GLOBAL STATUS OF CCS 2024

COLLABORATING FOR A NET-ZERO FUTURE

GLOBAL CCS INSTITUTE

Contents

About the report

This report documents the key milestones in the global adoption of carbon capture and storage (CCS) over the past 12 months.

The number of facilities in operation has risen to 50 over this period, while the total number of facilities in the development pipeline has surged 60% to 628. The recent increase in CCS development activity in China is covered in its own section for the first time.

The report identifies the significant policy and regulatory updates relevant to the deployment of CCS by region and describes how finance and investment are driving development over the reporting period.

This authoritative snapshot of the global CCS industry is based on the Institute's database of CCS facilities (CO_2RE) and analysis by the Institute's global team.

This report describes how CCS is being positioned by leading governments as an indispensable component of their strategies to meet net-zero commitments, how collaboration between governments and between companies is advancing CCS, and the significant challenges that remain for CCS to help meet global climate targets.

*The Global Status Report is based on recorded data as of 24 July 2024.

How to Navigate This Report

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About us

The Global CCS Institute is a not-for-profit think tank whose mission is to accelerate the deployment of CCS as an integral part of the net-zero emissions future through fact-based advocacy and knowledge sharing.

Our 200+ members include governments, global corporations, private companies, research bodies and non-governmental organisations.

We are a trusted advisor, offering data and analysis to our members and using fact-based advocacy to communicate the role of CCS. We support the global CCS community by hosting forums, workshops and meetings, publishing authoritative thought leadership and expert reports, offering bespoke consultancy services and providing accurate and up-to-date information to policy makers.

The Institute's efforts support policy formulation that enables the public and private sectors to work together to unlock and accelerate investment.

We also help businesses and governments integrate CCS into their net-zero strategies, and we work with the financial sector to increase its understanding of CCS so that it may be included in investment strategies and portfolios.

Our core strength is our globally-based team with a diverse range of technical, economic, commercial, legal, regulatory and policy experience, expertise and advocacy skills.

Headquartered in Melbourne, Australia, we have offices in Abu Dhabi, Beijing, Brussels, London, Tokyo and Washington DC. Global CCS deployment must increase more than 100-fold by 2050 to meet net-zero emissions targets. It is achievable if government, industry, and the financial sector work effectively together over the next 25 years. Our mission is to make this happen.

We are a trusted advisor, offering data and analysis to our members and using fact-based advocacy to communicate the role of CCS.

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1.0 From the CEO

Jarad Daniels

Working together toward a shared common goal is necessary for the world to reach net-zero greenhouse gas (GHG) emissions as quickly as possible. This is especially true to help advance global deployment of carbon management technologies that must reduce and remove gigatonnes of carbon emissions every year to help address global climate change.

The global environmental community has a rich history of achieving success through partnerships and collaboration. The Montreal Protocol to protect the Earth's ozone layer is a monumental achievement that proves global collaboration can succeed when governments, industries, scientific communities, and civil society work together to address a global challenge. Thanks to government commitment, industry action, and collaborative efforts around the world, the ozone layer is now on its way to recovery and the Montreal Protocol parties are also working to address emissions of potent greenhouse gases.

After the Intergovernmental Panel on Climate Change (IPCC's) First Assessment Report was completed in 1990, the United Nations Framework Convention on Climate Change was signed in 1992, creating a platform for global collaboration that has been in place for more than 30 years. Public-private partnerships focused on solving energy and environmental challenges have leveraged government's ability to spur progress with industry's ability to build and operate projects at commercial scale. In the early 2000s, the IPCC convened experts from around the world to evaluate the scientific, technical, economic and policy dimensions of CCS and published its seminal IPCC Special Report on Carbon Capture and Storage in 2005.

There is also a rich history of global collaboration on carbon management. The IEA GHG Programme, a technology collaboration programme of the IEA, was the first multilateral programme dedicated to evaluating CCS technologies, facilitating deployment, connecting people, and sharing research in 1991. The Carbon Sequestration Leadership Forum (CSLF) was launched in 2003 as a government ministerial-level initiative that facilitated technical collaboration, promoted awareness, and championed supportive policy, legal, and regulatory environments. The Global CCS Institute itself began in 2009 as an innovative member-owned think tank now with over 200 members including governments, industry, and NGOs.

More recently, the Clean Energy Ministerial (CEM) CCUS Initiative has been building a community of leading countries, companies, and financial sector experts to speed deployment of carbon management technologies, and Mission Innovation is working to catalyse clean energy action and investment focused on Carbon Dioxide Removal (CDR). The Carbon Management Challenge (CMC) is the latest global effort to spur government and private sector action to reach gigatonne-scale deployment of carbon management by 2030. More than 20 countries are committed to this goal and the collaborative effort needed to achieve it.

All these international efforts, driven by scientific analyses, demonstrate a widely held view that all forms of carbon management, including both point source CCS and CDR, are necessary to help reach net-zero while continuing to supply the world's growing population with necessary energy services and commodities like cement, steel, and fertiliser.

Thanks in part to these and other global collaborations, carbon management has steadily progressed, and we are now witnessing an exponential growth in project development activities catalysed by strong government policies and industry actions built on decades of shared learnings.

Collaboration has moved from focusing on early research and early adopters to where we are today with the highest level of government and

1.0 From the CEO (cont.)

industry executives on the international stage at the UNFCCC's Conference of the Parties (COP). At last year's COP28, world leaders across both governments and industry committed to public-private collaborations on all forms of clean low-carbon energy and climate change mitigation: tripling renewables, doubling the rate of energy efficiency improvements, reducing fugitive methane missions, and accelerating carbon management to gigatonne levels through the Carbon Management Challenge.

There are now 50 commercial CCS projects operating around the globe, another 44 under construction, and over 500 more in development. This represents another year of exponential growth in project development we have been witnessing over the past 6 years. The Institute is tracking over 680[1] projects globally, with strong progress being seen in the US, Europe, the Middle East, China, and South-East Asia. The Institute has also identified over 50 bilateral agreements or memorandums of understanding (MoUs) executed by national governments since 2020 that include CCS within their scope. While this growth in projects and transnational collaboration is very encouraging, we still have a long way to go to attain the gigatonnes per annum of carbon management deployment, both point source and CDR, required to help reach net-zero and avoid the most severe consequences of global temperature rise.

Massive infrastructure investments will be required to mitigate climate change, including new transmission grids for low-carbon electric generation and pipelines and shipping for both CO_2 and low-carbon energy carriers such as hydrogen in various forms. Carbon management hubs and networks can help bring economies of scale to this new infrastructure.

As policy support and markets progress, new business models are emerging for carbon management projects. This past year has seen growth in insurance offerings, consolidation across large corporates active in carbon management, and the Green Climate Fund support its first CCS activity. Engaging and partnering with the financial sector remains an important part of our strategy to accelerate commercial deployment in many regions.

While we see forward progress and exponential growth for carbon management and other climate technologies, there continue to be challenges and headwinds such as community concerns about risks, pushback on new infrastructure of all types – including CO_2 pipelines, and erosion of supporting policy tools in some jurisdictions due to inflationary pressures and high interest rates that make financing capital-intensive projects more challenging. There is also still a critical need for continued and accelerated geologic storage characterisation, regulatory development, and human capital development to accelerate progress in many countries in the Global South. Collaborations with academic institutions will be critical to develop and grow the next generation of practitioners required to deploy low-carbon technologies to climate-relative scale.

I am immensely optimistic that we will overcome these challenges by continuing to build and grow our partnerships. The Institute, working in partnership with other organisations, will support and enable global collaboration and strive to share lessons learned between regions and across public and private sectors.

Effective collaboration and open communication are required at all levels to mitigate global climate change, from the development of global policy drivers and markets to local efforts where industry leaders, local officials, and communities partner to develop and operate successful projects that provide lasting global and local benefits. We look forward to working with you to achieve our common goals.

[1] Includes 54 projects at "Announced" status that are not included in statistics elsewhere in this report.

"I am immensely optimistic that we will overcome these challenges by continuing to build and grow our partnerships."

2.0

GLOBAL COLLABORATION FOR CCS

2.0 Global Collaboration For CCS

Achieving the objective of the Paris Agreement, and limiting global temperature increase to 1.5 degrees, (UNFCCC, 2024) requires greenhouse gas emissions to decline to net zero by the middle of this century followed by decades of carbon removals to reduce the stock of carbon dioxide in the atmosphere.

Greenhouse gas emissions continue to rise just as they have since the Industrial Revolution. This trend is increasing the stock of CO_2 in the atmosphere and must be reversed to meet climate targets. This has contributed to an increased focus on “carbon management”, which includes both emissions reductions at the source and carbon dioxide removal (CDR) from the atmosphere. Carbon capture and storage serves both components of carbon management. It can deliver emissions reductions across a broad range of industries and CDR through direct air capture or capture from processes that utilise biomass such as ethanol production via fermentation. Consequently, carbon capture and storage is gaining greater recognition as a critical component of the global portfolio of carbon management strategies and technologies.

The value of CCS is globally recognised and the most rapid progress is occurring in North America and Europe. The policies of countries in these regions, and the resulting investment in CCS technologies and projects, is catalysing action around the globe. The US government and some governments in Europe were the first to provide material support to accelerate private investment in CCS. They were closely followed by the government of Japan and state-owned enterprises of the Middle East and China. Now, South-East Asian nations are beginning to drive CCS primarily through their national oil companies as they begin their transition to net zero emissions.

Strong and sustained policy support by leading nations has launched the CCS industry. Collaboration is now essential to drive the industry’s growth by applying the collective knowledge and capabilities of governments, the private sector and researchers to remove barriers, decrease costs and support investment.

Governments continue to play a critical role in supporting carbon management research and development, driving investment, and addressing legal and regulatory issues.

Collaboration on CCS is taking many forms. Private sector companies are entering into public-private partnerships with governments to advance CCS projects. Governments are collaborating with each other and with researchers to create regulatory and policy frameworks, and private sector companies are collaborating with each other to develop CCS value chains.

Strong and sustained policy support by leading nations has launched the CCS industry. Collaboration is now essential to drive the industry's growth.

Stock image

Government collaboration

One of the first collaborative initiatives operating today is the International Energy Agency Greenhouse Gas Research & Development Programme (IEAGHG). The IEAGHG is a technology collaboration programme established by the International Energy Agency in 1991 to deliver research on the development and deployment of CCS to its 17 government (including the European Union) members and 20 private sector members (IEAGHG, 2024).

The Industrial Carbon Management Strategy adopted by the European Commission in February 2024 is possibly the most comprehensive example of government collaboration to accelerate deployment of CCS. The strategy calls on European Union Member States to implement a comprehensive suite of initiatives related to policy, infrastructure, standards, regulation and liability, carbon accounting, storage resource development, project finance, and research and development in support of capturing approximately 450 million tonnes of CO_2 from industrial sources and the atmosphere by 2050 (European Union, 2024). In addition, there is a growing number of collaborative platforms that bring governments, the private sector and researchers together to advance CCS. These include the Clean Energy Ministerial (CEM), Mission Innovation (MI), the Asia CCUS Network (ACCUSN), and the Carbon Management Challenge (CMC).

The CEM and MI are broad in nature with sub programs that address different elements of the transition to net zero emissions, but both include programs on CCS. The CEM includes the Carbon Capture Utilization and Storage Initiative (CEM CCUS) with 15 government members. CEM CCUS aims to accelerate CCUS as a viable CO_2 mitigation option (Clean Energy Ministerial 2024). Government collaboration with industry and the finance sector to accelerate investment in CCS is a key element of the CEM CCUS operating model.

Mission Innovation, with 23 government members plus the European Commission, focuses on research, development and demonstration to accelerate innovation in climate mitigation technologies. It includes partnerships with the private sector and researchers and has seven missions, two of which include carbon management: the Net-Zero Industries Mission and the Carbon Dioxide Removal Mission (Mission Innovation, 2024).

The ACCUSN aims to facilitate deployment of CCUS in Asia. It is managed and supported by the Economic Research Institute of ASEAN and East Asia (ERIA), which has a significant research capability. In addition to its 13 government members, the ACCUSN has over 200 supporting members from across the private sector ranging from banks and financial institutions to heavy industry (Asia CCUS Network, 2024).

A recent initiative in the early stages of developing its work program is the Carbon Management Challenge (CMC), launched at the April 2023 Major Economies Forum, to accelerate the scale up of carbon capture, utilisation and storage and carbon dioxide removal.

The CMC aims to increase financing opportunities for carbon management projects, to help ensure that carbon management is appropriately included in UNFCCC discussions and data sets such as country-specific NDCs, and to track progress toward gigatonne-scale deployment. At the time of writing, 21 countries plus the European Commission had joined the CMC.

CMC participants all agree to support a global goal of advancing carbon management projects (i.e. CCS or CDR) that collectively have the capacity to capture 1 Gt of CO_2 by 2030 (Carbon Management Challenge, 2024).

In addition to these multilateral initiatives, there are many bilateral agreements or arrangements with the purpose of driving collaboration on CCS. Agreements such as the Sunnylands Statement on Enhancing Cooperation to Address the Climate Crisis jointly issued by China and the US in November 2023 establish commitments to collaborate to support CCS deployment. In this statement, China and the US aim to advance at least five large-scale cooperative carbon capture, use and storage projects each by 2030 (US Department of State, 2023).

Collaboration between governments is accelerating. The Institute has identified over 50 bilateral agreements or MoUs executed by national governments since 2020 that include CCS within their scope (see Figure 2.1).

Bilateral agreements between governments are particularly important where carbon capture and storage value chains are developing across national borders. Two recent examples are:

- A Letter of Intent executed by Singapore and Indonesia in February 2024 to collaborate on cross-border carbon capture and storage (Singapore Ministry of Trade & Industry, 2024).
- Separate arrangements between the governments of Denmark, Belgium, the Netherlands and Sweden with Norway on cross-border transport and geological storage of CO_2 established in April 2024 Government of the Netherlands (2024).

Agreement-making to enable transnational transport of CO_2 for geological storage is most advanced in Europe, however it is also an active discussion in the Asia Pacific region. For example, the Bayu Undan Project owned by Santos, which involves re-tasking existing gas production infrastructure to transport CO_2 from Australia for storage in Timor-Leste, is demonstrating the criticality of collaboration between nations to put in place regulations and bilateral agreements necessary to enable transnational CCS value chains.

More generally, Singapore, South Korea and Japan are considering options for exporting CO_2 for storage in other countries with very large storage resources such as Australia, Malaysia and Indonesia. For example, the Malaysian and South Korean governments are collaborating with the Shepherd CCS project to enable the export of CO_2 from South Korea to Malaysia for geological storage. Shepherd CCS is being developed by a consortium of industry leaders including Lotte Chemical, Petronas, Samsung E&A, Samsung Heavy Industries, SK Earthon, KNOC, Hanwa Corporation, Air Liquide and Shell (Shepherd CCS 2024).

There are also many examples of public-private partnerships to develop CCS facilities from other regions. For example, in Saudi Arabia, the energy ministry has signed a joint development agreement with Saudi Aramco, SLB and Linde to establish a CCUS hub at Jubail with a capacity to store up to 9 Mtpa of CO_2 later this decade. Sarah Glubb and Nirmal Narayanan (2022).

In the Netherlands, the Port of Rotterdam Authority, Gasunie and EBN have formed a joint venture to develop a large-scale CO_2 transport and storage project (Porthos) with the strong support of the Dutch government. (Levina E, Gerrits B, Blanchard M, 2023)

Collaboration between governments is accelerating. The Institute has identified over 50 bilateral agreements or MoUs executed by national governments since 2020 that include CCS within their scope.

In the US, the Department of Energy has awarded up to $1.2 billion to support development of two direct air capture hubs, each with a capacity of 1 Mtpa CO_2. The hub in Louisiana is being developed by Climeworks Corporation and Heirloom Carbon Technologies with geological storage services provided by Gulf Coast Sequestration. The hub in Texas is being developed by 1PointFive (subsidiary of Occidental), Carbon Engineering and and Worley (Department of Energy, 2023).

Private sector collaboration

The CCS value chain comprises a diverse set of competencies that are almost never held by a single company. This is driving companies to collaborate to develop CCS projects or CCS technologies. New partnerships, joint ventures or MoUs are announced every month.

Project developers are partnering with technology developers to optimise CO_2 capture for their particular application. Ship-building companies are collaborating with shipyards or ports to study the design and integration of liquid CO_2 carriers and port facilities.Oil and gas companies are partnering with other oil and gas companies to develop geological storage resources and with shipping companies and technology developers to develop entire CCS value chains. Companies from hard-to-abate sectors are collaborating with technology providers to complete studies related to the application of CCS in their industry.

These collaborations leverage the competencies, knowledge and resources of their participants, accelerating innovation not only with respect to technology development, but also with respect to developing new business models that over time, reduce the cost and business risk of CCS.

Collaboration between private sector entities is a critical driver of innovation to deliver CCS and help meet climate targets at lower cost, across a broader range of industries and in a growing number of projects.

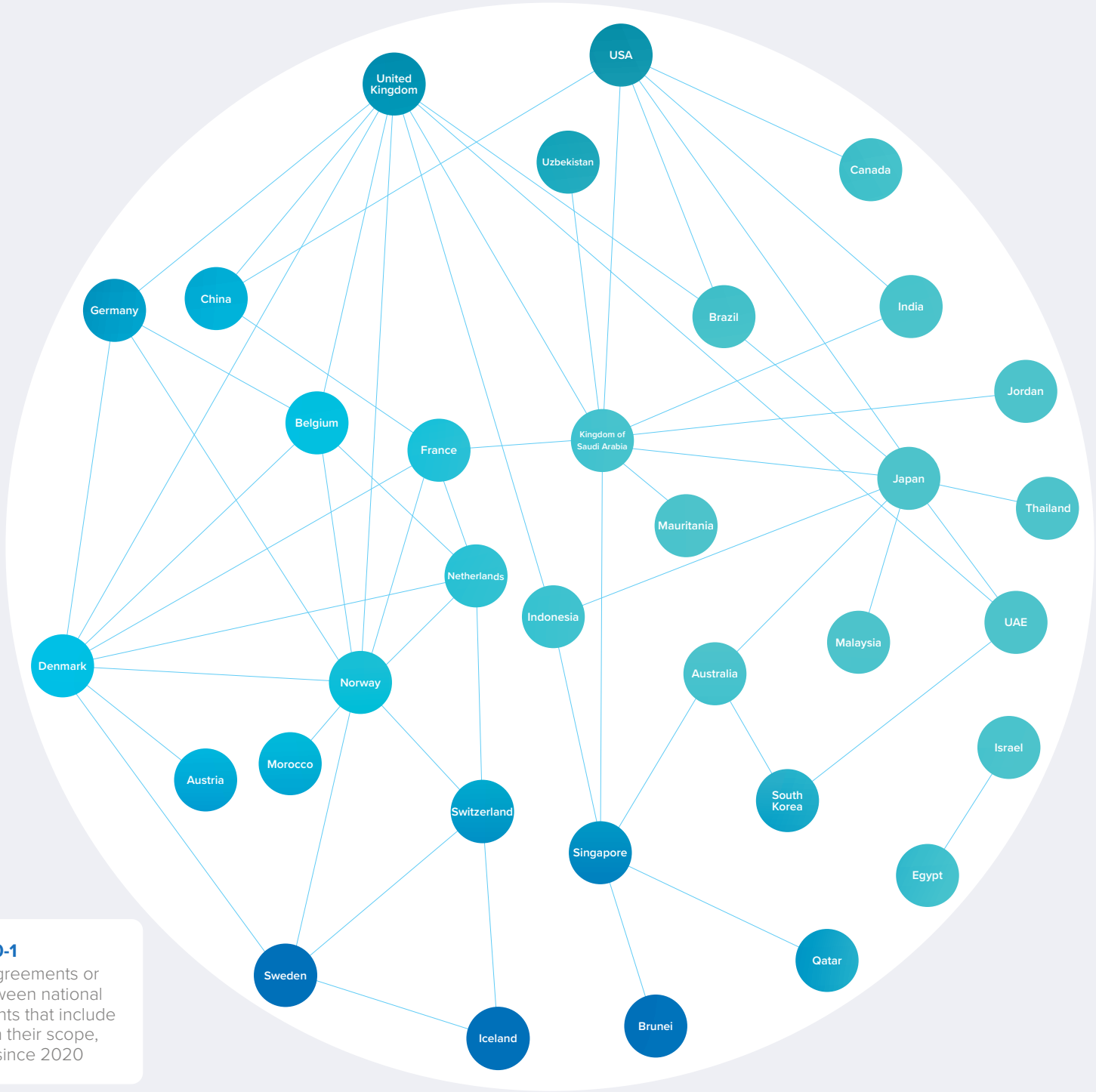


Figure 2.0-1
Bilateral agreements or MoUs between national governments that include CCS within their scope, executed since 2020

3.0

GLOBAL FACILITIES AND TRENDS

3.1 Global Facilities and Trends

Overview

2024 has seen significant growth in CCS facility development. 50 facilities are now in operation (3 of which are dedicated transport and/or storage projects) and 44 are under construction (7 of these are transport and/or storage). As of July 2024, the pipeline includes 628 projects, a 60% year-on-year increase.

Both in facility count and capacity, the project pipeline has reached record levels. Capture capacity has seen strong growth since 2017, with an annual compound rate of 32%. Figure 3.1-1 shows growth in the number and total capture capacity of CCS projects since the 2023 Global Status of CCS Report. Over the past year, capture capacity in the pipeline rose 15%. More significantly, the capture capacity of facilities under construction increased by 57%.

Figure 3.1-2 shows capacity growth from 2010 to 24 July 2024. Projects in Advanced Development of all types, with substantial engineering funding and commitment levels, signify a notable step towards funding approval and construction.

The more than doubling of these projects in the past 12 months, from 121 to 247, is particularly noteworthy.

By 24 July 2024, 222 transport/storage projects (which do not include capture) were in various stages of development, showcasing significant capacity growth across all stages, including a 118% boost in the number of Advanced and Early Development projects.

Early Development

The facility is completing or has completed a pre-feasibility or feasibility study.

Advanced Development

The facility is completing or has completed a front-end engineering and design (FEED). For storage sites, the proponent is completing a submission or has submitted a field development plan or equivalent to regulators.

In Construction

A positive final investment decision (FID) was reached.

Operational

CO_2 is being actively captured, transported, and stored.

Figure 3.1-1
Commercial CCS facilities by number and total capture capacity

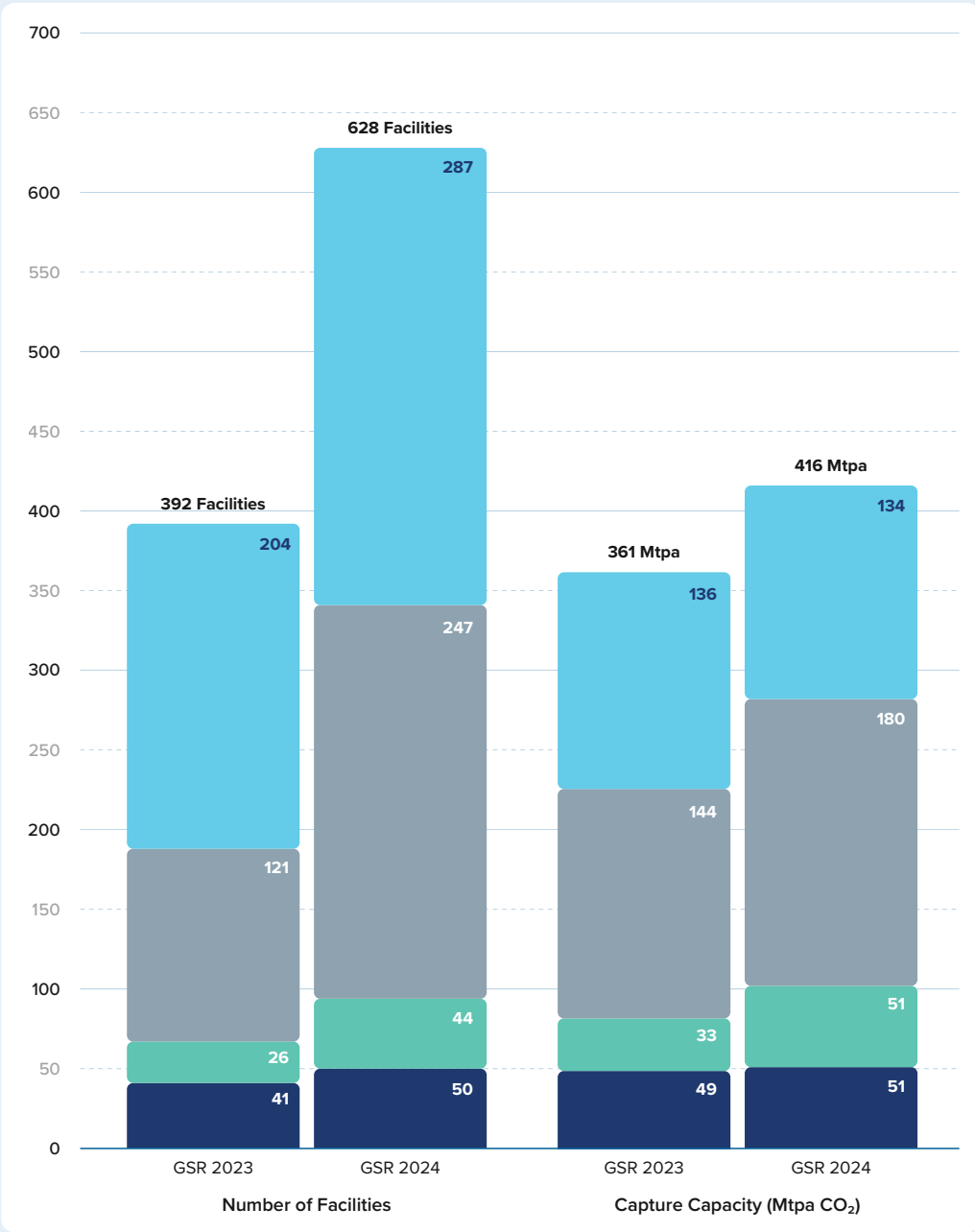
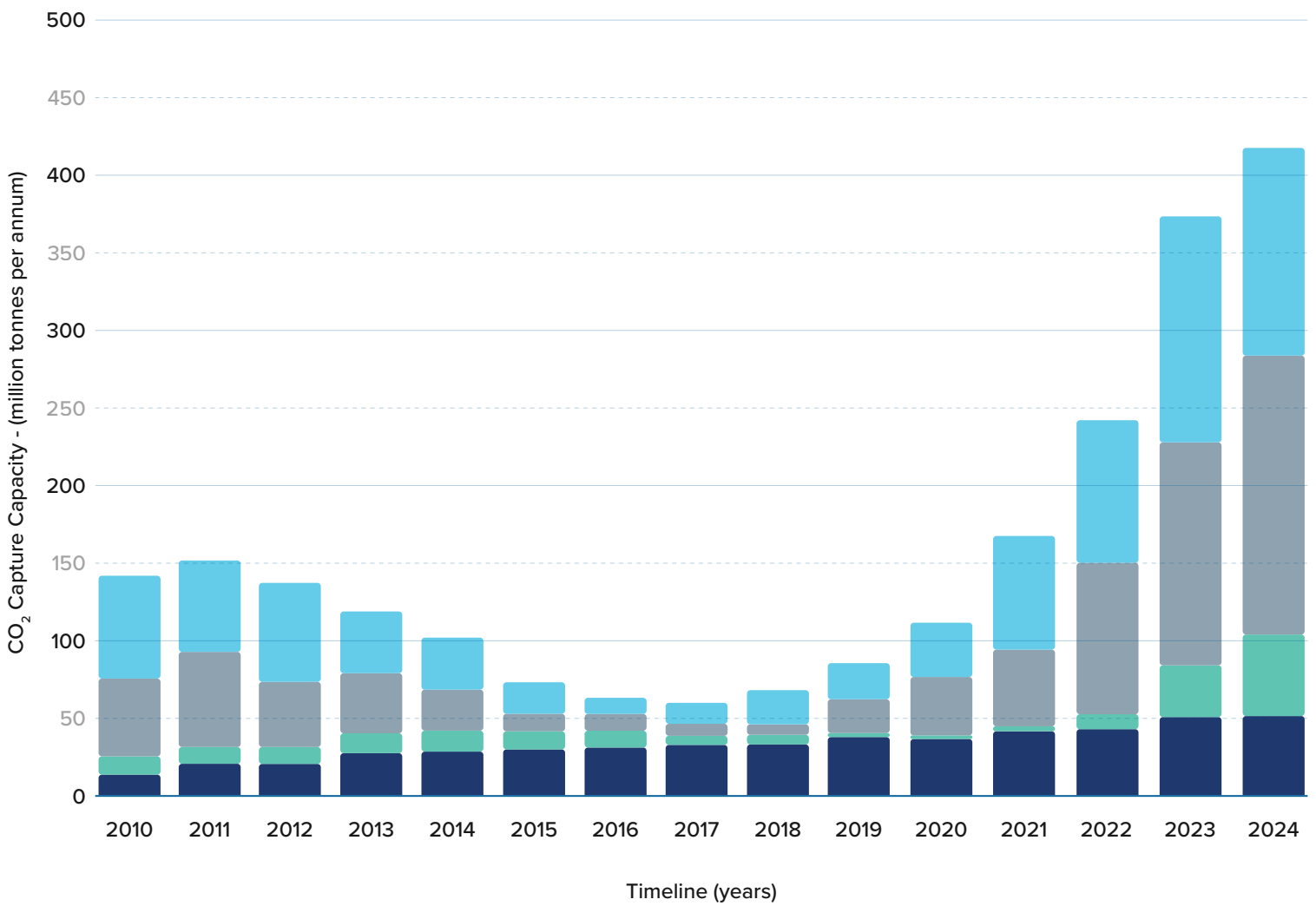
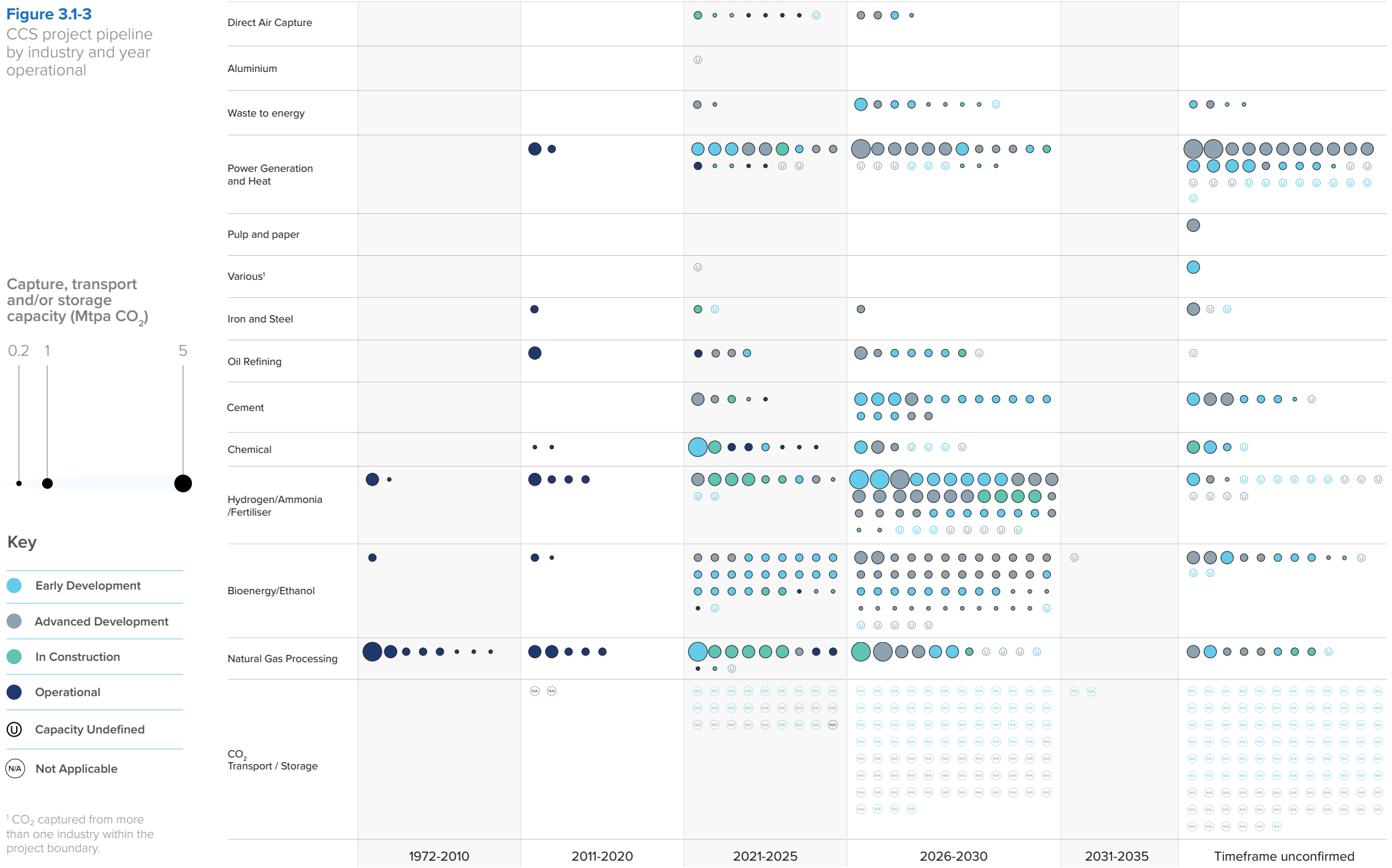


Figure 3.1-2
CO_2 capture capacity of commercial CCS facility pipeline since 2010



57%
year-on-year increase in CO_2 capture capacity under construction

Figure 3.1-3
CCS project pipeline by industry and year operational



[1] CO_2 captured from more than one industry within the project boundary.

