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A GLOBAL AND EUROPEAN PERSPECTIVE ON CCS

UIMP: TRANSFORMING CO₂ INTO OPPORTUNITIES

DOMINIC RASSOOL
SENIOR CLIENT ENGAGEMENT LEAD EUROPE, GLOBAL CCS INSTITUTE



GLOBAL CCS
INSTITUTE

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Accelerating the deployment of CCS for a net-zero emissions future.

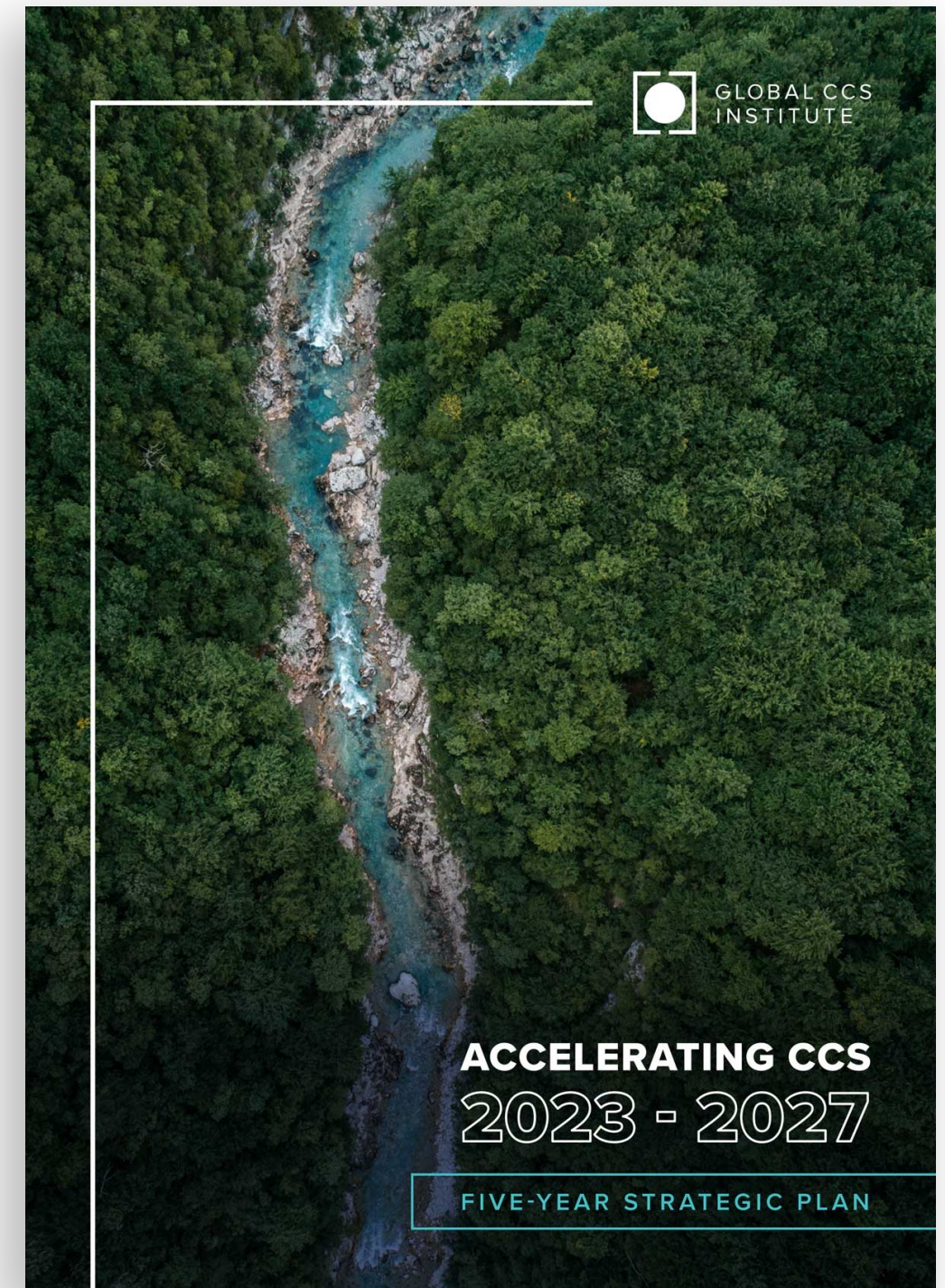
WHO WE ARE

International CCS think tank with offices around the world.

Over 200 members across governments, global corporations, private companies, research bodies and NGOs, all committed to a net-zero future.

WHAT WE DO

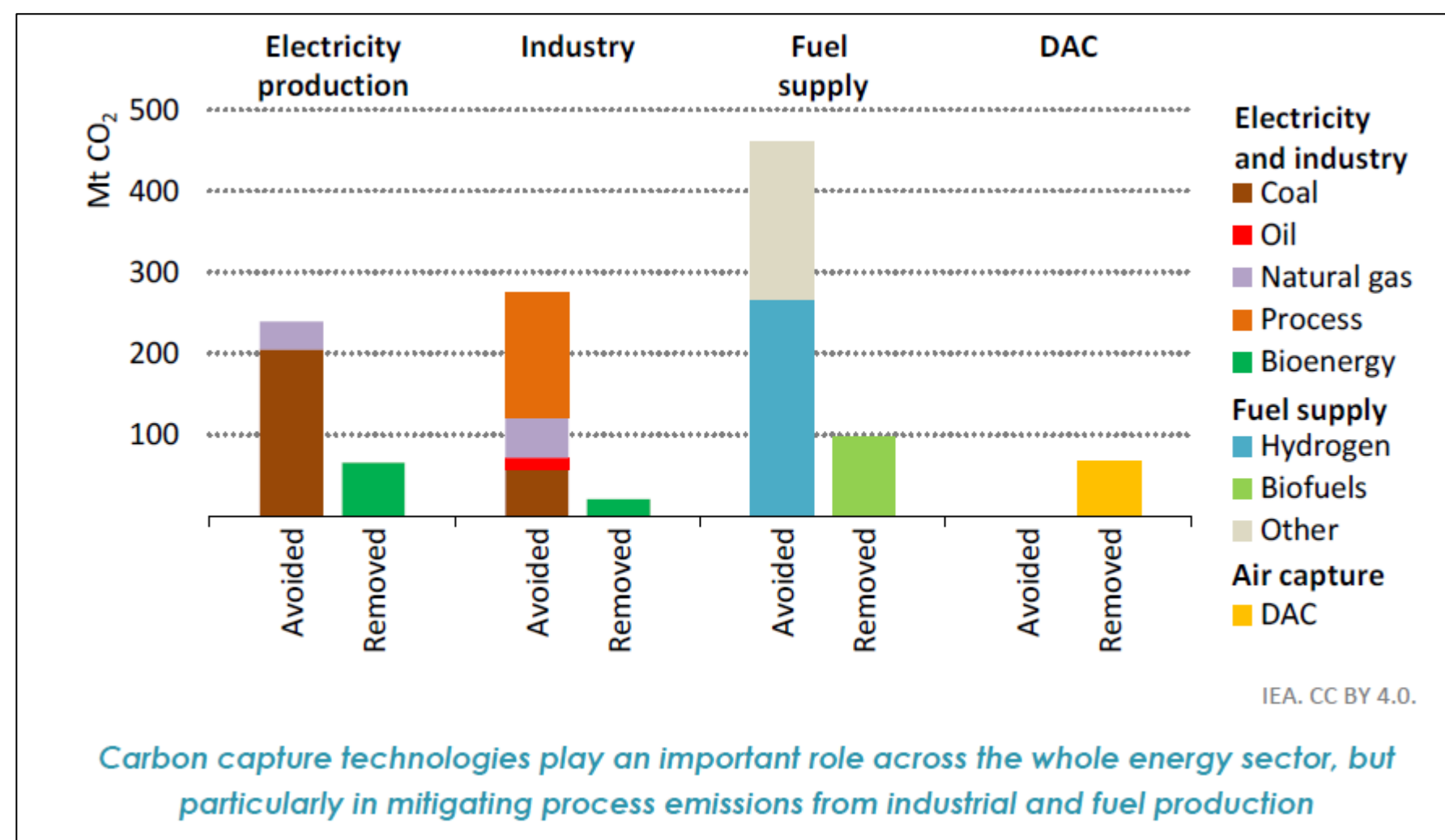
Fact-based influential advocacy, catalytic thought leadership, authoritative knowledge sharing.



SCALING UP THROUGH 2030

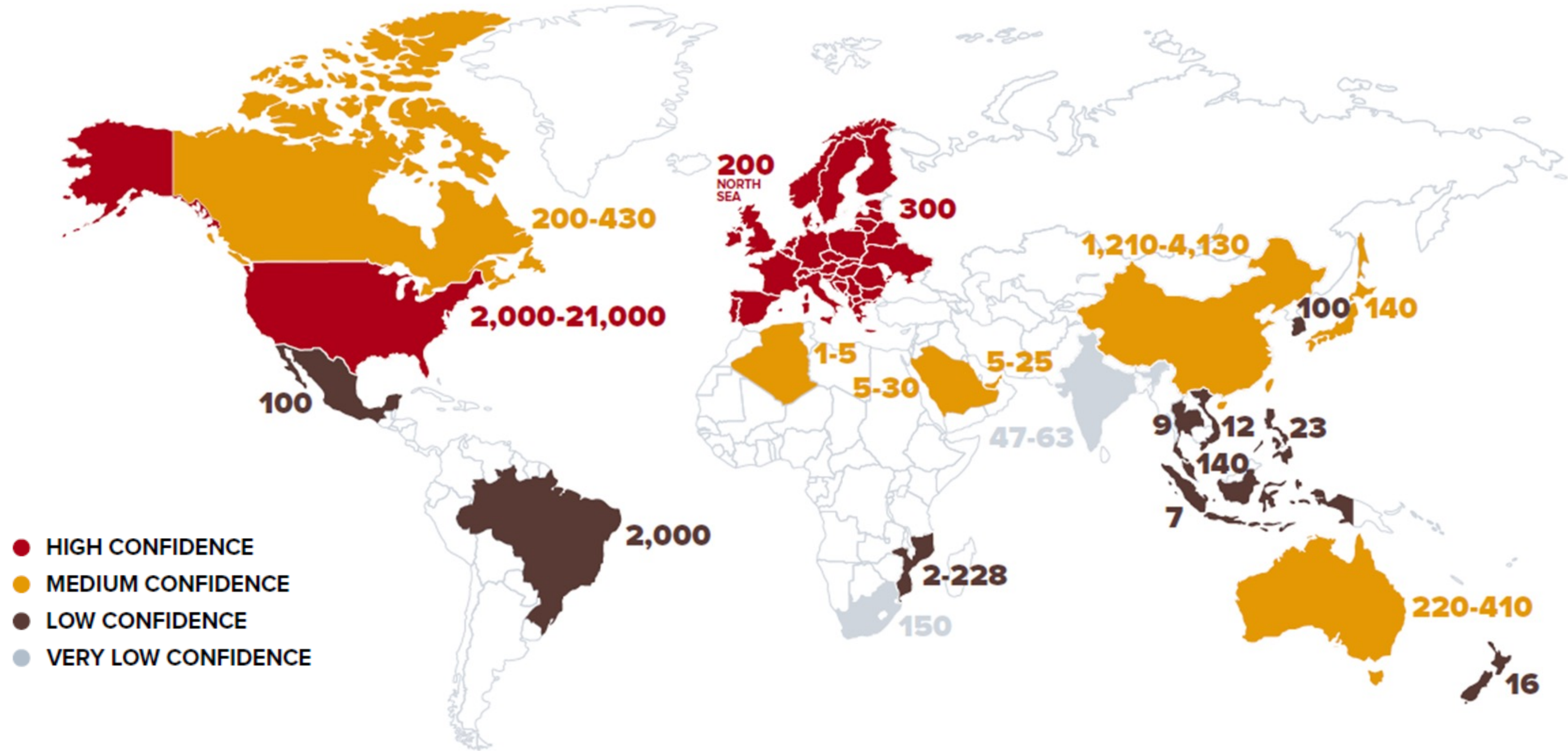
- According to IEA NZE, 1.2 GtCO₂ per annum should be captured by 2030, including for removals.
- Capturing 1.2 GtCO₂ by 2030 as modelled, requires 25-fold increase over current operational capacity and 4 times increase over the current pipeline.
- CCUS is required across diverse sectors and is increasingly important to industry.
- Stronger policy to incentivise rapid CCS investment is needed.

