GLOBAL CCUS INVESTMENT INDEX

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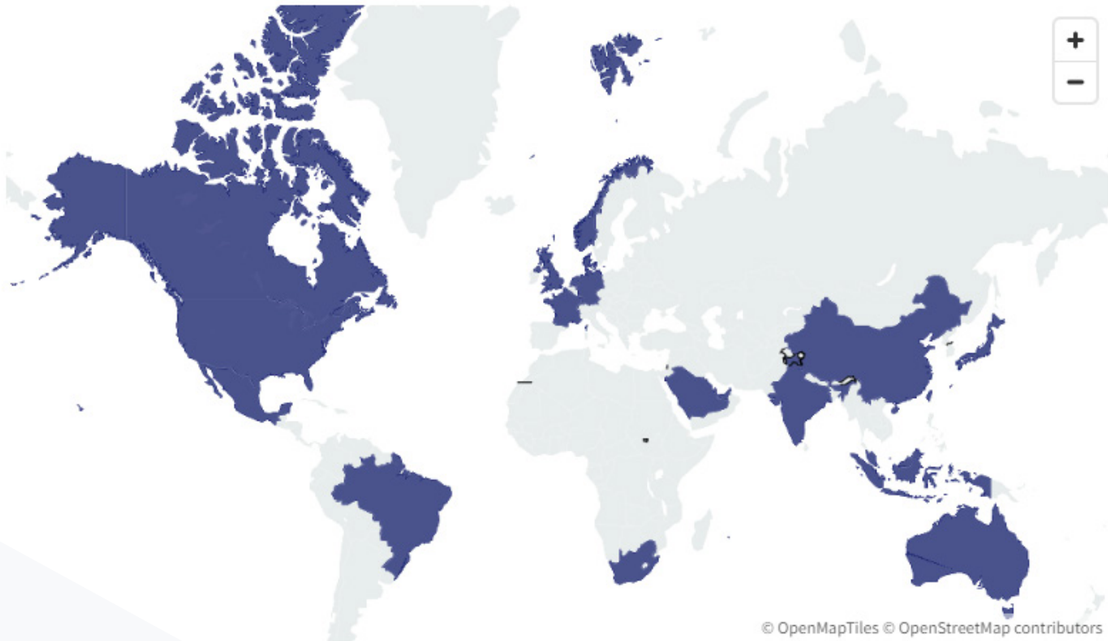
An E-FWD report in conjunction with GaffneyCline

Our index compares 20 countries

Map shows the 20 countries which were compared as part of our CCS investment index



GLOBAL CCUS INVESTMENT INDEX

AIM

The aim of the Global CCUS Investment Index is to provide a high-level ranking of a number of selected countries that are active in terms of CCUS development. The ranking looks at comparative commercial attractiveness for CCUS project investment. It aims to answer the question of "which country is investor friendly for CCUS project development?"

METHODOLOGY

- Four main categories were established for the ranking metrics. The four categories are:
    1. Track record
    2. Fundamental Conditions to begin CCUS project development
    3. Revenue Opportunity
    4. Investment Opportunity
- For the Track Record category, we examined the country's performance in CCUS projects. This included looking at the number of commercial-scale projects in operation. We regarded commercial scale as anything above 1 Mt of CO2 per year, and including mandatory storage; emissions sequestered to date and commercial-scale projects that are currently post FID.
- For the second category, we checked whether the fundamental conditions for CCUS project development exist in a particular state. This included looking at whether CCUS friendly policies are in place, if a regulatory framework is in place, if there is any government financial support and whether the CCUS value chain is open or under a state monopoly.
- For the Revenue Opportunity category, we looked at whether a carbon pricing mechanism exists, carbon price value, GHG targets and if there are any bilateral transboundary agreements in place to allow for cross-border movement of CO2. Under international treaty, transportation of CO2 across boundaries is prohibited. Countries can, though, strike a bilateral deal on such trade. In 2022, Denmark and Belgium became the first two countries globally to sign such an agreement.
- Finally, for the Investment Opportunity category, we examined the availability of storage licences, the number of pre-FID commercial-scale projects in development, the current and planned storage capacity and the "capturable" domestic industrial CO2 emissions.

    1. The four categories add up to 100 and each country was given a score out of 100. The country with the highest score was ranked no.1.
    2. Some of the categories were weighted more highly than others due to their importance for CCUS investment.
    3. We did not review all countries in the world but rather selected 20 countries that are active in the CCUS space.
    4. We included EOR projects, not just dedicated storage projects.

RANKING

The ranking of countries is shown below.

COUNTRY	TOTAL	RANK
United States	80	1
Canada	68	2
Norway/Denmark	62	Joint 3rd
UK	61	5
Netherlands	57	6
Australia	49	7
Japan/France	43	Joint 8th
Indonesia	42	10
Brazil	39	11
Malaysia	35	12
China/Germany	33	Joint 13th
Mexico	32	15
South Africa	31	16
UAE	28	17
Qatar	26	18
Saudi Arabia	24	19
India	21	20

COUNTRY NARRATIVE

UNITED STATES

The US is the top of the tree, with a robust track record in CCUS and scope for further growth. Of the top 10 global CCUS operational projects, seven are in the US. Furthermore, the largest two projects currently in operation are in the US (LaBarge Phase 1 and Century).

The country has supported CCUS primarily through grants, subsidies and tax credits. The 45Q Tax Credit, first introduced in 2008 and enhanced in 2018, has been instrumental in progressing CCUS. In 2022 the Inflation Reduction Act (IRA) was passed into law and further reformed the 45Q. The credits as they stand now are listed below. The 45Q will be inflation-adjusted post-2026.

- Point-source capture & dedicated storage: from US$50/tonne to US$85/tonne
- Point-source capture & EOR/utilisation: from US$35/tonne to US$60/tonne
- Direct air capture (DAC) & dedicated storage: from US$50/tonne to US$180/tonne
- DAC & EOR/utilisation: from US$50/tonne to US$130/tonne

PROJECT

LaBarge, Wyoming

Started in 1986

Captures 6-7 Mt per year, will increase by 1.2 Mt per year in 2025

The ExxonMobil operated facility captures associated CO2 from fields in Wyoming. It then uses the CO2 for enhanced oil recovery (EOR). It completed an expansion project in 2010 and completed FEED on a further increase in December 2021.

Also, as part of the IRA, the construction start date window has been extended by seven years to 2033. Credits will be granted for 12 years of operation.

The Infrastructure Investment and Jobs Act, passed in 2021, provided over US$12 billion for CCUS and related activities over the next five years, including:

- US$2.5 billion for carbon storage validation
- US$8 billion for hydrogen hubs, including blue hydrogen
- Over US$200 million for CCUS technology development.

The Act also amended the Outer Continental Shelf Lands Act, directing the Department of Interior to develop regulations for establishing a permitting framework for offshore CO2 storage.

Several agencies have issued guidance on CCUS, including:

- Council on Environmental Quality (CEQ) issued guidance to promote the responsible development and permitting of CCUS projects.
- Department of Energy Office of Fossil Energy and Carbon Management (FECM) strategy for advancing CCUS, establishing a framework for making informed carbon management decisions regarding deep decarbonisation and addressing legacy emissions.
- Pipeline and Hazardous Materials Safety Administration (PHMSA) publishing new safety measures for CO2 pipelines.

