

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

Global Developments with Carbon Capture, Use and Storage Deployment Programmes

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CLEAN ENERGY MINISTERIAL
Advancing Clean Energy Together

Contents

Global CCUS Policy Developments

2 October 2024

Dear reader,

This slide deck contains a snapshot of carbon capture, use and storage (CCUS) policy and programme developments across the Clean Energy Ministerial CCUS Initiative Members.

To combat climate change, CCUS 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. Deploying CCUS will however require significant government programmes, to kickstart the CCUS industry. Several countries have enacted CCUS programmes and policies, and this document provides a high-level snapshot into today's status.

These slides are published on 2 October 2024, during the 15th Clean Energy Ministerial meeting hosted by Brazil, at Foz do Iguaçu.

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

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CEM CCUS Members

Australia

Climate Change Policies

- ***Climate Change Act 2022***: National Determined Contribution of **43 per cent below 2005 levels by 2030, and net zero emissions by 2050**. This is aligned with the Government's ambition to be a **renewable energy superpower**.
- The Australian Government is developing a ***Net Zero Plan***, as outlined in our 2022 Annual Climate Statement to Parliament and consistent with the recommendations of the Climate Change Authority (CCA).
    - The Australian Government will develop *6 sectoral decarbonisation plans* which, between them, cover all major components of the economy: electricity and energy; transport and infrastructure; industry; agriculture and land; resources; and the built environment.
- The ***Powering Australia plan*** is focused on creating jobs, reducing pressure on energy bills and lowering emissions by boosting renewable energy.

Current government strategy for CCUS

- The Australian Government sees CCUS as **part of a portfolio of approaches and technologies to reduce emissions and meet net zero**. CCUS can complement emissions reduction efforts, particularly in hard-to-abate sectors.
- The Australian Government is focused on **ensuring the right policy and regulatory setting are in place**, for project proponents to make commercial decisions for CCUS projects.

Deployment policies and programs in place

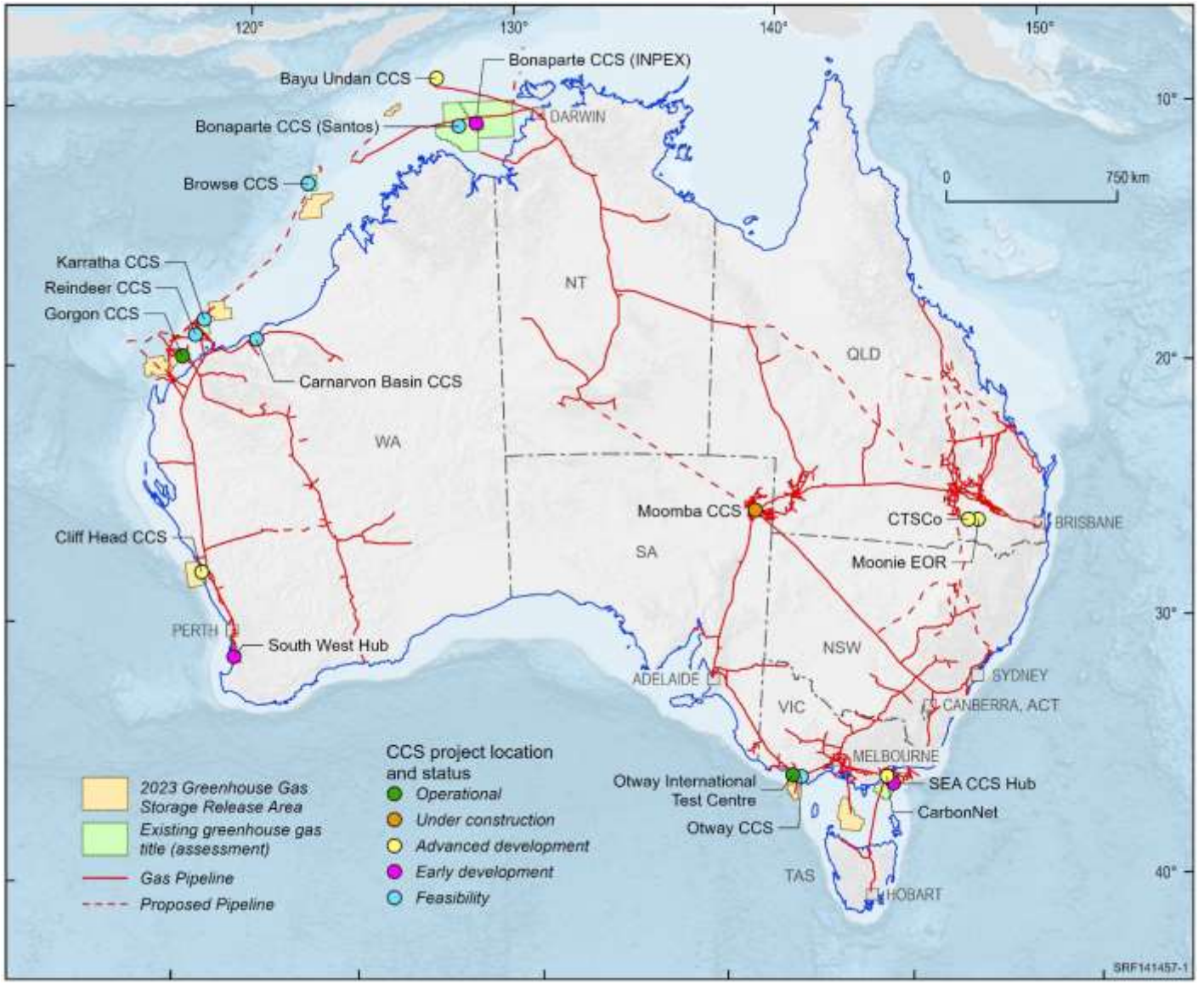
- Australia's **Future Gas Strategy** outlines the role of geological storage of CO_2 in Australia's decarbonisation plan.
- *May 2024-25 Budget measure*: **$32.6 million *Regional Cooperation Initiative on Carbon Sequestration*** - to establish regulatory frameworks and bilateral instruments to better support heavy industry to reduce emissions to meet Paris Agreement commitments, both in Australia and overseas.
    - This supports the passage of the *Environment Protection (Sea Dumping) Amendment (Using New Technologies to Fight Climate Change) Act 2023*, which is the first step to Australia ratifying the 2009 Amendment to the London Protocol.
- *May 2024-25 Budget measure*: **$566.1 million over 10 years *Resourcing Australia's Prosperity*** initiative for Geoscience Australia (GA) to map the whole of onshore Australia by 2060 and deliver high-quality precompetitive data and information - for CCS, hydrogen storage and critical minerals.
- The **$1.9 billion *Powering the Regions Fund* (PRF)** supports existing Australian industries to reduce emissions and develop associated workforces. Over $530 million in grant funding has been announced to date to support decarbonisation and domestic production of critical inputs into clean energy supply chains, such as steel and cement.
- The **$65 million *Carbon Capture Technologies (CCT) Program*** will fund research, development and demonstration of novel carbon dioxide capture and utilisation technologies. This will include support for projects that address emissions in hard-to-abate sectors, utilise CO_2 in the development of low-carbon products, or accelerate Australia's carbon dioxide removal capabilities through technologies such as Direct Air Capture. Announcement of grants is expected in mid-2024.
- The ***Safeguard Mechanism*** ensures that Australia's largest emitters (facilities with Scope 1 emissions >100,000 tonnes of CO_2e/year) contribute to our national net zero by 2050 target.
- ***Modernisation of Offshore Regulatory Framework*** – In the May 2023-24 Budget, the Government committed **$12 million over 3 years** for reviews of (1) the environmental management regime for offshore petroleum and greenhouse gas storage activities to ensure it is fit-for-purpose for a decarbonising economy and (2) the offshore CCS regulatory framework to examine opportunities for regulatory and administrative certainty and efficiency.
- 10 areas have been made available for bidding as part of the 2023 ***Offshore Greenhouse Gas Storage (GHG) Acreage Release***. Work program bidding closed on 28 November 2023. 9 bids are currently with the government, 1 bid is still being assessed. This will be followed by permits being offered to successful bidders for GHG exploration activities.

