



Global Developments with Carbon Capture, Use and Storage Programmes

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Carbon Sequestration leadership forum
www.csforum.org



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Global CCUS Policy Developments

Dear reader,

This slide deck contains a snapshot of carbon capture, use and storage (CCUS) policy and programme developments across several countries, by both CEM CCUS Initiative Members and beyond.

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 CO₂ 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.

The document also includes a brief summary of progress towards the CCUS Roadmap by the Carbon Sequestration Leadership Forum Technical Group, a key partner of the CEM CCUS Initiative.

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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Australia

Climate Change Policies

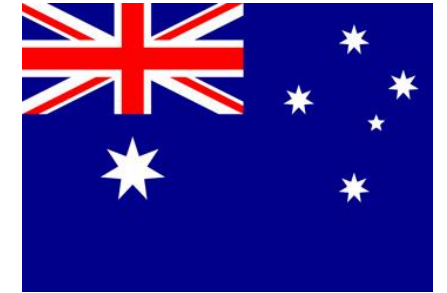
- **Climate Change Bill 2022:** To enshrine into law emissions reductions targets of **43 per cent below 2005 levels by 2030, and net zero emissions by 2050.**
 - This Bill passed into Parliament and enshrined into law on 8 September 2022.

Current government strategy for CCUS

- The Government is interested in all technologies and tools that can assist us to achieve our net zero ambitions, recognising that **CCUS is a part of the mix of technologies** needed to help abate emissions.
- Decarbonising technologies such as Carbon Dioxide Removal, including DAC; Cement sector decarbonisation.

Deployment policies and programmes in place

- \$50 million **CCUS Development Fund Grantee projects are ongoing.**
 - Grantees include Boral, CTSCo, Corporate Carbon, MCi, EDL and Santos CCS projects, which are progressing past pre-commercial phase, and accelerating pilot projects towards commercial scale.
- A decision has not yet been made on the \$250 million **CCUS Hubs and Technology Program.**
- The government releases offshore areas for CO₂ storage through an annual **Greenhouse Gas Offshore Acreage Release.** These provide a key mechanism to support investment in Australia's CCUS projects, while also supporting the reduction of emissions.
 - Area nominations for the **2022 Release** closed on 31 July 2022.
 - Public consultation proposed in September 2022; release scheduled on December 2022.
 - **Five permits have been awarded from 2021 Release.**
 - INPEX, Woodside and Total Energies JV for an area in the Bonaparte Basin (NT).
 - Woodside for two areas in the Northern Carnarvon Basin (WA), and Browse Basin (WA).
 - Santos for two areas in Bonaparte Basin (NT) and Northern Carnarvon Basin (WA).



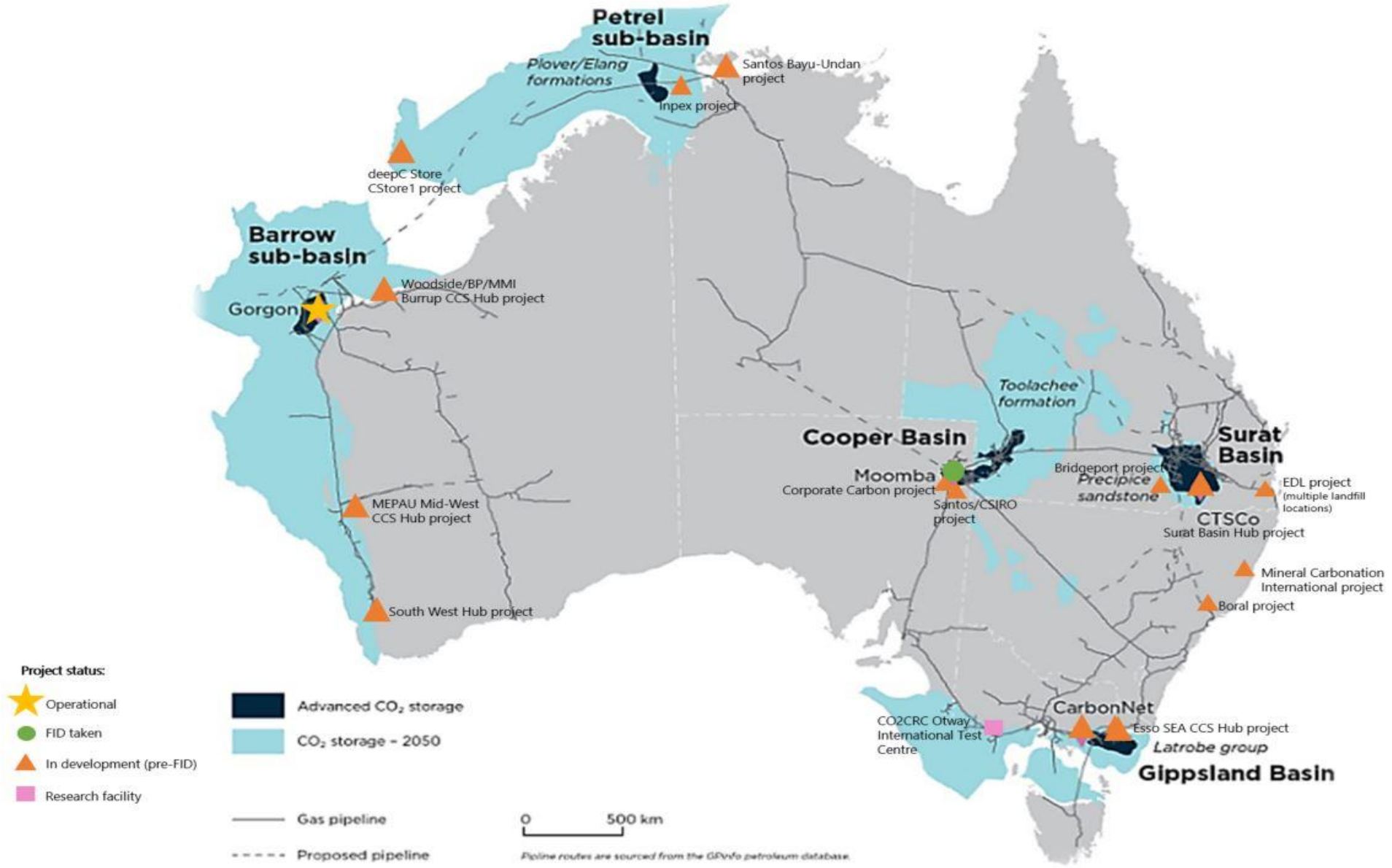
LARGE-SCALE CCUS PROJECTS

- **Current:** Gorgon CO₂ Injection Project (Chevron Australia): over 6 Mt of CO₂ equivalent stored since August 2019. The system will capture up to 4 Mt of CO₂ annually and reduce greenhouse gas emissions by more than 100 Mt over the project life.
- **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 to be operational in 2024 and store 1.7 Mtpa of CO₂.

Priorities going forward

- Powering Australia – create jobs, lower power bills, reduce emissions by boosting renewable energy.
- With the change in government, Australia currently considering its options going forward on CCUS.

Australia – Map of Projects



Canada

Current Government Approach to CCUS

- Contribute to “**net-zero by 2050**” goals and the [2030 Emissions Reduction Plan](#) (Apr 2022), which projects there will be opportunities for CCUS to reduce emissions by 19.4Mt (12.9% of domestic reductions targets), with another 1.3Mt from CCUS-enabled hydrogen production, and 0.5Mt from DAC by 2030.
- Build on Canada’s **CCUS advantages**, including domestic projects that have already captured and stored millions of tonnes of CO₂.

Federal Policies / Funding

- [CCUS Investment Tax Credit \(ITC\)](#) for projects which permanently store CO₂ in dedicated geological storage or in concrete. To come into effect in 2022, budgeted at CAD \$2.6B/5 yrs. Draft legislation released for consultation in Aug 2022.
 - 2022-2031 rates: 60% for DAC; 50% for capture equipment in all other projects; 37.5% for transportation, storage, and utilization.
 - Will apply to eligible expenses incurred before 2041 but reduced by 50% in 2031 (to incentivize projects this decade).
- The final [Clean Fuel Regulations](#) came into force in June 2022. CCUS-related opportunities for credit creation: CCS and CO₂-EOR projects that reduce the lifecycle carbon intensity of liquid fossil fuels, DAC-to-fuels, and clean H₂ that displaces traditional liquid or gaseous fuels.
- **Carbon Pricing Systems** (federal or provincial equivalents): The 2022 federal carbon price is \$50/t and will rise to \$170/t in 2030 as per the [Strengthened Climate Plan](#).
- **Budget 2022 announced the \$15B Canada Growth Fund** to speed private investment in decarbonization/cleantech projects; expected Fall 2022; and expanded the role of the [Canada Infrastructure Bank \(CIB\)](#) to invest in private sector-led infrastructure projects that will accelerate Canada’s transition to a low-carbon economy, including CCUS.