In addition, the Securities and Exchange Commission (SEC) proposed a rule for the requirement of climate-related company disclosures, which recognised CCUS as likely having a role to play in reducing GHG emissions.

To inject CO2 underground, companies must obtain a Class VI well permit. By default, these are regulated by the EPA, which can result in lengthy approval times (of around six years). States can apply for primacy over Class VI wells, shifting the regulatory rights to the state. Only Wyoming and North Dakota have obtained primacy. Texas, Louisiana and Ohio have initiated the application process.

The CCUS regulatory framework varies across the states. Only nine states have some form of legislation in place: Montana, Wyoming, North Dakota, Oklahoma, Kansas, Illinois, Louisiana, Texas (on- and offshore) and West Virginia. Transfer of liability back to the state varies, ranging from 0 to 30 years post-closure. Kansas has stated that it will not assume liability. California is in an advanced stage of legislation related to CO2 storage as well as establishing programmes to support CCUS.

US oil and gas companies have been more sceptical of moving into renewable energy, citing concerns over different asset models. However, many see CCUS as offering potential and tying in to existing skills and mechanisms. ExxonMobil, for instance, is working on projects that tie low-carbon hydrogen plans into CCUS, Baytown project, which may capture up to 10 Mt per year..

Exxon's plans at Baytown tie into a larger plan, the Houston carbon capture hub, which is planned to reach up to 100 Mt per year of CO2 by 2040. This would decarbonise power plants, refineries and petrochemical facilities.

So successful are the US' regulations that the country is attracting international CCUS developers.

The US obtains low marks for carbon pricing, as there is no countrywide carbon-pricing mechanism. In terms of targets, the US is targeting net-zero emissions economy-wide by 2050. Whilst no separate target has been announced for CCUS, it has been acknowledged to play an important role in reaching the target.

CANADA

Canada's CCUS history dates back to 2000, when CO2 was utilised for EOR in the Weyburn and Midale oil fields in Saskatchewan. This was then followed by an international research project studying injection and geological storage of CO2 within the depleted Weyburn oil field, which enabled the development of a key global framework for implementation of CO2 geological storage. The project ran from 2000 to 2013 and was managed by Saskatchewan's Petroleum Technology Research Centre (PTRC), with significant government support.

In 2014, the Boundary Dam CCUS facility was developed to capture CO2 from a coal-fired power plant. It is the only CCUS facility currently operating at a power plant. Most of the captured CO2 is used for EOR, while the remaining volumes go to the Aquistore site, via pipeline. There it is injected 3.4 km deep in a naturally occurring layer of brine-filled sandstone for permanent storage. To kick-start the project, a federal grant was provided to SaskPower in 2008.

PROJECT

Quest, Alberta

Started in 2015

Captures 1 Mt per year

Shell's Quest project cost $1.35 billion and takes emissions from the Athabasca Oil Sands Project (AOSP), in which the company is a shareholder. Shell is planning another CCUS project in the oil sands, Polaris, which will have initial capacity of 750,000 tpa and could ramp up to 10 Mt per year.

Alberta has also witnessed CCUS development. The Alberta Carbon Trunk Line (ACTL) system, launched in 2020, is planned to be a CCUS hub currently capturing CO2 from two blue hydrogen projects, the Sturgeon Refinery and Redwater Fertilizer Facility. The ACTL

pipeline is owned by transporter Wolf Midstream and backed by the Canadian Pension Plan Investment Board (CPPIB). The investor which has committed up to C$305 million to Wolf to fund the project.

In 2021, the Oil Sands Pathways to Net Zero, an alliance of six companies including Canadian Natural Resources Ltd. (CNRL), ConocoPhillips, Cenovus, MEG Energy, Suncor and Imperial, announced a plan for a carbon capture network in the oil sands-producing region of Northern Alberta. At the heart of the network is a proposed carbon transportation line that will gather CO2 from more than 20 oil sands facilities from the Fort McMurray, Christina Lake and Cold Lake regions and deliver it to a carbon storage hub near Cold Lake. The line will also be available to other industries in the region interested in capturing and storing CO2. The pipeline and storage hub is projected to remove about 10 million tonnes of CO2e by 2030. Government grants for first-of-a-kind projects were vital in order to start up the large-scale CCUS projects, including Quest, Boundary Dam CCUS and the ACTL.

The development of CCUS in Canada has been supported by policies and government incentives, both at the federal and provincial level. Large and diverse CCUS projects and network elements have been announced – with Alberta leading the way

The Canadian Net-Zero Emissions Accountability Act, which became law on June 29, 2021, enshrines in legislation the country's commitment to achieve net-zero emissions by 2050 and reduce emissions by 40-45% from 2005 levels by 2030. In addition, the "Healthy Environment and a Healthy Economy" policy document, published in 2020, proposed the development of a Canadian CCUS strategy and launched a Net Zero Challenge for large industrial emitters to encourage plans for net zero emissions by 2050. A "Strategic Innovation Fund – Net Zero Accelerator" was also announced to provide C$3 billion over the next five years to fund initiatives such as decarbonisation projects for large emitters. The Hydrogen Strategy for Canada was also released in 2020 by Natural Resources Canada, citing CCUS as part of an expanded, low-carbon intensity hydrogen strategy. The Clean Fuel Standard regulations were issued by the Canadian government in 2022, effectively setting a carbon price. One potential pathway for compliance credits, under the Clean Fuel Standard, is to undertake projects that use CCUS to reduce the lifecycle carbon intensity of fossil fuels. Carbon taxes has been introduced by the Government of British Columbia.

The Canadian government also set a target of at least 15 Mt per year of CO2 reductions using CCUS technology until 2030. This includes capturing and storing CO2 emitted from oil sands facilities (8 Mt per year), refineries (3 Mt per year) and gas plants (4 Mt per year). In addition, the 2022 budget proposed a refundable investment tax credit for businesses that incur CCUS expenses on projects that capture and permanently store CO2 through an eligible use. This includes dedicated geological storage and storage of CO2 in concrete, but excludes EOR. The tax credits for investment became effective immediately, with the following rates set until 2030: :

- 60% in DAC equipment
- 50% in capture equipment
- 37.5% in equipment for transportation, storage and use
- 10% in refurbishment costs

The credit can be claimed on eligible expenses in the year in which the expense is incurred, regardless of when the equipment becomes available for use. From 2031, the rates will be reduced by 50%. However, there is still uncertainty regarding the time frame in which these credits will be paid.

The government of Alberta also announced funding for CCUS of up to C$750 million from its Technology Innovation and Emissions Reduction (TIER) programme, including C$80 million for a new Industrial Energy Efficiency and CCUS Grant Programme. Alberta also moved forward with policies to enable CCUS, including the ongoing development of a Hydrogen Roadmap to define how Alberta will build a low-carbon hydrogen industry. Alberta Energy also set in place the Carbon Sequestration Tenure Management process whereby the provincial government would issue carbon sequestration rights to advance development of carbon storage hubs through a competitive process.