LARGE-SCALE CCUS PROJECTS

- **Operational:** *Gorgon CO_2 Injection Project* (Chevron Australia): More than 9 Mt of CO_2 equivalent stored since Aug 2019. The project aims to reduce greenhouse gas emissions by more than 100 Mt over the life of the project.

- **Future:** *Moomba CCS Hub Project* (Santos): Moomba CCS Hub Project (Santos and Beach Energy): Santos has announced it has made a final investment decision to develop a CCS plant in the onshore Cooper basin in South Australia. Expected be operational in Q3 2024 and store 1.7 Mtpa of CO_2.

Australia – Map of Projects



(AECR, 2023) - Updated from Australia's Energy Commodity Resources 2023: https://www.ga.gov.au/digital-publication/aecr2023

Canada

Current Approach to Carbon Management

- Carbon management is expected to play a critical role in Canada's road to net zero, including to Canada's **legislated net-zero by 2050 goals** and **2030 Emissions Reduction Plan**.
- Canada's **Carbon Management Strategy** sets a vision for a competitive and robust sector in Canada that contributes to climate and economic objectives. The Strategy identifies **5 key pathways**: Decarbonizing heavy industry, including oil and gas; low-carbon H2 production; low-carbon dispatchable power; carbon removal; and CO2-based industries.

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.
- **Canada's Carbon Pricing System** (federal minimums, provincial implementation): $80/t in 2024, 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 remains for CCFDs and carbon offtake agreements.**
- **Procurement Policies:** Policies for CDR and CCUS-enabled low-carbon products and services to drive demand: Buy Clean Initiative, and Low Carbon Fuel Procurement Program (expanded in Spring 2024 to include CDR procurement/offsets).
- **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 under Budget 2021 delivered by Natural Resources Canada (NRCan)'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 the development and adoption of clean technologies, large-scale decarbonization and industrial transformation projects (**including CCUS** in high-emitting sectors).
- **Canada Infrastructure Bank (CIB)**: Crown corporation investing in private-sector low-carbon infrastructure projects, inc. FEEDs

Future Priorities

- Budget 2024 provides details of a refundable Clean Electricity ITC (15% rate) – includes the eligibility of **natural gas energy systems with carbon capture**. Effective as of April 16, 2024. Possible Legislation introduced in Parliament (Fall 2024).
- Canada's **GHG Offset Credit System Regulations**: A DACCS protocol in development; BECCS Protocol under consideration.

LARGE-SCALE CCUS PROJECTS: 8 CURRENTLY IN OPERATION

- **Boundary Dam, SaskPower, SK**: CO_2 captured at coal-fired power plant (>6Mt captured since 2014).
- **Weyburn-Midale, SK:** EOR & CO_2 storage (>45Mt stored since 2000).
- **Quest, Shell Canada, AB**: >9Mt CO_2 captured & stored since 2015, at 3 hydrogen production units at oil sands upgrader.
- **Alberta Carbon Trunk Line (ACTL), Wolf, AB**: 240-km pipeline delivering ~1.6 Mt CO2/year from a fertilizer plant (Nutrien) & Sturgeon Refinery – total 14.6Mt capacity.
- **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 (>5Mt stored since 2020).
- **Glacier, Entropy, AB:** World-1st commercial project to capture & store CO_2 from NG combustion (Phase 1: 0.47Mt/year).

PROJECTS & HUBS IN DEVELOPMENT PIPELINE

- Recent Final Investment Decisions (2023-24): Shell & ATCO (Polaris and Atlas Hub), Dow and Linde (Path2Zero), Entropy (Glacier CCS).
- CGF Investments (2024): Svante, Strathcona Resources, Varme Energy, and Entropy for Glacier Phase 2 and other CCS projects.
- Construction: Hydrogen (e.g., Air Products), chemicals (e.g., Dow), ACTL extension, Glacier (0.2Mt/yr from phases 1 & 2).
- Alberta allocating sequestration rights through a competitive process to enable carbon storage hubs (23 in evaluation). Two hubs (Atlas & Bison Meadowbrook) granted sequestration rights.
- NRCan funding CCUS FEEDs in oil & gas, power, ethanol, potash, and BECCS projects, alongside regional hubs.