Policy

Policy developments in some jurisdictions this past year have improved conditions for project development. Apart from direct funding, examples of key policy levers employed include:

Enabling legislation and regulations – Japan passed the CCUS Business Act (Japan's Ministry of Economy, 2024); the EU Council approved the Net-Zero Industry Act, targeting CO_2 injection capacity of 50 million tonnes per year by 2030 (Council of the EU, 2024); Indonesia issued comprehensive CCS regulations (Indonesian Ministry of Energy and Mineral Resources, 2024). The US EPA issued a new rule requiring existing coal and future natural gas plants to reduce their CO_2 emissions by 90% by 2032, using technology such as carbon capture (United States - Environment Protection Agency Press Office, 2024).

Strategic signalling – The EU released communication outlining an intermediate 2040 climate target together with its Industrial Carbon Management Strategy, presenting a vision to scale up carbon management technologies (Global CCS Institute, 2024a). The UAE announced its long-term decarbonisation strategy and the role of CCUS.

Cross-border arrangements – Norway signed bilateral instruments with Sweden, Denmark, Belgium, and the Netherlands (Global CCS Institute, 2024b) for transboundary transport and storage of CO_2; as did France and Denmark (Euractive, 2024).

Carbon tax – The EU launched its Carbon Border Adjustment Mechanism (CBAM), pricing embedded emissions in imported carbon intensive goods (European Commission 2023). High-carbon product exporters to the EU will become less competitive in the EU if they do not reduce their product emissions, for example through CCS.

Singapore raised its carbon tax to S$25/t$CO_2$e for 2024 and 2025 and will increase it to S$45/t$CO_2$e in 2026, aiming to reach S$50-80/t$CO_2$e by 2030 (Singapore Ministry of Sustainability and the Environment, 2024). Canada's carbon price has increased from CA$20 in 2019 to CA$80 in 2024 and will increase by CA$15/t$CO_2$e annually to 2030 (Government of Canada, 2023b).

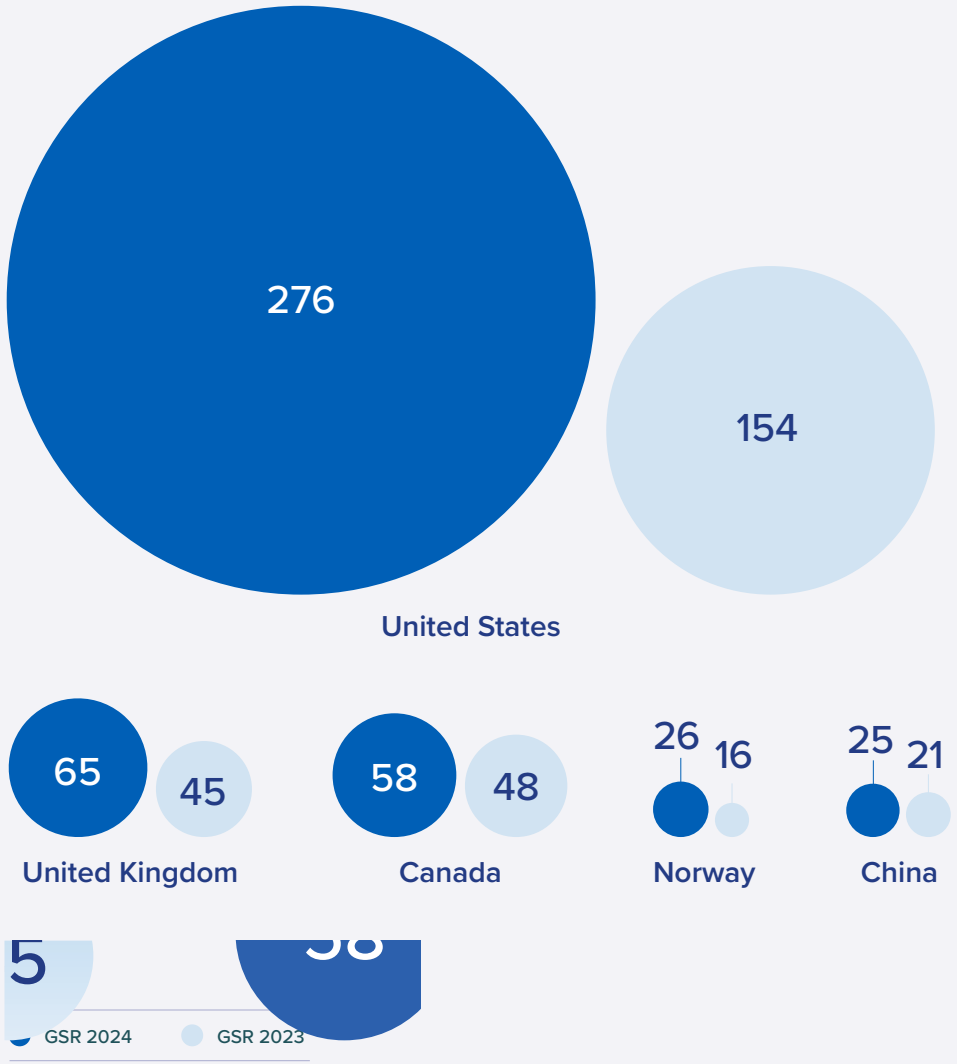
New business models that have been in planning for some time are now being implemented, creating investment opportunities and increasing project commerciality, including:

Implementation of **transport and storage (T&S) as-a-service** – Porthos project (Netherlands) commenced construction and will provide T&S services to various companies, including Air Liquide, Air Products, ExxonMobil, and Shell (Porthos, 2023).

Establishment of **cross-boundary value chains** – MoUs and cooperation agreements have been concluded between private parties, for cross-boundary transport of CO_2, including from emitters in Japan to storage locations in Indonesia, Malaysia and Australia respectively; and from Yara International (Netherlands) to Northern Lights (Norway)(Yara International, 2023).

Formation of **CO_2 hubs** – ExxonMobil and Shell (S-Hub consortium), have partnered with the Singapore Government to develop a CCS hub for cross-border transport and storage (ExxonMobil, 2024). The UK government has commenced engagement with T&S providers for its Track-2 (Acorn and Viking) CCS cluster (Government of the UK - Department for Energy Security and Net Zero, 2024).

Figure 3.1-4:
Top 5 countries with CCS projects in 2024 v 2023



Regional Trends

Middle East and Africa

The Middle East and Africa region is increasingly focusing on CCS as part of its decarbonisation strategies. Countries like the UAE, Saudi Arabia, and Qatar have announced ambitious targets, supported by substantial investments. The UAE's ADNOC aims to capture and store 10 Mtpa of CO_2 by 2030 (ADNOC, 2024), while Qatar is targeting 11 Mtpa (QatarEnergy), and Saudi Arabia's Aramco planning 14 Mtpa by 2035 (Saudi Aramco, 2023). At the national level, Saudi Arabia has set an overall target of capturing and storing 44 Mtpa CO_2 by 2035 (Saudi & Middle East Green Initiatives, 2024), and the UAE's Long-Term Strategy highlights a 32% CCS contribution in the industrial sector's decarbonisation by 2050, equivalent to 43.5 Mtpa (Ministry of Climate Change and Environment, 2024), while Oman is committed to achieving 15% carbon abatement through CCUS by 2050 (Maryam Ahmed Yousef Al Nofli, 2024).

With a current regional operational capacity of 3.8 Mtpa, these targets, demonstrated in large-scale planned projects such as Habshan (ADNOC, 2024 and Ghasha (ADNOC, 2024) in the UAE, the Al Jubail CCUS hub in Saudi Arabia (Saudi Aramco, 2023), the Ras Laffan project in Qatar (Worley, 2023), and the 1 Mtpa Direct Air Capture project in Kenya (Climeworks, 2023), are expected to contribute to a projected regional CCS capacity of at least 65 Mtpa by 2035.

Northern Lights onshore pipeline, Norway. Image courtesy Northern Lights JV.

Regional Trends (MEA cont.)

Decarbonisation and net-zero targets are major drivers behind these initiatives, as countries seek to meet international climate commitments. UAE and Oman aim to achieve net zero emissions by 2050 while Saudi Arabia, Kuwait, and Bahrain have set their net-zero targets for 2060. Other countries like South Africa are focused on reducing their carbon emissions as per their updated Nationally Determined Contributions (NDCs) and sectoral targets. Enhanced oil recovery (EOR) is another critical factor, leveraging captured CO_2 to increase oil extraction efficiency while reducing emissions.

Moreover, the development of low-carbon hydrogen and ammonia production, essential for a sustainable energy transition, is being supported by CCS technologies. For example, the UAE plans to produce 7 Mtpa of low-carbon hydrogen by 2050 (Ministry of Energy and Infrastructure, 2024), while Saudi Arabia plans to produce up to 2 Mtpa by 2030 (Saudi Aramco, 2024). Both countries have demonstrated production, certification and exports of low-carbon hydrogen to key demand markets including Japan, South Korea and Germany. The establishment of a CO_2 transport network and supportive policies are critical for achieving these ambitious goals.

China

China continues to make progress in CCS development, with the government consistently acknowledging CCUS in policy documents. One notable advancement is the Implementation Plan for Green and Low-Carbon Technology Demonstration, led by the National Development and Reform Commission and 10 other ministries, which provides financial support to recognised decarbonisation projects, including CCS. This program was announced in August 2023, and the first group of selected projects was released in March 2024.

Among the 47 selected projects, six are CCS-related, including Huaneng's coal power CCUS project, the world's largest on a coal power station, which will capture 1.5 Mtpa CO_2.

Regarding project development, China National Petroleum Corporation's Xinjiang Oilfield began constructing the first phase of an integrated 2 Mtpa coal power CCS project in May 2024, aiming to be fully operational by summer 2026. The first phase captures 1 Mtpa of CO_2 from a new coal power plant.

Huaneng's integrated 1.5 Mtpa coal power CCS project is expected to be operational by the end of this year, becoming the world's largest coal power

CCS project.

Additionally, in January 2024, the world's largest oxyfuel combustion carbon capture project in the cement sector, owned by China United Cement Company, successfully commenced operation, capturing 200 ktpa of CO_2. Oxyfuel combustion offers an attractive decarbonisation option for the cement industry, involving the enrichment of CO_2 via oxygen injection and lowering the cost of capture.

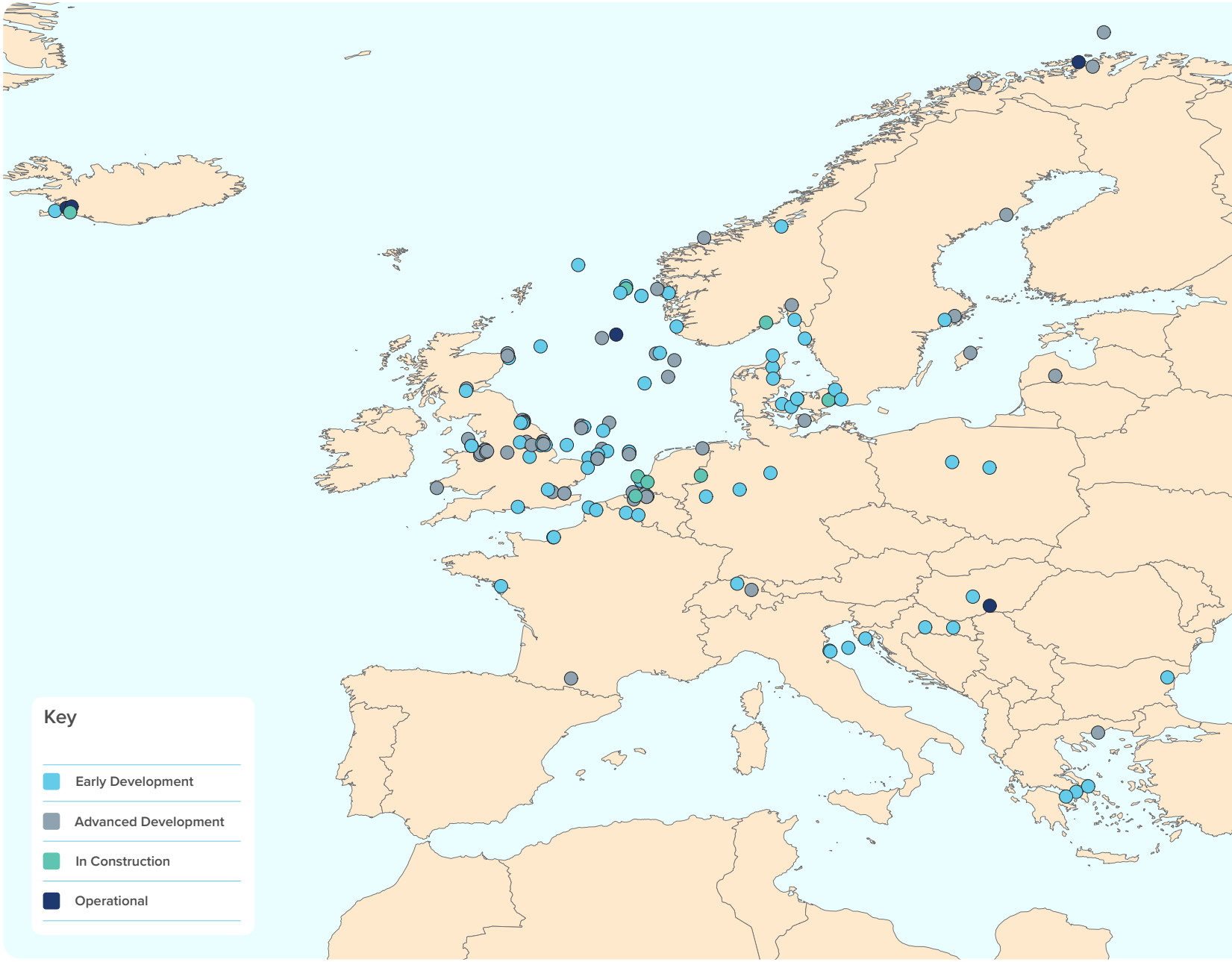
Europe & UK

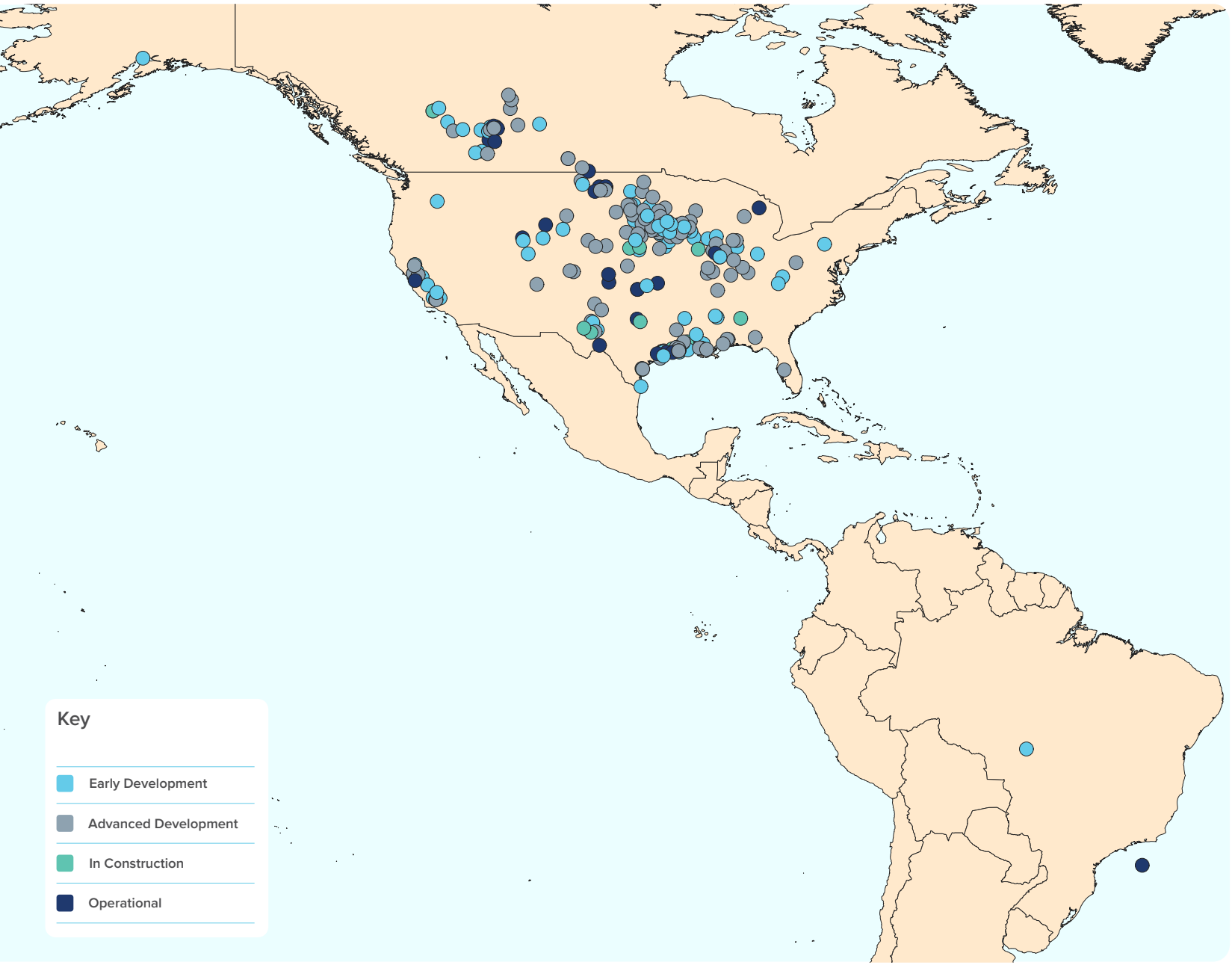
European decarbonisation policies continue to drive the emergence of a robust CCS value chain. The EU-wide target of 50 Mtpa CO_2 injection capacity by 2030, introduced by the Net-Zero Industry Act, came into force in June 2024 (Official Journal of the EU, 2024).

Concurrently, the UK Government has been supporting the delivery of four CCUS clusters capturing 20-30 Mtpa CO_2. In early October 2024, the UK Prime Minister announced up to £21.7 billion of funding over 25 years to support the Teesside and Merseyside clusters. (UK Department for Energy Security & Net Zero, 2023). As a result, the number of commercial CCS projects under construction in Europe has grown to 10 in July 2024, up from six in July 2023. This surge highlights significant progress, yet challenges in scaling up remain.

The establishment of cross-border transport infrastructure is pivotal for meeting these objectives and creating a single CO_2 market in Europe. Norway and the Netherlands achieved significant milestones with Phase 1 of Northern Lights completed in September 2024 and Porthos construction launched in April 2024 (Porthos, 2024). To further support such initiatives, the long-awaited EU Industrial Carbon Management Strategy, released in February 2024, outlined plans for a forthcoming CO_2 transport regulatory package (European Commission, 2024). However, with legal enforcement at the national level not anticipated before 2029, European nations are taking proactive measures in this field.

Notably, the parliaments of Wallonia and Flanders, two regions in Belgium, adopted CO_2 pipeline decrees in March 2024 (Belgian Official Gazette, 2024b, 2024a). Similarly, France has tasked its national energy regulatory authority with advancing discussions on CO_2 transport regulations this year (French Government, 2023).





Americas

Federal funding and policy incentives continue to drive world-leading CCS facility deployment in the US. The US DOE has awarded or is negotiating awards for over US$2.2 billion from the 2021 Bipartisan Infrastructure Law (BIL) to advance carbon management projects. 231 Class VI CO_2 injection well permit applications are being evaluated for 88 projects across 18 US states and one tribal nation under the US EPA's Underground Injection Control (UIC) program. Facility deployment rates are highest in the ethanol, natural gas processing, and hydrogen/ammonia/fertiliser production sectors.

Government policy in Canada is also bolstering project deployment. Canada's federal investment tax credit for CCUS was approved by Parliament in June, the federal carbon price increased to CA$80/tonne in April, and, as of June, the Canada Growth Fund has established two carbon contracts for difference (CCfD) for CCS projects (Government of Canada, 2023a, 2024b, 2024a, 2024c).

Governments at national and sub-national levels in the Americas continue to develop their legal and regulatory frameworks for CCS. In the US, CCS policy development has partially shifted from the federal level to US states. In December 2023, Louisiana became the third US state to be granted primacy (after North Dakota and Wyoming), while several states, including Alaska, Arizona, Texas, and West Virginia, are seeking UIC primary enforcement authority ("primacy") for CO_2 injection wells from the US EPA. Many US states are developing laws governing pore space and landowner rights, post-injection site care, long-term liability, CO_2 pipelines, and other CCS regulations.

In Brazil, the Fuels of the Future Bill 528/2020 was signed into law. The law names the CCS regulatory authority and establishes the legal instrument and obligations for operators to access geologic storage sites.

Asia Pacific & India

CCS is of particular importance in the region as many jurisdictions face the challenge of decarbonising their rapidly growing economies that are dependent upon fossil fuels for a large proportion of their energy and industry. Further, hubs and cross-border projects continue to emerge as the dominant CCS trend in Asia as geological storage resources are not evenly distributed across the region.

Countries including Malaysia and Indonesia are seeking to develop all aspects of the CCS value chain to manage domestic emissions and also to receive CO_2 from other jurisdictions without sufficient geological storage resources, storing it for a fee (Kementerian ESDM, 2023; Malaysian Investment and Development Authority, 2023). Japan, Singapore and South Korea are actively seeking to develop transnational CCS value chains and to export CO_2 for storage in Malaysia, Indonesia or Australia (Carbon Herald, 2023; JOGMEC, 2024; Ministry of Trade and Investment Singapore, 2024).

Asian governments and the private sector are actively and rapidly addressing hurdles to a fully-fledged regional CCS industry. In just the past 12 months, Indonesia, South Korea, and Japan have all released regulatory frameworks, with Malaysia expected to follow suit in late 2024. Multiple agreements are already in place regionally, across both the private and public sectors, to enable geological assessments, feasibility studies, and, eventually, investment. Full regulatory certainty, financing, the monetisation of CCS activities, and the complex international agreements surrounding the transboundary movement of CO_2 remain, making continued collaboration key.

Sectoral trends

A key role for CCS on the road to net zero is its utility in decarbonising hard-to-abate facilities including gas processing, chemical, fertiliser, cement, iron and steel. These are critical sectors for decarbonisation.

Together, the cement, iron and steel sectors contribute 13.5% of human-induced CO_2 emissions (Fennell et al., 2022).

It is essential that these sectors decarbonise, despite the technical and economic challenges. CCS provides the capacity to deliver deep emissions reductions in these industries.

Cement and lime manufacturing

CO_2 is unavoidably produced as an inherent byproduct of the process chemistry of cement and lime production. Additionally, significant emissions are produced from fossil fuel combustion in cement and lime kilns, as the process chemistry requires high temperatures. The volumes involved and the unavoidable nature of the CO_2 produced make CCS a key technology for cement decarbonisation.

There are presently 30 CCS projects in active development in the cement industry, including one operating facility (Qingzhou Oxy-Fuel Combustion Carbon Capture Project in China) and one under construction (Brevik Cement Plant in Norway). These projects are located across Europe, North America and China and have a combined capture capacity of 29 Mtpa. This demonstrates the strong growth of CCS in the cement sector.

Iron and steel

Steel is a globally important industry, providing essential materials for construction, vehicle manufacturing and consumer goods. Historically, iron and steel have relied on fossil fuels to provide essential heat and as a chemical reductant to convert iron ore to iron.

CCS has two pathways to assist decarbonisation of iron and steel. The first is as a retrofit decarbonisation technology for blast furnaces. Blast furnaces represent a substantial fraction of the world's steel production fleet – particularly in China and India. Steel facilities tend to have long lives and it is unlikely these existing plants will be decommissioned for new technologies – hence post-combustion CO_2 capture offers a significant pathway for decarbonisation.

In addition, hydrogen-based ironmaking has been under development. CCS has a pivotal role in the reasonable cost production of hydrogen that could support the operation of these future iron plants.

Presently there is one operational capture unit on an iron and steel plant: the Al Reyadah facility operated by ADNOC at EMSTEEL's facility. Six more CCS projects are in development in the iron and steel sector in North America and Asia Pacific.

Direct Air Capture (DAC)

Direct Air Capture (DAC) has emerged as an area of intense interest for net zero in recent years.

Removing CO_2 directly from the atmosphere is a relatively expensive undertaking compared to point-source capture, but early-stage commercial deployments are already growing in scale, helping improve project economics, prove new process concepts, and make the process more competitive.

A dynamic constellation of new technology companies has emerged to develop novel chemical and physical approaches to direct air capture.

Four commercial DAC facilities – Climeworks' ORCA and Mammoth plants in Iceland, Heirloom's DAC California plant and Heimdal's Bantam facility in Oklahoma – are presently operational, while 16 more facilities are in various stages of development, including two in the construction phase in Oman and the United States.

CO_2/H_2S Injection well in Hellisheidi, Iceland. Image courtesy of Carbfix.

In the US, two DAC hubs, each with a total capacity of 1 Mtpa, have been selected by the Department of Energy (DOE) for significant financial support from a US$3.5 billion funding pool. Additionally, 29 other DAC hub concepts are also receiving DOE support (under US$10 million each).

DAC projects are showing a wide geographic spread including in Africa, reflecting the location flexibility of DAC technology. DAC tends to be located where low-carbon energy is affordable and geological storage resources are of high quality. Unlike point-source CO_2 capture, DAC is not tied to particular industrial sources of CO_2.

Direct Air Capture has emerged as an area of intense interest for net zero in recent years.

3.2 International Policy, Legal and Regulatory Developments

22 Carbon Management Challenge's 22 joiners

A Australia
B Bahrain
Brazil
C Canada
D Denmark
E European Commission
Egypt
I Iceland
Indonesia
J Japan
K Kenya
M Mozambique
N Netherlands
Nigeria
Norway
R Romania
S Saudi Arabia
Senegal
Sweden
U UAE
UK
US

G7

Canada
France
Germany
Italy
Japan
UK
US

International Climate Policy

In the highly anticipated Global Stocktake (GST) decision to transition away from fossil fuels, CCS, particularly in hard-to-abate sectors, was included in the list of zero and low-emissions technologies for countries to act on and accelerate (UNCC, 2024).

The third round of country climate action plans, known as Nationally Determined Contributions (NDCs 3.0), are due in February 2025. With the outcomes of the GST designed to inform the upcoming round of NDCs, how CCS technologies will feature in the last round before 2030 looks promising.

In previous Global Status of CCS reports, the Institute has reported year-on-year incremental growth of countries including CCS in their NDCs. In this critical decade for implementation and in line with current messaging from the United Nations Framework Convention on Climate Change (UNFCCC), this third generation of NDCs will need to integrate CCS project investment plans to send a clear signal to investors and donors.

In 2024, the first round of submissions of Biennial Transparency Reports (BTRs) will include information on each country's national inventory reports (NIR), progress towards NDCs, policies and measures and levels of finance, technology development and transfer, and capacity building needs. The Mitigation Ambition and Implementation Work Programme (MWP) under the UNFCCC will continue its work under the theme "Cities, buildings and urban systems". Through the biannual investment-focused global dialogues, the MWP offers a unique opportunity for continuous government and stakeholder engagement on the diverse application of CCS and its financing.

Last year, the MWP published key findings, opportunities, barriers, and actionable solutions for CCS, which can be built upon as discussions mature.

Aligning with the wider framework of the UNFCCC, the 22 joiners of the Carbon Management Challenge (CMC) could more comprehensively incorporate CCS in their updated NDCs to support their goal of collectively managing 1 Gt or more of carbon management projects annually by 2030. At last year's COP28, the CMC was supported by the UAE Presidency, which co-hosted a high-level ministerial event with the CMC Co-Sponsor Governments of Brazil, Canada, Indonesia, the United Kingdom, and United States, with regionally diverse participation from the governments of Bahrain, China, Iceland, Japan, Kenya, Mozambique, Romania, Senegal, and Sweden, exemplifying opportunities for CCS collaboration and creating bridges between countries with varying national circumstances.

Further reinforcement of the highest levels of government support and global collaboration on CCS came through in the Group of 7 (G7) Climate, Energy and Environment Ministers' meeting in Turin, Italy in April 2024. In the published communiqué, the participants highlighted the outcomes of the GST and mentioned the CMC.

They also noted the importance of carbon management technologies, particularly in hard-to-abate sectors, to reach net zero.

The need to significantly increase the pace and scale of deployment and develop export/import mechanisms for CO_2 were also affirmed.

While the need to advance CCS was acknowledged in these important multilateral venues, financing CCS is still a barrier. With this year's COP29 dubbed "the finance COP", there is an opportunity to integrate CCS into broader fiscal and market mechanisms, tailored across regions and geographies.

A flagship goal for COP29 is an agreement on a new global climate finance goal to support developing countries' climate action, replacing the existing goal of US$100 billion per year (known as the New Collective Quantified Goal on Climate Finance – NCQG).