In 2021, Alberta opened a competitive application process for storage rights, to enable CCUS hub developments within its industrial heartland. In March 2022, six submitted proposals were selected for further evaluation. A second application round was announced in March 2022 for proposals outside of Alberta's industrial heartland region. Applications closed in May 2022. In September 2022, the government selected 19 proposals to progress.

In terms of regulatory framework, this varies across provinces. Provincial governments have jurisdiction over natural resources, property and civil rights, and are therefore the primary body to regulate and permit CCUS activity in the respective territory. The federal government could regulate activities if CO2 is transported across provincial boundaries. In Alberta, storage rights will transfer from the operator to the government; however, the timeframe for this is unclarified. There is a stewardship fund to cover measurement, monitoring and verification (MMV) costs. In December 2022, Saskatchewan announced federal approval for its provincial Output-Based Performance Standards (OBPS) system; further details are expected in 2023. In the 2023 federal budget British Columbia was added as an eligible storage region for investment tax credit purposes.

In terms of carbon pricing, Federal prices sit at C$50/tCO2 and are scheduled to rise by C$15/tCO2 in April 2023, reaching C$170/tCO2 by 2030. In December2022, Alberta formalised its industrial carbon price increasing to C$170/tCO2 by 2030 as per the federal schedule.

NORWAY

Norway is joint 3rd with Denmark. Norway has a track record in CCUS, with the Sleipner project having been in operation since 1996, followed by Snohvit CCUS in 2008 and CO2 Test Centre (TCM) opening in 2012. As such, Norway has 27 years of operational CCUS experience, with around 22 million tonnes of CO2 stored so far. There is high-level and consistent political support for policies that have helped achieve this. This began with legislating a carbon tax in 1991, which effectively led to the Sleipner and Snohvit CCUS projects. The tax currently sits at NOK952/tonne (US$91). Proposals are in place for it to rise steadily, reaching NOK2,000/tonne (US$220) by 2030. The tax applies to EU Emissions Trading System and non-EU ETS emissions. The government also established Gassnova, a state entity responsible for all CO2 activities in Norway.

In addition, regulations for transport and storage of CO2 are mature and have been in place since 2014. Following completion of CO2 injection, the storage licence will be transferred to the state government no less than 20 years later. The operator will be liable for funding 30 years of MMV costs post-closure. This must be paid into a fund upfront.

PROJECT

Northern Lights

Start planned for 2024

Capture 1.5 Mt per year, increasing by 3.5 Mt per year

Equinor's Northern Lights project is part of the full-scale Longship plan, which includes capturing CO2 from industrial sources and transportation by pipeline. The company may approve a second phase in 2024. Northern Lights also has a cross-border deal to receive CO2 from the Netherlands by ship.

The Northern Lights is a CCUS project that has passed FID and is under construction. It is a partnership between Equinor, Shell and Total and it will be the first ever cross-border, open-source CO2 transport and storage infrastructure network, offering companies across Europe the opportunity to store their CO2 under the Norwegian seabed. It consists of two dedicated CO2 carriers and will ship captured CO2 to an onshore terminal on the Norwegian west coast and, from there, transport it by pipeline to an offshore subsurface storage location in the North Sea. Phase one of the project will be completed mid-2024 with a capacity of up to 1.5 Mt per year of CO2. The ambition is to expand capacity by an additional 3.5 Mt per year, to make a total of 5 Mt per year, dependent on market demand. However, the receiving terminal, offshore pipeline and the umbilical to the offshore template will be built to accommodate the additional volumes. Both phases will offer flexibility to receive CO2 from European sources.

Northern Lights was a first-of-a-kind full chain CCUS commercial project based on industrial emissions. In the absence of a market for CCUS, the project required a public-private partnership to kick-start the industry in order to assist and bridge the financing gap. Also posing a challenge was the use of phases. It was difficult for the project to get commitment from industrial emitters to build capture plans without having storage, but the project required commitment from emitters to justify building the storage. State support was therefore critical during the market development phase. The Norwegian government provided funding of US$1.8 billion, covering 80% of the Northern Lights' cost.

DENMARK

Denmark is joint 3rd with Norway, which is a phenomenal achievement, as CCUS is only a recent development in Denmark. Pre-2020, injection of CO2 into the Danish subsoil was prohibited under legislation, and all previous attempts at launching CCUS had been publicly opposed. The change happened in 2020 when the Danish government passed the Danish Climate Agreement for Energy and Industry, committing the country to a 70% reduction in GHG emissions relative to 1990 levels by 2030. The agreement acknowledged CCUS as a critical component to achieve the target and a CCUS target was set at 4-9 Mt per year of CO2 storage by 2030. In addition, the Danish government has allocated over €3 billion of support to projects across the CCUS value chain. Danish CCUS projects are also eligible to apply for funding from the EU Innovation Fund, which aims to allocate over €38 billion towards low-carbon technologies by 2030. The state company Nordsøfonden will have a 20% interest in all future CO2 storage licences. The state will receive a share of future profits and also invest in the project (sharing the risk) with investors.

PROJECT

Greensand

Start planned for late 2025

Capture 1.5 Mt per year, increasing by 6.5 Mt per year in 2030

Test injections of CO2 began in March 2023. The initial volumes were transported from an Ineos chemicals site in Belgium, the first cross-border CO2 delivery in Europe. Ineos and Wintershall Dea aim to reach FID on the first phase in 2024.

Since then, a series of successive changes to update the country's subsoil and marine laws have taken place. In January 2022, the Danish Marine Act was amended to exclude geological storage of CO2 under the seabed from the prohibition and carriage of materials and substances for dumping. In October 2022 a bilateral agreement was signed under the London Protocol between Belgium and Denmark, which allowed for cross-border transportation of CO2 between the two countries. In January 2023, the European Commission approved a €1.1 billion Danish scheme to support the roll-out of CCUS technologies.

The staggering and rapid change in Denmark's CCUS journey culminated in the initiation of CO2 injection at the Project Greensand pilot in March 2023. This was the first cross-border CO2 to be stored in the North Sea, and the first CO2 to be stored in a depleted North Sea reservoir. The Greensand pilot received funding of DKK197 million (€26 million) from the Danish Energy Agency.

In just three years, Denmark is now a frontrunner in the global CCUS industry. Project Greensand is only the first chapter in Denmark's CCUS story. Beyond Greensand, there are wider ambitions to scale up storage in Denmark. Also in development is Project Bifrost, a 5 Mt per year transport and storage hub being developed by the DUC, TotalEnergies, Nordsøfonden, Noreco and Ørsted. With additional plans for both an offshore and near-shore/onshore CO2 storage licensing round later this year, Denmark is firmly keeping its eyes on the prize.

UK

The UK ranks fifth, lagging behind Norway and Denmark, as a result of its lack of a track record. The UK has not yet sequestered any CO2. The country has proved very good at setting out its ambitions and strategy but must move into delivery and deployment in order to move up the ranking.