China

Current government strategy for CCUS

- National 14th Five-year Plan
- Opinions of the Central Committee of the CPC and the State Council on Carbon Dioxide Peaking and Carbon Neutrality in Full and Faithful Implementing of the New Development Philosophy
- Action Plan for Carbon Dioxide Peaking Before 2030
- Scientific and Technological Deployment Strategy for Carbon Dioxide Peaking and Carbon Neutrality (2022 - 2030)
- Implementation Plan for Synergetic Reduction of Pollution and Carbon Emissions
- Implementation Plan for Carbon Peaking in the Industrial Sector
- Notice on Promoting the Healthy Development of the Modern Coal Chemical Industry
- Implementation Plan for Green and Low-Carbon Advanced Technology Demonstration Projects
- Guiding Principles on Accelerating the Transformation of Traditional Manufacturing Industry
- Action Plan for Low-Carbon Transformation and Construction of Coal-Fired Power (2024–2027)

Deployment policies and programmes in place

- CCUS research projects supported by the National Key R&D Programme
- R&D support from private sectors

Priorities going forward

- CO_2 capture in the industrial sector
- Offshore CO_2 sequestration
- Large-scale integrated demonstration and pipeline system

CURRENT LARGE-SCALE CCUS PROJECTS

- Sinopec ShengLi Oil Field 1Mt/a CCUS Project
- CNPC JiLin 0.8 Mt/a CO2-EOR Commercial Project
- YanChang Petroleum YanAn 0.3Mt/a Full-Chain CCUS Project (EOR)
- CHN Energy JinJie 150 Kt/a Power Plant Full-chain CCUS Project
- CHN Energy Taizhou 0.5Mt/a Thermal Power CCUS Demonstration Project
- QiangNai Jiaozuo 10 Kt CO2 to Concrete Project
- CNOOC Enping Oilfield 0.3Mt/a Offshore CO2 Sequestration Project

POTENTIAL FUTURE PROJECTS

- OGCI&CNPC XinJiang 1.5 Mt/a CCUS Hub
- CNOOC Daya Bay 10 Mt/a CCUS Cluster
- HuaNeng Group ZhengNing Power Plant Post-Combustion 1.5 Mt/a CCUS Project
- Baotou Steel 0.5 Mt/a CCUS Project
- CHN Energy & CNPC Ningdong 3 Mt/a CCUS Demonstration Project (CO2 Capture+EOR)
- CHN Energy JinJie 4Mt/a Power Plant Full-chain CCUS Project

Germany

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

European Union

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
- CCS Directive
- 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.

(Main) priorities going forward:

- Implementation of industrial carbon management strategy:
  - Capturing and storing CO2: NZIA implementation, CO2 storage atlas, CO2 demand aggregation platform
  - Framework and support for removing CO2 from atmosphere
  - Framework for accounting carbon utilization
  - Preparation of possible future CO2 transport regulatory package
  - Standardisation of CO2 streams

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

Japan

【Key climate policy targets】

- Achieve carbon neutrality in 2050
- Reduce Japan's GHG emissions by 46% in FY2030 from its FY2013 level

【CCS business Act (accepted on 24th May, 2024) 】

Japanese CCS business act was approved the Japanese cabinet.

The CCS business Act has been approved by the National Diet of Japan

【LCO2 shipping demonstration project】

Demonstration ship for liquefied CO2 transport completed

Establish liquefied CO2 ship transportation technology

【CCU/carbon recycling】

- We established The Carbon Recycling Roadmap in June, 2024. https://www.nedo.go.jp/carbon-recycling/2023/en/230927.pdf
- We developed R&D and demonstration base for promoting Carbon Recycling technologies in Sept, 2022.

【Priorities going forward】

Leveraging Asia CCUS Network to establish CCUS market in Asia and develop import/export mechanisms for CO2

CURRENT LARGE-SCALE CCUS PROJECTS

- Liquefied CO2 ship transportation demonstration project
- Several CCS projects were selected under the Advanced CCS Program, which supports CCS operations through 2030
- Improve a business environment toward the start of CCS business by 2030

POTENTIAL FUTURE PROJECTS

- Bilateral discussions on cross-boundary transport and storage of CO2

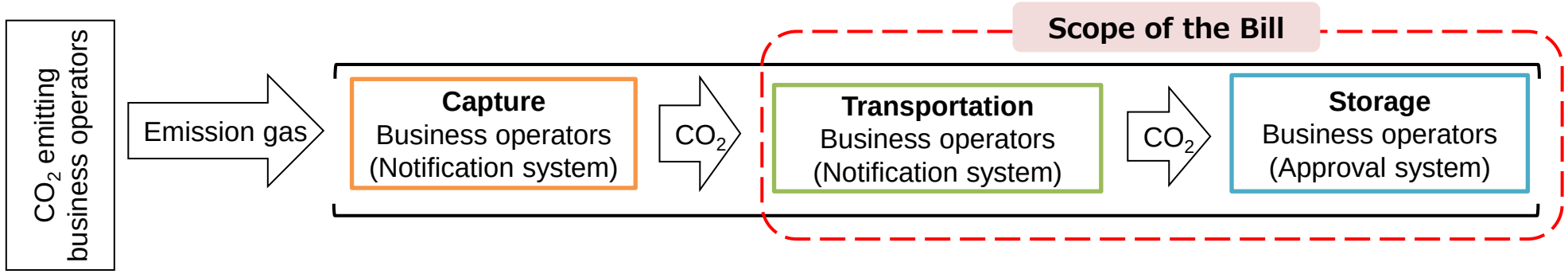
CCS Business Act (accepted on 24th May, 2024)

Purpose

◆Ensuring adequate business environment and public safety for CCS business in Japan

Scope

◆**Regulations for** business operators of **pipeline transportation** and **storage**
*Including **not only safety regulation** but **also economic regulation**
*Regulations for Carbon capture will be considered in the future



London Protocol

◆**Japan is the contracting parties to the London Protocol 1996**.

