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Stakeholder workshop Oct 12 2023

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Global status of CCS

CCS development is scaling rapidly

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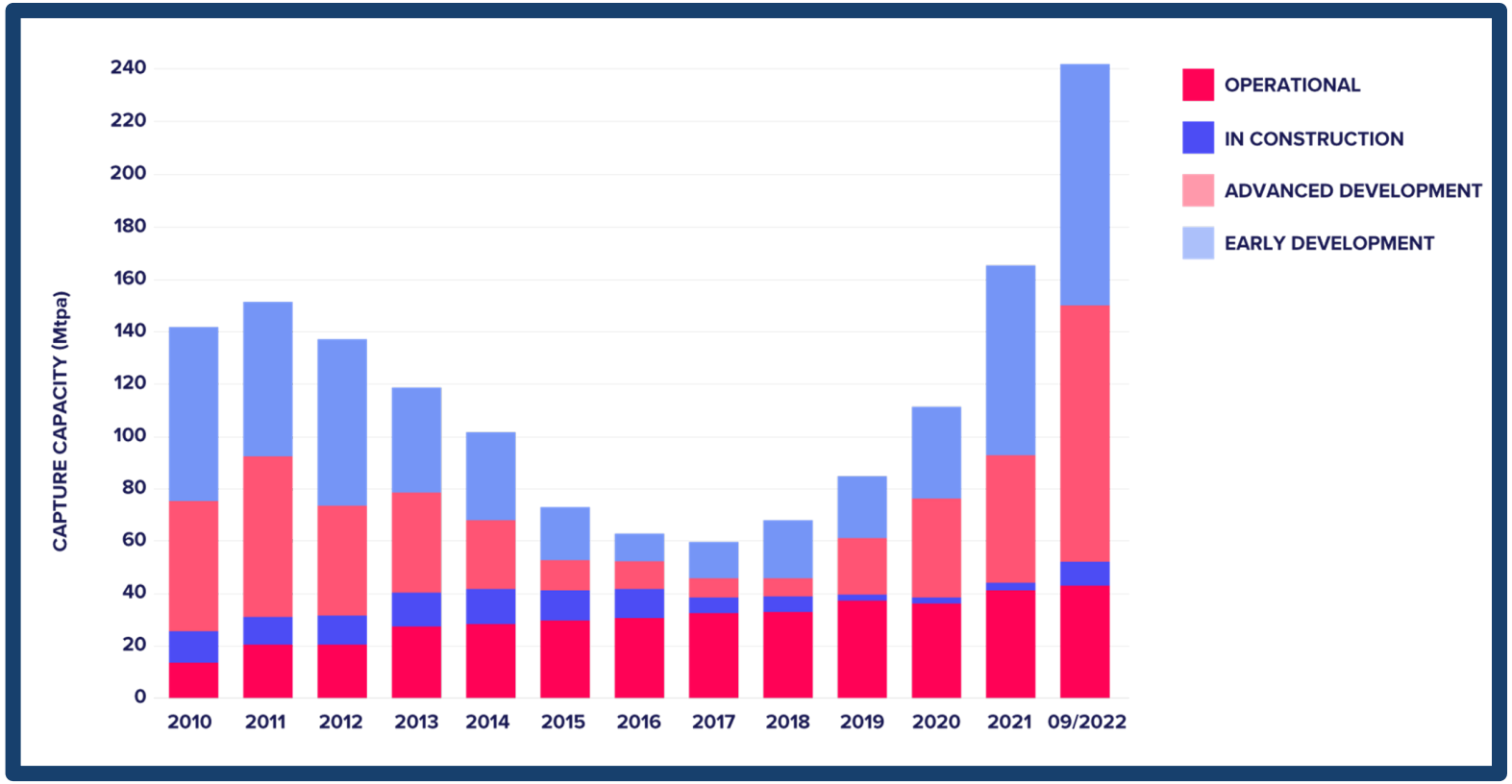
- IPCC (Oct 2018): Three of four pathways require CCS
- IEA (2020): by 2070 up to 15% of global emissions reductions could be abated through CCS
- IRENA (March 2022): 20% of all CO_2 emission reductions through (BE)CCS by 2050.
- Bloomberg NEF (2023): CCS the largest contributor (29%) to industrial decarbonization in its Net Zero Scenario



- Currently, 244 Mt of projects in development worldwide
- 235 facilities worldwide

