GIGATONNE BY 2030 CAMPAIGN BY CEM CCUS & MI CDR

Developments with Carbon Management (CCUS and CDR) Programmes

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16TH CLEAN ENERGY MINISTERIAL AND 10TH MISSION INNOVATION MINISTERIAL MEETING

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Introduction

26 August 2025

Dear reader,

This slide deck contains a snapshot of carbon management policy and programme developments across the Clean Energy Ministerial CCUS Initiative and Mission Innovation CDR Mission Members.

Carbon management technologies can play a significant role in decarbonizing several industrial and energy sectors, and in providing the necessary removal of CO_2 from the atmosphere. Carbon management also has the capability to help create and retain jobs and contribute to economic prosperity. Deploying carbon management will however require significant government programmes, to kickstart the industry. Several countries have enacted carbon management programmes and policies, and this document provides a high-level snapshot into today's status.

This slide deck is published on 26 August, at the 16th Clean Energy Ministerial and 10th Mission Innovation Ministerial meeting, hosted by South Korea in Busan. The slides are published under the joint CEM-MI "Gigatonne by 2030" campaign, which has its lighthouse objective to accelerate carbon management deployment to gigatonne scale by 2030.

If you are interested in these developments, or in the work of the CEM CCUS Initiative or MI CDR Mission, we would be delighted to hear from you. Please email us at info@cemccus.org or mi.cdr@outlook.com.

Summary (1/3): CCUS

- Carbon management is part of a wide portfolio of measures to reduce and remove CO_2 emissions, and create and retain jobs by all CEM CCUS and MI CDR Members, in sectors such as power, hydrogen, cement and steel. It is not a “silver bullet” solution, but indeed part of a wider toolkit to enable a sustainable and prosperous energy future.
- Carbon management comprises of both carbon capture, utilization and storage (CCUS) and carbon dioxide removal (CDR) activities. Their respective roles vary amongst the CEM and MI Members, as does also their technological maturity.
- Typically CCUS programmes are currently in the deployment phase. This means that government policies and industry action is in planning, building and operating large-scale, industrial projects. Large-scale CCUS projects are operational or under construction in several CEM CCUS and MI CDR Member countries: Australia, Brazil, Canada, China, Netherlands, Norway, Saudi-Arabia, United Arab Emirates, United Kingdom and United States.
- CCUS deployment programmes include various incentives, ranging from “stick” approaches that set limits to emissions by economic actors (e.g. emissions trading mechanisms and emission regulations), to “carrot” approaches offering multi-billion dollar economic incentives (e.g. tax credits, direct subsidies, contracts for difference) for the construction and operation of CCUS projects.

Summary (2/3): CDR

- Carbon Dioxide Removals are recognized as a key contributor to countries' net-zero strategies, in compensating for remaining residual emissions.
- Amongst MI CDR and CEM CCUS Members, the technological CDR approaches typically fall under three main categories: direct air capture (DAC), biomass carbon removal and storage (BiCRS) and mineral carbonation.
- CDR policy programmes focus currently more on R&D and innovation. Mechanisms include various public R&D and innovation grants and co-funding programmes, aiming to help the scaling up of CDR technologies.
- In the CDR industry, focus is also currently more on R&D and innovation, due to a lower degree of technology maturity relative to CCUS. Consequently the first projects tend to be smaller than CCUS projects, i.e. in the thousands of tonnes per year. Pilots or early commercial projects are underway in Australia, Canada, China, EU, Japan, Netherlands, Norway, Saudi Arabia, United Arab Emirates, United Kingdom and United States. Also some first large-scale projects are under construction, notably in the United States.
- Other enabling policy frameworks are also starting to emerge, e.g. national roadmaps (Australia), business model development (United Kingdom), procurement policies (Canada) or carbon removal certification frameworks (EU).

Summary (3/3): Key next steps and enablers

- **From pilots to scale:** Both government programmes and industry action focus on larger and larger opportunities and scaling up. Many CEM CCUS and MI CDR Members aim to transition from demonstration projects to fully commercial CCUS/CDR hubs by 2030.
- **Infrastructure build-out:** Hubs are a central paradigm for many countries, due to the obvious opportunity to benefit from economies of scale by linking many capture points to common CO_2 transport & storage networks (e.g., Northern Lights, Porthos, Aramis).
- **International cooperation:** CEM CCUS and MI CDR countries are actively exploiting international opportunities, be it under various bilateral agreements, or by working with international networks to share learnings and build confidence in the domestic carbon management programmes.
- **Private sector momentum:** We observe an increasing pipeline of FEED studies and final investment decisions, driven by policy programmes and strategic industry visions.
- **Boosting strategic priority:** CEM CCUS and MI CDR Members continue to position CCUS and CDR as cornerstones of industrial decarbonisation and climate targets, while simultaneously creating jobs, regional growth and economic prosperity.

Contents

Australia – CCUS

Strategy and approach to CCUS

- Australia sees carbon management technologies, including CCS, CCUS and CDR, **as part of a portfolio of approaches to meeting its legislated emissions reduction targets,** of 43 per cent by 2030 and net-zero emissions by 2050.
- Government support focusses on reducing emissions from **hard-to-abate industries** and **creating jobs and opportunities** in our regions.
- Australia has **vast potential for the geological storage of carbon dioxide**, with a sub-commercial storage capacity of over 31 gigatonnes.
- We're focused on ensuring the right policy and regulatory frameworks are in place to enable the safe and permanent removal of greenhouses gases, including **transboundary CCS** to help our trading partners decarbonise.

Climate policies

- The **Safeguard Mechanism** ensures Australia's largest emitters contribute to our national emissions reduction targets.
  - Facilities must reduce their emissions by 4.9% annually by undertaking onsite abatement, from activities like CCS, or surrendering carbon credits.
- The **Australian carbon credit unit scheme** is a voluntary scheme allowing project proponents to earn carbon credits for activities that reduce, avoid or sequester emissions, including from eligible CCS projects.
- Australia's Future Gas Strategy outlines the role of geological storage of CO_2 in supporting Australia's decarbonisation plans.

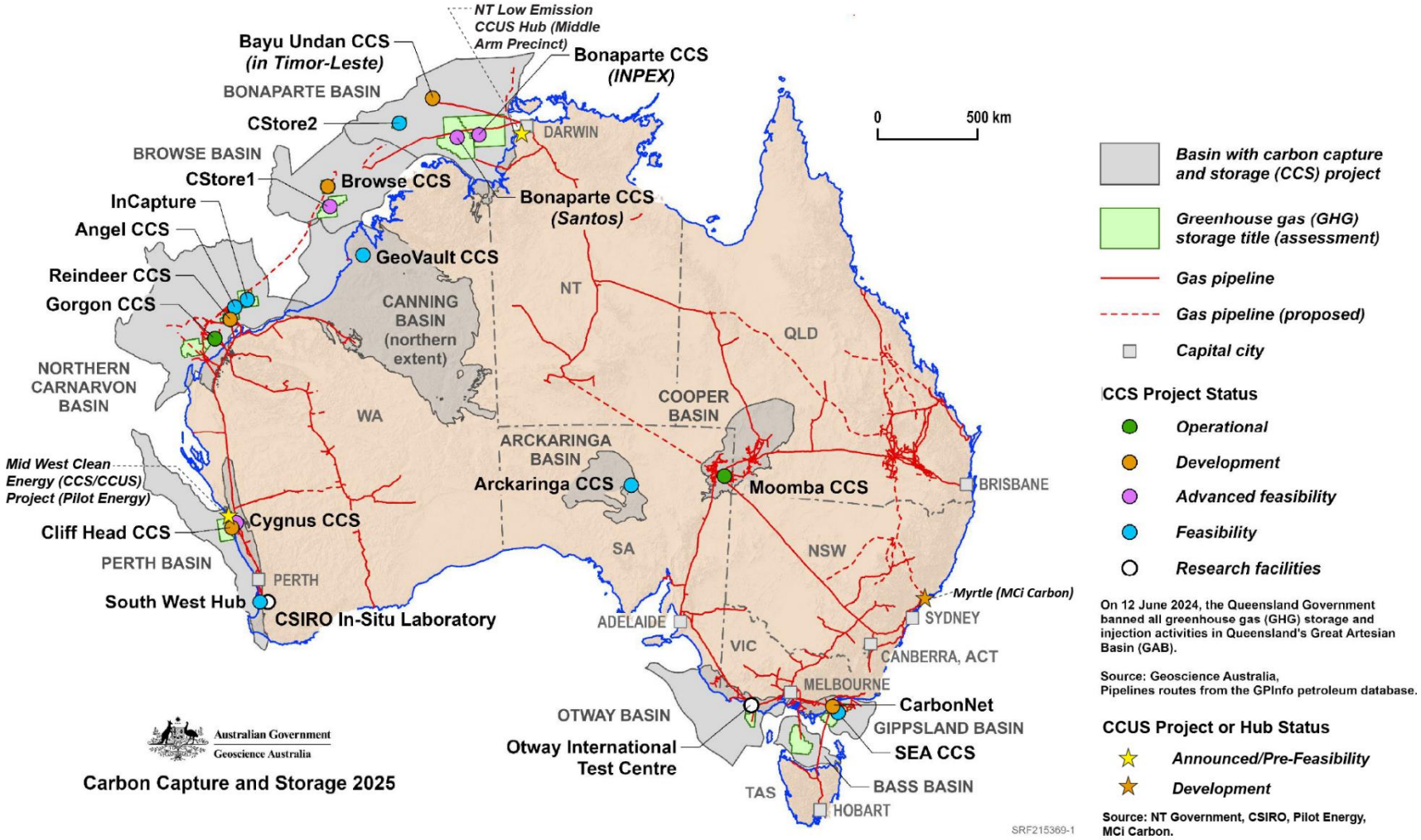
CCS and CCUS Initiatives and Programs

- Under the ***Regional Cooperation Initiative on Carbon Sequestration***, Australia is working towards establishing regulatory frameworks and bilateral instruments, as required under the London Protocol. These instruments will support Australia and its trading partners to decarbonise by enabling the transboundary movement of carbon dioxide for offshore storage.
  - This builds on Australia's recent acceptance of the 2009 amendment to the London Protocol, with the declaration of provisional application taking effect from 7 November 2024.
- Under the ***Resourcing Australia's Prosperity Initiative***, Geoscience Australia is developing a national atlas of onshore and offshore geological storage potential for carbon dioxide, for release in 2028.
- The ***Carbon Capture Technologies Program*** is funding the research, development and demonstration of novel carbon dioxide capture and utilisation technologies. In 2024, $65 million in grant funding was awarded to projects addressing emissions in hard-to-abate sectors and utilising CO2 in the development of low-carbon products, including building materials and batteries.
- Following the ***2023 Offshore Greenhouse Gas Storage Acreage Release***, an additional 10 greenhouse gas storage assessment permits were awarded in 2024. There are now a total of 17 active greenhouse gas storage assessments permits located in Commonwealth waters offshore of Western Australia, Northern Territory, Victoria and Tasmania, providing significant exploration potential.