Total CO₂ capture by sector and type in the NZE, 2030

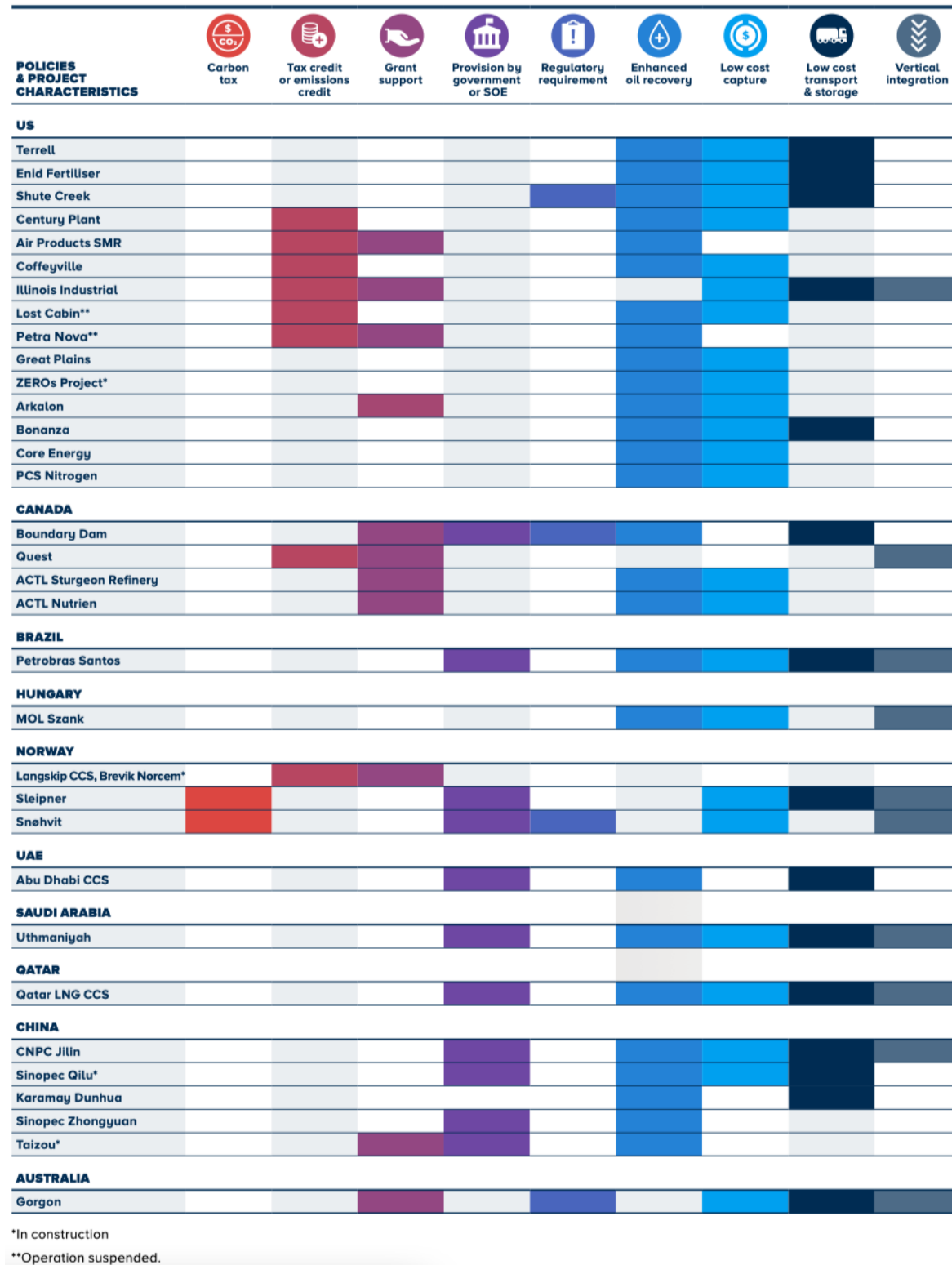


THE PROBLEM ISN'T STORAGE

CO₂ Geological Storage Capacity – Billion of Tonnes



OVERVIEW OF OPERATIONAL PROJECTS GLOBALLY



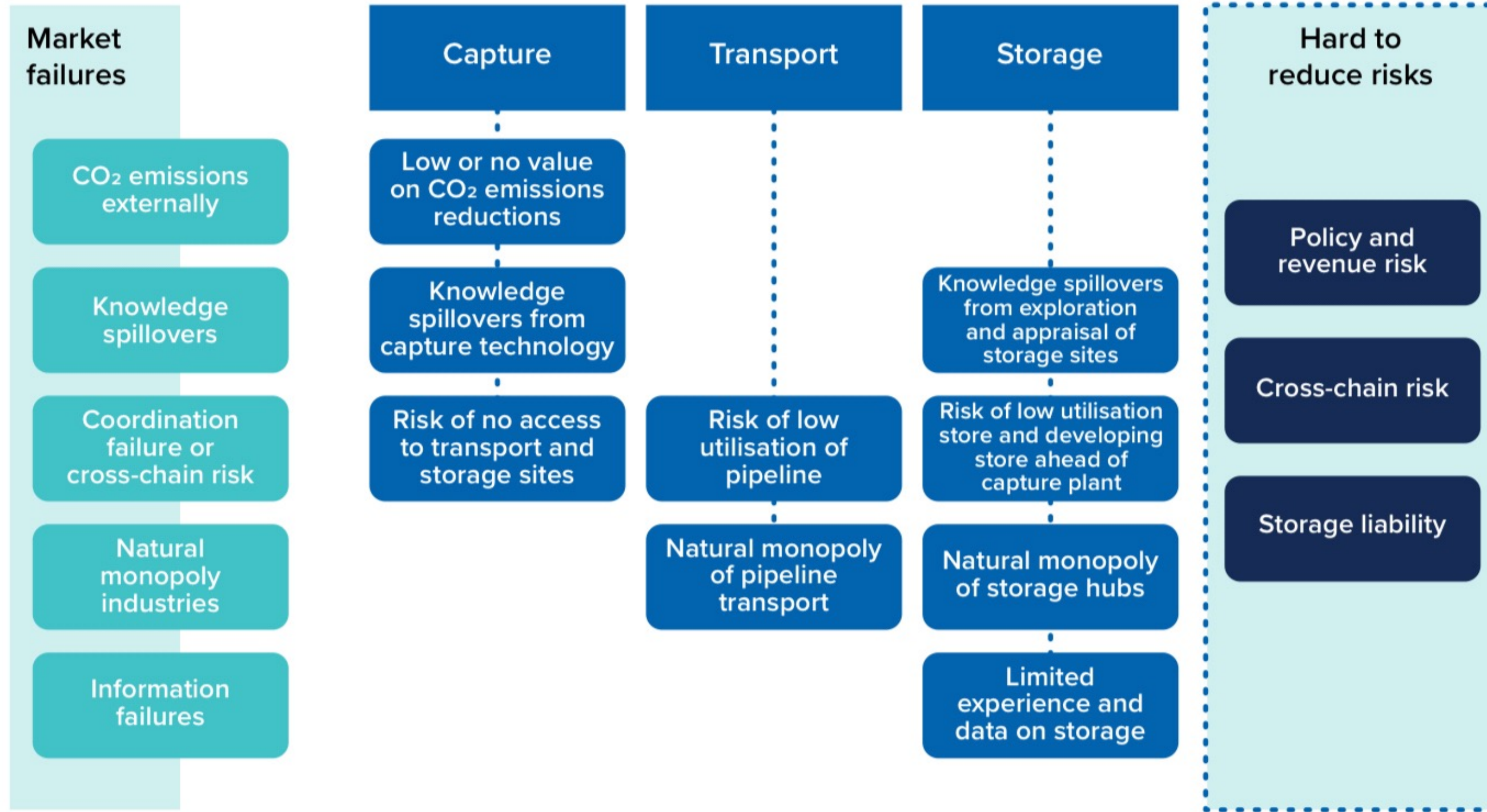
- CCS deployment has occurred chiefly across low-cost capture opportunities
- Most of the world's CCS facilities rely upon revenue generated from the sale of CO2 for enhanced oil recovery (EOR) purposes
- Most CCS facilities have been developed on the books of large corporations or state-owned enterprises (SOEs)



BARRIERS TO DEPLOYMENT



BARRIERS TO INVESTMENT IN CCS



... BUT SOME RISKS ARE REDUCED THROUGH DEPLOYMENT

General project risks – these come down through learning by doing

WHILST OTHERS REQUIRE INTERVENTION FROM GOVERNMENT...

Hard-to-reduce risks – these require government intervention:

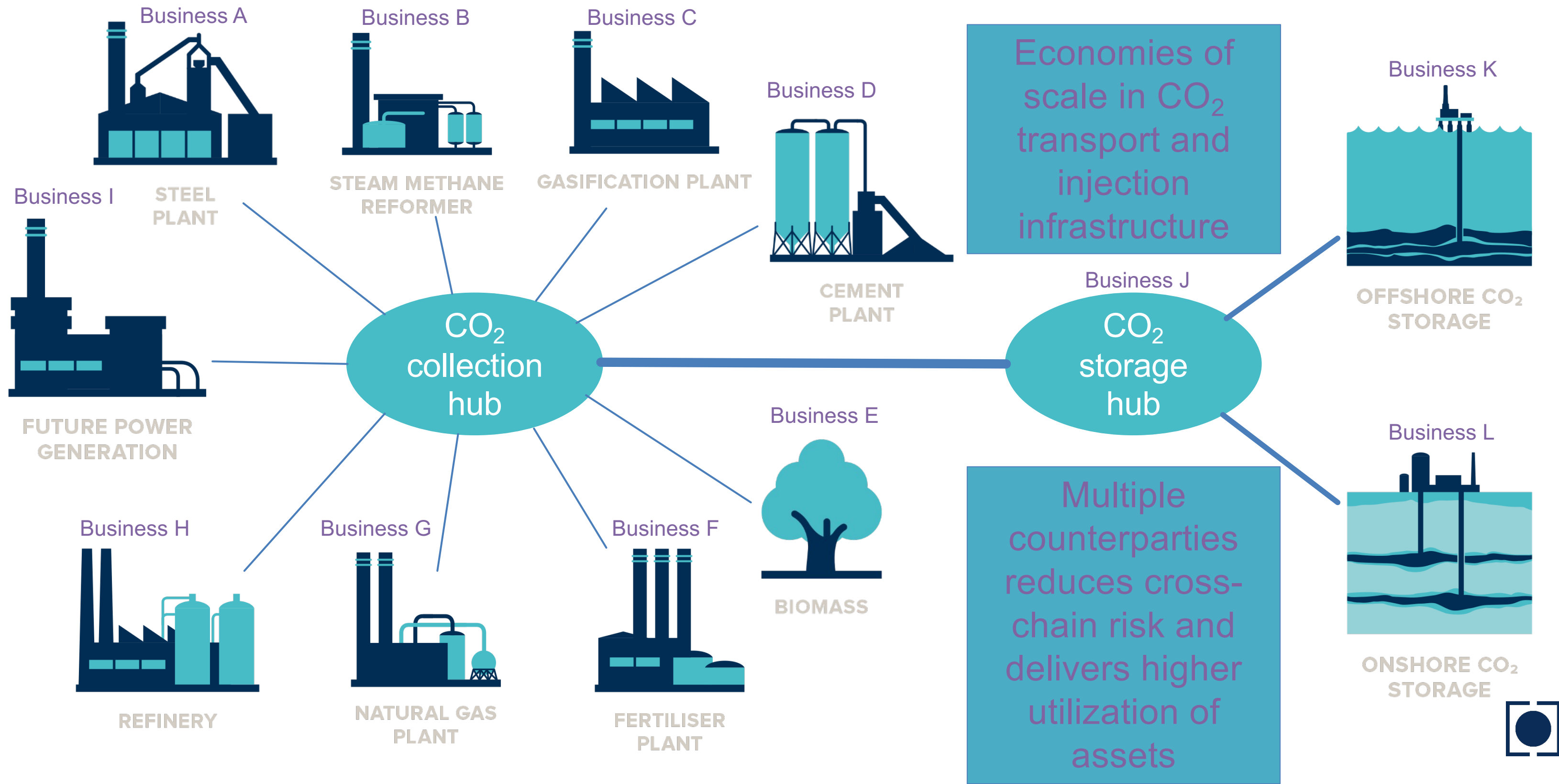
- Revenue risk: overcome by placing a sufficient value on CO₂
- Cross-chain risk: overcome through hubs and clusters?
- Long-term storage liability: overcome through development of legal and regulatory framework



DEPLOYMENT HAS RELIED ON SOME KEY ELEMENTS

- A sufficient value being placed on CO₂ either through EOR or a government incentive such as a carbon tax or carbon credit
- In most projects, investments have only gone ahead when an offtake agreement between the capture facility and a transport and storage facility exists
- A legal and regulatory framework that clearly denotes storage liabilities over the operational phase of a project as well as post-closure
- CCS investments have been made by either SOCs or large corporations. In addition, some of the projects have also received significant grant funding to support investments.





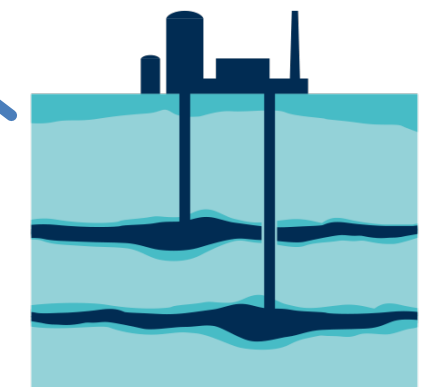
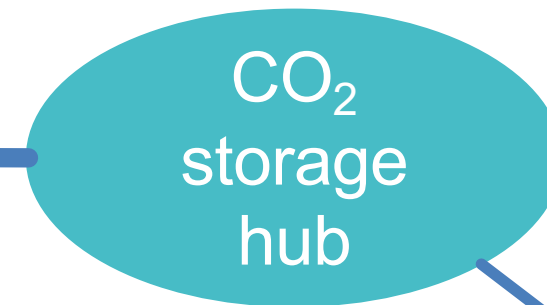
Economies of scale in CO₂ transport and injection infrastructure

Multiple counterparties reduces cross-chain risk and delivers higher utilization of assets





STEEL PLANT



ONSHORE CO₂ STORAGE

- All the risks and costs of a single source – single sink business model
- Larger capital cost and lower asset utilization of pipeline infrastructure that is oversized to accommodate future demand as the hub grows.

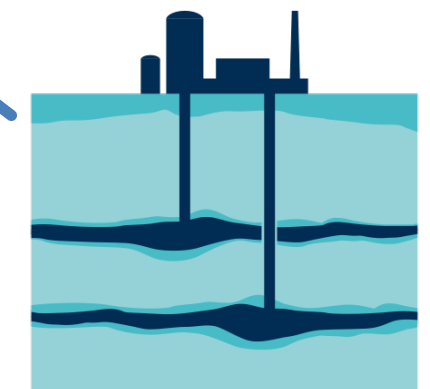
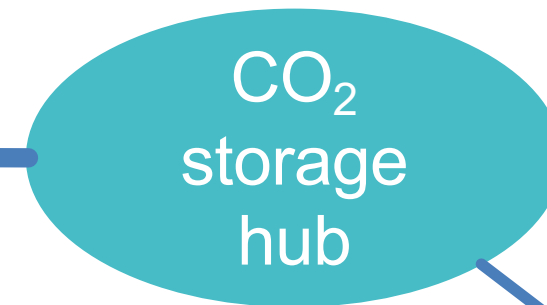




STEEL PLANT



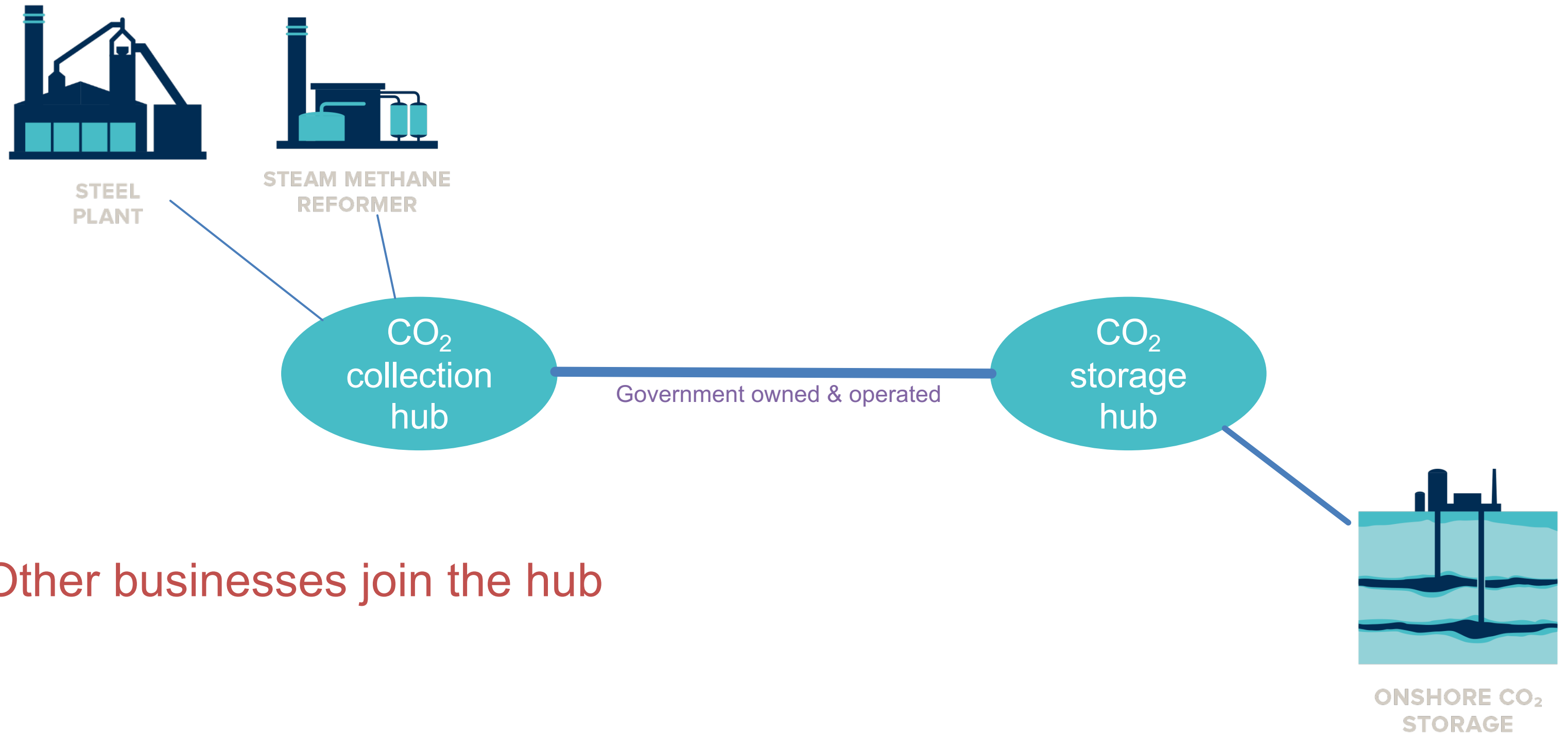
Government owned & operated



ONSHORE CO₂ STORAGE

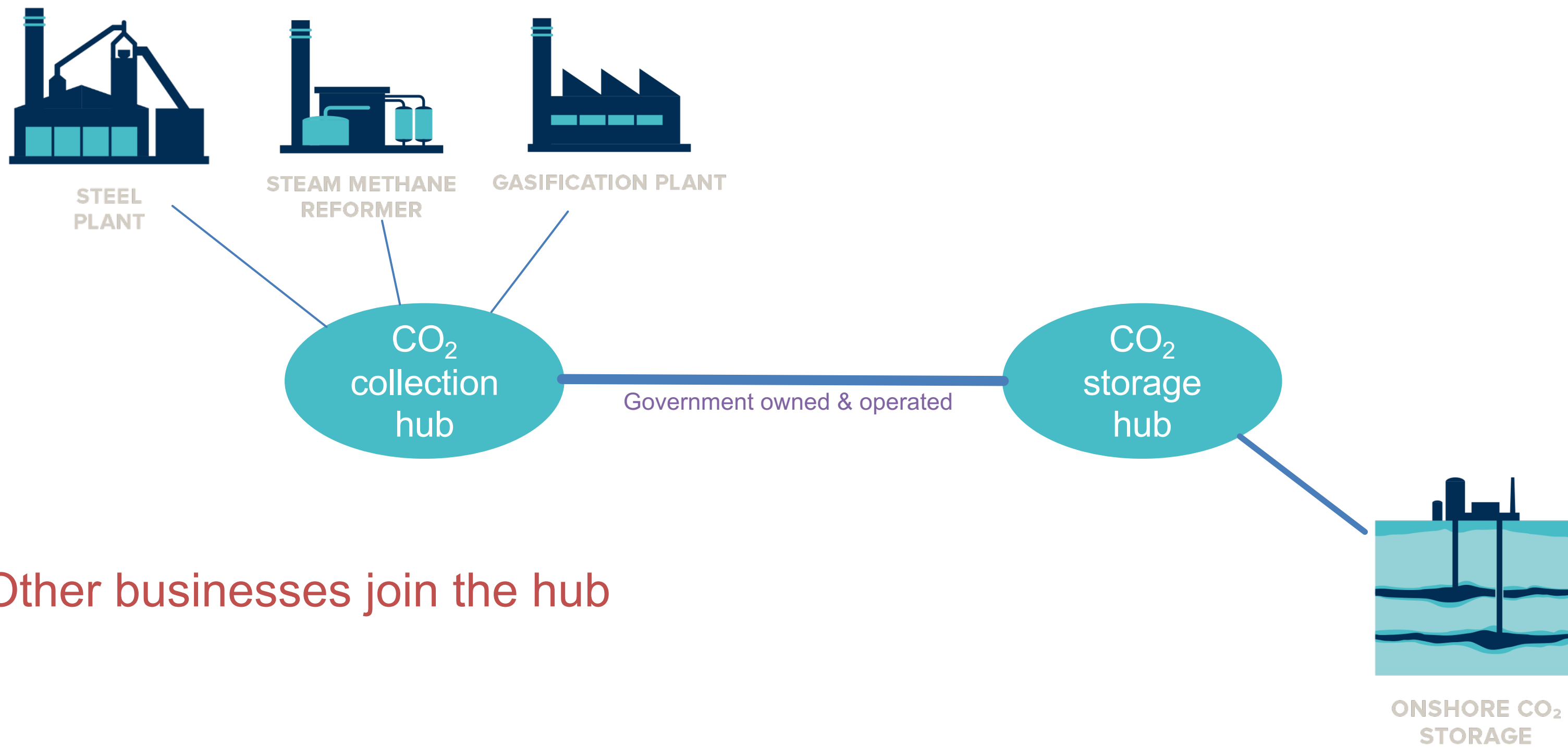
- Government takes up to 100% equity in initial CO₂ pipeline and compression infrastructure after securing an “Anchor customer”