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IPCC: https://www.cambridge.org/core/books/global-warming-of-15c/D7455D42B4C820E706A03A169B1893FA#
IEA: https://iea.blob.core.windows.net/assets/7f8aed40-89af-4348-be19-c8a67df0b9ea/Energy_Technology_Perspectives_2020_PDF.pdf
IRENA: https://www.irena.org/publications/2022/mar/world-energy-transitions-outlook-2022
Bloomberg NEF: https://about.bnef.com/blog/net-zero-industry-requires-exponential-growth-from-carbon-capture-hydrogen-and-clean-power/

CCS Has A Long History

- Currently 30 facilities in operation, capturing about 43 Mtpa
- 18 NAM + 4 Europe +3 in MENA + 5 in RoW
- 61 CCS new facilities we added in 2022
- This list now includes a wide range of power and industrial sources
- Red circles indicate emerging low carbon markets. While green circles indicate nascent regulatory areas

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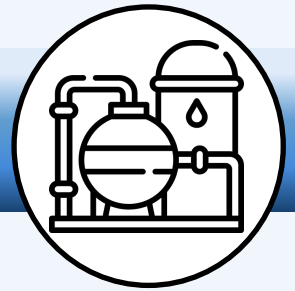
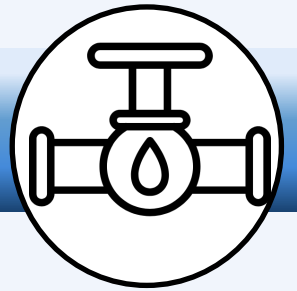
CCS Components and market creation



CAPTURE

- CO_2 has been captured commercially since the 1930's
- Capture technology has been around a lot longer

