

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

Global Developments with Carbon Capture, Use and Storage Deployment Programmes

Date: 20 June 2024

Next update: This document will be updated again for 15th Clean Energy Ministerial meeting, October 2024

CLEAN ENERGY MINISTERIAL
Advancing Clean Energy Together

Contents

Global CCUS Policy Developments

June 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 4 June 2024. The next update is scheduled for the 15th Clean Energy Ministerial meeting on 1-3 October 2024.

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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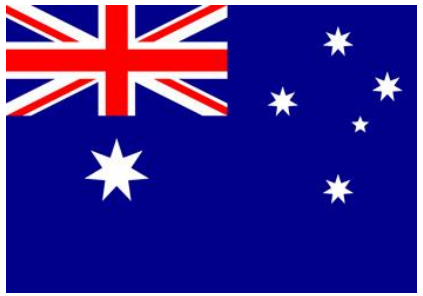
CEM CCUS Members

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

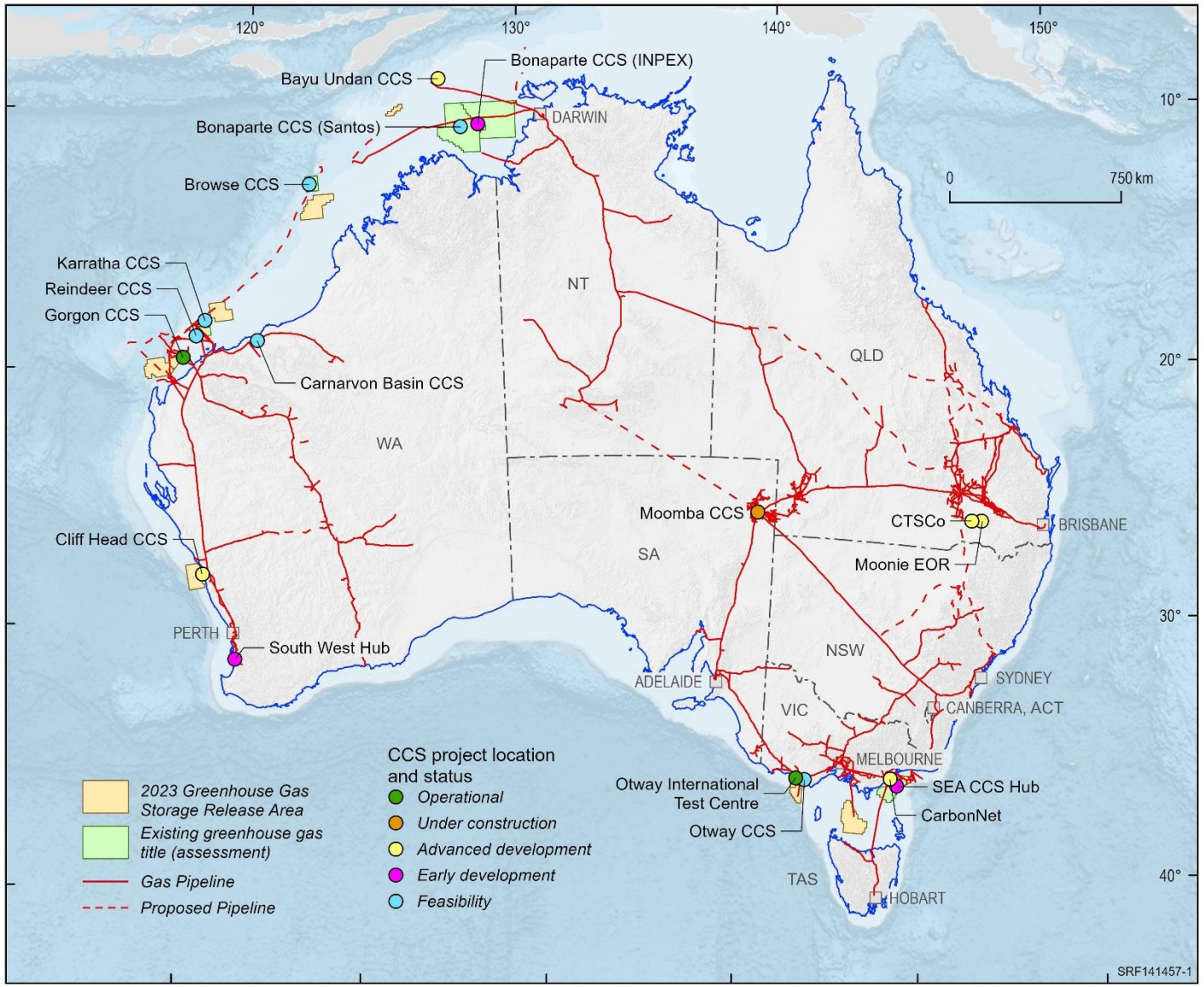
- Australia's **Future Gas Strategy** outlines the role of geological storage of CO_2 in Australia's decarbonisation plan.
- *May 2024-25 Budget measure*: **$32.6 million *Regional Cooperation Initiative on Carbon Sequestration*** - to establish regulatory frameworks and bilateral instruments to better 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 Government 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 H_2 production; low-carbon dispatchable power; carbon removal; and CO_2-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). **Budget 2024 anticipates Royal Assent by June 1, 2024** (to be effective Jan 1, 2022).
- **Canada's Carbon Pricing System** (with provincial equivalents): Prices carbon at $80/t in 2024, rising to $170/t in 2030.
- **Canada Growth Fund (CGF):** $15B arm's-length public investment vehicle to attract private capital and invest in low-carbon projects and businesses, with up to $7B for Carbon Contracts for Difference (CCFDs) – **Budget 2024 states that the CGF has ~$6B remaining to continue issuing, on a priority basis, all forms of CCFDs and carbon offtake agreements**.
- **Clean Fuel Regulations**: CCUS projects that reduce the lifecycle carbon intensity (CI) of gasoline and diesel are eligible to generate credits. **CCUS opportunities** include: 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 with a mandate to invest in private-led low-carbon infrastructure projects – including the support of FEED capital expenditures by the private sector (**including CCS, hydrogen, clean fuels)**.