Related to this, there has been a promising development for CCS finance in the Global South. The Green Climate Fund (GCF), the world's largest climate finance body for developing countries, is funding its first CCS activity in Trinidad and Tobago. Article 6, high on the COP29 Presidency Agenda, is considered a key tool towards enabling the ambition of the Paris Agreement. Article 6 provides for a UN carbon crediting mechanism that allows countries to implement their NDCs more affordably and collaboratively. Negotiations continue after two years of rejected proposals to operationalise Articles 6.2 and 6.4, based on outstanding governance and technical issues. A comprehensive commentary on Article 6 and CCS after COP28 has been published by the King Abdullah Petroleum Studies and Research Centre (KAPSARC, 2024a).

For CCS, these governance and technical issues include guidance and methodologies on CO_2 removal and storage which has so far been rejected due to concerns related to environmental and social safeguards, potential CO_2 reversals, and differentiating between land-based and engineered removals. To begin addressing some of these accounting methodological issues, the IPCC held an Expert

The importance of CCS is recognised at the highest levels including by the G7 Climate, Energy and Environment Ministers in April 2024.

CapsolGo® at EEW Energy from Waste plant in Hanover, Germany. Image courtesy of Capsol Technologies.

Meeting on CDR Technologies and CCS in July 2024 and they are planning to clarify and update national GHG inventory methodologies (KAPSARC, 2024b). It is important to note that national GHG inventory methodologies have been in place for CCS since 2006.

Shifting towards greater collaboration

The strengthening of international policy commitments and national policy ambitions for carbon management, together with closer examination of the commercial opportunities for projects, has increased collaborative activities between national governments aimed at more widespread geographical deployment of the technologies.

For example, in Europe, the adoption of the Industrial Carbon Management Strategy has further strengthened the European Union's commitment to CCS, carbon capture and utilisation (CCU) and CDR as central to the success of the EU's decarbonisation effort. The Commission's engagement and collaboration with Member States includes the development of an EU-wide CO_2 transport infrastructure planning mechanism, permitting pathways, and an investment atlas of potential CO_2 storage sites.

Globally, several other national governments have announced similar bilateral initiatives. (see Figure 2.0-1) These agreements position carbon management activities as central to actions aimed at addressing climate change, energy security, and net-zero targets.

The potential for the transboundary movement of CO_2 is a critical factor in this dialogue and agreement between nations. Within the auspices of the London Protocol, an international agreement focused on ocean dumping that addresses the legal implications of transporting captured CO_2 across territorial boundaries, several governments across Europe and South-East Asia have completed or are in the process of negotiating bilateral agreements and declarations to support transboundary CCS operations.

Strengthening national policy commitments

In addition to the policy developments undertaken in international platforms, national governments have continued to strengthen and expand their domestic commitments to deployment of carbon management technologies. Several countries have strengthened existing policy frameworks and launched new initiatives, seeking to promote greater recognition and investment in these technologies.

Among the nations that were early movers on CCS, national and sub-national policy activities continue to build on many of the previously announced policy initiatives and programmes. Activities include commitments to expand funding for individual projects or technical applications, new incentive schemes to support deployment, targeted policy commitments for deployment and collaboration, and the strengthening of domestic legal and regulatory regimes for carbon management.

In the US, the federal government continues to strongly support carbon management. Federal funding for carbon management has been strengthened further by recent federal and state-level legislative activities aimed at addressing a variety of discrete issues including permitting, pipeline siting, and access to tax credits.

Scandinavian governments have continued to advocate for closer collaboration with their neighbouring states, signing partnerships and formal arrangements to support cooperative activities and transport of captured CO_2 between nations.

In the UK, the government highlighted its ambitions for CCS as a high-value national asset when it released its 2023 plan for the CCS sector beyond 2030.

The government set out several strategies for realising these aspirations and ensuring the technology will play a vital role in achieving the UK's 2050 net-zero target. New funding support, including up to £21.7 billion for two CCS clusters announced in October 2024 and licensing regimes for CO_2 transport and storage have underpinned this commitment.

Across the Global South, similar policy commitments are emerging, with policymakers and regulators announcing new initiatives, funding support, and legislative packages.

In China, for example, the government has launched an Advanced Green and Low-Carbon Program and Carbon Emission Reduction Facility, which includes funding support for CCS projects through investments from the central budget and monetary and tax policy incentives.

In other regions, national governments have made explicit commitments to carbon management technologies as part of their climate and energy policies. In the Middle East, the government of the United Arab Emirates has emphasised CCS in the nation's Decarbonisation Roadmap and Long-Term Strategy, and particularly its role in decarbonising the industrial sector.

In Oman, the Ministry of Energy and Minerals announced a formal Memorandum of Cooperation with local energy companies on CCS and low carbon hydrogen and has recently commenced a work program to design the nation's regulatory framework for CCS.

Strengthened international policy commitments and national policy ambitions for carbon management, together with closer examination of the commercial opportunities for projects, has increased collaborative activities.

Developing Appropriate Laws and Regulations

Legal and regulatory frameworks to implement national policy commitments and facilitate project deployment are critical for successful deployment of carbon management technologies. Over the past 12 months, governments worldwide have emphasised their desire to strengthen their policy and regulatory regimes or take preliminary steps in the design of CCS-specific legislation.

As noted above, for several first-mover nations, there has been a focus on the expansion, refinement, or completion of domestic legal and regulatory regimes.

In the US, the Environmental Protection Agency (EPA) remains focused on permitting wells operating under Class VI of the Underground Injection Control (UIC) Program. The Pipeline and Hazardous Materials Safety Administration (PHMSA) is evaluating rules governing CO_2 pipelines and plans to propose new requirements later in 2024 and the Department of Interior is planning to propose regulations for CO_2 storage offshore.

The US federal government also launched CCS permitting task forces to improve the performance of the permitting process and regional coordination to promote the efficient, orderly, and responsible development of CCS projects, including CO_2 pipelines (US DOE FECM, 2024).

Governments worldwide are strengthening and developing their policy and regulatory regimes to support CCS deployment.

There are subnational (state) legislative activities underway across the US to implement and expand on federal authorities and address issues around siting, long-term liability, and public engagement.

Similarly, in Europe, national regulators in the UK and Norway are building on their early legal and regulatory frameworks and refining permitting processes to ensure alignment with early project experience and to implement transboundary CCS value chains.

In both nations and across the EU more broadly, these developments focus on regulatory approaches that seek to attract private sector investment and improve investor confidence.

In Australia, state and Commonwealth regulators have addressed some of the remaining barriers to deployment for projects in the country. The state of Western Australia passed the Petroleum Legislation Amendment Bill 2023, a detailed regulatory regime that will regulate onshore and offshore CCS activities.

The Commonwealth government has introduced legislation to implement the country's London Protocol commitments and support Australia's import and export of CO_2 within a new permit regime. Both developments have been long-awaited by project proponents in Australia and will further bolster investor and industry confidence across the region.

In jurisdictions across the Middle East, South America, and South-East Asia, policymakers and regulators are now taking steps to develop legal and regulatory frameworks for carbon management. A broad array of activities is underway in these countries, ranging from storage capacity assessments and training of national regulators to commissioning technical studies and promulgating CCS-specific frameworks.

For many countries, these initiatives represent the first engagement in regulating CCS, and there has been a rise in regulatory capacity building projects aimed at addressing this challenge.

Axens DMX™ Carbon Capture Technology Demonstration plant at Arcelor Mittal Dunkirk, France. Image courtesy of Axens.

Several governments have sought support and guidance from first-mover nations and organisations with experience in designing CCS- specific law and regulation. The work of the US government's Commercial Law Development Program (CLDP) is a notable example.

The publication of the CLDP's CCUS Handbook in May 2024 offers a practical overview of policies, rules, and proven approaches that countries may adopt in their own regulatory frameworks.

In some jurisdictions, policymakers and regulators have moved beyond these preliminary steps and have completed, or are in the latter stages of developing, CCS legal and regulatory frameworks. In the Asia Pacific region, where there is a strong focus on enabling transboundary CCS value chains, legal and regulatory frameworks are being developed to facilitate hub development and enable CO_2 import and export activities.

A new legal and regulatory framework regime in Indonesia, as well as those in development in Japan, South Korea, and Malaysia, represent important steps in supporting these ambitions.

3.3 CCS Business Models and Finance

The business case for CCS investors depends upon regulations that price or limit CO_2 emissions, policies that create direct financial incentives for capturing and storing CO_2, or a combination of both.

GSR 2023 details policy tools that can accelerate deployment (Global CCS Institute, 2023). Such enabling policy would create CCS business models for capital to leverage.

The following summary of projects in development shows that derisking, in the form of long-term direct or indirect public sector support, is imperative for successful and accelerated CCS infrastructure deployment.

In recent years, substantial momentum has been achieved in supportive CCS policy and regulation in certain jurisdictions. In the US, the Inflation Reduction Act (2022) and the Infrastructure Investment and Jobs Act (2021) provide funding and enhanced tax incentives for CCS. In the EU, Emissions Trading System (ETS) revisions in May 2023 provided support for the EU's carbon price – the main lever for climate change mitigation. These were followed by policy initiatives, including direct government or national energy company initiatives in the Middle East and China, and the development of policy frameworks in the APAC region.

While such policy initiatives have improved financing prospects, the incentives were partially offset by cost inflation, high interest rates, time overruns caused by longer lead times, and permitting delays for some jurisdictions and some projects. The erosion of the EU-ETS price and political uncertainty about the carbon tax in Canada elevated risk factors in those jurisdictions. In the US, the lack of inflation adjustment until 2027 for the 45Q subsidy partly eroded the appeal of CCS business models.

Due to eroding project economics and rising risks such as permitting delays, the initial spike in projects shows signs of slowing down. Some notable examples are the delays or cancellations of CO_2 pipelines in the Midwest US, the slowdown in greenfield low-carbon hydrogen/ammonia projects awaiting offtake agreements with export markets, and the delays and cancellations in CCS on power projects such as Capital Power's cancellation of the Genesee project in Canada without a long-term offtake.

In such an environment, it is unsurprising that the initial projects that reached final investment decision (FID), or have the prospects to do so, benefited from further government derisking and underwriting policies.

Carbon Contracts for Difference (CCfD) schemes, government offtakes, investment tax credits, or direct capital injection are examples of derisking tools in the EU and Canada. In addition to tax credits, the US government provides support via low-cost government loans, and direct grants.

For example, at the time of writing, Wabash Valley Resources, a zero-carbon fertiliser project using petcoke as feedstock, is readying to take FID. The project has received $38 million funding for FEED studies from the US DOE and expects further financial support from the DOE Loan Program Office (LPO).

Whilst direct financial support is essential, governments can also substantially reduce risk by implementing clear, predictable and efficient permitting and approval processes for CCS.

Enterprise Pilot operating with ION Clean Energy's ICE-31 capture technology at the Lost Mendanos Energy Centre in Pittsburg, CA. Image courtesy of ION Clean Energy and Calpine.

A bright pocket in the US is the DAC space benefiting from the demand for DAC carbon credits in the voluntary carbon markets by big tech, government funding, and 45Q tax credits.

Such projects are DAC hubs bringing together technology providers (such as Climeworks, Stratos, and 1PointFive), institutions such as Battelle, and transport and storage infrastructure and strategic investors such as Occidental and Chevron. Proponents of the projects expect technological advancements and decreasing costs to enable scaling. All these projects require substantial government funding.

Other progressing US projects are low-cost capture facilities, mostly in ethanol and gas processing, with sequestration nearby to minimise transportation and storage costs. They include Blue Flint, Red Trail, and Grey Rock's Vault project, with Alto Ingredients as the ethanol producer (Alto Ingredients, 2024). The project developers also developed sequestration sites close to the emitters.

Canada is another good example of how public sector derisking accelerates investments. Canada's investment tax credit (ITC) covers 50% of the capital expenditure, and Alberta's grant program another 12%. In addition, the Canada Growth Fund (CGF), a CA$15 billion federal public fund, makes direct equity investments and provides CO_2 offtake agreements. Entropy, an integrated technology provider and project manager, secured a 15-year offtake agreement to capture 3 million tonnes of CO_2 from industrial emitters with CGF. Furthermore, the Canada Growth Fund made a CA$200 million direct investment. Entropy took FID for Glacier 1 and 2 projects and a CCS on a gas-fired power turbine. Strathcona, an oil and gas producer, received a direct investment commitment of up to CA$1 billion from CGF, 50% of capital expenditure.

The ITC will accrue to Strathcona, so the upfront investment is completely de-risked. The CGF, Gibson Energy, and Varme Energy (majority owned by Green Transition Holding of Norway) announced a strategic partnership to develop a municipal waste-to-energy plant with CCS; CGF provides 15-year offtake for 200,000 tonnes of CO_2 annually. Wolf Midstream secured a CA$200 million term loan credit facility for its CCS pipeline investments under the Export Development Canada Sustainable Finance Guarantee program, which backstops the loan. In the Netherlands, the Porthos project started construction in April 2024 thanks to three state-owned enterprises Gasunie, Port of Rotterdam, and EBN underwriting transport and storage costs, which have almost tripled from an estimated EUR 400-500 million to EUR 1.3 billion (Ranevska, 2024). In addition, the Dutch government is providing a CCfD, effectively a CO_2 offtake agreement, at an estimated EUR 86 per tonne for the project's customers.

In Norway, the Norwegian government provided NOK 16.8 billion of the total NOK 21.1 billion capital expenditure for project Longship, a cross-border open access CO_2 transport and storage project, and Longships' first customer, Yara, will receive a EUR 30 million subsidy to make the CCS investment in its Netherlands ammonia plant. Brevik Norway (Norcem) capture project by Heidelberg, which was expected to cost NOK 1.15 billion, is almost entirely funded by the state (ESA, 2020). In the UK, the Teesside hub, which includes a CCS facility on the NGCC power plant, is expected to cost US$5 billion and be funded by the UK Government's US$25 billion CCS facility, either directly or through loan guarantees (Energy Intelligence, 2024).

In the Middle East, the current and announced projects are funded by national oil companies. This includes the Abu Dhabi National Oil Company's Habshan project, which reached FID last year (ADNOC, 2024). The drivers include low-carbon hydrogen and ammonia and low-carbon power. The Al Jubail hub, a JV between Aramco, Linde, SLB, and QatarEnergy provides examples of potential business models. Most, if not all, projects in the region are expected to receive direct government or national oil company funding, but the exact mechanisms have not been announced.

CCS deployment in China continues to scale. China Energy has had a 0.5 Mtpa capture facility running since June 2023 on one of the most efficient coal-fired power plants. China Huaneng is constructing a 1.5 Mtpa CCS project at a fully integrated new build coal facility. Sinopec built the Qilu megatonne project in 2022. All these projects are undertaken by state-owned enterprises and the funding source is not publicly available. One notable policy tool from the People's Bank of China is the carbon emissions reduction facility, providing low-cost funds to decarbonisation projects from 2021 to 2024.

This brief but non-exhaustive list clearly shows that without a mandate or strong carbon price signals, CCS projects and infrastructure rely on direct or indirect public sector funding to derisk investment in addition to supportive policy and financial incentives.

Without a mandate or a firm global carbon price, CCS projects and infrastructure rely on direct or indirect public sector funding to derisk investment in addition to supportive policy and financial incentives.

Brevik CCS facility in Brevik, Norway. Image courtesy of SLB Capturi.

Advantage Glacier Gas Processing Facility with Entropy's Integrated (iCCS™) and Modular (MCCS™) Carbon Capture Technology in Canada. Image Courtesy of Entropy Inc.

Potential Tailwinds for CCS Business Models

The recent developments in power markets as baseload power demand projections increase substantially and the demand for high-quality carbon credits can act as potential tailwinds for CCS business models as CCS ticks both boxes: CCS is one of the tools to provide low-carbon dispatchable power and it can deliver high quality, measurable carbon credits.

According to the International Energy Agency (IEA), the power sector accounted for the largest share of global emissions (42%) in 2022 or 14.65 gigatonnes of CO_2 (IEA, 2023). For decades, power demand growth was primarily driven by developing countries like China, India and Brazil -- in the US over the last 20 years, electricity demand has grown only around 0.5% per year and in Europe has barely changed (IEA, 2020). However, policies driving the push for electrification across all sectors and the exponential demand growth from data centers have changed the situation.

The US Energy Information Administration (EIA) expects total US generation to grow by 3% in 2024 and 1% in 2025 (EIA, 2024). McKinsey expects global demand growth to be between 3-4% annually between 2022 and 2050 (McKinsey & Co., 2024).

While renewables and batteries are expected to meet a large portion of the demand, governments, regulators, utilities, and consumers are realising the importance of grid reliability and the limits of intermittent power supply and, hence, the need for dispatchable and baseload supply such as nuclear or natural gas power plants. This is especially true for fast-growing demand from AI data centers, even with generous, built-in assumptions of electricity efficiency. CCS has a significant role to play, as indicated by Google's September 2023 paper, The Corporate Role in Accelerating Advanced Clean Electricity Technologies, which indicates CCS as part of the solutions set (Google, 2024a).

Regulatory drivers can also be an effective policy tool to accelerate CCS project deployment. The EPA designated CCS as the Best System of Emission Reduction (BSER) and in April 2024 released a final rule mandating CCS for new baseload natural gas combined cycle (NGCC) power plants with a capacity factor higher than 40% and existing coal fired plants. EPA power rules can accelerate the deployment of CCS, meeting the growing demand for clean baseload power and ensuring the grid's reliability (US EPA, 2024).

The need for CCS on gas turbines is not limited to the US; the rest of the world is also warming up to the proposition, with the UK's support for the Teesside project and the recent proposal in Germany considering CCS on natural gas-fired power plants (Wehrmann and Wettengel, 2024). The draft legislation will now be forwarded to the Bundestag for discussion in the parliamentary procedure. CCS deployment on coal fired power plants remains of interest in China and South- East Asia.

Demand for high-quality removals credits

The increasing demand to offset emissions is also a driving force for durable, high quality carbon credits as a supplement when purchasing sufficient low or no carbon energy is not feasible. Such demand is led by the high margin and fast growth companies needing to compensate for their data center emissions. Demand initially started with DACCS credits and has now spread to BECCS credits: Microsoft recently signed offtake agreements for two energy projects with CCS: one in Denmark with Orsted (3.67 million tonnes over 10 years) and the other in Sweden with Stockholm Exergi (3 million tonnes) (Kimball, 2024; Saptakee, 2024). Google set aside US$35 million for CDR credits in response to the US DOE Voluntary Carbon Dioxide Removal Purchasing Challenge (Google, 2024b).

The EU, the UK, and Japan are forging ahead with their own initiatives to encourage and integrate CDR credits in meeting their climate targets.

The US administration issued its Voluntary Carbon Markets Joint policy statement and principles. (EU Council, 2024; Quantum Commodity Intelligence, 2024; White House, 2024).

These credits add incremental and essential revenue streams to CCS business models, increasing the projects' scale and bankability.

As voluntary carbon markets mature, quality credits could provide support for other applications such as in the industrial and power sectors.

Sustainability, transition, and green bonds

Sustainable finance aims to increase funding and decrease the cost of capital for sustainable investments. However, green and climate bond certification processes are generally not standardised and have historically not included CCS.

Recent examples of corporates issuing green or sustainability bonds for CCS include Air Liquide, Dow Chemicals and Air Products. Issuing green or sustainability bonds to help finance CCS projects appropriately recognises the essential role of CCS in mitigating climate change.

Multinational development banks

Financing climate action is vital for developing and supporting the people who are most vulnerable to the impacts of climate change. However, fiscal constraints make it challenging to find the resources. Multinational Development Banks (MDBs) are established to help ease budgetary constraints in developing countries.

MDBs consist of member nations from developed and developing countries. Five major MDBs are the World Bank and four regional development banks: the African Development Bank (AfDB), the Asian Development Bank (ADB), the European Bank for Reconstruction and Development (EBRD), and the Inter-American Development Bank (IDB) (Congressional Research Service, 2023).

The World Bank, the largest MDB provided and mobilised US$38.6 billion in climate finance, representing 41% of its commitment of US$95 billion in credits, loans, and grants in 2023 (World Bank, 2023).

Of the total funding, little was provided to fund CCS. The World Bank's CCS trust fund, which was established in 2009 and disbursed a cumulative US$15.9 million for capacity building technical assistance, has recently closed.

Increasing MBD support for CCS will be pursued by the Carbon Management Challenge, and more countries' support for the initiative and their active engagement can help to increase MDBs' allocation of resources to CCS investments. Greater inclusion of CCS in country-specific NDCs can also help drive MDB support.

Such funds, like the CCS trust fund, would help finance activities such as writing legislation, CO_2 storage resource assessments, techno-economic modeling, feasibility studies, and small-scale demonstration projects.

The importance of CCS in the power sector enabling decarbonisation while ensuring grid stability and reliability cannot be overstated.

Northern Lights ship launch in April 2024. Image courtesy Northern Lights JV.

Table 3.3.1
Recent Notable Deals
(Table continues on next page)

Private capital

Private capital available for CCS deployment comes primarily through corporate balance sheets as project debt finance is not yet available.

That said, the momentum in equity investments and mergers and acquisitions indicates rising interest from diverse financing sources, including pension plans, infrastructure funds, venture arms of oil and gas companies, and private equity. Increasing interest from such a diverse set of investors indicates the potential of CCS as a commercially viable decarbonisation technology. Examples of deals the Institute has identified are provided in the following table.

EQUITY INVESTMENTS

Key Parties	Description	Investors	Investor Type	Size	Date
Svante	Carbon capture technology	Canada Growth Fund	Canadian Government investment vehicle	US$100 million	15-Aug-24
44.01	Carbon Dioxide Sequestration (Mineralisation)	Equinor Ventures Shorooq Capital (UAE)	Corporate Venture Capital Venture Capital	US$37 million	15-Jul-24
Neustark	Carbon Dioxide Removal (Mineralisation)	Decarbonization Partners Blume Energy	Blackrock and Temasek (Growth Equity) Venture Capital / Climate Tech	US$69 million	25-Jun-24
Air Products - Aramco	Aramco agreed to invest in the Jubail based Blue Hydrogen Industrial Gases Company, owned by Air Products Qudra	Low Carbon Hydrogen	Aramco will own 50% of the Blue Hudrogen project in Jubail and will have an option to offtake	Not Disclosed	17-May-24
ION Clean Energies	Post-combustion, point-source capture technology (Liquid amine system) (Post-combustion amine)	Chevron New Energies Carbon Direct Capital	Corporate Venture Capital Venture Capital	$US45 million	4-Apr-24
SLB - Aker Carbon Capture	SLB will acquire 80% of Aker Carbon Capture	CO_2 Capture and Sequestration	Provides SLB the opportunity to support accelerated industrial decarbonisation at scale	~US$400 million	27-Mar-24 (Announced)
Total - Talos	TotalEnergies acquired 100% of Talos Low Carbon Solutions	CO_2 Transportation and Storage	Provides TotalEnergies 25% share in the Bayou Bend (USA) project	US$148 million	18-Mar-24
Avnos (Series A)	Direct Air Capture	Shell Ventures Safran Corporate Ventures Rusheen Capital Mgmt NextEra Energy Envisioning Partners	Venture Capital Corporate Venture Capital Private Equity Utility Private Equity	US$36 million	6-Feb-24
Entropy	Carbon capture technology	Canada Growth Fund	Canadian Government investment vehicle	C$200 million	20-Dec-23

Source: various media reporting, publicly available analytical reports and Crunchbase

Table 3.3.1
Recent Notable Deals (Continued)

MERGERS & ACQUISITIONS

Key Parties	Description	Industry Vertical(s)	Rationale	Size	Date
Occidental - Carbon Engineering	Direct Air Capture	Direct Air Capture	Provides Occidental, through its 1PointFive subsidiary, the opportunity to advance DAC technology and accelerate deployment of DAC as a carbon removal solution	US$1,100 million	3-Nov-23
ExxonMobil - Denbury	ExxonMobil acquired Denbury Inc. in an all-stock transaction	CO_2 Transportation and Storage	Provides ExxonMobil's Low Carbon Solutions Business the opportunity for growth supported by Denbury's existing CO_2 pipeline and storage infrastructure	US$4,900 million	2-Nov-23
SK Capital Partners - Milestone Environmental Services	SK Capital Partners acquired Milestone Environmental Services, LLC from Amberjack Capital Partners, L.P.	CO_2 Storage	Provides SK Capital the opportunity to further progress towards becoming a leader in CCS and other related markets	Not Disclosed	4-Oct-23
Equinor - Carbonvert	Equinor acquired Carbonvert's 25% share in the Bayou Bend Project	CO_2 Transportation and Storage	Provides Equinor 25% share in the Bayou Bend (USA) project	Not Disclosed	28-Aug-23
Carbon Upcycling Technologies (Series A)	CO_2 Utilisation	Oxy Low Carbon Ventures CRH Ventures Climate Investment Clean Energy Ventures Clean Energy Venture Group Cemex Ventures BDC Venture Capital BDC Capital Climate Tech Fund Amplify Capital	Corporate Venture Capital Venture Capital Venture Capital Venture Capital Angel Group Corporate Venture Capital Venture Capital Venture Capital Venture Capital	US$26.1 million	31-Jul-23
Buckeye Partners - Elysian	Buckeye Partners acquired Elysian Carbon Management from EnCap Flatrock Midstream	CCS as a Service	Provides Buckeye the opportunity to grow its infrastructure and logistics solutions for the energy transition	Not Disclosed	17-Jul-23
Avnos (Pre-Series A)	Direct Air Capture	Shell Ventures JetBlue Partners ConocoPhillips	Venture Capital Corporate Venture Capital Energy	US$80 million	13-Jul-23

Source: various media reporting, publicly available analytical reports and Crunchbase

4.0

REGIONAL OVERVIEWS

4.1 Americas

Overview

The Americas region continues to lead the world in CCS facility deployment, with 27 projects in operation and 18 commencing construction across the US, Brazil, and Canada in the past year. The US remains the global facility leader with 19 projects in operation, due in part to the strategic and durable policy support established by its federal government.

In addition to the recent historic federal funding provided by the 2021 Bipartisan Infrastructure Law (BIL), the 2022 Inflation Reduction Act (IRA), and the 2022 CHIPS & Science Act, several US Department of Energy offices and programs have been supporting CCS technology deployment for decades. For example, DOE's CarbonSAFE initiative has invested in nearly 20 years of research, development, and demonstration of safe geologic storage of CO_2 in the US – unique among national governments.

US leadership in CCS policy and facility deployment is bolstering collaborative partnerships with Canada, Brazil and other countries on international decarbonisation initiatives, including the Carbon Management Challenge, the Clean Energy Ministerial, and Mission Innovation. The US also has bilateral CCS collaboration with various countries including China and in November 2023 announced the bilateral Sunnylands Statement to advance at least five large-scale cooperative CCUS projects in each country by 2030 (US Department of State, 2023).

At the sub-national level, US states are collaborating to develop and strengthen CCS policy and carbon markets.

At the sub-national level, US states are collaborating to develop and strengthen CCS policy and carbon markets.

For example, Colorado and Wyoming in June 2023 signed an MoU establishing a partnership on DAC activity and development (State of Colorado, 2023), while California and Washington in March 2024 issued a joint statement with the Canadian province of Québec expressing shared interest in linking carbon markets between the three jurisdictions (State of Washington, 2024).

A combination of carbon management policy mandates and incentives is driving project deployment across the region. Canada's federally mandated minimum carbon price has increased to CA$80/tonne and its parliament has established a federal CCUS investment tax credit. In the US, new regulations by the US EPA will require CCS implementation across some coal and gas-fired power plants.

CCS facilities are being developed across diverse industrial sectors in the Americas including power generation and cement manufacturing, but ethanol, fertiliser, and gas processing facilities have been the early movers, benefitting from lower capture costs.

Projects with higher capital and capture costs are facing macroeconomic headwinds. Persistently high interest rates and the inflationary pressures of 2022 and 2023 have increased capital costs and eroded the value of tax incentives. In Canada, Capital Power Corporation in May 2024 determined its Genesee natural gas-fired power plant CCS project was technically viable but not economically feasible (Snowdon, 2024).

However, some carbon management infrastructure projects in the US are beginning to take shape despite localised resistance to CO_2 pipeline development. Developers are

27

Facilities in operation across US, Canada & Brazil

310

facilities in construction or early/advanced development

Canada hikes minimum price on carbon pollution to CA$80/t and will increase to CA$170/t by 2030

US leadership in CCS is

- bolstering bilateral and multilateral partnerships
- fuelling collaboration between US states

BIL

The US Bipartisan Infrastructure Law (BIL), less commonly known as the 2021 Infrastructure Investment and Jobs Act, (IIJA), assigns $12.5 billion for carbon management, including $50 million for Secure Geologic Storage Permitting and $8 billion for Regional Clean Hydrogen Hubs

IRA

Section 45Q of the US tax code provides a credit for carbon dioxide sequestration of:

- **$60/tonne for CO_2** utilisation or secure CO_2 storage in oil fields through enhanced oil recovery from industrial and power generation facilities
- **$85/tonne for CO_2** storage in saline geologic formations from industrial and power generation facilities
- **$130/tonne for CO_2** utilisation or secure CO_2 storage in oil fields through enhanced oil recovery from direct air capture facilities
- **$180/tonne for CO_2** storage in saline geologic formations from direct air capture facilities

US EPA Underground Injection Control Program (UIC)

Regulates the construction, operation, permitting, and closure of injection wells used to place fluids underground for storage or disposal. UIC Class VI wells are geologic sequestration wells used to inject CO_2 into deep geologic formations for storage.

North American coal-fired power plants with CCS

Canada
SaskPower Boundary Dam

US
Petra Nova Carbon Capture

building community buy-in through collaboration and engagement while working to overcome permitting complexity. Tallgrass received approval from the Federal Energy Regulatory Commission (FERC) in October 2023 to convert its Trailblazer Pipeline in Nebraska from natural gas to CO_2 service and in April 2024 established a community benefits agreement with a state-based community group providing funding to nonprofits, first responders and landowners in the region, as well as provisions for royalty payments to landowners on the pipeline route.

Policy

United States

Policy incentives and funding from BIL, IRA and the CHIPS & Science Act continue to catalyse CCS deployment in the US. Nearly US$2.2 billion of the BIL's US$12.5 billion appropriations for carbon management have been awarded or are in negotiations. This is in addition to US$8 billion awarded or under award negotiations for regional clean hydrogen hubs (Figure 4.1-1). The IRA increased the dollar value of tax credits for geologic storage of CO_2, lowered carbon capture thresholds to qualify for tax credits, and added provisions for direct pay and tax credit transferability, while the CHIPS & Science Act provided new funding for CCS research.

Durable federal-level policy tools and regulations have partially shifted new CCS policy development to the states. Several US states are building legal and regulatory frameworks for CCS that address issues such as pore space ownership, long-term liability, financial assurance, and CO_2 pipeline development. However, CO_2 pipeline projects have received scrutiny and struggled to gain social acceptance in some communities, manifesting in new state laws relating to CO_2 pipelines. South Dakota passed bills to develop a landowner bill of rights and Illinois became the second US state behind California to pass a state law pausing pipeline development until federal regulators propose new requirements.

At the federal level, the EPA issued New Source Performance Standards (NSPS) for GHG emissions from existing coal-fired and new base-load gas-fired power plants (US EPA, 2024a), which mandates plants capture 90% of their CO_2 emissions by 2032 and identifies CCS as the best system of emission reduction (BSER) for long-term coal plants and new gas-fired plants operating at >40% capacity.

