Scottish Enterprise

Oil & Gas diversification opportunities:

Hydrogen

Hydrogen production is an established market that largely serves demand from the ammonia manufacturing and chemical refining industries. However, hydrogen is also being developed for use as a transport fuel, heating fuel and as energy storage medium, and could generate significant opportunities for the Scottish oil and gas supply chain.

Key Facts:

- Aberdeen is home to the UK's first commercial-scale hydrogen production and bus refuelling station, as well as Europe's largest fleet of hydrogen busses. Aberdeen City Council is considering the addition of 10-20 new busses to the £21m demonstration project.
- Fife Council is piloting the world's first hydrogen and diesel dual-fuel refuse collection vehicles as part of fleet of 17 hydrogen powered commercial vehicles based out of Levenmouth.
- Orkney has been chosen to host the £9m EU BIG HIT project that will convert excess wind generation into hydrogen to power a fleet of 10 vehicles and two hydrogen boilers installed on council premises.The project builds on Orkney Surf 'n' Turf, which converts excess tidal generation to hydrogen for use in Kirkwall harbour.
- The UK Government is contributing £5m towards the construction of 12 hydrogen refuelling stations in 2016 as part of a roll-out of 65 stations by 2020. Up to 1,150 refuelling stations could be installed across the UK by 2030 under plans set out in the UK H2 Mobility roadmap.
- Northern Gas Networks has developed a proposal to convert Leeds city gas network into a hydrogen network at a cost of £2bn to 2030.
- Under a high growth scenario, as many as 150m hydrogen fuel cell vehicles could be sold worldwide between 2015 and 2050, requiring investment of £700bn - £1,500bn in hydrogen infrastructure.
- The global fuel cells market could be worth over £16bn in 2020 and over £111bn by 2050.

UK Opportunities

There is considerable potential for the oil and gas supply chain to leverage its expertise in natural gas for application in the emergent hydrogen transport, heating and storage markets. While the UK market remains in the very early stages of development, the country is already home to several hydrogen technology developers and hosts a number of globally significant demonstration projects in the transport sector. The most immediate supply chain opportunities are in the development of the UK hydrogen refuelling network, as well as demonstration projects for green hydrogen production (via electrolysis) and storage. There have also been a number of UK studies considering hydrogen as an alternative to natural gas as a heating fuel, used in combination with hydrogen boilers or fuel cell CHP systems. Northern Gas Networks recently undertook a feasibility study for converting the Leeds gas network to hydrogen by 2030 and is currently seeking funding to develop a detailed roadmap for the £2bn project.

International Opportunities

While the UK has made minimal use of hydrogen for heating to date, there are presently around 150,000 domestic fuel cells providing heat and power to Japanese households. The Japanese Government has ambitious plans to create a 'hydrogen society' and is targeting 5.3m home fuel cells and 800,000 fuel cell cars by 2030. The South Korean Government also has ambitious plans for hydrogen and is targeting 100,000 domestic fuel cell installations by 2020 and 630,000 fuel cell cars by 2030. The US is a major market for commercial and industrial fuel cells and has the world's largest fleet of fuel cell vehicles, comprising over 1000 passenger and commercial vehicles in 2016. Germany is the leading European market for hydrogen heating and transport, with over 300 domestic fuel cells installed in German households, a fleet of around 200 fuel cell vehicles, and the world's first hydrogen powered train. Germany has plans to install up to 400 hydrogen refuelling stations by 2023, up from approximately 50 in 2016.

Area	Skills & Expertise Required
Hydrogen production	Including the design, development and construction of steam methane reformers for hydrogen production.
Hydrogen storage	Including the design and construction of small-scale storage in the shorter term and large-scale projects over the longer term.
Hydrogen distribution	Including high pressure pipelines for hydrogen transmission, shipping of hydrogen internationally, hydrogen filling stations for transport applications and distribution by road.
Technology development and deployment	Including the development of fuel cells, hydrogen turbines and domestic heating appliances.
Health & safety services	Including hydrogen related HSE and process safety support.

Market Entry

The chemical refining and ammonia production markets are large and well established, and may prove challenging for new supply chain entrants. Conversely, the emerging hydrogen transport, heating and storage markets are much smaller and less well developed, but may present considerable opportunities for first-mover companies over the longer term. Scottish oil and gas supply chain companies with an interest in hydrogen may wish to consider joining an industry association and undertaking additional research to deepen their understanding of the sector and its requirements.

Further Information & Support

Scottish Enterprise provides a range of information and support for oil and gas companies considering diversification opportunities. Further information is available from: **www.scottish-enterprise.com/industry-support/oil-and-gas**

Additional information on hydrogen opportunities is available from:

- Scottish Hydrogen Fuel Cell Association: **www.shfca.org.uk**
- European Hydrogen & Fuel Cell Association: **www.h2euro.org**
- Hydrogen Europe: **www.hydrogeneurope.eu**

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