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 since 2000).
- **Quest, Shell Canada, AB**: >8Mt CO_2 captured & stored at 3 hydrogen production units at oil sands upgrader since 2015
- **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 pipeline capacity.
- **Nutrien Redwater Fertilizer Facility, AB:** CO_2 captured from H_2 production to make ammonia used in fertilizer manufacturing.
- **Sturgeon Refinery, North West Redwater 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 (>4Mt 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

- Construction: Hydrogen (e.g., Air Products), chemicals (e.g., Dow), ACTL extension, Glacier (0.2Mt/yr from phases 1 and 2).
- Advanced development: Cement (e.g., Heidelberg), power (e.g., Capital Power), biofuels (e.g., Federated Coop Ltd), etc.
- Alberta allocating sequestration rights through a competitive process to enable carbon storage hubs (25 in evaluation).
- CGF granted Entropy 1st ever fixed-price ($86.50 CDN) carbon credit offtake in compliance market (up to 1Mt/yr, 15 years).
- 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

Deployment policies and programmes in place

- CCUS research projects supported by the National Key R&D Programme

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
- QiangNai Jiaozuo 10 Kt CO2 to Concrete Project
- CHN Energy Taizhou 0.5Mt/a Thermal Power CCUS Demonstration 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
- Cement Plant CCUS (Hailuo, Jinyu, China National Building Material Group)
- Baotou Steel 0.5 Mt/a CCUS Project
- CHN Energy & CNPC Ningdong 3 Mt/a CCUS Demonstration Project (CO2 Capture+EOR)
- Huaneng Gansu Longdong Energy Company 1.5 Mt/a CCUS R&D Project

Germany *

Evaluation report of the German CCS-Law (published Dec 2022 [link])

- Recommends changes to legal framework to allow CCS/CCU in GER
- Based on the report, development of a carbon management strategy for Germany was announced

The carbon management strategy (CMS)

- Shall provide the economic, legal 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 and Draft Amendment of German CCS-Law (both published Feb 2024)

- Political core messages are (excerpt)
  - ➢ CCS/CCU are necessary to reach climate goals, at least in sectors with hard-to-abate emissions
  - ➢ Allow offshore CO2 storage in GER EEZ
  - ➢ Exclude CCS/CCU for power generation using 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

- Finalize CMS asap
- Create economic framework for CCS/CCU
- Generate governance structure
- Continuous stakeholder participation, monitoring and re-evaluation

* Situation May 2024

European Union *

Current government strategy for CCUS

- EU financial support to CCUS research, innovation and demonstration

Deployment policies and programmes in place

- Innovation Fund, TEN-E and Connecting Europe Facility, Horizon 2020 and Horizon Europe, Recovery – NextGenerationEU, Sustainable carbon cycles communication

Priorities going forward:

- Foster the deployment of large-scale, innovative projects
- Propose certification of carbon removals (2022)
- Publish strategic CCUS Vision Paper (2023)
- Assess CO2 infrastructure investment needs and CO2 infrastructure regulatory needs

CURRENT LARGE-SCALE CCUS PROJECTS

Currently there are no large-scale CCUS projects running in the EU

POTENTIAL FUTURE PROJECTS

CO2 transportation projects included in the 5th list of "Projects of Common Interest":

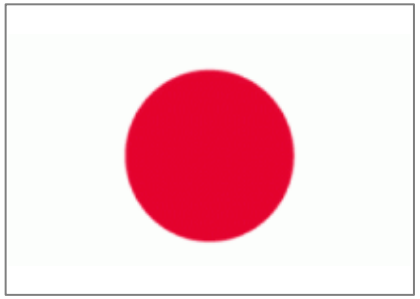
- CO2 TransPorts, part of PORTHOS (Netherlands), Northern lights project (Norway), ATHOS (Netherlands), Aramis project (Netherlands), Dartagnan project (France), EU CCS Interconnector (Poland)

CCS and CCU projects supported from the Innovation Fund:

- Kairos-at-C, Port of Antwerp – CO2 capture from hydrogen, ammonia and ethylene oxide production (Belgium), BECCS Stockholm - Bio-energy CO2 capture at a CHP plant (Sweden), K6 – CO2 capture at cement plant, reuse & storage (France), SHARC - Green hydrogen and blue hydrogen with CCS (Finland)
- C2B: Carbon2Business - Oxyfuel CO2 capture and use for methanol production (Germany), ANRAV: Oxy-fuel in cement production (Bulgaria), Coda Terminal: CO2 mineral storage hub in onshore basalt formation (Iceland), AIR: Methanol production from renewable hydrogen and carbon capture (Sweden), HySkies: Sustainable Aviation Fuel from RES H2 and CCU (Sweden), GO4ECOPLANET: Cryocap CO2 capture in cement (Poland), CalCC: CO2 capture in lime production (France)

* Situation September 2022

Japan



Key climate policy targets

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

CCS long-term roadmap, released in 2023

- Tentative target: 120-240 million tons stored by 2050, or an increase of 6 – 1.2 million tons annually from 2030
- Improve a business environment toward the start of CCS business by 2030

CCS business Act

Japanese CCS business act was approved the Japanese cabinet.

We will proceed to have the Act 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

- Established "Carbon Recycling Roadmap" in June, 2024. https://www.nedo.go.jp/carbon-recycling/2023/en/230927.pdf
- 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