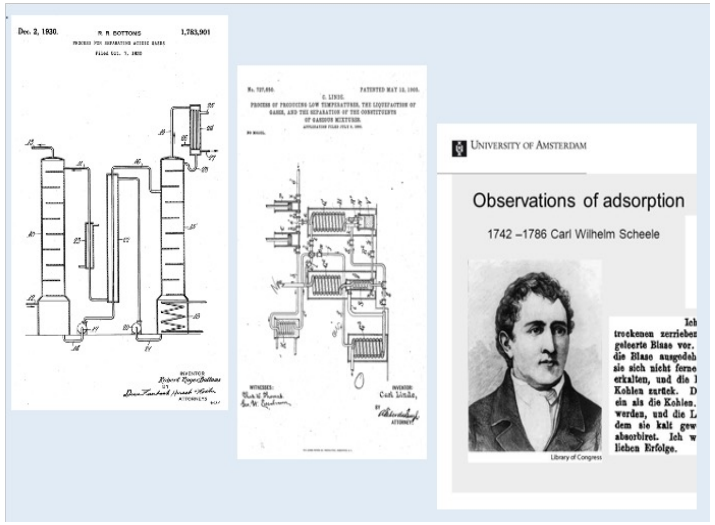


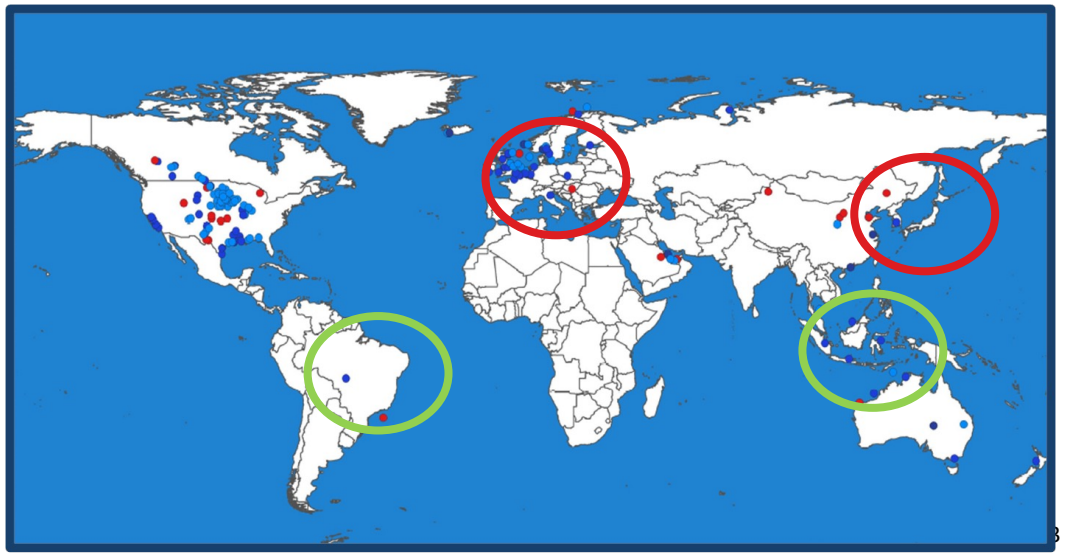
TRANSPORT

- CO_2 has been transported in pipelines since the 1970's
- There are currently ~9000 km of pipelines in operation

STORAGE

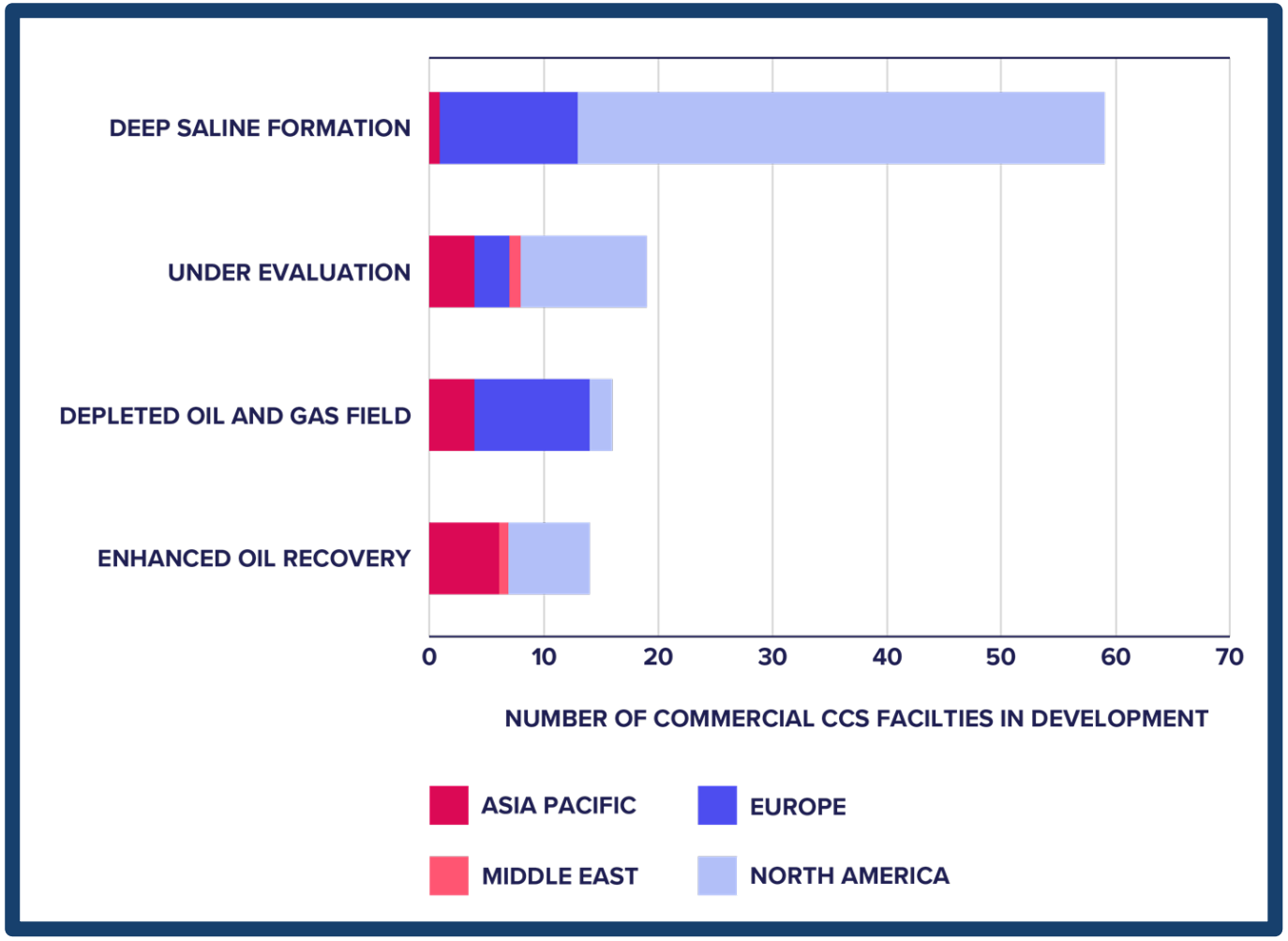
- CO_2 has been stored geologically in CO_2 EOR projects since the 1970's
- The worlds first industrial scale project (Sleipner, Norway) started up in 1996





