DECARBONISATION

UK road to decarbonisation

***Brian Davis* presents Part 2 of our report on ambitious plans for decarbonisation of significant UK industrial clusters.**

As noted in Part 1 of this feature, published in last month's issue, world-leading initiatives are being established in industrial clusters around the UK to capture carbon dioxide (CO_2) and store it offshore, along with innovative hydrogen projects and new infrastructure. Two of the leading contenders give further insight into current projects.

Net Zero North West Cluster

The HyNet initiative is core to the Net Zero North West (NZNW) industrial cluster covering the north-west of England and North Wales, and has significant projects already underway. Dr Chris Manson-Whitton, Director of Progressive Energy, describes HyNet as a 'demand-led project' with over 35 users signed up to use the new infrastructure. These users will either be supplied with low-carbon hydrogen so they can switch from natural gas as a fuel, or be directly connected to a CO_2 network, for capture, transport and storage of their CO_2.

Hydrogen demonstrations are being run with Pilkington and Unilever, and early-stage agreements have been signed with 22 other potential hydrogen users including Encirc and food giants such as Heinz, Kelloggs and Pepsico. Similarly, major CO_2 emitters have signed up, including CF Fertilisers, cement manufacturer Hanson, energy-from-waste company Viridor, the Essar refinery at Stanlow (which aims to be the first net zero refinery in the UK by 2030) and Fulcrum for sustainable aviation fuel (SAF) production.

Progressive Energy leads the HyNet cluster in a consortium of key partners including Eni, Essar and Cadent. Low-carbon hydrogen production will be delivered by a joint venture between Progressive and Essar. The facility is planned to produce 3 TWh/y by 2025, rising to 30 TWh/y by 2030 through incremental installation to around 4 GW of capacity. This is 80% of the UK government's 2030 target. It will use Johnson Matthey's process for blue hydrogen production from natural gas, with the captured CO_2 transported to depleted offshore gas field reservoirs in the Liverpool Bay area, owned by Eni. Pipelines and offshore infrastructure will be repurposed.

'Repurposing gives us a low-cost position and only a short section of new CO_2 pipeline will be required, connected to the Stanlow manufacturing complex at the heart of HyNet,' explains Manson-Whitton.

The hydrogen distribution system is being developed by Cadent (the region's natural gas distributor) and will support a wide range of industrial users and power generators looking to switch to hydrogen in order to fill gaps in intermittent wind and solar supply. Intergen, which runs the Rocksavage power station, also wants to switch to hydrogen and will be connected to the new hydrogen distribution system. It will initially use a blend of hydrogen and natural gas as a pathway to 100% hydrogen-fuelled generation. Inovyn is developing >1 TWh of underground hydrogen storage in salt caverns to balance hydrogen production and demand.

The initial investment is £1bn up to 2025 and a further £5bn by 2030 to deliver 10mn tonnes of CO_2 transport and storage infrastructure and 30 TWh of hydrogen production.

'HyNet infrastructure, hydrogen production and carbon capture can expand incrementally up to 2030, so the infrastructure is fully utilised. HyNet will be financed by private investment, in a similar way that offshore wind is funded today against early government backing,' says Manson-Whitton. 'HyNet is the most advanced UK industrial decarbonisation cluster project in terms of its ability to deliver by 2025. We have completed FEED [front-end engineering design] on the hydrogen plant, have a CO_2 licence, and are on the way for the consent process of the pipeline. So, we are well positioned to be the first of the clusters under proposals the UK government is currently reviewing.'

'The demand-led approach and ability to expand incrementally sets HyNet apart from the other clusters,' Manson-Whitton emphasises. 'But at the end of the day, we need all these clusters for the UK to decarbonise and reach net zero by 2050. We've got the skills in the UK, the geology and the legislation that is driving our net zero goals. It's good economically for this country and opens the potential for the UK to lead the world in both CCS [carbon capture and storage] and hydrogen.'

Myles Kitcher, Managing Director of Peel NRE, part of Peel L&P, is a founding member of the NZNW initiative, together with

Artist's impression of the Protos works, one of the key projects within the NZNW cluster being developed by Peel NRE

Photo: Peel NRE

CF Fertilisers, Tata Chemicals Europe, Siemens, Encirc, NW Leadership Team, Storengy and Inovyn. Kitcher sees the cluster as 'a leading contender for the first tranche of funding in the government's cluster sequencing competition, as HyNet and related projects can begin operations by 2025 as a precursor to wider decarbonisation'.

Protos is one of the key projects within the NZNW cluster and is being developed by Peel NRE. Based near Ellesmere Port, Cheshire, Protos is an energy and resource hub leading the way in low-carbon energy and waste management, including the UK's first plastic-to-hydrogen facility, a 50 MW windfarm, a 26 MW biomass plant, a 49 MW energy-from-waste plant in construction and a plastic park blueprint for recycling nationwide.

Peel NRE and waste-to-energy provider Bioenergy Infrastructure Group (BIG) have been awarded £250,000 from the UK government for the Ince Bioenergy Carbon Capture and Storage (InBECCS) project based at Protos. Phase one includes design of a 20 t/d CO_2 demonstrator, with potential for a further £5mn from the government to fund construction.