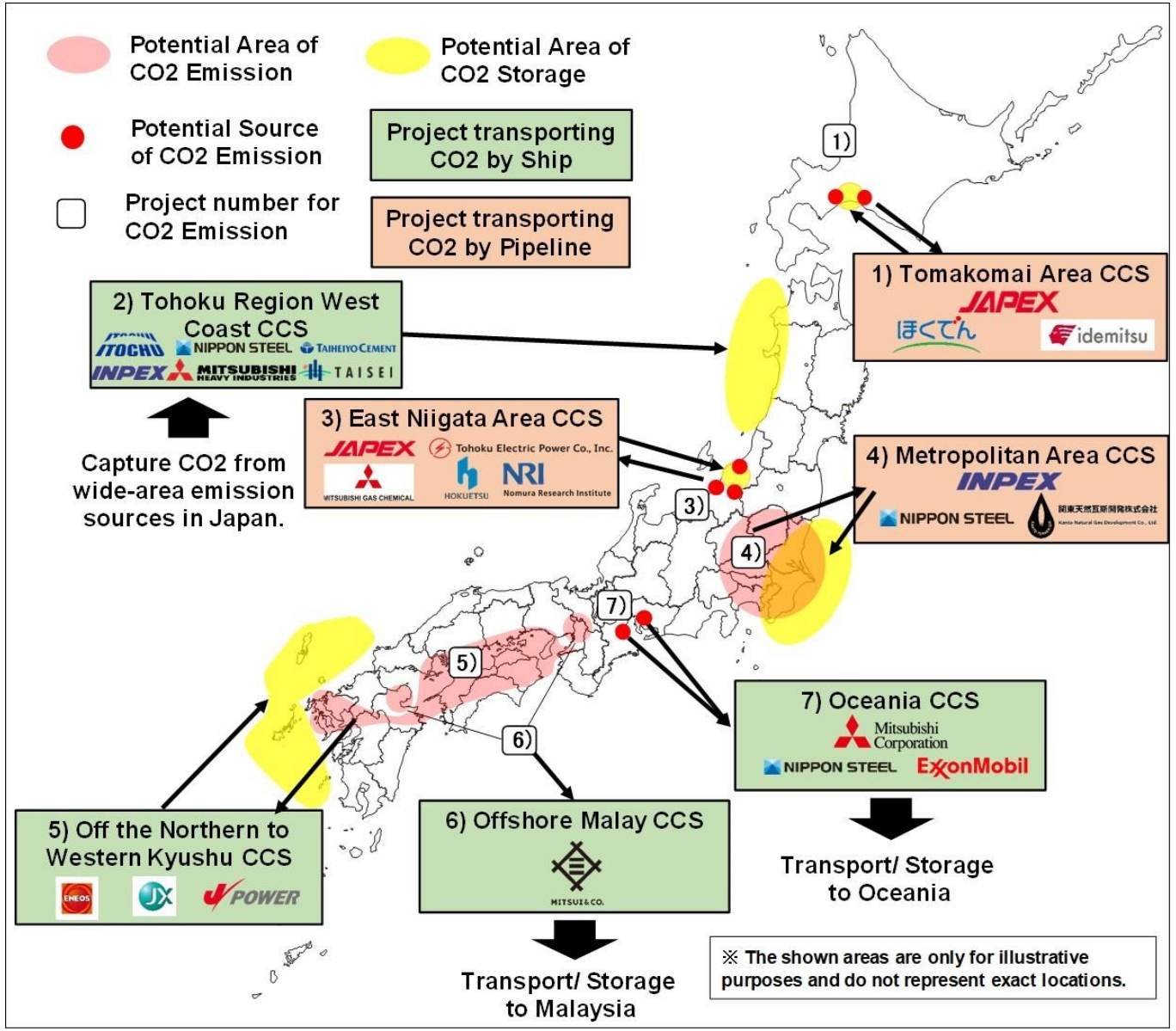
CURRENT LARGE-SCALE CCUS PROJECTS

- Previous Tomakomai demonstration project
- 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

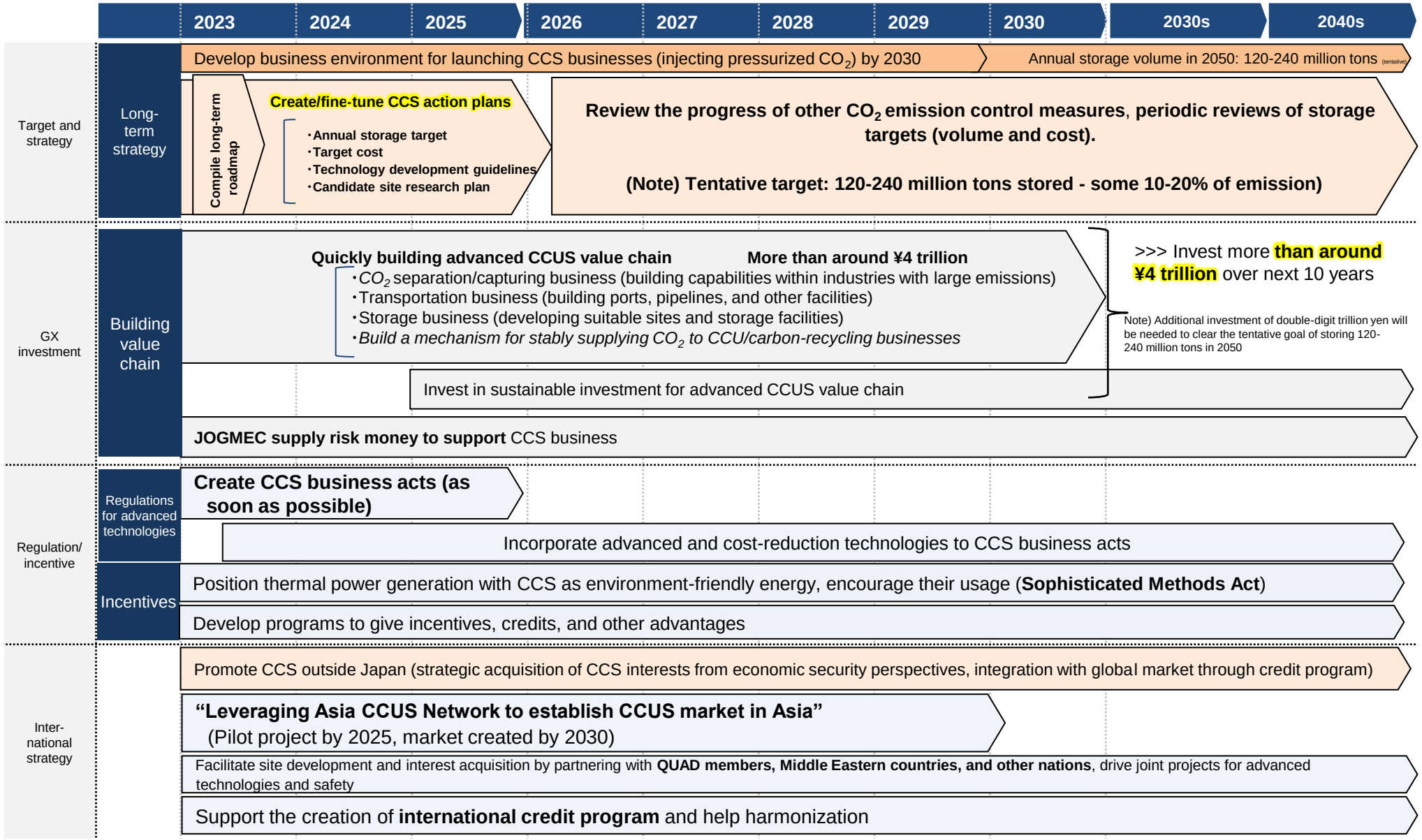
POTENTIAL FUTURE PROJECTS

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

Japan - Map of the selected projects and companies



■ In order to secure the annual CCS capacity required for achieving carbon neutrality by 2050, build advanced CCUS value chain and win CCUS markets in Asia over the next 10 years, and also develop CCS business acts as quickly as possible to create business environment for launching businesses by 2030.