Australia – Map of CCS & CCUS Projects

LARGE-SCALE, OPERATIONAL CCS PROJECTS

- **Gorgon CO_2 Injection Project (Chevron Australia):** Over 11 Mt of CO_2 stored since Aug 2019. The project aims to reduce greenhouse gas emissions by over 100 Mt over the project's life.
- **Moomba CCS Hub Project (Santos):** Began operating in Sept 2024, with an annual storage capacity of 1.7 Mt of CO_2. Moomba earns carbon credits for emissions sequestered.



Australia - CDR

Vision and strategy for CDR

- Australia's **Climate Change Authority** states that novel CDR will play a role in reducing residual emissions. In 2050, at least 10% of Australia's residual emissions will need to be removed using novel CDR to achieve our net-zero target.
- Australia's National Science Agency (CSIRO) is developing the first **National CDR Roadmap**, which will identify the most promising novel CDR technologies for Australia in terms of offering scalable, durable and economically viable CO_2 storage.
- The National CDR Roadmap will underpin and inform policy considerations for carbon management technologies in Australia.

CDR technology innovation and RD&D programs

- ***Carbon Capture Technologies Program*** - $65 million investment in projects using emerging technologies to help decarbonise hard-to-abate industrial processes and remove CO_2 from the atmosphere:
  - Mineral carbonation: MCi Carbon, Novalith, and the University of Melbourne.
  - Direct air capture: Airthena Technology Development Company Pty Ltd and Capture 6 (Pilot Energy Limited).
- ***Lower Carbon Grants Program – Gorgon Fund*** - $33.6 million investment in green energy and technology projects in Western Australia to support a sustainable, low-carbon future:
  - Direct air capture: CSIRO's Carbon Capture Material Acceleration Centre.
  - Biochar carbon removal: Biomass Projects Pty Ltd - Mardi Char Biomass Project.
- ***CSIRO's CarbonLock Program*** - $30 million investment in Australia's leading novel CDR research program.
- ***Carbon Innovation Grants Program*** - $15 million in feasibility studies, pilot projects, or capital works to help avoid, reduce or offset CO_2 from heavy industrial processes.
- ***Accelerated Mineral Carbonation Research Program*** - $2.5 million to accelerate the development and implementation of mineral carbonation using mining wastes and byproducts.

Current and Future CDR Projects

** CCU(S) project using CDR technology (potential to become CDR)*

Project Status: ⁰RD&D; ¹Announced; ²Development; ³Construction; ⁴Operational

Brazil – CCUS

•Current government strategy for CCUS

- Brazil is fully aligned to meet the goals of the Paris Agreement and achieve Net Zero by 2050. Within the new Climate Plan, the country has made progress in the construction of its Adaptation and Mitigation Plans. The Ministry of Mines and Energy is responsible for conducting the Adaptation and Mitigation Plans related to the Energy Sector.
- Brazil already stands out for its renewable energy matrix, with more than 49% of its energy coming from renewable sources, and 89.2% of the electricity generated by these sources in 2023.
- The main GHG-emitting sectors are the agriculture/feedstock and land use sectors, followed by the energy sector, which has a significant share of GHG emissions from the transportation sector.
- To achieve Net Zero, the land use sector needs to become negative, but that will not be enough. We need technologies such as CCS/CCUS/BECSS and DACS to achieve Net Zero.

•Deployment policies and programmes in place

- With the approval of the Future Fuel Law (Law 14,993/2024), the legal basis for the capture and geological storage of carbon dioxide was established.
- Currently, the National Agency of Petroleum, Natural Gas and Biofuels (ANP) is responsible for defining the regulatory framework for the capture and geological storage of carbon dioxide.

•Priorities going forward

- Establish the regulatory framework for capture and geological storage of carbon dioxide.
- Develop the business model
- Monitor the development of ongoing regulatory pilot projects

CURRENT LARGE-SCALE CCUS PROJECTS

- Brazil has one of the largest carbon sequestration projects in the world: CCUS in the Santos Basin. Actually, we are talking of twenty millions tons of CO2 per year, and by 2030 will be injecting more than forty millions tons per year.

POTENTIAL FUTURE PROJECTS

- CCS Pilot Project - Rio de Janeiro - Petrobras
  - Cabiúnas Terminal
  - First CCS pilot project in Brazil
  - Injection of 100,000 t CO2/year in saline reservoirs
- BECCS - FS Project - Agrisolutions Biofuels Industry (FS) – Mato Grosso
  - Lucas do Rio Verde corn ethanol plant
  - 423,000 t CO2/day
- BECCS HUB – Manacá – São Paulo
  - BECSS for sugarcane ethanol production
  - Potential of 2 billion t of CO2Pilot well with ~300,000 tCO2/year
  - Extension to HUB of 2 million t/year
- R&D Projects: 10 using R,D&I funds from E&P contracts

Canada – CCUS

Current Approach to CCUS

- Implementing a suite of measures and investments to expand deployment of large CCUS projects and infrastructure, enable RD&D, and support regulatory development, reflected in several CCUS funding announcements over the past year.
- **Carbon Management Strategy** (2023): Sets a vision for a competitive and robust sector across industrial, power, hydrogen, carbon removal, and CO2-based industries pathways, which contributes to economic and climate goals.
- CCUS is expected to play a key role in Canada's **legislated net-zero by 2050 goals** and **2030 Emissions Reduction Plan**.

Federal Policies / Funding

- **CCUS Investment Tax Credit (ITC):** Refundable ITC for projects that permanently store CO_2 in dedicated geological storage or concrete (CAD $7.6B to 2030). Available for projects starting after Jan 1, 2022.
    - Other ITCs (Clean Hydrogen, proposed Clean Electricity) can also provide support to CCUS.
- **Industrial Output-Based Pricing System**: Price incentive for industrial emitters to reduce their greenhouse gas emissions and spur innovation (federal minimums, provincial implementation; $95/t in 2025, rising to $170/t in 2030).
- **Canada Growth Fund (CGF):** $15B public investment vehicle to attract private capital for low-carbon projects, with up to $7B for Carbon Contracts for Difference (CCFDs). **As of Spring 2024, ~$6B remained for CCFDs and offtake agreements.**
- **Clean Fuel Regulations**: CCUS projects that reduce the lifecycle carbon intensity (CI) of gasoline and diesel are eligible to generate credits. Includes: 1) Carbon Storage and EOR projects which reduce the lifecycle CI of liquid fossil fuels, 2) DAC-to-fuels projects, and 3) Clean Hydrogen projects that displace traditional liquid or gaseous fuels.
- **CCUS RD&D funding**: $319M/7 years delivered by Natural Resources Canada's Energy Innovation Program via a suite of funding calls – with **up to $50M for Front-End Engineering and Design (FEED)** studies.
- **Strategic Innovation Fund - Net Zero Accelerator**: An $8.5B fund to support developing and adopting clean tech, large-scale decarbonization and industrial transformation projects (**including CCUS** in high-emitting sectors).
- **Canada Infrastructure Bank**: Crown corporation investing in private-sector low-carbon infrastructure projects, CCUS FEED capital expenditures eligible.

Future Priorities

- *One Canadian Economy Act* received Parliamentary approval (June 2025) – provides the national government a mandate to expedite nation-building projects, while ensuring environmental protections and Indigenous rights are upheld.
- Canada has conducted public consultations earlier this year to inform the development of legislative and regulatory frameworks for sub-seabed geological CO2 storage in offshore Atlantic.

LARGE-SCALE CCUS PROJECTS: 8 CURRENTLY IN OPERATION

- **Boundary Dam, SaskPower, SK**: CO_2 captured at coal-fired power plant (7Mt captured since 2014).
- **Weyburn-Midale, Whitecap, SK:** EOR & CO_2 storage (>45Mt since 2000).
- **Quest, Shell Canada, AB**: >9.5Mt CO_2 captured & stored since 2015, at 3 hydrogen production units at oil sands upgrader.
- **Alberta Carbon Trunk Line (ACTL), Wolf, AB**: 14.6Mt/yr capacity, 240-km pipeline delivering ~1.6 Mt CO2/yr from fertilizer plant & refinery.
- **Nutrien Fertilizer Facility, AB:** CO_2 captured from H_2 production to make ammonia for fertilizer manufacturing.
- **Sturgeon Refinery, NWR Partnership, AB**: World's 1st greenfield refinery designed with CO_2 capture.
- **Enhance Energy Clive Project, AB:** CO_2 received via ACTL for EOR & CO_2 storage (7Mt stored since 2020).
- **Glacier, Entropy, AB:** World-1st commercial project to capture & store CO_2 from NG combustion (Phase 1: 32Kt/yr).

PROJECTS & HUBS IN DEVELOPMENT PIPELINE

- Recent Final Investment Decisions (2023-24): Shell & ATCO (Polaris and Atlas Hub), Dow and Linde (Path2Zero), Entropy (Glacier Phase 2).
- CGF Investments: Svante, Strathcona Resources, Varme, and Entropy.
- Construction: Hydrogen (e.g., Air Products), ACTL extension, Glacier (0.2Mt/yr from phases 1 & 2).
- Alberta allocating sequestration rights via a competition to enable hubs. To date, three hubs – Shell-ATCO Atlas, Bison's Meadowbrook, Enhance's Origins – have signed carbon sequestration agreements with the province.
- NRCan funding CCUS FEEDs in oil & gas, power, ethanol, potash, and BECCS projects, alongside regional hubs.
- Pathways Alliance: proposed CCS network of 10-12 Mt/yr by 2030.

Canada – CDR

Current Approach

- Canada's **Carbon Management Strategy** identifies CDR as a key pathway to help Canada achieve its legislated net zero by 2050 climate targets**.**
- CDR presents a unique opportunity for Canada to cultivate an innovative new sector with long-term growth and export potential, as well as novel supply chains that complement Canada's natural resource base.
- Canada is home to ~70 innovative CDR firms, several of which have been recognized by XPRIZE and the Global Cleantech 100.

Federal Policies / Funding

- **CCUS Investment Tax Credit (ITC):** eligible CAPEX for DAC project equipment receive the maximum rate of 60%.
- **CCUS RD&D Funding:** CDR projects eligible; funded projects include Bioenergy with Carbon Capture and Storage (BECCS), enhanced mineralisation (EM) and Direct Air Capture (DAC).
- **Procurement Policies:** World-leading program to spend at least $10M CAD to procure CDR services from broad portfolio of projects based in Canada. Request for Proposals for initial phase anticipated Q4 2025.
- **International cooperation:** As a co-lead of the CDR Mission, Canada provides strategic guidance to members while promoting Canadian innovation, enabling critical knowledge exchange through the DAC and LCA/TEA technical tracks, and leading cross cutting projects such as a global student prize competition and mapping initiative.