The queue of Class VI injection well permit applications is robust and growing. The EPA released a permit tracker dashboard that shows 49 projects with 148 applications under review in 15 US states and one tribal nation in August 2024; however, an additional 39 projects with 83 applications are under review in states with Class VI primacy (WY, LA, ND). The largest number of projects and applications (16 and 65, respectively) is in Louisiana, which received Class VI primacy in December 2023.

Investment and policy support for voluntary carbon markets (VCMs) is increasing. In March 2024, DOE launched the Voluntary Carbon Dioxide Removal Challenge to increase voluntary purchases of high-quality Carbon Dioxide Removal (CDR) credits, transparency of voluntary CDR credit purchases and recognition of both CDR credit buyers and high-quality CDR credit suppliers (US DOE, 2024).

Industry responded quickly, with Google announcing a pledge of at least US$35 million of CDR credit purchases over the next 12 months (Google, 2024).

1PointFive in July 2024 announced an agreement with Microsoft to sell 500,000 tonnes of CDR credits over six years, complementing earlier CDR purchase agreements with AT&T and Trafigura (1PointFive, 2024).

In March, Red Trail Energy became the first ethanol production facility to generate VCM credits on the Puro.Earth registry (Businesswire, 2024).

The US government in May 2024 also released a joint policy statement and principles for responsible participation in VCMs that provides seven principles focusing on carbon credit integrity, including protections for climate and environmental justice, carbon credit use, and market-level integrity, as well as facilitating efficient market participation and lowering transaction costs.

The queue of Class VI injection well permit applications is robust and growing. The EPA released a permit tracker dashboard that shows 49 projects with 148 applications under review in 15 states and one tribal nation in August 2024.

Canada

Canada's federally mandated minimum price on carbon pollution, established under the 2018 Greenhouse Gas Pollution Pricing Act (GGPPA), increased by CA$15/tonne to CA$80/tonne on April 1, 2024. Though provinces have different approaches to pricing carbon under the GGPPA, all programs must meet the federal benchmark (CA$80/tonne), which is scheduled to escalate by CA$15/tonne annually to reach CA$170/tonne by 2030 (Government of Canada, 2024c).

Eligible projects in Canada can benefit from several federal and provincial incentives. The Canadian Parliament in June 2024 also passed Bill C-59 that included an investment tax credit (ITC) for CCUS projects. The ITC will cover qualified projects capturing carbon that

would otherwise be released to the atmosphere, capturing carbon directly from the atmosphere (DAC), carbon transportation projects, and carbon storage or utilisation projects. Credit rates vary depending on the project, and EOR is not an eligible use for captured CO_2 (Government of Canada, 2024a).

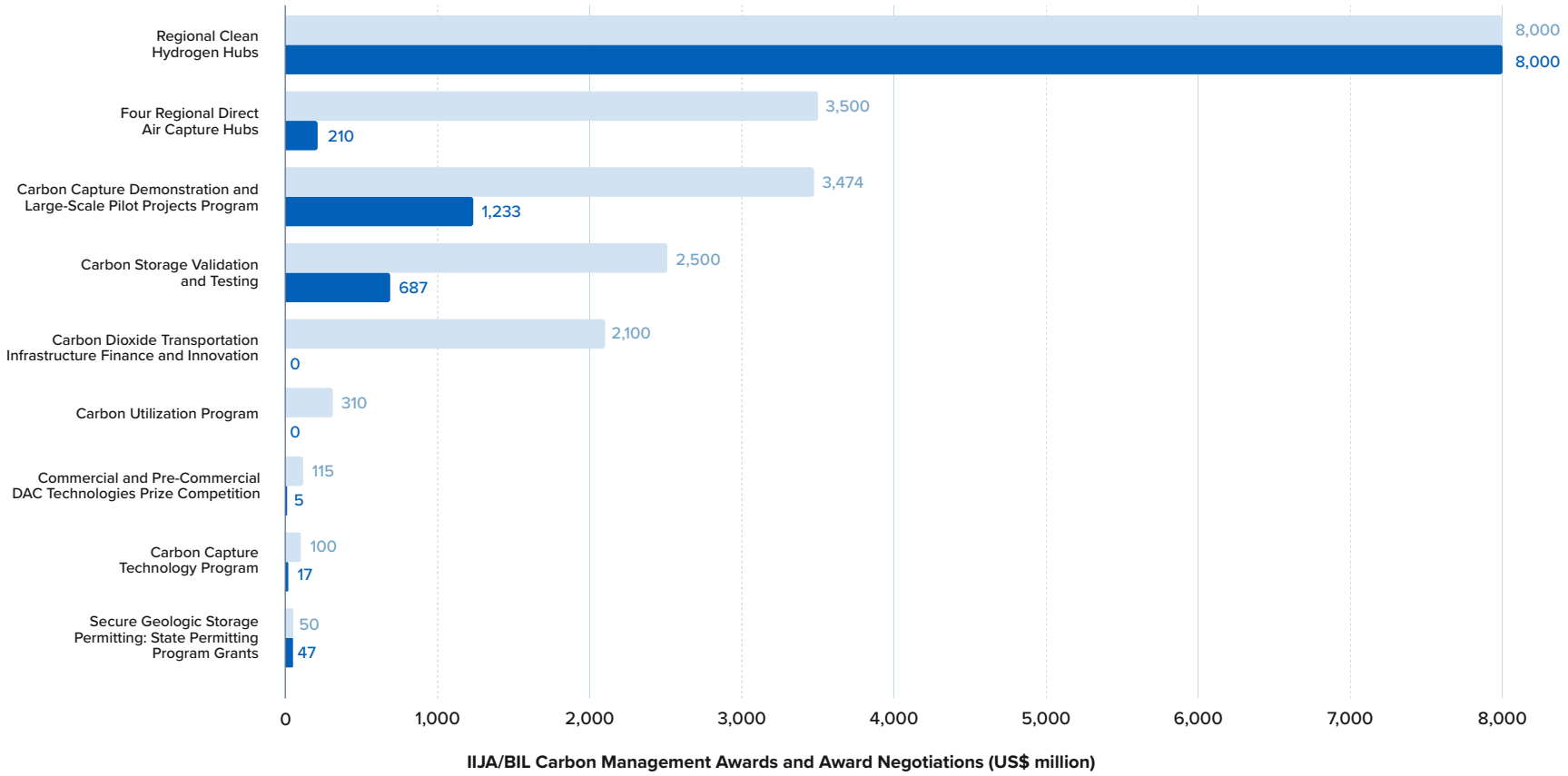
In Canada's Fall Economic Statement (November 2023), the Canada Growth Fund was announced as the principal federal entity to issue carbon contracts for difference (CCfD), which guarantee a fixed minimum price of carbon. Up to CA$7 billion of CGF's $15 billion in capital can be allocated to CCfDs.

In June 2024, the CGF established its second offtake agreement (a form of CCfD) for Varme Energy Inc.'s waste-to-energy plant project in Edmonton (Government of Canada, 2024b). The first offtake agreement was established in 2023 for Entropy Inc.'s Glacier Phase 2 project (Government of Canada, 2023). Other significant CGF investments include the July 2024 agreement with Strathcona to split initial capital costs of Strathcona CCS infrastructure on a 50/50 basis, up to CA$1 billion (Strathcona, 2024).

Provincial incentives include transferrable royalty credits in Saskatchewan and the Alberta Carbon Capture Incentive Program (ACCIP),

Figure 4.1-1

Status of funding for carbon management programs in the Infrastructure Investment and Jobs Act (IIJA)/BIL as of June 2024.



Nearly US$2.2 billion has been awarded or is under negotiation for carbon management, in addition to US$8 billion awarded or under negotiation for Regional Clean Hydrogen Hubs

*Additional Funding Opportunity Announcements (FOAs) are still open and not included.

launched in November 2023 and designed to work in parallel with the federal CCUS ITC. The ACCIP will provide a grant of 12 percent for new eligible CCUS capital project costs (Government of Alberta, 2023).

Brazil

Brazil has the potential to become a regional and global hub for CCS, given its geological storage resource base and skilled energy industry workforce.

CCS activity in Brazil has largely been limited to the Santos Basin pre-salt injection operation by Petrobras but momentum is building to expand CCS operations, driven in part by strong interest from the agricultural sector in BECCS. The National Agency for Petroleum, Natural Gas, and Biofuels (ANP), Petrobras, CCS Brasil and others have been collaborating with the government to establish a legal and regulatory framework for CCS.

Brazil achieved a major milestone on 8 October 2024 when the Fuels of the Future Bill 528/2020 was signed into law. The law names ANP as the CCS regulatory authority and establishes the legal instrument and obligations for operators to access geologic storage sites. Brazil is the first South American country to enact CCS-specific legislation, providing a benchmark framework for other South American nations.

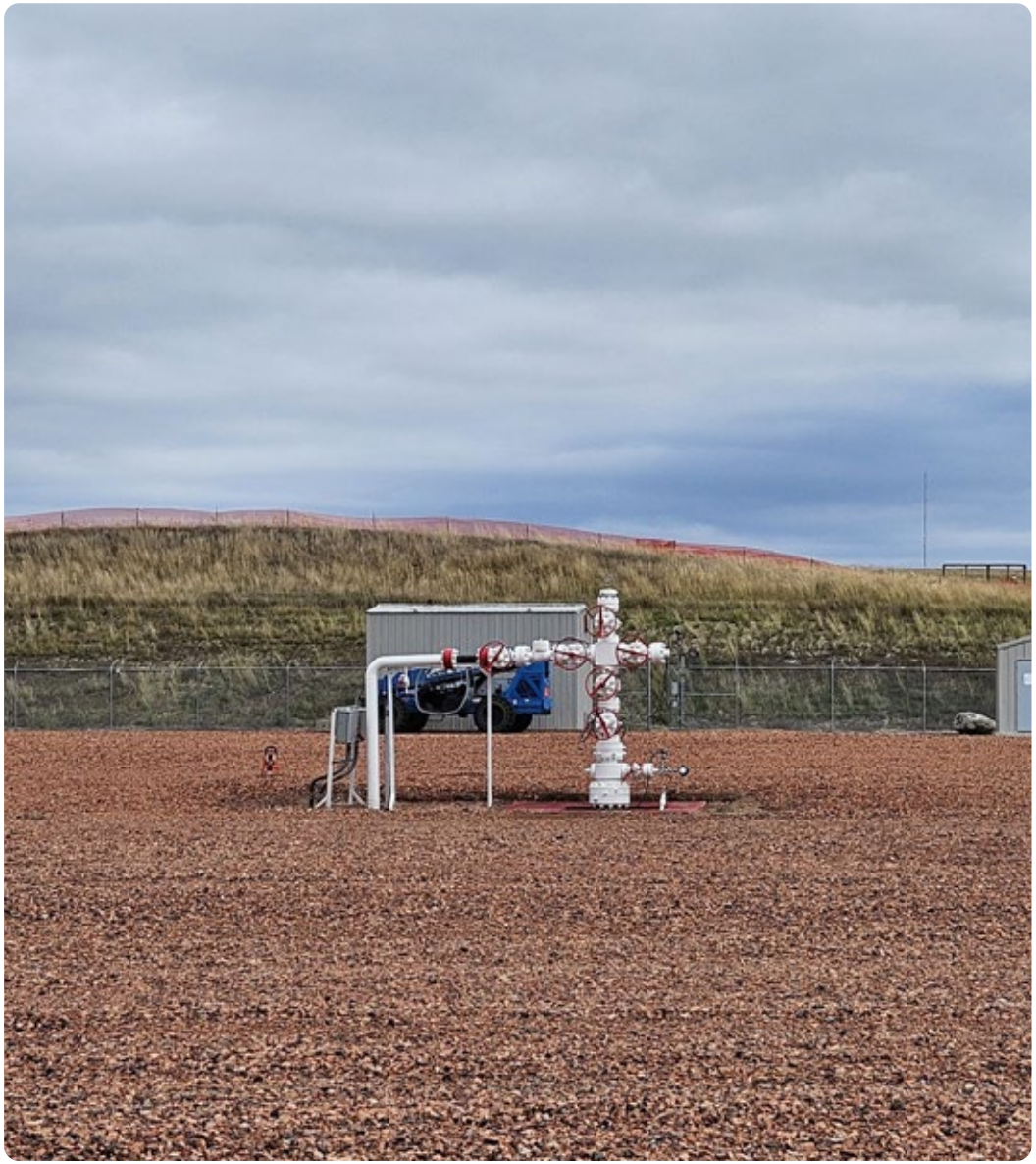
This comes after the Federal Senate approved Bill 1425/2022 on 30 August 2023, which aims to establish a comprehensive legislative and regulatory framework for CCS. Key provisions include granting licenses for the exploration of geological storage reservoirs (onshore, offshore, and exclusively to Brazilian companies), liability provisions, post-closure monitoring and management responsibilities, and developing codes to regulate third-party access to CO_2 transport infrastructure (Chyzh, 2024).

Two other relevant bills are currently passing through the Brazilian Senate: one to establish a Brazilian emissions trading system (SBCE) and one to establish the Energy Transition Acceleration Program (PATEN), incentivising the development of low-carbon energy products, including energy production with CCS.

Mexico

In June 2024, Mexico elected Claudia Sheinbaum as President, a climate scientist and UN IPCC contributor whose energy policy priorities, specifically regarding CCS, remain to be seen (Franco, 2024; Oré, 2024). In her roadmap for 2024-2030 Sheinbaum proposes to "decarbonise the energy matrix as quickly as possible" (Quiroz, 2024).

Brazil has the potential to become a regional and global hub for CCS, given its geological storage resource base and skilled energy industry workforce.



A CO_2 injection well at the Dakota Gasification CO_2 sequestration site near Beulah, North Dakota. Image courtesy Dakota Gasification Company.

Table 4.1-1
Projects selected for funding award or award negotiations exceeding US$10 million under the Bipartisan Infrastructure Law (BIL) as of June 2024.

Project Name	Funding US$	Award or Award Negotiations	Date (MM/DD/YYYY)
California Hydrogen Hub	1,200,000,000	negotiations	10/13/2023
Gulf Coast Hydrogen Hub	1,200,000,000	negotiations	10/13/2023
Midwest Hydrogen Hub	1,000,000,000	negotiations	10/13/2023
Pacific Northwest Hydrogen Hub	1,000,000,000	negotiations	10/13/2023
Regional Clean Hydrogen Hubs - Multiple (EFI Foundation, S&P Global, Intercontinental Exchange)	1,000,000,000	negotiations	1/17/2024
Appalachian Hydrogen Hub	925,000,000	negotiations	10/13/2023
Heartland Hydrogen Hub	925,000,000	negotiations	10/13/2023
Mid-Atlantic Hydrogen Hub	750,000,000	negotiations	10/13/2023
Project Tundra	350,000,000	negotiations	12/14/2023
Baytown Carbon Capture and Storage Project	270,000,000	negotiations	12/14/2023
Sutter Decarbonization Project	270,000,000	negotiations	12/14/2023
Project Crossroads: Appraising Storage Facilities to Decarbonize Northern Indiana, Northeastern Illinois, and Southwestern Michigan — BP Carbon Solutions LLC	98,240,569	award	11/14/2023
Carbon Capture Large-Scale Pilot Projects - Carbon Capture Pilot at Big Spring Refinery	95,000,000	negotiations	2/2/2024
CarbonSAFE Phase III, Polk Carbon Storage Complex Detailed Site Characterization — Tampa Electric Company	88,349,189	award	11/14/2023
Carbon Capture Large-Scale Pilot Projects - Carbon Capture Pilot at Vicksburg Containerboard Mill	88,000,000	negotiations	2/2/2024
Carbon Capture Large-Scale Pilot Projects - Carbon Capture Pilot at Cane Run Generating Station	72,000,000	negotiations	2/2/2024
South Texas DAC Hub	60,000,000	negotiations	8/11/2023
Tri-State CO_2 Storage Hub; Tri-State Project — Southern States Energy Board	55,248,174	award	11/14/2023
Project Cypress	50,174,880	award	3/27/2024
Carbon Capture Large-Scale Pilot Projects - Carbon Capture Pilot at Dry Fork Power Station	49,000,000	negotiations	2/2/2024

Projects

United States

In a signal of international interest in power sector decarbonisation and the increasing business case for CCS, JX Nippon restarted operations at the Petra Nova CCUS plant in Texas in September 2023 (JX Nippon, 2023). Petra Nova remains the only operational carbon capture facility at a coal-fired power plant in the US and one of only four operating at commercial coal-fired plants globally. If completed, Project Tundra in North Dakota will be the second such facility in the US and was selected for award negotiations of up to US$350 million in funding from the BIL in December 2023.

Many projects with low capture costs and limited need for new transport infrastructure are advancing in the US.

In November 2023, Harvestone's Blue Flint Ethanol CCS facility in North Dakota and EnLink and BKV's Barnett Zero CCS facility (natural gas processing) in Texas began operations (EnLink, 2023; Harvestone, 2023). In January 2024, the EPA gave Wabash Valley Resources final approval for two UIC Class VI well permits linked to its Indiana gasification and fertiliser production facility in Indiana (US EPA, 2024b).

CO_2 pipelines are progressing with Summit Carbon Solutions earning approval in June 2024 for the Iowa segment of its pipeline network that will transport captured CO_2 from 57 ethanol plants across the Midwest US to storage sites in North Dakota.

Tallgrass is converting its ~640 km (400 mile) Trailblazer pipeline from natural gas to CO_2 service. The project received approval for its

Table 4.1-1 (cont.)
Projects selected for funding award or award negotiations exceeding US$10 million under the Bipartisan Infrastructure Law (BIL) as of June 2024.

Project Name	Funding US$	Award or Award Negotiations	Date (MM/DD/YYYY)
Four Corners Carbon Storage Hub: CarbonSAFE Phase III Project — New Mexico Institute of Mining and Technology	41,409,910	award	11/14/2023
CarbonSAFE Phase III: Sweetwater Carbon Storage (SCS) HUB – University of Wyoming	40,504,935	award	5/17/2023
The Phoenix Project: Demonstration of Safe, Reliable Conversion of a Mature Oilfield for Dedicated CO_2 Storage in the Permian Basin — Projeo Corporation	38,376,061	award	11/14/2023
Coal Creek Carbon Capture: Site Characterization and Permitting – University of North Dakota Energy & Environmental Research Center	38,148,520	award	5/17/2023
Lone Star Storage Hub Project – BP Corporation North America Inc.	33,411,193	award	5/17/2023
CarbonSAFE Eos: Developing Commercial Sequestration for Southern Colorado – Colorado School of Mines	32,671,554	award	5/17/2023
A Critical Carbon Storage Hub for the Louisiana Chemical Corridor — River Parish Sequestration LLC	25,634,345	award	11/14/2023
Timberlands Sequestration Project – Timberlands Sequestration, LLC	23,779,020	award	5/17/2023
Magnolia Sequestration Project – Magnolia Sequestration Hub	21,570,784	award	5/17/2023
Monkey Island Carbon Storage Project — Advanced Resources International Inc.	21,175,655	award	11/14/2023
Longleaf CCS – Southern States Energy Board	17,984,523	award	5/17/2023
Illinois Basin West CarbonSAFE – University of Illinois	17,736,972	award	5/17/2023
Bluebonnet Sequestration Project – Bluebonnet Sequestration Hub	16,480,117	award	5/17/2023
Prairie Compass DAC Hub — Phase 1— University of North Dakota Energy & Environmental Research Center (EERC)	12,500,000	negotiations	8/11/2023
The Wyoming Regional Direct Air Capture Hub — Carbon Capture Inc.	12,500,000	negotiations	8/11/2023
California Direct Air Capture Hub Front-End Engineering Design and Planning — Electric Power Research Institute, Inc.	11,829,634	negotiations	8/11/2023
Southwest Regional Direct Air Capture Hub — Arizona Board of Regents on behalf of Arizona State University	11,586,146	negotiations	8/11/2023
Southeast DAC Hub: Leveraging Legacy Work in Mobile Region — Southern States Energy Board	10,242,232	negotiations	8/11/2023

first CO_2 injection well in Wyoming in June and has built community support in Nebraska by negotiating a community benefits agreement with a state-based community organisation.

Several US DAC companies have launched both demonstration and commercial facilities in the last two years, securing investments from large banks, tech companies, and airlines for carbon credits. In November 2023, Heirloom began operations at its 1 ktpa Tracy, California, facility and in June 2024 announced plans for two new facilities in Louisiana (320 ktpa max. capture capacity) (Heirloom, 2023, 2024). In early August Heimdal's 5,000 tpa Bantam facility commenced operations in Oklahoma. Global Thermostat and Carbon Capture, Inc. released details of their commercial DAC systems in April 2023 and June 2024, respectively.

Large-scale geologic storage projects continue to develop across the region, with international corporations undertaking acquisitions and investments to build their storage portfolios.

In November 2023, ExxonMobil acquired Denbury, Inc., adding 15 onshore storage sites and more than 2,000 km of CO_2 pipelines to ExxonMobil's US network, and in March 2024, TotalEnergies acquired Talos Low Carbon Solutions, providing a share in both the Bayou Bend (>1 Gt storage resources) and Coastal Bend (50-75 Mt storage resources) storage projects (ExxonMobil, 2023; Global CCS Institute, 2023; TotalEnergies, 2024).

California

California Resources Corporation (CRC) in December 2023 received approval from the US EPA for four draft Class VI well permits for its Carbon TerraVault (CTV) 1 project at its Elk Hills field in Kern County, California.

The CTV1 project is targeting first injection by the end of 2025, with a goal of injecting ~1.5 Mtpa of CO_2 with a total estimated storage resource of 38 Mt (California Resources Corporation, 2024). CRC estimates a combined total CO_2 storage resource of approximately 190 Mt across its five projects.

Louisiana

Louisiana received UIC Class VI primacy in December 2023 and as of August 2024 was evaluating applications for 65 Class VI wells – more than any other state or EPA region. Capture Point's Central Louisiana Regional Carbon Storage Hub (CENLA Hub) is one of the larger storage projects in development with an estimated CO_2 storage resource of 2 Gt. Capture Point has 12 pending applications for Class VI wells in Louisiana.

OnStream CO_2, a joint venture between Carbonvert and Castex Carbon Solutions, signed an MoU with Commonwealth LNG to capture CO_2 at the Commonwealth LNG facility under development in Cameron, Louisiana, and store it offshore in the Cameron Parish CO_2 Hub (Commonwealth LNG, 2023) that has more than 250 Mt of CO_2 storage resources.

Wyoming

Frontier Carbon Solutions in December 2023 received approval for the state's first three Class VI injection well permits as part of Frontier's open-source Sweetwater Carbon Storage Hub, comprising over 550 Mt of CO_2 storage resources (Frontier Carbon Solutions, 2023).

Tallgrass is progressing its Eastern Wyoming Sequestration Hub (EWS) and in June 2024 received approval from the state of Wyoming for a draft Class VI injection well permit for the Juniper I-1 well (Wyoming DEQ, 2024). It will be the first well in the EWS Hub, designed to inject 1.5 Mtpa of CO_2 and permitted to inject a total 7 Mt of CO_2. The EWS Hub plans to transport more than 10 Mtpa of CO_2 from capture facilities in Nebraska, Colorado, and Wyoming to EWS Hub storage sites.

Brazil continues successful CCS operations at its Santos Basin pre-salt reservoirs, injecting 13 Mt CO_2 in 2023.

Canada

For the first time, Alberta's Energy Regulator (AER) included a chapter on CCUS in its energy outlook, noting two of Canada's large-scale CCUS projects, Shell's Quest facility and Wolf Midstream's Alberta Carbon Trunk Line (ACTL) permanently stored a combined total of 2.6 Mt of CO_2 (AER, 2024). Construction has also begun on an ACTL extension – the ACTL Edmonton Connector – capable of transporting ~7 Mtpa at full capacity, and the Pathways Alliance filed an application with AER for approval of its proposed 400 km pipeline that would transport captured CO_2 from northern Alberta to its storage site near Cold Lake (Wolf Midstream, 2023; Bakx, 2024; Stephenson, 2024). Also notable, in July 2024, Entropy announced its FID on Phase 2 of the Glacier facility, which will include post-combustion capture on one gas-fired power generation turbine and nine gas-fired engines (Advantage Energy, 2024).

In 2022, Alberta selected 25 CCS hub project proposals to evaluate and explore CO_2 storage site suitability in the Edmonton region and across the province, one of which was later cancelled. (Oil and Gas Journal, 2022; Williams, 2022; Government of Alberta, 2024). The storage site evaluation process is ongoing; however, in June Shell announced its FID for the first phase of its Atlas Carbon Storage Hub (650 ktpa) and Bison announced its sequestration application has been submitted for its 3 Mtpa Meadowbrook CCS Hub project, both near Edmonton (Bison Low Carbon Ventures, 2024; Shell, 2024).

Brazil

Petrobras continues successful CCS operations at its Santos Basin pre-salt reservoirs, injecting 13 $MtCO_2$ in 2023, raising its cumulative CO_2 injection total to 53.8 $MtCO_2$ (Petrobras, 2024). Petrobras also signed an MoU with steel producer ArcelorMittal to study the viability of a CCS hub in the state of Espírito Santo (ArcelorMittal, 2024).

Other project developers are proceeding with CCS feasibility studies. Ethanol producer FS announced in May 2024 completion of technical studies, including drilling a stratigraphic well, evaluating the suitability of the Diamantino Formation to store CO_2 in the Mato Grosso's Parecis Basin for a BECCS project with the potential to capture 423 ktpa (FS, 2024).

Carbon America's FrostCC™ pilot at the National Carbon Capture Center in the US. Image courtesy of Carbon America.

4.2 Asia Pacific and India

Overview

The role of CCS is increasingly critical in Asia given the confluence of rising energy demand, continuing reliance on fossil fuels, and the need for rapid decarbonisation. However, needs for CCS deployment and the actual structural capability to do so are not evenly distributed, largely due to a disparity of geological storage resources.

The region (excluding China which is described in Section 4.3) has one operating project and four facilities in construction.

Based on the projected ongoing need for regional geological storage and, therefore, the inherent future economic opportunity it underpins, several jurisdictions – notably Malaysia, Indonesia, and Australia – are now actively developing their geological resources to establish themselves as CCS hubs in the region. To this end, multiple MoUs and agreements are being put in place across the region to lay the groundwork for cross-border projects.

Indicative of the rapid action taking place are the emerging national and sub-national legal and regulatory frameworks for CCS. Governments including South Korea, Japan, Indonesia, and the state of Western Australia have released CCS regulations in the past year. Malaysia is expected to do the same by the end of 2024.

Notably, the frameworks in place all consider enabling transboundary CCS value chains, with some making explicit allowances for storage reserves to be accessed by third parties. Although this is mostly framework legislation with much of the detail to be clarified, it highlights the underlying drive to establish the requisite regulatory infrastructure to deliver emissions reductions and realise long-term economic opportunities.

The challenges facing CCS, particularly in developing economies, remain. This includes the full development of regulations and integrated policy mechanisms, infrastructure financing and development, and the monetisation of abatement activities involving CCS. Specific to CCS hubs, an outstanding challenge remains the transboundary movement of CO_2 and the complex interrelated and overlapping national regulations, policies, and international agreements that govern it.

Malaysia, Indonesia, and Australia are now actively developing their geological resources to establish CCS hubs in the Asia Pacific region.

4

Facilities in construction, one in operation across Asia Pacific & India

Japan

Exploring feasibility of 9 CCS networks:

- **5** to store CO_2 domestically
- **4** elsewhere in the Asia Pacific

Malaysia, Indonesia, Australia

Lining up to develop geological storage

US$2 billion

Java Sea storage hub under evaluation by Indonesia's Pertamina, ExxonMobil

Pertamina also signs agreement with Chevron to collaborate on CCUS in East Kalimantan

Policy

Establishing a sound investment environment for CCS begins, in part, with clear and stable regulatory settings. To this end, progress in the Asia Pacific region over the past year has been impressive, marked by a continued uptick in activity. Regionally, the focus is establishing commercial transnational CCS value-chains. This is evidenced in national legislative developments making provisions for conducting 'CCS businesses' as well as by the growing number of MoUs, letters of intent, and other agreements between governments and the private sector to export CO_2 for storage in other jurisdictions. Regulatory frameworks are being introduced with commercial incentives to deploy CCS, which include tax credits, storage fees, and access to national carbon markets.

Australia

International cooperation remains a focus point for the federal government, as highlighted by the passing of the Environment Protection (Sea Dumping) Amendment (Using New Technologies to Fight Climate Change) Bill 2023 (Parliament of Australia, 2023), and the subsequent development of a National Action List (Australian Department of Climate Change Energy the Environment and Water, 2024).

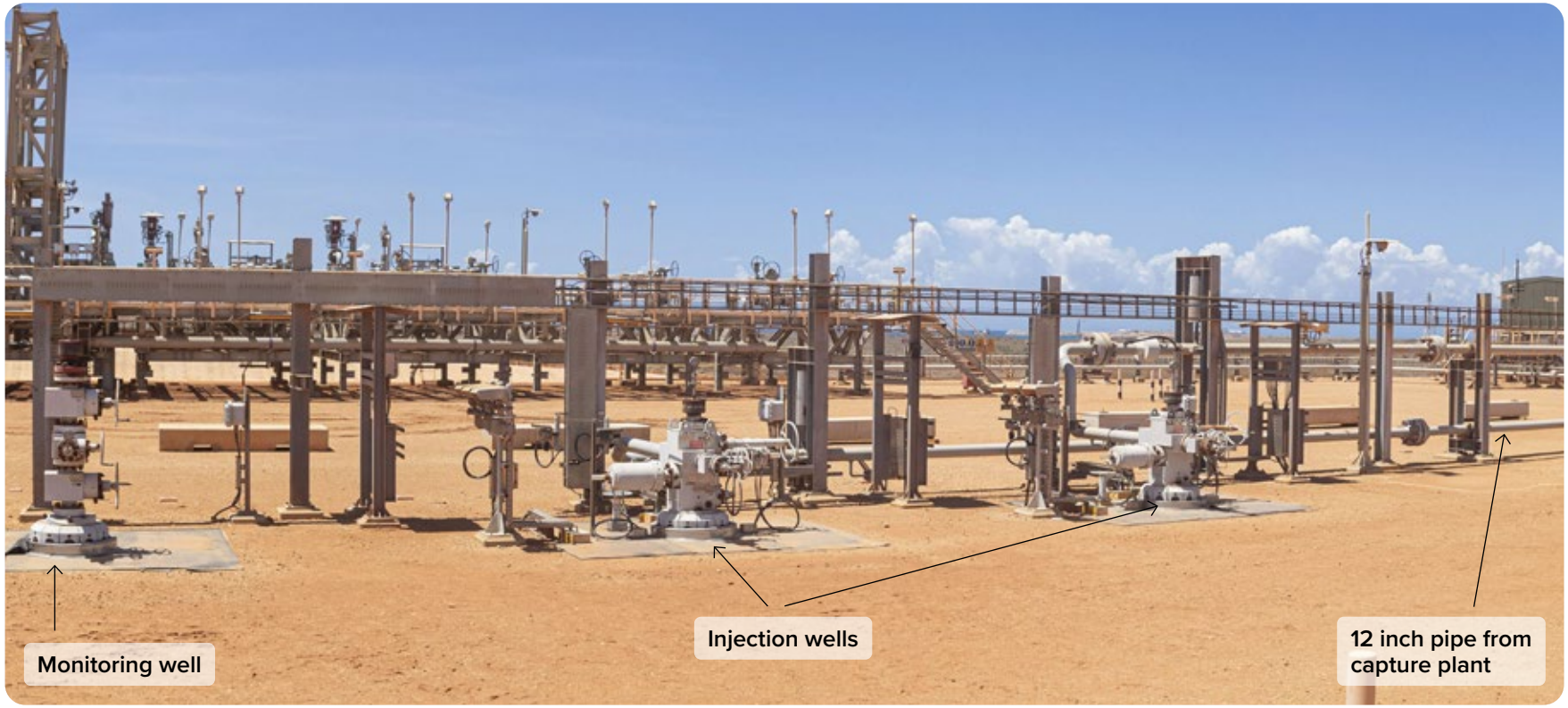
In the 2024-25 Federal Budget, the government provided AU$556.1 million over 10 years for Geoscience Australia to comprehensively map Australia's subsurface resources, including geological resources with the potential to store CO_2.