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 having prioritized CCUS technology in the Energy Transition Framework, NTAP :

- Based on the outcome of the Diagnostic and Scoping Assessment, creation of a national geological atlas is being undertaken
- Pre-launch of a CCUS Centre of Excellence with focus on unconventional geological formation.
- Engagement with IDDI on potential CCUS PCR for Cement and Steel.

Deployment Policies, Programmes and Frameworks in place:

- Energy Transition Plan;
- National Technology Action Plan for Climate Change Mitigation and Adaptation and
- National Council on Climate Change (NCCC) established.

Priorities going forward:

- Geological Formation Atlas Development
- ICCUS Policy direction
- instititional capacity development /
- increase stakeholder enegagement for broader awareness creation and acceptance

CURRENT LARGE-SCALE CCUS PROJECTS

N/A

POTENTIAL FUTURE PROJECTS:

- Outcome of World Bank phase 2 ICCUS development and engagement with Government of Nigeria will determine any potential future project.

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

Current large-scale CCUS projects

- Sleipner (1 mill. tons per year)
- Snøhvit (0.8 mill. tons per year)

PROJECTS UNDER DEVELOPMENT

- The full chain CCS project: "Longship" (start 2024)
  - 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)

POTENTIAL FUTURE DEVELOPMENTS

- Northern Lights part 2
- Develop additional CCS projects
- 6 new exploration permits for CO2 storage acreage, in the North Sea and the Barents Sea respectively

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

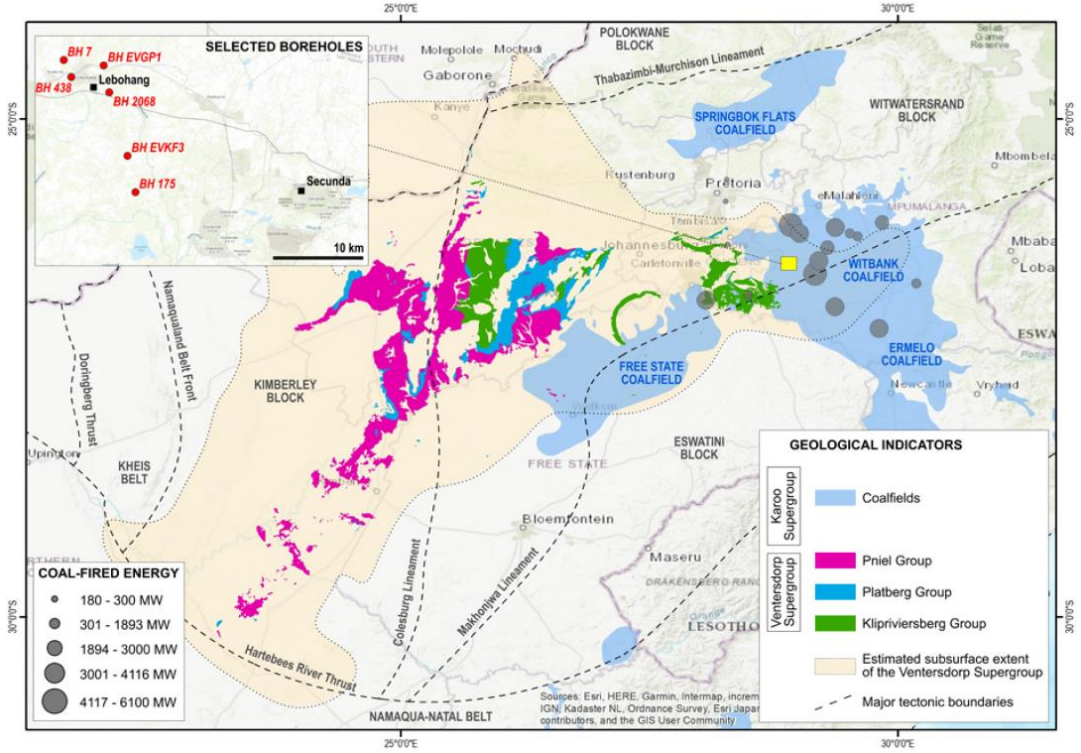
CURRENT LARGE-SCALE CCUS PROJECTS

- 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.

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.