◆Together with CCS business bill, **acceptance of the amendment of London Protocol was approved** by the National Diet on this May which **enable Japan to export CO2.**

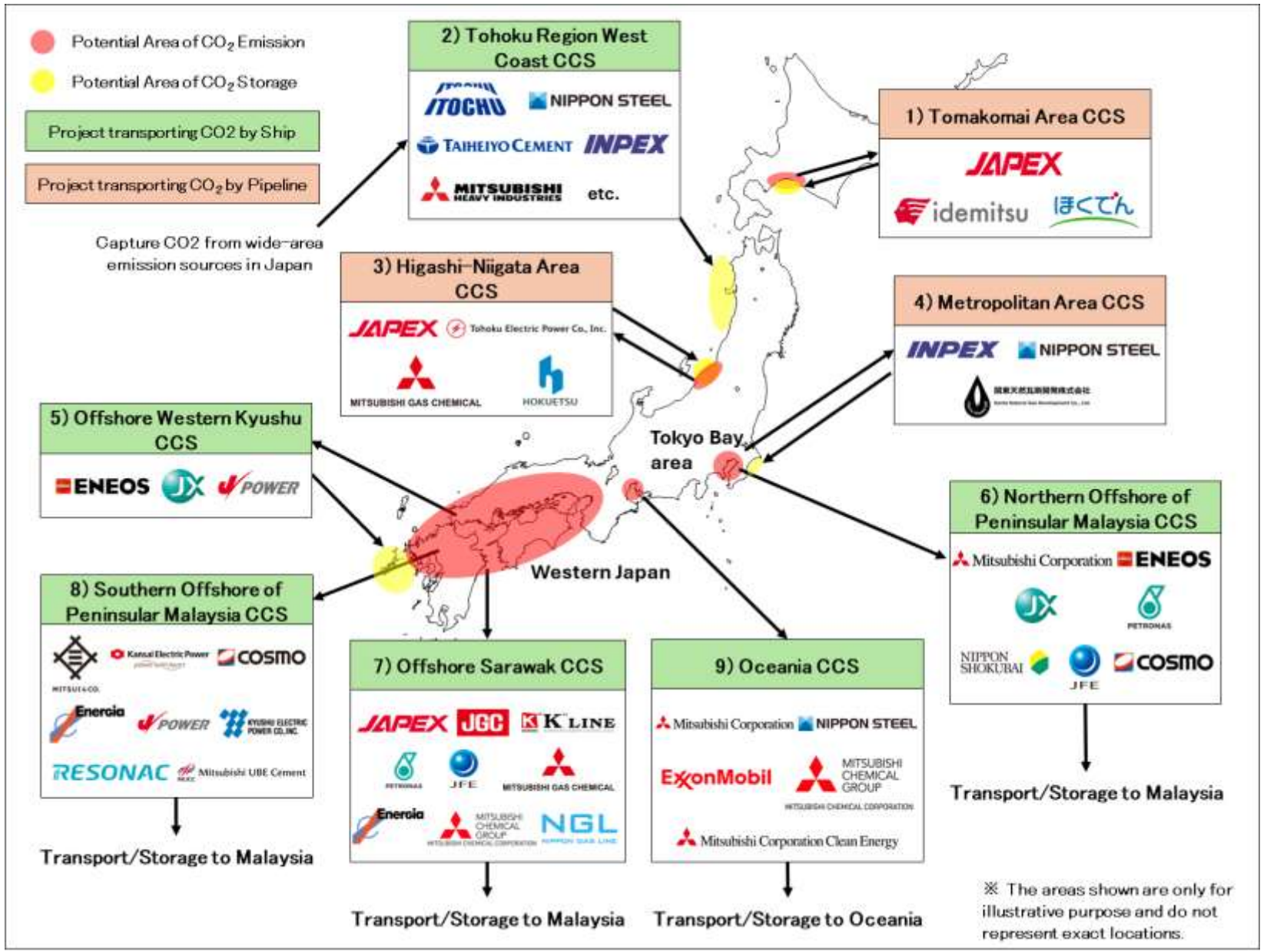
Purpose of “Advanced CCS Program”

- To secure annual storage of 120-240 million tons of CO2 by 2050, A business model for CCS that can cross-sectoral should be established at an early stage. Thus, Japanese government selected “Advanced CCS projects” led by operators and will actively support them.
- This supporting program will establish various CCS business models by supporting projects with different combinations of CO2 source, transportation methods and CO2 storage areas. Furthermore, it aims to secure 6-12 million tons of CO2 storage per year by 2030.
- This year, this program will provide support for the analysis of this geologic data and feasibility study.

Possible types of CO2 source, transport methods, and CO2 storage areas

CO2 sources	Transport methods	CO2 storage areas
Thermal power plant Steel plant Chemical plant Cement plant Paper plant Hydrogen plant etc.	Pipeline Ship	Onshore Near shore Offshore

Advanced Efforts for Commercialization of CCS
- JOGMEC selects Nine projects as Japanese Advanced CCS Projects -



Liquefied CO2 Shipping Demonstration Project

A demonstration project for long-haul transportation from emission sources to places suitable for storage will be carried out to establish liquefied CO2 shipping techniques.
Through this project, LCO2 carrier will be expanded to LNG carrier (around 50K ton class).

Route examples

Maizuru Power Station (Coal fired power plant)

- Capture
- Coal fired power plant

Tomakomai CCS demonstration

- Storage and monitoring
- Tomakomai CCS/CR hub

Osaki CoolGen (IGCC)

- Capture
- Carbon Recycling R&D base

Demonstration transportation of CO2 will start in 2024

In the hub and cluster plan for CCS, liquefied CO2 ship transportation is an important technology for transporting CO2 which is captured at distant emission sources.

