



Energy Efficiency Business Support

Hydrogen energy

Hydrogen offers a potential alternative to natural gas and makes use of excess energy from renewables

Hydrogen has been touted as the holy grail of clean energy. The Hydrogen Council believes it could account for almost a fifth of global energy consumption by 2050. Hydrogen could be used on a large scale as a cleaner replacement for natural gas in the gas grid, supplying individual boilers or district heat networks. It can also be used to power fuel cells. Hydrogen promises much but there are significant technical challenges to overcome. The main one is finding a low carbon replacement for the natural gas currently used to produce hydrogen.

Hydrogen in the gas network

At the moment, steam methane reforming (SMR) is the most common method for producing hydrogen in large quantities. It's a chemical process that uses steam and a catalyst to heat natural gas and create hydrogen. It creates CO₂ as a by-product, which means it needs to be used in conjunction with carbon capture and storage (CCS) to be considered low carbon. And CCS is still unproven in the UK. There are currently around 12 SMR plants producing hydrogen for sale as an industrial gas in the UK. A number of others are integrated directly into refineries and chemical sites.

There's a growing amount of research in the UK looking at producing hydrogen on a larger scale for the gas grid. In the KPMG report, UK Gas Networks Role in a 2050 Whole Energy System, this is seen as the lowest cost option to meet 2050 climate targets when compared to other low carbon heating sources. To begin with, hydrogen would be blended with gas until production was ramped up and network upgrades completed. There are various small-scale trials and studies

underway around the country to test the use of hydrogen in the grid. Some are mixing hydrogen and gas. SGN in Scotland is undertaking a feasibility study, the 'Hydrogen 100 project', to use only hydrogen. It's looking to develop site specific evidence that will support the construction of a physical 100 per cent hydrogen demonstration.

A pilot scheme by Northern Gas Networks, the H21 Leeds City Gate project, plans to substitute hydrogen for methane in the local gas network. It aims to be operational by the late 2020s. The company expects to see carbon emissions from heating cut by almost three-quarters. It will use SMR to create hydrogen from existing natural gas supplies, with the resultant CO₂ stored underground. If successful it could lead the way to a nationwide rollout.

Meanwhile, CCS techniques are being investigated in the north east of Scotland by the Acorn project. The project involves researchers from the Netherlands, Norway and the UK who are looking into capturing and storing carbon beneath the North Sea.

Hydrogen storage

Hydrogen for fuel cells is made using a process known as electrolysis. This splits water into its constituent parts – hydrogen and oxygen. It's essentially a storage technology and could prove beneficial in remote areas, especially parts of Scotland with excess renewable energy. The hydrogen can be used to power vehicles and provide electricity or heat to buildings. Hydrogen fuel cells work by converting the chemical energy from hydrogen and oxygen into electrical energy. It's similar to

a battery but instead of just storing power, fuel cells use hydrogen to continually generate power.

Hydrogen has not taken off before now because it takes more energy to split water into hydrogen than you get from the resulting hydrogen. But clean and plentiful energy sources, which as wind and tidal power, can be harnessed to make it.

The islands of Scotland often produce so much electricity from wind energy that turbines have to shut down because there's not enough capacity in transmission lines to cope. It has led to some exciting developments over the last few years, most notably in Orkney, Shetland and the Western Isles. On these islands, public and private enterprise have been looking into uses for this excess energy, including hydrogen.

One of these is a community run project in Orkney called Surf'n'Turf, based on the island of Eday. It has been using

surplus electricity from the EMEC tidal energy centre, located just west of the island, along with onshore wind turbines to produce hydrogen using a 500kW electrolyser.

The hydrogen is stored as compressed gas then transported to Orkney's capital Kirkwall where it powers a fuel cell to generate clean electricity on demand. Heat is produced as a by-product and piped into nearby buildings. Orkney is now laying the foundations for a hydrogen economy on the back of this.

Similar research is underway at the Hebridean Hydrogen Park, which is part of the University of the Highlands and Islands. They recently set up a renewable hydrogen production, storage and distribution facility at Creed Enterprise Park just outside Stornoway. ●

AT A GLANCE

- Promising as a low carbon replacement for gas in the existing grid, when used with carbon capture and storage (CCS)
- Creating hydrogen through steam methane reforming with CCS has not yet been proved to be technically and economically feasible in the UK
- Good as a way to harness excess renewable energy in parts of Scotland for use in fuel cells for transport, power and heat
- Lots of research currently underway