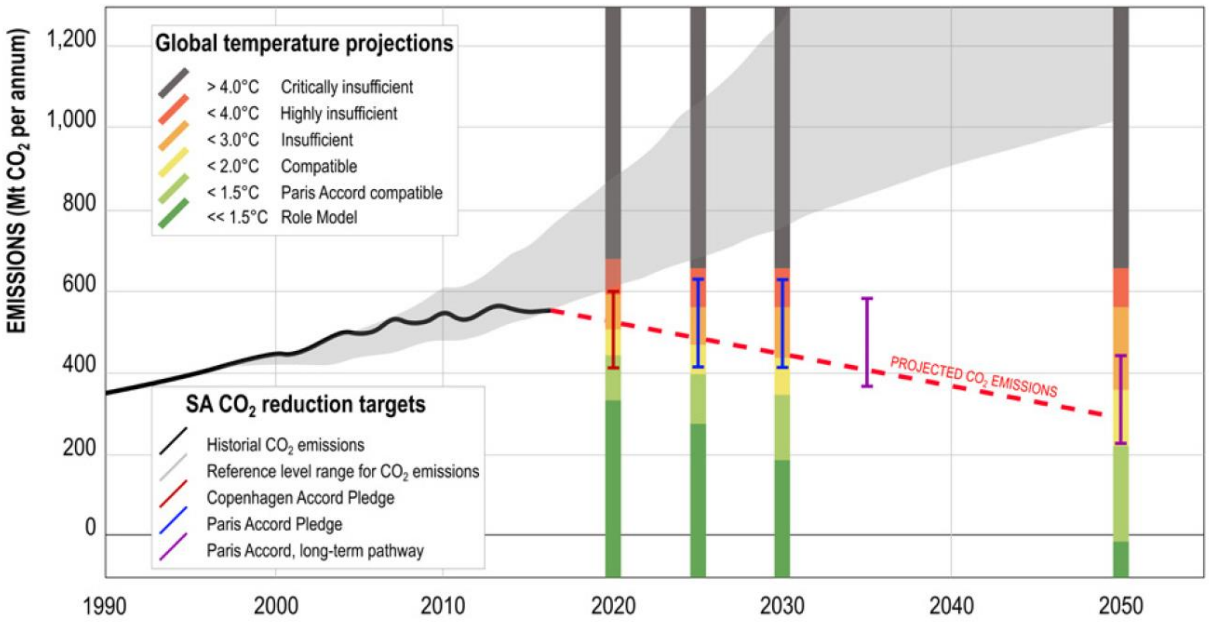
Regional map of pilot site, Mpumalanga, South Africa

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

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)

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 (on going)

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.
- 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 United Arab Emirates

- 2023/2024- CCUS hubs roadmap
- Development of CCUS Policy.
- 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.

POTENTIAL FUTURE PROJECTS

- ADNOC expansion of CCUS initiatives
  - Shah gas plant, which has the potential to capture 2.3 million tonnes of CO2 per year
  - Habshan-Bab gas plant, which has the potential to enable the capture of 1.9 million tonnes of CO2 per year
- The equivalent of a forest area that is twice the size of the UAE.

UAE: Hydrogen and CCUS Initiatives (as of Q1 2022)

1 — Taziz - Ruwais chemical hub
- 1 mtpa blue ammonia production plant located in the Taziz chemicals hub
- 0.2 mtpa H2 equivalent capacity

2 — Masdar – Demonstration plant
- Green H2 initially for road transport, then expanding to e-kerosene synthesis and ocean shipping
- Demonstration scale

3 — UAE Hydrogen Hub
- Initial development of 1GW of low carbon hydrogen together with BP as well as pioneering decarbonized air corridors between the UK and UAE
- 0.1-0.2 mtpa H2 equivalent capacity

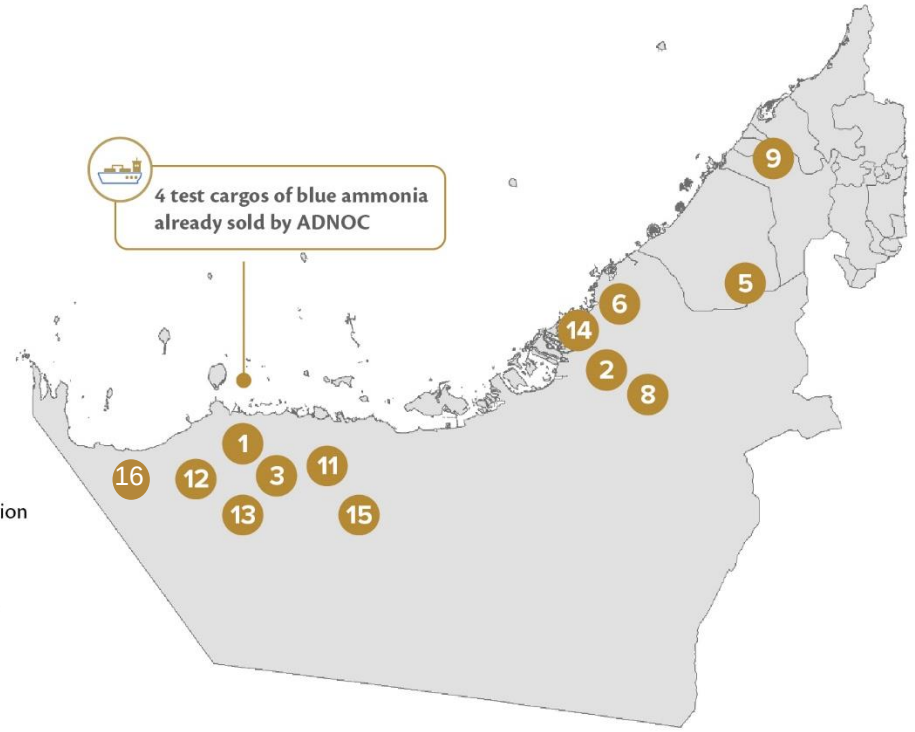
5 — Mohammed bin Rashid Al Maktoum Solar Park
- Mohammed bin Rashid Al Maktoum Solar Park First solar PV and green hydrogen producing facility in the MENA region
- Demonstration scale

6 — Abu Dhabi, Khalifa Industrial Zone
- Final goal of 200kt of ammonia and 40kt of H2 annual production
- 0.1 mtpa H2 equivalent capacity

7 — TAQA & Abu Dhabi Ports
- Green ammonia project under discussion powered by a 2 GW solar based electrolyzer facility
- 0.1 mtpa H2 equivalent capacity

8 — TAQA & Emirates Steel
- MOU for large-scale green hydrogen project enabling the first green steel produced in the MENA region

ESMA
- The first technical regulation of Hydrogen powered vehicles in the UAE



9 — Sharjah Waste-to-H2 Plant
- The facility will use up to 37.5 tonnes (t) of unrecyclable solid waste an hour to generate 30MW of electricity.

Developer: Bee'ah - Masder

10 — Mubadala & Siemens Energy (E-fuel Project)
- Mubadala signed a Memorandum of Understanding with Siemens Energy and other energy players to accelerate green hydrogen capabilities in UAE, goals:
  - Produce e-fuel with airlines as off-takers
  - Promote hydrogen-based ecosystems.

