to

get worse as the level of installed renewable capacity increases. This also leaves Northern Ireland exposed to more volatile electricity prices and limits renewables' ability to provide security of supply benefits.

The solution

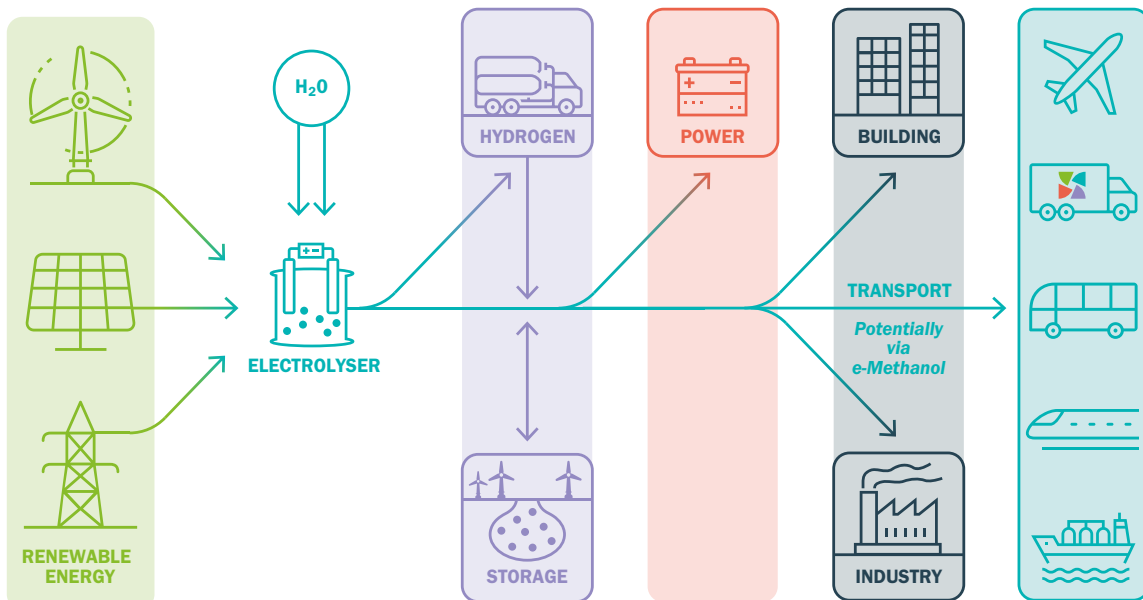
Northern Ireland needs to utilise more of the renewable energy when it is available, or store surplus renewable energy over long periods of time for future use when the output from renewable generation is too low to meet demand. This is where the Ballylumford Power-to-X Project fits in.

What is Power-to-X?

Power-to-X is the process of using **electrolysis** to split water into hydrogen and oxygen using electricity.

Hydrogen is a versatile, safe and clean energy carrier that can be used to store surplus renewable energy at scale for later use across multiple sectors.

Hydrogen can also be used to power dispatchable power generation when the output from renewable generation is low, providing a means to maintain decarbonised security of electricity supply.



The Project

The Ballylumford Power-to-X project's vision is to create a full cycle economy to take green hydrogen right from production, through storage, to distribution, and end use.

Located close to one of the main sites used for electricity generation near Islandmagee on the Co. Antrim coast, Northern Ireland, it has direct access to strategic key electricity and gas network infrastructure and is in an area expected to support the future connection of offshore wind generation. The local geology is also able to support large-scale hydrogen storage, making the project of unique significance to the UK and Ireland.

Ballylumford Power-to-X was awarded £986,000 in government funding as part of the Longer Duration Energy Storage Demonstration (LODES) programme by the Department for Business, Energy & Industrial Strategy (BEIS in 2022).