Future Priorities

- [A CCUS Strategy for Canada](#) is in development, to be released in 2022. CCUS is expected to be critical to **six key pathways** to a prosperous net-zero economy for Canada: decarbonizing heavy industries, oil & gas, and the power sector; enabling low-carbon H₂ production, negative emissions technologies to support CDR, and CO₂ based industries.
- Canada’s [GHG Offset Credit System Regulations](#): A DACCS protocol is under development, and BECCS has been identified as a priority for the next round of protocol development.



LARGE-SCALE CCUS PROJECTS - CURRENT

- **Alberta Carbon Trunk Line**: 240-km pipeline delivering ~1.6 Mt of CO₂ / year from a fertilizer plant & new refinery for EOR – up to 14.6Mt / year capacity
- **Quest**: >6Mt CO₂ captured & stored at 3 hydrogen production units at oil sands upgrader since 2015
- **Boundary Dam**: >4Mt captured via post-combustion capture technology at coal-fired power plant, operating since 2014
- **Weyburn-Midale**: >40 Mt stored via CO₂-EOR project (since 2000)

PLANNED PROJECTS & HUBS

As part of \$319M being provided for CCUS RD&D/7 years:

- **11 successful applicants** for Canada’s [CCUS RD&D FEED studies call](#) were announced in July 2022 and are currently under review.
- [Second call](#) (2022-2023) to support earlier-stage RD&D across capture, storage/sequestration, and utilization. Deadline for capture focus area applications is Oct 3, 2022.

Phase I of [Alberta’s Carbon Sequestration Tenure Management Competition](#) resulted in **6 proposed** hubs that will further evaluate if they can safely and permanently store CO₂ emissions from Alberta’s industrial heartland region near Edmonton.

Phase II looks to develop carbon storage hubs in the rest of Alberta. Projects are under review and results expected in 2022.

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

Deployment policies and programmes in place

- CCUS research projects supported by the National Key R&D Programme
- China Carbon Emission Trade Exchange (CCETE) officially launched
- National guidance for promoting CCUS demo projects

Priorities going forward:

- CO₂ utilisation
- CO₂ capture in industrial sectors
- Offshore CO₂ sequestration
- Emission restrictive & CCUS incentive policy
- Large-scale integrated demonstration and pipeline system
- Opportunities for low-carbon hydrogen production with CCUS in China (ACCA21 & IEA)



CURRENT LARGE-SCALE CCUS PROJECTS

- Sinopec ShengLi Oil Field 1Mt/a CCUS Project
- CNPC JiLin 0.4Mt/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

POTENTIAL FUTURE PROJECTS

- OGCI&CNPC XinJiang CCUS Hub
- CNOOC DaYa Bay CCUS Cluster
- HuaNeng Group ZhengNing Power Plant Post-Combustion CCUS Project
- Cement Plant CCUS (Hailuo, Jinyu)
- Steel Pant CCUS (Baogang, HBIS)
- DunHua Petroleum XinJiang Hydrogen Energy CCUS Project

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)

Japan

Key climate policy targets

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

Current government strategy for CCUS

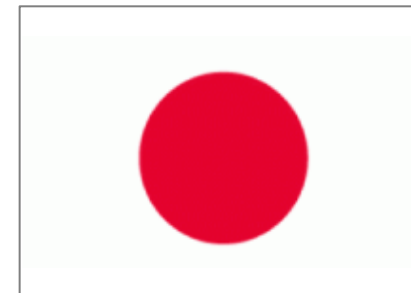
- Intermediate Summary on an upcoming CCS long-term roadmap (released on May 27)
 - Improve a business environment toward the start of CCS business by 2030
- The 6th Strategic Energy Plan (approved by the Cabinet on Oct. 22)
 - Continue to incorporate CCUS into society
 - Introduce CCS by 2030 premised on its commercialization

Deployment policies and programmes in place

- Enhance JOGMEC's functions through an amendment to the JOGMEC law
 - Investment and debt guarantee services for CCS and geological surveys
- R&Ds on safety evaluation technologies and CO2 capture technologies
- Investigation of potential CO2 storage sites

Priorities going forward:

- Launch two working groups in preparation for the legislation of domestic laws governing CCS business and discussing current costs and future cost targets in the entire CCS value chain as well as ideal support from the Government
- Support CCS deployment in Asia through Asia CCUS Network
- Establish liquefied CO2 ship transportation technology
- Formulate a roadmap for CCS deployment in Japan



CURRENT LARGE-SCALE CCUS PROJECTS

- Tomakomai CCUS demonstration project (Post-injection monitoring ongoing)
- Liquefied CO2 ship transportation demonstration project
- Feasibility Study on JCM-CCS at Gundih Gas Field in Indonesia

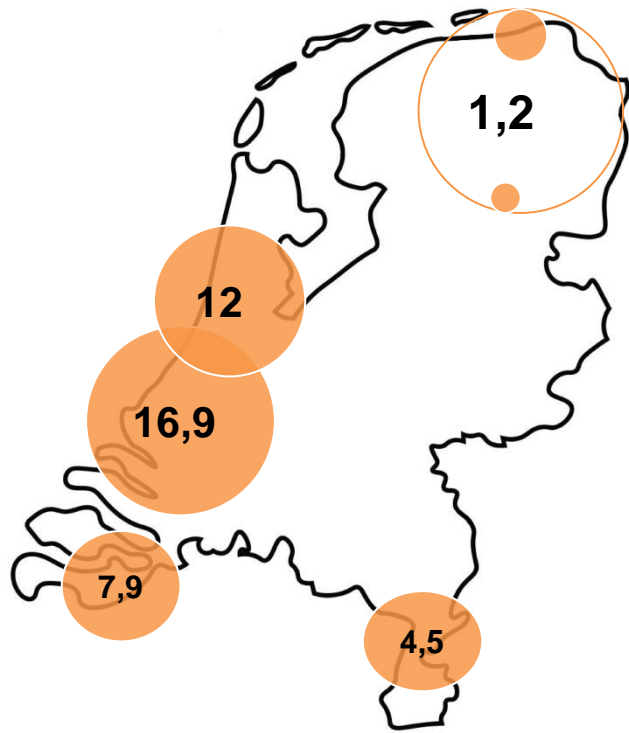
POTENTIAL FUTURE PROJECTS

- Summarize possible government support for CCS projects
- Prompt legislation of domestic laws governing CCS business

CCUS country overview – The Netherlands

CEM CCUS Initiative Annual Members' meeting
Wednesday 21 September 2022

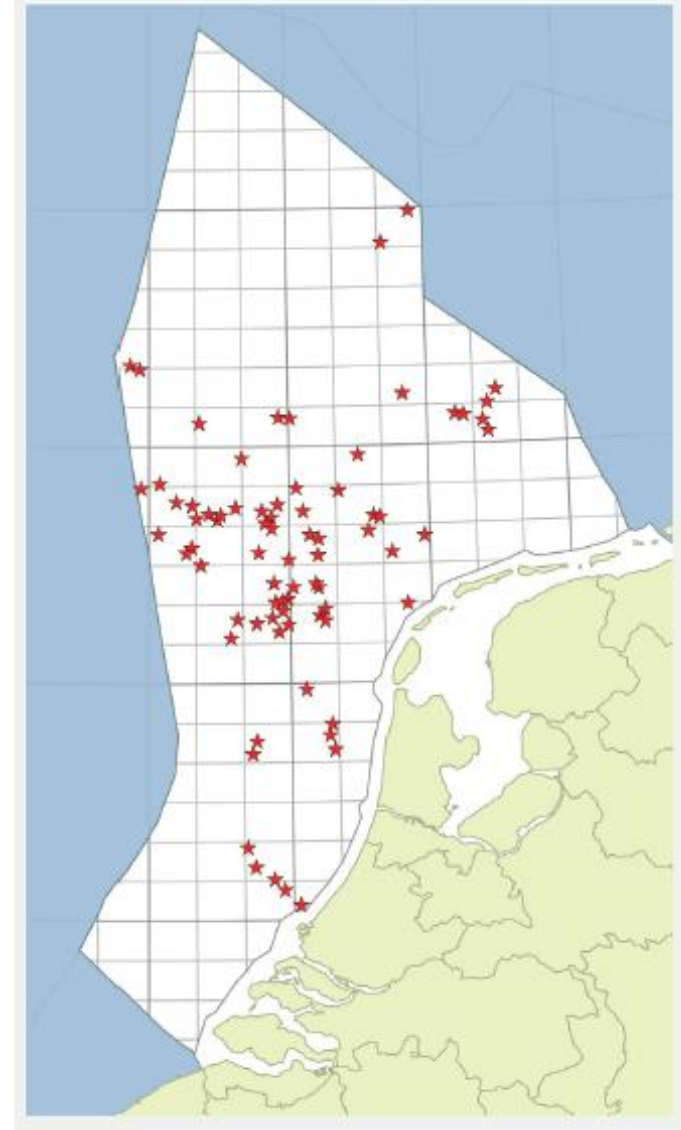
Emissions and storage capacity



12 companies are responsible for 75% of total industrial CO2 emissions

1. Shell Refinery(14%)
2. Tata Steel (13%)
3. Dow Chemicals (8%)
4. Yara (8%)
5. Sabic (6%)
6. ExxonMobil Refinery (5%)
7. BP Refinery (4%)
8. Air Liquide (4%)
9. OCI (4%)
10. Total Refinery (3%)
11. AkzoNobel (2%)
12. Air Products (2%)

Ligging van alle opslaglocaties die bijdragen aan de totale praktische opslagcapaciteit op zee.