Netherlands

Current government strategy for CCUS

- CCUS important technology to reduce CO2 emissions in industry
- CCUS only when no cost-effective alternatives
- De-risking CCUS 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 2024:

- **Porthos**: operation foreseen in 2026, capture from 4 industrial sources with support from the SDE++, storage in P-18 gas fields offshore.
- **Aramis**: operation foreseen in 2028, 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: Noordkaap, Delta Rhine Corridor, Carbon Collectors (shipping solution), H2M**

Nigeria

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 update: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 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:

- Pilot demonstration
- 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 PLR.

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

Heidelberg, Brevik in Norway

CCS Project deployment in Norway

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

Øygarden, Norway

Alex Engh

Saudi Arabia

Current Management strategy for CCUS

- Carbon Capture strategy identified 20 initiatives across CCUS value Chain; this include:
  - 12 Technical Initiative
  - 4 Regulation/Governance Initiatives
  - 2 R&D Initiatives
  - 2 Enablers Initiatives

Deployment policies and programs in place

- Ministry of Energy established Circular Carbon Economy National Program (CCE-NP) to supervising implementation across Hydrogen and Carbon management with a steering Committee from government entities, research institutes and national champion to enable CCUS.

Priorities going forward:

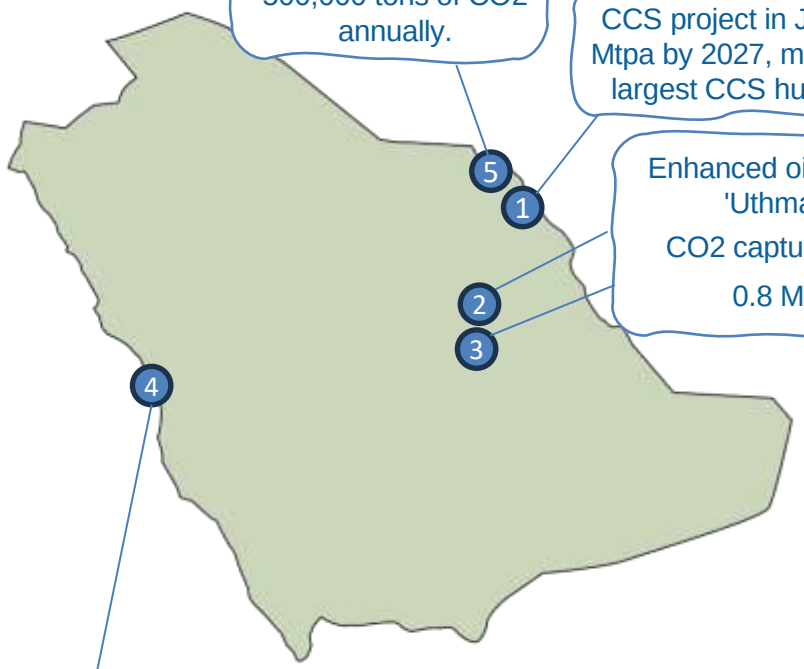
- Carbon Management is one of the focus areas in the Circular Carbon Economy national program and its key objectives are to review initiatives implementation, provide guidance & facilitation and ensure alignment in CCUS.
- Implementation process activated 12 dedicated taskforces aligned with major KSA stakeholders (government entities, research institutes and national champion)
- Raise CCUS profile to G20 leaders

CURRENT LARGE-SCALE CCUS PROJECTS

- The Kingdom has announced its ambition to capture 44 Mtpa of CO_2 by 2035 as announced during the first version of the Saudi Green Initiative (SGI) held by October 2021. Building on that, a Joint Development Agreement (JDA) between Saudi Aramco, SLB and Linde has been announced during the second version of the SGI and held by November 2022 in order to develop Phase I of the CCS Project in Jubail with 9 MTPA by 2027 as one of the largest CCS hub in the region
- The Kingdom is studying the deployment of CCU Hub in Yanbu emitting facilities within Yanbu industrial area and transports it to a special CO_2 utilization zone, which contains different facilities that will then utilize that CO_2 to produce valuable products such as e-methanol or low carbon urea.
- In 2015, Saudi Aramco has launched the Kingdom's first carbon capture and sequestration (CCS) project and CO_2 Enhanced Oil Recovery (EOR) project at its 'Uthmaniyah and Hawiyah NGL facilities. The CO_2 EOR project is the largest CCS project in the Middle East.
- In 2015, SABIC has built the largest facility of its kind in the world of carbon capture and utilization (CCU) at United, a SABIC affiliate, with a capacity of 500,000 tons of CO_2 captured and utilized annually.

CCUS Efforts in Kingdom of Saudi Arabia

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



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

- Carbon cured concrete
- Cryogenic carbon capture
- CCU project at AlSafwa cement.
- CCU Project at Maadan.

Saudi Arabia

2024 Major Contributions

1 "Gigatonne by 2030" Campaign

KSA is supporting the launch of the "Gt by 2030" campaign.

2 CDR Student Competition

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.

3 COP29 Carbon Management Ministerial Roundtable

KSA worked with COP presidency and participated in the 2nd annual CMC roundtable in COP29 in Baku. KSA is focused on advancing Carbon management through the Strategic Engagement and Communication Workstream.

4 CCU Competition (UpLink)

KSA made significant contributions to the Carbon Capture and Utilization (CCU) competition in collaboration with the World Economic Forum's UpLink platform.

