

The Orkney Hydrogen Economic Strategy - Consultative Draft

Foreword

Orkney has been at the forefront of energy innovation ranging from the first commercial wind turbine connected to the grid at Costa Head in 1951, to the innovative research and development of wave and tidal energy at the European Marine Energy Centre (EMEC).

The Orkney community has been enthusiastic in its uptake of renewable electricity production. We have been so successful that generation not only exceeds our own needs but is greater than the capacity of Orkney's existing grid and electricity export connection to Mainland Scotland. Even with innovative use of the grid network, production of green electricity is being curtailed, with a negative impact on the investments made by individuals, communities and businesses.

Innovation is infectious and our communities, industry and the Council see the storage and use of green produced electricity in the form of hydrogen as an opportunity to help address the problems caused by this curtailment. It would also provide opportunities to address some of our farming, transport, heating and power challenges.

Orkney is rich in energy resources, but it imports high levels of fossil fuels and has some of the highest levels of fuel poverty in the country. This Strategy outlines how hydrogen offers a way to address this, as well as the opportunities it could provide as an opportunity during the transition to an improved grid connection – as well as the potential benefits in its own right for our economy in the short, medium and long term.

As the Council we have an aspiration for a low carbon economy, not just because it is the environmentally right thing to do, but as there can also be social and economic benefits. This Hydrogen Economic Strategy is designed to highlight the energy challenges we face and the Council's role in enabling individuals, communities and businesses to develop opportunities to make good use of hydrogen in ways that benefit all of our lives.

In the short term there will be feasibility plans to be considered to utilise the electricity which is currently curtailed, and demonstrating and implementing at scale those initiatives that prove successful and replicable. In the long term this is a strategy to create real jobs, attract young skilled people, and generate economic growth and real sustainable wealth for future generations.

Introduction

Orkney has some of the best wind, wave and tidal resources in Europe, and in the summer it has long daylight hours. As a result there are over 1,000 domestic scale micro generators (700 wind and 350 solar), a combination of both community and private investment, and significant research and development that includes world's first and only wave and tidal energy test centre. Indeed, Orkney has embraced

renewable electricity production and use to the extent that in 2014 it produced 104% of its electricity needs. Lack of a large enough Grid Connection is Orkney's major weakness to matching the ambition and capacity to generate renewable energy. This has resulted in the curtailment of existing renewable energy generators, and Scottish and Southern Energy (SSE) has imposed a moratorium on new grid connections since September 2012, effectively stalling further investment in renewable energy generation either from local or inward investment.

Orkney's Distribution Network Operator (DNO) developed a zoned Active Network Management scheme (ANM), which initially allowed additional renewable generation to connect under arrangements where the DNO can curtail generators at times when output exceeds capacity on the local distribution grid. However, there has been greater than anticipated curtailment, with some renewable generators having 40-60% of their potential electricity production curtailed. As a result, investors in renewable assets including Community based schemes in Orkney have lost substantial revenue from electricity sales and from UK Government Feed in Tariffs (FITs) scheme.

Developing hydrogen-based projects provides a way to transform these challenges into opportunities to make good use of this 'lost' electricity.

A number of pipeline projects have already been identified, including the use of hydrogen in sea and road transport; local solutions which are potentially replicable in other areas facing similar challenges. Moreover, we have a knowledgeable community, a supportive public sector and innovative industries with successful track records, as well as existing networks that are willing and able to work with academia and other partners in order to take proof of concept projects to commercial reality.

A number of policy and practical factors are driving these projects forward. Opportunities for hydrogen in Orkney that have already been identified include EMEC's hydrogen electrolyser and the Orkney Surf 'n' Turf project. These involve producing hydrogen from curtailed marine and community-owned wind renewables, to be transported and used to provide electricity at Kirkwall Harbour, which will include providing auxiliary power for ferries tied up at the pier. In addition, the Wind - Agri Energy project has received initial funding from the Scottish Government to explore the feasibility of using hydrogen that has been produced using otherwise curtailed electricity to provide synthetic diesel and agricultural fertiliser.

Unlike any other European and worldwide hydrogen projects that we are aware of, Orkney's hydrogen production will be based on using green electricity which would otherwise be wasted. This innovative approach to grid constraint will utilise hydrogen-based technology in the development of a local island energy economy, where renewable energy is both commercially generated and used locally in a manner not reliant on grid infrastructure.

Why Hydrogen?

Hydrogen is the most abundant element in the universe. but very little of it is freely available. However, hydrogen can be produced through electrolysis of water (H₂O) by using an electrical current to split it into its component parts of Hydrogen (H₂) and Oxygen (O₂).

This process will allow Orkney to make good use of an abundance of renewable electricity that would otherwise be lost or wasted. Hydrogen produced this way allows surplus renewable energy to be stored and used where it is needed for heat, power, transport and other purposes – without the need for an electricity grid.