Future Priorities

- Canada's **GHG Offset Credit System**: Draft DACCS protocol published; BECCS Protocol under consideration for development.

Projects in the pipeline

Canada

- **Carbon Sandbox Project, Arca:** carbon mineralization of mine tailings pilot project in operation since July 2024.
- **Deep Sky Alpha, Deep Sky:** the world's first carbon removal innovation and commercialization center. Multiple state-of-the-art DAC technologies will be deployed at the facility starting in 2025:
  - Airhive, Avnos, Phlair, Greenlyte, Mission Zero, Skyrenu, Skytree, Neg8 Carbon
- **Merritt Electrofuels DAC Project, Huron Clean Energy, Oxy and Carbon Engineering**: proposed facility will use Carbon Engineering's DAC and AIR TO FUELS technologies to capture up to 0.25MTPA/y and produce 100ML/y of low carbon fuel.
- **Peace River Pulp Mill BECCS Project, Mercer and Svante**: Conducting pre-FEED study; Phase 1 0.5MTPA/y biogenic CO2 capture capacity.
- **TerraFixing**: Developer with patented DAC tech for deployment in cold dry climates. Demonstration project anticipated to commence in 2025.
- **Hinton Bioenergy CCS Project, Vault 44.01, Mondi Group, Torchlight Bioresources:** Conducting FEED study; proposed negative emissions BECCS project at Hinton Pulp Mill in Alberta; 1.26MTPA/y biogenic CO2 capture capacity.
- Others with pre-purchases/offtakes tied to Canadian projects include Karbonetiq (carbonation of steel slag), CO280 (BECCS), Phlair (DAC), UNDO (ERW), Planetary (OAE), PHathom (OAE), Carbon Run (RAE), NULIFE (BiCRS), Exterra (EM), and more.

China – CCUS

China

Current government strategy for CCUS

- National 14th Five-year Plan
- "1+N" policy framework for carbon peaking and carbon neutrality: CPC, The State Council, NDRC, MOST, MEE, MIIT…
- **RD&D:** Roadmap for CCUS technology development in China (MOST); Action Plan for Low-Carbon Transformation of Coal-Fired Power (2024–2027) (NDRC) ; Implementation Plan for Green and Low-Carbon Advanced Technology Demonstration Projects (NDRC)
- **Incentive:** Green Finance Support Project Catalogue (2025)(PBOC)

Deployment policies and programmes in place

- National Key R&D Programme and National Natural Science Foundation
- Private capital, such as Tencent's CarbonX project

Priorities going forward

- Low cost CO_2 capture
- CO_2 capture in the industrial sector
- Offshore CO_2 sequestration
- Large-scale integrated demonstration, pipeline system and hubs
- Regulatory, standards, and methodology framework

CURRENT LARGE-SCALE CCUS PROJECTS

- **Sinopec:** ShengLi Oil Field **1Mt/a CCUS Project** (largest project in China)
- **HuaNeng Group:** ZhengNing Power Plant Post-Combustion 1.5 Mt/a CCUS Project
- **CHN Energy:** JinJie 150 Kt/a Power Plant Full-chain CCUS Project; Taizhou 0.5Mt/a Thermal Power CCUS Demonstration Project
- CHN Energy & CNPC: Ningdong 3 Mt/a CCUS Demonstration Project (CO_2 Capture+EOR)
- **CNPC:** Jilin 0.8 Mt/a CO2-EOR Commercial Project
- **Baotou Steel:** 0.5 Mt/a CCUS Project
- **Qingzhou Zhonglian**: 0.5 Mt/a CCUS Project
- **CNOOC:** Enping Oilfield 0.3Mt/a Offshore CO2 Sequestration Project

POTENTIAL FUTURE PROJECTS

- **Industry sector:** Cement Plant CCUS (Hailuo, Jinyu, CNBM); Steel; etc.
- **Hub** (Pre-feasibility study):
  OGCI & CNPC: XinJiang 1.5 Mt/a CCUS Hub;
  CNOOC & Shell & ExxonMobil: Daya Bay 10 Mt/a CCUS Cluster;
  Sinopec & Baosteel & Shell & BASF: East China 10 Mt/a open-source CCUS Cluster

China - CDR

China

Vision and strategy for CDR

- Roadmap for CCUS technology development in China
- Implementation Plan for Science and Technology Support for Carbon Peaking and Carbon Neutrality (2022-2030)
- CDR provide solutions for hard-to-abate or residual emissions

CDR Innovation and deployment policies and programmes

- National Key R&D Programme and National Natural Science Foundation
- Private capital, such as Tencent's CarbonX project

Priorities going forward

- Evaluate the role and potential of CDR
- Life Cycle Assessment and Techno-Economic Analysis
- Low cost CO_2 capture techonoly
- Development of CO2 storage resources
- Sustainability Impact Assessment

Notable CDR Projects

- China National Petroleum Corporation: 1000 t/y CO_2 DAC pilot (In construction)
- China Energy Engineering Co. Ltd. & Shanghai Jiao Tong University: 600 t/y CO_2 DAC pilot “CarbonBox” (In operation)
- Zhejiang University: 30 kg/d CO_2 DAC prototype
- Nanjing Nianda Environmental Technology Co. Ltd. & Nanjing Forestry University: Nian’da Biochar Project, 330 CORCs in the first crediting period
- Jinan Boiler Group: Integrated biomass carbon capture boiler
- Nanjing University: Enhanced Rock Weathering field trials in Xuyi, Jiangsu

Germany – CCUS

The carbon management strategy (CMS)

- Shall provide the economic and political framework conditions for CCS/CCU in GER
- For CMS development, relevant stakeholders from NGOs, industry and science are involved

Key points of CMS [link] and Draft Amendment of German CCS law (both passed the German Federal Cabinet end of May 2024)

- CCS/CCU are necessary to reach climate goals, at least in sectors with hard-to-abate emissions
- Create comprehensive legal framework for transport infrastructure / pipelines
- Allow offshore CO_2 storage in GER Exclusive Economic Zone, but neither injection in nor storage below marine reserves
- Opt-in clause for Federal States to allow for onshore CO_2 storage on their territory
- No access to CO_2 pipelines and storage facilities for CO_2 from energy generation with coal

Overarching goals of German climate policy

- Reduce/mitigate emissions, before they are created
- Decarbonize industry and phase-out of fossil fuels
- Expand renewable energy, increase energy and resource efficiencies, boost circular economy
- No fossil lock-ins (due to application of CCS/CCU, e.g.)

Next steps / open aspects in carbon management

- Amendment of CCS law: legislative procedure in Parliament and with obligatory consent of *Bundesrat* will follow
- Finalize CMS asap
- Create economic framework for CCS/CCU
- Generate governance structure
- Continuous stakeholder participation, monitoring and re-evaluation

Germany – CDR

Vision and strategy for CDR

- In 2025, the Federal Government will present **a long-term strategy for negative emissions,** outlining the role of negative emissions and the ramp-up of the necessary technologies in Germany.
- This strategy will also form the basis for the **targets for industrial CDR** pursuant to Section 3b of the federal climate law.

Notable CDR Projects

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CDR Innovation and deployment policies and programmes

- Funds in the federal budget are earmarked for CDR (subject to parliament approval): Starting in 2026, the Federal Ministry for the Environment, Climate Action, Nature Conservation and Nuclear Safety (BMUKN) will invest in the technology market ramp-up of CDR to utilize the climate and economic opportunities offered by negative emissions in two ways:
  - Direct **financial support for CDR-Projects**.
  - **Purchase of CO2-removal certificates** to strengthen the voluntary market for negative emissions.
- Two Research Programmes of the Federal Ministry of Research, Technology and Space (BMFTR), called **CDRmare** and **CDRterra,** dealing marine and terrestrial CDR methods, respectively, are being continued in second phases.

European Union – CCUS

Current EU strategy for CCUS

- The industrial carbon management strategy (COM/2024/62) of 6 February 2024

Deployment policies and programmes in place

- NZIA Regulation: 50 Mtpa storage target for 2030 with investment obligation; 44 Oil&Gas companies are obliged to invest in storage sites in the EU.
- CCS Directive: 3 storage permits awarded in 3 EEA states, 5 permits ongoing (as of 06/25)
- Carbon Removals and Carbon Farming Regulation
- Deployment decarbonised and low carbon fuels (Renewables Directive / ReFuelEU Aviation / FuelEU Maritime
- Finance: EU Innovation Fund, TEN-E and Connecting Europe Facility, Horizon 2020 and Horizon Europe, Recovery and Resilience Facility/RePowerEU, NextGenerationEU.

Priorities going forward:

- Implementation of industrial carbon management strategy:
  - Capturing and storing CO2: NZIA implementation, CO2 storage atlas
  - Framework and support for removing CO2 from atmosphere
  - CO2 aggregation platform
  - Framework for accounting carbon utilisation
  - Legislative initiative for an EU CO2 market and transport infrastructure
  - Standardisation of CO2 streams

41 CCS and CCU projects co-funded from the Innovation Fund (exmpl.):

CUSTARD (IT), GeZero (D), IFESTOS (HE), IRIS (HE), KOdeCO (HR), EVEREST (D), GO4ZERO (B), Columbus (B), CCPILOT4CCS (NL), CO2nrcEAT (B), Carbon2Business (D), ANRAV (BG), Coda Terminal (IS), AIR (SE), HySkies (SE), GO4ECOPLANET (PL), CalCC (F), Olympus (HE), K6 Program (F), Beccs Stockholm (SE), Kairos@C (B), AGGREGACO2 (ES), Silverstone (IS), (...)

CO2 transportation projects on the 1th PCI/PMI list:

Aramis (NL), Bifrost(DK), CO2TransPorts (NL), Norne(DK), EU2NSEA(NO), ECO2CEE(PL), CCS Baltic Consortium(LT), Pycasso(FR), Prinos(EL), Callisto(FR), Geothermal CCS (HR), Delta Rhine Corridor (NL), Northern Lights (NO), Nautilus (FR)

CURRENT LARGE-SCALE CCUS PROJECTS: Currently there are no large-scale CCUS projects operational

European Union – CDR

Vision and strategy for CDR

- CDR is instrumental to balance out around 400 million tonnes CO2 equivalent of residual emissions in hard-to-abate sectors to reach net-zero economy-wide GHG emissions by 2050.
- The European Commission will assess how to support the development of carbon removals, in line with the EU's 2040 climate ambition and the goal to reach climate neutrality by 2050 and negative emissions thereafter.