11 — ADNOC & TAQA
- New Green Hydrogen Venture
- The two energy giants will create a clean energy powerhouse, with a total generating capacity of at least 30 gigawatts (GW) of renewable energy by 2030

12 — Ruwais Ammonia (FERTIL-I and II)
Capacity: 370,000 tH2/
Developer: Borouge
Integration with CCUS: NO

13 — Ruwais Hydrogen Plant
Capacity: 24,000 tH2/y
Developer: ADNOC
Integration with CCUS: NO

14 — CO2 pilot injection project at Rumaitha field
Capacity: Injected 60 tCO2/d
Developer: ADNOC and Masdar
Operational: 2012

15 — Al Reyadah CCUS plant (Emirates Steel) Phase I
Capacity: Injected 800,000 tCO2/d
Developer: ADNOC and Masdar
Operational: 2016

16 — Barakah Plant: UAE can produce 1 mil mt/year of hydrogen from nuclear units at full capacity

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 **20-30 MtCO2 per year by 2030** to help us meet our legally binding target of 78% emissions reductions by 2035.
- We are committed to deploying two CCUS clusters by the mid-2020s and a further two by 2030.
- 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.

Deployment and programmes

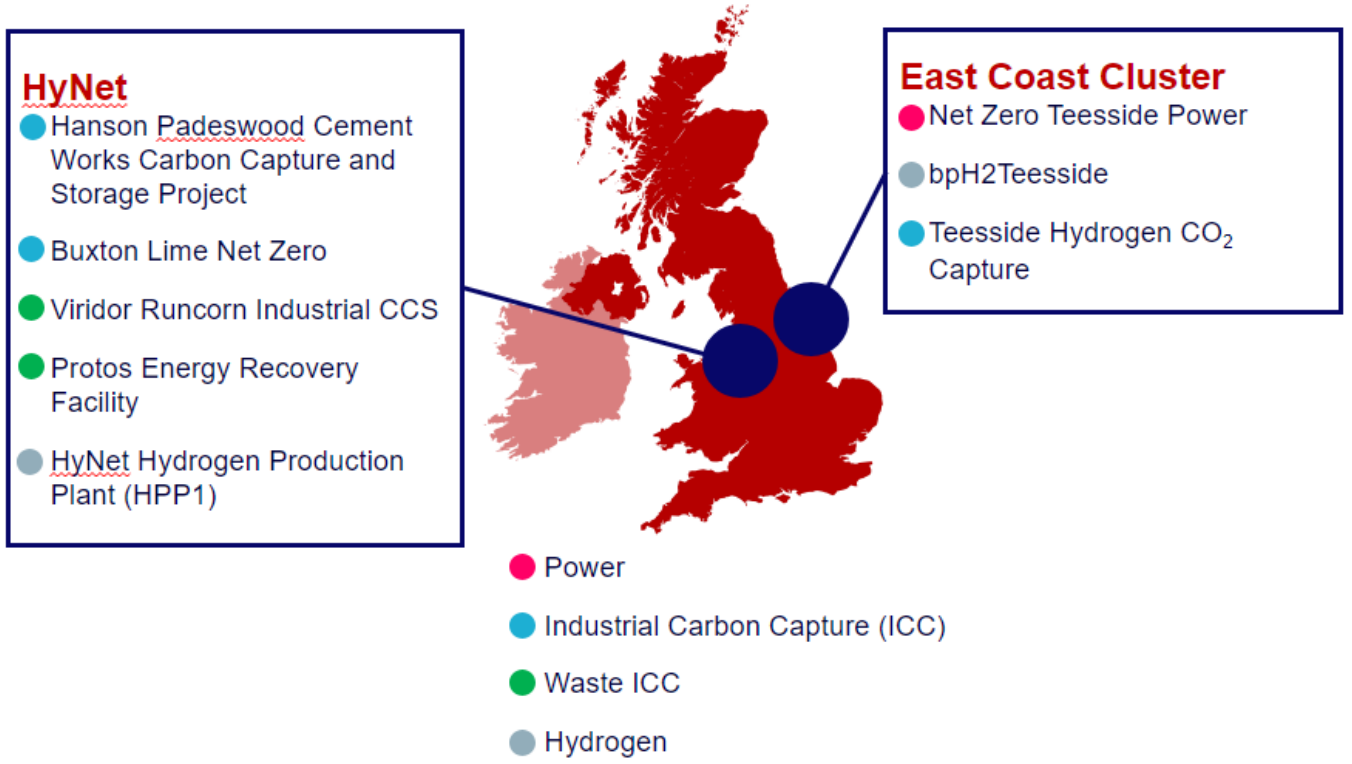
- **First Track-1 clusters** announced as **HyNet and East Coast Cluster** (Oct '21) and **Track-1 project negotiation list confirmed 8 projects** which we have selected through the Cluster Sequencing Process to progress to negotiations to form the first two CCUS clusters (Mar '23 – see map).
- Published an update to the **UK CCUS Investment Roadmap** (Apr '23) outlining the investment landscape for UK CCUS.
- Designed the CCUS (Industrial Carbon Capture [ICC], Waste ICC, Power, Transport and Storage [T&S]) **business models** to provide clear, long-term sight of revenue models and a stable investment environment.

Funding

- **£20 billion investment in the early deployment of CCUS**, including the £1 billion CCUS Infrastructure Fund to support the capital costs of strategic CCUS infrastructure, T&S networks, and ICC projects.
- **Industrial Decarbonisation and Hydrogen Revenue Support scheme** to fund business models for low carbon hydrogen production and industrial carbon capture that give investors long-term revenue certainty.

Priorities going forward

- We launched **Track-2 of the CCUS Cluster Sequencing Process** and will announce next steps for this in the summer. We will launch a process to enable **expansion of the Track-1 clusters**, beyond the initial deployment, later this year (2023).



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: 9.37 MMT of CO_2 captured (December 2023)
- Illinois ICCS Project: 3.50 MMT of CO_2 injected (December 2023)
- Petra Nova CCS Project: 4.23 MMT of CO_2 injected (December 2023)
- 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
- 128 EPA Class VI well permits pending (across a total of 43 projects)

Brief overview of CEM CCUS Initiative

Clean Energy Ministerial CCUS Initiative

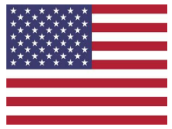
Fourteen Member Countries:

Lead countries


Norway


Saudi Arabia


United Kingdom


United States

Participating CEM Members


Australia


Canada


China


EU Commission


Germany


Japan


Mexico


Netherlands


Nigeria


South Africa


United Arab Emirates

Other countries and Partners:

Links to further countries: Brazil, 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.