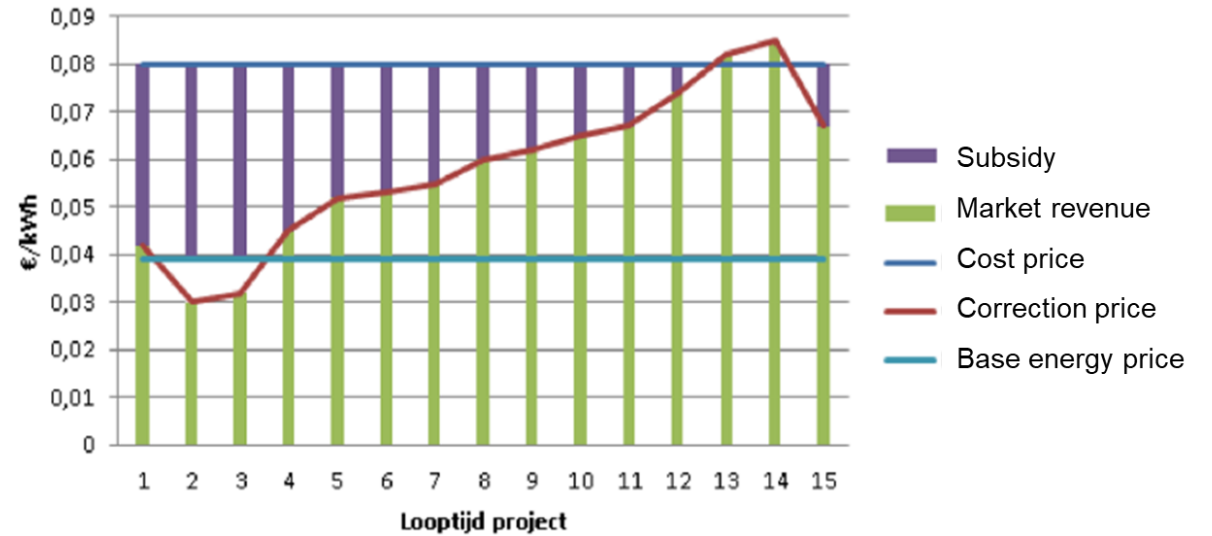


The role of CCS in climate policy

- **Dilemma: cost-efficient vs. bridging technology**
- CCS **controversial topic** during negotiations Of the Climate Agreement – strongly opposed by ENGO's
- CCS in **industry sectors only** (e.g. steel, refinery, hydrogen, fertilizer, waste incineration) – where no cost-effective alternatives exist
- **Capex + Opex** subsidy for industrial CCS (SDE++)
- CCS not foreseen in power sector → **pre-combustion CCS with hydrogen or biomass** in the future
- CCS **limited** in 3 ways:
 - **Cap** on # Mton CCS subsidized (8,7 Mton + 3 Mton)
 - CCS only subsidized if **no cost-effective alternatives**
 - After **2035** no new subsidies granted to fossil CCS projects
- Negative emissions (DAC's + BECCS) after 2030
- CCU could have substantial potential on the longer term, focus is now on agricultural use (horticulture)
- Storage of CO2 → **offshore**
- Offshore storage capacity ~**1700 Mton**

SDE++ subsidy for CCS

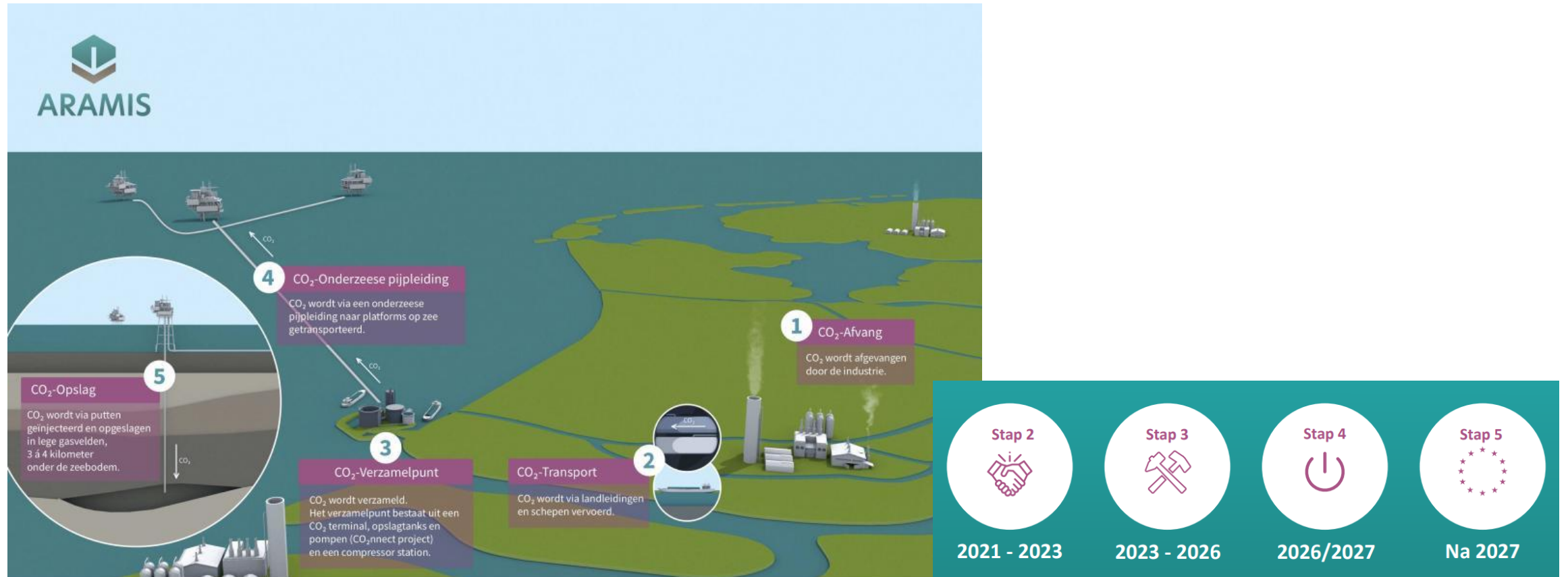
- SDE++ subsidy available for CCS since 2020
- Covers post and pre-combustion projects at existing and new industrial installations
- Capex/Opex 15 years
- Project with lowest reduction costs have highest chance of subsidy
- Projects have to be realised within 6 years from subsidy approval
- Export of CO₂ for storage outside NL currently not applicable



Porthos – 2024/25 – 2.5 Mt/a



Aramis CCS Project – 2026/27 – 5Mt/a+



Nigeria

Key climate policy targets

- Revised NDC update: 20% unconditional and 47% conditional targets by 2030.
- Net Zero target (Energy Transition) by 2060.
- Long-Term Emissions Reduction Plan to achieve 50% by 2050 using a climate technology led approach.