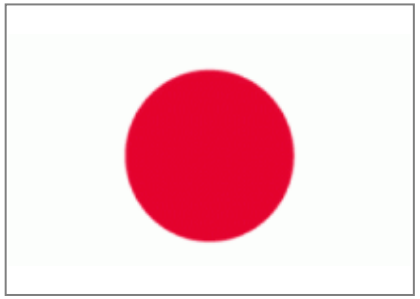
Notable CDR Projects

- CarbFix2; AirInMotion; DDAC; C-DAC; CAPTURE; EcoFuel
- BECCS, Danube Removal, Innozhero, CapturEste, Ambassador

CDR Innovation and deployment policies and programmes

- An **EU certification framework for carbon removals** was adopted on 6 December 2024 to ensure the environmental integrity of certified carbon removals.
- For the purposes of this Regulation, 'carbon removal' means the anthropogenic removal of carbon from the atmosphere and its durable storage in geological, terrestrial or ocean reservoirs, or in long-lasting products.
- The Commission has already been mandated by the co-legislators to assess by 2026 if and how the CO2 removed from the atmosphere (and safely and permanently stored) could be accounted for and covered by **emissions trading**; this would create price-based incentives for the generation of industrial CDR.
- Beyond the role of permanent carbon removals in the ETS, the Commission is also exploring complementary measures such as the development of a purchasing programme for carbon removals or the recognition of carbon removals in the development of lead markets for products.
- in parallel, the European Commission will continue to boost EU **research, innovation and early-of-a-kind demonstration** for novel industrial technologies to remove CO2 under Horizon Europe and the Innovation Fund.

Japan - CCUS



【Key climate policy targets】

- Achievement of carbon neutrality in 2050.
- Reduction of domestic GHG emissions by 46% in FY2030 from that of FY2013 level.

【CCS business Act (accepted on 24th May, 2024 by the National Diet) 】

- Ensure the adequate business environment and public safety for CCS business in Japan.
- Implement safety & business regulations for business operators of pipeline transportation and storage.
- Designate suitable areas for CCS as “specified areas” and grant licenses for exploratory drilling to qualified businesses.

  > The offshore of Tomakomai City (Hokkaido) was designated as the first specified area.

【Support scheme for domestic pipeline CCS programs】

- Interim Review of Support Scheme for CCS Business (Pipeline Project) issued in Jun. 2025.

【LCO2 shipping demonstration project】

- Establish liquefied CO2 ship transportation technologies.
- Building of a demonstration ship for liquefied CO2 shipping.

【CCU/carbon recycling】

- The Carbon Recycling Roadmap was established in Jun, 2024.
  (https://www.nedo.go.jp/carbon-recycling/2023/en/230927.pdf)
- A R&D and demonstration base for promoting Carbon Recycling technologies in Osaki-Kamijima island in Hiroshima prefecture (established in Sep, 2022).

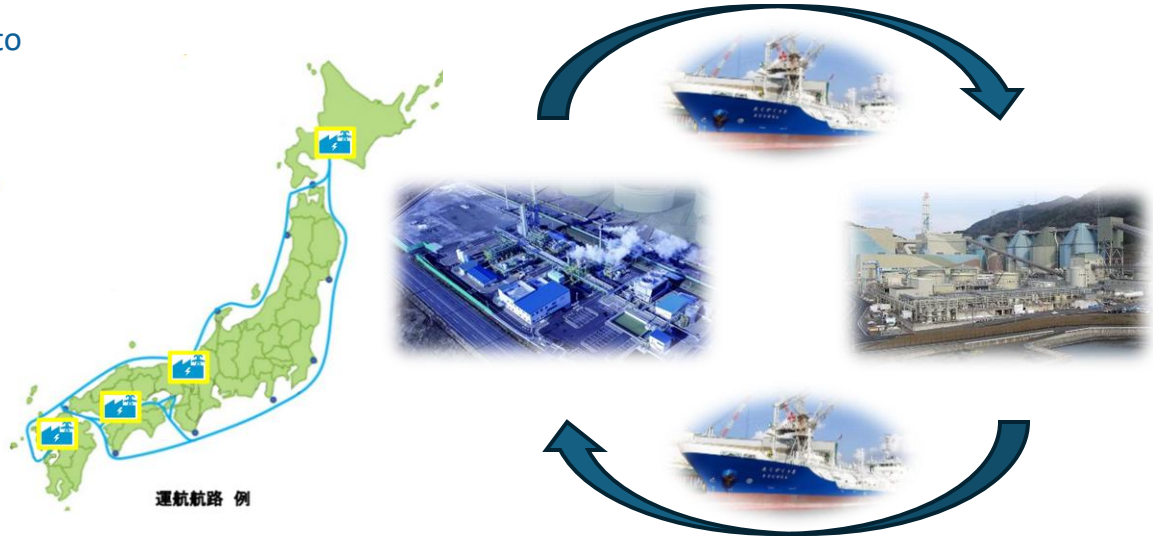
【Priorities going forward】

- CCS business projects to be started in early 2030s.
- Leveraging Asia CCUS Network to accelerate CCUS throughout Asia-Pacific.

  > Next Asia CCUS Network Forum will be held on Sep. 10th to 11th, 2025, in Jakarta (Indonesia).

  URL: https://www.eria.org/events/the-5th-asia-ccus-network-forum

Demonstration of L-CO2 transportation from 2024



CURRENT LARGE-SCALE CCUS PROJECTS

- Demonstration project for ship transportation of liquefied CO2.
- 9 full value chain pilot CCS projects for business model development (Advanced CCS Program)

POTENTIAL FUTURE PROJECTS

- CCS business projects to be started in early 2030s.

Japan – CDR

Current government strategy for CDR:

- As articulated in the 7th Strategic Energy Plan, published in February 2025, the government recognizes that CDR is “necessary as a means to offset residual emissions” and plans to improve the environment, create markets, and accelerate technology development.
- Meeting Japan's 2050 carbon neutrality goal necessitates the annual removal of several hundred million tonnes of CO2 via CDR technologies, to balance the approximately 50 to 240 million tonnes of residual emissions projected each year. Therefore, the Ministry of Economy, Trade and Industry (METI) has formulated the Study Group for Creating Markets of Negative Emissions Technologies in 2023 and conducted technological and business analysis both domestically and internationally and identified key factors for CDR development.
- The government recently revised its Green Transformation (GX) strategy, government’s initiative to shift industry towards sustainable structure, and issued “GX 2040 Vision”. The GX 2040 Vision highlights CDR’s potential to create new industries in local areas as indicated by leading examples in Japan. The government plans to explore CDR policies to expand efforts beyond research and development to regional revitalization through the creation of new industries.
- Through its various initiatives such as Green Innovation Fund, Moonshot, and the Global South Future-Oriented Co-Creation Project, the government supports R&D of CDR technologies, providing timely policy support. The government looks at a wide range of possibilities and supports the development of diverse CDR solutions, rather than narrowing down the scope.

CDR projects under development / execution:

- Cutting-Edge DAC demonstration at the World Expo 2025 - The Expo showcases demonstrations of Moonshot research on DAC. At the Carbon Recycling Factory exhibition, DAC demonstration machine developed by the Research Institute of Innovative Technology for the Earth captures 300-500 kg of CO2 per day from the atmosphere.
- Feasibility Study of Enhanced Mineralization - Establishing systematized LCA/TEA evaluation tool for enhanced weathering.
- Development of high-functional biochar, etc. - Production and application of highly functional biochar from agricultural by-products as part of the Green Innovation Fund projects.

Innovation programmes:

- Mission Innovation CDR – Japan is a core mission member of this global initiative, actively engaging in data and knowledge sharing, including the CDR Mission’s latest publication, “Measurement, Reporting and Verification (MRV) for CDR”, which was developed by Japan. Additionally, Japan hosted an online workshop titled “MRV Issues and Opportunities for International Harmonization” in early 2025 and an online webinar on biochar in late 2024. Furthermore, Japan contributed to the SMART-CDR Competition in the role of evaluator and mentor, and a Japanese team was selected among the winning teams.
- Green Innovation Fund – Government initiative to continuously support companies and other organizations in pursuing carbon neutrality by 2050, including CDR.
- Moonshot Research and Development Program < Goal 4 “Realization of sustainable resource circulation to recover the global environment by 2050” > - Government supports challenging research and development to achieve Moonshot Goal 4 including CDR.
- Global South Future-Oriented Co-Creation Project - Government subsidy program to support companies with technologies such as CDR to conduct demonstrations or feasibility studies in the Global South.

DAC Facility at the World Expo 2025 Osaka, Kansai

Mexico - CCUS

Current government strategy for CCUS

- We are currently seeking to resume the work carried out in 2010-2018, which included the publication of North American Carbon Sequestration, the Atlas of Geological Storage of CO_2 in Mexico, and the first edition of the CCUS Technology Roadmap in Mexico.

Deployment policies and programmes in place

- **Electricity Sector Law (Article III, fraction XXI, index m).** It establishes that the energy generated by thermal power plants with CCS processes is to be considered clean energy.
- **Energy Planning and Transition Law (Article III, fraction XXVI).** Establishes CCS as a clean technology.
- **Sustainability Plan of Petroleos Mexicanos (PEMEX):** The state oil company (PEMEX) considers low carbon business opportunities, including CCS, in its sustainability plan. It also envisages the development of CCS for petrochemical and gas processing refineries in the short and medium term. In the long-term it seeks to extend the capture and storage service to customers of incentivized industries.

Priorities going forward

- Establish the regulatory framework for CCS.
- Development and supervision of pilot projects.
- Development of financing and incentive mechanisms.
- Creation of a roadmap to facilitate cross-institutional coordination between key actors from the public, private and academic sectors.

CURRENT LARGE-SCALE CCUS PROJECTS

- There are currently no large-scale CCUS projects in Mexico.
- Nevertheless, 3 small-scale pilot projects have been carried out by the Mexican Petroleum Institute (IMP) in recent years.