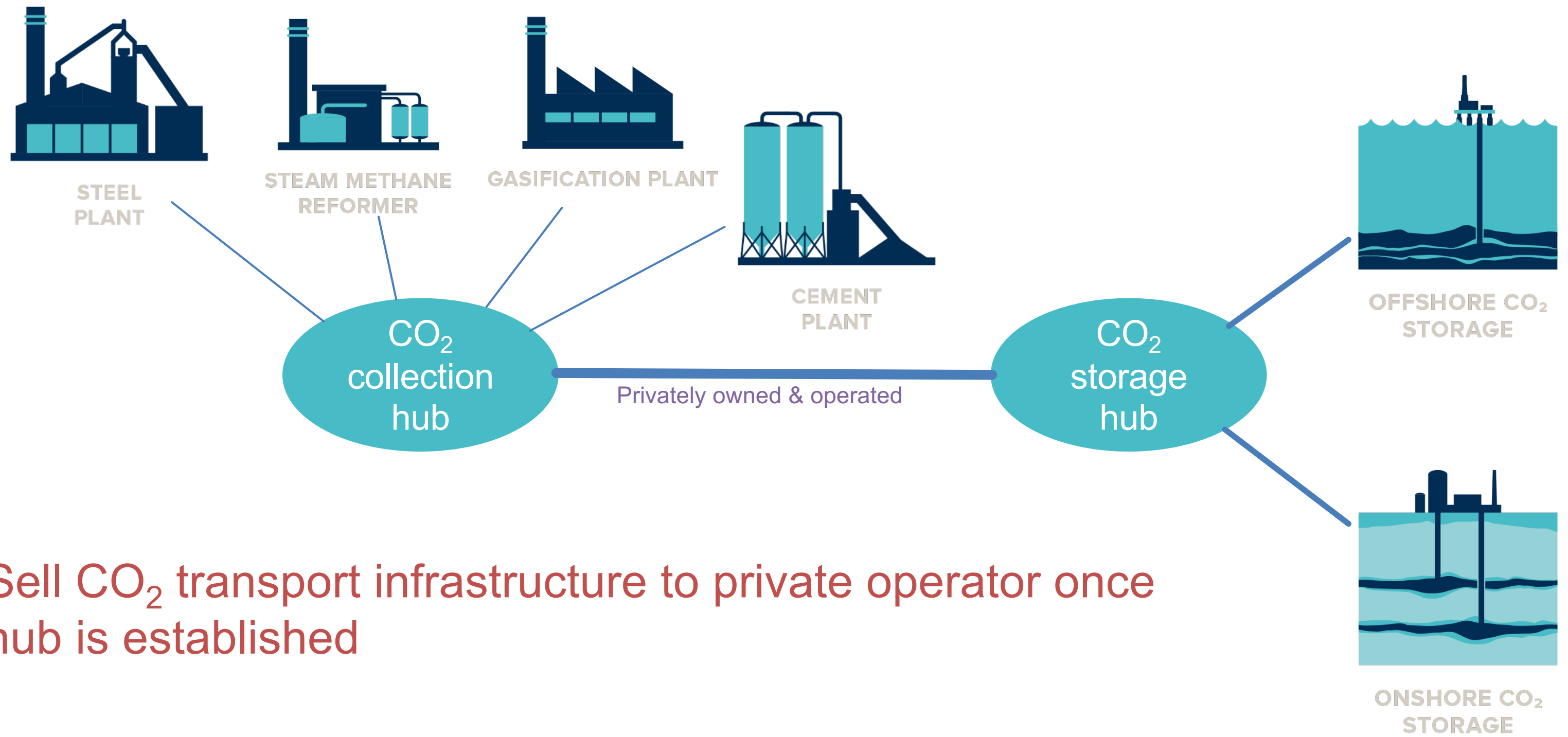
- Other businesses join the hub





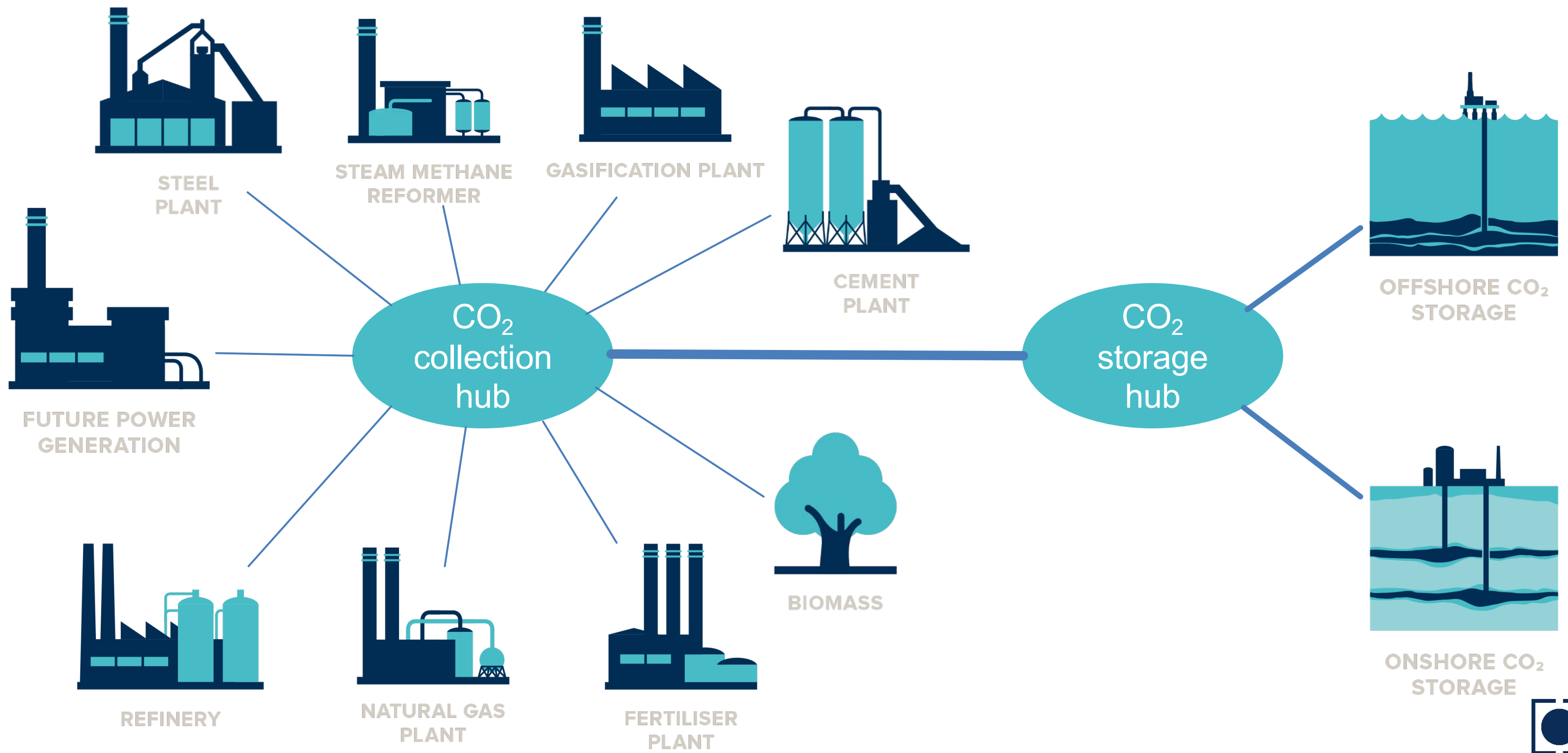
- Other businesses join the hub





- Sell CO₂ transport infrastructure to private operator once hub is established





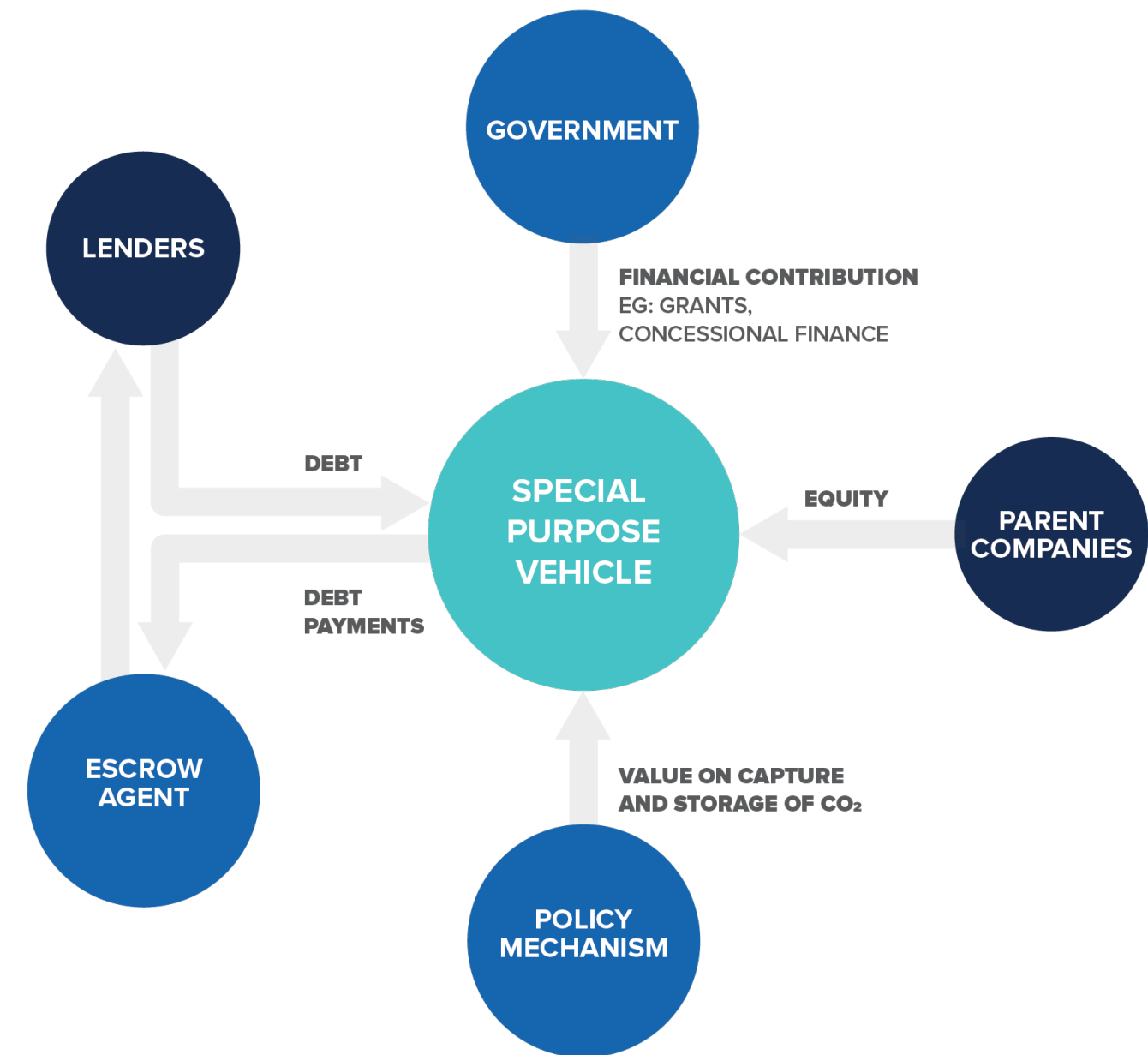
BARRIERS TO UPSCALING CCS

- Meeting climate targets requires the application of CCS to a broad range of industries
- Sale of CO₂ for for usage does not scale with requirement; logistically challenging
- Most companies not be able to fund CCS projects on their balance sheets – **project finance** or **CCS as a service** needed.



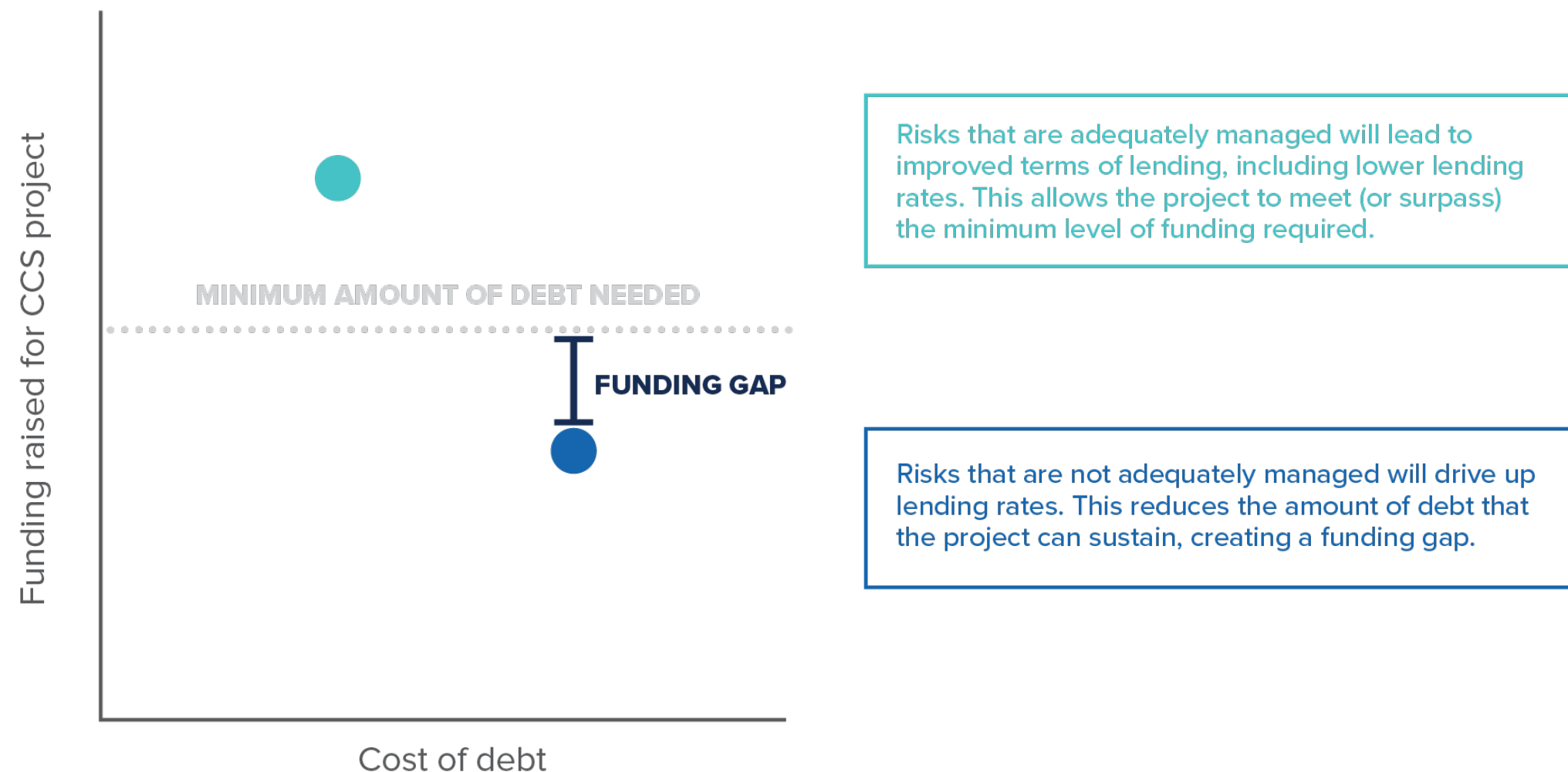
ENABLING PROJECT FINANCE

- Capital raised based on future cashflows;
- Financiers have no recourse to the assets of project owners;
- Lenders are exposed to uncertainties – higher cost of debt;
- Allows multiple equity investors and suits smaller companies



ENABLING PROJECT FINANCE

- Risks lead to higher cost of debt, increasing project costs
- This can limit the amount of debt applied to a CCS project, creating a funding gap
- Governments can help close such funding gaps through specialist financiers



ENABLING PROJECT FINANCE

FINANCING TYPE OR SOURCE	EXAMPLES OF FINANCIAL INSTITUTIONS	ROLE	EXAMPLES OF SPECIALIST AREAS OF FINANCING
Commercial Banks	HSBC, Wells Fargo, BNP Paribas	Experts at pricing term debt to projects. Commercial banks are sensitive to risks.	● ●
Export Credit Agencies (ECAs)	NEXI, UK Export Finance	ECAs provide risk guarantee to cover a significant proportion of a transaction. They also provide improved terms and conditions.	● ● ● ●
Multilateral Agencies (MLAs) and Development Financial Institutions (DFIs)	World Bank Group, Asian Development Bank, Inter-American Development Bank, UK Infrastructure Bank ³ and the European Investment Bank.	Term debt providers that promote sustainable economic and social development in low-income member countries.	● ● ● ● ● ●
Developmental Financial Institutions (DFIs)	FMO (Netherlands), DEG (Germany), Proparco (France), UK Infrastructure Bank ³ and OPIC (USA).	DFIs are owned by singular governments and are tasked with promoting sustainable economic and social development	● ● ● ● ● ●