Current government strategy for CCUS

- identify near-term needs and opportunities for CCUS development and deployment that are consistent with Nigeria's net zero emission target by 2060
- Creating an enabling environment through identifying storage resources; matching emission point sources and industrial clusters with CO2 storage; developing legal and regulatory frameworks; performing techno-economic assessments; engaging with stakeholders; supporting capacity development; and ultimately piloting and demonstration of CCUS in industrial settings
- National CCUS Centre of Excellence

Deployment policies and programmes in place

- Energy Transition Plan
- Climate technology Need Assessment.
- Climate Change Bill

Priorities going forward:

- Industrial CO2 CCUS Diagnostic and Scoping Study
- Legal and Regulatory Assessment & frameworks
- Institutional capacity development



CURRENT LARGE-SCALE CCUS PROJECTS

N/A

POTENTIAL FUTURE PROJECTS

- CCUS gas development –blue hydrogen,
- carbon dioxide removal

Norway



Current government strategy for CCUS

- Cost-effective development of CCUS projects
- Facilitate large-scale storage opportunities at NCS
- Focus on decarbonization of industry and low carbon H2
- Establish open access CO2 infrastructure
- Share knowledge and experience

Deployment policies and programmes in place

- CO2 tax and the European Trading Scheme
- Ratified the amendment to the London Protocol and deposited a declaration on provisional application
- Financial support for the Longship project

Priorities going forward:

- Establish a business case for CO2-storage
- Establish bilateral agreements with relevant countries as foreseen under the LP
- 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 (Norcem), a waste incineration plant (Celsio) 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
- 2 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

- Saudi Aramco 'Uthmaniyah and Hawiyah NGL facilities to **Reuse** CO₂ as EOR (0.8 MtCO₂/year)
- United, a SABIC affiliate, to **Reuse** CO₂ as Chemicals (0.5 MtCO₂/year)

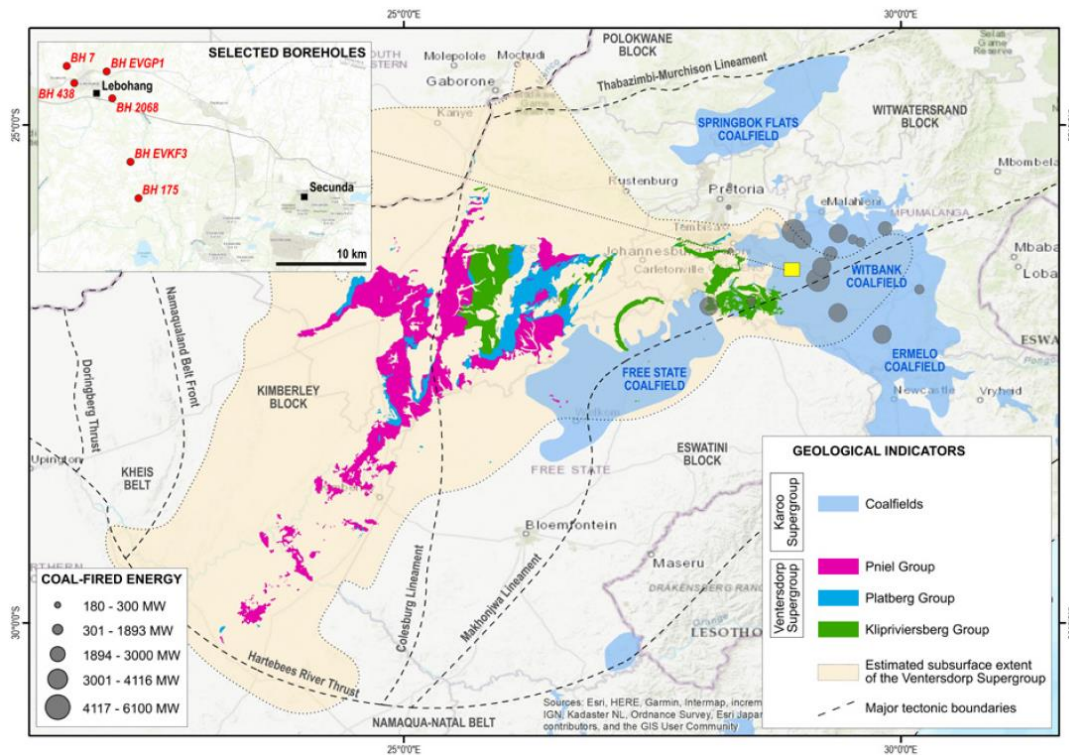
POTENTIAL FUTURE PROJECTS

- Kingdom ambition target plan to capture 44 Mtpa of CO₂ by 2035 as announced during the Saudi Green Initiative (SGI) held by October 2021.
- During September 2021, Saudi Aramco, through its industrial investment program, Aramco Namaat, have signed three separate non-binding MoUs to evaluate Carbon Capture & Sequestration (CCS) opportunities and potential partnerships. The consortiums are working to finalize the feasibility and the scope of the CCS.

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 initiated, targeted finalisation in the 2023/24 financial year.



Regional map of pilot site, Mpumalanga, South Africa

Priorities for the implementation of CCUS

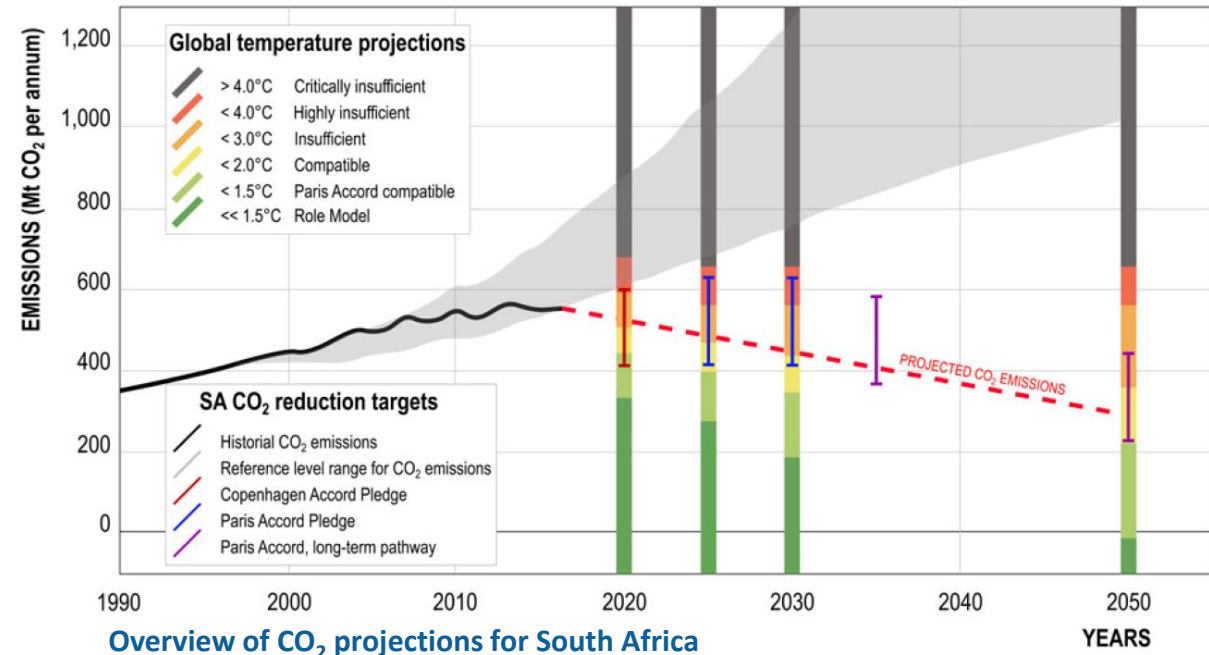
- Integrated geoscience research and focus on utilisation and socioeconomic aspects.

Future programmes

- Basaltic injection near major point-source CO₂ emitters and large coalfields.



South Africa



Overview of CO₂ projections for 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).
- 2022- UAE is on track to submit its revised 3rd Nationally Determined Contribution (NDC).
- Hydrogen Leadership roadmap (2021)

Current government 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.
- Investment in R&D.
- 2021- Updating the National Energy Strategy 2050 in partnership with Khalifa University (KU) and the International Renewable Energy Agency (IRENA)
- 2022- National Hydrogen Strategy which will include the CCUS/CCS hubs(anticipated to be published later 2022)
- 2021- 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.

Priorities going forward:

- Development of CCUS Policy.
- Continuous support towards the CCUS Initiative.