POTENTIAL FUTURE PROJECTS

- Carbon Capture in ammonia production processes.
  Description: Capture and storage of the CO_2 stream from PEMEX's ammonia production plants in Tabasco.
  - Cactus, Nuevo Pemex and Ciudad Pemex gas processing installations

- Carbon capture in sulphur recovery plants.
  Description: Recovery of high purity CO_2 stream from a PEMEX plant in Veracruz.
  - Cosoleacaque Petrochemical Refinery

- CCS in CO_2 streams in Minatitlan and Dos Bocas.
  Description: capture and storage of high purity CO_2 stream in two depleted oil & gas fields belonging to PEMEX.
  - "Lazaro Cardenas del Rio" Refinery, Minatitlan
  - " Olmeca" Refinery, Dos Bocas

Netherlands - CCS

Current government strategy for CCUS

- CCS important technology to reduce CO2 emissions in industry
- CCS only when no cost-effective alternatives
- De-risking CCS projects by providing financial support
- Large scale deployment of CCS before 2030
- Fossil CCS as a transition technology but CO2 storage necessary for negative emissions

Deployment policies and programmes in place

- Subsidy scheme for CO2 reduction in industry (SDE++), covers unprofitable top (total cost for capture, transport and storage minus ETS price and national CO2-levy) for a period of 15 years.
- CCUS feasibility studies (pre-FEED) and FEED studies (subsidy)
- Subsidies for R&D program
- EU (Horizon Europe, CEF, Innovation Fund)
- Project procedure (permitting coordination)

Priorities going forward:

- Successful realization of the first projects
- Implementation of the EU Net Zero Industry Act
- Roll-out of the EU Industrial Carbon Management Strategy

Projects in further stages of development 2025:

- **Porthos**: in building phase, operation foreseen in 2026, capture from 4 industrial sources with support from the SDE++, storage in P-18 gas fields offshore.
- **Aramis**: operation foreseen by 2030, max capacity 22 Mtons/ year (open access), launch phase of 7.5 mtpa (3 stores). Capture from several industrial sources. Dutch emitters supported through SDE++, storage in depleted gas fields offshore (North Sea).
- **Yara Sluiskil (NL) / Northern Lights (NOR)**: capture and transport of CO2 for storage in Norway. Definitive contract signed 2023, commercial shipments from 2025.
- **Multiple transport/infrastructure initiatives: Delta Rhine Corridor, Delta Schelde Connection, Carbon Collectors (shipping solution).**

Netherlands – CDR

Vision and strategy for CDR

- The Netherlands considers CDR as a vital second pilar of climate mitigation policy, next to emissions reduction.
- CDR necessary to reach climate neutrality by 2050 (likely 20-25 Mton in NL) and negative emissions beyond.
- Spring 2025: the Netherlands published Roadmap on CDR, with key principles for developing policy:
  1. Not at the expense of emission reduction.
  2. Permanent removals for fossil and long-lived GHGs; temporarily removals for short-lives GHGs.
  3. Based on robust methodologies and MRV.
  4. CDR aligned with other policies (CCU, circular economy, agriculture, global sustainability)
  5. National CDR policies to complement EU policies.
- Need for governance to create demand, support innovation and set enabling conditions:
  - Focus at EU level on creating demand for scaling up CDR: start of procurement programme for early scaling up followed by linkage to EU-ETS.
  - Focus at national level on supporting innovation and early scale-up of broad portfolio of CDR options.
  - Focus internationally on accounting rules/MRV.

Current CDR Policies and projects

- Policies supporting enhanced natural sinks (forestry, peat land management)
- National programme for biobased building of €200 million (including supply chain from agriculture and forestry)
- Selected projects:
  - Mineralisation: Paebble
  - DACCS: Carbyon
  - Marine CDR: SEO2

CDR Innovation and deployment policies and programmes

- Support programme for demos and pilots of CO2 and energy technologies including CDR (DEI+)
- Support programmes for early small scale CDR technologies (BECCS, DACCS) (SDE++)
- National programme to stimulate innovation and scale up of CDR-technologies (€50 million)

Nigeria – CCUS

Updated Key Climate Policy targets:

- National Technology Action Plan (NTAP) for Climate Change Mitigation and Adaptation in key economic sectors approved by the Federal Executive Council on 3rd May, 2023 to serve as Technology roadmap for meeting Nigeria's NDC commitment under the Paris Agreement;
- CCUS prioritized as a key technology in the NTAP in line with Government's CCUS strategy development programme of 2021 (Developed by IEA and Government of Nigeria)
- Revised NDC - NDC 3.0 to include CCUS as key decarbonisation levers . Current commitment:20% unconditional and 47% conditional targets by 2030;
- Net Zero target (Energy Transition) by 2060; and
- Long-Term Emissions Reduction Plan to achieve 50% by 2050 using a climate technology led approach.

Current Government Strategies for CCUS Development:

- Launch of the National geologicalAtlas Map aimed at providing an overview of the country's potential for CO2 storage and establishing a starting point to support the identification of CCS opportunities
- Increase focus on local capacity building
- Pilot demonstration subject to a clear, defined and robust policy, regulatory and incentive frameworks

Deployment Policies, Programmes and Frameworks in place:

- Energy Transition Plan;
- National Technology Action Plan for Climate Change Mitigation and Adaptation and
- Advanced stage in Carbon Market development - leveraging on article 6, VCM and carbon tax.

Priorities going forward:

- Policy direction, Legal and regulatory frameworks
- instititional capacity development / increase stakeholder enegagement for broader awareness creation and acceptance
- Incentive mechanisms to support private sector participation

CURRENT LARGE-SCALE CCUS PROJECTS

N/A

POTENTIAL FUTURE PROJECTS:

- Some pipeline projects being considered but dependent on strong PLR frameworks in place as well as local capacity deepening

Norway - CCUS

Norway

Current government strategy for CCUS

- Cost-efficient development of CCS projects
- Facilitate large-scale storage opportunities at the NCS
- Focus on decarbonization of industry and low carbon H2
- Establish CO2 infrastructure
- Share knowledge and experience

Deployment policies and programmes in place

- R&D – Norwegian Research Council and Climit
- Test Centre Mongstad, world's largest t.c. for CO2 capture
- MoUs of 15 April 2024 with the Netherlands, Belgium, Sweden and Denmark on X-B CO2 transport and storage
- Financial support for the Longship project
- State enterprise Gassnova, knowledge hub
- CO2 tax and the European Trading Scheme

Priorities going forward

- Establish a business case for CO2-storage
- Continue discussions on X-B CO2 transport with new countries
- New acreage for CO2 storage

CCS projects in operation

- **Sleipner and Snøhvit**

CCS Projects under construction

- The full chain CCS project: "Longship" (start 2025)
  - Capture at a cement plant (Heidelberg Materials), a waste incineration plant (Celsio), Ørsted in Denmark and Yara in the NL
  - The Northern Lights (transport and Storage at the NCS)

Cross-border Projects under consideration, EU projects of Mutual Interest under the EU TEN-E Regulation

- Northern Lights part 2, CO2 cross-border connection project between several European capture initiatives, transport by ship to storage on the NCS
- EU2NSEA, cross-border CO2 network developed by Belgium, Norway and Germany, with a view to storage at the NCS
- Nautilus CCS, Emissions from Le Havre, Dunkirk, Duisburg and Rogaland, to be captured and transported by ships to various sinks in the North Sea

Norway – CDR

Norway

Ambitions within CDR

- Norway is opening several storage sites in the North Sea for permanent storing of CO_2
- Norway has biomass available from e.g. forest, agriculture and marine resources
- Political ambition within Bioeconomy and CDR
- Relevant competence and market players;
  - Industrial Activities on Biogenic CO_2 with CCS and within Direct Air Capture (DAC)
  - R&D community with national- and international projects focusing on bioCCS and DAC

CDR Innovation and deployment policies and programmes

- Funding of the Longship CCS and CDR demonstration project
- Policy implement systems like CLIMIT, ENOVA, Research Council, and Innovation Norway

Notable CDR Projects

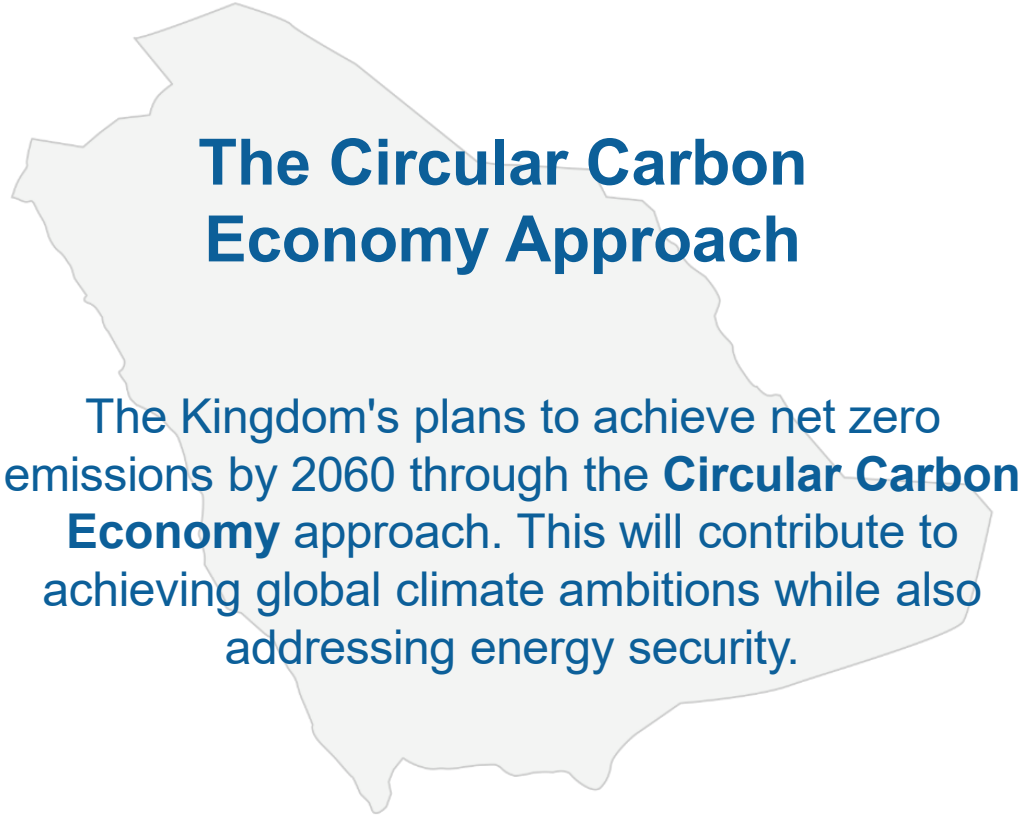
- Hafslund Celsio Waste-to-Energy plant in Oslo is part of the Longship full scale demonstration project. Frontier buyers will pay $31.6 million to remove 100,000 tons of CO_2 between 2029 and 2030.
  https://frontierclimate.com/writing/hafslundcelsio
- Norwegian startup companies Removr and GreenCap Solutions have secured private- and state funding for piloting their innovating DAC technologies
  https://greencap-solutions.com/greencap-solutions-selected-by-the-arctic-direct-air-capture-initiative/
  https://www.enova.no/om-enova/om-organisasjonen/teknologiportefoljen/accelerating-large-scale-dac-for-co2-removal-from-air/
- Energy Intensive Industry receive state funding from ENOVA and CLIMIT for their projects and consortiums (hub/clusters) to find optimal solutions for bioCCS/CDR
  Eramet Norway - CCS PFS Project | Enova,
  CCUS Mid-Norway, Industrial Cluster for CO2 Capture and Transport in Mid-Norway – Phase 2 – Climit

Source: Hafslund Celsio Waste-to-Energy plant in Oslo
Sketch showing the facility with CCS

The Kingdom of Saudi Arabia Efforts in Carbon Management

Saudi Arabia

Net Zero by 2060



The Circular Carbon Economy Approach

The Kingdom's plans to achieve net zero emissions by 2060 through the **Circular Carbon Economy** approach. This will contribute to achieving global climate ambitions while also addressing energy security.

