

DECARBONISATION



UK industrial decarbonisation gains momentum

World-leading initiatives are being established in industrial clusters around the UK to capture carbon dioxide (CO₂) and store it offshore, along with innovative hydrogen projects and new infrastructure. Indeed, the UK government is scheduled to announce at least two multi-billion pound carbon capture and storage (CCS) projects in October in the run-up to the COP26 UN climate conference in Glasgow in November 2021.

Prime Minister Boris Johnson has pledged to invest at least £1bn to support four CCS industrial clusters by 2030, with the first two planned to begin operations in mid-2020. Under Phase 1 of the Cluster Sequencing Process, the government has received submissions from five industrial clusters.

DelpHYnus project – involves CO₂ transport and storage for the South Humber industrial area, alongside hydrogen production facilities at the former Theddlethorpe gas terminal site. Led by Neptune Energy, the project aims to develop an ‘end-to-end value chain’ combining CCS together with blue hydrogen (from natural gas) production. Suitable offshore storage locations have been located in the southern North Sea. Neptune is also a partner in the PosHYdon project in the Dutch North Sea, to generate electricity

Ambitious plans for decarbonisation of significant UK industrial clusters are gaining momentum. But there are concerns about a North-South divide. Brian Davis reports.

using offshore wind turbines for electrolysis of seawater to produce hydrogen.

East Coast Cluster (CO₂AST) – unites the Humber and Teesside regions aiming to remove nearly half of UK industrial cluster CO₂ emissions to achieve net zero by 2050, as well as kick-starting the UK’s hydrogen economy by 2030. The East Coast Cluster is facilitated by the Northern Endurance Partnership (NEP) and is bidding to develop infrastructure to transport CO₂ from emitters across Humber and Teesside, while securing offshore storage in the Endurance aquifer in the southern North Sea. The partnership includes BP, Eni, Equinor, National Grid, Shell and Total, with BP leading as operator.

Hynet North West – aims to reduce carbon emissions across North-west England (serving Liverpool, Manchester and Cheshire) and North Wales, including upgrades to existing facilities and development of new infrastructure. HyNet is considered to be a leader in the creation of the UK’s low carbon economy, with the potential to create about 75,000 jobs by 2035 as well as protecting tens of

thousands of jobs as part of the government’s ‘levelling up’ strategy.

Scottish Cluster – is led by a cross-section of Scottish industrial CO₂ emitters and the Acorn CCS and hydrogen project partners. Developers of the Acorn CCS project are Storegga (through its wholly-owned subsidiary Pale Blue Dot Energy), Shell and Harbour Energy. The Scottish Cluster is expected to support over 15,000 jobs up to 2050. Hydrogen production capacity is forecast to reach 3.7 GW by the mid-2030s. Repurposing of oil and gas infrastructure will reduce the cost and time involved in establishing a CO₂ transport and storage system. Acorn will serve multiple emitters around Scotland, the UK and Europe, with at least 5mn t/y of CO₂ storage by 2030 – half of the target set out in the UK government’s 10-point plan for a ‘green industrial revolution’. It can be scaled up to at least 20mn t/y of CO₂ emissions storage within the first decade of operations.

NECCUS, the Scottish industrial decarbonisation group, received £1.23mn from the UK government in January 2021 (as did each of the other UK cluster facilitators) to create plans to decarbonise large

Selection of the first two UK industrial decarbonisation clusters is expected in October 2021

Source: Shutterstock

sections of Scotland's industry. Government support is matched by industry players including Cairn Energy, Harbour Energy, Petroineos, SGN, Shell and SSE Thermal. Some 30 industrial sites are being assessed, aimed at cutting about 80% of Scotland's industrial emissions before 2045.

By 2030 the Scottish Cluster could include nine different UK CO₂ sources, spanning major industrial sites and power generation plants, as well as hydrogen production and direct air capture (DAC). Eight of these CO₂ sources should be operational by 2027, including two gas terminals at the St Fergus gas complex and SSE and Equinor's Peterhead carbon capture power station; with 1mn t/y CO₂ from the Ineos and Petroineos sites at Grangemouth and a large-scale DAC facility. There are also likely to be green hydrogen projects coupled to offshore wind, with projects such as the ERM Dolphyn project and the Cromarty Firth energy hub. New Peterhead port facilities will receive about 3mn t/y of domestic CO₂ shipping by 2030, potentially rising to 9mn t/y.

V Net Zero – led by Harbour Energy, this cluster aims to store and transport CO₂ from the Immingham cluster on Humberside, with capture, compression and conditioning of the CO₂ by the Humber Zero project. This cluster will be complemented by Zero Carbon Humber (ZCH), the Gigastack Project and the Northern Endurance Partnership (NEP). Decarbonisation will require deployment of CCS, fuel switching (hydrogen, electricity and biomass) and bioenergy with CCS (BECCS).

There are also two clusters for second phase consideration.