The viability study funded by BEIS looked at the potential of grid connected electrolysis producing green hydrogen for storage in an underground salt cavern system, alongside distribution and use in power generation, in a first-of-a-kind solution to the curtailment problem. The work completed included a front-end engineering

study (FEED) that has produced valuable knowledge and practical experience of developing strategic hydrogen infrastructure, critical to helping Northern Ireland and the wider UK meet their decarbonisation obligations.

Phase One of the project was delivered collaboratively by B9 Energy, Mutual Energy, Islandmagee Energy Ltd and the Net Zero Technology Centre.

What we've found out so far

Technical studies

Electrolyser

The project utilises electrolysis as a form of dispatchable demand that can be turned on during periods of excess renewable generation to balance the electricity system. This requires a proton exchange membrane (PEM) electrolyser, which can be turned off and on. Alternative technology types, such as alkaline electrolysers, do not offer this flexibility.

The FEED study also suggested that electrolysers could be 'stacked' in a modular way to incrementally increase the capacity of the power-to-x site over time to match hydrogen demand growth, as well as the future increase in renewables.

Hydrogen pipeline

The FEED study found that a high-pressure 100% hydrogen pipeline was technically feasible with appropriate design and approach to safety and asset management. It also demonstrated that existing gas arrangements could be adapted to accommodate an 100% hydrogen pipeline network in the future.

Salt cavern storage

Storage of hydrogen within salt caverns in Northern Ireland was demonstrated to be technically feasible, with appropriate safety protocols. For salt cavern storage to be commercially viable, however, the study indicated that hydrogen infrastructure would need to be developed at scale.

A 100MWe electrolyser would need to run for a period of a year at a circa 40% duty factor to produce sufficient gas to commission one salt cavern. The scale however is commensurate with the extensive flexibility and storage requirements required by Northern Ireland to deliver upon its decarbonisation ambitions.

Electrical generator

Power generation is possible with existing combined cycle generators at a 40-60% hydrogen blend by volume. The project had originally considered repurposing an existing gas turbine but the FEED study demonstrated that manufacturers are currently developing turbine technologies that are compatible with 100% hydrogen fuel.



Next steps

The Ballylumford Power-to-X FEED study identified that the modular nature of electrolyser technologies means the project can be scaled up over time. The project will now be progressed in two phases: a small-scale pilot project and a large-scale project that can provide a solution to the major decarbonisation challenges facing Northern Ireland.

Small-scale pilot

The pilot project will be up to 20MWe. The green hydrogen produced will be purified to fuel cell grade purity, compressed, and dispensed into tube trailers for onward delivery and sale to transport and industrial end users.

This initial project will facilitate the development of common standards and protocols between wind farms, electrolysers, and the electricity and gas networks. It will also build skills and expertise in a range of areas such as health and safety, regulation and market operation, and integration of the supply chain.

Large-scale vision

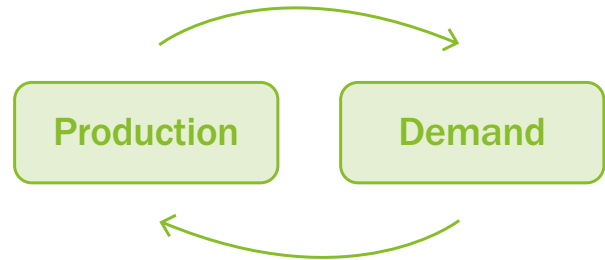
The pilot project will then be scaled up over time to a circa 300MWe project, which could be connected directly to an offshore wind farm. At this scale salt cavern storage would be feasible and the hydrogen produced either blended into the existing natural gas network, or transported via an 100% hydrogen pipeline network to end users.

