Scotland is a country with very ambitious targets for the integration of renewable energy sources into its electricity mix. In 2011 its First Minister, Alex Salmond, increased the target for renewable electricity generation to be the equivalent of 100% of Scotland’s own electricity demand by 2020. The plan is to achieve this goal by generating two times more electricity than the country needs with more than half of it coming from renewable sources. According to Scottish Government estimates, Scotland has a quarter of Europe’s total offshore wind and tidal energy resource and a tenth of its potential wave capacity, potentially totalling 58 GW. Even assuming a low capacity factor of 25% this potential could meet the country’s current electricity needs more than three times over.

Hydrogen and fuel cells are not new technology to Scotland, back in 2005 it was host to the world’s first community owned renewable hydrogen production plant demonstration project, on the island of Unst. The PURE renewable energy project incorporated two 15 kW wind turbines, a 3.55 Nm\(^3\) water electrolyser, hydrogen storage and a 5 kW PEM Plug Power fuel cell. The project was owned and run by the local community with the turbines providing power and heat to a neighbouring business estate and the fuel cell providing backup power. Excess electricity was used to produce hydrogen which fed the fuel cell and a fuel cell vehicle.

This small-scale approach to developing a self-sufficient smart grid is one which is now receiving more attention at the national scale. The Unst project included hydrogen energy storage in order to enable a balanced system, maximise the use of available wind energy and ensure the fuel cell could provide backup power when necessary. On a small scale this use of hydrogen as an energy store is simple when compared to the energy needs of an entire country, but Scotland is pursuing this holistic energy model, and is not alone in doing so.
The Scottish Government is supporting a project being led by Aberdeen City Council to develop a hydrogen hub in Aberdeen. In 2012, alongside Scottish Enterprise, it committed up to £3.3 million to build Scotland’s first hydrogen refuelling station and to fund a fleet of ten hydrogen fuel cell buses for the city as part of an EU-backed project. The project plans to generate electrolytic hydrogen to power this fleet of vehicles. There are also plans to extend the scheme to other hydrogen uses including refuelling hydrogen-powered passenger cars, as they become available. Other partners in the project include Scottish & Southern Energy Power Distribution (SSEPD), industrial gas company BOC, Stagecoach and First Group.

Hydrogen generated from sources of renewable electricity is likely to be a significant contributor to the decarbonisation of the UK’s transport network, claim findings published from the first phase of the UK H2Mobility project. Transport Scotland joined the UK H2Mobility project in October 2013 and alongside its support for the Aberdeen hydrogen hub recently published its roadmap to support the widespread adoption of plug-in vehicles. The report, Switched on Scotland, sets out a vision that by 2050 Scotland’s towns and cities will be free from the damaging effects of petrol and diesel fumes. It also expects hydrogen fuel cell electric vehicles to contribute more than 20% to annual new car sales in the country by that time.

International electricity and gas company National Grid operates the UK’s gas distribution and transmission pipelines. It controls more than 278,000 kilometres of mains pipeline stretches from the north of Aberdeen, down as far as Cornwall in the south of England. The company also runs the UK’s national transmission system, the high-pressure part of National Grid’s pipeline network, consisting of more than 7,600 kilometres of pipeline operating at pressures of up to 85 bar. National Grid is a member of the North Sea Power to Gas Platform, which is a joint body of stakeholders, aiming to explore the viability of power-to-gas in the countries surrounding the North Sea area.

Scotland is also home to five ‘independent’ gas grids in Campbeltown, Oban, Wick, Thurso (regasified LNG) and Stornoway (LPG) which could also benefit from power-to-gas. Using domestic Scottish renewable energy sources could contribute to decarbonising these grids, enhancing energy security.

Caledonian Maritime Assets Ltd (CMAL), which owns the ferries, ports and harbours and infrastructure necessary for vital ferry services serving the west coast of Scotland and the Clyde Estuary, completed a feasibility study at the end of 2012 for Scottish Enterprise evaluating the technical and commercial possibilities of using hydrogen fuel cells to power zero emission ferries. The planned vessel would produce no exhaust fumes and it is hoped would run on green hydrogen produced using renewable electricity generated overnight from local wind farms or other renewables. A successful outcome from this study could lead to a £15 million demonstration vessel being built within the next few years.

Scotland also has a highly active fuel cell and hydrogen industry association, the Scottish Hydrogen and Fuel Cell Association (SHFCA), which works to promote and develop Scottish expertise in fuel cells and hydrogen technologies and its membership including both industry and academia. Scottish universities are actively researching fuel cell technology with examples including solid oxide fuel cells at the University of St Andrews and hydrogen storage at Strathclyde University. Not content with focussing solely on Scottish companies, SHFCA has also developed international collaborations with other fuel cell associations, such as in Canada, working together to evolve mutually beneficial strategies for globally sustainable hydrogen and fuel cell markets. SHFCA’s recent 5th annual conference took place at the end of September 2013 and Fuel Cell Today provided coverage of the event which can be read in our latest event report.

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