South Wales Industrial Cluster – the second largest industrial emitter in the UK, the region accounts for 16mn t/y CO₂ across industry and power generation. This project is led by CR Plus and will last until

2024 under the government's UK Research and Innovation Industrial Decarbonisation Challenge, which aims to establish at least one UK industrial cluster by 2030, and the world's first net zero industrial cluster by 2040.

Repowering the Black Country – a cluster led by the Black Country Consortium.

The six largest industrial clusters were mapped by the Department for Business, Energy & Industrial Strategy (BEIS) and reported in the Industrial Clusters Mission. Under the Industrial Decarbonisation Challenge, the UK government invested £132mn for initial deployment planning of the above clusters to submit proposals. An £8mn cluster plan investment produced a blueprint to achieve net zero emissions for each industrial cluster. Phase 2 will be launched in parallel or soon after Phase 1 and will allow potential applicants to consider update of power and industrial CCUS business models.

In addition, the government has invested £20mn in the Industrial Decarbonisation Research and Innovation Centre (IDRC) at Heriot Watt University, to advance cutting edge decarbonisation research.

Considering these highly ambitious projects, how are these decarbonisation initiatives progressing?

Scotland's Net Zero (SNZR) industrial roadmap

The SNZR industrial roadmap plans aim to define a net zero industrial cluster and pathway to cut 80% of the nation's industrial CO₂ emissions by 2045. NECCUS Chief Executive Officer Ronnie Quinn admits: 'This is ambitious but achievable. For the first time we have big players and credibility. Different sectors and blue-chip investors are involved. However, we need some regulatory certainty going forward. There are parallels to the offshore wind sector 20 years ago which had the benefit of ROCs [renewable obligation certificates] and more recently the CFD [contracts for difference] system that catapulted projects forward.'

Technologically, he maintains: 'Scotland is well placed with shovel-ready projects ready to deliver by the mid-2020s and build scale thereafter. It's a very exciting opportunity, our oil and gas industry has relevant skills and experience and there's momentum now. The cluster sequencing bid results are due soon and the winners should be announced just before COP26.'

I would be very disappointed if we were not mentioned in the first cluster to share in the £1bn CCS infrastructure fund.'

The Roadmap projects are fully funded. And Quinn says it is encouraging to see strong support from institutional investors as demonstrated by investments in the Acorn project lead partner Storegga from GIC (Singapore's sovereign wealth fund), Mitsui and Macquarie, one of the world's largest financial services companies. Although it is difficult to gauge how much is needed to fund these UK industrial cluster decarbonisation projects, the Carbon Capture and Storage Association (CCSA) and BEIS have concluded that expenditure on CCUS (including hydrogen production and greenhouse gas removal) could reach £41bn by 2035 for the UK as a whole.

Numerous pilot projects are underway across Scotland, from hydrogen pilot programmes in the Orkneys with EMEC, hydrogen fuelling stations in Aberdeen and hydrogen home heating testing at SGN's H100 site in Fife.

Zero Carbon Humber (ZCH)

ZCH leads a plan to decarbonise the UK's largest emitting industrial region, the Humber, and includes ABP, British Steel, Drax, Equinor, Centrica Storage, Mitsubishi Power, National Grid, SSE Thermal, University of Sheffield and others.

'Use of shared trans-regional pipelines for low carbon hydrogen and captured CO₂ emissions aims to create the world's largest net zero industrial cluster by 2040,' says Ian Livingston, Project Engineer, Equinor Low Carbon Solutions. Captured CO₂ will be compressed at Centrica Storage's Easington site and stored under the southern North Sea using offshore infrastructure shared with the Teesside industrial cluster.

Other ZCH partners will connect their infrastructure to the pipelines. For example, use of BECCS (bio-energy with CCS) at Drax power station will operate from 2027 for scale-up to become the world's first carbon negative power station by 2030. SSE Thermal's Keadby 3 gas-fired power station will be equipped with CCS by the mid-2020s. There are also proposals to develop Keadby Hydrogen, a venture by SSE and Equinor, for the world's first at-scale 100% hydrogen power station.

Uniper's Killinghome site in Immingham aims to produce clean hydrogen by 2035. While ZCH partners Equinor and National Grid, as part of the Northern Endurance

The Stanlow refinery at Ellesmere Port, part of the HyNet North West decarbonisation cluster project

Source: Net Zero NW



Partnership, will develop offshore pipeline and storage infrastructure in the southern North Sea for CO₂ captured by ZCH and Net Zero Teesside.

South Wales Cluster

Dr Chris Williams, Head of Industrial Decarbonisation for Industry Wales (seconded from Tata Steel), expresses some concerns about the UK government's industrial decarbonisation goal to reach net zero by 2040, 'although we are trying to meet that target with our cluster plan under the UK Research and Innovation Industrial Decarbonisation Challenge'.