Key Enablers

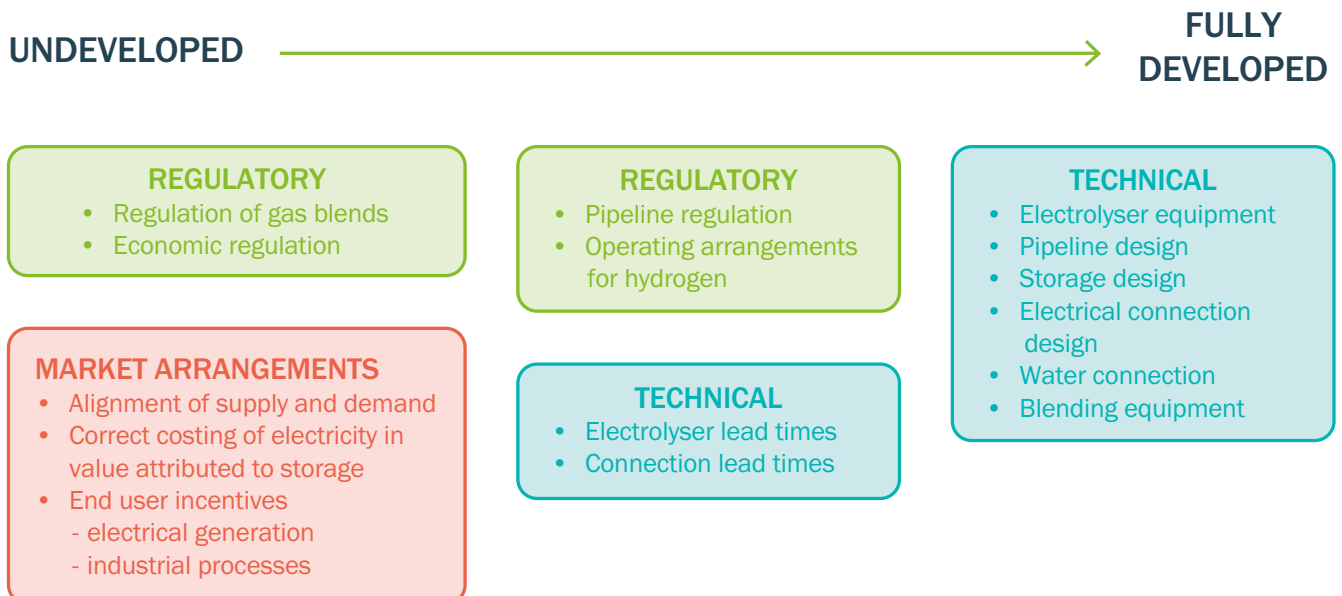
Develop regulatory framework

It is essential that the Utility Regulator has the legal authority to regulate hydrogen networks in the same way that they currently regulate natural gas networks. An appropriate regulatory framework will provide the certainty required by investors, as well as protect energy consumers.

Develop hydrogen demand



The FEED study has demonstrated that it is technically possible to produce and store hydrogen at a large scale in Northern Ireland, however, it is currently not commercially viable to do so because there is insufficient accessible demand. Rapid development of government policy and funding is urgently required to stimulate growth in hydrogen demand in Northern Ireland.



Key policy recommendations

The hydrogen economy will bring benefits to Northern Ireland in terms of investment, economic growth, and jobs, as well as a practical route to meeting carbon reduction targets set out in Climate Change Act (NI) 2022.

To realise the potential of the hydrogen economy in Northern Ireland, policymakers, industry and other stakeholders should collaborate to deliver the following:



Development of an NI hydrogen strategy



Require trials involving hydrogen blending for electricity generation to begin as soon as possible, and set a target date for 100% decarbonisation of the NI power system



Development of an NI energy storage strategy



Incentivise end user to switch to hydrogen via targeted subsidy schemes



Ensure adequate funding mechanisms are in place to support hydrogen innovation



Impose obligations on energy suppliers to source % of their demand as hydrogen



Establish the feasibility of hydrogen blending in the NI gas network



Develop a revenue guarantee scheme for large-scale hydrogen storage



Establish the feasibility of repurposing the NI gas network for hydrogen

For more information

To find out more about the Ballylumford Power-2-X project, please contact project member Mutual Energy, B9 or Islandmagee Energy on:

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POWER 2 X