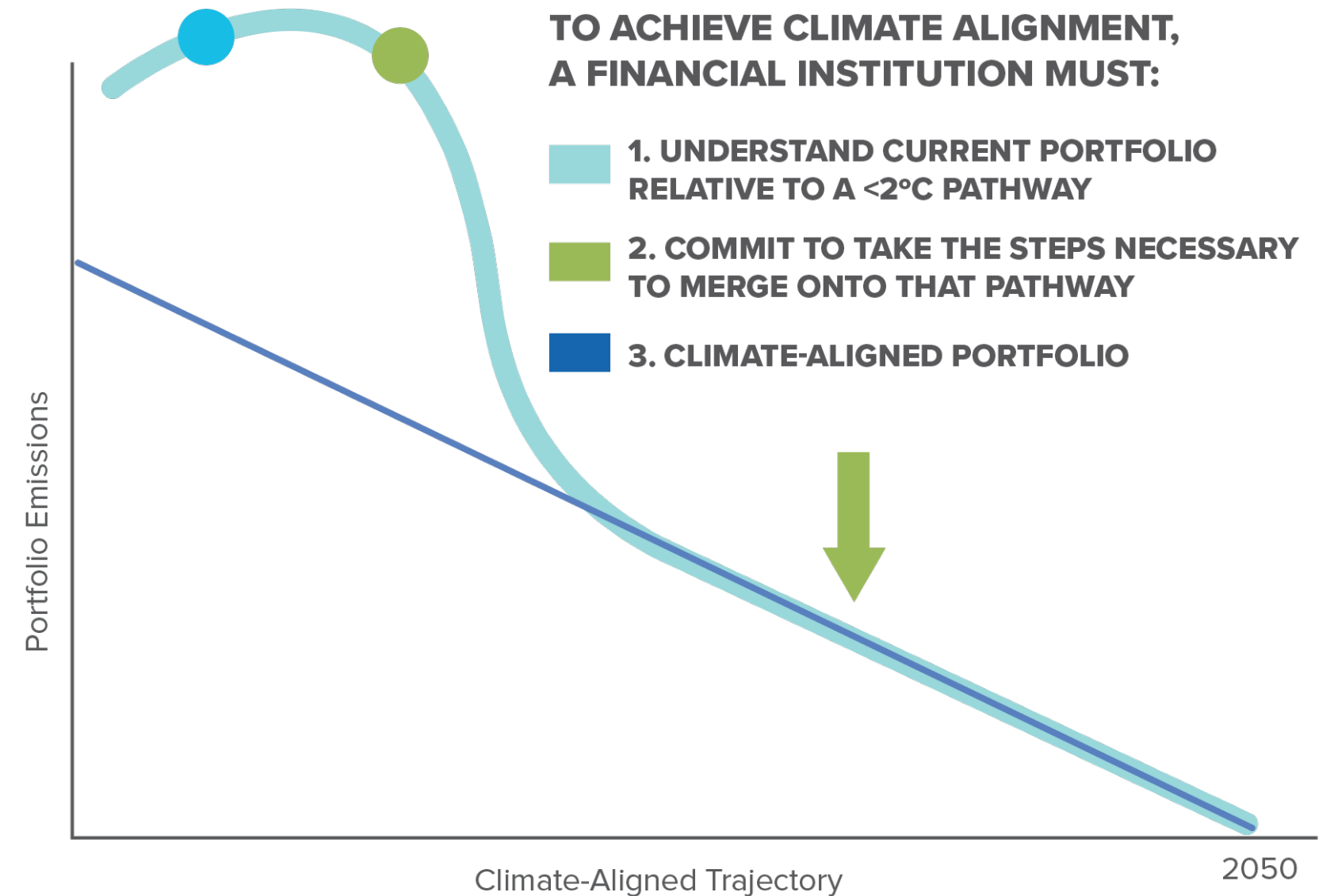
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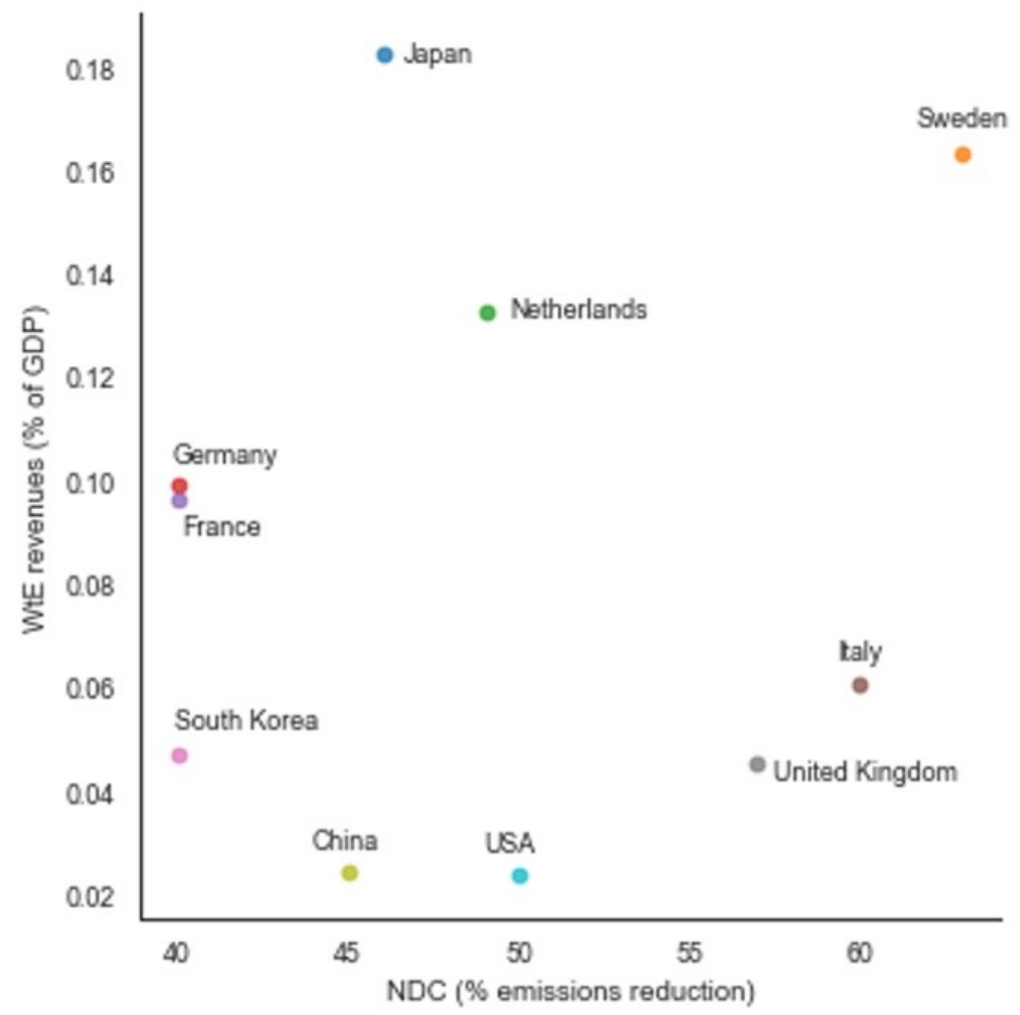
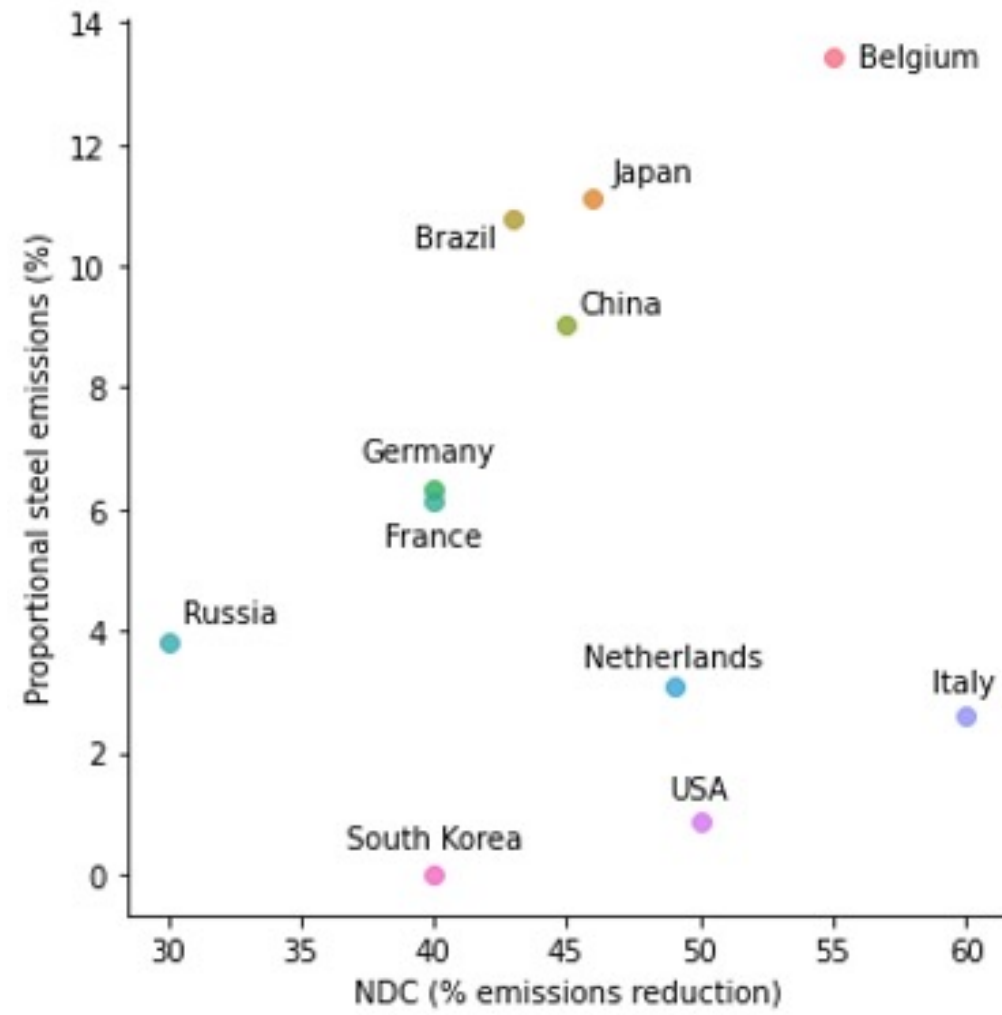
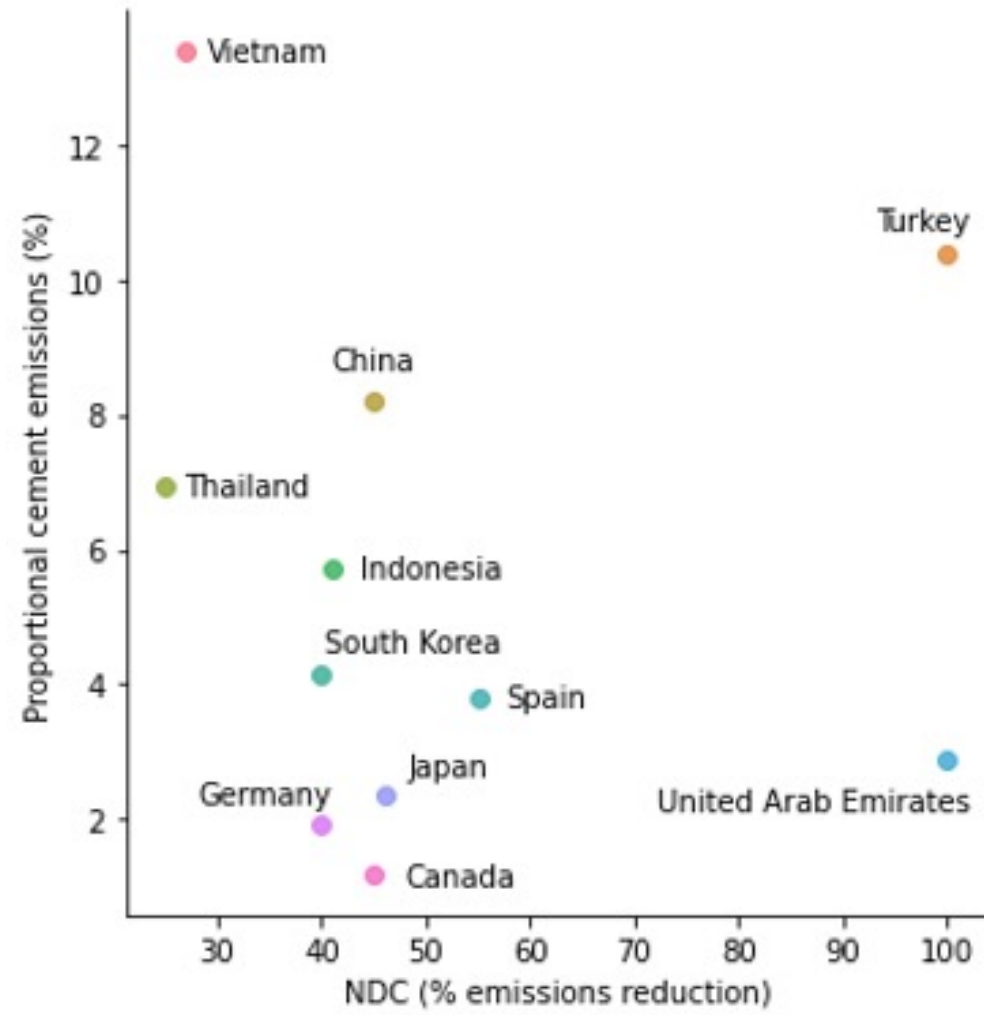
- EQUITY
- LONG-TERM DEBT
- MEDIUM-TERM DEBT
- POLITICAL OR COMMERCIAL RISK INSURANCE
- GUARANTEES
- CONCESSIONAL FINANCING



TRANSITION RISKS HELP DRIVE INVESTMENTS IN CCS

- Operational and **portfolio emissions** must be covered
- For some investors, climate risk is best managed by active engagement with businesses.
- This means supporting CCS investments.





SO, THINGS ARE CHANGING...