CURRENT LARGE-SCALE CCUS PROJECTS

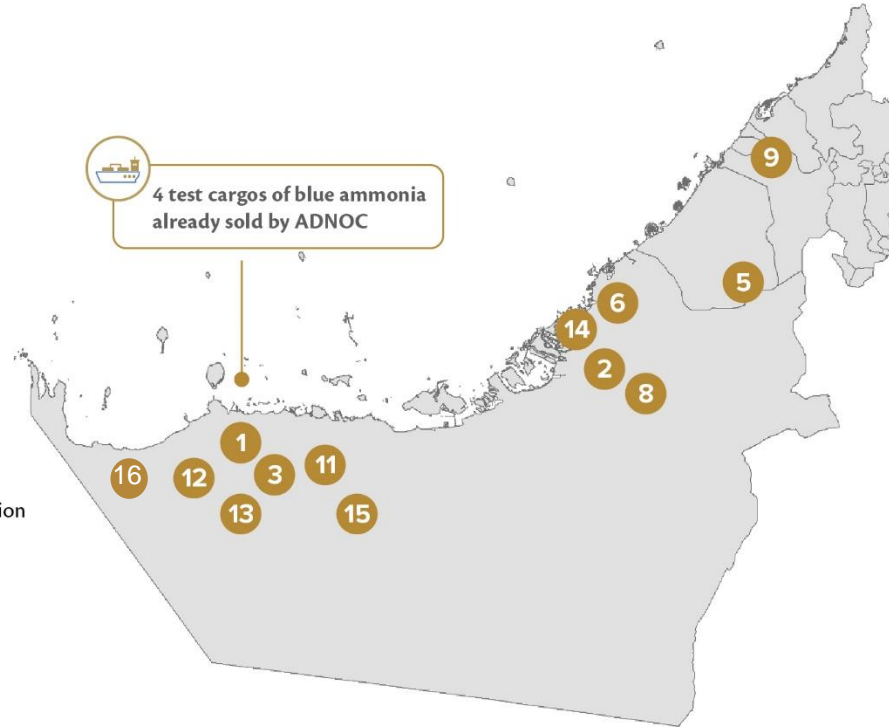
- Al Reyadah Plant: which is the largest carbon capture steel project, that captures 800,000 tonnes of CO₂ that is injected for EOR.

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.

Hydrogen and CCUS Initiatives 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 - Masdar
- 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 has potential to store more than **78 billion tonnes of carbon dioxide (CO₂)** in its continental shelf which is one of the largest potential storage capacities in Europe.
- The UK is committed to progressing CCUS as part of our **2050 Net Zero Strategy**, utilising industrial "clusters" to capture and store **20-30 MtCO₂ per year by 2030**.

Deployment and programmes in place

- Initiated the "Cluster Sequencing" process, first Track-1 clusters announced as **HyNet and ECC** (Oct '21), projects shortlisted for Track-1 confirmed within **Phase-2 announcement** (Aug '22).
- Published the CCUS Investor Roadmap (Apr '22), summarising the government and industry's work on CCUS, outlining opportunities to drive investment for CCUS.
- Designed the CCUS (ICC, Power, Transport and Storage) and hydrogen **business models** to provide clear and long-term sight of revenue models, as well provide a stable investment environment for investment (updated in 2022).

Funding

- The UK's £1billion Carbon Capture and Storage (CCS) Infrastructure Fund will help establish CCUS in at least **four UK industrial clusters**, two by the mid-2020's and another two by 2030.
- Up to **£170m** from the Industrial Decarbonisation Challenge Fund being delivered between 2021 - 2024 through the Industrial Decarbonisation Challenge. Up to **£100m** funding to research and develop Direct Air Capture technology and other Greenhouse Gas Removal technologies, with initial projects receiving funding. **£140m** to set up the Hydrogen Revenue Support Scheme.
- **£20m** Carbon Capture, Usage and Storage (CCUS) Innovation 2.0 competition.

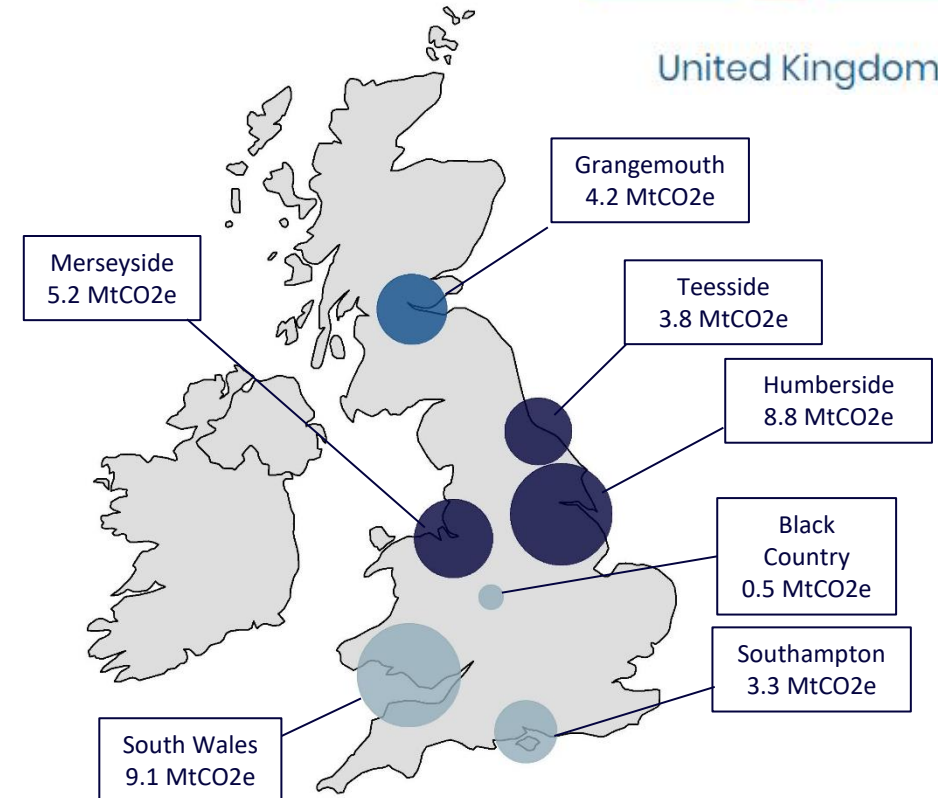
Priorities going forward

- We have committed to announcing next steps on **Track 2 clusters** shortly, starting due diligence on P2 projects for Track 1 clusters and continuing **international collaboration** through ACT, CEM, ECCSEL etc.

- Track-1 clusters
- Reserve Track-1 cluster
- Other industrial clusters



United Kingdom



Map of major UK industrial cluster emissions from large point sources (2019). Source: NAEI 2019 data. Does not capture non-ETS emissions in a cluster.

There are other areas of industrial activity across the UK with an interest in developing CCUS

United States



United States

Key climate policy targets: New climate goals: 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 in place

- Inflation Reduction Act: Reduce greenhouse gas emissions by about 1 gigaton in 2030, or a billion metric tons
 - Includes enhancements to 45Q tax credit (e.g., credit value increases, direct pay, extension of commence construction window, lower capture threshold)
- CHIPS and Science Act: \$1 billion for carbon dioxide removal RD&D (\$67 billion total for DOE)
- Bipartisan Infrastructure Law: \$12 billion for carbon management approaches
- Enhanced 45Q tax credits, loan programs, and state policies/mechanisms
- Regional Initiative to Accelerate CCUS Deployment, Carbon Storage Assurance Facility Enterprise (CarbonSAFE), 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: 8 million metric tonnes of CO₂ captured (June 2022)
- Illinois ICCS Project: 2.7 million metric tonnes of CO₂ injected (June 2022)
- 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

Denmark

Key climate policy targets

- 70% reduction target by 2030 and climate neutrality by 2050
- CCS important technology to reduce emissions in otherwise hard to abate sectors e.g. cement, heavy industry, waste incineration
- Capture potential of large emitters in Denmark is estimated at 4,5-9 mio. tons pr. year in 2030, but geological storage capacity up to 400-700 of yearly DK emissions
- Goal to become a Nordic Hub for CCS, storing not only from DK but also other countries

Current government strategy for CCUS

- Part 1: Storage (June 2021)
- Part 2: Capture and transportation (Dec. 2021)
- Part 3: PtX strategy (March 2022)
- Part 4: State participation in CCS storage activities (June 2022)

