IEAGHG Information Paper: 2017-IP23; Clean Hydrogen and CCS

The European Zero Emission Platform (ZEP) has issued a report entitled ***"Commercial Scale Feasibility of Clean Hydrogen"***. The report investigates the potential of decarbonised hydrogen produced through CCS on natural gas ("clean" / "low GHG emissions" hydrogen) and concludes that hydrogen has the potential to decarbonise a number of different industries and play a key role in Europe's energy transition. Clean hydrogen could be an accelerator of the hydrogen economy and if located in industrial clusters - where several large users of hydrogen can co-exist - hydrogen production with CCS could trigger the initiation of CCS transport and storage networks. The technologies required to produce clean hydrogen from natural gas are available today, with multiple projects already capturing CO_2 from the hydrogen production process.

The full report is available on the ZEP website at:
http://www.zeroemissionsplatform.eu/news/news/1669-launch-of-zep-report-commercial-scale-feasibility-of-clean-hydrogen.html

The Executive Summary of the report is attached overleaf for further reference.

The ZEP working group that developed the report included Stanley Santos from IEAGHG, and inputted data from IEAGHG's study report:

IEAGHG 2017-02 – Techno-Economic Evaluation of Deploying CCS in Standalone (Merchant) SMR Based Hydrogen Plant using Natural Gas as Feedstock/Fuel., January 2017.
http://www.ieaghg.org/publications/technical-reports/129-publications/new-reports-list/786-2017-02

The Executive Summary and report draw reference to the UK Leeds City Gate H21 Project, which was the subject of a separate Information Paper, see:
http://www.ieaghg.org/docs/General_Docs/Publications/Information_Papers/2016-IP22.pdf

The ZEP report was issued to coincide with a meeting of the European Parliament's Committee on Industry, Research and Energy (ITRE)[1] as part of the consolation process on the newly proposed European Electricity Market Design[2]. One area for reform is the rising share of variable renewable energy in the electricity system. ZEP's report aims to demonstrate the key role clean hydrogen equipped with CCS can play in providing reliable and clean base load power to realise Europe's renewable energy demand.

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1 http://www.europarl.europa.eu/committees/en/itre/home.html
2 https://ec.europa.eu/energy/en/consultations/public-consultation-new-energy-market-design

Executive Summary

It is widely recognised that hydrogen has the potential to decarbonise a number of different industries and play a key role in the energy transition. Decarbonised hydrogen can be produced through the application of CCS on established natural gas to hydrogen production units ("clean"/"low GHG emissions" hydrogen), or electrolysis using renewable energy sources. This report addresses the role of clean hydrogen and provides recommendations for its promotion. Clean hydrogen currently has lower production costs than that of electrolysis-derived hydrogen from renewable energy (3-4 €/kg ex-works at 30-40 bar) and could be a key accelerator of the hydrogen economy. This report shows that, depending on location specifics, clean hydrogen production is currently achievable at the same cost as that projected for the renewables route for around 10 to 25 years. Furthermore, hydrogen production equipped with CCS in industrial clusters - where several large users for hydrogen can co-exist - could also trigger the initiation of a CO2 transport and storage network.

There are multiple country roadmaps and studies that discuss the ability of hydrogen to decarbonise different industries. Current and future uses for decarbonised hydrogen range from mobility and synthetic fuels production, to power generation and fuel switching for domestic or industrial heating. A recent study by CertifHy[1] predicts a potential hydrogen demand of up to 300 Million Tonnes Per Annum (mtpa) in 2050, increasing from the current demand of 65 mtpa (2% of primary energy). A US study[2] estimates that up to 10% of primary energy could come from hydrogen by 2050, and a study for Japan[3] predicts an increase up to 20% of primary energy from hydrogen, with significant volumes of hydrogen for mobility and power generation. The UK Leeds City Gate H21 Project[4] assesses the feasibility to decarbonise the city of Leeds in Northern England through end use fuel switching and the replacement of natural gas used for domestic heating/use with hydrogen. The results show a peak hydrogen demand of 6.4 TWh per annum (corresponding to 0.2 mtpa H_2) and a decarbonisation potential of approximately 1 mtpa CO_2, using predominantly centralised hydrogen production from natural gas with CCS. The technologies required to produce clean hydrogen from natural gas are available, with multiple projects already capturing CO_2 from the hydrogen production process. Today the limiting factors are the availability of CO_2 transport and storage infrastructure, demand for hydrogen as a clean fuel, and the requirement for substantial hydrogen infrastructure and adaptations at points of use.

Recommendations

- Identify policies and stable support mechanisms that could promote the production of clean hydrogen, for example EU RFD, and to create economically viable clean hydrogen projects.
- Encourage collaboration along the clean hydrogen value chain to promote new projects.
- Identify local clusters where synergies could be established between hydrogen production, hydrogen consumption, and CCS. First targets are intensive industrial areas like the industrial clusters of Antwerp, Rotterdam and Teesside, especially where hydrogen or CO2 networks exist.
- Investigate the role clean hydrogen could play in decarbonising the EU power sector, including assessment of the ability to balance intermittent renewable energy with hydrogen combustion in Combined Cycle Gas Turbines (CCGTs).
- Maximize crosscutting opportunities with other world initiatives around low-carbon hydrogen (Japan, China), and other EU hydrogen initiatives.
- Develop Least Cost Analysis (LCA) for clean and electrolysis-derived hydrogen from renewable energy value chains to assess the CO_2 abatement potential.
- Support Research Development and Innovation (RD&I) for emerging clean hydrogen production technologies, with the potential to significantly reduce energy consumption and/or cost.

- Initiate the establishment of CO_2 transport and storage infrastructure as soon as possible, recognising that the production of clean hydrogen can be one of the early suppliers of CO_2 for geological storage, or for other uses, such as Enhanced Oil Recovery (EOR)

References:

1. https://ec.europa.eu/research/energy/pdf/weto-h2_en.pdf – H_2 Case
2. http://energy.gov/eere/fuelcells/downloads/h2-scale-potential-opportunity-webinar
3. Analysis of Global Hydrogen Energy System from Low Carbon Resources toward 2050. Yuki Ishimoto, Atsushi Kurosawa, Masaharu Sasakura, Ko Sakata, The Institute of Applied Energy - WHEC2014, 16th June, 2014.
4. http://www.northerngasnetworks.co.uk/wp-content/uploads/2016/07/H21-Report-Interactive-PDF-July-2016.pdf