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ACCELERATING CCUS TOGETHER
AN INITIATIVE OF THE CLEAN ENERGY MINISTERIAL

3

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

4

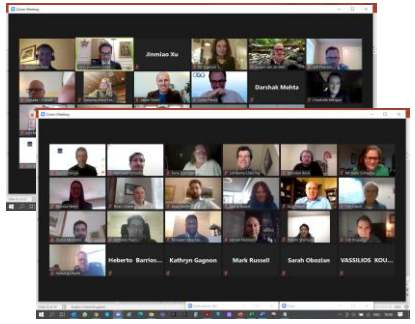
Disseminating **best practice** in CCUS policy, regulation and investment.

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.

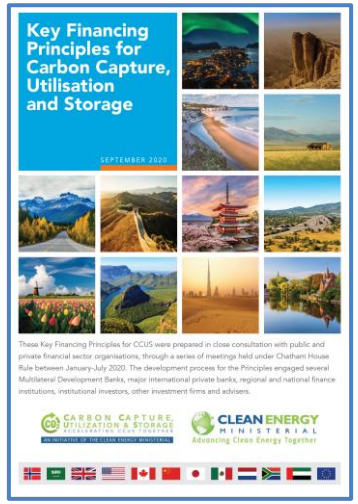


2. LINKING WITH THE FINANCE SECTOR

"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.

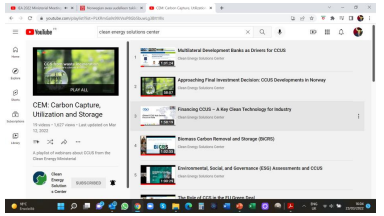


3. DISSEMINATING BEST PRACTICE

Sharing country developments in monthly meetings.

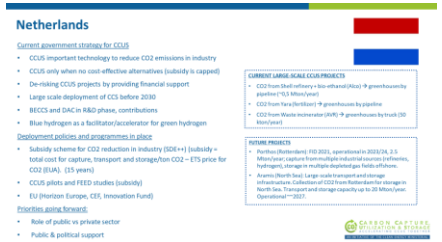
Sharing best practice in regional workshops and events.

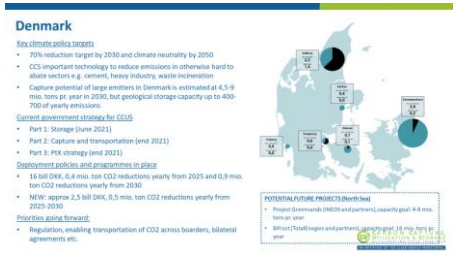
Sharing best practice in webinars.

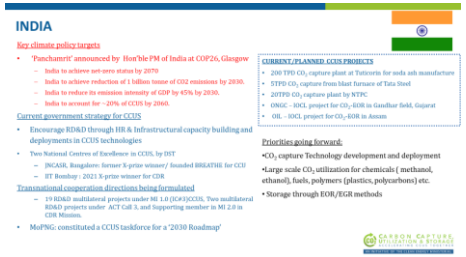


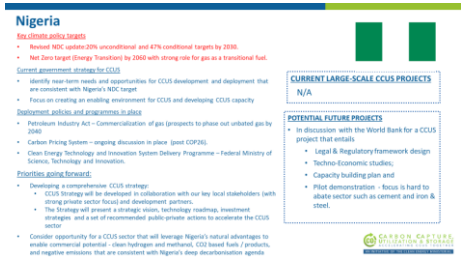
Disseminating country experience and facilitating dialogue

MEMBERS' MEETINGS: MONTHLY AND ANNUAL









REGIONAL WORKSHOPS


Accelerating CCUS in hard-to-abate sectors and in the Gulf Region

Workshop by the Clean Energy Ministerial CCUS Initiative
Wednesday 15 January 2020
Hotel Andaz Capital Gate, Abu Dhabi

Workshop summary

On Wednesday 15 January 2020 the Clean Energy Ministerial CCUS Initiative organised a workshop on CCUS in hard-to-abate sectors and in the Gulf Region. Hosted by the Ministry of Energy and Industry of United Arab Emirates, the event was held in the sidelines of the World Future Energy Summit in Abu Dhabi.

The workshop had two parts, the first on particular challenges with CCUS in energy-intensive industry, and a second on closer CCUS collaboration in the Gulf Region, following from an earlier event held in Abu Dhabi in September. Workshop participants were from governments in the region, other Clean Energy Ministerial CCUS initiative governments, from various industries in the region and beyond, academia, as well as from key organisations such as the Carbon Sequestration Leadership Forum, Global CCS Institute and the UNFCCC Secretariat.

Dr. Matar Alfeiyadi, Undersecretary for Energy at the UAE Ministry of Energy and Industry welcomed the participants to the event. He highlighted the role of CCUS as a tool and solution for a sustainable energy future. He also stressed the idea of circular economy and the need to use the captured CO_2 whenever possible and sustainable.

1


Annex 1. Workshop agenda

"Accelerating CCUS in hard-to-abate sectors and in the Gulf Region"

Wednesday 15 January 2020
Hotel Andaz Capital Gate Abu Dhabi

DRAFT WORKSHOP AGENDA

08:30 Registration & welcome coffee

09:00 Welcome and opening

09:10 Panel discussion: Accelerating CCUS in hard-to-abate sectors

Industry today accounts for 25% of global CO_2 emissions and a number of sectors such as cement, steel and chemicals are among the hardest to decarbonise. This panel discussion explores the state of play and discusses aspects hindering progress, specific policy approaches and mechanisms to join forces to accelerate CCUS in hard-to-abate sectors.