In May, the government released its Future Gas Strategy (Australian Department of Industry Science and Resources, 2023). Action item five of the strategy is to "promote geological storage of CO_2 and support our region's transition to net-zero". Through the Climate Change Authority, the government is developing a sectoral decarbonisation strategy which includes CCS for relevant industries (Climate Change Authority, 2024).

At a sub-national level, state and territory governments are taking a divergent approach to CCS. In May, the West Australian parliament passed the Petroleum Legislation Amendment Bill (2023), now an act, and regulations – secondary legislation – are now under development. In Queensland, the state government disallowed the progress of Glencore's CTSCo project, citing – despite thorough scientific analysis from independent organisations – potential groundwater contamination in the Great Artesian Basin (GAB) (Miles, 2024). The Queensland government has introduced a bill to ban all future CCS projects planning to use parts of the GAB for storage (Queensland Parliament, 2024).

1.6 Mtpa of CO_2

Stored at Barrow Island off the coast of Western Australia.



Gorgon LNG facility incorporating CCS system, Western Australia, image courtesy of Chevron

Japan

In May, the National Diet (Parliament of Japan) passed the CCS Business Act (Fukushima, 2024; JOGMEC, 2024). The law grants the Ministry of Economy, Trade, and Industry (METI) the ability to identify and designate specific areas for CO_2 storage and to operate a permitting system under which businesses will be given exploratory drilling and storage rights. Drilling and storage permits will be conducted via a public tender in which applicants will be assessed against technical competence, financial security, and so on. The law also includes details on monitoring and liability, including post-closure transfer.

In February, the Japanese Government launched the first tranche of a planned 10-year, US$130 billion climate bond (Climate Bonds Initiative, 2024). In line with the Climate Transition Bond Framework published in 2023, proceeds must go to specific projects aligned with the Green Transformation Promotion Strategy, which seeks to balance economic growth, industrial performance, and decarbonisation. 55% of the bond is allocated to R&D activities associated with national industrial and energy transition objectives and 20% is expected to be earmarked for CCS.

Malaysia

The Malaysian Government in 2023 released the National Energy Transition Roadmap (NETR), which lays the groundwork for the economy-wide transition to net zero (Ministry of Economy Malaysia, 2023). The NETR includes 10 flagship projects based on six energy transition levers, one of which is CCUS. Under the CCUS lever, the government's goal is to develop three CCUS hubs and its key initiatives include developing CCUS regulations and improving the uptake of CCUS across relevant industries through policy incentives. One of the CCUS hubs will be located in Sarawak, where the state already has a regulatory framework in place to facilitate its development. A national regulatory framework for CCUS is expected by December 2024.

In September 2023, the government released the New Industrial Master Plan 2030 (NIMP 2030), which aims to enhance the Malaysian manufacturing sector's global competitiveness (Malaysian Investment and Development Authority, 2023). The NIMP has four missions which incorporate 21 strategies and 62 action plans. Under the third mission – Push for Net Zero – the role of CCUS in supporting the decarbonisation of hard-to-abate sectors was recognised and included along with establishing CCUS as its own sector.

Indonesia

The Indonesian Ministry of Energy and Mineral Resources in early 2023 issued initial regulations for CCS and CCUS in upstream oil and gas operations (Kementerian ESDM, 2023). Subsequently, in January 2024, the government released Presidential Regulation 14/2024 (PR 14/2024), which provides a framework for CCS activities across multiple sectors in Indonesia (BPK RI, 2024). Both the 2023 and 2024 regulations establish a process for storage permitting, environmental safety, monitoring, and post-closure liability, while PR 14/2024 mandates a 30% cap on foreign CO_2. Notably, PR 14/2024 also provides built-in incentive mechanisms. These include tax incentives, allowances for storage operators to monetise activities through fee charging, as well as providing the basis for the implementation of carbon pricing associated with CCS activity (regulated under PR 98/2021).

Singapore

The Singaporean Economic Development Board and the S-Hub consortium (comprised of Shell Singapore and ExxonMobil Asia Pacific) in December 2023 signed an MoU to coordinate the planning and development of a 2.5 Mtpa project by 2030 (EDB Singapore, 2024). Multiple agreements and MoUs have been put in place between Singapore and other jurisdictions, perhaps most notably a Letter of Intent with Indonesia, signed in January (Ministry of Trade and Investment Singapore, 2024). The Singaporean government has also begun early-stage discussions with the Malaysian government and Petronas about CO_2 export for storage in Malaysia.

Thailand

The Thai Government released a draft amendment to the existing Petroleum Act (although the act has not been passed), adding "carbon business" to the act, in early 2024 which represents a regulatory framework for CCS activities. Carbon business refers to exploration for the purposes of carbon capture and storage (Peerapan Tungsuwan et al., 2024).

South Korea

The Carbon Dioxide Capture, Usage and Storage Act passed the National Assembly in January 2024 and will come into effect in January 2025 (MOTIE, 2024). The act outlines processes around permitting, financial support mechanisms, and provides a framework for activities under operation, safety standards, and monitoring.

India

India has great potential for CCS, particularly in its hard-to-abate sectors. Following the 2022 release of Niti Aayog's (a think tank affiliated with the central government) comprehensive policy report on CCUS, the Department of Science and Technology established two National Centres of Excellence in CCUS (NCoE) in 2022 and supported a third NCoE in 2023 (Department of Science and Technology, 2023, 2024). These NCoEs conduct research and development of technologies to reduce the cost of CCS and provide best-practice sustainable solutions.

India's Bureau of Standards has recently adopted ISO standards on CCS, covering capture, transport and storage relating to EOR and geologic storage. In addition, the Bureau of Energy Efficiency has established a task force to build a carbon market framework for both carbon taxation and trading of carbon credits in India.

The Carbon Credit Trading Scheme draft report has been released by the Ministry of Power and Ministry of Environment, Forests and Climate Change, for public feedback (Global Cement and Concrete Association, 2024).

As part of its G20 presidency in 2023, India released Technical and Financial Reports highlighting that storage assessments, and supportive policies would encourage investments in CCUS (Arnab Dutta, 2024).

Currently, there are four interministerial task forces on CCUS, led by Niti Aayog, collectively working on various aspects of CCUS including safety and technical standard development (Ministry of Petroleum & Natural Gas, 2023).

The Institute is collaborating with the Global Cement and Concrete Association, and the Clean Energy Ministerial CCUS Initiative to deliver a study on decarbonisation in the Indian cement industry. The study comprises four outcomes:

- Identify potential emitter hubs, and map these hubs to geological storage locations in proximity;
- Identify gaps in policy, legal and regulatory frameworks for CCUS, and considerations for incentives and international collaboration around CCUS;
- Identify 'first-mover' CCUS projects, and develop high-level conceptual design studies;
- Raise awareness and build capacity around CCUS in the cement industry.

The study is sponsored by the Global Carbon Management Foundation.

India has great potential for CCS, particularly in hard-to-abate sectors.

Projects

Projects in the Asia Pacific region continue to emerge across the full spectrum and cost-curve of CCS applications, from natural gas processing through to direct air capture with CCS. Many project developers are seeking to establish storage hubs to serve both domestic emitters and receive CO_2 from other jurisdictions. This, in large part, is being led and driven by oil and gas operators across the region.

However, the full value-chain often comprises a diverse array of sectors, companies and governments, setting the stage for new and noteworthy strategic partnerships in the CCS space.

Australia

Various hard-to-abate capture projects are advancing in Australia, providing potential users for storage hubs under development in Western Australia. Mitsui E&P Australia (MEPAU) and Wesfarmers Chemicals, Energy & Fertilisers (WesCEF) completed a successful CO_2 injection test as part of the initial stages of the Cygnus CCS Hub, based in mid-west Western Australia (Mitsui E&P Australia, 2024). Yara Pilbara Fertilsers signed an MoU with Woodside to examine the feasibility of storing captured emissions from their facilities in Western Australia in the depleted Angel gas field (Woodside, 2024). The proposed hub would be multi-user and could provide up to 5 Mtpa of storage.

In August 2023, Hexagon Energy announced completion of a pre-feasibility study for their WAH2 low-emissions ammonia project, with FEED to follow (Hexagon Energy, 2024). In June, Pilot Energy received key government approval for its Cliff Head CO_2 storage project where it will transition existing oil and gas infrastructure to be used for dedicated geologic storage– as part of the Mid West Clean Energy Project (MWCEP) in Western Australia (Pilot Energy, 2024). In South Australia, Santos' Moomba project is expected to commence operations before the end of 2024 and Chevron's Gorgon facility on Barrow Island off the coast of Western Australia continues to store approximately 1.6 Mtpa of CO_2 (Chevron, 2024; Santos, 2024).

Gorgon LNG facility incorporating CCS system, Western Australia,. Image courtesy of Chevron.

Indonesia

Indonesian government-backed oil and gas company Pertamina signed an agreement with ExxonMobil in November 2023 to evaluate the potential for a hub in the Java Sea potentially worth US$2 billion (Pertamina, 2023). The same month, Pertamina and Chevron signed an agreement to collaborate on CCUS in East Kalimantan, which includes a study to assess the feasibility of CCS and sharing geological and commercial data.

Pupuk, an Indonesian fertilisers and chemicals company, announced plans in late 2023 to develop two low-carbon ammonia projects in the country, one in collaboration with INPEX and the other with Mitsui (Pupuk Indonesia, 2023).

Japan

The government of Japan is exploring nine candidate CCS networks, focusing on feasibility studies to capture and store CO_2 emissions (JOGMEC, 2024). These projects are strategically located across industrial regions, aiming to leverage existing infrastructure and suitable geological formations. Five are expected to store CO_2 domestically and four to store CO_2 elsewhere in the Asia Pacific region (JOGMEC, 2024). The initiative aligns with Japan's carbon neutrality goals and its objectives around enhancing technological capability.

Japan remains at the forefront of regional collaboration.

Under a joint study agreement, thermal power company, JERA, and Malaysia's PETRONAS will investigate the capture of CO_2 in the Tokyo Bay area for transport and storage in Malaysia (PETRONAS, 2024). Similarly, bp and Chubu Electric signed an MoU in September 2023 to investigate the transport of CO_2 to other jurisdictions – potentially Indonesia – for permanent storage (bp, 2023).

Malaysia

PETRONAS and the Malaysian government have signed agreements and MoUs with various governments and companies. In February 2024, PETRONAS CCS Ventures, PETROS, and a consortium of Japanese companies signed a Storage Site Agreement for the M3 depleted field in offshore Sarawak, focusing on feasibility and development plans (PETROS, 2024). Petronas is also part of the Shepherd Consortium described in the South Korea section.

South Korea

The Shepherd CCS project provides a stand-out example of public-private regional partnerships. A consortium of private sector proponents is collaborating with the South Korean and Malaysian governments to develop a project capturing CO_2 from multiple sources and aggregating it at a hub for transport to Malaysia for permanent storage. Although in feasibility study stages, the consortium said that it identified at least one domestic hub site (at Ulsan) and one Malaysian storage site (Carbon Herald, 2023). The Shepherd project is notable for its broad and inclusive approach, which will encompass a full transnational value-chain for CCS – a significant initiative in Asia.

The South Korean government is leading research into a potential CCS project in the Ulleung Basin in the East Sea. The Korea National Oil Corporation is undertaking an initiative to explore and identify potential storage sites in the waters around the Korean peninsula.

Thailand

PTTEP and INPEX are undertaking a study to determine the potential for a CCS hub offshore from Thailand. Siam Cement Group is undertaking feasibility studies to support the implementation of CCUS in cement manufacturing facilities (Inoue, 2023).

4.3 China

Overview

CCS development in China has remained robust over the past year, evident in policy advancement, project implementation, and international collaboration.

Policy

China has begun addressing certain barriers and testing policy instruments needed for the broader deployment of CCS since 2021. In addition to the monetary policy tool Carbon Emissions Reduction Facility launched by the People's Bank of China in 2021, the National Development and Reform Commission (NDRC), along with 10 other ministries, launched the Implementation Plan for Green and Low-Carbon Technology Demonstration in August 2023.

The significance of this program lies in its status as China's first policy initiative to support selected projects using the central government's budget. CCUS is included in this program, alongside new energy technologies (such as energy storage, green hydrogen, advanced power grids) and process decarbonisation technologies.

In April 2024, the NDRC announced the first group of selected projects. Six out of 47 selected projects are CCUS-related, including Huaneng's 1.5 Mtpa coal-fired power plant CCUS project, Baotou Steel's CCUS project in Inner Mongolia, a geological storage project in Shaanxi, and a carbon mineralisation project in Ningxia. The official policy document also indicates that, in addition to the government grant, the government will assist the selected projects in seeking other low-cost financial sources. This program serves as a pilot policy test platform for the Chinese government to determine the most effective policies for driving commercial CCUS projects in the country.

On 16 July, China announced a new action plan aimed at decarbonising its coal-fired power plant fleet, setting an ambitious goal to reduce coal-fired power plant emissions to levels comparable with those of gas-fired plants by 2027. The plan outlines three main strategies to achieve this target: co-firing with green ammonia, co-firing with biomass, or implementing CCUS. The government will back these decarbonisation initiatives through a combination of policy measures and financial support.

Another positive development is that China officially relaunched its voluntary carbon market, the China Certified Emission Reduction Scheme (CCER), in January 2024, which is designed to supplement China's compulsory Emission Trading Scheme as part of a broader strategy to achieve national carbon targets. CCER was initially established in 2012 but suspended in 2017. Although CCUS is not included in the first announced methodologies of the relaunched CCER, which include forestation, mangrove cultivation, solar thermal power, and offshore wind power, CCUS stakeholders in China are making efforts to link the technology to the voluntary market. As of June 2024, the average CCER price was around US$15/t.

6 of 47

projects in China's first Implementation Plan for Advanced Green and Low-carbon Technology Demonstration are CCUS-related

1.5 Mtpa

World's largest power station CCUS project on track to complete construction in Zhengning, Gansu

200 ktpa

World's largest oxyfuel combustion project in the cement sector commences operations in Qingzhou, Shandong

CCS highlighted

in China's bilateral climate collaborations with:

- France - Carbon Neutrality Center
- the US - Sunnylands Statement

Huaneng Longdong CCUS project under construction, image courtesy Huaneng Clean Energy Research Institute

Key focus

CCS has become a key focus in China's bilateral climate collaboration. In November 2023, China and France launched the China-France Carbon Neutrality Center, where CCS was a major topic of discussion. In the same month, China and the US announced the Sunnylands Statement on Enhancing Cooperation to Address the Climate Crisis in which both sides agreed to advance at least five large-scale cooperative CCUS projects each by 2030, encompassing industrial and energy sources.

Since the early 2000s, international collaboration has played a vital role in the development of CCS technologies in China. Key programs like the China-EU COACH (Cooperation Action within CCS) Initiative (2006-2009), the China-UK NZEC (Near Zero Emissions Coal) Initiative, the China-Australia Geological Storage of CO_2 Project, and the China-US Clean Energy Research Center have been instrumental in building China's research capacity and advancing several important pilot projects.

Since the early 2000s, international collaboration has played a vital role in the development of CCS technologies in China.

Projects

China has achieved significant milestones every year since SINOPEC commenced full operation of the country's first integrated megatonne-scale CCUS project in Shandong province in August 2022. Including the launch of China's first offshore CO_2 storage project, first commercial-scale CO_2 transport pipeline, and a 500 ktpa coal-fired power plant CCUS project, 2023 marked continued progress.

In January 2024, China United Cement Company began commissioning the world's largest oxyfuel combustion project in the cement sector in Qingzhou, Shandong, which is also China's largest CCUS project in this sector. This 200 ktpa project involves two core processes – oxyfuel combustion and pressure swing adsorption – to capture the CO_2. By enriching the CO_2 concentration, oxyfuel combustion could prove to be a cost-effective way for the cement sector to manage its carbon emissions (Carrasco-Maldonado et al., 2016). The project completed its engineering design in December 2022, started construction in July 2023, and finished construction in December 2023.

In May 2024, Xinjiang Oilfield, a wholly owned subsidiary of China National Petroleum Corporation (CNPC), began constructing the first phase of a 2 Mtpa coal-fired power plant CCUS project. This project is part of a larger construction initiative that includes 2.64 GW of solar power and two 660 MW ultra-supercritical coal-fired power units. The first phase aims to capture 1 Mtpa of CO_2 and is expected to be fully operational by June 2026. The captured CO_2 will be transported for enhanced oil recovery, also managed by CNPC. Notably, this is the second large-scale CCUS project being built in conjunction with a new coal-fired power plant. The first is Huaneng's Longdong 1.5 Mtpa coal-fired power plant CCUS project in Zhengning, Gansu province, which is on track to complete construction. Once operational, Huaneng's 1.5 Mtpa project will become the world's largest coal-fired power plant CCUS project. The captured CO_2 will be partially used for geological storage, and the rest sent for enhanced oil recovery.

China has achieved significant milestones every year since 2022 when SINOPEC commenced full operation of the country's first megatonne-scale CCUS project in Shandong.

China is still in the early stages of developing its monitoring, reporting and verification (MRV) framework, including for enhanced oil recovery projects (Yang, 2024). To build its knowledge base, China is actively involved in the international standards development for CCS through ISO/TC265, and also drawing on lessons from the IPCC and global voluntary carbon markets.

Meanwhile, CNOOC, ExxonMobil, and Shell are continuing to advance their Dayawan Hub in Guangdong province. SINOPEC, BAOWU, Shell, and BASF are making progress in their joint cluster in the East China region. Both hubs aim to develop the capacity to capture up to 10 Mtpa of CO_2 in the long run and to support decarbonisation across the region

The Dayawan Hub is located in the Dayawan Petrochemical Industrial Park, one of China's largest petrochemical industrial bases.

Some other project developments include:

- Huaneng commenced a pilot-scale carbon capture project demonstration at one of its new Natural Gas Combined Cycle power plants on Hainan Island with a capacity of 2 ktpa in July 2023.
- A month later, a subsidiary of Dongfang Electric Corporation completed the world's largest chemical looping combustion demonstration facility in Sichuan, with thermal power of up to 4 MW.
- China Resources began constructing a 60 ktpa CCUS project at one of its cement plants on Hainan Island in December 2023.
- ExxonMobil and Baowu, the world's largest steel producer, signed an MoU in January 2024 to explore decarbonisation opportunities, including CCS.
- Major progress was made in May 2024 in the construction of the first phase of the 3 Mtpa CCUS project in the Ningxia region by China National Energy Investment, which is on track for operation in October 2024. The first phase aims to capture 500 ktpa CO_2 from a coal-to-liquids facility for enhanced oil recovery.

Stock image

The interest of China's multinational technology conglomerates in supporting CCS is notable. Tencent in March 2023 launched its CarbonX program to support new technologies and capabilities required to achieve carbon neutrality with a commitment of US$28 million over three years. The first year's focus was on CCUS. After several rounds of selection, 13 teams were chosen from 320 applicants to receive support from Tencent in May 2024. The winners range from projects demonstrating phase-change carbon capture solvents to the development of geological storage site inventories, with total funding of around US $14 million.

4.4 Europe & UK

Overview

CCS gained considerable importance in the climate and industrial agenda of the European Union (EU) in 2024. Across Europe there are five projects in operation, with 10 in construction.

Key milestones since last year's Global Status Report include the release of the long-awaited EU industrial carbon management strategy, the enactment of the Net-Zero Industry Act, and the selection of 14 cross-border CO_2 infrastructure projects on the list of Projects of Common Interest (PCIs) and Projects of Mutual Interest (PMIs).

Numerous European countries are making significant progress in enhancing their CCS policy and regulatory frameworks. By end 2024, a growing number of EU Member States – alongside Iceland, Norway, Switzerland and the United Kingdom (UK) – adopted strategies and roadmaps for CCS deployment (Figure 4.4-1), refined their regulatory frameworks to facilitate technology scaling, or established agreements with other governments to foster bilateral cooperation in this sector (Table 4.4-1).

Industry-led initiatives also played a crucial role in promoting international collaboration and calling for more government support. The surge in dedicated transport and storage (T&S) project announcements in 2024, most of which have a cross-border dimension, is a positive signal. However, for the region to meet its decarbonisation and competitiveness objectives, more initiatives must reach final investment decisions (FIDs) and move towards construction.

Industry-led initiatives played a crucial role in promoting international collaboration.

14

cross-border CO_2 infrastructure projects selected as Projects of Common Interest (PCIs) and Projects of Mutual Interest (PMIs)

€4 billion

Record EC Innovation Fund budget for decarbonisation technologies including CCS

£21.7 billion in funding over the next 25 years for 2 CCS clusters announced by UK Government

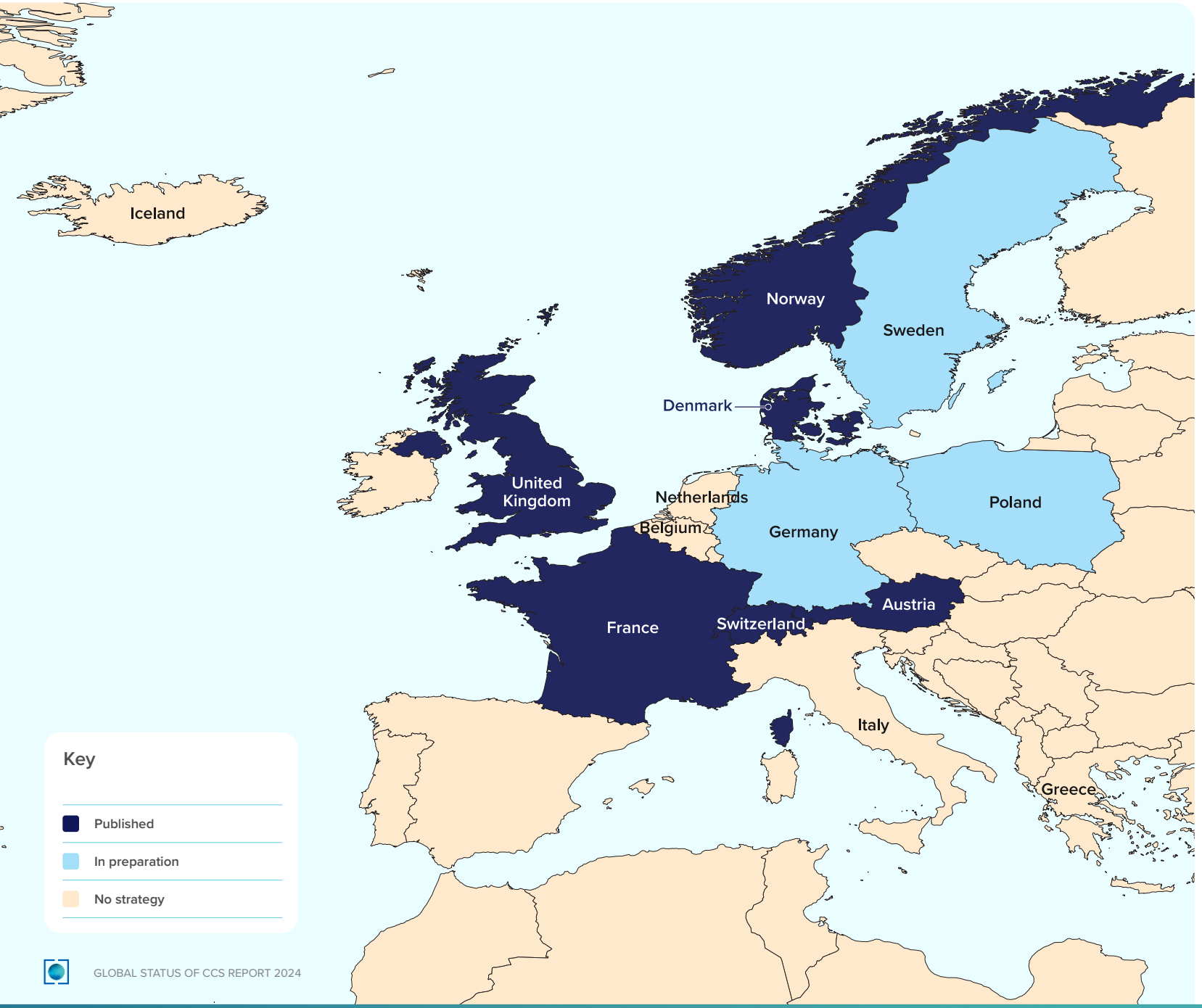
EU 2040 climate target

explicitly links CCS and CDR to proposed climate goals, complements existing goals of a 55% GHG reduction by 2030 and net-zero emissions by 2050

Key milestones

- ✔ Release of EU industrial carbon management strategy
- ✔ Enactment of Net-Zero Industry Act

Figure 4.4-1
Overview of national carbon management strategies and roadmaps for CCS deployment



Policies

European Union

In the EU, this year marked the conclusion of a political cycle with the end of the mandate of the European Commission and Parliament. Despite lingering challenges from the Covid-19 pandemic, Russia's invasion of Ukraine, and economic crises, the 2019-2024 European Commission's flagship project, the European Green Deal, drove the adoption of numerous climate and energy strategies and legislative acts that solidified the position of renewables and low-carbon technologies. The EU also reaffirmed its commitment to CCS, recognising the crucial role of this technology in achieving climate objectives more than a decade after the publication of the CCS Directive.

Against this backdrop, the European Commission in February 2024 unveiled its proposed EU 2040 climate target, complementing the existing goals of a 55% GHG emissions reduction by 2030 and net-zero emissions by 2050 (European Commission, 2024c). The attainment of these targets was explicitly linked to the deployment of CCS and CDR, as evidenced by the simultaneous publication of the EU industrial carbon management strategy (European Commission, 2024d). From November 2023 to April 2024, the European Commission launched a new call for proposals under the Innovation Fund, with a record budget of €4 billion for the deployment of decarbonisation technologies, including CCS and CDR (European Commission, 2024b). It also published its revised guidance documents supporting the implementation of the CCS Directive in July 2024.

In the run-up to the European elections in June, the European Parliament and the Council accelerated the adoption of several significant legislative dossiers to support CCS.

The Net-Zero Industry Act, echoing the US Inflation Reduction Act, was passed to stimulate

investment in net-zero technologies, including CCS, while mandating oil and gas producers to collectively invest in 50 Mtpa of CO_2 injection capacity in the EU by 2030 (Official Journal of the EU, 2024b). The EU Hydrogen Package, in development since December 2021, was also endorsed, paving the way for future advancements in low-carbon hydrogen, which includes CCS technologies (Official Journal of the EU, 2024a).

EU Member States

Among the most significant political shifts in EU Member States is the reconsideration of initial restrictions on CCS, notably in Austria and Germany. In November 2023, the Austrian Council of Ministers announced plans for a national carbon management strategy, formally adopted in June 2024 (Austrian Federal Ministry for Climate Action, 2024). Similarly, in February 2024, the German Federal Ministry for Economic Affairs and Climate Action announced the key points of its carbon management strategy and a draft bill to amend the Carbon Dioxide Storage Act, approved by the Federal Cabinet in May (German Federal Ministry for Economic Affairs and Climate Action, 2024). After many years of reluctance, these moves will enable CO_2 capture, transport, and storage (offshore for Germany).

France and Italy significantly increased their policy and regulatory activity on CCS. In July 2024, France released an updated national CCUS strategy, building upon the version introduced for consultation in June 2023 (French Government, 2023; French Ministry of Economy, 2024a). A pivotal aspect lies in the country's willingness to develop its domestic CO_2 storage capacity.

To this end, in April 2024, the Ministry of Economy, Finance and Industrial and Digital Sovereignty recommended amendments to the mining code to facilitate the conversion of onshore hydrocarbon reservoirs into CO_2 storage facilities and launched a call for expressions of interest to identify potential future players across the CCS value chain (French Ministry of Economy, 2024c, 2024b).

In Italy, key developments included the adoption of the Energy Decree in February 2024, aimed at addressing regulatory gaps in CO_2 storage licences and authorisation processes, and the Infrastructure Decree in June that established a CCS Committee mandated to identify suitable areas for CO_2 storage and examine exploration applications (Gazzetta Ufficiale della Repubblica Italiana, 2024; Italian Ministry of Environment and Energy Security, 2024).

Other notable developments include the adoption of CO_2 pipeline decrees by the parliaments of Wallonia and Flanders in Belgium in March 2024, addressing the limited scope of the EU CCS Directive on this aspect (Belgian Official Gazette, 2024a, 2024b). Concurrently, in June, Denmark's Ministry for Climate, Energy, and Supply issued the country's first onshore CO_2 storage exploration licenses (Danish Energy Agency, 2024).

Lastly, Denmark and Sweden committed to providing financial support for the reduction of biogenic CO_2 emissions. In April 2024, the Danish Energy Agency backed three BECCS projects through its fund for negative emissions via CCS (NECCS) (Danish Energy Agency, 2024). Additionally, in July 2024, Sweden secured approval from the Commission under the state aid rules to allocate €3 billion to support CCS projects aimed at reducing emissions from biomass combustion or processing (European Commission, 2024a).

UK and EFTA countries

Beyond the EU, the UK and European Free Trade Association (EFTA) countries (Iceland, Liechtenstein, Norway and Switzerland) made significant strides in advancing CCS policies since the last reporting period. In November 2023, the UK bolstered its support by launching its Green Industry Growth Accelerator – a £960 million fund for CCUS, greenhouse gas removals (GGRs), and hydrogen (UK Department for Energy Security and Net Zero, 2024a). In December, it unveiled its vision for a competitive CCUS market by 2035 and consulted the public on topics such as a CCS network code to define the future commercial, operational and technical arrangements for the use of CO_2 networks, and, in May 2024, the integration of GGRs into the UK Emissions Trading System (ETS) (UK Department for Energy Security and Net Zero, 2023b, 2023a, 2024b). In October 2024 the UK government announced up to £21.7 billion pounds of funding support over the next 25 years for two CCS clusters.

Norway continued facilitating the storage of CO_2 on its continental shelf by designating two additional exploration areas in March 2024 , followed by three more in June (Norwegian Government, 2024).

In June, Iceland's Parliament approved a bill to align its Act on Hygiene and Pollution Prevention with the EU CCS Directive (Icelandic Supreme National Parliament, 2024). Finally, Switzerland announced its intention to ratify the 2009 amendment to Article 6 of the London Protocol in November 2023 and published new legislative proposals in January 2024 aimed at offering funding opportunities for CCS and CDR projects (Swiss Confederation, 2023, 2024).

Among the most significant political shifts in EU Member States is the reconsideration of initial restrictions on CCS, notably in Austria and Germany.

Leilac-1 Pilot Plant at the Heidelberg Materials Plant in Lixhe, Belgium. Image courtesy of Leilac Ltd.