Development of CO_2 storage capacity

- Historically, CO_2 storage focused on CO_2-enhanced oil recovery
- As CCS has become more accepted as a climate solution, focus has shifted to developing saline aquifer stores
- 9 of the 30 facilities currently operating use dedicated geological storage with the remainder using EOR.
- 70% of the commercial CCS projects in development aim to use dedicated geological storage (deep saline, depleted oil and gas).
- Important implication: a business case for CCS without the need for EOR is emerging



Modified from *Global Status of CCS 2022 Report*, GCCSI

Carbon intensive products are becoming increasingly exposed to demand / margin erosion in the Energy Transition. CCS offers a solution.

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Problem statement

Carbon Intensity (CI) of products are coming under increasing scrutiny from regulators, customers and general society.

High CI products are particularly exposed:

- More stringent regulations
- Consumer demand influenced by internal targets

Marketability

Significant uncertainties ahead:

- Regulations
- Customer demands
- Development & cost of low carbon technologies
- Competitor activity
- Political drivers, e.g. Energy Security vs. Climate ambitions)

→ difficult to predict the impact of Energy Transition on high CI product marketability and returns.

Consequences

Potential consequences as regulators and customers develop policies to reduce carbon emissions:

- CO_2 penalties incurred for high CI products sold into regulated markets (e.g. CBAM in Europe)
- High CI products sold into less attractive markets at a reduced netback due to higher freight and/or lower commodity price in destination markets
- Discounts required to retain customers.
- NBS / bio-blending / Carbon credit offerings required to retain customers.
- Loss of high value customers who can source lower CI products elsewhere

Solution

Which combinations will occur, and on what timeframe, is unclear and this will differ by product and region.

However, even with these uncertainties it is clear there is a need to reduce the carbon intensity of higher CI products to remain competitive.

CCS provides a cost effective solution to significantly reduce carbon intensity of products.

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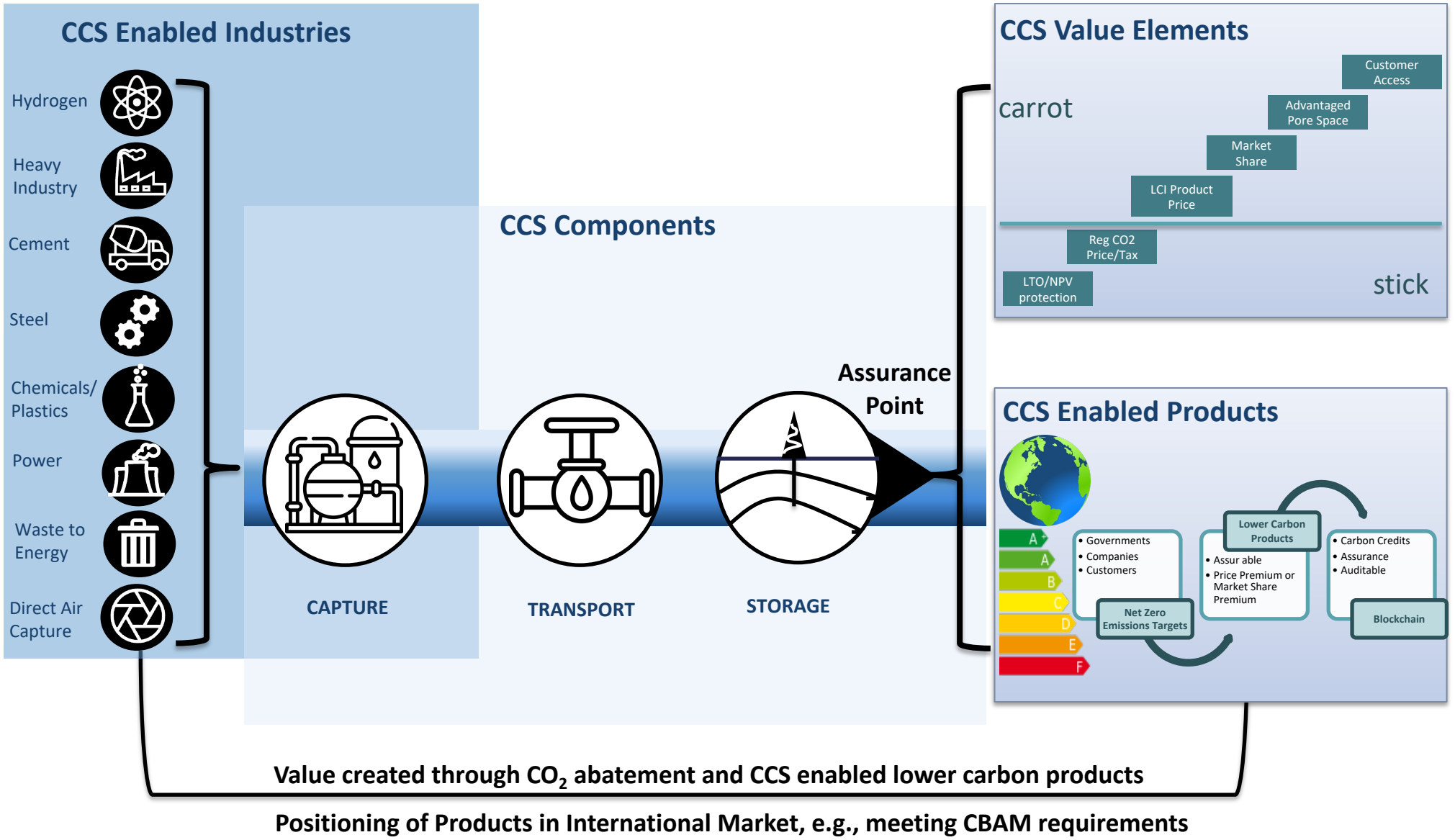
Value Chains

