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  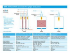

Low carbon hydrogen for the UK

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“Low carbon hydrogen is essential component for the green energy transition”, says Dan Sadler, UK Low Carbon Strategy Director at Equinor. “And the Humber cluster is the perfect place to get started on the journey to net-zero.”

At the western tip of the Humber estuary is Drax power station, whilst on the north bank of the river is the Saltend Chemicals Park and on the south bank is Scunthorpe steel works and one third of the UK’s refining capacity. Based on industrial carbon dioxide (CO_2) emissions, the Humber is the UK’s largest emitting industrial cluster.

The presence of these industries is part of the reason that Sadler says that “Zero Carbon Humber is the vision. This cluster is the ideal place to get started with the transition to low-carbon hydrogen as a green energy vector”.

Another reason why the Humber is regarded as the ‘best place in the world’ for an integrated low-carbon hydrogen production, utilisation and storage cluster is the presence of underground salt strata. Large hydrogen gas storage caverns can be made deep underground in the salt. Unlike CCS, where the CO_2 is permanently buried under ground, these salt caverns can be filled and emptied with hydrogen gas on seasonal cycles to balance supply and demand considerations.

Safe underground hydrogen storage to reduce energy costs

Three salt caverns at Teesside have been in use for hydrogen storage since 1972. Underground hydrogen storage is also in use in Texas where hydrogen suppliers use the salt caverns as a strategic reserve to guarantee hydrogen gas availability to refineries and petrochemicals producers. Worldwide, there are many more underground salt caverns in use for strong natural gas. The technology is established and is tried and tested for hydrogen applications.

Salt caverns can be up to 100m wide and 1000m deep. The dimensions are governed by the shape and geology of the salt layer. They can be charged with hydrogen in the summer months when applications such as heating are not using so much hydrogen and hydrogen production. Then they can be depleted during cold winter months when the demand surges.

Underground salt cavern hydrogen storage capacity is much cheaper to bring on stream than above-ground hydrogen liquefaction or high-pressure storage of hydrogen gas. Super-scale storage also reduces the cost of the overall scheme because a smaller hydrogen production facility can be operated continuously to meet the fluctuations in demand. Sadler points out that “we must use the right mix of technologies to develop hydrogen infrastructure that does not burden industry and consumers with excessive energy costs.”

Low carbon hydrogen with carbon capture and storage

Natural gas from the North Sea is the main ingredient for making hydrogen at scale via steam methane reformers (SMRs) or auto thermal reformers (ATRs). To ensure that hydrogen is low carbon, the CO2 emissions must be mitigated with carbon capture and storage (CCS). The resultant hydrogen is referred to as ‘blue hydrogen’, or ‘Low Carbon Hydrogen’.

In a net-zero future, CO2 from the industrial cluster will be transferred back out to the North Sea in a pipeline to safely store the gas in suitable underground geological formations. Equinor has more than two decades of experience operating CCS schemes in the Norwegian sector of the North Sea.

SMRs are used to produce more than half of the world’s so called ‘grey hydrogen’ today. Only when the SMR is combined with CCS may it be regarded as a sustainable, low carbon solution. ATRs can also produce hydrogen at scale and tend to operate at a higher pressure than an SMR. This is ideal if the hydrogen is to be used for injection into the existing natural gas transmission pipeline grid, which operates at pressures up to 85 bar.

Sadler points out that “in the planning of Net Zero Humber, Equinor is focused on a safe, decarbonised future. We are broadly technology agnostic. Process optimisation will include a thorough analysis of the requirements of local industry, power generation and domestic consumers.”

Looking to a green energy future

“To use hydrogen in the home we must demonstrate that it is safer, or at least as safe as natural gas”, adds Sadler. “One of the main challenges in the transition to hydrogen as green energy is public acceptance. That will come as people become more familiar with the gas.” Another challenge will be to manage the transition from grey to blue to green hydrogen cost effectively.

Sadler says that “renewable power generation capacity is ramping up quickly and in the long term, there will be sufficient capacity available to produce green hydrogen via electrolysers. Until then, we need bridging solutions with blue hydrogen production with CCS.”

Equinor has committed to carbon-neutral operations by the year 2050 and is investing heavily in wind energy to meet that goal. The coast close to the Humber estuary is already bristling with offshore wind turbines. 130km off the coast is Equinor’s Dogger Bank A, B and C wind farms. When complete, these will be the world’s largest offshore windfarm with a capacity of 3.6GW.

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