Policy Drivers

The European Union requires:

- A 20% reduction of carbon emissions by 2020.
- To limit emissions of new vehicles of 95g CO₂ per km for new cars by 2021.
- Compliance with the requirements of the EU Clean Air Policy Package.
- Achieving resilience through Energy Security as in the European Energy Security Strategy.
- Expansion of renewables capacity through the mass deployment of alternative fuelled vehicles that use electricity as the main feedstock; EU 2020 targets; H2Mobility.

The UK and Scottish Governments require or are aiming for:

- Respectively 40% and 42% reductions in carbon emissions by 2020, relative to 1990 levels.
- 80% reduction of carbon emissions by 2050, relative to 1990 levels.
- A mass market transition to low emissions vehicles.
- Compliance with National Air Quality Strategy (UK).
- Compliance with the Scottish Air Quality Strategy 2015.
- That, in accordance with the Scottish Electricity Generation Policy Statement 2013, that Scotland's generation mix should deliver the four principles of security of supply, affordable to the consumer, decarbonisation by 2030 and to achieve the greatest possible economic benefit and competitive advantage.
- Resilience through Energy Security as in the Energy Security Act 2015.
- Long-term affordability.
- Expansion of renewables capacity through the mass deployment of alternative fuelled vehicles that use electricity as the main feedstock; EU 2020 targets; Climate Change Act (2008) UK; UK H2Mobility; Climate Change Act (2009) Scotland.
- Energy storage - Scotland's renewable energy targets include 100% electricity demand equivalent from renewables by 2020; grid balancing; low carbon vehicles using electricity as power and storage.

Furthermore, Orkney Islands Council has the following stated ambitions in its current Council plan:

- Promote successful and thriving communities.
- Have a low carbon Orkney approach.
- Attract investment, investors and companies.
- make use of resources to capture energy.
- produce policy to deal with the development of renewable energy and associated infrastructure;
- ensure community benefit from renewable investments;

- ensure a skilled workforce and training in Orkney associated to energy;
- secure and integrate Orkney's transport network;
- where possible to secure Orkney's transport electric future;
- address Orkney's fuel poverty.

H2 Orkney - Strategic Hydrogen Programme

Due to the significant curtailment of renewable energy generation and subsequent loss of revenue to local investors, Orkney businesses, communities and the public sector have already embarked on a number of innovative hydrogen feasibility studies, projects and investments.

The following projects have already been initiated in Orkney:

- EMEC has invested in a 0.5 megawatt (MW) electrolyser to create hydrogen from otherwise curtailed tidal turbines off Eday.
- As a partner in the Surf and Turf project that is being led by Community Energy Scotland, Eday Renewable Energy Ltd will contribute electricity from its otherwise curtailed community wind turbine to the EMEC electrolyser to create hydrogen. This hydrogen will be transported to power a fuel cell at Kirkwall Harbour. As part of this project, training will be developed for seafarers, enabling them to handle hydrogen to Maritime Coastguard Agency (MCA) standards. This could be a stepping stone towards the development of hydrogen powered vessels .
- Shapinsay Development Trust are leading a project to explore how the use of curtailed electricity from their community wind turbine could be utilised to produce synthetic diesel for local farm transport and urea for use as a fertiliser.

In addition, the following project ideas are also being explored:

- DUAL Ports, for the design of a hydrogen bunkering facility (to allow hydrogen ships to be refuelled).

The Strategy

In the Council's view, Orkney will benefit greatly by using curtailed electricity to store and generate through electrolysis a range of low carbon fuels and power sources. Hydrogen could be used in a number of different applications such as transport, heat, power, as a storage medium, or as part of the process for manufacturing liquid fuels, diesel, and fertiliser (ammonia and urea) for the farming industry.

The high level aims of this strategy are to use hydrogen that is produced using renewable energy sources:

- As an energy vector to utilise Orkney's curtailed energy
- To store intermittent renewable energy in Orkney
- To decarbonise heat and transport in Orkney
- To reduce imports into Orkney of fossil fuels.