CCS requires restructuring how you look at End-to-End Value chains.

EU CBAM and Japan EPS already driving market demand for low CI products



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CC□regulation and policy is accelerating globally , led by the North America , European Union and UK

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CCS TECHNOLOGIES Program at MIT conducts research to store CO_2

WEYBURN CO_2 EOR study by Canadian O&G Corporation

CARBON SEQUESTRATION LEADERSHIP CHARTER. EU commission and 13 countries

LOW EMISSION COAL ENERGY TECHNOLOGY signed between Australia and China

CANADA CCS QUEST CCS PROJECT awarded Federal and Provincial funding starts up 2015

UK CCS DEPLOYMENT AMBITION to become a global leader in CCS at scale by 2030's

GLOBAL EXPANSION (see next slide) EU-wide climate policies, CCS-specific interventions in select countries. CCS key in energy & climate US policies. APAC and ME countries rapidly expanding CCS ambition and regulatory framework

NORWAY Sleipner – CO_2 capture & storage is developed

EU ETS The European Union Greenhouse Gas Emissions Trading Scheme commenced operations

EU CCS DIRECTIVE Implemented establishing a legal framework for the safe geological storage of CO_2

INDUSTRIAL SCALE CCS PROJECTS In operation around the world with full chain pilots also ongoing

US 45Q US introduced the 45Q tax credit to subsidise the development of the CCS industry

CO_2 CAPTURE PROJECTS PHASE 1 launched. A collaboration between 8 leading energy companies & 3 government organisation to conduct research into CO_2 capture & storage

FIT FOR 55 Introduction of EU Framework on certification of CO_2 removals being developed. EU CCS directive documents reviewed

US DOE Announces intention to provide <$2.52 Bn in funding for CCS programs to reduce emissions from electricity generation and industrial sectors