The UK government has developed a regulatory framework approach to CCUS that governs the network and users separately. Each network is considered a regulated monopoly (akin to an electricity or water transportation network), such that the network codes mandate open access, but also carefully control user tariffs. Users of the network are (currently) selected through competitive tender. They are awarded subsidy arrangements directly with the government, designed to 'shield' the relevant project (either a power project, through a 'Dispatchable Power Agreement' (DPA), or an industrial user that wishes to decarbonise its operations through the award of an 'Industrial Capture Contract' (ICC)) from the increased costs of operating with both capture equipment and the incremental costs of transportation and storage into the CCUS network.

PROJECT

HyNet

Start planned for 2025-26

Capture 4.5 Mt per year, increasing by 5.5 Mt per year by 2030

Eni's HyNet project will involve the storage of CO2 in depleted gas fields in the Liverpool Bay. The Italian company reached a heads of terms with the UK government in October 2023, claiming the project would be the world's first asset based regulated CCUS business. Eni is also working on more CCUS plans in the UK, at Bacton.

The government has a target to capture and store 20-30 Mt per year of CO2 (including removals) by 2030. There has since been a step change in policy support alongside significant industry appetite for CCUS, following the acknowledgment by the CCC that these technologies are "a necessity not an option" for the UK to achieve net-zero emissions.

In 2020, a year after the UK legislated its 2050 net-zero target, it confirmed £1 billion of government investment to support the deployment of CCUS in four industrial clusters. The Hynet and East Coast clusters were subsequently selected for initial support (Track 1) and are set to enter operation by the mid-2020s, with two further clusters selected (Acorn and Viking as Track 2) due to come online by 2030. This 'cluster sequencing' process was complemented by the 2023 announcement of a longer-term funding package of up to £20 billion for CCUS in the UK, to help meet the government's climate commitments.

NSTA regulates the CO2 storage licensing rounds. In September 2023 it awarded 21 licences to 14 companies in the UK's first ever carbon storage licensing round.

In terms of carbon price, the UK ETS started operating on January 1, 2021, as the UK officially departed from the EU and the EU ETS. The ETS will be reviewed in 2023 and 2028, and the UK government has also indicated its openness to linking to other schemes internationally in the future.

The UK carbon price has recently dropped from approximately £85 per tonne of CO2 to £58 in June 2023 and has continued its slide into autumn. Prices slipped as a result of the UK government delaying some decarbonisation pledges, and an oversupply of credits in the market.

NETHERLANDS

The Netherlands ranks 6th. The country has attempted three CCUS projects in the recent past: two onshore in Barendrecht and the Northern regions and one offshore near the Port of Rotterdam. However, none of these projects have been realised due to societal, political and funding challenges. However, this changed in 2017 when a newly elected government set an ambitious target for 2030 of reducing national CO2 emissions by 49% relative to 1990. This effectively required 48.7 Mt of additional reductions compared to the baseline outcome of the policies that were in place at the time. The new targets were then enshrined in the Climate Act, as well as the negotiation of the Climate Agreement which set out the pathway to sustainability. CCUS was highlighted as an important instrument in the Climate Agreement, providing proposed emissions reductions of up to 7.2 Mt per year until 2030, second in importance only to the contribution of new renewables.

In addition, the EU CCUS directive (2009/31/EC) contains important rules aimed at safeguarding safety and health conditions applicable in all member states as well as minimum requirements for storage permits, liability and roles and tasks. Furthermore, it can introduce necessary legal instruments, such as permits, rules concerning the protection of health and environment and rules for liability, for instance, in the case of CO2 leakages.

PROJECT

Porthos

Start in 2026

Capture 2.5 Mt per year

EBN, Gasunie and the Port of Rotterdam approved the Porthos project in October 2023, with the aim to begin construction in 2024. The project will take ownership of CO2 at Rotterdam and transport it 20 km offshore for storage in depleted gas fields in the North Sea. The EU awarded a 102 million euro subsidy for the 1.3 billion euro scheme.

In addition to creating the appropriate legal frameworks, the Dutch government played an active role in providing financial incentives. These included subsidies and taxes that made GHG emissions less attractive. These were the EU ETS, the Dutch SDE++ subsidy (from Stimuleren Duurzame Energie, Stimulating Sustainable Energy) and a carbon tax.

The government broadened the scope of the SDE++ subsidy in 2020 to include emission reduction technologies, such as CCUS. The subsidy for CCUS is capped at 7.2 Mt per year CO2, from the industry reduction target of 14.3 Mt per year in order to keep societal costs low and to stimulate industrial parties to find alternative solutions, such as large-scale electrification and green hydrogen. So far, the Port of Rotterdam's 2.5 Mt per year Porthos project has received €2.1 billion of SDE++ subsidies, and reached FID in October 2023.

AUSTRALIA

PROJECT

Gorgon, WA

Started in 2019

Capture 4 Mt per year

Chevron's Gorgon plant is part of its LNG export facility in Australia. Shortcomings at the plant, which have seen it operate at around one third of its capacity, have forced Chevron to buy carbon credits to cover the shortfall. The company plans to drill more wells in 2024 in an attempt to remedy the problems at its CCUS plant.

Australia came 7th in the ranking. In 2020, the Australian government issued its "First Low Emissions Technology Statement", which gave CCUS a prominent role. It set a goal of reducing the combined cost of compression, transport and hub storage to A$20/tCO. There is also funding commitment of providing A$50 million in research for R&D and for amending legislation to ensure CCUS is eligible for support from the Emissions Reduction Fund, the Australian Renewable Energy Agency and the Clean Energy Finance Corporation.

The Emissions Reduction Fund offers landholders, communities and businesses the opportunity to run projects in Australia that avoid the release of greenhouse gas (GHG) emissions or remove and sequester carbon from the atmosphere. A number of activities are eligible under the scheme and participants can earn Australian carbon credit units (ACCUs). Each ACCU represents 1 tCO2e emissions stored or avoided by a project. ACCUs can be sold to generate income, either to the Australian government through a carbon abatement contract, or to companies and other private buyers in the secondary market. In late 2021, a CCUS methodology was included under the Emissions Reduction Fund, allowing projects to generate ACCUs and thereby generate income.

The government has also legislated a net-zero goal by 2050, acknowledging that CCUS is a necessary action to reach that target. It released additional acreage for geological storage of CO2 and announced over A$300 million in funding to support CCUS in the following areas:

- Carbon Capture Use and Storage Development Fund to support pilot or pre-commercial projects.
- CCUS Technologies stream to fund technology R&D, commercialisation and identification of storage sites.
- CCUS Hubs stream to fund shared infrastructure.

The legal framework for encouraging and regulating CCUS in Australia is shared between the Commonwealth and the states and territories. Commonwealth CCUS law and the Offshore Petroleum and Greenhouse Gas Storage Act 2006 only apply to the offshore areas within the Commonwealth jurisdiction, while state and territory CCUS laws apply to onshore and offshore projects within their jurisdictions. Queensland and Victoria have passed legislation regulating CCUS, with the latter working on its proposed CarbonNet CCUS project. The Gorgon CCUS project is regulated under Western Australian environmental law and the Barrow Island Act 2013 (WA).

The Gorgon CCUS project has been injecting CO2 since 2019, and the Australian government has committed A$60 million to the project through the Low Emissions Technology Demonstration Fund (LETDF).