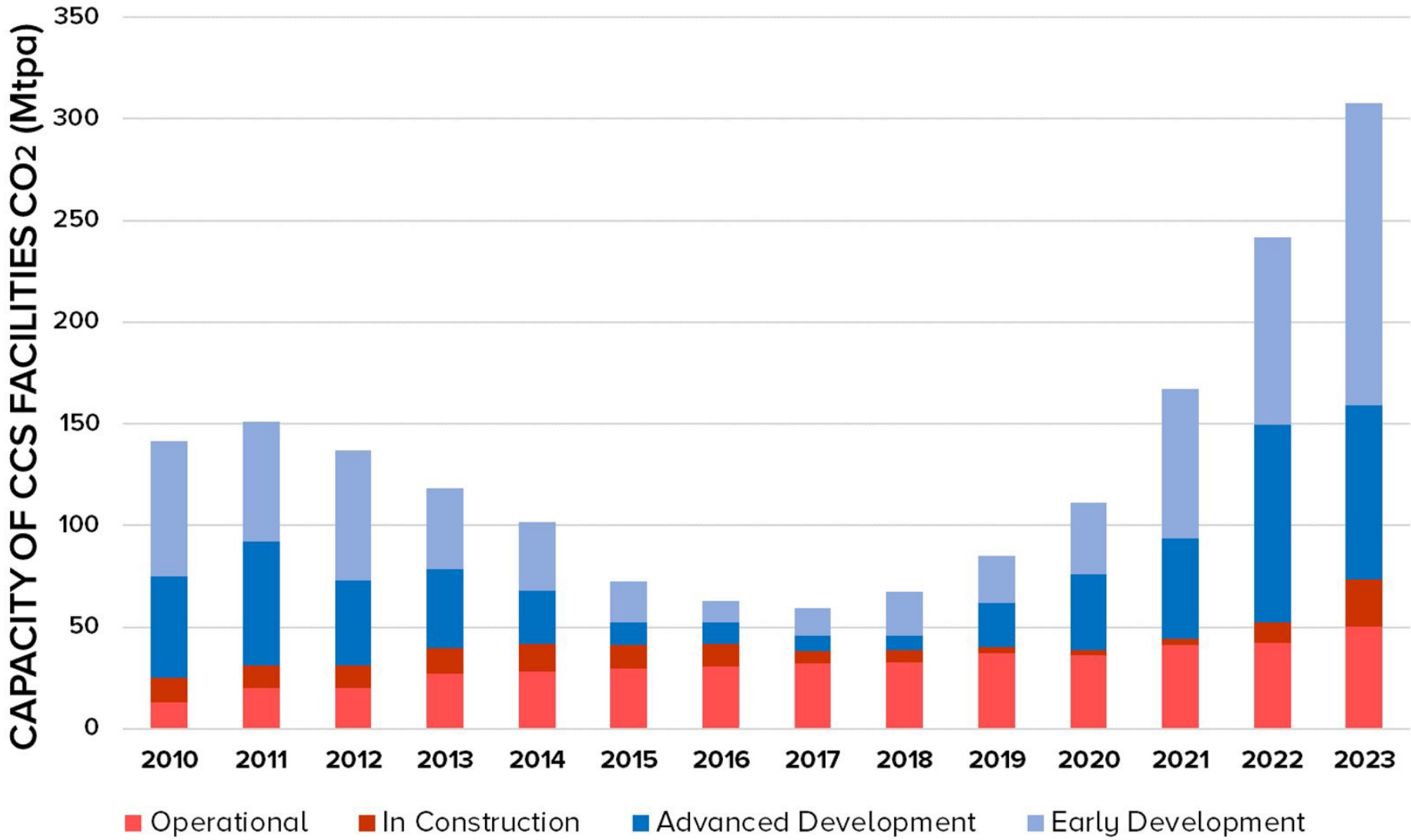
COUNTRIES REACTING WITH INCREASING AMBITION

- **The EU** needs to have 300 to 550 mtpa of installed CCUS capacity by 2050 to meet its NZE target. Net-Zero Industry Act aims to have **50 mtpa** storage developed by 2030.
- **The UK's** CCUS roadmap foresees **20 to 30 mtpa** of installed capacity by 2030.
- **The US**, through the Inflation Reduction Act (IRA), has given immense stimulus to the deployment of CCUS and Direct Air Capture (DAC) and could increase the deployment of CCS by 13-fold* compared to existing policy to between **200 and 250 mtpa** of capacity by 2030.
- **The KSA** has announced the target of capturing and storing **44 mtpa** by 2035.
- In **Brazil**, Petrobras injected more than 10 mt of CO₂ in 2022, a world record for a company, and aims to inject **40 mtpa** between 2023 and 2025.

* According to analysis carried out by REPEAT project



CCS FACILITY PIPELINE GROWING



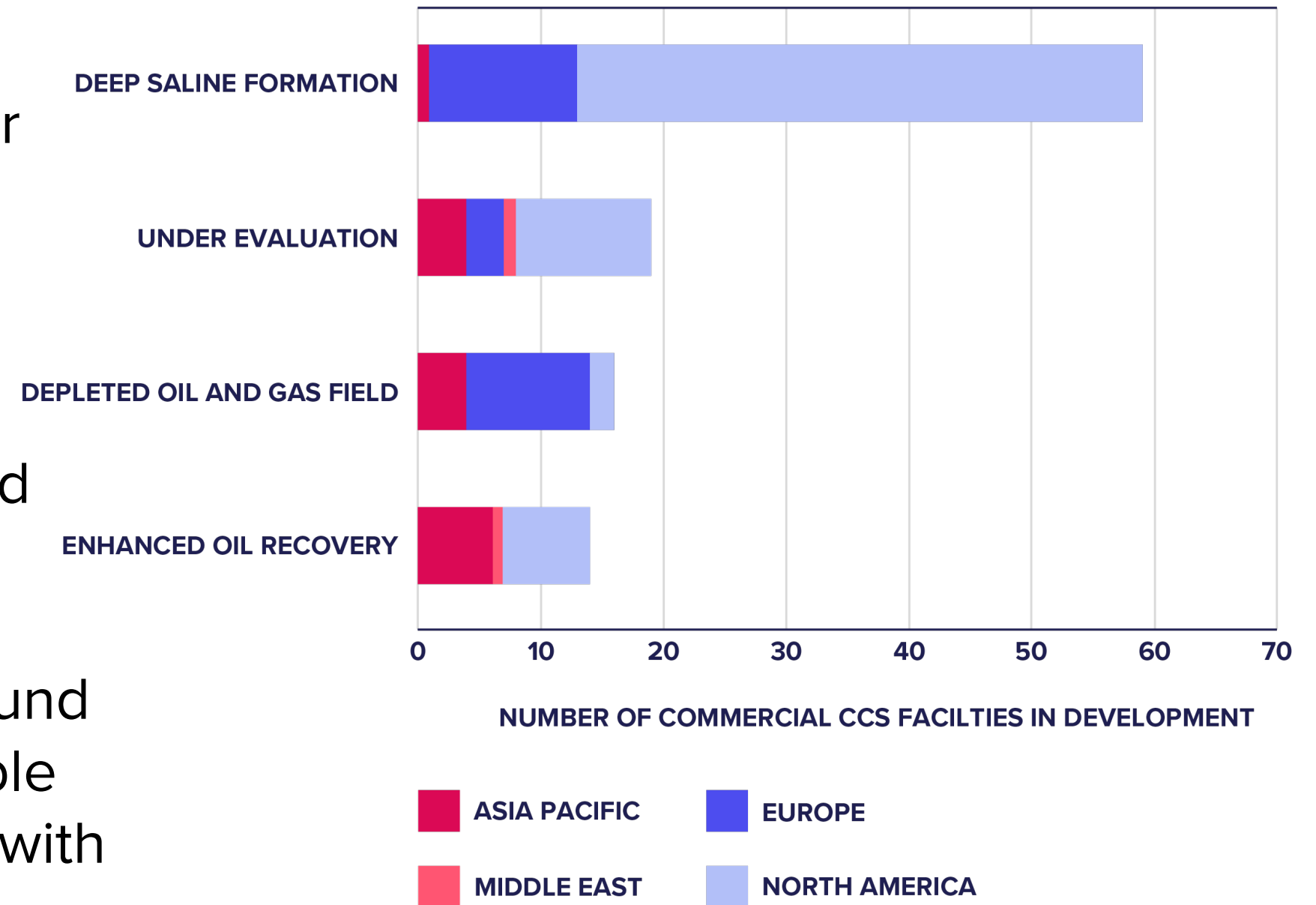
Status	GSR 2022	CO2RE 2023
Operation	30	37
Construction	11	20
Adv Dev	78	97
Early Dev	75	103
Total	194	247

* By capture capacity



EVOLUTION OF STORAGE

- 13 of the 37 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 formations, depleted oil and gas fields).
- Operational facilities, on average, can inject around 1 mtpa CO₂. That average could more than double within a decade. Many storage sites associated with the development of CCS networks necessarily have rates of around 5 Mtpa.

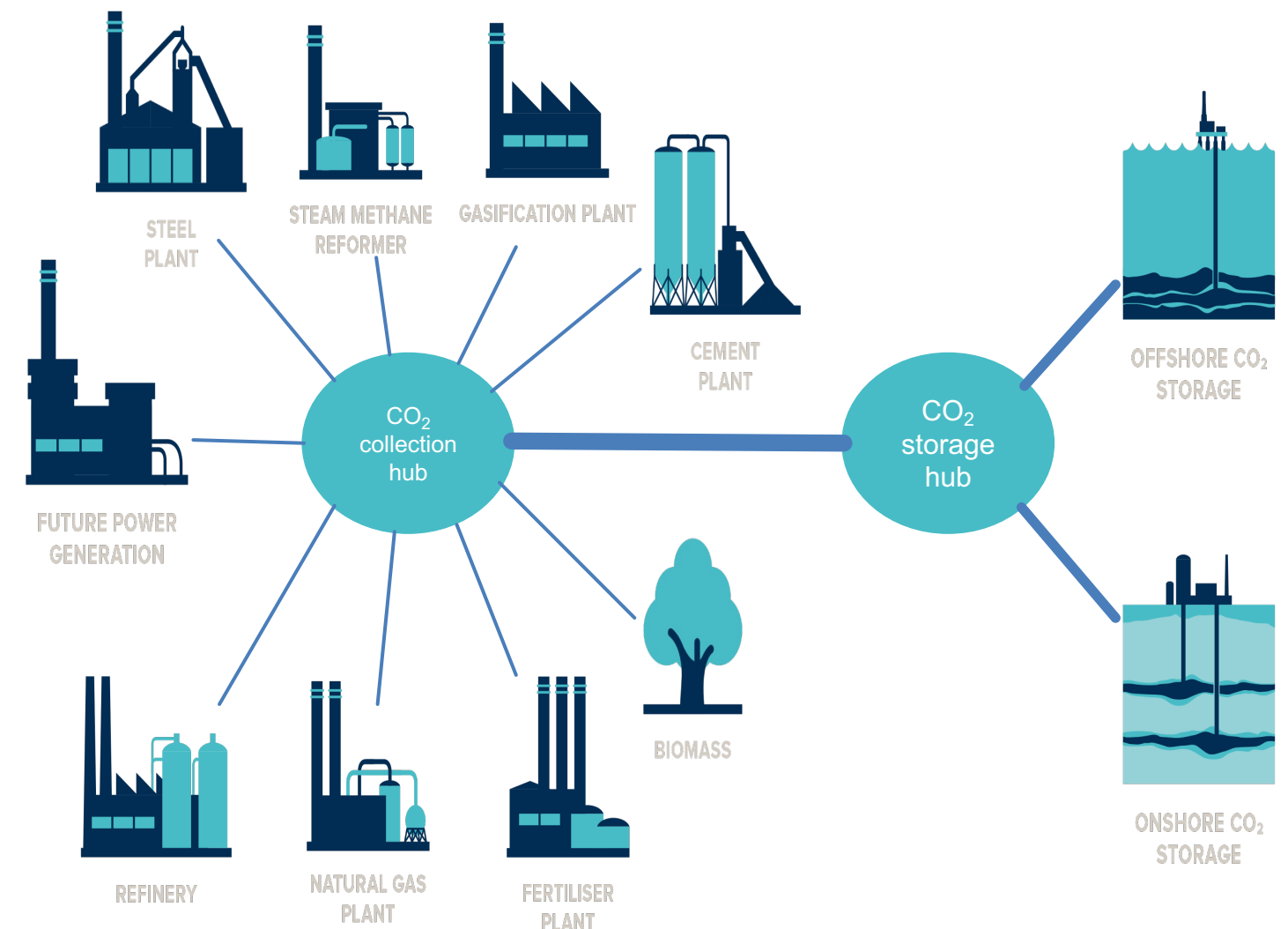


* Analysis of 108 facilities in development with dedicated storage sites



THE CONTINUED RISE OF CCS NETWORKS

- Networks continue to emerge as the preferred deployment method in the US and Europe.
- Multiple industrial point sources of CO₂ connected to a CO₂ transport and storage network.
- Access to large geological storage resources with the capacity to store CO₂ from industrial sources for decades.
- Economies of scale deliver lower unit-costs for CO₂ storage.
- Synergies between multiple CO₂ sources and the storage operator reduce cross chain risks and support commercial viability.