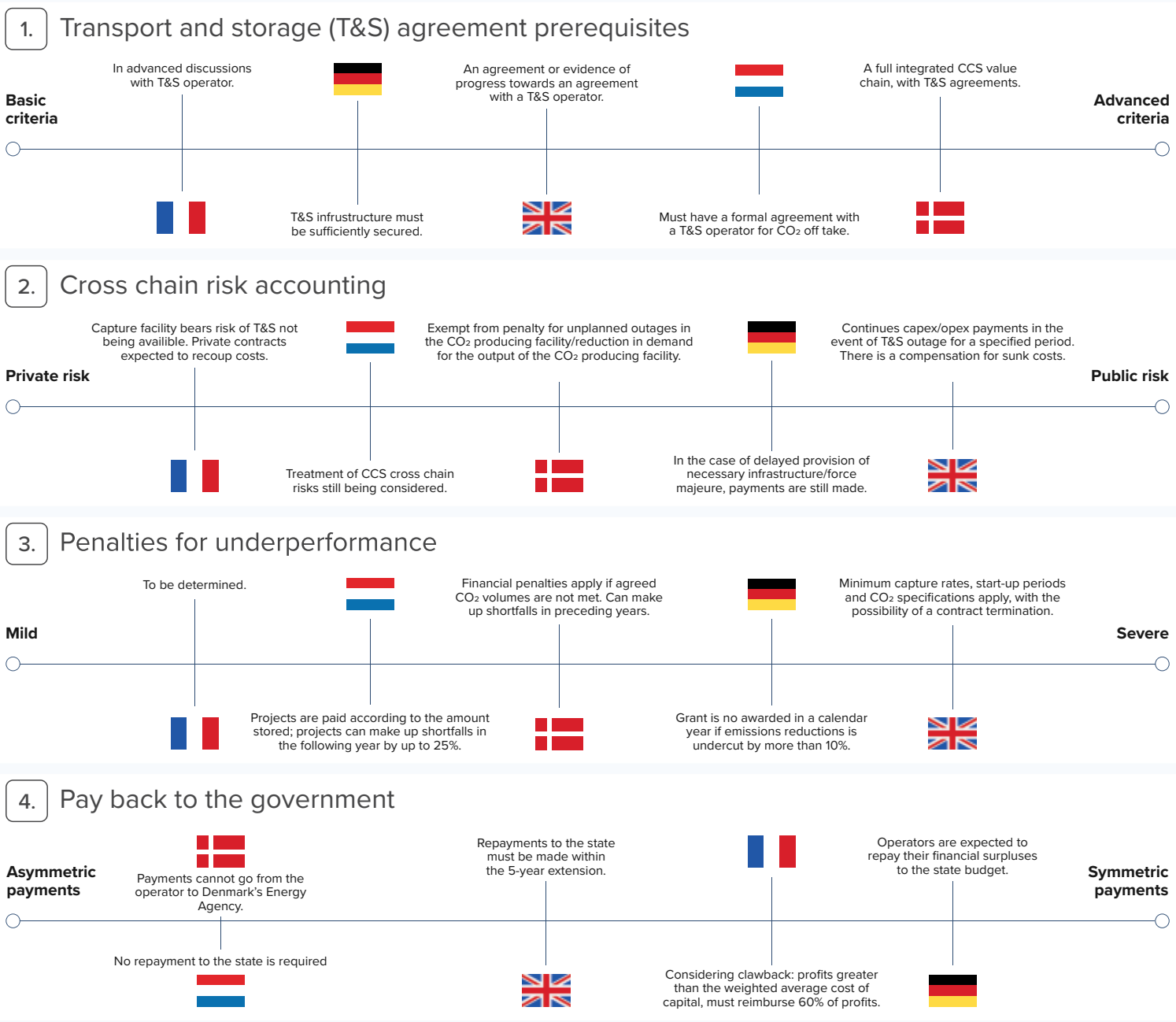
Case study 1

In February 2024, EU ETS prices dropped to around €52 per tonne of CO_2, tumbling from a peak of €100 per tonne the previous year (Ember, 2024). Contributing factors included lower gas prices, reduced industrial energy demand, and the EU's REPowerEU plan introducing additional allowances on the market to accelerate the energy transition and reduce reliance on Russian gas.

Despite challenges posed by lower carbon prices – like reduced revenues for certain public funds and weaker incentives for emission reduction technologies – several European countries, including Denmark, France, Germany, the Netherlands and the UK, implemented or planned Carbon Contracts for Difference (CCfD) schemes.

These schemes, compared in Figure 4.4-2, vary in design but share the objective of bridging the financial gap between emission allowances and the costs of clean technologies. Specifically, they compensate emitters when carbon prices dip below the cost of deploying CCS technologies, ensuring consistent financial incentives for climate mitigation investments.

Figure 4.4-2 Overview of CCfD schemes in Europe



1 Extent to which agreements between the T&S operator must be established prior to bidding.

2 Extent to which cross-chain risk in the form of T&S unavailability/outage is managed by the public or private sector.

3 Extent of financial penalty across the schemes if the facility underdelivers on CO_2 stored.

4 Whether the scheme includes a clawback mechanism requiring the payment of surpluses to the government in the event of profits above the carbon market price

Brevik CCS facility in Brevik, Norway. Image courtesy of SLB Capturi.

Projects

As of July 2024, there are 191 commercial CCS projects operating or at various stages of development in Europe, a 62% increase since last year's Global Status Report.

The number of dedicated CO_2 T&S facilities being developed in Europe doubled in a year, a departure from the past 25 years dominated by capture announcements over storage developments. Predominantly led by oil and gas companies, 23 facilities across the full development and operational pipeline target deep saline formations, while 18 others focus on depleted fields. Additionally, several carbon mineralisation storage sites in Iceland are operational or under development, although their potential scale is still being assessed.

The surge in storage demand is largely attributed to the emergence of CCS networks driven by policies and incentives that have transformed CO_2 T&S into a dedicated business model.

This shift has prompted European governments to release permits for the exploration and storage of CO_2, offshore and onshore, totaling over 40,000 km^2, roughly equivalent to the Netherlands' surface area.

The majority of the T&S projects are concentrated around the North Sea. In the Netherlands, the construction of the infrastructure of Porthos project, aimed at establishing a T&S network in Rotterdam's port, started in April 2024 (Porthos, 2024). From 2026, it is anticipated to store around 2.5 Mtpa of CO_2, with a total capacity of around 37 Mt. Aramis, focusing on capturing CO_2 from industrial sources for storage in North Sea fields, also progressed, with Petrofac commencing the front-end engineering design for its T&S system (Petrofac, 2024).

In Denmark, the Norne Carbon Storage Hub, aimed at developing a set of CO_2 reception facilities at Danish ports and pipelines for the transportation and storage of CO_2, was confirmed as a PCI by the EU in April 2024, recognising its role as a priority project with significant EU impact (Norne CCS, 2024).

In Norway, Northern Lights, a CO_2 T&S supplier, signed Europe's first commercial cross-border CCS contract with Yara International in December 2023. The contract will involve capturing 800,000 tonnes of CO_2 from a Dutch ammonia production plant and storing it in a reservoir 2,600 metres beneath the Norwegian seabed from 2026 (Yara, 2023).

In the UK, the government granted a development consent order in March 2024 for the HyNet CO_2 pipeline that will transport captured CO_2 from industrial areas in northwest England and north Wales to depleted gas reservoirs in Liverpool Bay (UK Government, 2024).

A handful of countries are intensifying their efforts to create similar decarbonisation opportunities for emitters in southern and eastern Europe. In the Mediterranean region, the Greek government is in talks with the European Commission to provide state aid to Prinos, a CO_2 storage site expected to receive FID in late 2024 and start operations in early 2026 with an initial storage capacity of up to 1 Mtpa of CO_2 (energypress, 2023; S&P Global 2024).

From February to May 2024, Italy's gas transmission operator, Snam, opened its first market survey on the potential demand for the transportation and storage of CO_2 at the Ravenna site where pilot injections began. Once fully operational in 2027, it is expected to store 4 Mtpa of CO_2 (Snam, 2024).

Despite limited policy developments in CCS, Poland showcased promising progress on the project front. Key initiatives include the Innovation Fund-supported Go4ECOPlanet project, set to be operational at the Lafarge cement plant in Kujawy by 2027, with a building permit obtained in June 2024 (Holcim, 2024), and the PCI-PMI ECO2CEE project, aiming to link Plisu industrial emitters with CO_2 storage sites.

Lastly, DAC initiatives are progressing in the region, with Mammoth, the world's largest plant, commencing operations in Iceland in May 2024 (Climeworks, 2024).

The number of CO_2 transport and storage facilities being developed in Europe doubled in a year.

Case Study 2 – International cooperation in CCS: European government initiatives

Europe has witnessed a surge in the adoption of Memoranda of Understanding (MoUs), Letters of Intent (LoIs) and other forms of bilateral partnerships, including CCS, in recent years aimed at promoting knowledge sharing, fostering business and financial cooperation, and facilitating the transboundary transport of CO_2 for geological storage.

Table 4.4-1 presents an overview of these arrangements from 2020 to 2024.

This trend highlights a growing commitment among European nations to collaborate on CCS to meet their climate goals. Notably, 12 of these agreements were signed during the reporting period from November 2023 to October 2024, indicating a significant acceleration in collaborative efforts. An important milestone was reached in April 2024 when five countries concluded bilateral agreements adhering to the requirements of the London Protocol, marking a crucial step in the development of a regional CCS market (Government of the Netherlands, 2024).

Table 4.4-1 Overview of bilateral agreements and partnerships, including CCS, adopted by European countries (2020-2024)

	Austria	Belgium	Denmark	France	Germany	Iceland	The Netherlands	Norway	Sweden	Switzerland	United Kingdom
Austria			**MoU** (July 2024)								
Belgium			**MoU** (September 2022)		**Joint declaration** (February 2023)		**MoU** (June 2023)	**MoU** (April 2024)			**MoU** (February 2022)
Denmark	**MoU** (July 2024)	**MoU** (September 2022)		**LoI** (March 2024); **MoU** (March 2024)	**Joint declaration** (April 2023)		**MoU** (August 2022); **MoU** (October 2023)	**MoU** (June 2023); **MoU** (April 2024)	**MoU** (April 2024)		**MoU** (April 2023)
France			**LoI** (March 2024); **MoU** (March 2024)				**Pact** (April 2023)	**LoI** (December 2022); **LoI** (January 2024)			**Statement of cooperation** (March 2023)
Germany		**Joint declaration** (February 2023)	**Joint declaration** (April 2023)					**Joint declaration** (January 2023)			**Joint declaration** (November 2023)
Iceland										**Declaration of Intent** (July 2021)	
The Netherlands		**MoU** (June 2023)	**MoU** (August 2022); **MoU** (October 2023)	**Pact** (April 2023)				**MoU** (April 2024)		**MoU** (March 2022)	
Norway		**MoU** (April 2024)	**MoU** (June 2023); **MoU** (April 2024)	**LoI** (December 2022); **LoI** (January 2024)	**Joint declaration** (January 2023)		**MoU** (April 2024)		**MoU** (April 2024)	**Declaration of Intent** (May 2024)	
Sweden			**MoU** (April 2024)					**MoU** (April 2024)		**MoU** (December 2023)	
Switzerland						**Declaration of Intent** (July 2021)	**MoU** (March 2022)	**Declaration of Intent** (May 2024)	**MoU** (December 2023)		
United Kingdom		MoU (February 2022)	**MoU** (April 2023)	**Statement of cooperation** (March 2023)	**Joint declaration** (November 2023)						

4.5 Middle East and Africa

Overview

The Middle East and Africa (MEA) region has three projects in operation and six in construction. CCS adoption in the region was initially driven by enhanced oil recovery (EOR) as it provided an economic incentive for national oil companies. The urgent need to achieve climate commitments and carbon neutrality goals has since shifted the focus towards the decarbonisation of carbon-intensive energy and industrial sectors.

The push for low-carbon fuels, including low-carbon hydrogen, sustainable aviation fuels (SAF), and low-carbon shipping fuels (e.g. low carbon ammonia), underscores the need for CCS. Moreover, the establishment of carbon markets in the region further supports carbon capture and removal initiatives. The region saw significant progress, with numerous projects, investments, and partnerships announced.

In the United Arab Emirates (UAE), ADNOC expanded its CCS portfolio by acquiring a 10% stake in Storegga, a UK-based CCS developer and a key player in the Acorn project in Scotland (ADNOC, 2024b). This investment complements ADNOC's existing CCS initiatives, such as the operational Al Reyadah project and the Habshan project, which recently reached final investment decision (Global CCS Institute, 2023)(ADNOC, 2023). The company also significantly boosted its budget for decarbonisation projects to US$23 billion, aiming to expand both its domestic and international carbon management platforms (Benny, 2024). Moreover, ADNOC signed an agreement with the Japan Bank for International Cooperation (JBIC) to establish a US$3 billion green financing facility (ADNOC, 2024a).

In addition, ADNOC is collaborating with Australia's Santos to explore a carbon management platform and develop CO_2 shipping and transportation infrastructure, while also partnering with Mitsubishi Heavy Industries (MHI) to support the decarbonisation of its oil and gas production sites and produce low-carbon hydrogen and ammonia (Offshore Magazine, 2023)(MHI, 2023). To facilitate the cross-border transfer of CO_2, the UAE signed an MoU with South Korea to strengthen cooperation on low carbon hydrogen production and CCS.

Saudi Arabia has set an overall target of capturing and storing 44 Mtpa CO_2 by 2035. Saudi Arabia is also undertaking new forms of international collaborations. Together with China, the country intends to explore CCS applications beyond oil and gas, including industrial decarbonisation, under the circular carbon economy framework (KAPSARC, 2024). In addition, the Saudi and UK governments took steps towards strengthening cooperation on CCUS and low-carbon hydrogen (UK Government, 2024). Similar bilateral efforts have also been undertaken throughout 2024 between Saudi Arabia and the European Union, US, Mauritania, Uzbekistan and Jordan.

In Oman, OQ Gas Network (OQGN) aims to leverage its extensive pipeline infrastructure for hydrogen and CO_2 transport as it explores new CCS and EOR projects. Occidental and OQGN signed an MoU to study CCS deployment in conjunction with EOR projects, aligning with Oman's broader CCUS regulatory framework development for blue hydrogen and CCS (Occidential, 2023) (Oman Ministry of Energy and Minerals, 2023). Oman engaged in conversations with the US to bolster cooperation in the field of environmental conservation and clean energy development, touching upon CCUS technologies.

In Morocco, the government signed an MoU with Norway to cooperate on Article 6 of the Paris Agreement, focusing on carbon market mechanisms and capacity-building programs (Benoit-Ivan, 2024).

3 facilities in operation

6 six in construction

in the Middle east and Africa (MEA) region

44 Mtpa

Saudi Arabia's target for capturing and storing CO_2 by 2035

US **$23 billion** ADNOC's decarbonisation project budget

10 Mtpa

ADNOC's UAE carbon capture target by 2030, net-zero operations by 2045

Saudi Arabia

strengthens collaborations with China, UK, the European Union, US, Mauritania, Uzbekistan, Jordan

In addition, Exxaro and the Council for Geoscience in South Africa signed an MoU to collaborate on CCS initiatives aimed at reducing greenhouse gas emissions.

These investments and agreements highlight the growing commitment in MEA to utilise CCS as strategic technologies to reduce greenhouse gas emissions and achieve carbon neutrality. Each country is leveraging its unique strengths and resources to advance CCS initiatives, demonstrating a regional momentum towards sustainable development and climate action.

Policy

The development of CCS policies in MEA is progressing rapidly, driven by ambitious decarbonisation targets and international climate commitments. Several countries in the region outlined comprehensive strategies to integrate CCS into their broader efforts to reduce carbon emissions.

At COP28, the UAE launched its Industrial Decarbonisation Roadmap, with CCUS, clean electricity, hydrogen and efficiency enhancements expected to collectively account for 70% of the emissions reductions in the industrial sector. The roadmap envisages a cumulative emissions reduction target of 2.9 Gt by 2050, equivalent to 93% emissions reduction (UAE Government, 2023). The UAE's Long-Term Strategy (LTS) also highlights CCS as a key technology for decarbonising hard-to-abate industrial sectors, expected to contribute 32% to the sector's carbon neutrality target, equivalent to 43.5 Mtpa of CCS capacity by 2050.

In July 2023, the UAE unveiled its updated Energy Strategy 2050 and National Hydrogen Strategy, aiming to bolster hydrogen production with incentives, including a potential cap-and-trade system. The strategy targets 7 Mtpa of low-carbon hydrogen production by 2050 (A&O Shearman, 2023).

Meanwhile, ADNOC doubled its carbon capture target to 10 Mtpa by 2030 ahead of COP28 in line with its long-term goal of achieving net-zero operations by 2045 (S&P Global, 2023).

The UAE announced the details of its General Policy for SAF, which aims to support the decarbonisation of the aviation sector and lay the ground for the establishment of a regional hub for low-carbon aviation fuel (UAE Government, 2024).

The UAE's focus on carbon markets is also intensifying. The Air Carbon Exchange (ACX), established in late 2022, created a regulated voluntary carbon trading exchange in Abu Dhabi. This initiative is expected to encourage a significant increase in carbon trading across the UAE and the broader region, with an estimated market value of US$40 billion by 2030. The UAE Carbon Alliance pledged to purchase US$450 million in African carbon credits by 2030, reflecting a strong commitment to integrating CCS into its carbon market strategy (UAE, 2023b).

Saudi Aramco published its 2023 sustainability report and announced increasing its CCS target to 14 Mtpa by 2035 (Saudi Aramco, 2023). In addition, Saudi Arabia announced in early 2024 the launch of a domestic carbon crediting scheme, the Greenhouse Gas Crediting and Offsetting mechanism, which will enable companies to offset emissions by purchasing credits compliant with Article 6 of the Paris Agreement. Furthermore, Saudi firms, including Saudi Airlines, bid for 2 million tonnes of carbon credits in a significant auction in Kenya, showcasing the country's proactive approach to carbon trading (Miriri, 2023).

Egypt is also making significant strides in CCS policy. The Financial Regulatory Authority (FRA) approved several certification bodies for carbon emissions reduction projects, which is a crucial step in establishing a regulated carbon market (Daily News, 2024).

Oman launched its CCUS and Blue Hydrogen Framework, spearheaded by the Ministry of Energy and Minerals (MEM). The Institute is partnering with Petroleum Development Oman (PDO), in the development of guidance that will support the government in the design and implementation of CCS-specific legislation (Muscat Daily, 2023). Oman's updated second Nationally Determined Contributions (NDC) underscores the importance of large-scale CCUS, as well as the possibility for the country to also leverage engineered negative emissions methods, such as Direct Air Capture (DAC), to reduce emissions beyond 2030 (Argus, 2023).

The Global Carbon Council (GCC) based in Qatar published a methodology for CCS projects that covers the capture, transport, and geological storage of CO_2.

GCC methodologies enable project owners to calculate, monitor, and report emission reductions or removals from eligible GHG mitigation projects, facilitating their access to the global carbon market (GCC, 2024). Additionally, the GCC signed an MoU with the West African Alliance (WAA) on Carbon Markets and Climate Finance to advance the implementation of Article 6.2 of the Paris Agreement and the development of carbon market tools in West Africa, (Global Carbon

CycloneCC Industrial Demonstration Unit in the UAE. Image courtesy of Carbon Clean.

Council, 2023). Moreover, GCC partnered with Global Environmental Markets (GEM) to acquire the Global Carbon Registry® (GCR), a fully integrated carbon registry solution (GORD, 2023).

Across MEA, there is a growing recognition of the importance of CCS in achieving climate goals. These policy developments underscore a regional commitment to harnessing CCS and CDR technologies to reduce carbon emissions. Financial incentives, such as tax credits, grants, and subsidies, are crucial to lower the initial investment barriers and make CCS technologies more economically viable. Establishing carbon pricing mechanisms can also drive investments by creating a financial incentive to reduce emissions. The concept of joint ventures has proven to be an effective way of deploying CCS projects. This is evident with the Al Reyadah project and the Al Jubail hub, which started or are being developed as joint ventures.

Projects

The MEA region is a promising hub for CCS technologies, with several operational projects demonstrating the region's commitment to reducing GHG emissions. In particular, the GCC countries, namely Saudi Arabia, the UAE and Qatar, demonstrated their net-zero and climate ambitions in several large-scale operational CCS projects. The UAE has been producing low-carbon steel since 2016 through its 0.8 Mtpa CCS-integrated steel production facility, while Qatar is capturing and storing 2.1 Mtpa CO_2 at its Ras Laffan LNG Facility. Saudi Arabia is leading the MEA CCS charge, with the 0.8 Mtpa Uthmaniyah project and the Al Jubail CCUS hub, which is expected to reach a capacity of 9 Mtpa by 2027 (Global CCS Institute, 2023). Alongside these operational and planned projects, the region is also developing multiple new projects and initiatives, and heavily investing in CCS technologies.

Saudi Aramco signed partnership agreements with Siemens AG and Spiritus in the field of DAC (CNBC, 2023) (Aramco, 2024). The company also signed agreements to demonstrate the technical feasibility and commercial viability of a synthetic e-fuel facility with ENOWA, aiming to produce 35 barrels per day of low-carbon, synthetic gasoline from renewable-based hydrogen and captured CO_2 (Aramco, 2023). Additionally, Saudi Arabia launched a carbon capture facility in Rabigh to capture CO_2 from a mono-ethylene glycol (MEG) plant (Arab News, 2023). The Kingdom is preparing for CCS-integrated power generation with projects amounting to 7,200 MW, emphasising carbon capture unit readiness (Arab News 2024, 2024). Aker Carbon Capture and Aramco signed an MoU to explore modular CCS solutions in Saudi Arabia (Aker, 2023).

The UAE positioned itself as a regional CCS frontrunner with several high-profile projects. Recently, ADNOC announced plans to partner with POSCO to produce low carbon hydrogen at a facility in Gwangyang (Hydrogen Central, 2024). This follows an earlier FID decision where ADNOC awarded a contract to Petrofac for the Habshan CCUS project, valued at over US$600 million, to build carbon capture units and associated infrastructure (Petrofac, 2023). Two commercial projects are under construction for ADNOC: Habshan and Ghasha Concession with 1.5 Mtpa each. As part of another collaboration, ADNOC will use Carbon Clean's modular CycloneCC technology at the Ruwais petrochemical project (CarbonClean, 2023).

Additionally, the Sharjah National Oil Company (SNOC) is planning a CCS hub project to capture CO_2 from various emitters, store it in an onshore mature gas field, and potentially trade carbon credits. Sumitomo and SNOC signed an MoU to study the feasibility of CCS in Sharjah (Sumitomo, 2023).

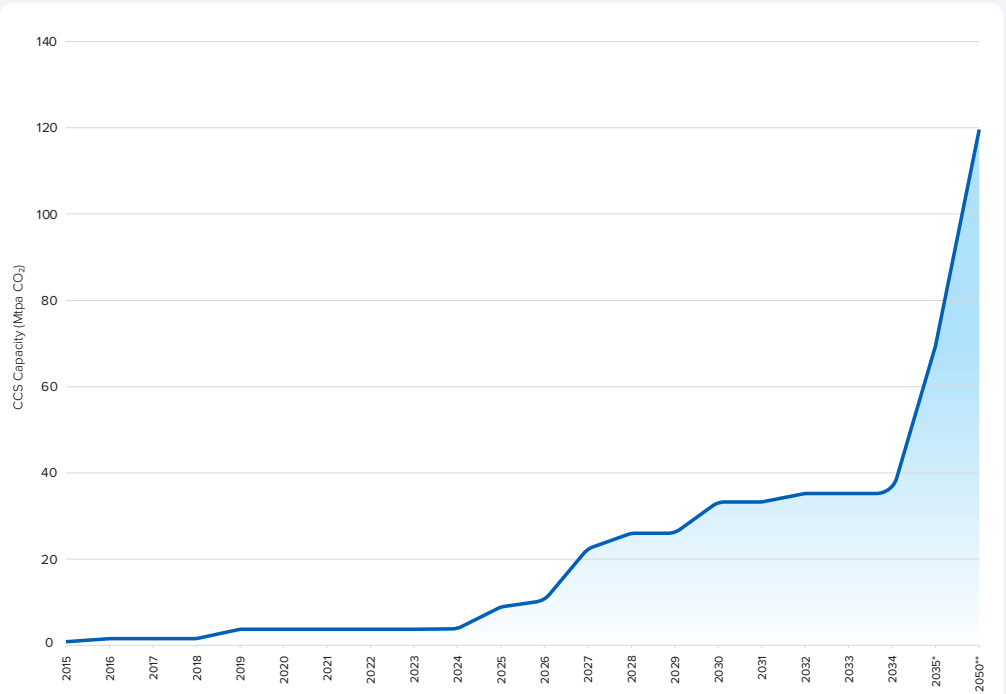
The MEA region is a promising hub for CCS technologies, with several operational projects demonstrating the region's commitment to reducing GHG emissions.

Oman is making strides in CCS with multiple projects aimed at reducing CO_2 emissions. The CO_2 mineralisation start-up 44.01 commenced operations with Aircapture at its DAC and mineralisation pilot project in the Hajar Mountains, successfully completing initial safety and injectivity tests (44.01, 2023). Oman's Sohar Net Zero Alliance plans to introduce a CCUS facility in Sohar Port as part of its goal to achieve carbon neutrality by 2050 (Offshore Energy, 2023b). PDO launched a pilot project dedicated to utilising CO_2 for EOR in northern Oman. (Raj, 2023). Additionally, Jindal Shadeed Iron and Steel (JSIS) is collaborating to establish a pilot plant for capturing CO_2 from flue gas, with expansion plans to capture 0.7 Mtpa by 2027 (Steel Mill of the world, 2023).

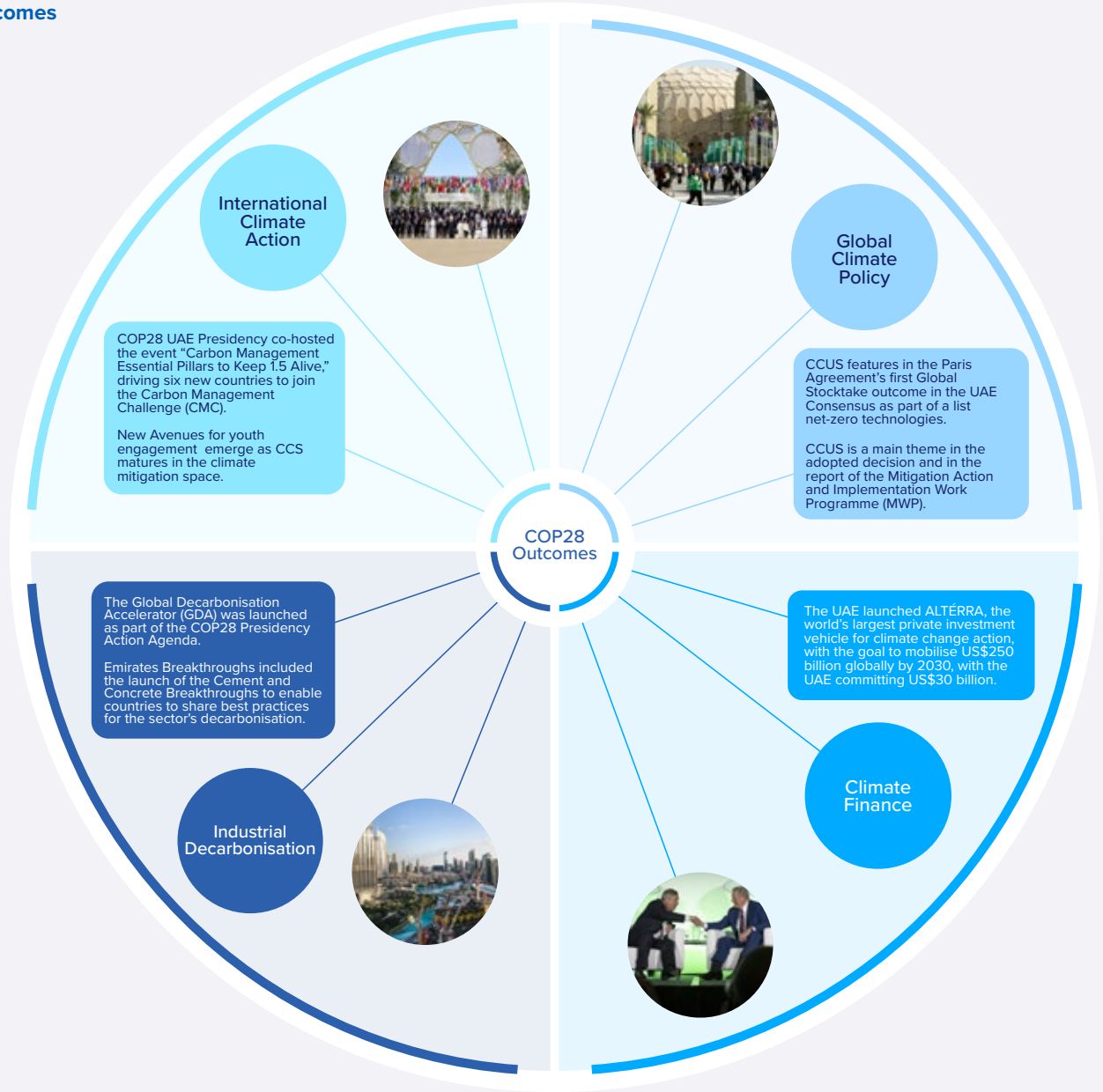
In Bahrain, Mitsui OSK Lines (MOL) and Bapco Energies intend to establish a cross-border CCS value chain where liquefied CO_2 will be shipped by MOL and sequestered by Bapco (Offshore Energy, 2023a).

Egypt made progress in identifying potential carbon storage sites, with SLB screening and ranking CO_2 storage sites for Cheiron in Egypt's Western Desert, thus aiding Cheiron and its partners in reaching a 2040 net-zero target by capturing and sequestering 350 ktpa of CO_2 and utilising an additional 15 ktpa (SLB, 2024).

Figure 4.5-1
Operational and planned CCS Capacity in MEA (Mtpa) by 2050



COP28 Outcomes



In South Africa, the Council for Geoscience and Mzansi Exploration, Drilling and Mining completed the drilling for the Carbon Capture and Utilisation Storage pilot project, marking a critical step in its CCS project development (Council of Geoscience, 2024). In Kenya, Octavia Carbon is demonstrating DAC technology and MRV tools with a pilot project that has an initial removal capacity of 250 tonnes of CO_2, scaling up to 1,000 tonnes per year (Carbon Herald, 2024). Moreover, Climeworks and Great Carbon Valley (GCV) have announced their intention to jointly explore the development of large-scale direct air capture and storage (DAC+S) projects in Kenya (Climeworks, 2023).

CCS growth in the MEA region, particularly in GCC countries, is promising. By 2035, the project pipeline capacity is expected to reach at least 65 Mtpa, driven by announced projects and commitments from governments and companies.

DAC projects are on the rise, particularly in Kenya, Saudi Arabia, UAE, and Oman, where they are often combined with CO_2 mineralisation or SAF production. The future growth of these projects will be determined by policies and agreements related to CDR and SAF offtake.

CCS growth in the MEA region, particularly in GCC countries, is promising. By 2035, the project pipeline is expected to reach at least 65 Mtpa.