Domestic Applications

CDR + CCUS

International Cooperation

The Kingdom of Saudi Arabia Efforts in Carbon Management

Saudi Arabia

CLEAN ENERGY MINISTERIAL
Advancing Clean Energy Together

MISSION INNOVATION
accelerating the clean energy revolution

Carbon Management Challenge

CARBON CAPTURE, UTILIZATION & STORAGE
ACCELERATING CCUS TOGETHER
AN INITIATIVE OF THE CLEAN ENERGY MINISTERIAL

- Actively including CCUS within CEM agenda and global clean energy discussions.
- Disseminating best practice in CCUS policy, regulation and investment.

CARBON DIOXIDE REMOVAL
MISSION

- KSA has supported the CDR Student Competition by $65,000, in-kind support to the project and judge panelists part of kingdom belief in the importance of carbon removals.

SMART-CDR COMPETITION

Workstream 3: Strategic Communication and Engagement

- Elevating the strategic ambition of the CMC and advocating for carbon management in international fora.
- Developing public messaging, outreach materials and educational content on carbon management.

CCUS Efforts in Kingdom of Saudi Arabia

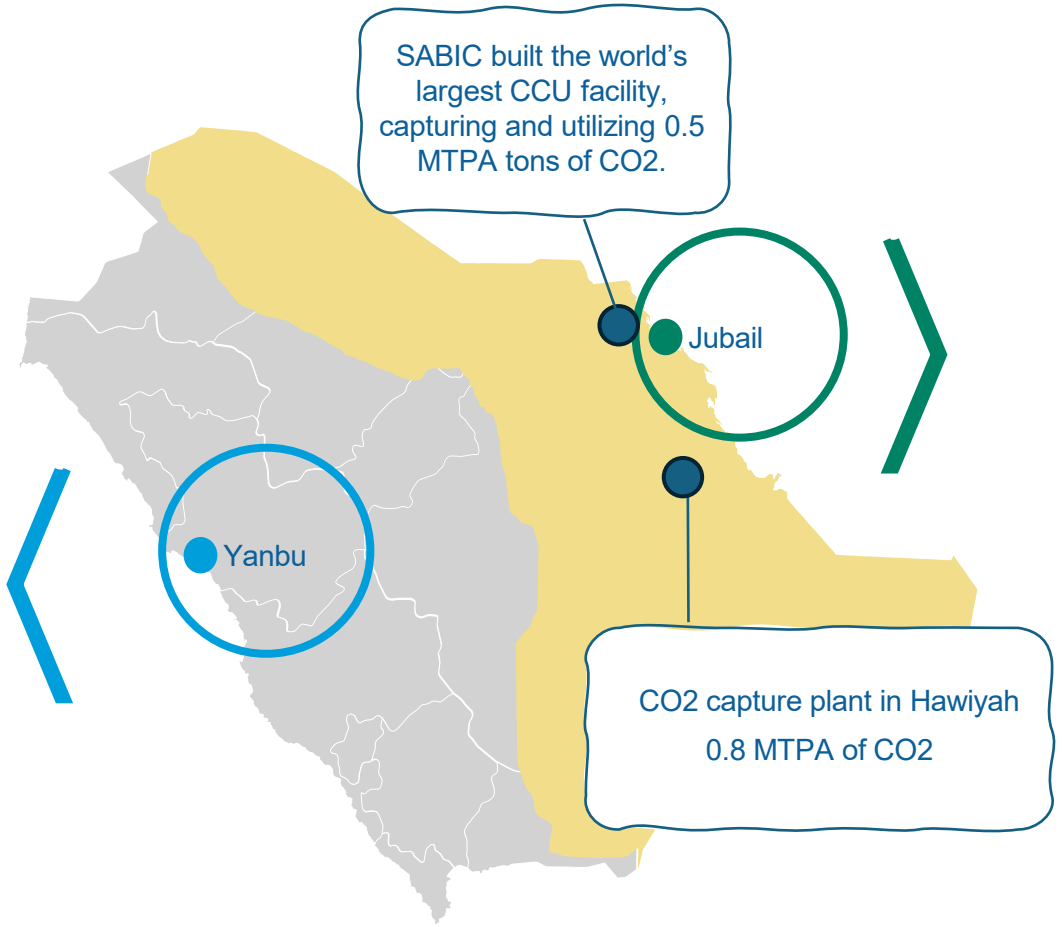
The Kingdom aims to reduce emissions through investing in carbon capture, utilization, and sequestration infrastructure

- Ambition: The Kingdom aims to capture 44 Mtpa of CO2 by 2035, as announced during the Saudi Green Initiative (SGI).

CCU Hub in the West

During the 2024 SGI, an MoU was signed between the Ministry of Energy and Royal Commission for Jubail and Yanbu to deploy carbon capture and utilization hub in Yanbu Industrial City

At its initial phase, the project is expected to utilize 1.5 million tons of CO2 annually to produce green methanol, low-carbon urea, and other products.



CCS Hub in the East

Deploy one of the world's largest CCS hubs in the Eastern region with a capacity of 9 Mtpa by 2028 and 44 Mtpa by 2035, with site preparation already in progress

وزارة الطاقة
MINISTRY OF ENERGY

aramco slb Linde

The Kingdom has launched pilots across a wide range of novel DAC and CCUS technologies

Saudi Arabia

Direct Air Capture (DAC)

Saudi Arabia is conducting a feasibility study to assess DAC deployment locally and launched the first Riyadh DAC unit to evaluate the technology under local weather conditions

Carbon cured concrete

Carbon Cured Concrete uses CO_2 in concrete that is permanently stored, reduces costs, and strengthens mixes. Currently used in residential projects and NEOM's *The Line*.

CCU Project at Ma'aden

Ma'aden & GulfCryo decarbonization project is utilizing up to 300 KTPA of CO2 emissions from Ma'aden's facilities, in various applications

South Africa – CCUS

South Africa

Current strategy for CCUS

•CCUS identified as a key enabler of the Just Transition in SA as part of 2050 developmental goals.

•The pilot CO_2 injection project FEED study was completed in 2024.

•Implementation, is in progress & target for execution of pilot scale injection is planned for the 2025/26 financial year.

•Request for Proposal (RFP) for an EPCm for the Pilot Injection has been published.

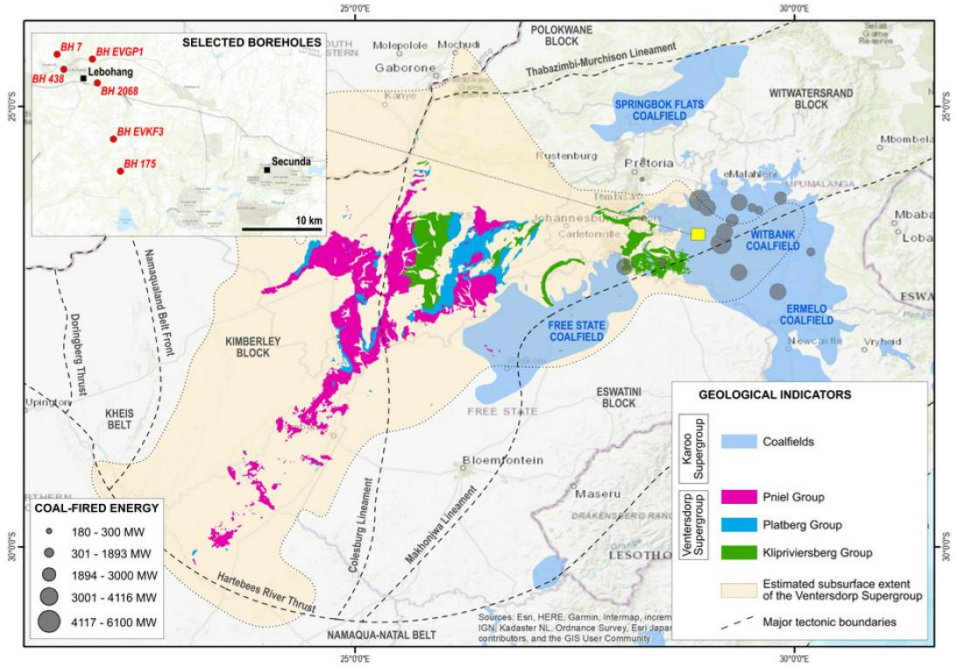
•Appointment & Implementation of the Pilot Injection is scheduled to start in Q4 2025.

Priorities for the implementation of CCUS

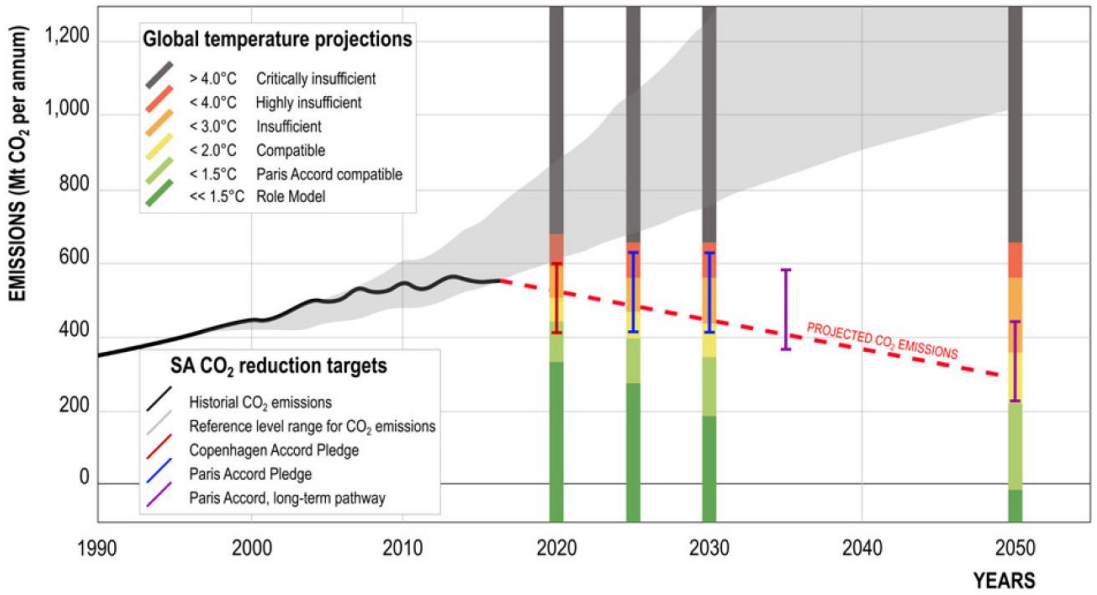
- Integrated geoscience research and focus on utilisation and socioeconomic aspects.