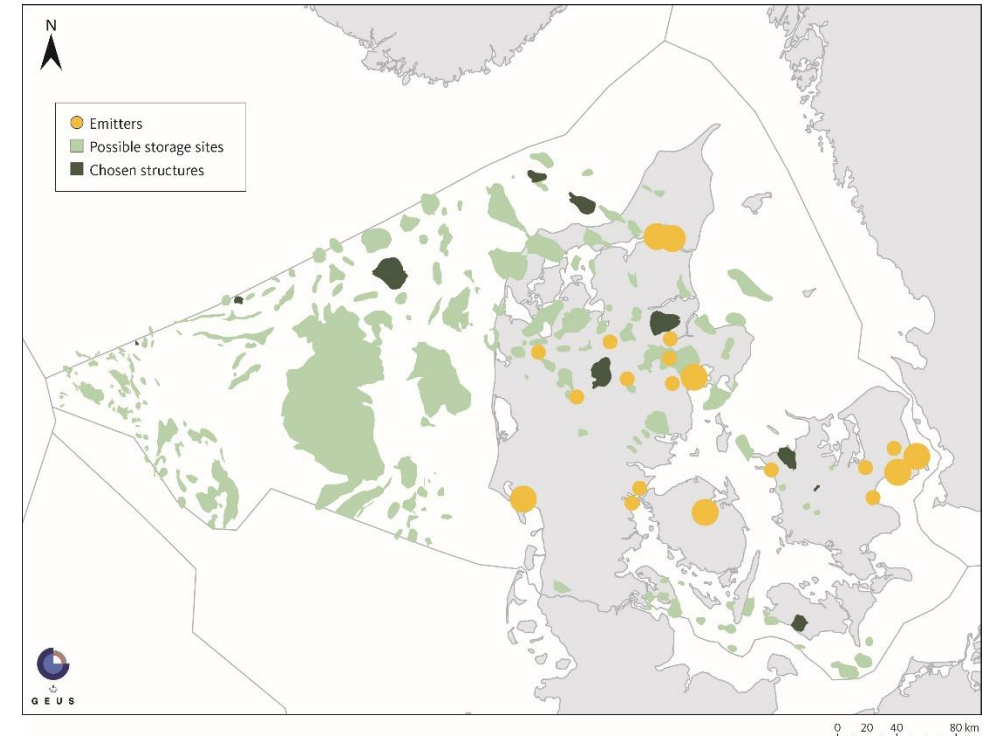
(Important related development: Carbon taxation reform in June 2022)

Deployment

- Combined funding for CC(U)S 37,2 bill. DKK approx. 5 bill. EUR, all in 2022-prices with a total reduction estimate of 3,2 mio. ton CO₂ yearly from 2030
- Three companies pre-qualified for first tender round of CCUS funds for reduction of 0,4 mio. ton yearly from 2026, winner will be announced approx. primo 2023
- From 15th of August 2022 it has been possible to apply for licenses for investigation of and storage of CO₂ in an area of the North Sea (deadline 1st of October 2022)
- Process to mature other structures near-shore and on-shore has begun.

Priorities going forward:

- Enabling transportation of CO₂ across Denmark and across borders, bilateral agreements, focus on promoting holistic CCS approach in the EU



POTENTIAL FUTURE PROJECTS (North Sea)

- Project Greensands (INEOS and partners), storage capacity of 0,5-1,5 mio. ton CO₂ /y in 2025 and 4-8 mio. ton CO₂ /y in 2030.
- Bifrost (TotalEnergies and partners), storage capacity of 3 mio. ton CO₂ /y in 2027 and a long term potential of 16 mio. ton CO₂/y.
- Pilot at Stenlille (on-shore), storage capacity of 0,5 mio. ton CO₂ /y in 2025, total potential of 2,5 mio. ton.

Finland



Key climate policy targets and CCUS-related deployment

- Climate neutrality by 2035
- The Sustainable Growth Programme for Finland allocated EUR 150 million to hydrogen and carbon capture and utilisation projects.
- E-fuels will be included in the transport fuel distribution obligation from the beginning of 2023.
- Government has initiated a strategic research project for carbon use and removals

Current Climate and Energy Strategy (2022) includes CCUS

- The development and use of carbon capture and utilization (CCS/CCU) technologies and solutions will be accelerated.
- E-fuels will amount to 3 per cent of all transport fuels by 2030.
- The legislative framework for CCS/CCU regulation at the EU level will be promoted.
- CCS/CCU techniques to reduce CO2 emissions caused by waste incineration will be piloted.
- Legislative framework for carbon dioxide removal solutions, will be assessed.

Radical CCU innovations

- Finland currently hosts an active business cluster and investment portfolio of carbon capture and utilisation projects (e.g e-fuels production) . Also opportunities for long-term storage and permanent storage (CCS) are being studied by the companies
- Investment pipeline is around 20 projects corresponding investments of approximately 1 billion euros. Many investments include hydrogen production.
- Examples
 - A Finnish start-up is constructing a plant to produce proteins out of thin air thus utilising CO2 in the air
 - An other start-up is developing CCU solution to be installed to HVAC systems in buildings



Germany



Key climate policy targets

- Climate Law : 65 % by 2030, Climate Neutrality by 2045 and negative emission from 2050

Current government strategy for CCUS

- Coalition Agreement:
“We acknowledge the need also for technical negative emissions and will develop a long-term strategy for dealing with the approximately 5 percent of unavoidable residual emissions.”

Deployment policies and programmes in place

- On State(Länder)-level North Rhine-Westphalia released new Carbon Management Strategy in Oct. 2021

Priorities going forward:

- Evaluating current legal framework in Germany till the end of 2022
- Clarify government policy on CCU/CCS and draft a Carbon Management Strategy on federal level accordingly in 2023

Studies, Small scale projects and future large scale projects

- Funding for CDR R&D (10 Research networks, 21 Mio.€)
- Study by CapTransCO2: Network of the Chemical Industry in the center of Germany – CCU/CCS including Total, Linde etc
- Heidelberg Cement (Leilac 2, 100.000 t CO2/a), Cement industry as a whole very active
- Carbon2Chem - (ThyssenKrupp et al) using carbon from steel production for chemical materials, 100 Mio in R&D Phase, 1 Bio in Commercialisation Phase
- HyScale100 (Holcim Cement Plant capture 1 Mio t CO2/a for Methanol from green hydrogen)

Indonesia

Key climate policy targets

- **NZE 2060**
 - Modeling roadmap NZE 2060, in balance of high ambition, science and the real economy
 - Inter-ministerial discussion on Long Term Strategy for Low Carbon and Climate Resilient (LTS-LCCR) for target carbon emission from energy sector.
 - Include CCS option in carbon emission strategy for steel and cement industry.
- **NDC 2021 for carbon emission reduction by 2030**
 - Alignment strategic plan 2030 into energy sector long term strategy NZ 2060
 - 2021-2022 outlook of CO₂ emission from upstream oil and gas (UOG) around 20 MTPA
 - 2030 net zero routine flaring policy for UOG activities

Current government strategy for CCS-CCUS

- Involving research institutions as center of Experts on CCS-CCUS
- Strengthening cooperation to deploy CCS-CCUS project

Deployment policies and programmes in place

- Carbon pricing system, cap and trade, cap and tax scheme in place,
 - Issuance Act No. 7 Year of 2021 regarding Harmonized Taxation,
 - Issuance Presidential Regulation Number 98 of 2021 regarding carbon pricing.
- Current PSCs scheme accommodate CCS-CCUS from upstream oil and gas

Priorities going forward:

- **Legislation program**
 - Finalizing draft ministerial regulation on CCS-CCUS program
 - Include CCS-CCUS activities into revision of Oil and Gas Act
 - Include CCS-CCUS operating cost charges within petroleum operation cost
- **Multi point sources for CCS-CCUS**
 - Consider integration with upstream oil and gas which have nature sink
- **Establishing international cooperation on CCS-CCUS implementation**

Approved Plan CCS-CCS Project

- CCUS Project
 - UCC Project by BP Berau Ltd., Ubadari and Vorwata EGR Field development with onshore compression and CCUS, to increase production 0,5TSCF by 2045 and reduce CO₂ emission 33 MT by 2045
- Looking forward for CCS opportunity

Potential Future CCS-CCUS Project

- PT Pertamina EP Gundih CCUS-EGR Project (2027),
Potentially reduce CO₂ 3 MT for 10 years, with incremental production 13.89 BSCF and 110 TSTB
- PT Pertamina EP Sukowati CCUS-EOR Project (2031),
Potentially reduce CO₂ 10 MT for 15 years, with Incremental production 37.7M STB
- Repsol Sakakemang CCS Project,
Potentially reduce CO₂ 30 MT for 15 years, with proposed production 450 mmscfd (to be injected under other PSC).
- Inpex Abadi CCS Project,
Potentially reduce CO₂ 2.8 MTPA or 70MT for 25 years, with proposed production 150 mmscfd and 9.5 MTPA LNG since 2027.
- Blue Ammonia + CCS Central Sulawesi (PT PAU, JOGMEC, Mitsubishi & ITB),
- CCUS for Coal to DME (PT Pertamina & Chiyoda),
- Arun CCS (ODIN & PEMA),
- Ramba CCUS (Pertamina),
- Central Sumatera Basin CCS/CCUS Hubs (Pertamina & Mitsui),
- East Kalimantan & Sunda Asri Basin CCS/CCUS Hubs (Pertamina & ExxonMobil), CCUS Study (Pertamina & Chevron),
- East Kalimantan CCS/CCUS Study (Kaltim Parna Industri & ITB),
- CCU to Methanol RU V (Pertamina & Air Liquide)

MT = million tons; MTPA = million tons per annum

Sweden

Key climate policy targets

- 85 % reduction target by 2045, baseline 1990, after 2045 negative emissions
- CCS important technology to reduce emissions in otherwise hard to abate sectors
- Bio-CCS important as supplementary measure, most likely the biggest source – large potential at least 10 millions tonnes p.a. 2030