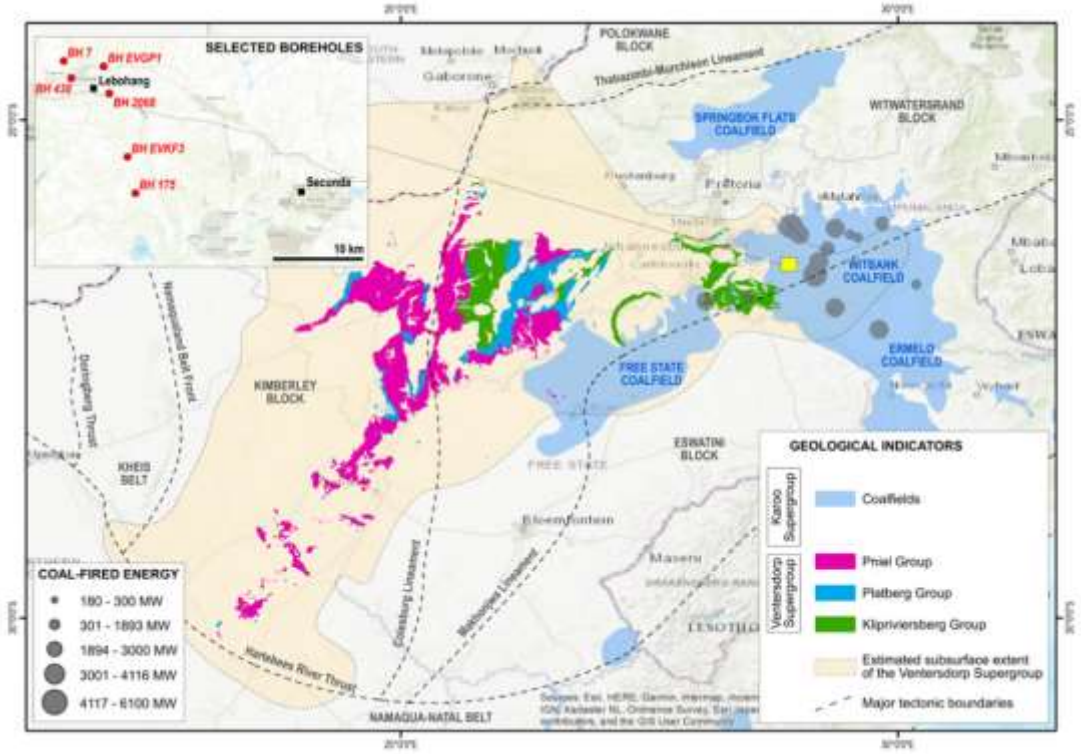
5 CMC workshop

KSA has organized a regional CMC Workshop through CCERC (Circular Carbon Economy Regional Collaboration) initiative.

South Africa

Current strategy for CCUS

- CCUS identified as a key enabler of the Just Transition in SA as part of 2050 developmental goals.
- A pilot project is in implementation, targeted finalisation in the 2024/25 financial year. FEED study completed.



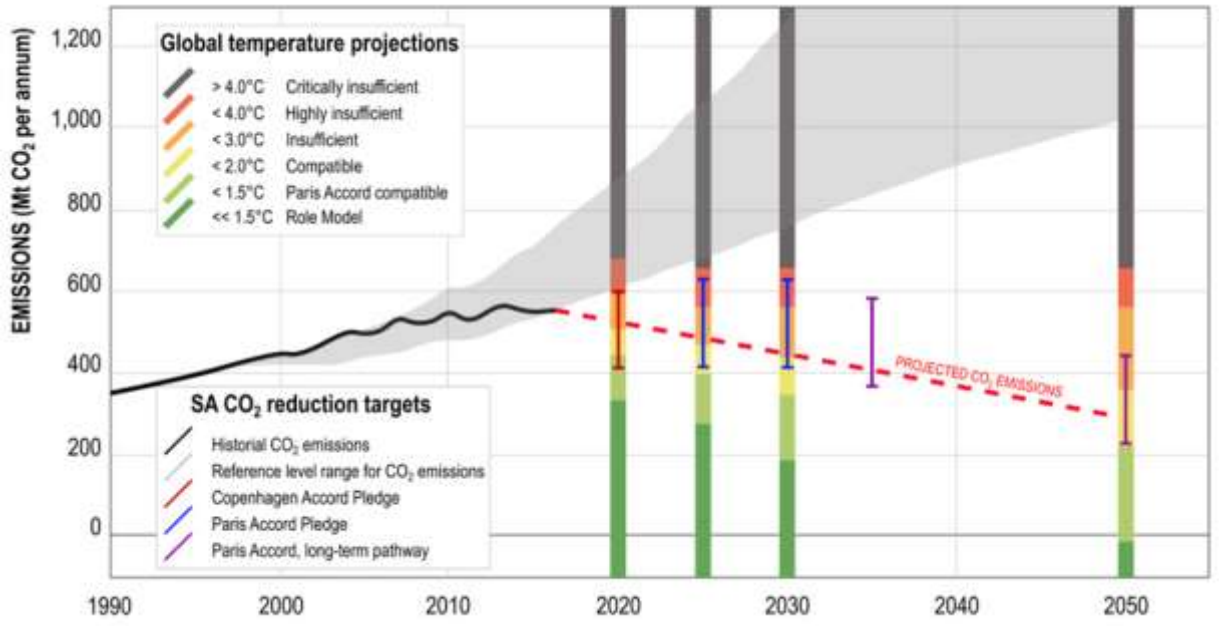
Regional map of pilot site, Mpumalanga, South Africa

Priorities for the implementation of CCUS

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

Future programmes

- Basaltic injection near major point-source CO_2 emitters and large coalfields.
- Adaption of current coal-fired fleet.
- Researching opportunities for CO_2 utilisation”