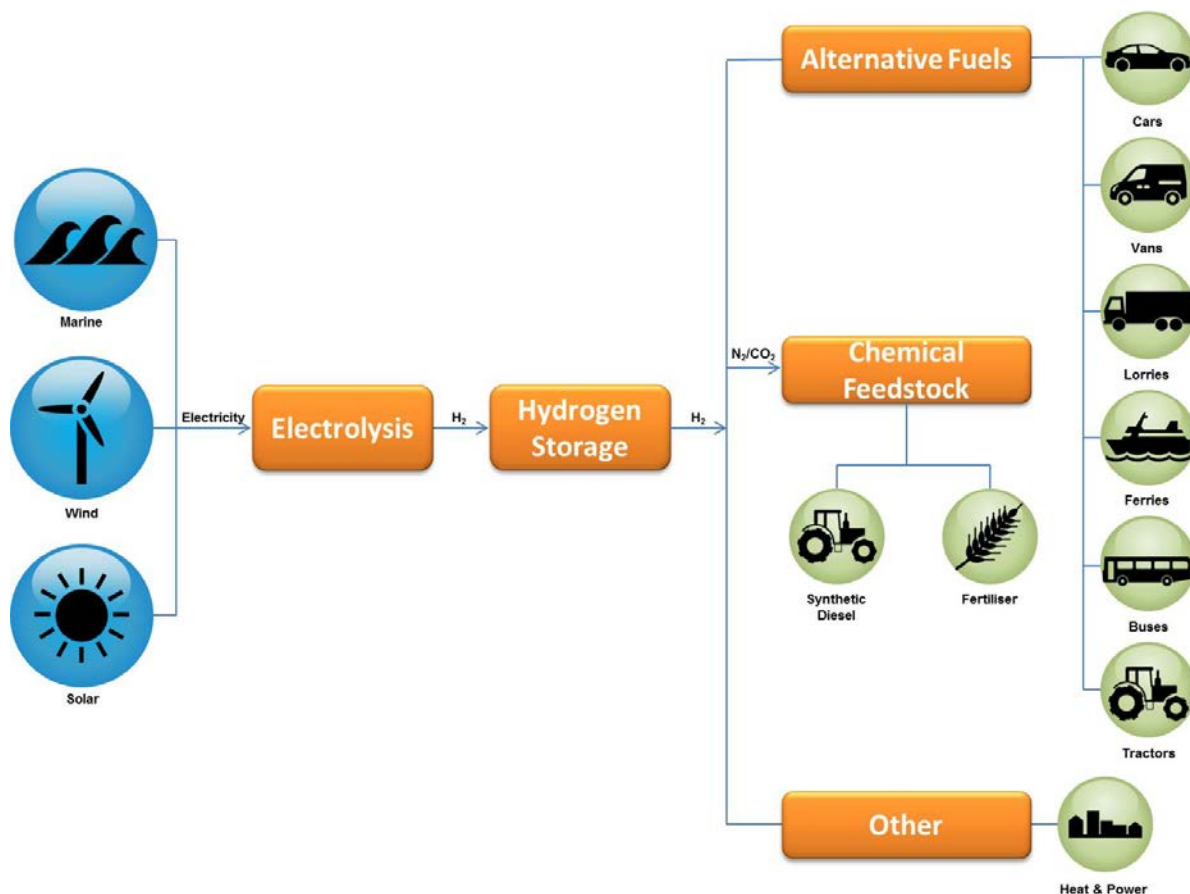


Figure 1: Potential hydrogen production, storage and use in Orkney.

For example, where viable and achievable this could include ambitions such as:

- The addition of electrolysis to other constrained turbines to increase hydrogen production and increase income to renewable energy operators.
- The roll out of the model pioneered by the Orkney Surf 'n' Turf project of the transportation of hydrogen from outer isles to Orkney's mainland.
- The construction of a hydrogen refuelling station in a strategic location.
- The introduction and popular use of hydrogen vehicles.
- The use of hydrogen in heating and power applications.
- Working with operators to investigate the use of hydrogen at the Flotta terminal to make operations more competitive.
- The addition of a hydrogen bunkering system as part of harbour operations.
- The use and operation of hydrogen ferries on inter-isles routes.
- The production of diesel / urea.
- Where there is volume in production, a hydrogen pipeline to reduce operational costs and create the backbone of a hydrogen grid.
- The possibility of a hydrogen grid versus a district heating system in suitable areas of Orkney.
- Where successful, roll out and sale to other locations in Scotland or nationally.

These will be new industries for Orkney and it will be important to ensure that they are located in areas where environmental impact can be avoided or minimised.

Through the pursuit of this strategy, the Council aims to meet its requirements under EU, national and local obligations. In addition, it has the specific objectives to:

- Eliminate curtailed energy in Orkney.
- Create skilled employment opportunities in Orkney through making it a centre of excellence in hydrogen.
- Bring additional commerce to Orkney through establishing Kirkwall harbour as hub for marine hydrogen transport.
- Decrease rates of fuel poverty by providing further options for fuel choice for individuals and the public through the replacement of traditional fuels with hydrogen.
- Improve the energy security of Orkney by reducing imports of diesel, urea and other commodities through production from hydrogen.

Such ambitions can only be achieved through the activities of communities, private industry and commerce. The Council has specific roles in enabling these projects, for example through economic support and also by ensuring the location and design of individual developments are consistent with the policies of the Orkney Local Development Plan. The Council would also ensure that they can be undertaken without impacting significantly on natural and cultural heritage assets or public health and amenity. Therefore the Council's ambition is that, where economically viable, it will:

- Use hydrogen equipment where the cost over life is shown to be equal or less than standard equipment.
- Provide help in-kind.
- Participate in grant funded projects where the external grant allocation is 50% or greater.
- Establish a methodology to react to funding opportunities, including a pre-approved budget.
- Promote Orkney as a destination that is open for H2 business.
- Support the development of a local hydrogen economy supply chain, seeking opportunities with Orkney's existing energy supply chain and potential inward investment opportunities.
- Promote greater understanding and acceptance of the use of hydrogen technologies through local communication and education activities.
- Contribute to strategy and policy development at all levels of government to ensure they are supportive of hydrogen technology.
- Work collaboratively with other local authorities, governments and industries to advance the use of green hydrogen technologies.