Government actions and assignments CCS

- National centre for CCS as a part of the Swedish Energy Agency
- Treaty with Norway – London protocol
- Reporting and accounting (Swedish Energy Agency & The Swedish Environmental Protection Agency)

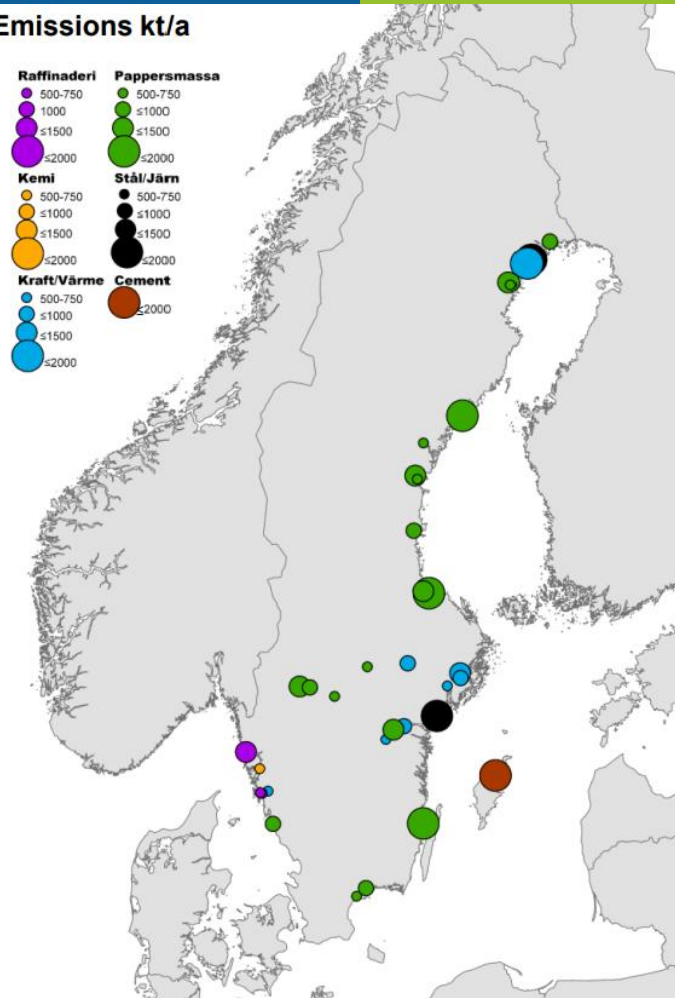
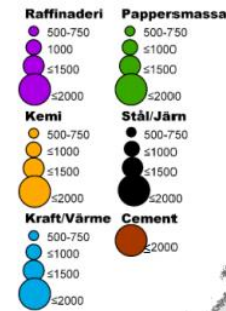
Deployment policies and programmes in place

- The Industrial Leap shall support huge and complex technology leaps, focus on carbon dioxide intensive industries, long term 2018-2040. 70 million €/year 2020-2022 whereof 10 million €/year to bio-CCS.
- Support scheme for bio-CCS. Reverse auctions first auction 2023.

Priorities going forward:

- Reporting and accounting, Article 6, facilitate a market for CDR-all connected.

Emissions kt/a



Raffinaderi=Refinery
Pappersmassa=Pulp and paper
Kemi=Chemistry
Stål/Järn=Iron/steel
Kraft/Värme=Heat & Power
Cement=Cement

(From Johnsson & Kjærstad, 2019)

Sweden total emission 51 Mt CO₂e

Future and ongoing projects

- Stockholm Exergi full scale bio-CCS facility about 800 000 tonnes p.a.
- Several feasibility studies on bio-CCS – first step to participate in auction, mainly CHP and WtE
- Test facilities on plants

Key messages from CSLF Technical Group (1/5)



Accelerating Carbon Capture, Utilisation and Storage

The Carbon Sequestration Leadership Forum (CSLF) Technical Group brings together countries to share experience on carbon capture, utilisation, and storage (CCUS) at the technical level. The Technical Group provides relevant technical background for the work of the Clean Energy Ministerial (CEM) CCUS Initiative, whose aim is to accelerate CCUS strategies and policies.

The CSLF 2021 Technology Roadmap (TRM 2021) stressed the challenging deployment pathway for CCUS in the coming decades, based on the IEA Sustainable Development Scenario (SDS):

- By 2030: CO₂ capture and storage should increase by a factor of 10 – 15 from the 2020 level of 40 mega-tonnes (Mt) of CO₂ per year.
- By 2050: CO₂ capture and storage should increase by a factor of 100 or more from the 2020 level.

To meet these challenges the TRM 2021 recommended efforts in the following key areas:

- Technology development, innovation, and cost reduction.
- Strategic build-out of CCUS projects and hubs.
- Development of strategy, policy, legal, and financial frameworks.

The following slides contain highlights regarding the progress towards the key Recommendations on CCUS in the CSLF Technology Roadmap 2021.

Key messages from CSLF Technical Group (2/5)

1. Technology development, innovation, and cost reduction – investments increase:

- a) Several CSLF members as well as international partnerships have allocated significant funding to Research, Development and Demonstration (RD&D) for CCUS.
- b) Transferring knowledge is continuously taking place, amongst other in numerous workshops, for example the CSLF Technical Group meeting in Bergen, Norway, June 2022.
- c) There has been significant increase in activities and funding for pilots on Carbon Dioxide Removal (CDR) and Greenhouse Gas Removal (GGR) technologies.

The progress is rated as good and contributes to meeting the challenges in the CSLF TRM 2021.

Key messages from CSLF Technical Group (3/5)

2. Infrastructure projects and hubs are moving forward:

- a. One additional project has begun construction (Northern Lights in Norway) and three others have received significant private and public funding to proceed to Final Investment Decision (FID): the East Coast Cluster and the Hynet project in the United Kingdom, and the Porthos project in the Netherlands.
- b. The number of infrastructure projects and hubs in planning has increased by a factor of two. The hubs can serve as an enabler for industries without technical capability for CO₂ storage, and the diversity of industries that are now planning CCUS is increasing.
- c. New funds have been made available for infrastructure and hubs projects in USA, Canada, and Europe.
- d. In Canada, the province of Alberta is leading a competitive process to allocate CO₂ pore space to hub operators
- e. The Oil and Gas Climate Initiative (OGCI) has launched The CCUS Hub Platform, a tool to help industrial emitters and transport & storage operators to identify potential hubs and learn lessons on how best to set them up from the most advanced hubs.

Progress is encouraging as an extensive number of potential hubs and clusters have been identified, and several are in early planning. However, the progress is insufficient to meet the challenge of a 10-15-fold increase in captured and stored CO₂ by 2030. ***More projects need to enter the Front-End Engineering and Design (FEED) phase and make the final investment decision.***

Key messages from CSLF Technical Group (4/5)

3. Development of strategy, policy, legal, and financial frameworks show progress

- a) 123 countries have submitted updated Nationally Determined Contributions to the UNFCCC but just 16 include CCS and three implicitly include CCS. COP26 adopted the Glasgow Climate Pact and important changes to Article 6 of the Paris Agreement.
- b) In addition to the UNFCCC agreements, several bilateral, multilateral, and global agreements have come into place
- c) National or regional CCUS strategies, incentive frameworks, business models, risk-sharing mechanisms, and legal, regulatory, and accounting frameworks are being implemented in several countries, including Australia, Brazil, Canada, China, Denmark, Indonesia, Japan, the Netherlands, Nigeria, Norway, Saudi Arabia, South Africa, United Arab Emirates, United Kingdom, and United States.

Progress is encouraging but insufficient to meet the challenge of a 10-15-fold increase in captured and stored CO₂ by 2030. More countries need to put the necessary regulations and financial frameworks in place.

Key messages from CSLF Technical Group (5/5)

4. Overall conclusion

The deployment of CCUS lags behind what is needed to meet the challenge to increase CCUS deployment by a factor of 10-15 above 2020 level (40 Mt CO₂/year) by 2030.

- Deployment of CCUS at scale is not possible without supportive policy settings, long-term political commitment, public engagement, and the appropriate financial support for early and long-term CCUS deployment.
- The CSLF Technical Group invites all its members, Clean Energy Ministerial Members, and all other relevant countries, as well as industry and the financial sector, to join forces to work together to achieve rapid and tangible progress on the above pathway.
- The CSLF will continue to offer a platform for its member governments, industry and the financial sector to come together to identify both immediate and longer-term investment opportunities and to accelerate CCUS deployment.
- The CSLF 2021 Technology Roadmap is available at: www.cslforum.org

Clean Energy Ministerial CCUS Initiative

Fourteen Member Countries:

Lead countries



Norway



Saudi Arabia



United Kingdom



United States

Participating Members



Australia



Canada



China



EU Commission



Japan



Mexico



Netherlands



Nigeria



South Africa



United Arab Emirates

Other countries and Partners:

Links to further countries: Bahrain, Denmark, Germany, India, Indonesia, Ireland, Malaysia, Nigeria, Singapore etc.