Overview of CO_2 projections for South Africa

South Africa

United Arab Emirates

United Arab Emirates

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

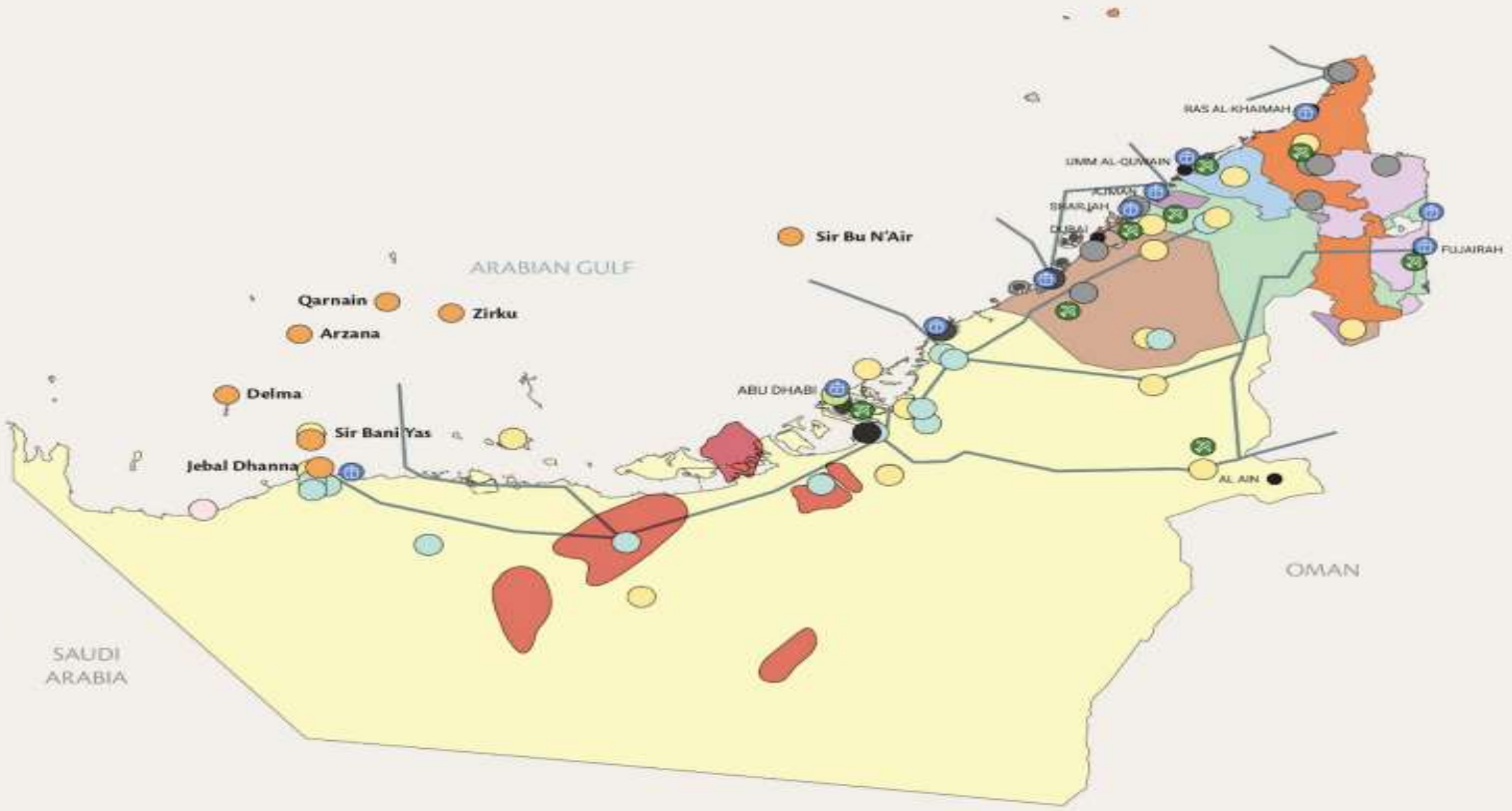
These hubs and clusters will play an important part in establishing a hydrogen value chain in the UAE.

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 Nuraï 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

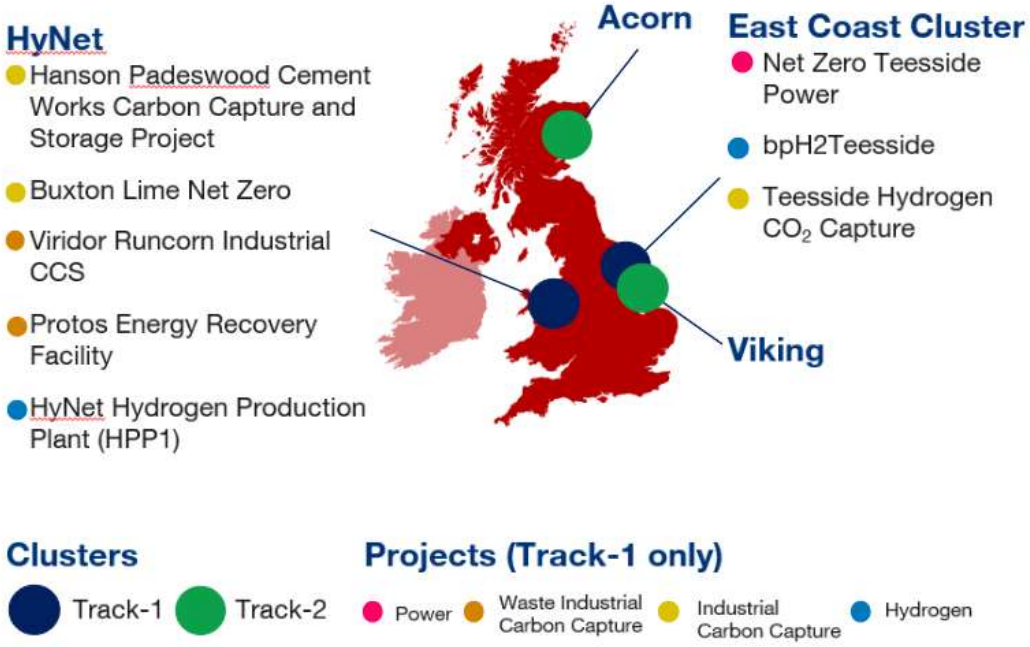
Emirates
Abu Dhabi
Dubai
Sharjah
Ajman
Umm Al Quwain
Ras Al Khaimah
Fujairah

United Kingdom

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.
- 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.