5.0

FACILITIES LIST

Operational

Facility Name	Country	Operational Year	Industry	Capture Capacity (Mtpa CO_2)	Storage Code
Occidental Terrell	United States	1972	Natural Gas / LNG	0.5	Enhanced Oil Recovery
Enid Fertilizer	United States	1982	Hydrogen / Ammonia / Fertiliser	0.2	Enhanced Oil Recovery
ExxonMobil Shute Creek Gas	United States	1986	Natural Gas / LNG	7	Enhanced Oil Recovery
Hungary's Mol Szank Field CO2-EOR	Hungary	1992	Natural Gas / LNG	0.16	Enhanced Oil Recovery
Sleipner CCS project	Norway	1996	Natural Gas / LNG	1	Deep Saline Formation
Great Plains Synfuels Plant and Weyburn-Midale	United States	2000	Hydrogen / Ammonia / Fertiliser	3	Enhanced Oil Recovery
Core Energy CO2-EOR South Chester plant	United States	2003	Natural Gas / LNG	0.35	Enhanced Oil Recovery
Equinor Snohvit	Norway	2008	Natural Gas / LNG	0.7	Deep Saline Formation
Petrobras Santos Basin Pre-Salt Oil Field	Brazil	2008	Natural Gas / LNG	10.6	Enhanced Oil Recovery
Arkalon CO_2 Compression Facility	United States	2009	Bioenergy / Ethanol	0.5	Enhanced Oil Recovery
Longfellow WTO Century Plant	United States	2010	Natural Gas / LNG	5	Enhanced Oil Recovery
Yanchang Integrated Demonstration	China	2012	Chemical	0.05	Enhanced Oil Recovery
Bonanza BioEnergy CCS	United States	2012	Bioenergy / Ethanol	0.1	Enhanced Oil Recovery
Air Products Valero Port Arthur Refinery	United States	2013	Hydrogen / Ammonia / Fertiliser	0.9	Enhanced Oil Recovery
Coffeyville Gasification Plant	United States	2013	Hydrogen / Ammonia / Fertiliser	0.9	Enhanced Oil Recovery
Contango Lost Cabin Gas Plant	United States	2013	Natural Gas / LNG	0.9	Enhanced Oil Recovery
SaskPower Boundary Dam	Canada	2014	Power Generation and Heat	1	Enhanced Oil Recovery
Xinjiang Dunhua Karamay	China	2015	Chemical	0.1	Enhanced Oil Recovery
Saudi Aramco Uthmaniyah	Saudi Arabia	2015	Natural Gas / LNG	0.8	Enhanced Oil Recovery
Shell Quest	Canada	2015	Hydrogen / Ammonia / Fertiliser	1.3	Deep Saline Formation
ADNOC Al-Reyadah	United Arab Emirates	2016	Iron and Steel	0.8	Enhanced Oil Recovery
ADM Illinois Industrial	United States	2017	Bioenergy / Ethanol	1	Deep Saline Formation
Petra Nova Carbon Capture	United States	2017	Power Generation and Heat	1.4	Enhanced Oil Recovery
CNPC Jilin Oil Field	China	2018	Natural Gas / LNG	0.6	Enhanced Oil Recovery
QatarEnergy LNG	Qatar	2019	Natural Gas / LNG	2.2	Deep Saline Formation
Chevron Gorgon	Australia	2019	Natural Gas / LNG	4	Deep Saline Formation
WCS Redwater	Canada	2020	Hydrogen / Ammonia / Fertiliser	0.3	Enhanced Oil Recovery
NWR Sturgeon Refinery	Canada	2020	Oil Refining	1.6	Enhanced Oil Recovery

Facility Name	Country	Operational Year	Industry	Capture Capacity (Mtpa CO_2)	Storage Code
Enhance Clive Oil Field	Canada	2020	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Enhanced Oil Recovery
Wolf Alberta Carbon Trunk Line	Canada	2020	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Enhanced Oil Recovery
Climeworks Orca	Iceland	2021	Direct Air Capture	0.004	Mineral Carbonation
Yangchang Yan'an CO_2-EOR	China	2021	Chemical	0.1	Enhanced Oil Recovery
China National Energy Guohua Jinjie	China	2021	Power Generation and Heat	0.15	Under Evaluation
Sinopec Nanjing Chemical	China	2021	Chemical	0.2	Enhanced Oil Recovery
Dark Horse Storage	United States	2021	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Red Trail Energy Richardton Ethanol	United States	2022	Bioenergy / Ethanol	0.18	Deep Saline Formation
Yangchang Yulin CO_2-EOR	China	2022	Chemical	0.3	Enhanced Oil Recovery
Entropy Glacier Gas Plant (Phase 1A,1B)	Canada	2022	Natural Gas / LNG	0.32	Deep Saline Formation
Sinopec Qilu-Shengli	China	2022	Chemical	1	Enhanced Oil Recovery
Heirloom DAC California	United States	2023	Direct Air Capture	0.001	Mineral Carbonation
Huaneng Yangpu Gas-fired Carbon Capture Demo Project	China	2023	Power Generation and Heat	0.002	Enhanced Oil Recovery
Guanghui Energy Methanol Plant	China	2023	Chemical	0.1	Enhanced Oil Recovery
Harvestone Blue Flint Ethanol	United States	2023	Bioenergy / Ethanol	0.2	Deep Saline Formation
CNOOC Enping	China	2023	Natural Gas / LNG	0.3	Deep Saline Formation
Sinopec Jinling Petrochemical (Nanjing Refinery)	China	2023	Oil Refining	0.3	Enhanced Oil Recovery
China National Energy Taizhou	China	2023	Power Generation and Heat	0.5	Enhanced Oil Recovery
Barnett Zero CCS	United States	2023	Natural Gas / LNG	0.185	Deep Saline Formation
CarbFix Mammoth	Iceland	2024	Direct Air Capture	0.03	Mineral Carbonation
Qingzhou Oxy-Fuel Combustion Carbon Capture Project	China	2024	Cement and Concrete	0.2	Enhanced Oil Recovery
Bantam DAC Oklahoma[1]	United States	2024	Direct Air Capture	0.005	Enhanced Oil Recovery

[1] Facility commenced operations in early August 2024, replaces utilisation facility that has been removed.

In Construction

Facility Name	Country	Operational Year	Industry	Capture Capacity (Mtpa CO_2)	Storage Code
44.01 Project Hajar	Oman	2024	Direct Air Capture	0.001	Mineral Carbonation
Air Products Blue But Better	Canada	2024	Hydrogen / Ammonia / Fertiliser	3	Enhanced Oil Recovery
Baotou Steel	China	2024	Iron and Steel	0.5	Under Evaluation
China National Energy Ningxia	China	2024	Chemical	3	Enhanced Oil Recovery
China National Energy Xinjiang Chemicals CCUS	China	2024	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Enhanced Oil Recovery
Cotton Cove CCS	United States	2024	Natural Gas / LNG	0.045	Enhanced Oil Recovery
Heidelberg Materials Brevik Cement Plant	Norway	2024	Cement and Concrete	0.4	Deep Saline Formation
Huaneng Longdong Energy Base	China	2024	Power Generation and Heat	1.5	Under Evaluation
Santos Moomba CCS	Australia	2024	Natural Gas / LNG	1.7	Depleted Oil and Gas Field
Xinjiang Jinlong Shenwu	China	2024	Power Generation and Heat	0.2	Enhanced Oil Recovery
ADNOC Ghasha Concession Fields	United Arab Emirates	2025	Natural Gas / LNG	1.5	Enhanced Oil Recovery
ADNOC Habshan	United Arab Emirates	2025	Natural Gas / LNG	1.5	Under Evaluation
CF Industries Donaldsonville	United States	2025	Hydrogen / Ammonia / Fertiliser	2	N/A
Linde Beaumont hydrogen plant	United States	2025	Hydrogen / Ammonia / Fertiliser	2.2	N/A
Northern Lights Transport and Storage	Norway	2025	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
OCI Iowa Fertiliser Company	United States	2025	Hydrogen / Ammonia / Fertiliser	0.45	N/A
Petronas Kasawari	Malaysia	2025	Natural Gas / LNG	3.3	Depleted Oil and Gas Field
Qatar Petroleum North Field East	Qatar	2025	Natural Gas / LNG	2.9	Under Evaluation
Shell Atlas Carbon Storage Hub	Canada	2025	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Shell Polaris (Scotford Complex)	Canada	2025	Hydrogen / Ammonia / Fertiliser	0.75	N/A
Silverstone	Iceland	2025	Power Generation and Heat	0.03	Mineral Carbonation
STRATOS (1PointFive Direct Air Capture)	United States	2025	Direct Air Capture	0.5	Deep Saline Formation
Summit Central City Biorefinery	United States	2025	Bioenergy / Ethanol	0.33	Deep Saline Formation
Summit Wood River Biorefinery	United States	2025	Bioenergy / Ethanol	0.35	Deep Saline Formation
Summit York Biorefinery	United States	2025	Bioenergy / Ethanol	0.14	Deep Saline Formation
Air Liquide Rotterdam	Netherlands	2026	Hydrogen / Ammonia / Fertiliser	0.5	Depleted oil and Gas field
Air Products Louisiana Clean Energy Complex	United States	2026	Hydrogen / Ammonia / Fertiliser	5	Deep Saline Formation

Facility Name	Country	Operational Year	Industry	Capture Capacity (Mtpa CO_2)	Storage Code
Asnaes CHP Plant	Denmark	2026	Power Generation and Heat	0.28	Deep Saline Formation
Avedore CHP Plant	Denmark	2026	Power Generation and Heat	0.15	Deep Saline Formation
Entropy Glacier Gas Plant Phase 2	Canada	2026	Power Generation and Heat	0.16	Under Evaluation
Porthos CO_2 Transport and Storage	Netherlands	2026	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field
QAFCO Ammonia-7 Blue Ammonia Facility	Qatar	2026	Hydrogen / Ammonia / Fertiliser	1.5	Under Evaluation
Summit Mid-West Express Trunk Pipeline	United States	2026	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Yara Sluiskil	Netherlands	2026	Hydrogen / Ammonia / Fertiliser	0.8	Deep Saline Formation
Air Products Rotterdam	Netherlands	2026	Hydrogen / Ammonia / Fertiliser	Under Evaluation	Depleted Oil and Gas Field
Shell Pernis Refinery Rotterdam	Netherlands	2026	Oil Refining	1.15	Depleted Oil and Gas Field
CapturePoint Solutions Central Louisiana Regional Carbon Storage (CENLA) Hub	United States	2027	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Dow Fort Saskatchewan ethylene CCS	Canada	2027	Chemical	Under Evaluation	Enhanced Oil Recovery
Saudi Aramco Jubail Hub	Saudi Arabia	2027	Natural Gas / LNG	9	Deep Saline Formation
Total Energies Papua LNG	Papua New Guinea	2027	Natural Gas / LNG	1	Enhanced Gas Recovery
OASIS Shelby County	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
PTTEP Arthit	Thailand	Under Evaluation	Natural Gas / LNG	1	Deep Saline Formation
Targa Red Hills natural gas processing complex	United States	Under Evaluation	Natural Gas / LNG	0.5	Deep Saline Formation
Yulin Integrated Coal Liquefication	China	Under Evaluation	Chemical	4	Enhanced Oil Recovery

Advanced Development

Facility Name	Country	Operational Year	Industry	Capture Capacity (Mtpa CO_2)	Storage Code
Buxton Lime Net Zero	United Kingdom	2024	Cement and Concrete	0.02	N/A
Mote Wood Waste to Hydrogen Facility	United States	2024	Hydrogen / Ammonia / Fertiliser	0.15	N/A
Parc Adfer CCS	United Kingdom	2024	Waste-to-Energy	0.235	Deep Saline Formation
FCL Regina Refinery	Canada	2024	Oil Refining	0.25	N/A
Summit Madison Biorefinery	United States	2024	Bioenergy / Ethanol	0.25	Deep Saline Formation
Summit Mount Vernon Biorefinery	United States	2024	Bioenergy / Ethanol	0.25	Deep Saline Formation
Aemetis Keyes Ethanol	United States	2024	Bioenergy / Ethanol	0.4	Deep Saline Formation
Entropy Athabasca Leismer	Canada	2024	Oil Refining	0.44	N/A
Venture Global LNG CP2	United States	2024	Natural Gas / LNG	0.5	Deep Saline Formation
Carbon Connect Delta	Belgium	2024	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	N/A
Tallgrass Energy Eastern Wyoming Sequestration Hub	United States	2024	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Whitecap Resources Southeast Saskatchewan Hub	Canada	2024	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Alba Aluminium Bahrain	Bahrain	2024	Aluminium	Under Evaluation	Under Evaluation
Freeport LNG CCS project	United States	2024	Natural Gas / LNG	Under Evaluation	N/A
KVA Linth CCS	Switzerland	2025	Waste-to-Energy	0.12	N/A
Bridgeport Ethanol	United States	2025	Bioenergy / Ethanol	0.17	Deep Saline Formation
Lone Cypress Hydrogen	United States	2025	Hydrogen / Ammonia / Fertiliser	0.2	N/A
Amager Bakke Waste to Energy	Denmark	2025	Power Generation and Heat	0.5	N/A
One Earth Energy Ethanol	United States	2025	Bioenergy / Ethanol	0.5	N/A
Acorn Carbon Capture, Storage and Hydrogen	United Kingdom	2025	Hydrogen / Ammonia / Fertiliser	1	N/A
Lehigh Cement Plant	Canada	2025	Cement and Concrete	1	Under Evaluation
Holcim Cement	United States	2025	Cement and Concrete	1.3	N/A
Cal Capture	United States	2025	Power Generation and Heat	1.55	Depleted Oil and Gas Field
Net Zero Teesside - CCGT Facility	United Kingdom	2025	Power Generation and Heat	2	Deep Saline Formation
Caledonia Clean Energy CCS	United Kingdom	2025	Power Generation and Heat	3	Under Evaluation
East Coast Cluster Humber Pipeline (HCCP)	United Kingdom	2025	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation

Facility Name	Country	Operational Year	Industry	Capture Capacity (Mtpa CO_2)	Storage Code
East Coast Cluster Teesside Pipeline	United Kingdom	2025	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Maroa (Decatur Addition)	United States	2025	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Northern Endurance Transport and Storage	United Kingdom	2025	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Prinos CO_2 Storage	Greece	2025	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field
Project Greensand	Denmark	2025	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field
Wolf Lamont Carbon Hub	Canada	2025	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Frog Lake Capture	Canada	2025	Power Generation and Heat	Under Evaluation	N/A
SK Energy Shepherd	South Korea	2025	Various	Under Evaluation	Under Evaluation
Starwood Energy Power Plant	United States	2025	Power Generation and Heat	Under Evaluation	Enhanced Oil Recovery
Heirloom Shreveport Dac	United States	2026	Direct Air Capture	0.017	N/A
Kvitebjørn Waste to Energy	Norway	2026	Waste-to-Energy	0.06	Deep Saline Formation
Summit Huron Biorefinery	United States	2026	Bioenergy / Ethanol	0.09	Deep Saline Formation
Summit Galva Biorefinery	United States	2026	Bioenergy / Ethanol	0.11	Deep Saline Formation
Summit Aberdeen Biorefinery	United States	2026	Bioenergy / Ethanol	0.14	Deep Saline Formation
Summit Norfolk Biorefinery	United States	2026	Bioenergy / Ethanol	0.15	Deep Saline Formation
Summit Atkinson Biorefinery	United States	2026	Bioenergy / Ethanol	0.16	Deep Saline Formation
Summit Lamberton Biorefinery	United States	2026	Bioenergy / Ethanol	0.16	Deep Saline Formation
Summit Merrill Biorefinery	United States	2026	Bioenergy / Ethanol	0.16	Deep Saline Formation
Summit Otter Tail Biorefinery	United States	2026	Bioenergy / Ethanol	0.17	Deep Saline Formation
Summit Redfield Biorefinery	United States	2026	Bioenergy / Ethanol	0.17	Deep Saline Formation
Summit Superior Biorefinery	United States	2026	Bioenergy / Ethanol	0.17	Deep Saline Formation
Summit Granite Falls Biorefinery	United States	2026	Bioenergy / Ethanol	0.18	Deep Saline Formation
Summit Heron Lake Biorefinery	United States	2026	Bioenergy / Ethanol	0.19	Deep Saline Formation
Summit Sioux Center Biorefinery	United States	2026	Bioenergy / Ethanol	0.19	Deep Saline Formation
Summit Goldfield Biorefinery	United States	2026	Bioenergy / Ethanol	0.22	Deep Saline Formation
Summit Onida Biorefinery	United States	2026	Bioenergy / Ethanol	0.23	Deep Saline Formation
Summit Steamboat Rock Biorefinery	United States	2026	Bioenergy / Ethanol	0.23	Deep Saline Formation
Summit Bushmills Biorefinery	United States	2026	Bioenergy / Ethanol	0.24	N/A
Summit Shenandoah Biorefinery	United States	2026	Bioenergy / Ethanol	0.24	Deep Saline Formation

Facility Name	Country	Operational Year	Industry	Capture Capacity (Mtpa CO_2)	Storage Code
Summit Nevada Biorefinery	United States	2026	Bioenergy / Ethanol	0.26	Deep Saline Formation
Summit Wentworth Biorefinery	United States	2026	Bioenergy / Ethanol	0.26	Deep Saline Formation
Summit Plainview Biorefinery	United States	2026	Bioenergy / Ethanol	0.32	Deep Saline Formation
Summit Fairmont Biorefinery	United States	2026	Bioenergy / Ethanol	0.34	Deep Saline Formation
Summit Grand Junction Biorefinery	United States	2026	Bioenergy / Ethanol	0.34	Deep Saline Formation
Summit Mason City Biorefinery	United States	2026	Bioenergy / Ethanol	0.34	Deep Saline Formation
Summit Obion Biorefinery	United States	2026	Bioenergy / Ethanol	0.34	Deep Saline Formation
Project Intersect - Hereford Ethanol Plant	United States	2026	Bioenergy / Ethanol	0.35	Enhanced Oil Recovery
Project Intersect - Plainview Ethanol Plant	United States	2026	Bioenergy / Ethanol	0.35	Enhanced Oil Recovery
Summit Watertown Biorefinery	United States	2026	Bioenergy / Ethanol	0.37	Deep Saline Formation
Hafslund Oslo Celsio Waste-to-Energy Plant	Norway	2026	Waste-to-Energy	0.4	Deep Saline Formation
Redcar Energy Centre	United Kingdom	2026	Power Generation and Heat	0.4	Deep Saline Formation
Storegga Acorn Hydrogen	United Kingdom	2026	Hydrogen / Ammonia / Fertiliser	0.4	N/A
Summit Mina Biorefinery	United States	2026	Bioenergy / Ethanol	0.4	Deep Saline Formation
Summit Marcus Biorefinery	United States	2026	Bioenergy / Ethanol	0.46	Deep Saline Formation
NorDAC Kollsnes	Norway	2026	Direct Air Capture	0.5	Deep Saline Formation
Summit Casselton Biorefinery	United States	2026	Bioenergy / Ethanol	0.5	Deep Saline Formation
Summit Lawler Biorefinery	United States	2026	Bioenergy / Ethanol	0.57	Deep Saline Formation
Alto's Pekin CCS	United States	2026	Bioenergy / Ethanol	0.6	Under Evaluation
Nucor Steel DRI	United States	2026	Iron and Steel	0.8	Under Evaluation
TotalEnergies Zeeland refinery (H2ero)	Netherlands	2026	Hydrogen / Ammonia / Fertiliser	0.8	N/A
Northeast Scotland DAC	United Kingdom	2026	Direct Air Capture	1	N/A
Wabash Valley Resources West Terre Haute fertilizer plant	United States	2026	Hydrogen / Ammonia / Fertiliser	1.75	Under Evaluation
Repsol Sakakemang	Indonesia	2026	Natural Gas / LNG	2	Depleted Oil and Gas Field
BP Tangguh LNG	Indonesia	2026	Natural Gas / LNG	3	Enhanced Gas Recovery
BP Lone Star Storage Hub	United States	2026	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
ExxonMobil South East Australia Carbon Capture Hub	Australia	2026	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field

Facility Name	Country	Operational Year	Industry	Capture Capacity (Mtpa CO_2)	Storage Code
Hafslund Oslo Celsio - Truck Route	Norway	2026	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Longleaf CCS	United States	2026	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Pilot Energy Cliff Head (Mid-West Clean Energy)	Australia	2026	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field
Stella Maris CCS	Northern Europe	2026	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	N/A
Summit Mid-West Express Storage	United States	2026	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Synergia Energy Medway Transport and Storage	United Kingdom	2026	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field
Air Products Refinery Rotterdam	Netherlands	2026	Hydrogen / Ammonia / Fertiliser	Under Evaluation	N/A
PTTEP Lang Lebah	Malaysia	2026	Natural Gas / LNG	Under Evaluation	Depleted Oil and Gas Field
Strathcona Resources Cold Lake CCS Hub	Canada	2026	Oil Refining	Under Evaluation	N/A
Umea Dava plant CCS (Flagship THREE)	Sweden	2027	Power Generation and Heat	0.072	Under Evaluation
Gibson CCS	Canada	2027	Waste-to-Energy	0.1	N/A
BOC Teesside Hydrogen	United Kingdom	2027	Hydrogen / Ammonia / Fertiliser	0.2	Deep Saline Formation
Geismar CCS	United States	2027	Hydrogen / Ammonia / Fertiliser	0.3	Enhanced Oil Recovery
Phillips 66 Humber Refinery	United Kingdom	2027	Oil Refining	0.5	N/A
EET HPP1 Hydrogen	United Kingdom	2027	Hydrogen / Ammonia / Fertiliser	0.6	Depleted Oil and Gas Field
8 Rivers Whitetail Clean Energy	United Kingdom	2027	Power Generation and Heat	0.8	Deep Saline Formation
Beccs Stockholm	Sweden	2027	Bioenergy / Ethanol	0.8	Under Evaluation
Hydrogen to Humber Saltend	United Kingdom	2027	Hydrogen / Ammonia / Fertiliser	0.89	Deep Saline Formation
Viridor Runcorn ERF CCS	United Kingdom	2027	Bioenergy / Ethanol	0.9	N/A
Lake Charles Methanol II	United States	2027	Chemical	1	Under Evaluation
Air Liquide Houston Ship Channel Ammonia Production	United States	2027	Hydrogen / Ammonia / Fertiliser	1.6	Under Evaluation
BP and Equinor NZT Power Teesworks	United Kingdom	2027	Power Generation and Heat	2	Deep Saline Formation
BP H2Teesside	United Kingdom	2027	Hydrogen / Ammonia / Fertiliser	2	Deep Saline Formation
SSE Thermal Keadby 3 Power Station	United Kingdom	2027	Power Generation and Heat	2.6	Deep Saline Formation
FCL Belle Plaine Ethanol Complex	Canada	2027	Bioenergy / Ethanol	3	Enhanced Oil Recovery
VPI Immingham Power Plant	United Kingdom	2027	Power Generation and Heat	3	N/A
Sustainable Fuels Group (CIP blue ammonia plant)	United States	2027	Bioenergy / Ethanol	5	N/A
Drax BECCS	United Kingdom	2027	Power Generation and Heat	8	Deep Saline Formation

Facility Name	Country	Operational Year	Industry	Capture Capacity (Mtpa CO_2)	Storage Code
CarbFix CODA Transport and Storage	Iceland	2027	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Mineral Carbonation
Eni Hynet North West CO_2 Transport and Storage	United Kingdom	2027	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field
Havstjerne Storage	Norway	2027	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Heartland Generation Battle River Carbon Hub	Canada	2027	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Sutter Decarbonization	United States	2027	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Vault 44.01 Rocky Mountain Carbon Vault	Canada	2027	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Victorian Government Carbon Net	Australia	2027	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Abadi CCS	Indonesia	2027	Natural Gas / LNG	Under Evaluation	Under Evaluation
Commonwealth LNG CCS	United States	2027	Natural Gas / LNG	Under Evaluation	N/A
St. Charles Clean Fuels Hydrogen Louisiana	United States	2027	Hydrogen / Ammonia / Fertiliser	Under Evaluation	N/A
Yara Hydrogen Texas	United States	2027	Hydrogen / Ammonia / Fertiliser	Under Evaluation	N/A
Hanson Padeswood Cement CCS	United Kingdom	2028	Cement and Concrete	0.8	N/A
Prax Lindsey Carbon Capture (PLCCP)	United Kingdom	2028	Oil Refining	1	Deep Saline Formation
EET HPP2 Hydrogen	United Kingdom	2028	Hydrogen / Ammonia / Fertiliser	1.2	Depleted Oil and Gas Field
8 Rivers Cormorant Clean Energy	United States	2028	Hydrogen / Ammonia / Fertiliser	1.4	N/A
H2BE	Belgium	2028	Hydrogen / Ammonia / Fertiliser	1.7	Under Evaluation
Barents Blue	Norway	2028	Hydrogen / Ammonia / Fertiliser	2	Deep Saline Formation
H2M (Equinor Hydrogen 2 Magnum)	Netherlands	2028	Hydrogen / Ammonia / Fertiliser	2	Under Evaluation
Kellas Midstream H2NorthEast	United Kingdom	2028	Hydrogen / Ammonia / Fertiliser	2	Deep Saline Formation
Project Tundra	United States	2028	Power Generation and Heat	4	Under Evaluation
ExxonMobil Baytown Low Carbon Hydrogen	United States	2028	Hydrogen / Ammonia / Fertiliser	7	N/A
Santos Bayu-Undan	Timor-Leste	2028	Natural Gas / LNG	10	Depleted Oil and Gas Field
Aramis	Netherlands	2028	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field
Eni L10 Transport and Storage	Netherlands	2028	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field
Gemah field EOR	Indonesia	2028	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Enhanced Oil Recovery
Neptune Bunter CCS	United Kingdom	2028	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Santos Reindeer	Australia	2028	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field

Facility Name	Country	Operational Year	Industry	Capture Capacity (Mtpa CO_2)	Storage Code
WH2V Terminal	Belgium, Germany, Netherlands, Switzerland, USA	2028	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	N/A
Aukra Hydrogen Hub	Norway	2028	Hydrogen / Ammonia / Fertiliser	Under Evaluation	Deep Saline Formation
Cleco Diamond Vault	United States	2028	Power Generation and Heat	Under Evaluation	Deep Saline Formation
H2GE Rostock	Germany	2029	Hydrogen / Ammonia / Fertiliser	2	N/A
Horisont Energi Polaris Storage	Norway	2029	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Neptune Trudvang Storage Project	Norway	2029	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Cerilon gas-to-liquids complex	United States	2029	Hydrogen / Ammonia / Fertiliser	Under Evaluation	Under Evaluation
Broceni CCS	Latvia	2030	Cement and Concrete	0.75	Under Evaluation
CORY EfW CCS	United Kingdom	2030	Power Generation and Heat	1.3	Depleted Oil and Gas Field
BASF Antwerp (Kairos@C)	Belgium	2030	Chemical	1.42	N/A
Slite CCS	Sweden	2030	Cement and Concrete	1.8	Under Evaluation
RWE Pembroke Power Station	United Kingdom	2030	Power Generation and Heat	5	N/A
CCS Baltic Consortium	Latvia, Lithuania	2030	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Mineral Carbonation
Harbour Energy Viking Transport and Storage	United Kingdom	2030	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field
Higashi-Niigata Region CCS	Japan	2030	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field
Malaysia Northern Malay Peninsula CCS Project	Japan, Malaysia	2030	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
Malaysia Southern Malay Peninsula CCS Project	Japan, Malaysia	2030	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
Metropolitan CCS	Japan	2030	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Morecambe Net Zero Cluster	United Kingdom	2030	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field
Oceania CCS	Japan	2030	CO_{22} Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
Oil Sands CCUS Pathways to Net Zero	Canada	2030	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
Pathways Alliance Oil Sands Pathways to Net Zero	Canada	2030	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Project Lochridge (Gulf of Mexico CCS Partnership Hub)	United States	2030	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Ruby Project	Denmark	2030	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Tohoku Region CCS	Japan	2030	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Tomakomai Region CCS	Japan	2030	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation

Facility Name	Country	Operational Year	Industry	Capture Capacity (Mtpa CO_2)	Storage Code
Western Kyushu offshore CCS	Japan	2030	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
GE Gas Power CCUS	United States	2030	Power Generation and Heat	Under Evaluation	Under Evaluation
INEOS Antwerp	Belgium	2030	Chemical	Under Evaluation	N/A
Summit Gevo, Isobutanol and Ethanol, Luverne, Minnesota	United States	2030	Bioenergy / Ethanol	Under Evaluation	N/A
Summit Gevo, Lake Preston, South Dakota	United States	2030	Bioenergy / Ethanol	Under Evaluation	N/A
Summit Hanlontown	United States	2030	Bioenergy / Ethanol	Under Evaluation	N/A
Summit St. Ansgar, Iowa	United States	2030	Bioenergy / Ethanol	Under Evaluation	N/A
Synergy Energy Medway Power Station	United Kingdom	2030	Power Generation and Heat	Under Evaluation	N/A
Summit Gevo, Northwest Iowa Project, Iowa	United States	2031	Bioenergy / Ethanol	Under Evaluation	N/A
Pertamina Jatibarang	Indonesia	Under Evaluation	Natural Gas / LNG	0.146	Enhanced Oil Recovery
Russel Storage Complex	United States	Under Evaluation	Bioenergy / Ethanol	0.15	Deep Saline Formation
Summit Gevo Lake Preston Biorefinery	United States	Under Evaluation	Bioenergy / Ethanol	0.29	Deep Saline Formation
Protos Energy Recovery Facility	United Kingdom	Under Evaluation	Waste-to-Energy	0.38	N/A
Summit Marion Ethanol	United States	Under Evaluation	Bioenergy / Ethanol	0.45	N/A
Summit Grand Forks Blue Ammonia	United States	Under Evaluation	Hydrogen / Ammonia / Fertiliser	0.5	N/A
Venture Global LNG Calcasieu Pass	United States	Under Evaluation	Natural Gas / LNG	0.5	Deep Saline Formation
Venture Global LNG Plaquemines	United States	Under Evaluation	Natural Gas / LNG	0.5	Deep Saline Formation
Project Cypress	United States	Under Evaluation	Direct Air Capture	1	N/A
Sinopec Shengli Power Plant	China	Under Evaluation	Power Generation and Heat	1	Enhanced Oil Recovery
South Texas DAC Hub	United States	Under Evaluation	Direct Air Capture	1	Deep Saline Formation
Marquis Industrial Complex	United States	Under Evaluation	Bioenergy / Ethanol	1.2	Deep Saline Formation
Hinton Bioenergy Carbon Capture and Sequestration (BECCS)	Canada	Under Evaluation	Pulp and Paper	1.3	Under Evaluation
Golden Spread Electric Mustang Station	United States	Under Evaluation	Power Generation and Heat	1.5	N/A
EPRI Cane Run	United States	Under Evaluation	Power Generation and Heat	1.7	Under Evaluation
Southern Company Plant Daniel Capture	United States	Under Evaluation	Power Generation and Heat	1.8	Deep Saline Formation
Baytown Carbon Capture and Storage	United States	Under Evaluation	Power Generation and Heat	2	N/A
Mitchell Heidelberg Materials CCUS	United States	Under Evaluation	Cement and Concrete	2	Dedicated Geological Storage
Pelican Rindge Tract CCS	United States	Under Evaluation	Bioenergy / Ethanol	2	Deep Saline Formation
Sempra Hackberry Carbon Sequestration	United States	Under Evaluation	Natural Gas / LNG	2	Deep Saline Formation
Calpine Delta Energy Centre	United States	Under Evaluation	Power Generation and Heat	2.36	N/A