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

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

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

CEM CCUS Initiative: accelerating CCUS together by:



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



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



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



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

Disseminating country experience and facilitating dialogue

MEMBERS' MEETINGS: MONTHLY AND ANNUAL

REGIONAL WORKSHOPS

WEBINARS: TO DISSEMINATE EXPERIENCE

Australia

Key climate policy targets

- 2030 reduction target by 2030 and climate neutrality by 2050
- CCS important technology to reduce emissions in otherwise hard-to-abate sectors e.g. cement, heavy industry, waste incineration
- Capture potential of large emitters in Denmark is estimated at 4.5-9 mln tons per year in 2030, but geological storage capacity up to 400-700 mln tons

Current government strategy for CCUS

- Part 1: Storage (June 2021)
- Part 2: Capture and transportation (April 2021)
- Part 3: PPA strategy (April 2021)

Deployment policies and programmes in place

- 16.8 Mt CO₂-e/yr, 0.4 mln ton CO₂ reductions yearly from 2025 and 0.9 mln ton CO₂ reductions yearly from 2030
- NEW: approx 2.5 Mt CO₂-e/yr, 0.5 mln ton CO₂ reductions yearly from 2025-2030

Potential future projects in place

- Project Gorgona (MNO and partner), capacity goal: 4.8 mln ton/year
- Project Dargaville (MNO and partner), capacity goal: 1.8 mln ton/year

Prospects going forward

- Regulation, enabling transportation of CO₂ across borders, bilateral agreements, etc.

Denmark

Key climate policy targets

- 2030 reduction target by 2030 and climate neutrality by 2050
- CCS important technology to reduce emissions in otherwise hard-to-abate sectors e.g. cement, heavy industry, waste incineration
- Capture potential of large emitters in Denmark is estimated at 4.5-9 mln tons per year in 2030, but geological storage capacity up to 400-700 mln tons

Current government strategy for CCUS

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- Project Dargaville (MNO and partner), capacity goal: 1.8 mln ton/year

Prospects going forward

- Regulation, enabling transportation of CO₂ across borders, bilateral agreements, etc.

Nigeria

Key climate policy targets

- Revised NDC update 2030 unconditional and 47% conditional targets by 2030
- Net Zero target (Energy Transition) by 2062 with strong role for gas as a transitional fuel

Current government strategy for CCUS

- Identify near-term needs and opportunities for CCUS development and deployment that are consistent with Nigeria's NDC target
- Focus on creating an enabling environment for CCUS and developing CCUS capacity

Deployment policies and programmes in place

- Petroleum Industry Act - Commercialization of gas (premier to phase out unbranded gas by 2040)
- Carbon Pricing System - ongoing discussion in place (post COP26)
- Clean Energy Technology and Innovation System Delivery Programme - Federal Ministry of Science, Technology and Innovation

Prospects going forward

- Developing a comprehensive CCUS strategy
- CCUS strategy will be developed in collaboration with key local stakeholders (both strong private sector focus) and development partners
- Strategy will present a strategic vision, technology roadmap, investment strategy and a set of recommended public-private actors to accelerate the CCUS sector
- Consider opportunity for a CCUS sector that will leverage Nigeria's natural advantages to enable commercial potential - clean hydrogen and methanol, CO₂-based fuels (jet-fuels), and negative emissions that are consistent with Nigeria's deep decarbonisation agenda

Netherlands

Current government strategy for CCUS

- CCUS important technology to reduce CO₂ emissions in industry
- CCUS only when no cost-effective alternatives (sustainability is capped)
- De-risking CCUS projects by providing financial support
- Large scale deployment of CCS before 2030
- BCCS and DACM R&D phases, contributions
- Blue hydrogen as a facilitator/accelerator for green hydrogen

Deployment policies and programmes in place

- Sustainability criteria for CO₂ reduction in industry (Emission-1) (sustainability = total cost for capture, transport and storage) CO₂ - ETS price for CO₂ (EUA), (15 years)
- CCUS pilots and EED studies (sustainability)
- EU (European Energy, CCS, Innovation Fund)

Prospects going forward

- Role of public vs private sector
- Public & political support

Current large-scale CCUS projects

- CO₂-free industrial hydrogen (with ethanol) (Oxy) @ green hydrogen plant (1.5 Mtpa/year)
- CO₂ from Iron (BASF) @ greenhouses by pipeline
- CO₂ from Waste incineration (WtE) @ greenhouses by pipeline (1.5 Mtpa/year)

Potential future projects

- Ammonia (BASF) @ Large scale transport and storage
- Ammonia (BASF) @ Large scale transport and storage
- Ammonia (BASF) @ Large scale transport and storage

India

Key climate policy targets

- "Panchsheel" announced by Hon'ble PM of India at COP26, Glasgow
- India to achieve net-zero status by 2070
- India to achieve reduction of 1 billion tonnes of CO₂ emissions by 2030
- India to reduce its emissions intensity @ GDP by 45% by 2030
- India to account for ~30% of CO₂ by 2060

Current government strategy for CCUS

- Encourage R&D through FIR & Infrastructure capacity building and deployments in CCUS technologies
- Two National Centres of Excellence in CCUS by IIT
- INCASIR, Bangalore: Sector 3-pilot witness/ funded BREAKTHRU for CO₂
- IFT Bangalore: 2023 3-pilot witness for CO₂

Transnational cooperation directions being formulated

- 19 R&D multilateral projects under NE-1.0 (JICA)/CCUS. Two multilateral R&D projects under ACT Call 3, and supporting member in MO 2.0 in CO₂ streams
- MoFNG constituted a CCUS taskforce for a "2030 Roadmap"

Current large-scale CCUS projects

- 200 TPD CO₂ capture plant at Trelca for soda ash manufacturing
- 20 TPD CO₂ capture from blast furnace of Tata Steel
- 20 TPD CO₂ capture plant by NTPC
- ONGC - ONGC project for CO₂-EOR in Gharhar field, Gujarat
- ONGC - ONGC project for CO₂-EOR in Assam

Potential future projects

- CO₂ capture Technology development and Deployment
- Large scale CO₂ utilization for chemicals (methanol, ethanol), fuels, polymers (plastics, polycarbonates) etc.
- Storage through EOR/BECC methods

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 organized 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 auditorium of the Grand 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 IAPFCCC Secretariat.

Dr. Matar Alshamsi, 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 CO₂ whenever possible and sustainable.

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

DEBAT WORKSHOP AGENDA

08:30 Registration & welcome coffee

09:00 Welcome and opening

09:30 Panel discussion: Accelerating CCUS in hard-to-abate sectors

Industry today accounts for 23% of global CO₂ 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:

- Aus Fakhri, Head of Environment and Climate Change, Worldsteel
- Brad Page, Chief Executive Officer, Global CCS Institute
- Nasser Shamsah, Chief Operating Officer, Emirates Steel
- Majed Alshamsani-Alshamsi, 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 vision 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 panelists in this session are:

- Rafael Fakhri, Senior Vice President, ARA, ADNOC
- Yahya Nasser, CCUS Lead, Saudi Aramco
- Nasser Shamsah, Senior Advisor, Bahrain National Oil and Gas Authority

Further discussions 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, IAPFCCC Secretariat and other organisations.

15:30 Example of a national vision: The US National Petroleum Council's CCUS Roadmap

- Jared Daniels, Director, Department of Energy, United States (by phone)

15:55 Final remarks by meeting chair

16:00 Close of workshop

The screenshot shows a YouTube playlist with 19 videos and 1,627 views. The videos listed are:

- Multilateral Development Banks as Drivers for CCUS (Clean Energy Solutions Center, 1:01:24)
- Approaching Final Investment Decision: CCUS Developments in Norway (Clean Energy Solutions Center, 58:07)
- Financing CCUS - A Key Clean Technology for Industry (Clean Energy Solutions Center, 1:58:19)
- Biomass Carbon Removal and Storage (BICRS) (Clean Energy Solutions Center, 1:02:55)
- Environmental, Social, and Governance (ESG) Assessments and CCUS (Clean Energy Solutions Center, 1:00:29)
- The Role of CCS in the EU Green Deal (Clean Energy Solutions Center)

The channel is 'Clean Energy Solutions Center' and is subscribed to.



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



@ccuscem



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



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