Deployment and programmes:

- Published updates on the CCUS **business models** to provide clear, long-term sight of revenue models and a stable investment environment as well as Heads of Terms.
- 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.
- The **UK infrastructure bank** has £18bn of financing available across sectors, including for CCUS and hydrogen

Projects under deployment:

- Clusters announced as **HyNet, East Coast Cluster (ECC), Acorn and Viking** and **8 projects confirmed** to progress to negotiations to form the first two CCUS clusters (HyNet and ECC).
- Our ambition is to take the first final investment decisions for the first two clusters this year (2024).
- The next wave of projects we aim to select for CCUS support will be in the Track 1 clusters Hynet and ECC and in the two new Track 2 clusters, Viking (Humber) and Acorn (Scotland).
- 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 States

United States

Key climate policy targets: 50% emissions reduction by 2030, 100% clean electricity by 2035, and net-zero carbon emissions by 2050

Current government strategy for CCUS: New goals on justice and equity and community engagement

Deployment policies and programmes:

- **Inflation Reduction Act:** Reduce GHG emissions by about 1 gigaton in 2030, or a billion metric tons
  - Includes enhancements to 45Q tax credit (e.g., credit value increases to $50 - $85, direct pay, extension of commence construction window, lower capture threshold)
- **Bipartisan Infrastructure Law:** $12 billion for carbon management approaches (~50% of this has been awarded)
  - Including $8 billion for regional clean hydrogen hubs (H2Hubs)
- **CHIPS and Science Act:** $1 billion for carbon dioxide removal RD&D ($67 billion total for DOE)
- **Industrial Demonstrations Program:** up to $6 billion in BIL/IRA funding for 33 projects across the industrial sector, including cement/concrete, glass, pulp/paper, iron/steel, chemicals and refining
- Loan programs and state policies/mechanisms
- Regional Initiative to Accelerate CCUS Deployment, Carbon Storage Assurance Facility Enterprise (CarbonSAFE), Carbon Dioxide Transportation Infrastructure Finance and Innovation Act (CIFIA), CCUS Demonstrations, and FEED Studies

Priorities going forward: Point-source carbon capture, hydrogen, carbon dioxide removal, industrial decarbonization

CURRENT LARGE-SCALE CCUS PROJECTS

- Air Products Port Arthur Project: 9.86 MMT of CO_2 captured (June 2024)
- Illinois ICCS Project: 3.69 MMT of CO_2 injected (June 2024)
- Petra Nova CCS Project: 4.39 MMT of CO_2 injected (June 2024)
- Over 35 active CCUS projects in the U.S. on variety of applications—power, ethanol, industrial projects, and DAC

POTENTIAL FUTURE PROJECTS

- Many projects announced since the 45Q tax credit values were increased
- Projects are in various stages of development, ranging from early planning stages to those ready for construction
- 152 EPA Class VI well applications (across a total of 52 projects)

Brief overview of CEM CCUS Initiative

Clean Energy Ministerial CCUS Initiative

Sixteen Member Countries:

Lead countries


Norway


Saudi Arabia


United Kingdom


United States

Participating CEM Members


Australia


Brazil


Canada


China


EU Commission


Germany


Japan


Mexico


Netherlands


Nigeria


South Africa


United Arab Emirates

Other countries and Partners:

Links to further countries: Denmark, Finland, India, Indonesia, Sweden etc.

Industry: Global Cement and Concrete Association, Oil and Gas Climate Initiative, worldsteel

Financial institutions: Multilateral Development Banks, private banks, investment firms

Organizations: International Energy Agency (IEA), IEA Greenhouse Gas R&D Programme (IEAGHG), Global CCS Institute (GCCSI), Mission Innovation (MI)

CEM CCUS Initiative: accelerating CCUS together by:

1

Actively **including CCUS** within Clean Energy Ministerial agenda and global clean energy discussions.

2

Bringing **together** governments, the private sector and the investment community.

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

3

Facilitating identification of both near and longer-term **investment opportunities**.

4

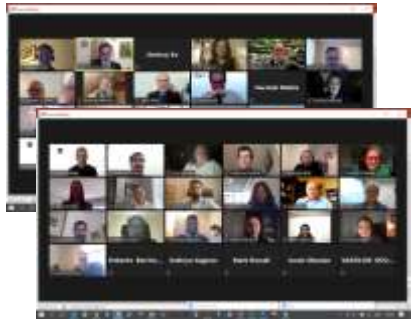
Disseminating **best practice** in CCUS policy, regulation and investment.

CEM CCUS: Key activities

1. WORKING WITH INDUSTRY TO ACCELERATE PROJECT DEPLOYMENT

Working with Global Cement and Concrete Association to materially accelerate CCUS in the cement sector.

Working with Oil and Gas Climate Initiative to accelerate strategic CCUS hubs and infrastructure.

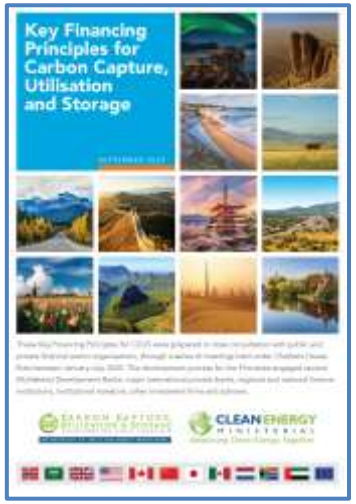


2. LINKING WITH THE FINANCE SECTOR

"Finance Sector Lead Group for CCUS"

- Informal group of banks interested in CCUS: development banks, commercial banks etc.
- Platform to discuss CCUS as investment opportunity and to link with industry
- Opportunity to give advice to governments and ministers

"Key Financing Principles for Carbon Management" drafted in collaboration with the finance group.



3. DISSEMINATING BEST PRACTICE

Sharing country developments in monthly meetings.

Sharing best practice in regional workshops and events.

Sharing best practice in webinars.

https://www.linkedin.com/company/clean-energy-ministerial-ccus-initiative/

@ccuscem

https://www.youtube.com/user/cleanenergypolicy/playlists

info@cemccus.org

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