Facility Name	Country	Operational Year	Industry	Capture Capacity (Mtpa CO_2)	Storage Code
Cypress Carbon Capture	United States	Under Evaluation	Power Generation and Heat	2.6	N/A
Holcim Ste. Genevieve Cement Plant	United States	Under Evaluation	Cement and Concrete	2.75	Under Evaluation
Indiana Burns Habor Capture	United States	Under Evaluation	Iron and Steel	2.8	N/A
ION Polk Power Station	United States	Under Evaluation	Power Generation and Heat	3.7	Under Evaluation
Gerald Gentleman Station	United States	Under Evaluation	Power Generation and Heat	4.3	Enhanced Oil Recovery
Calpine Texas Deer Park Energy Centre	United States	Under Evaluation	Power Generation and Heat	5	N/A
Project Bison Wyoming	United States	Under Evaluation	Direct Air Capture	5	N/A
Prairie State Generating Station	United States	Under Evaluation	Power Generation and Heat	7.6	Deep Saline Formation
Four Corners Power Plant Integrated CCS	United States	Under Evaluation	Power Generation and Heat	9.5	Under Evaluation
Aker BP Poseidon Norway	Norway	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
CarbonSAFE Eos	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Chevron Bayou Bend	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
CNPC Xinjiang Karamay Coal-Fired Power Plant Integrated Project	China	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Enhanced Oil Recovery
CO2NEXT Terminal	Netherlands	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	N/A
CO2TransPorts	Belgium, Netherlands	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
Coal Creek Carbon Capture (Site Characterization and Permitting)	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Corpus Christi-Mississippi Pipeline	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	N/A
Gassum Storage	Denmark	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Havnsø. Storage	Denmark	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Illinois Basin West CarbonSAFE III	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Magnolia Sequestration Hub	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Malaysia Sarawak Offshore CCS Project	Malaysia	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field
Minerva Storage	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Mitchell CarbonSAFE	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Monkey Island Storage	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Montezuma NorCal Carbon Hub	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Norvik Infrastructure CCS East (NICE)	Sweden	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	N/A
Pineywoods CCS Hub	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
Project Crossroads	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation

Facility Name	Country	Operational Year	Industry	Capture Capacity (Mtpa CO_2)	Storage Code
Project Diamond CO_2 Transport	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	N/A
Project WyoTCH	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	N/A
Protos CO_2 network (phase 1)	United Kingdom	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	N/A
River Parish Sequestration	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Sweetwater Carbon Storage Hub	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Tampa Regional Intermodal HUB	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
Timberland Sequestration	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Trailblazer Pipeline	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	N/A
Tri-State CCS Hub	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
ADNOC Rabdan Blue Ammonia	United Arab Emirates	Under Evaluation	Hydrogen / Ammonia / Fertiliser	Under Evaluation	Under Evaluation
Air Liquide Northern California	United States	Under Evaluation	Hydrogen / Ammonia / Fertiliser	Under Evaluation	N/A
Air Liquide US Gulf Coast Carbon Capture	United States	Under Evaluation	Hydrogen / Ammonia / Fertiliser	Under Evaluation	N/A
Appalachian Regional Clean Hydrogen Hub (ARCH2)	United States	Under Evaluation	Hydrogen / Ammonia / Fertiliser	Under Evaluation	Under Evaluation
ArcelorMittal Texas (formerly voestalpine Texas)	United States	Under Evaluation	Iron and Steel	Under Evaluation	N/A
Babcock & Wilcox Filer City CCS	United States	Under Evaluation	Bioenergy / Ethanol	Under Evaluation	Under Evaluation
Bakken Energy Resources Heartland Hydrogen Hub	United States	Under Evaluation	Power Generation and Heat	Under Evaluation	Under Evaluation
Black Hills Energy's Neil Simpson Power Plant CCS	United States	Under Evaluation	Power Generation and Heat	Under Evaluation	Under Evaluation
CF Industries Blue Point	United States	Under Evaluation	Hydrogen / Ammonia / Fertiliser	Under Evaluation	N/A
Coal Creek Station power plant	United States	Under Evaluation	Power Generation and Heat	Under Evaluation	N/A
CPV Shay Energy Center (CPV West Virginia Natural Gas Power Station)	United States	Under Evaluation	Power Generation and Heat	Under Evaluation	Under Evaluation
Gulf Coast Hydrogen Hub (HyVelocity H2Hub)	United States	Under Evaluation	Hydrogen / Ammonia / Fertiliser	Under Evaluation	Under Evaluation
Martres-Tolosane Cement Plant	France	Under Evaluation	Cement and Concrete	Under Evaluation	N/A
Pecos County Capture	United States	Under Evaluation	Oil Refining	Under Evaluation	N/A
Shepard Energy Centre	Canada	Under Evaluation	Power Generation and Heat	Under Evaluation	N/A
Southern Company Farley DAC	United States	Under Evaluation	Direct Air Capture	Under Evaluation	Under Evaluation
Sumitomo Hydrogen Energy Supply Chain (HESC)	Australia	Under Evaluation	Hydrogen / Ammonia / Fertiliser	Under Evaluation	Deep Saline Formation

Early Development

Facility Name	Country	Operational Year	Industry	Capture Capacity (Mtpa CO_2)	Storage Code
Imperial Oil Strathcona refinery	Canada	2024	Hydrogen / Ammonia / Fertiliser	0.5	N/A
Tanjung Enim CCS	Indonesia	2024	Chemical	1	Enhanced Oil Recovery
Wolf Central Storage Hub Edmonton	Canada	2024	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Cygnus CCS Hub	Australia	2024	Hydrogen / Ammonia / Fertiliser	Under Evaluation	Under Evaluation
AspiraDAC	Australia	2025	Direct Air Capture	0.00031	Under Evaluation
Poet Arthur, IA	United States	2025	Bioenergy / Ethanol	0.28	N/A
Poet Ashton, IA	United States	2025	Bioenergy / Ethanol	0.28	N/A
Poet Big Stone, SD	United States	2025	Bioenergy / Ethanol	0.28	N/A
Poet Chancellor, SD	United States	2025	Bioenergy / Ethanol	0.28	N/A
Poet Coon Rapids, IA	United States	2025	Bioenergy / Ethanol	0.28	N/A
Poet Corning, IA	United States	2025	Bioenergy / Ethanol	0.28	N/A
Poet Emmetsburg, IA	United States	2025	Bioenergy / Ethanol	0.28	N/A
Poet Fairbank, IA	United States	2025	Bioenergy / Ethanol	0.28	N/A
Poet Fairmont, NE	United States	2025	Bioenergy / Ethanol	0.28	N/A
Poet Gowrie, IA	United States	2025	Bioenergy / Ethanol	0.28	N/A
Poet Groton, SD	United States	2025	Bioenergy / Ethanol	0.28	N/A
Poet Hanlon town, IA	United States	2025	Bioenergy / Ethanol	0.28	N/A
Poet Hudson, SD	United States	2025	Bioenergy / Ethanol	0.28	N/A
Poet Iowa Falls, IA	United States	2025	Bioenergy / Ethanol	0.28	N/A
Poet Jewell, IA	United States	2025	Bioenergy / Ethanol	0.28	N/A
Poet Menlo, IA	United States	2025	Bioenergy / Ethanol	0.28	N/A
Poet Mitchell, SD	United States	2025	Bioenergy / Ethanol	0.28	N/A
Poet Shell Rock, IA	United States	2025	Bioenergy / Ethanol	0.28	N/A
IOCL Koyali	India	2025	Oil Refining	0.54	Enhanced Oil Recovery
8 Rivers Capital Saskatchewan NET Power Plant	Canada	2025	Power Generation and Heat	0.95	Deep Saline Formation
CNPC Songliao Basin Hub	China	2025	Power Generation and Heat	3	Under Evaluation
INEOS Greenport Scandinavia	Denmark	2025	Power Generation and Heat	3	N/A
Pieridae Energy Caroline Power	Canada	2025	Power Generation and Heat	3	N/A
Next Decade Rio Grande LNG	United States	2025	Natural Gas / LNG	5.5	Under Evaluation

Facility Name	Country	Operational Year	Industry	Capture Capacity (Mtpa CO_2)	Storage Code
The Illinois Clean Fuels	United States	2025	Chemical	8.13	Under Evaluation
Alberta Carbon Grid	Canada	2025	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Bison Meadowbrook Storage Hub	Canada	2025	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
CRC Carbon TerraVault I	United States	2025	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field
Enbridge Wabamun Carbon Hub	Canada	2025	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Equinor North Sea Pipeline Zeebrugge	Belgium	2025	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	N/A
Fluxys-Equinor Belgium-Norway Trunk Line	Belgium, Norway	2025	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	N/A
Gemini (formerly Denbury Ascension Parish sequestration)	United States	2025	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Leo Sequestration Site	United States	2025	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Liberty CCUS hub	United States	2025	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Dedicated Geological Storage
Livingston Parish Sequestration Hub (Pelican)	United States	2025	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Midland Basin Project (Dusek CCS)	United States	2025	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Wolf Mt. Simon Hub (Iowa Illinois Carbon Pipeline)	United States	2025	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	N/A
ADM Clinton	United States	2025	Bioenergy / Ethanol	Under Evaluation	Deep Saline Formation
ArcelorMittal Sestao CCS	Spain	2025	Iron and Steel	Under Evaluation	Under Evaluation
PAU Central Sulawesi Clean Fuel Ammonia	Indonesia	2025	Hydrogen / Ammonia / Fertiliser	Under Evaluation	Depleted Oil and Gas Field
St. Lawrence River Valley DAC hub	Canada	2025	Direct Air Capture	Under Evaluation	Deep Saline Formation
Yosemite Hydrogen Project	United States	2026	Hydrogen / Ammonia / Fertiliser	0.04	N/A
FREVAR Waste to Energy	Norway	2026	Waste-to-Energy	0.06	Deep Saline Formation
Lapis Energy El Dorado	United States	2026	Hydrogen / Ammonia / Fertiliser	0.45	Deep Saline Formation
KeyState Natural Gas Synthesis	United States	2026	Hydrogen / Ammonia / Fertiliser	0.5	Deep Saline Formation
Preem CCS	Sweden	2026	Hydrogen / Ammonia / Fertiliser	0.5	Deep Saline Formation
Air Liquide Normandy	France	2026	Hydrogen / Ammonia / Fertiliser	0.6	N/A
Holcim Cement (Höver)	Germany	2026	Cement and Concrete	1.3	N/A
Velocys Bayou Fuels Negative Emission	United States	2026	Chemical	1.5	Under Evaluation
INPEX CCS Darwin	Australia	2026	Natural Gas / LNG	2	Deep Saline Formation
Aries Sequestration	United States	2026	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Bayou Bend Louisiana Transport and Storage	United States	2026	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Bluebonnet Hub	United States	2026	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation

Facility Name	Country	Operational Year	Industry	Capture Capacity (Mtpa CO_2)	Storage Code
Callisto Mediterranean CO_2 Network	France, Italy	2026	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	N/A
Coastal Bend Transport and Storage	United States	2026	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
Corvus Sequestration Site	United States	2026	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Cygnus Sequestration Site	United States	2026	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field
Enhance Energy Origins Carbon Storage Hub	Canada	2026	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Fidelis Norne Carbon Storage Hub	Denmark	2026	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
Norne storage hub	Denmark	2026	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Orion Sequestration Site	United States	2026	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
RETI East Calgary Region Carbon Sequestration Hub	Canada	2026	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Storegga Acorn Transport and Storage	United Kingdom	2026	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field
Synergia Energy Damhead Pipeline	United Kingdom	2026	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	N/A
Synergia Energy Isle of Grain Transport	United Kingdom	2026	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	N/A
Virgo Sequestration Site	United States	2026	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Whitecap Resources Rolling Hills Hub	Canada	2026	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
B&W's BrightLoopTM	United States	2026	Hydrogen / Ammonia / Fertiliser	Under Evaluation	N/A
North East Alliance blue ammonia Yakutia	Russia	2026	Hydrogen / Ammonia / Fertiliser	Under Evaluation	Under Evaluation
Pannonia Bio refinery	Hungary	2026	Bioenergy / Ethanol	Under Evaluation	Under Evaluation
SUEZ Tees Valley Energy Recovery Facility (TVERF)	United Kingdom	2026	Bioenergy / Ethanol	Under Evaluation	Deep Saline Formation
Synergia Energy Grain Power Station	United Kingdom	2026	Power Generation and Heat	Under Evaluation	N/A
Suez Waste to Energy	United Kingdom	2027	Bioenergy / Ethanol	0.24	Deep Saline Formation
Grannus Blue Ammonia and Hydrogen CCS	United States	2027	Hydrogen / Ammonia / Fertiliser	0.37	N/A
GO4ECOPLANET	Poland	2027	Cement and Concrete	1	Under Evaluation
Calpine Sutter Energy Center	United States	2027	Power Generation and Heat	1.75	Deep Saline Formation
Adams Fork Energy Clean Ammonia	United States	2027	Hydrogen / Ammonia / Fertiliser	2.7	Deep Saline Formation
Novatek Obskiy Blue Ammonia	Russia	2027	Hydrogen / Ammonia / Fertiliser	4	Under Evaluation
Novatek Yamal LNG	Russia	2027	Natural Gas / LNG	5	Under Evaluation
Clean Hydrogen Works Ascension Clean Energy	United States	2027	Hydrogen / Ammonia / Fertiliser	12	Under Evaluation
ECO2CEE	Poland	2027	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Eni Ravenna Hub	Italy	2027	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field

Facility Name	Country	Operational Year	Industry	Capture Capacity (Mtpa CO_2)	Storage Code
Fluxys Ghent Carbon Hub	Belgium	2027	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
Stanlow Terminal	United Kingdom	2027	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field
Eni Structures A&E	Libya	2027	Natural Gas / LNG	Under Evaluation	Under Evaluation
North Star CCS	Canada	2027	Power Generation and Heat	Under Evaluation	Under Evaluation
Öresundskraft Filborna CCS	Sweden	2027	Waste-to-Energy	Under Evaluation	Under Evaluation
Holcim KOdeCO Koromačno Plant	Croatia	2028	Cement and Concrete	0.37	Under Evaluation
Sysav Waste CCS	Sweden	2028	Waste-to-Energy	0.5	Under Evaluation
Air Liquide CalCC	France	2028	Cement and Concrete	0.6	Under Evaluation
EQIOM K6	France	2028	Cement and Concrete	0.8	Under Evaluation
Heidelberg Materials CBR Antoing Cement Plant (Project Anthemis)	Belgium	2028	Cement and Concrete	0.8	Under Evaluation
HeidelbergCement ANRAV	Bulgaria	2028	Cement and Concrete	0.8	Depleted Oil and Gas Field
Motor Oil Hellas IRIS	Greece	2028	Hydrogen / Ammonia / Fertiliser	0.85	N/A
Net Power Odessa Gas Plant CCS	United States	2028	Power Generation and Heat	0.85	N/A
Direct Air Capture and Storage (DAC+S) Kenya	Kenya	2028	Direct Air Capture	1	Mineral Carbonation
Olympus	Greece	2028	Cement and Concrete	1	Under Evaluation
Pertamina Sukowati	Indonesia	2028	Oil Refining	1.4	Enhanced Oil Recovery
Suncor and ATCO Heartland Hydrogen	Canada	2028	Hydrogen / Ammonia / Fertiliser	2	N/A
Onyx Power Blue Hydrogen Plant	Netherlands	2028	Hydrogen / Ammonia / Fertiliser	2.5	Under Evaluation
Mountaineer Gigasystem	United States	2028	Hydrogen / Ammonia / Fertiliser	10	N/A
Central Sumatera Basin CCS hub	Indonesia	2028	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field
D'Artagnan Dunkirk CO_2 Hub	France	2028	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	N/A
Delta Rhine Corridor	Netherlands	2028	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	N/A
ECO2Normandy	France	2028	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	N/A
Equinor Smeaheia Transport and Storage	Norway, France, Netherlands	2028	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Gismarvik CO_2 Terminal (Koole Terminal)	Norway	2028	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
KNOC Donghae	South Korea	2028	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field
OGE CO_2 Grid	Germany	2028	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	N/A
Greenlight Electricity CCS	Canada	2028	Power Generation and Heat	Under Evaluation	Under Evaluation

Facility Name	Country	Operational Year	Industry	Capture Capacity (Mtpa CO_2)	Storage Code
Yara-BASF Gulf Coast	United States	2028	Hydrogen / Ammonia / Fertiliser	Under Evaluation	N/A
CO2NTESSA	Croatia	2029	Cement and Concrete	0.7	Deep Saline Formation
GeZero	Germany	2029	Cement and Concrete	0.7	N/A
EVEREST	Germany	2029	Cement and Concrete	1	Under Evaluation
Holcim GO4ZERO Obourg Plant	Belgium	2029	Cement and Concrete	1.1	N/A
Uniper Humber Hub Blue Project	United Kingdom	2029	Hydrogen / Ammonia / Fertiliser	1.6	N/A
$7CO_2$	United kingdom	2029	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	N/A
Carbone Aceh Arun Hub	Indonesia	2029	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field
CO_2 Highway Europe Pipeline	France, Norway	2029	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
EU2NSEA	Germany	2029	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Greenstore	Denmark	2029	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
Perenco UKCS Poseidon	United Kingdom	2029	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field
Sunda Asri Basin CCUS hub	Indonesia	2029	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
Lyse Forus Energigjenvinning Stavanger	Norway	2030	Waste-to-Energy	0.1	Under Evaluation
Statkraft CCS	Norway	2030	Waste-to-Energy	0.3	N/A
Valero Albert City	United States	2030	Bioenergy / Ethanol	0.3875	Deep Saline Formation
Valero Albion	United States	2030	Bioenergy / Ethanol	0.3875	Deep Saline Formation
Valero Aurora	United States	2030	Bioenergy / Ethanol	0.3875	Deep Saline Formation
Valero Charles City	United States	2030	Bioenergy / Ethanol	0.3875	Deep Saline Formation
Valero Fort Dodge	United States	2030	Bioenergy / Ethanol	0.3875	Deep Saline Formation
Valero Hartley	United States	2030	Bioenergy / Ethanol	0.3875	Deep Saline Formation
Valero Lakota	United States	2030	Bioenergy / Ethanol	0.3875	Deep Saline Formation
Valero Welcome	United States	2030	Bioenergy / Ethanol	0.3875	Deep Saline Formation
Kalundborg CCS	Denmark	2030	Oil Refining	0.43	Deep Saline Formation
Soderenergi bio-CCS	Sweden	2030	Bioenergy / Ethanol	0.5	Under Evaluation
Holcim Exshaw Cement	Canada	2030	Cement and Concrete	1	Deep Saline Formation
INEOS Grangemouth	United Kingdom	2030	Oil Refining	1	N/A
Orlen Plock CO_2 Capture	Poland	2030	Hydrogen / Ammonia / Fertiliser	1	Deep Saline Formation
Enfinium Ferrybridge	United Kingdom	2030	Waste-to-Energy	1.2	Deep Saline Formation
ExxonMobil Blue Hydrogen Fawley Refinery	United Kingdom	2030	Hydrogen / Ammonia / Fertiliser	2	Under Evaluation

Facility Name	Country	Operational Year	Industry	Capture Capacity (Mtpa CO_2)	Storage Code
Peak Cluster	United Kingdom	2030	Cement and Concrete	3	Under Evaluation
deepC Store CStore1	Australia	2030	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
Eni Bacton Thames Net Zero Transport and Storage	United Kingdom	2030	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field
ExxonMobil Houston Ship Channel Innovation Zone	United States	2030	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
GOCO2 (Grand Ouest CO_2)	France	2030	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	N/A
Mitsui Offshore Malay	Japan	2030	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
NOR-GE Pipeline	Germany, Norway	2030	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
Offshore Malay CCS	Malaysia	2030	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field
PYCASSO	France	2030	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field
Ramba CCUS	Indonesia	2030	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Enhanced Oil Recovery
Wintershall Dea North Sea CO_2 Corridor	Belgium, Germany	2030	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	N/A
Borealis Antwerp	Belgium	2030	Chemical	Under Evaluation	N/A
ExxonMobil Antwerp Refinery	Belgium	2030	Chemical	Under Evaluation	N/A
Gonfreville Raffinerie	France	2030	Oil Refining	Under Evaluation	Under Evaluation
DUC Bifrost	Denmark	2030	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field
Orion CCS	United Kingdom	2031	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field
CO2nnectNow	Germany	2032	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	N/A
Osage CCS	United States	Under Evaluation	Direct Air Capture	0.007	Enhanced Oil Recovery
CO2ncrEAT	Belgium	Under Evaluation	Cement and Concrete	0.012	N/A
Florida Regional DAC Hub	United States	Under Evaluation	Direct Air Capture	0.05	Deep Saline Formation
Fortum Waste Nyborg	Denmark	Under Evaluation	Waste-to-Energy	0.16	Under Evaluation
Kutina Petrokemija Ammonia	Croatia	Under Evaluation	Hydrogen / Ammonia / Fertiliser	0.19	Enhanced Oil Recovery
Beach Energy Otway CCS	Australia	Under Evaluation	Natural Gas / LNG	0.2	Under Evaluation
BIR Waste-to-Energy Bergen	Norway	Under Evaluation	Waste-to-Energy	0.2	Deep Saline Formation
Harvestone Dakota Spirit AgEnergy	United States	Under Evaluation	Bioenergy / Ethanol	0.2	Deep Saline Formation
Waste-to-energy Aker CCS	France	Under Evaluation	Power Generation and Heat	0.2	Under Evaluation
Byron Generation Station Nuclear DACS	United States	Under Evaluation	Direct Air Capture	0.25	N/A
Singleton Birch ZerCaL250	United Kingdom	Under Evaluation	Cement and Concrete	0.25	Deep Saline Formation

Facility Name	Country	Operational Year	Industry	Capture Capacity (Mtpa CO_2)	Storage Code
Chevron San Joaquin	United States	Under Evaluation	Power Generation and Heat	0.3	Depleted Oil and Gas Field
Fjernvarme Fyn Odense CHP plant	Denmark	Under Evaluation	Waste-to-Energy	0.325	Under Evaluation
Aemetis Riverbank Ethanol	United States	Under Evaluation	Bioenergy / Ethanol	0.4	Deep Saline Formation
Cementir Aalborg Plant	Denmark	Under Evaluation	Cement and Concrete	0.4	N/A
Hoosier (Cardinal ethanol facility)	United States	Under Evaluation	Bioenergy / Ethanol	0.4	Deep Saline Formation
FS Lucas do Rio Verde BECCS	Brazil	Under Evaluation	Bioenergy / Ethanol	0.423	Under Evaluation
Röhm Chemical Plants Capture	Germany	Under Evaluation	Chemical	0.5	N/A
Mendota Biomass Carbon Removal and Storage Project (BiCRS)	United States	Under Evaluation	Power Generation and Heat	0.6	Under Evaluation
RWE Great Yarmouth Carbon Capture	United Kingdom	Under Evaluation	Power Generation and Heat	0.6	N/A
National Cement Lebec CCS	United States	Under Evaluation	Cement and Concrete	0.95	N/A
Louisiana Green Fuels (LGF) CCS	United States	Under Evaluation	Chemical	1.36	N/A
SSE Thermal Peterhead Power Station	United Kingdom	Under Evaluation	Power Generation and Heat	1.5	N/A
Belridge CCS	United States	Under Evaluation	Natural Gas / LNG	1.6	Depleted Oil and Gas Field
Pacific Northwest Hydrogen Hub	United States	Under Evaluation	Hydrogen / Ammonia / Fertiliser	1.7	
Ackerman CCS	United States	Under Evaluation	Power Generation and Heat	1.8	N/A
IFESTOS	Greece	Under Evaluation	Cement and Concrete	1.9	N/A
Fidelis New Energy Cyclus Power Generation	United States	Under Evaluation	Bioenergy / Ethanol	2	Under Evaluation
RWE Stallingborough	United Kingdom	Under Evaluation	Power Generation and Heat	2	N/A
S-HUB	Singapore	Under Evaluation	Various	2.5	Under Evaluation
RWE Straythorpe	United Kingdom	Under Evaluation	Power Generation and Heat	4	N/A
Alaska Railbelt Carbon Capture and Storage (ARCCS)	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
Albondigas Storage	Norway	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
Angel CCS Hub	Australia	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field
Appalachian Basin Storage	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
ARC Resources Greenview Region	Canada	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Atlas Storage	Norway	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
Bison North Drumheller Hub	Canada	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Borg CO_2	Norway	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation

Facility Name	Country	Operational Year	Industry	Capture Capacity (Mtpa CO_2)	Storage Code
BP Nagoya port cluster	Japan, Indonesia	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field
Buru Energy Carnarvon Basin Storage	Australia	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
C Zero	Germany	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	N/A
California-Nevada CO_2 Storage Project (CANstore)	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Mineral Carbonation
Calpine Hermiston Power (HERO Basalt CarbonSafe)	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Mineral Carbonation
Cambay CCS Hub	India	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Cameron Parish CO_2 Hub	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
Carbon TerraVault 2	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Carbon TerraVault 3	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Carbon TerraVault 4	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Carbon TerraVault 5	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Chevron Mitsui CO_2 shipping SGP-AUS	Singapore	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	N/A
City of Medicine Hat Project Clear Horizon	Canada	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Dedicated Geological Storage
CNPC Junggar Basin Hub	China	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Enhanced Oil Recovery
CO2NNECTION Intermodal Transport Hubs	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	N/A
Coastal Bend Offshore CO_2 Storage	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Crescent Midstream Louisiana Offshore Hub	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field
Daya Bay Hub	China	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
Delaware Basin Storage	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
El Camino	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Enhance Grande Prairie Hub	Canada	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
EnQuest's Carbon Storage Hub	United Kingdom	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field
Entropy Bow Valley Hub	Canada	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
ExxonMobil Indonesia Regional Storage Hub	Indonesia	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
ExxonMobil Vermilion parish storage (Pecan island)	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Frontier Carbon Solutions Holdings Sweetwater Carbon Storage Hub	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Geothermal CCS Croatia	Croatia	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Goose Lake Storage	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation

Facility Name	Country	Operational Year	Industry	Capture Capacity (Mtpa CO_2)	Storage Code
Humberside CCS (Shell and Esso)	United Kingdom	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
Iroko Storage	Norway	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
Kinno CS Storage	Norway	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
Kiwetinohk Maskwa Swan Hills Hub	Canada	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Kiwetinohk Opal Carbon Hub	Canada	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
LA CCS	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
Lorain CCS	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Neptune BC05 CCS	United Kingdom	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Neptune Ciaster CCS	United Kingdom	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
NorthRiver Grand Prairie Net Zero Gateway Storage Hub	Canada	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Orchard Carbon Storage Hub	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Polk Carbon Storage Complex	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Project ACCESS	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
PTTEP Northern Gulf of Thailand CCS	Thailand	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
Quebec Carbon Sequestration	Canada	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Mineral Carbonation
Red Hills CO_2 Storage Hub	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Roughrider Carbon Storage Hub	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
SNOC Sharjah	United Arab Emirates	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Depleted Oil and Gas Field
Stryde CO_2 storage	Brazil	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Dedicated Geological Storage
Susitna Storage	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
Tidewater Brazeau Carbon Sequestration Hub	Canada	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Tidewater Ram River Carbon Sequestration Hub	Canada	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Tourmaline Clearwater CCUS	Canada	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
Train to Zero Carbon Capture Rail Link	United Kingdom	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	N/A
Tulare County Storage	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Unita Basin Carbon SAFE	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Vault 44.01 Athabasca Banks Carbon Hub	Canada	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Vault Linden Storage	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
Virginia CarbonSafe storage	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
West Bay Storage	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation

Facility Name	Country	Operational Year	Industry	Capture Capacity (Mtpa CO_2)	Storage Code
West Java sea rig-to-CCS	Indonesia	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Under Evaluation
West Lake Pincher Creek Carbon Sequestration Hub	Canada	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
William Echo Springs CarbonSAFE	United States	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Wintershall Dea Havstjerne	Norway	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Wintershall Dea Luna	Norway	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Wolf East Calgary Region Carbon Sequestration Hub	Canada	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Deep Saline Formation
Zutica and Ivanic grad Storage	Croatia	Under Evaluation	CO_2 Transport / Storage	N/A (CO_2 Transport and Storage)	Enhanced Oil Recovery
ADM Cedar Rapids	United States	Under Evaluation	Bioenergy / Ethanol	Under Evaluation	Deep Saline Formation
C.GEN North Killingholme Power	United Kingdom	Under Evaluation	Power Generation and Heat	Under Evaluation	Deep Saline Formation
Corpus Christi Integrated Ammonia CCS	United States	Under Evaluation	Hydrogen / Ammonia / Fertiliser	Under Evaluation	N/A
Energy Recovery Facility Edmonton EcoPark	United Kingdom	Under Evaluation	Power Generation and Heat	Under Evaluation	Under Evaluation
HALO Hydrogen Hub	United States	Under Evaluation	Hydrogen / Ammonia / Fertiliser	Under Evaluation	N/A
Harvestone Iroquois Bioenergy	United States	Under Evaluation	Bioenergy / Ethanol	Under Evaluation	Deep Saline Formation
Hexagon Energy Blue Ammonia Northern Territory	Australia	Under Evaluation	Hydrogen / Ammonia / Fertiliser	Under Evaluation	N/A
Idku Egypt	Egypt	Under Evaluation	Natural Gas / LNG	Under Evaluation	Depleted Oil and Gas Field
Indramayu CCS	Indonesia	Under Evaluation	Power Generation and Heat	Under Evaluation	Under Evaluation
Japan Malaysia steel CCS	Japan, Malaysia	Under Evaluation	Iron and Steel	Under Evaluation	N/A
KDW Ammonia Kemmerer CCS	United States	Under Evaluation	Hydrogen / Ammonia / Fertiliser	Under Evaluation	Under Evaluation
Kentucky Paradise Combined Cycle Plant Capture	United States	Under Evaluation	Power Generation and Heat	Under Evaluation	N/A
Lighthouse Green Fuels Project	United Kingdom	Under Evaluation	Chemical	Under Evaluation	Under Evaluation
Limeco Waste-to-Energy Dietikon	Switzerland	Under Evaluation	Power Generation and Heat	Under Evaluation	Under Evaluation
Mississippi Paradise Combined Cycle Plant Capture	United States	Under Evaluation	Power Generation and Heat	Under Evaluation	N/A
Moraine Power Generation Capture	Canada	Under Evaluation	Power Generation and Heat	Under Evaluation	Deep Saline Formation
PacifiCorp Dave Johnston Plant	United States	Under Evaluation	Power Generation and Heat	Under Evaluation	Enhanced Oil Recovery
Pelican Gulf Coast Carbon Removal	United States	Under Evaluation	Direct Air Capture	Under Evaluation	Deep Saline Formation
Southeast Hydrogen Hub	United States	Under Evaluation	Hydrogen / Ammonia / Fertiliser	Under Evaluation	N/A
Tambak Lorok CCS	Indonesia	Under Evaluation	Power Generation and Heat	Under Evaluation	Under Evaluation
Yara Pilbara Ammonia	Australia	Under Evaluation	Hydrogen / Ammonia / Fertiliser	Under Evaluation	N/A

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