Future programmes:

- Pilot CO_2 injection into Basalt lavas & Deep saline aquifers in fracture systems near major point-source CO_2 emitters and large coalfields.
- Adaption of current coal-fired fleet.
- Researching opportunities for CO_2 utilisation"



Regional map of pilot site, Mpumalanga, South Africa



Overview of CO_2 projections for South Africa

South Africa – CDR

South Africa

Vision and Government strategy for CDR

- South Africa's greenhouse gas (GHG) reduction policy is multifaceted, encompassing legislation, policy frameworks, and specific targets. Key components include: the Climate Change Act, the Carbon Tax Act, and the National Climate Change Response Policy (NCCRP), all aiming to mitigate climate change and transition towards a low-carbon economy.

CDR Innovation and deployment policies and programmes:

- *Climate Change Act*: This landmark legislation provides a comprehensive framework for both adaptation to and mitigation of climate change. It outlines how South Africa aims to achieve a just transition to a low-carbon economy.
- *National Climate Change Response Policy (NCCRP):*This policy outlines South Africa's commitment to sustainable development and climate change mitigation, emphasizing cleaner energy production and better resource management.

Emission Reduction Targets:

- *Nationally Determined Contributions (NDCs)*: South Africa has committed to reducing its greenhouse gas emissions to a fixed target range of 350-420 MtCO2e by 2030.
- *"Fair Share" Contribution*: These targets are based on South Africa's assessment of its "fair share" of global emissions, taking into account the latest scientific data and the Paris Agreement's temperature goals.
- *Integrated Resource Plan 2023 (IRP 2023*): This plan charts South Africa's long-term energy strategy, including the transition towards renewable energy sources. The main purpose of the IRP is to ensure security of electricity
- supply necessary by balancing supply with demand, while
- considering the environment and total cost of supply
- *Just Transition Framework*: South Africa is also developing a Just Transition framework to ensure a fair and equitable transition to a low-carbon economy, particularly for workers and equitable transition from a carbon emissions intensive to a low-carbon emissions economy, particularly for workers and communities dependent on fossil fuels.

Additional Measures

- *Carbon Pricing:* The government is strengthening its carbon tax policy by progressively increasing the carbon tax rates between 2023 and 2030.
- *Energy Efficiency*: South Africa is implementing policies to improve energy efficiency and reduce the emissions intensity of industries.
- *Renewable Energy:* The country is also focusing on expanding its renewable energy capacity, with the decreasing cost of renewables making this a more viable option.
- *Sector-Specific Strategies*: South Africa is developing sector-specific strategies to address emissions from different parts of the economy, including the building sectors.

The Just Energy Transition Partnership

- *The JET IP gives effect to the historic Just Energy Transition Partnership (JETP) which was forged at the COP26 Climate Summit in 2021 between South Africa and France, Germany, United Kingdom, United States, and the European Union. The JETP followed engagements between the parties on the unique economic and social challenges of transitioning South Africa's fossil fuel dependent economy in a just manner.*
- *The Political Declaration provides that the international partners will mobilise an initial US$8.5 billion between 2023 and 2027, subject to agreement on an investment framework. This catalytic financing is intended to leverage a much greater level of resources from both private and public sources.*
- *The JETP Political Declaration says the government's aim to "establish an ambitious long-term partnership to support South Africa's pathway to low emissions and climate resilient development, to accelerate the just transition and the decarbonisation of the electricity system, and to develop new economic opportunities such as green hydrogen and electric vehicles amongst other interventions to support South Africa's shift towards a low carbon future."*
- *The JETP identifies three priority areas to support the economy of the future: the electricity sector, New Energy Vehicles (NEV) and Green Hydrogen.*

United Arab Emirates – CCUS

Key climate policy targets

- UAE Net Zero by 2050 strategic initiative and currently UAE working on the National Net Zero Strategy 2050
- 2nd Nationally Determined Contribution – NDC on 2020 with United Arab Emirates (UAE) presents an economy-wide emission reduction target relative to BAU. The country projects the BAU scenario to reach 310MtCO2 in 2030. The country aims to reduce 23.5% by 2030, relative to the BAU scenario (UAE NDC, 2020).
- UAE Hydrogen Leadership roadmap (2021)
- 2022- UAE is on track to submit its revised 2nd Nationally Determined Contribution (NDC).
- 2022- UAE launched the National Net Zero by 2050 Pathway, which sets the timeframe and identifies the mechanisms of implementing the UAE Net Zero by 2050 Strategic Initiative, introduced in October 2021.
- 2023- UAE submit its revised 3rd edition to the 2nd Nationally Determined Contribution (NDC)
- 2024: UAE submit its 3rd Nationally Determined Contribution (NDC)

Current government initiatives/strategy for CCUS

- Hosted a CCUS Workshop that brought together the finance sector as well as industry to accelerate financing and deployment of CCUS projects.
- 2023: Launch the Updating the National Energy Strategy 2050 in partnership with Khalifa University (KU) and the International Renewable Energy Agency (IRENA)
- 2023: Launch the National Hydrogen Strategy which will include the CCUS/CCS hubs
- 2023: Hydrogen Regulatory framework (Abu Dhabi launches the Low-Carbon Hydrogen Policy)
- 2024: The UAE first certified CO2 storage site in the Middle East for carbon capture and storage project

Deployment policies and programmes in place

- ADNOC Announces Comprehensive 2030 Sustainability Goals and CCUS expansion capacity of 500% in the next 10 years.
- 2023 – UAE Announce Carbon Capture and Mineralization (CCM) technology project to eliminate CO2 from the atmosphere was announced. Fujairah pilot will be the region's first CCM project by ADNOC, 44.01's Earthshot prize-winning and include FNRC and Masdar, the pilot technology that permanently mineralizes carbon dioxide (CO2) within rock formations found in the Emirate of Fujairah and it will be, due to commence in January 2023, The project will be powered by solar energy supplied by Masdar. A successful pilot would open the possibility of mineralizing billions of tons of captured CO2 across the region.
- 2023 - The UAE Allocates 15 Billion to Low-Carbon Solutions
- Hosting the MENA headquarters of the Global Carbon Capture and Storage Institute at Masdar city underlines the UAE's commitment to practical solutions to climate challenges.

Priorities going forward:

- Development of CCUS Policy/Regulatory Framework.
- Continuous support towards the CCUS Initiative.

CURRENT LARGE-SCALE CCUS PROJECTS

- Al Reyadah Plant: which is the largest carbon capture steel project, that captures 800,000 tonnes of CO2 that is injected for EOR.

FUTURE PROJECTS

Expansion of CCUS initiatives

- key carbon management projects to reach our goal of capturing 10 million tonnes of CO_2 by 2030, including at our gas processing plant in Habshan and our gas mega-project, Hail and Ghasha – taking our committed investment to nearly 4 million tonnes of CO_2 capture per year. The equivalent of a forest area that is twice the size of the UAE.
- With innovators and industry leaders, we are also investing in technology with scale-up potential, including:
- A pilot to turn CO_2 into rock
- The world's first fully sequestered CO_2 injection well in a carbonate saline aquifer
- Modular carbon capture technology deployed at Fertiglobe
- We've also entered a partnership with Oxy to develop the region's first world-scale Direct Air Capture (DAC) project.

UAE: Hydrogen and CCUS Initiatives (as of Q4 2024)

Low carbon hydrogen oases and clean energy precincts

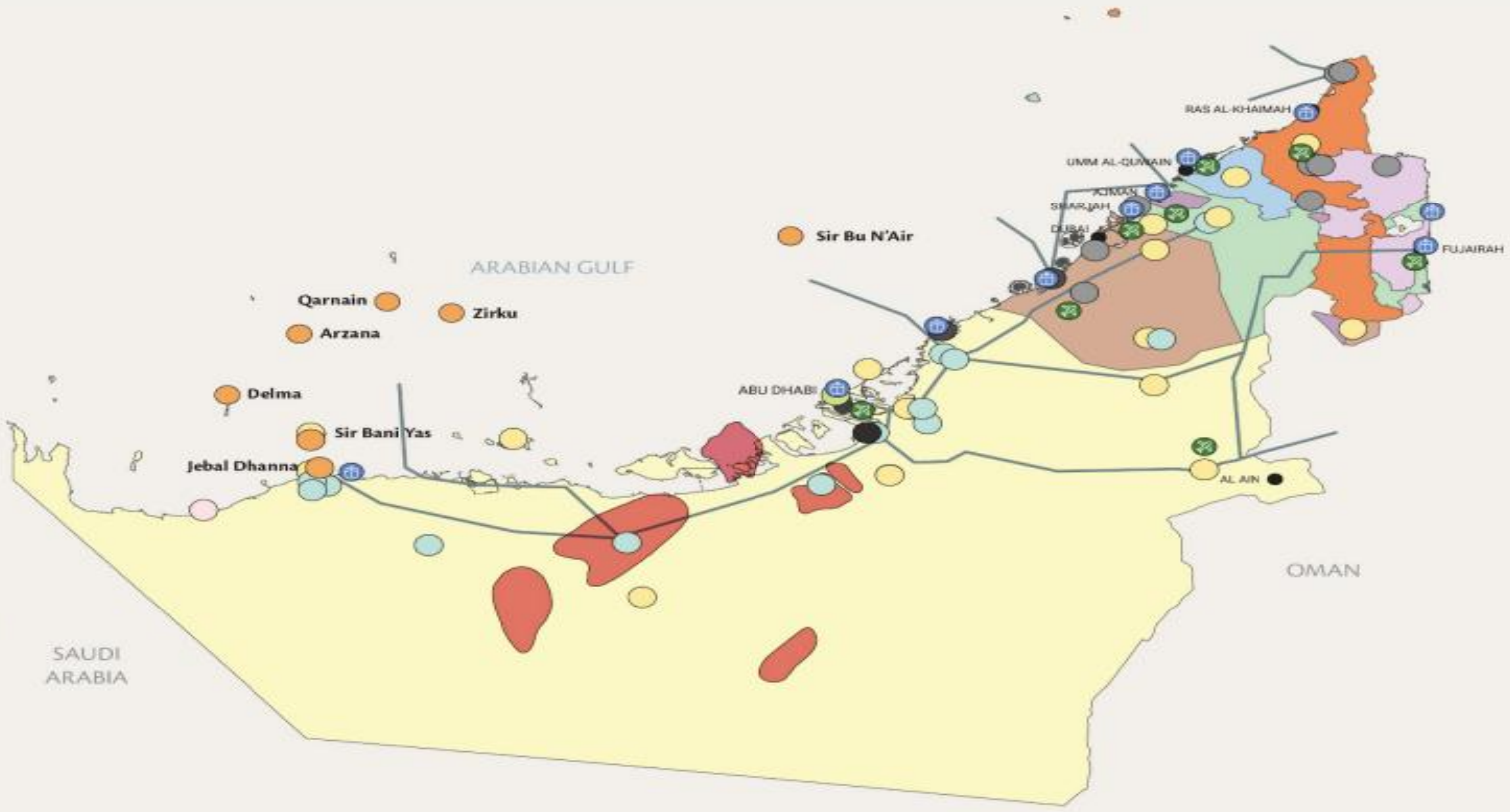
These hubs and clusters will play an important part in establishing a hydrogen value chain in the UAE.