FRANCE

France ranked joint 8th with Japan. France has released its Carbon Capture, Storage and Utilisation Strategy as part of the government's efforts to reach carbon neutrality by 2050. The strategy notes that CCUS can have the potential to capture and store 4-8.5 Mt per year of CO2 by 2030.

CCUS deployment in the country will be focused on industrial zones, such as Dunkerque, Le Havre, Fos-sur-Mer, Lacq/Sud-Ouest, Loire-Estuaire and Grand Est. To support project developers and scale up CCUS deployment, the government will launch a call for tenders through a contracts for difference (CfD) scheme. Under the aims outlined in the strategy, a framework for CO2 transport will be developed, and geological storage sites will undergo pilot testing from 2024-2025.

The French government invited stakeholders to participate in the CCUS strategy, via a consultation that closed in late September 2023. In its strategy,

PROJECT

Pycasso

Start 2030

Capture 1-3 Mt per year, reaching 5 Mt per year in 2035

The Pycasso facility will be part of the Hydrogen South West Corridor, led by Teréga, and the broader hub development. Pycasso will store CO2 in former gas fields from French industry and possibly from northern Spain. TotalEnergies carried out a pilot project in the region, from 2006 to 2013.

the government outlines carbon capture targets for France that include:

- 4-8.5 Mt per year of CO2 by 2030
- 15-20 Mt per year of CO2 by 2050
- an extra 10 Mt per year of CO2 in non-industrial sectors around 2050

At the heart of the French strategy remains the principle that CCUS is not a technology to maintain a "business as usual" approach but a technology that should only be used when there are no other options.

The strategy also outlines some other government steps towards improving knowledge and actions on CO2 storage. As there are currently no sufficiently detailed studies on storage capacities, the government plans to carry out an assessment of potential storage by the end of 2023 or beginning of 2024. It will also launch a call for tenders for seismic surveys and test injections of CO2 in pilot sites, with initial tests starting in 2024-2025.

France has also considered exporting CO2 to achieve its carbon abatement plans – and may well look to opportunities in the North Sea.

JAPAN

The Japanese government is working on creating a legal framework for CCUS with government estimating that the country will store 120-240 Mt per year in 2050.

Japan is also working on a CCUS roadmap and plan to submit a draft bill to the Diet in 2023 to establish a new right to store CO2 in Japan and limit liability of operators in the event of a leak or other events. The plan will be to include a scheme in the legal framework to transport CO2 emitted in Japan to other countries and store it there, as it may not be possible to store all the country's CO2 domestically.

Japan has recently selected seven CCUS projects for funding. These CCUS projects will capture emissions from multiple industries such as refineries, power plants, chemicals, steel and cement plants. The CO2 will be transported via pipelines or ships to storage sites: five projects will involve storage in Japan, one in offshore Malaysia and one in Oceania. The total storage capacity is 13 Mt per year of CO2. It expects to reach project FIDs in 2026-2027.

These projects will contribute to Japan's national CCUS target of 6 to 12 Mt per year by 2030 and 120 to 240 Mt per year by 2050. The funding amount and mechanism have not yet been determined.

PROJECT

Tomakomai, Hokkaido

Start 2030

Capture 1.5 Mt per year

JOGMEC chose Japex, Idemitsu Kosan and Hokkaido Electric Power Co. (HEPCO) to work on a CCUS project at Tomakomai in June 2023. The three companies launched a feasibility study, with plans for CO2 captured from the Hokkaido refinery and the Tomato-Atsuma power station by pipeline. The Tomakomai CCUS demonstration project captured 300,000 tonnes between 2016 and 2019.

Japan has recently signed a memorandum of cooperation (MoC) with Malaysia to strengthen collaboration on cross-border CO2 transportation from business to business for CCUS projects.

Domestic Japanese industry has set transportation of CO2 as a technological priority. For example, Mitsubishi Shipbuilding launched a first dedicated CO2 carrier in March 2023, backed by the NEDO research agency.

INDONESIA

PROJECT

Ubadari

Start 2026

Capture 1 Mt per year

BP is developing the Ubadari project alongside its Tangguh LNG field, where Train 3 recently started up. The Ubadari plan involves injecting CO2 from a power plant into an underground reservoir, which will help boost gas recovery and drive additional LNG output.

Indonesia is one of the first countries in the Asia-Pacific region to introduce regulations on CCUS. In March 2023, Indonesia's Ministry of Energy and Mineral Resources (MEMR) issued Regulation No. 2 of 2023 – MEMR Regulation 2/2023 (Regulation) which came into force in March 2023. This regulation aims to support upstream oil and gas activities and help decarbonise the extraction industry in Indonesia, on top of being a step towards Indonesia's net-zero emissions target by 2060.

The regulation sets out ways that carbon can be captured, how carbon is to be used (including EOR), how carbon is to be stored in accordance with various technologies, and how carbon is to be transported. Even before the processes can begin, interested parties must seek approval from MEMR, which will then evaluate whether the proposed CCUS activities take into account the technical, economical, operational, environment and safety considerations.

CCUS activities can be monetised by carbon trading in accordance with the applicable laws and/or through reimbursement of operational costs. For carbon emissions not from upstream oil and gas activities, CCUS facilities can profit from storage services. Following these rules, Indonesia is also looking at introducing a "cap and trade" and a "cap and tax" mechanism, along with tax incentives.

While a game-changer in the CCUS space, the Indonesian regulation still has gaps. For example, key issues such as quality specifications, leakage risks and commingled carbon are not addressed in specific detail. Regardless, Indonesia holds the first-mover advantage and it is likely that neighbouring countries such as Malaysia and Thailand are watching these developments closely.

Indonesia's state-owned Pertamina has signed preliminary agreements with ExxonMobil and Chevron to develop its own CCUS hubs, which will rely heavily on the new regulation to proceed smoothly.

A major hurdle for regional CCUS in Asia will be co-operation between nation states, including shared infrastructure and cross-border accounting of CO2.

In February 2023, Indonesia announced the launch of a mandatory, intensity-based ETS for the power sector. The system will initially cover 99 coal-fired power plants that account for 81.4% of the country's national power generation capacity. A market mechanism would set the price, with the price potentially ranging from $2 to $18 per tonne.

BRAZIL

Brazil has one CCUS project for EOR that has been operating since 2013. This is Petrobras' Santos Basin pre-salt oilfield. There is another planned project, which will be first Bioenergy with Carbon Capture and Storage (BECCUS) project in South America implemented by FS at the Lucas do Rio Verde ethanol biorefinery complex.

Significant policy developments regarding CCUS deployment occurred in 2021 and 2022 in Brazil. In addition to updating its Nationally Determined Contribution (NDC), legislation was introduced into Brazil's legislature. Bill 1.425/2022 establishes a legal framework for the geological storage of CO2, addressing pore space property rights, long-term responsibilities and its transfer from private to public agent, the definition of regulatory agencies and the period of monitoring. This is all being pushed by the recent change in government, where President Luiz Inacio Lula da Silva took office in January. There is also a proposal in Congress to create a regulated carbon market in the country.