CCS LICENSING ROUNDS UK, Australia, Canada, Denmark and Norway

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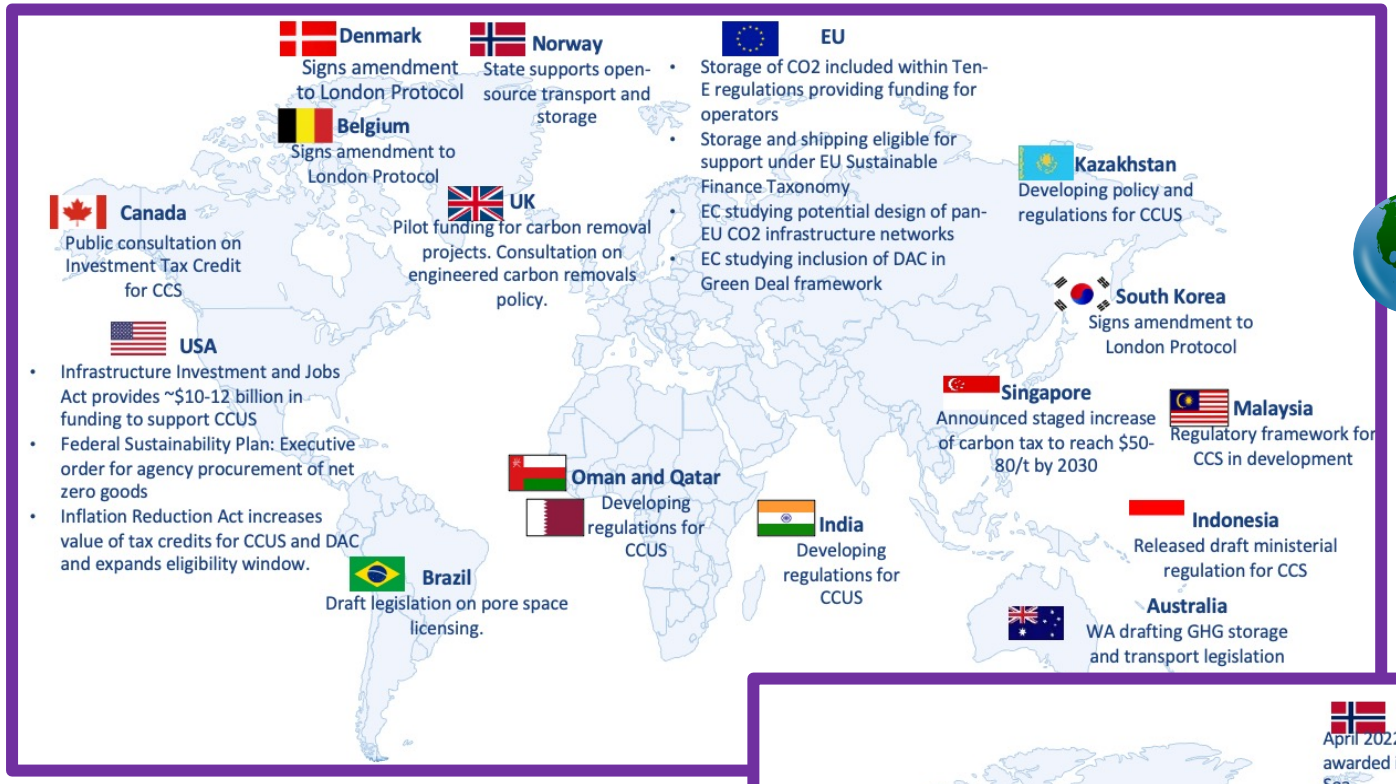
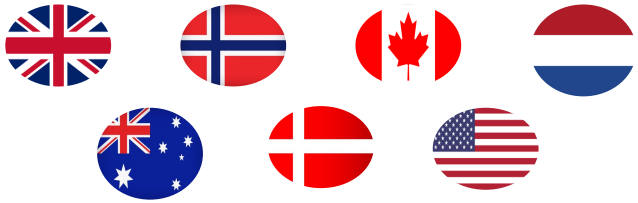
Regulatory Signposts are emerging at high pace