The South Wales Deployment Project is funded by a £1.5mn grant for planning and a £20mn grant from the UK government matched by £18.6mn from industry partners including Shell, Tata, Tarmac, RWE and Lanzatech.

Williams says individual industrial sites can find it difficult to decide how to get to net zero. 'All you can do is come up with options. However, even the utilities can't second guess what industry are going to do, in order to update their networks.'

Surprisingly, there's no overriding body currently. 'Though BEIS gives some direction along with Treasury input, the cluster groupings will have to take a leadership role with local government and councils maybe. We expect to get to the detail in four or five years' time, as everybody has different time lines for converting gas to electricity or introducing hydrogen and carbon capture', he says.

Williams believes: 'Coordinating each individual region and different industries around a capex planning process, with different networks and supply chains, will be horrendously complicated.'

But the big challenge for clusters is the North-South Divide. 'The South Wales cluster hasn't got local geological storage and will have to rely on CO₂ shipping,' notes Williams. Point 8 of Boris Johnson's 10-point plan talks of having two CCS projects up and running by 2030. 'So, the north of the country will be able to make things in a net zero way, supplied with CO₂ storage and blue hydrogen by 2030. But we're stuck in the south without CO₂ shipping to the north. London and factories on the Thames corridor have a similar problem, which puts net zero manufacturing in the south at risk. There are many challenges, but immediate advantages for industry in the north,' he remarks.

Looking at the BEIS Industrial Cluster Mission map, South Wales is aiming to cut 10mn t/y of CO₂ emissions, Humberside 12.4mn t/y, Teesside 3.1mn t/y, Grangemouth 4.3mn t/y, Merseyside 2.6mn t/y and Southampton 2.6mn t/y. But that is industrial CO₂ emissions, and when you add blue hydrogen (from natural gas) production over the next 10 years, this will also emit CO₂, until green hydrogen from electrolysis using renewables is available at scale.

However, Williams suggests there is capability to use floating offshore wind energy in the Celtic Sea. While Milford Haven, which already handles LNG imports, could support South Wales and the south-west of England for blue hydrogen supply initially and later green hydrogen with tidal energy.

'We are currently focused on individual industries to understand their decarbonisation options, to share outputs with infrastructure providers for electricity, gas and hydrogen, and also exploring options for CCS and CO₂ export,' says Williams.

Black Country anxiety

Matthew Rhodes, Programme Director of the Black Country Cluster project is also anxious about the Industrial Cluster programme. Having received £1.6mn to develop cluster plans, he believes the differentials between electricity prices for UK industry and EU and non-EU competitors 'makes it challenging to attract and retain competitive energy-intensive manufacturing in the Black Country'. He suggests that the recently published UK Industrial Decarbonisation Strategy describes a path to industrial decarbonisation which will make it even harder to attract and retain such businesses in inland regions in the UK.

'The essence of the strategy is to invest significantly during the 2020s in large-scale infrastructure decarbonisation projects in the north and on the coast, focusing on the top 100 or so industrial emitters and hoping that the innovations developed will at some stage in the future support decarbonisation of the remaining 295,000 smaller manufacturing businesses distributed across the UK. In parallel, demand-side policies (such as taxing carbon in intermediate products) will start to incentivise smaller companies to invest in decarbonisation. Although the UK government is unlikely to introduce such policies before the 2030s, there are a lot of outstanding questions about how to do this efficiently.'



He continues: 'From a Black Country industrial perspective, this strategy means we are being asked to contribute towards £10–20bn of investment to make northern coastal regions into attractive areas for low carbon manufacturing investment, while being held back at the pace necessary to compete globally or nationally.'

Rhodes argues that 'any rational investor will want to locate energy intense manufacturing businesses where clean power is cheapest and infrastructure is already in place'. The assumption that decarbonisation infrastructure suitable for heavy industrial sites on the coast will be adaptable to inland distributed clusters is wrong on two grounds, he says. 'First, large-scale CCS and hydrogen technologies and infrastructure cannot simply be down-scaled to meet the needs of smaller businesses economically. An entirely different approach is needed to facilitate decarbonisation of tens of thousands of small businesses. Secondly, investors won't wait. By the time UK government strategy has played out and the zero carbon energy investments made in the north are accessible to the Midlands and south, industry will already have migrated abroad or to the north.'

'This strategy is holding us back because we don't need to wait for technical innovation to deploy zero carbon energy technologies economically in the Black Country,' concludes Rhodes. 'What we need is targeted local infrastructure. For example, distributing clean energy around industrial parks and local areas. We can fund this privately, but we need access to public guarantees for infrastructure investment so that private companies will invest in the necessary projects and we don't accidentally hollow-out the UK and lose the bulk of UK manufacturing jobs in the transition to net zero.' ●

Visualisation of SSE Thermal's Keadby 3 power station, which will be equipped with CCS by the mid-2020s

Source: SSE Thermal

Part 2 of the industrial cluster decarbonisation story will follow in the October issue of *Petroleum Review*.