MALAYSIA

Malaysia's Petronas took FID to develop the Kasawari CCUS project off the coast of Sarawak, Malaysia, in November 2022. The facility will be able to capture around 3.3 Mt per year of CO2. The other CCUS Project in development is also offshore, where the operator will be Thailand's PTT Exploration and Production Public (PTTEP). This will capture CO2 from the Lang Lebah field, offshore Sarawak, and then transport it to the Golok field. The company hopes to reach FID this year and start commercial production in 2026.

State-owned Petroleum Sarawak Bhd (Petros) has also received their first licence for carbon storage to begin its strategic role as resource manager for CCUS in Sarawak.

Malaysia has acknowledged the critical importance of CCUS in delivering significant emission cuts in fossil fuel-based emissions. It has partnered with the Global CCUS Institute to develop and implement the Malaysian CCUS Capacity Development Programme.

The Malaysian government has said it will always support any initiative that can reduce carbon emissions to become a carbon-neutral country as early as 2050. The Budget 2023 proposes new tax incentives for companies working on CCUS activities as a new source of economic growth and in achieving net-zero GHG emissions. Currently CCUS projects in Malaysia will be regulated using the existing national legislation. Malaysia is also developing a carbon-pricing mechanism, but has no carbon price yet.

In addition, Petronas recently signed an MoC with Japan's Ministry of Economy, Trade and Industry (METI) and Japan Organization for Metals and Energy Security (JOGMEC) to strengthen collaboration on cross-border CO2 transportation from business to business for CCUS projects.

CHINA

China has ranked joint 13th with Germany. In recent years, China has made significant progress on CCUS development. In August 2022, the first integrated 1 Mt per year Qilu Petrochemical-Shengli Oilfield CCUS project officially came into operation. Furthermore, Baogang Steel Group plans to build an integrated 2 Mt per year -scale CCUS demonstration project for the steel industry, and a first phase of the 0.5 Mt per year demonstration project has already started construction. Meanwhile, CNOOC, Guangdong Development and Reform Commission, Shell China and ExxonMobil China have signed an MoU to jointly study a large-scale CCUS hub in Daya Bay. However, the development of CCUS in China still faces challenges such as the lack of market mechanism or sufficient policy incentives.

Since the introduction of China's "1+N" policy system for emission peaking and carbon neutrality, more CCUS-related policies have been released. By May 2023, China had issued about 80 CCUS-related policies at the national level, including plans, standards, roadmaps and technology catalogues accumulatively. CCUS has been included for the first time in China's national Five-Year Plan (2021-2025).

Most of the policies focus on the R&D and demonstration of CCUS, while policies related to technical standards, investment and financing are also increasing. These include the Climate Investment and Financing Pilot Work Plan, the Green Bond Endorsed Projects Catalogue (2021 Edition), China's National Standardisation Development Outline and the Implementation Plan for Science and Technology Support for Carbon Dioxide Peaking and Carbon Neutrality (2022-2030).

CCUS is also being covered in sectoral policies. Initially, it was only mentioned in the power and oil and gas industries. More recently, though, CCUS was added to hard-to-abate guidelines, including The Guidelines on the Transformation and Upgrading of Energy Intensive Industries and Key Areas for Energy Conservation and Carbon Reduction (2022 Edition) and the Carbon Peaking Implementation Plan for the Industrial Sector.

Local governments are also increasingly providing support. By May 2023, 30 provincial governments had issued policies relevant to CCUS R&D and promotion programmes.

In general, the current policies issued for CCUS are at the guidance stage, with the aim of setting out initial incentives. There is currently no specific legislation to regulate in detail the access, construction, operation, regulation and termination of CCUS.

By November 2022, there were around 100 CCUS demonstration projects in various stages of development. Nearly half of the projects are in operation, with CO2 capture capacity of more than 4 Mt per year and CO2 injection capacity of more than 2 Mt per year, an increase of about 33% and 65% respectively compared with 2021.

China has also implemented its own ETS in 2021 and is the world's largest in terms of covered emissions. The carbon price is $8/tCO2e.

GERMANY

Germany is ranked joint 13th with China. German adoption of CCUS has been relatively slow due to widespread opposition, both from the public and the Left Party. There is currently a ban on CO2 storage projects in Germany due to the 2012 Demonstration of Permanent Storage of CO2 Law, otherwise known as the Carbon Storage Law. Since the entry of the CCUS law into force in 2012 no storages or pipelines have been applied for, approved or built.

However, there are some indications from the government that the ban may be overturned. Every four years the government must publish a report evaluating carbon storage law. In the latest report, which was published in 2022, the government stated that the technology for capturing, transporting and storing CO2 is already mature and proven. However, the legal framework stood in the way of its application. The report showed that most climate neutrality research reports for Germany show a strong need for CCUS by 2045. In the short term, the report recommended the introduction of legal changes that would allow the planning and preparation of a CO2 pipeline infrastructure as well as short-term incentives for the capture, use and transport of CO2 from industrial processes and waste management.

As a result of this review report, the government is developing a Carbon Management Strategy for CO2 storage and utilisation, with projections revealing that around 30 Mt of CO2 will have to be captured, transported, reused or disposed of by 2045. The focus will be on industrial processes and waste. Within the framework of the strategy, the government will examine the possibility of CO2 storage in Germany under the seabed. Should the strategy endorse CCUS, the federal government would liaise with the state governments on possible implementation options, including necessary legal changes.

Companies are starting to come up with plans for CCUS developments based in Germany. Wintershall Dea, for instance, is working on the CO2nnectNow project and a potential CO2 pipeline to Norway, with Equinor.

SOUTH AFRICA

South Africa brought in a carbon tax in 2019 and it places a price on CO2 emissions from large businesses in the industry, power and transport sectors. As part of the 2022 budget, the government announced a range of updates to the carbon tax. These changes include an increase in the carbon tax rate from R134/tCO2e ($6.9/tCO2e) to R144/tCO2e ($7.4/tCO2e) for the 2022 tax period.

The carbon tax rate will increase by at least US$1/tCO2e each year to reach US$20/tCO2e per tonne of carbon dioxide equivalent by 2026. Then the carbon price will increase more rapidly, to at least US$30/tCO2e by 2030 and up to US$120/tCO2e beyond 2050. It is currently at R159/tCO2e ($8.2/tCO2e).

The government is also developing a regulatory framework and a CCUS roadmap.

The government has started geological mapping at the country's first CCUS site around the town of Leandra, in Mpumalanga, in the north-east. This is a carbon emissions hotspot and home to several coal-fired power stations, in addition to Sasol's Secunda coal-to-liquids (CTL) fuel plant, said to be the single largest source of emissions in the world.

The World Bank has put forward $23 million to fund the Leandra project, which plans to test the feasibility of injecting between 10-50 tonnes per year of CO2.

Sasol has struck deals with a local steel producer on CCUS, with the CO2 being used to produce chemicals.

Releasing around 470 Mt per year of CO2, South Africa is the continent's biggest emitter of GHGs, as coal provides the bulk of its electricity.

MEXICO

Mexico passed its Energy Transition Law in 2015. This promotes sustainable and efficient use of energy and regulates the obligations of power companies, which includes natural gas and CCUS projects. The law also pushes for the reduction of pollution from the electric power industry, while ensuring the competitiveness of the clean power sector within the new wholesale electricity market.