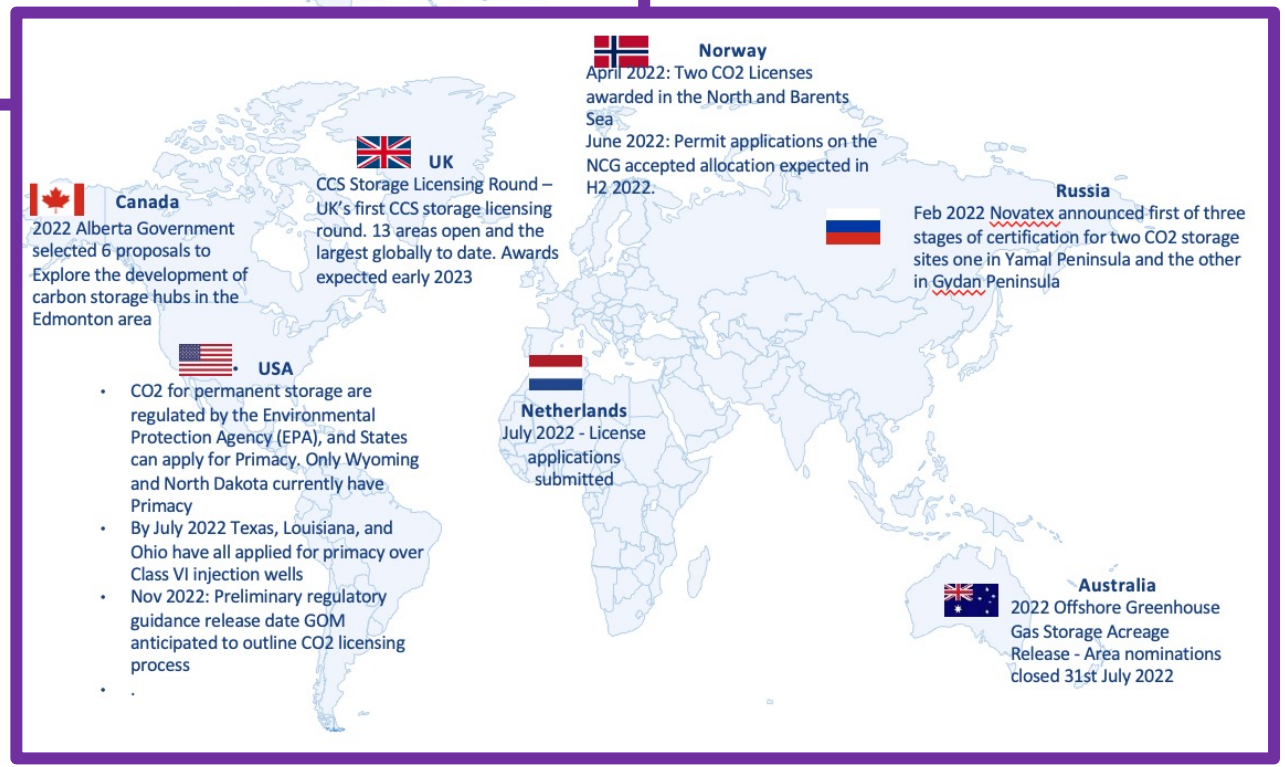
CCS is a rapidly transforming market, with significant global activity in the regulatory space.



GLOBAL EXPANSION EU-wide climate policies, CCS-specific interventions in select countries. CCS key in energy & climate US policies. APAC and ME countries rapidly expanding CCS ambition and regulatory framework



CCS LICENSING ROUNDS
UK, Australia, Canada, Denmark and Norway



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National policy frameworks – North America

Details of most mature regulatory environments

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USA

- Bipartisan Infrastructure Law (2021): $12bn for carbon management approaches
  - $2.5 billion for demonstration projects
  - $1 bn for large-scale CCS pilot projects
  - $3.5 bn for regional direct air capture (DAC) hubs over the next five years.
  - nearly $5 bn to support transport and storage infrastructure and sites.
- Inflation Reduction Act (2022)
  - 45Q and 45V for CO_2 sequestration and hydrogen production
  - 45Q has additional provision for direct air capture (DAC)
- CHIPS and Science Act (2022): $1bn for research into CO2 removal R&D

Canada

- 2030 Emissions Reduction Plan presented a roadmap meet the Canadian Paris Agreement target to reduce emissions by 40–45 per cent by 2030, and to achieve net-zero emissions by 2050.
- Federal CCUS ITC credit, set at 60% for DACCS, 50% for other CCS, and 37.5% for utilisation, transportation, storage.
  - Importantly, this reduces by 50% after 2030, i.e., intended to incentivise early investment. EOR is not eligible
- Federal carbon tax – mandated to increase to $170/t by 2030
- Mandatory GHG reporting requirement and policy support from Alberta and Saskatchewan emerging

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National policy frameworks – EU & UK

Details of most mature regulatory environments

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UK

- HMG published a Net Zero Strategy, and specific deployment targets for CCS, CDR, and H_2
- Project support through a competitive process to award grant funding to support FEED
- Combination of CfD and RAB support for individual projects and CO_2 T&S infrastructure
- Carbon tax supported via carbon price floor and emissions performance standard (EPS) to inhibit “backsliding”
- 4 CCUS networks by 2030 capturing 20-30 Mtpa, with £1 billion allocated to support CCUS development. First two recipient clusters announced in late 2021.

