IEAGHG Information Paper: 2016-IP22; Leeds City Hydrogen Project:
A new opportunity for CCS in the heat market

The H21 Leeds City Gate Project

The GM attended a meeting in London this week that launched a new report on the H21 Leeds City Gate, entitled "Could Hydrogen heat all homes and business in the future?" The project team behind the study were; Northern Gas Networks, Wales&West Utilities, Kiwa[1] and Amec Foster Wheeler all of the UK. The full report can be found at: http://www.kiwa.co.uk/uploadedFiles/Our_Services/Energy_and_Carbon_Advice/H21%20Report%20Interactive%20PDF%20July%202016.pdf.

The study has looked at the feasibility, both technical and economic of converting the existing natural gas network in Leeds[2], UK to 100% hydrogen. The hydrogen for the conversion would be supplied by steam methane reforming (SMR) of natural gas which is considered to be the current standard for industrial scale hydrogen production. The hydrogen production technology is considered to be technically mature and proven. Note: IEAGHG urgently has a study underway that is looking at the techno economics of hydrogen production with CCS which can be compared in due course with the analysis in this study.

To match inter day and inter-seasonal demand fluctuations in heat load demand the SMR plant (4 in total will operate at full load to maximise their operational performance with hydrogen being stored in salt caverns. The SMR's will be sited at Teeside, and industrial centre in the UK, which has also been proposed as a hub for CO_2 transport offshore[3]. The CO_2 is assumed to be exported 'over the fence@ to storage sites in the North Sea. The project is expected to store 1.5Mt CO_2 per annum, with net savings for the region of 927,000 t per year. This would go a long way to helping the UK meet its Climate Change budget commitments in the future[4].

One of the key issues pertaining to this proposal is that UK gas customers are currently paying a levy on their gas bills to finance the upgrading of the natural gas distribution systems from steel to polyethylene pipelines. This national upgrade started in 2002 and will end in 2032. The so called Iron Mains Replacement Programme is a risk based activity, it addresses the failure of 'at risk' iron gas mains (i.e. those pipes within 30 metres of buildings) and the consequent risk of injuries, fatalities and damage to buildings. It is designed to secure public safety, but will also reduce fugitive methane emissions from the natural gas distribution system. The new polyethylene pipes are considered suitable for transporting hydrogen. The study indicates that once converted the hydrogen network would meet the needs both intraday and inter-seasonal including peak demands periods for the city of Leeds. Note the main bulk of the IMPG programme begins to tail off in 2016 which leads to an opportunity to use the levy to first covert Leeds than in the future other cities without placing a future financial burden on the gas consumers.

[1] Mike Haines a former colleague of ours at IEAGHG was a contractor to Kiwa and provided specialist input on CCS and Steam Methane Reforming.
[2] Leeds is a city of some 700,000 people in the North of the UK.
[3] IEAGHG, CO_2 Pipeline Infrastructure, 2013/18, December 2013
[4] The UK Climate Change Act commits the Government to reduce emissions by at least 80% in 2050 from 1990 levels. See https://www.theccc.org.uk/tackling-climate-change/the-legal-landscape/global-action-on-climate-change/

The Gas distribution network for Leeds would be changed over in sections to make it manageable, based on the experience gained in the UK when it converted from Towns gas to natural gas in the late 1960's to mid-1970's[5].

It has been assumed in the economics that the costs of new hydrogen appliances; fires, boilers etc., will be financed by the project. The go ahead for the project will send a single to manufacturers to prepare products for this new market.

The Total cost of the project is considered to be £2,054M, with on-going costs of £139 million per year. The proposed roll out plan for the project is to start conversion in 2025. In order to achieve this it would requires

- Upfront investment of £60-£80m between 2017 and 2022
- Establishment of project team, 2016/2017
- 2018 – provision of funding for FEED study
- Decision by UK Regulator to allow provision in business plans for Gas network companies to include this in their business plans for 2021-2029
- 2021/2022 A policy decision by UK Government to begin incremental role out of hydrogen network across UK at an agreed schedule.

Additional benefits seen are:

- The availability of a hydrogen network could spin off to the transport sector for hydrogen vehicles
- Increases the UK's energy security by increasing its gas (hydrogen) storage capacity

Discussion

This is a highly ambitious and at present unique project which opens up a new opportunity for CCS for domestic heating. The UK seems to be well placed and may be uniquely placed to develop this hydrogen network. There are a lot of factors/drivers that support this project which include:

- An existing funded programme of pipeline upgrading,
- A strong climate policy driver
- Experience from an earlier conversion of the gas network,
- Access to natural gas offshore
- Good CO_2 storage capacity offshore
- A hub region like Teesside to centralise CCS in.

Whether this is a truly unique opportunity for the UK is an issue? It would be a shame if it is.

John Gale
12/07/2016

[5] https://en.wikipedia.org/wiki/Coal_gas