The country implemented a carbon tax in 2014, with an upper price of $4/tCO2e and a lower price of US$0.42/tCO2e. In addition, several Mexican states have enacted their own carbon tax including Baja California, Zacatecas and Tamaulipas.

In terms of specific CCUS regulations, there are not yet any, although the country has been working on its CCUS Technology Roadmap.

UAE

The UAE has one operational project, which is the Abu Dhabi CCUS Phase 1: Emirates Steel Industries located onshore in Mussafah. Phase 1 became operational in 2016 following successful CO2-EOR pilots in both 2009 and 2012. The project captures, compresses and dehydrates up to 90% of CO2 from an Emirates Steel production facility at Musaffah. It then transports and injects CO2 through a 43-km subterranean pipeline to the onshore Rumaitha and Bab oil fields for EOR.

The UAE has two projects which have taken FID, the Ghasha Mega-project gas concession that will capture 1.5 Mt per year of CO2 and Habshan. Adnoc recently set out plans to double its CCUS targets from 5 Mt per year to 10 Mt per year by 2030. However, this is not captured in legislation.

QATAR

Qatar has one operational CCUS project, Ras Laffan. This involves CO2 from the Ras Laffan LNG facility. Initial CO2 injection rates into the subsurface were estimated to be 1.1 Mt per year, with recent estimates suggesting an increase to 2.1 Mt per year.

QatarEnergy has taken FID on another CCUS project, part of its North Field East (NFE) LNG expansion. This is under construction and has a target capture capacity of 2.9 Mt per year of CO2.

QatarEnergy has set a target of capturing and storing 11 Mt per year of CO2 by 2035. However, this is not stipulated in legislation.

Qatar does not have a CCUS regulatory framework or a carbon-pricing mechanism.

SAUDI ARABIA

Saudi has one CCUS project in operation, the Uthmaniya EOR project, which launched in 2015. In addition, Saudi is planning a massive CCUS hub in Jubail. Aramco is developing this, with SLB and Linde, to capture and store 9 Mt per year. Saudi is targeting starting operations by 2027; however, there are no announcements yet on when FID will be in the public domain.

Saudi officials have publicly stated a CCUS target of 44 Mt per year CO2 by 2035; however, this is not in legislation, similar to the state of affairs in the UAE and Qatar.

Saudi Arabia does not have a CCUS regulatory framework or a carbon-pricing mechanism.

INDIA

India's Ministry of Petroleum Natural Gas has recently published its report entitled "The Green Shift - Low carbon transition of India's oil and gas sector".

India lacks a CCUS regulatory framework. However, the ministry has initiated efforts to provide opportunities for collaboration and knowledge sharing to the industry and to prepare a unified and practical strategy for development and implementation of CCUS. A task force, "Upstream for CCUS/CCUS", has been set up and is working to prepare the "2030 Roadmap for CCUS". This will provide the necessary direction guidelines for all oil and gas companies to develop and scale up CCUS. Consultations are being carried out on the draft roadmap.

In addition, ONGC has also recently signed an MoU with Equinor, which includes activities in CCUS. ONGC is also working on India's first industrial-scale carbon capture project at Koyali refinery where the CO2 captured at Koyali would be treated, compressed and transported through pipelines to Gandhar oil field of ONGC. The CO2 would be injected into the depleted oil field. The project has the potential to increase oil production by 10%, while storing 5-6 Mt per year of CO2 by 2040.

OIL has signed an MoU with IOCL for capturing CO2 from flue gas at the Digboi Refinery. The captured carbon will be utilised for EOR activities. Further, OIL has tied up with the Centre of Excellence in Carbon Capture and Storage (COE CCUS), established in IIT Bombay, for an R&D effort.

UK CCUS STATE OF THE NATION

By Peter Sainsbury, E-FWD contributor and Founder of Carbon Risk

The UK Government's 2021 Net Zero Strategy calls for the delivery of four CCUS clusters, capturing 20-30 Mt CO2 per year across the economy, including 6 Mt CO2 per year of industrial emissions by 2030. The Prime Minister's Ten Point Plan established a commitment to "deploy CCUS in a minimum of two industrial clusters by the mid-2020s, and four by 2030 at the latest." The HyNet and East Coast 'Track 1' CCUS clusters are targeting an operational date in the mid-2020s. Meanwhile, 'Track 2' Acorn and Viking CCUS clusters aim to become operational by 2030. In the longer term, the Net Zero Strategy indicates that CCUS capacity will need to rise to at least ~50 Mt CO2 per year by the mid 2030s.

TRACK 1 CCUS CLUSTERS PROGRESS

- HyNet: Eni is the leader of a multi-partner consortium that will develop HyNet North-West and is the operator of CO2 transport and storage activities (both onshore and offshore) at the cluster. In October, Eni signed a Heads of Terms Agreement with the Department of Energy Security and Net Zero (DESNZ), setting out the regulatory framework that will govern the HyNet CCUS project. HyNet is expected to store up to 4.5 Mt CO2 per year by 2030, rising to 10 Mt CO2 from 2030 onwards.
- Endurance: Endurance forms part of the Northern Endurance Partnership's (NEP) East Coast Cluster. Endurance could become one of the world's largest CCUS projects. The project aims to capture and store 20-30 Mt CO2 per annum from industrial emitters in Humber and Teeside by 2030. Some estimates suggest that it has the potential to store 450 Mt CO2. In October 2021 it was selected as one of the first clusters in Track 1 of the UK Government's CCUS cluster sequencing process. BP is operator of the CCUS project (45% stake), and partners with Equinor (45%) and TotalEnergies (10%). The Crown Estate has awarded an agreement for the lease to BP.

TRACK 2 CCUS CLUSTERS PROGRESS

- Acorn: This project entered the Track 2 process in July 2023. The development reuses legacy oil and gas infrastructure to transport captured CO2 to permanent storage 2.5 km underneath the seabed. Estimates suggest that it has the potential to store at least 5 Mt CO2 per year by 2030. The Acorn development include Storegga as lead developer, Shell, Harbour Energy, and North Sea Midstream Partners. In September 2023, the North Sea Transition Authority (NSTA) issued development licences to Acorn for the Acorn East and East Mey CO2 stores.
- Viking CCUS (formerly known as V Net Zero): As with Acorn, the UK Government also concluded that Viking CCUS remains best placed to deliver on its objectives for Track 2. Led by independent oil and gas firm Harbour Energy the project is estimated to have more than 300 Mt of initial CO2 storage capacity, with eight discrete reservoirs situated beneath the seabed. First CO2 injection is scheduled to start in 2027 at an initial rate of 2 Mt CO2 per annum. Viking CCUS aims to store up to 10 Mt CO2 per annum by 2030 and 15 Mt CO2 per annum by 2035.

COMMISSIONING OF CARBON CAPTURE PROJECTS UNDERWAY

In March 2023 the UK Government announced Phase 2 of Track 1, identifying the projects that will proceed into final negotiations for Track 1 Government funding. The eight projects outlined below include dispatchable low carbon power generation, industrial process emissions (cement and lime, energy from waste, etc.) and low-carbon hydrogen production.