The UAE will establish hydrogen oases as a practical approach to accelerating industry adoption of hydrogen, cultivating a supply chain, and enabling infrastructure. The oases will support demand generation and optimisation of development costs through co-locating production and end-use applications in clusters, removing network barriers, and providing commercial opportunities to test and validate technologies. Clusters are being adopted globally as best-practice for scaling the supply chain while minimising infrastructure costs.

The hydrogen oases will consider existing and new pipelines for distribution, depleted oil wells for carbon storage, and potential connections to salt caverns for high-volume storage. The RES capacity coming online over the next few decades, as detailed in the UAE Energy Strategy 2050, poses another challenge for existing grid networks. Grid requirements for low carbon hydrogen will need to be considered for long-term hydrogen production in parallel with decarbonising the grids.

Concentrations of the industry provide the most opportunity for UAE to establish and scale hydrogen oases within a short timeframe. Ruwais and KIZAD are existing industrial clusters with storage capacity that could be suitable areas for hydrogen oases. Abu Dhabi Department of Energy is pursuing clean energy clusters and hydrogen oases isolated from the broader UAE electricity system, creating micro-systems that avoid grid management problems. This accelerates and simplifies planning, given that co-location of hydrogen use, and renewable electric generation may not always be practical or technically possible.

The UAE will focus collaborative efforts towards establishing the oases by ensuring a clear policy timeline, financing and allocation of resources, and transparency of information to investors and developers.



Cement
Lafarge Emirates Cement
Sharjah Cement Factory
Union Cement Company
Ras Al Khaimah Co. for White Cement
Fujairah Cement Industries
National Cement Company
Gulf Cement
Star Cement
Pioneer Cement
Ras Al Khaimah Cement Company
Emirates Cement Factory

Tentative CCUS sink
Bab
Bu Hasa
Asab
Rumitha
Shanayel
Al Dabbiya
Aluminum
DUBAL
EMAL

Potential Cavern
Delma
Sir Bani Yas
Arzana
Qarnain
Zirku
Sir Bu N'Air
Jebal Dhanna

Nuclear Plants
Barakah

Fertilisers
Ruwais Fertilizer Plant

Iron, Steel and Aluminium
Emirates Steel
Emirates Global Aluminium Al Taweelah
Emirates Global Aluminium Jebel Ali

Clean Energy Projects
Hatta Hydroelectric plant
Sir Bani Yas wind farm
Al Dhafra Solar Project
Shams 1 CSP Plant
Noor Abu Dhabi Solar Project
Masdar City Station
MBR Solar Park
Umm Al Quwain Solar Project
Landfill Solar Project
Ras Al Khaimah Solar PV
Al Nurai Floating PV, Abu Dhabi
Murawah Island Solar Project
Warsan WastetoEnergy Project
Sharjah WastetoEnergy Project
AlDhafra landfill
Al Ain Bioenergy
Dubai Waste Management Center

Hydrogen and Ammonia
TazizRuwais chemical hub
Masdar Demonstration plant
UAE Hydrogen Hub
Mohammed bin Rashid Al Maktoum Solar Park
Abu Dhabi, Khalifa Industrial Zone
TAQA & Abu Dhabi Ports
TAQA & Emirates Steel
Sharjah WastetoH2 Plant
ADNOC & TAQA
Ruwais Ammonia (FERTIL I and II)
Ruwais Hydrogen Plant
CO2 pilot injection Rumaitha field
Al Reyadah CCUS plant (Emirates Steel) Phase I

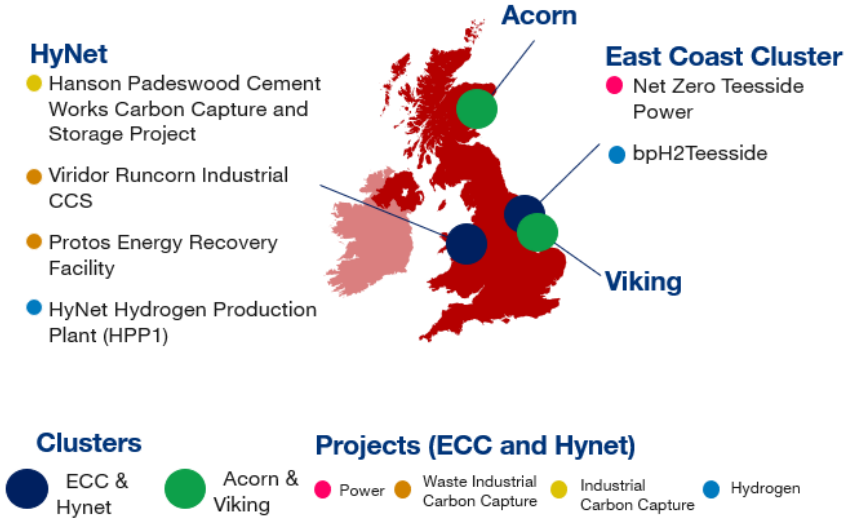
Emirates
Abu Dhabi
Dubai
Sharjah
Ajman
Umm Al Quwain
Ras Al Khaimah
Fujairah

United Kingdom – CCUS

United Kingdom

Current government strategy for CCUS:

- The UK is committed to progressing CCUS as part of our **2050 Net Zero Strategy,** using industrial "clusters" to capture and store CO2 to help us meet our legally binding target of 78% emissions reductions by 2035 and **net zero by 2050**.
- The UK has potential to store more than **78 billion tonnes of carbon dioxide in its continental shelf,** one of the largest storage potentials in Europe.
- In 2023, the UK passed **the Energy Act** - the largest piece of energy legislation in UK history, which includes provisions for the CCUS business models and the regulator for the sector in the UK.
- In December 2023, the previous government published the document "Carbon Capture, Usage and Storage: A Vision to Establish a Competitive Market". This document is widely known as the **CCUS Vision**. This set an ambition to transition to a self sustaining CCUS sector in the UK
- As part of the UK's Industrial Strategy, published June 2025, the Clean Energy Industries Sector Plan backs CCUS, including Greenhouse Gas Removals, as a frontier technology. It clarifies how Government will capitalise on the enormous growth potential while protecting and creating good jobs nationwide through the net zero trar



Deployment and programmes:

- Published updates on the CCUS **business models** to provide long-term sight of revenue models and a stable investment environment.
- Launched **National Wealth Fund**, including £1 billion for CCUS.
- **Industrial Decarbonisation and Hydrogen Revenue Support scheme** funds business models for low carbon hydrogen production and industrial carbon capture that give investors long-term revenue certainty.
- CCUS Innovation 2.0 projects:
  - Nuada - testing metal organic framework compounds at small scale in Energy from Waste simulated flue gases.
  - Econic Technologies – production of surfactants from CO2 feedstock

Projects under deployment:

- Clusters announced as **HyNet, East Coast Cluster (ECC), Acorn and Viking** and **8 projects originally confirmed** to progress to negotiations to form the first two CCUS clusters (HyNet and ECC).
- Govt announced (Oct '24) up to £21.7bn over 25 years to launch HyNet & ECC, supporting completion of some projects with which we had entered negotiations.
- The next projects we aim to select for CCUS support will be in the Hynet and ECC clusters.
- The HyNet expansion process intends to fill the remaining transport and storage capacity by CCUS projects that can connect to HyNet via pipeline by 2030.
- On the 11th June 2025, the UK Chancellor announced their support for the Acorn and Viking clusters and is providing the development funding to advance their delivery. A final investment decision will be taken later this Parliament, subject to project readiness and affordability.
- The CCSA's project pipeline tracks CCUS projects in the UK across sectors - https://www.ccsassociation.org/capture-projects/ - including those outside the current 4 clusters.

United Kingdom – CDR

Current government strategy for CDR:

- Government is committed to developing and deploying Greenhouse Gas Removals (GGR), also known as CDR, at scale in the UK, recognising the important role they play in achieving net zero by offsetting residual emissions from hard-to-abate sectors.
- The UK's independent Climate Change Committee (CCC) recognise the importance of GGRs to achieve net zero targets, estimating 35.8MtCO2/pa of CDR will be required by 2050.
- To support the development and deployment of GGRs in the UK, the government is -
  - Developing a GGR Business Model to incentivise private investment in GGR projects based on a contractual revenue guarantee mechanism (contract for difference like approach - CfD).
  - Working with the British Standards Institution to develop technology-specific methodologies, which will form part of the UK GGR Standard that projects supported under the business models will be required to use.
  - Signalled its intention to include engineered GGRs in the UK ETS and published a consultation on the integration of GGRs.
  - Invited GGR and Power BECCS projects to apply to the expansion of the HyNet cluster
  - Announced an Independent Review to consider how GGRs can assist the UK in meeting our net zero targets out to 2050.
  - Published six Principles for Voluntary Carbon and Nature Market (VCNM) Integrity to support organisations engaged in action towards net zero, and a VCNM consultation, seeking to clarify and test proposed policy and governance framework to boost market confidence.

Innovation programmes:

- The UK committed up to £100m into CDR innovation in 2020, these projects are now completing with 12 pilots installed, dominated by biochar and DAC. Additionally, a GGR Research hub has been established with 5 research demonstrators
- Mission Innovation CDR – The UK is a supporting member of this global initiative, providing data on CDR / CCUS projects and biomass stocks for global mapping, participated in webinars on policy, BECCS and Biochar, presented on Lifecycle Carbon Accounting, mentored a winning student team in the SMART-CDR challenge and presented at the Climit Summit, Norway 2025.

CDR projects under development / execution:

- Mission Zero, Direct Air Capture, CO2 into building materials due to be operational by July '25
- Blackbull Biochar – providing heat and power from woodchip to local industrial sites, and certified CDR biochar to farms
- Lapwing Energy – Reverse coal, burying biochar within peatland restoration, heat and power used for farming
- Severn Wye Biochar – Community based energy solutions with permanent storage of biochar.
- HyNet expansion projects progressing to negotiations will be announced in due course
- Various pilots on biomass power plants, AD biofuel plants and Energy from Waste sites

Mission Zero – DAC – CO2 to OCO sustainable construction products

GIGATONNE BY 2030

CAMPAIGN BY CEM CCUS & MI CDR

CARBON DIOXIDE REMOVAL MISSION

CARBON CAPTURE UTILIZATION & STORAGE

AN INITIATIVE OF THE CLEAN ENERGY MINISTERIAL