Panelists in this session are:
- *Asa Ekdahl, Head of Environment and Climate Change, Worldsteel*
- *Brad Page, Chief Executive Officer, Global CCS Institute*
- *Hassan Shashaa, Chief Operating Officer, Emirates Steel*
- *Majed Abdulrahman Alosalian, Chief Executive Officer, City Cement Company*

11:00 Coffee break

11:30 Focus on CCUS in the Gulf Region

This session will start with presentations on CCUS visions in countries in the Gulf Region, notably United Arab Emirates, Saudi Arabia and Bahrain. After forward-looking country visions, this session moves to a panel discussion on regional collaboration and how to accelerate CCUS in the Gulf Region employing a more holistic regional approach. How can the region come up with a common strategy? Can a joint roadmap or vision be identified and implemented? (Lunch is served 12:30 – 13:30.)

Presenters and panellists in this session are:
- *Khalid Kuleib, Senior Vice President R&D, ADNOC*
- *Tidjani Niass, CCUS Lead, Saudi Aramco*
- *Hussain Makki, Senior Advisor, Bahrain National Oil and Gas Authority*
- *Further discussants and participants will be the speakers from the morning session, as well as representatives from governments, industry and finance sector in the Gulf Region, Gulf Cooperation Council, academia, UNFCCC Secretariat and other organisations.*

15:30 Example of a national vision: The US National Petroleum Council CCUS Roadmap
- *Jarad Daniels, Director, Department of Energy, United States (by phone)*

15:55 Final remarks by meeting chair

16:00 Close of workshop

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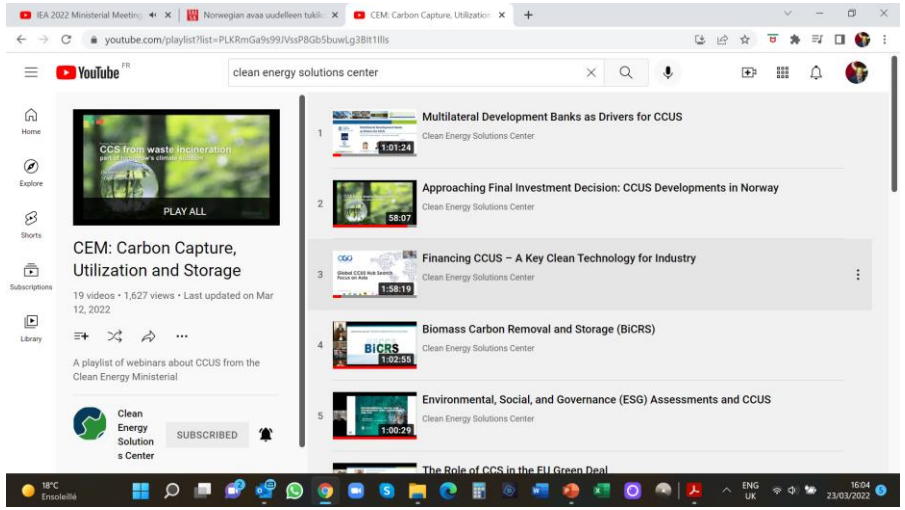
WEBINARS: TO DISSEMINATE EXPERIENCE



Clean Energy Ministerial CCUS Initiative: 2024 focus areas

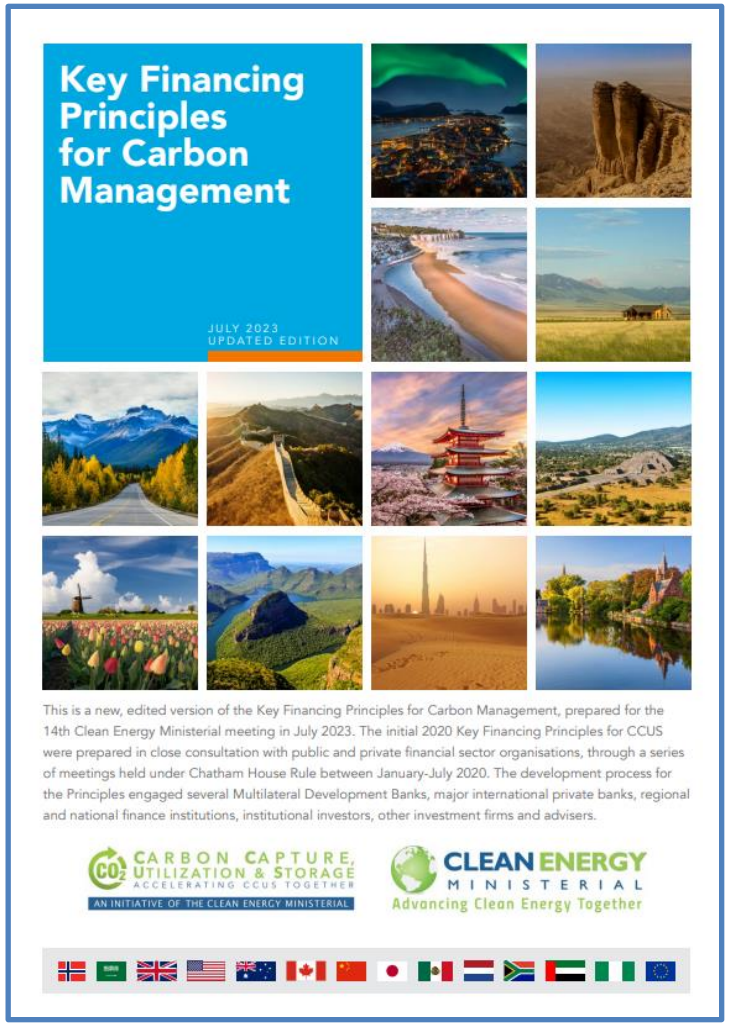
Keeping CCUS momentum by:

- Continuing best practice sharing on policy developments
- Advancing financing solutions and connections with the finance sector
- Actively working with industry sectors to accelerate carbon management: GCCA, OGCI and other industries
- Focusing efforts on emerging economies (both members and non-members)
- Advancing the Carbon Management Challenge
- Actively working with other CEM and MI work streams
- CEM-15 Brazil: elevating CCUS on ministerial level, plus side-events

Updated “Key Financing Principles for Carbon Management”

Ten key principles to be considered by governments, industry and the finance sector, to

- support the establishment of a business case for carbon management and
- kick-start the financing of CCUS projects globally.



Released at the 14th Clean Energy Ministerial meeting in Goa, India, July 2023.

Document available on CEM website:

https://www.cleanenergyministerial.org/initiatives-campaigns/carbon-capture-utilization-and-storage/

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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