NZNW recently published an Economic Investment Prospectus which estimates potential for £206bn investment by 2040 in the north-west, saving 38.5mn tonnes of CO_2 emissions and creating over 660,000 jobs.

'We've got a large renewables resource both onshore and offshore in the north-west,' Kitcher reflects. 'We are looking at CO_2 networks, hydrogen networks and heat networks, providing low-carbon energy, renewable electricity and carbon capture and storage as utilities for high energy consuming manufacturing. The government needs to provide a very clear policy and regulatory framework that will encourage investment. Once they do that, I think the private investment will flow into the decarbonisation sector.'

East Coast Cluster

BP is part of the East Coast Cluster, which brings Zero Carbon Humber and Net Zero Teesside together under one cluster, grouped under the Northern Endurance Partnership (NEP). The partnership is responsible for developing the complex pipeline, transport and storage system which will gather CO_2 from various major industry emitters in the two areas and transport CO_2 to the Endurance salt aquifer in the North Sea, for safe storage.

BP leads development of the Northern Endurance Partnership, as well as heading the Net Zero Teesside power station project and H2Teesside – aimed at developing a scalable hydrogen ecosystem with both blue hydrogen and green hydrogen to support the decarbonisation of industry in the Teesside area.

'H2Teesside complements Net Zero Teesside and the Northern Endurance Partnership, with CCUS as an anchor project to create a scalable hydrogen ecosystem,' explains Louise Jacobsen-Plutt, Senior Vice President for Hydrogen and CCUS at BP.

H2Teesside is targeted to produce up to 1 GW of blue hydrogen, roughly 20% of the UK's hydrogen target by 2030. About 2mn t/y of CO_2 will be stored in the offshore reservoir, with first CO_2 intended to be captured in 2027.

BP has signed memoranda of understanding to scope supply of blue hydrogen from the project to a number of potential customers in the region – chemicals manufacturer Venator, Northern Gas Networks, CF Fertilisers, Mitsubishi Chemical, Sembcorp Energy and Alfanar's waste-to-sustainable fuel (SAF) plant.

Jacobsen-Plutt recognises that the clean hydrogen market is still relatively immature. 'We aim to develop scalable projects that over time will bring down the cost of producing clean hydrogen and is competitive with today's grey hydrogen (from steam reformation of natural gas or methane) cost. The pathways for green (from electrolysis and renewable energy) and blue hydrogen (from natural gas, with carbon capture) are being developed in parallel. Blue hydrogen will give us scale, producing 1 GW of blue hydrogen by 2030. In parallel, we are working with the Tees Valley Authority on a green hydrogen project (using electrolysis) that will support mobility, as the Tees Valley Authority is keen to be one of the UK's first decarbonised transportation hubs.'

Natural gas could be sourced from North Sea fields. 'The UK currently consumes about 75 times as much gas as we will need for hydrogen. At present about 70mn t/y of hydrogen is produced almost exclusively as grey hydrogen, which is used as non-energy feedstock for refineries and ammonia,' she notes.

The new hydrogen initiatives will support hard-to-abate sectors in the Teesside area. 'We see hydrogen as a solution that will support industry decarbonisation more cost-effectively than electrifying high heat processes,' says Jacobson-Plutt. 'The clean hydrogen market will be driven by a lot of new users. There are common challenges in terms of cost and infrastructure. However, there are significant opportunities given the momentum we are seeing with our stakeholders and partners, whether potential customers or the government given the new Hydrogen Strategy. We are all driving in the same direction to really get projects on the ground that can be scaled up over time, driving costs down. The partnership will be building-out new infrastructure or in some cases refurbishing existing infrastructure and optimising the technology required.'

BP and Maersk Mc-Kinney Moller have also signed a partnership agreement for zero carbon shipping, that commits to long-term development of new alternative fuels and low-carbon solutions for the shipping industry. 'Shipping industry transition to net zero is recognised to be complex and requires technology advancements and policies that will give companies across the value chain the confidence to act,' said William Lin, BP's Executive Vice President of Regions, Cities and Solutions, when the agreement was announced in August.

However, Jacobsen-Plutt maintains: 'The decarbonisation technologies exist today for H2Teesside, and over time we will be testing how to optimise systems. It's more a question of scale. The great thing about Teesside developments is the closeness to the industrial area. We are currently evaluating different technologies to optimise hydrogen production, CO_2 capture and energy efficiency. Then as the market grows up to the 2040s and 2050, we will be able to scale up the technology efficiently for blue hydrogen and green hydrogen.'

There is also a global ambition for BP, clearly signalled last year by its strategy of becoming an integrated energy business, when the company launched its hydrogen and CCUS ambitions. 'We aim to capture 10% of clean hydrogen in our core markets in the UK, Europe and US, emulating what we are doing in Teesside. Emulating the hub concept of supporting multiple industries in a clean energy park/hub. As well as working on similar projects in Australia, what we are doing in Teesside and what the UK government is doing is very transferable to other parts of the world,' Jacobsen-Plutt notes. ●