Three projects that are part of the East Coast Cluster (Net Zero Teesside Power, bpH2Teesside, and Teesside Hydrogen CO2 Capture), will now enter negotiations with the Government for further support through relevant business models.

Meanwhile, five projects that are part of the HyNet CCUS cluster are also included in Phase 2 of Track 1. The five projects are Hanson Padeswood Cement Works Carbon Capture and Storage Project, Viridor Runcorn Industrial CCUS, Protos Energy Recovery Facility, Buxton Lime Net Zero, and HyNet Hydrogen Production Plant 1 (HPP1).

In the past month, the Government announced that the Track 1 expansion process will begin towards the end of 2023, with the ambition to move into final negotiations in autumn 2024.

COLLABORATION ESSENTIAL

In summer 2022, the NSTA awarded six CO2 storage licences to projects within the Track 1 East Coast CCUS cluster. Subsequently, the NSTA launched the UK's first-ever carbon storage licensing round in June 2022. After the awards were formally accepted by bidders, the NSTA announced in September that an additional 21 CO2 storage licences had been offered to a total of 14 companies. The NSTA estimates that up to 100 carbon storage licences will be needed to meet the Government's carbon sequestration targets.

E-FWD SUMMARY

The regulatory process enabling the UK's four CCUS clusters to develop the necessary carbon infrastructure continues to progress.

Eight carbon capture projects will proceed into final negotiations for 'Track 1' Government funding. They include dispatchable low carbon power generation, industrial process emissions, and low-carbon hydrogen production.

A total of 27 CO2 storage licences have now been issued by the North Sea Transitional Authority (NSTA); 21 were recently issued as part of the UK's first-ever carbon storage licensing round.

One of the main challenges to developing carbon storage in the North Sea is the need to capture extensive seismic data. Competing demands on UKCS prime acreage means collaboration is essential to accelerating this process.

Legal constraints on the cross-border CO2 trade, the need to develop onshore CO2 transport infrastructure, and clarity on the Government's position post 'Track 2' have all been identified as long-term challenges to UK CCUS growth.

One of the challenges identified by the NSTA to rapidly developing the UKCS for carbon storage is that there is "only a short time to build upon our existing knowledge, to comprehensively describe both the underground CO2 storage reservoir and ensure the competency of its surrounding trapping complex".

As such, the NSTA identifies seismic data as being crucial to its ability to identify, define, and in the future, monitor CCUS sites. The need for data on the geological basin underscores another tension between various demands on the North Sea as offshore wind farms can interfere with seismic activity.

The NSTA works with The Crown Estate, Crown Estate Scotland, and other bodies, including through the Offshore Wind CCUS Co-location Forum. Collaboration enables the NSTA to identify the key challenges and opportunities of co-location and identify innovative solutions. Once the NSTA has awarded an applicant a carbon storage licence, they still need to obtain a lease from The Crown Estate or Crown Estate Scotland before further development can take place.

CONNECTING INLAND CARBON CAPTURE PROJECTS

The location of the four CCUS clusters is based, in part at least, on their short distance from heavy concentrations of industrial emissions. For example, industrial point source emissions of CO2 from Humberside were almost 9 Mt in 2020, accounting for 18% of the UK's industrial emissions.

However, capturing these emissions will not be sufficient to fulfil the UK CCUS industry's full potential. For that to happen, infrastructure needs to be built that can transport CO2 away from carbon intensive industries based inland, while also providing them with a supply of blue hydrogen.

The National Infrastructure Commission (NIC) recently published their Second Infrastructure Assessment. One of their recommendations to the Government is that it "should commit to the development of a carbon transmission pipeline and storage network that can transport and store at least 50 Mt CO2e per year by 2035".

The NIC outlined how a CO2 transmission pipeline network could link up the CCUS clusters, while also seeking to maximise the opportunity to connect to dispersed cement and lime plants (likely to be heavily dependent on carbon capture to decarbonise), and existing gas fired power stations (where there is potential for retrofitting carbon capture equipment).

CROSS-BORDER BARRIERS

Favourable geology means the North Sea is in a strong position to develop significant carbon storage. Other parts of Europe close to heavy concentrations of industrial emissions, but without easy access to the North Sea, are not in such a strong position. This opens an opportunity for the UK North Sea to sequester CO2 from other countries short on domestic carbon storage capacity.

The first international cross-border trade in CO2 for sequestration was achieved earlier in 2023. Project Greensand (a consortium of 23 organisations) successfully exported captured carbon from one of INEOS' plants in Belgium and then injected it into a depleted oil field under the Danish North Sea, managed by Wintershall Dea.

The CO2 trade was only possible because of an agreement between Belgium and Denmark authorising a temporary amendment to the London Protocol (LP) on CO2 export. The LP prohibits the transhipment of wastes between countries for the dumping at sea.

BLUE HYDROGEN INFRASTRUCTURE

There is an increasing recognition in Europe that green hydrogen production is unlikely to ramp up quickly enough to meet the EU's 2030 targets. The alternative is to build Europe's blue hydrogen infrastructure, whereby hydrogen is produced from natural gas and the resulting CO2 is removed via CCUS.

For example, in March German energy firm RWE and Norway's Equinor signed a memorandum of understanding (MoU) to develop, among other things, hydrogen pipelines that enable Norway to ship the raw material to Germany. The UK must also develop this infrastructure quickly if it is not to be left behind by Norway and other countries with CCUS capacity.

There is increasing interest in the potential for Scotland to be an exporter of blue hydrogen to Europe. The Net Zero Technology Centre (NZTC) has received funding from the Scottish Government to research the potential for UK hydrogen exports to Germany. The so-called Hydrogen Backbone Link project could potentially provide around 10% of Europe's zero carbon hydrogen demands by 2050, according to NZTC. If it is developed there may also be an opportunity for the UK to import CO2 from Europe, and then export 'blue' hydrogen back to the continent via parallel infrastructure.

REGULATORY UNCERTAINTY

Developers of UKCS carbon storage face ongoing uncertainty over the commercial frameworks that will support them, according to a recent report by the Carbon Capture and Storage Association (CCUSA). In particular, the CCUSA identify uncertainty over Government support post Track 2 as potentially delaying investment. For example, what happens once all four CCUS clusters have been established and the 2030 carbon capture target has been achieved? With carbon storage estimated to take five to seven years to develop, the concern is that developers do not have sufficient clarity at present as to how future carbon storage development will be incentivised.

Notwithstanding the increased domestic competition for prime UKCS acreage from the CCUS and offshore wind industry, the CCUSA are also concerned about CCUS competition from other countries neighbouring the North Sea. For example, the Net Zero Industry Act (NZIA) sets European carbon storage target of 50 Mt CO2 per year by 2030. Carbon storage facilities can obtain Net Zero Strategic Project (NZSP) status, requiring them to receive storage permits within 18 months of application, provided the carbon store is based in the EU and is planned to be operational by 2030. A rapid and transparent process is likely to hasten investment into carbon storage capacity in Europe – potentially at the expense of UKCS investment into CCUS.

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