European Union

- Combination of EU-level and member state level action; CCS target has been set – “at least” 50 Mtpa by 2030, growing to more than 0.5 Gtpa by 2050
- EU CBAM creating international markets for low CI products
- 70+ commercial facilities in stages of development – almost doubling from 2021
- CCS is becoming increasingly trans-national : e.g., Switzerland/Iceland, Belgium/Denmark, Norway/Germany.
- Storage permits: Denmark, Italy, UK news announced
- The Netherlands and Norway are “front runners”, but e.g., Porthos or Brevik projects delayed meaning increased costs
  - Antwerp@C CO2 Export Hub is set to receive €144.6 million;
  - Ghent Carbon Hub, also in Belgium, will be awarded €9.6 million
  - D’Artagnan hub, in Dunkirk, France to receive €5.2 million in financing

https://www.euractiv.com/section/energy-environment/news/eu-sets-worlds-first-target-for-underground-co2-storage-capacity/
https://www.euractiv.com/section/energy-environment/news/denmark-inaugurates-worlds-first-cross-border-co2-storage-site/

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National policy frameworks – Indonesia

Example of a nascent policy regime

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Indonesia

- Indonesia is introducing "cap and trade" and "cap and tax" mechanisms, aiming to set emissions caps for high carbon sectors and imposing carbon taxes, aiming to stimulate a domestic carbon market and encourage investment in carbon capture

- The regulatory status is nascent and centered around oil and gas abatement
  - On March 3, 2023, Indonesia's ESDM introduced Regulation No. 2 of 2023, which governs the application of CCS and CCS in the upstream oil and natural gas sector, aiming to reduce carbon emissions and enhance oil and gas output
  - The CCS policy covers upstream oil, gas operations, and unspecified "other industries." The regulation permits direct carbon capture to be injected into areas designated for oil and gas exploration
  - Only companies with specific contracts, either with SKK Migas or BPMA (for Aceh region), can conduct CCS activities, with these companies potentially being Indonesian or foreign entities with a permanent establishment in Indonesia

- Strict liability transfer regulation no incentives for technology innovation
  - The contractor must continue to monitor their activities under the regulation for a period of 10 years after the closure of CCS activities.
  - In case of carbon leakage the contractor must carry out repairs if instructed by the Directorate General of Oil and Gas
  - The regulation also requires annual measurement, reporting and verification activities, such as taking inventory of stored carbon. Third parties may also be used to verify operations

- Current policy only relates to the usage of depleted oil fields and saline aquifers, in which current sites suggested a possible carbon capture capacity of 12.2 billion tonnes

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Project team and key collaborators

Multi-national team

Unparalleled expertise in CCS

Combination of academic and real-world experience

Deep expertise in India

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Syrie Crouch

Former VP CCUS at major IOC, with 30+ years experience with mega-project delivery. Overall development and commissioning of the Quest CCS Project.

Niall Mac Dowell

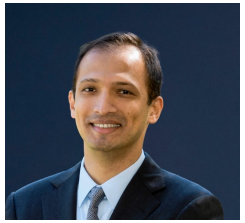
Professor at Imperial College London, with 20 years experience in the public & private sector, focusing on quantitative analysis & business model development.

Laura Hurley

Former Head of GHG Removals in UK BEIS, with over 10 years in public service. Oversaw the development of the UK's CDR strategy, and contributed to the UK's net zero strategy

Vikram Vishal

Associate Professor IIT Bombay, Visiting Professor MIT. Vikram is a globally recognised expert in CCS, with particular focus on India



Errol Pinto

Errol Pinto is the Senior Consultant Policy and Commercial at the Global CCS Institute. Errol is an energy sector expert skilled across the energy value chain with competencies in natural resource development, policy, strategy, and project delivery.

Ian Havercroft

Ian is the Principal Consultant – Legal and Regulatory at the Global CCS Institute. Ian has over 10 years' experience of working on CCS legal and regulatory matters and has acted as an expert reviewer or an adviser to several organisations, including the International Energy Agency and the IEA Greenhouse Gas R&D Programme.

Iain Macdonald

Iain is the Principal Carbon Relations Advisor at OGCI, and Principal Advisor Carbon Technical Advocacy at Shell

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