CCS IS ON THE RISE IN EUROPE

- **The EU supports CCUS** in Net-Zero Industry Act;
- **The EC** is developing a CCUS strategy;
- **The EU** through, the Innovation Fund, is to invest in 11 CCS and CCU projects (and counting);
- **Netherlands, Denmark, the UK** are progressing their CCS policies and projects.

* According to analysis carried out by REPEAT project



CCS IS ON THE RISE IN EUROPE

EU ETS

- Prices have risen and stabilized at around €90/tCO₂
- This is already high enough for some applications of CCS to be deployed
- Prices will continue to rise in coming years, supporting broader uptake of CCS across industries

Grant/capital support

- EU Innovation fund
- National initiatives:
- SDE++ (Netherlands)
- Northern Lights (Norway)
- Porthos (Netherlands)
- Several others also in development...

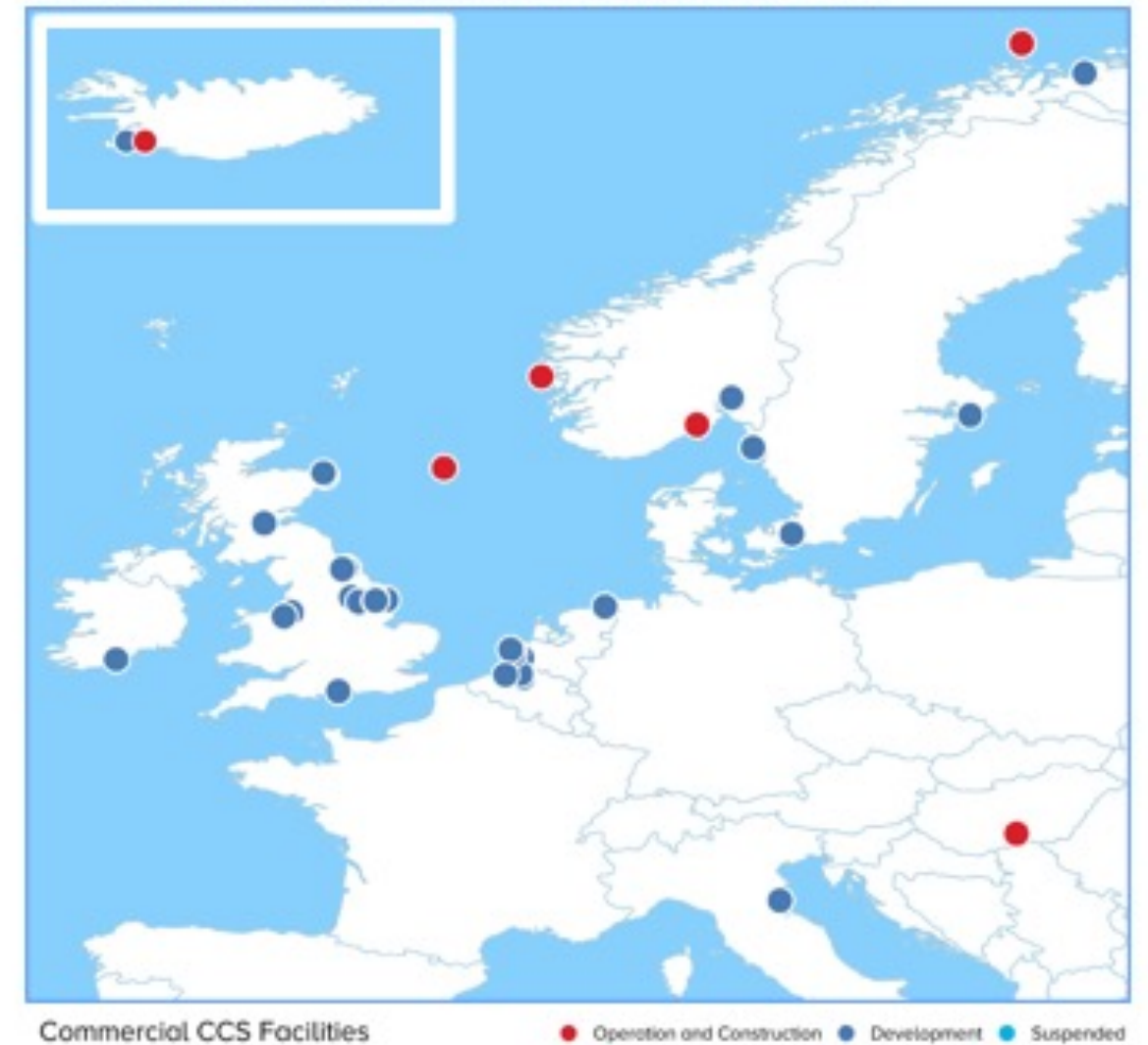
EU Storage Directive

- Sets a foundation upon which countries can develop their legal and reg framework to manage long term storage liabilities



PROJECTS IN EUROPE

- More than 30 commercial facilities in various stages of development across Europe.
- Legislative proposals to introduce regulatory mechanisms for CCS in the EU underway.
- EU Innovation Fund to invest in 11 CCS and CCU projects, supplemented by individual member state policies.
- Dutch Government allocated €2bn SDE++subsidy to capture facilities in the Port of Rotterdam network.
- Denmark allocated €2.5bn for CCS projects over 10 years under Energy Technology Development and Demonstration Project.



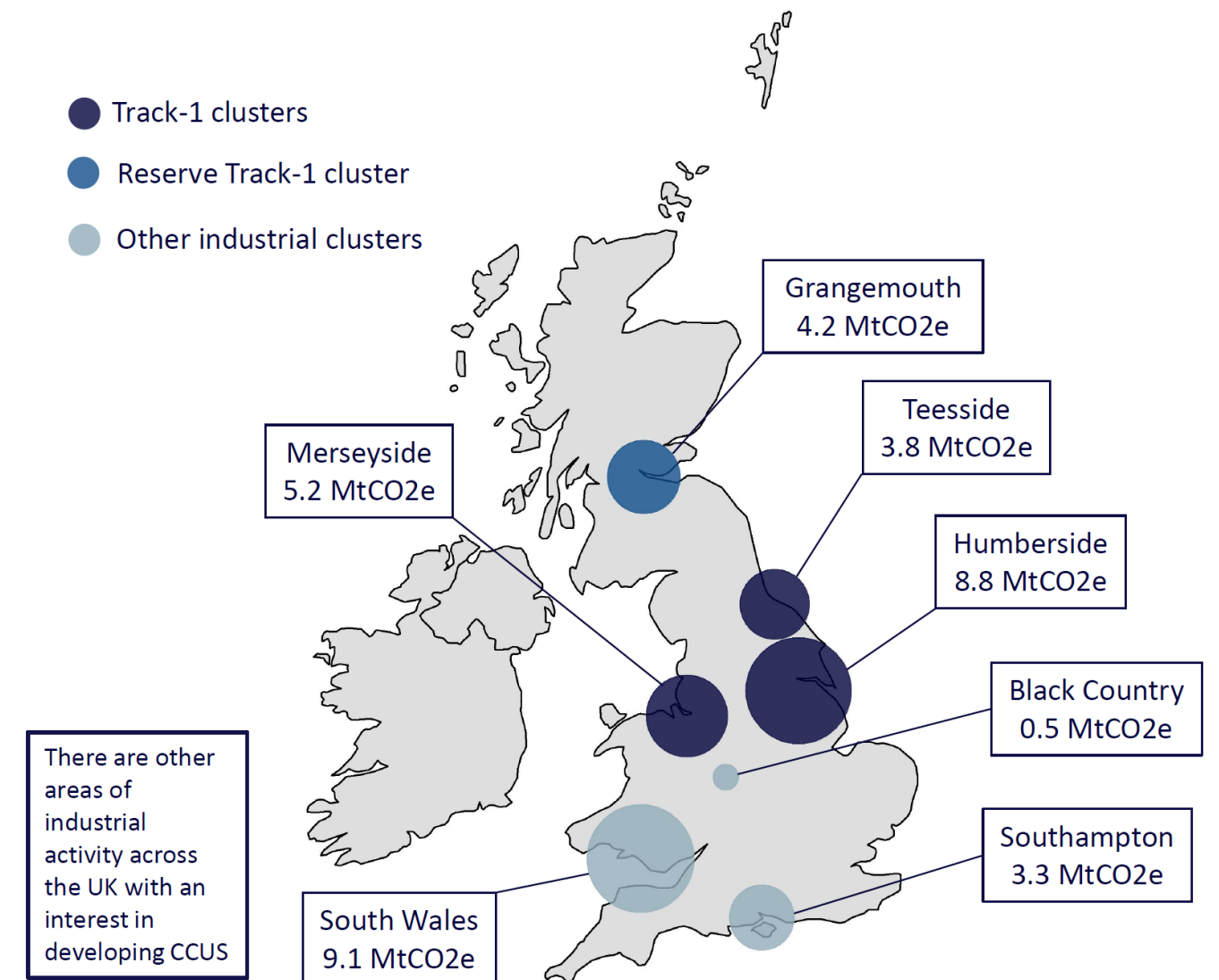
6 commercial projects operating or in construction.

32+ projects in development (not including announcements).



CCS DEVELOPMENTS IN THE UK

- Climate Change Act commits UK Government, by law, to net-zero by 2050.
- Climate Change Committee has described CCUS as ‘necessity, not an option’.
- UK CCUS Roadmap suggests progress on CCS is on schedule.
- The UK aims to establish 4 CCUS networks by 2030 capturing 20-30 mtpa, with £1 billion allocated to support CCUS development.
 - First two recipients announced in late 2021.
- CCUS Innovation 2.0 Programme.
- UK Emissions Trading Scheme.



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.

Source: CCUS Investor Roadmap: Capturing Carbon and a Global Opportunity



EUROPE – WHAT TO LOOK OUT FOR

- EU CCUS Strategy
- Regulatory Framework for CO₂ Infrastructure
- Review of the CCS Directive Guidance Documents
- Carbon Removal Framework
- Closer cooperation and CO₂ transport between North Sea countries
- Evolution of the EU ETS



LESSONS LEARNED

- Despite significant progress since 2017, more is required, urgently.
- CCS capacity needs to scale from 50 million tons today to multiple gigatons by mid-century.
- Capital investment of \$655 billion - \$1.28 trillion is required over the next 30 years.
- Governments to establish appropriate policies; Industry to build, own, and operate CCS facilities at scale and the Finance Sector to include CCS in their portfolios, ESG and green taxonomies.
- Stronger policy coupled with strong action by 2030 is crucial.



WHAT IS NEEDED?

- Define the role of CCS and CDR in meeting national climate strategies and plans, set and communicate targets.
- Create a long-term, high value on the storage of CO₂.
- Support the identification and appraisal of geological storage resources.
- Develop specific CCS laws and regulations.
- Identify opportunities for CCS networks and facilitate the establishment of transport and storage infrastructure.
- Enable investment in CCS through appropriate policy and market mechanisms.



THANK YOU

DOMINIC.RASSOOL@GLOBALCCSINSTITUTE.COM