Carbon Capture, Utilisation, and Storage (CCUS)

IETA Carbon Management Business Brief Series

EXECUTIVE SUMMARY

Carbon capture, utilisation, and storage (CCUS) involves the capture of CO_2 from industrial sources or the atmosphere, its transport, and storage either permanently in geological formations or in products. It is a proven, credible route to decarbonise hard-to-abate sectors (e.g. cement, steel, chemicals and power) and the IPCC considers that the Paris Agreement goals are unreachable without commercial-scale CCUS.

Global momentum is strong. Around 64 Mt/yr is captured today across 77 operating projects, with 47 projects under construction and more than 650 in the pipeline. Various analyses suggest capture volumes could rise to 7-fold in the next decade reaching almost 450 Mt/yr by 2035 under announced policy. This would equate an annual growth rate of about 19%, with the full project pipeline pointing well beyond 950 Mt/yr.

The central challenge for CCUS is financing. In many cases, the cost of a complete system sits above prevailing carbon prices, while the complex value chains can pose cross-chain risk that impairs funding and investment decisions. Government policy can be critical in backfilling finance shortfalls (e.g. through carbon contracts for difference) and the backstopping of cross-chain risks. Some governments in Europe are building the necessary policy infrastructure, while the U.S. tax credit scheme has proved robust in attracting project deployment.

Source: EY-Parthenon study, 2024: Capturing the growing opportunities in Carbon Capture Utilization and Storage (CCUS); Finds on growing CCS Sector, 2025; Carbon Management Understood, 2005

WHAT IS CCUS?

Carbon capture, utilisation, and storage (CCUS) is not a single technology but a value chain. Carbon dioxide is separated at source or pulled from the air, moved to a destination, and then locked away underground or embedded into a product. The four principal forms differ by carbon source and end location/use.

The CCUS value chain:

Emissions source
- *Steel, cement, chemicals, glass*
- *Hydrogen via Steam Methane Reforming (SMR)*
- *Power generation (fossil and bio)*
- *Fermentation (biogenic)*

Transport
- *Pipelines (can re-fit legacy oil and gas lines)*
- *Rail, truck, ship, import and export*

Storage
- *Operational or depleted hydrocarbon reservoirs*
- *Deep saline formations*
- *Mineral forms (e.g. basalts)*

Utilisation
- *CO_2 embedded into a chemical or product*
- *CO_2 used as working fluid (e.g. EOR)*

FORMS OF CCUS

Point-Source Capture (CCS)
Examples: Power, cement, steel, refineries.

Direct Air Capture (DAC)
Atmospheric CO_2 removal. See IETA DACCS Business Brief.

Bioenergy with CCS (BECCS)
Biogenic feedstock usage for heat/energy/fuel, with CCS. See IETA BECCS Business Brief.

Carbon Utilisation
Examples: Enhanced oil refinery, synthetic fuels, concrete.

POLICY AND REGULATORY OUTLOOK

THE CARBON CREDITING PROCESS

TYPICAL PROCESSES AND STEPS:

1. ***Capture****: Post-combustion (amines), pre-combustion, oxy-fuel, or DAC technologies (90-95% efficiency)*
2. ***Transport****: Pipelines (most common), ships, trucks*
3. ***Storage:*** *Injection via well bores, either onshore or offshore; injection in solution (e.g. basalts storage)*
4. ***Utilisation****: EOR, synthetic fuels, chemicals, building materials*

Permanent storage will become the main destination for captured carbon. EOR is the most developed route today because of mature injection technology, but dedicated storage is growing fastest, at ~30% CAGR through 2035.

CCUS IN CARBON MARKETS

VOLUNTARY CARBON MARKETS

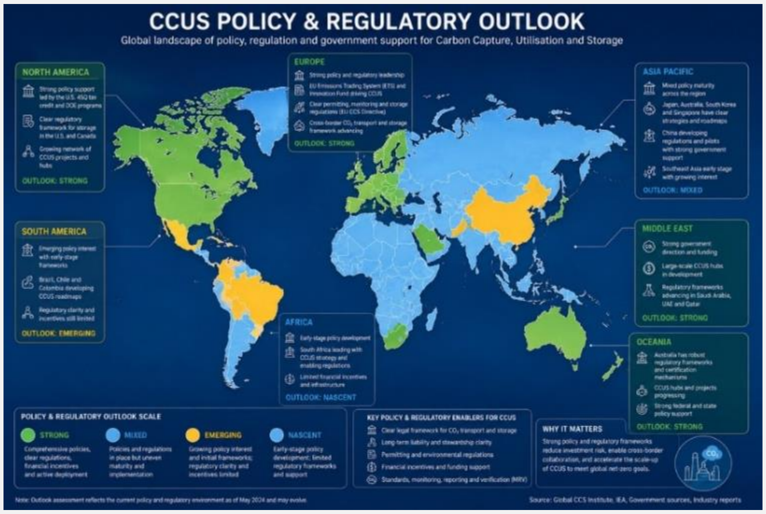
Various methodologies exist with differing scopes:
- *Fossil, BECCS & DACCS inclusion: ACR, GCC, CCS+*
- *Carbon removal only (BECCS and DACCS): Puro.earth, Gold Standard, Isometric.*

Detailed analysis of coverage & scopes found in IETA's Handbook for Geostorage and Carbon Crediting 2.0

COMPLIANCE / REGULATORY MARKETS

Mandatory, government-regulated systems requiring industry (e.g., power plants, cement, steel) compliance

a) ***ETS****: Under cap-and-trade systems, captured and stored CO_2 may be treated as not emitted, allowing facilities to potentially surrender fewer allowances or monetise surplus allowances*
b) ***National Carbon Markets****: Systems such as China ETS and India's CCTS are exploring integration of CCUS within domestic frameworks, including recognition of emission reductions*
c) ***Carbon Tax and Offsets****: CCUS may also reduce taxable emissions; some jurisdictions may allow these reductions to generate offsets or credits.*



Country archetypes: *The global CCUS landscape is being driven by net-zero commitments, compliance carbon pricing mechanisms, industrial decarbonisation needs, energy security concerns, and government incentives. Policy maturity is strongest in North America, Europe, Australia, and the Middle East, while Asia-Pacific is rapidly evolving through national CCUS roadmaps and emerging economies in Latin America and Africa are establishing foundational regulatory frameworks to attract investment and scale deployment.*

Full-chain players	***Emerging storage providers***	***High-emission economy with CCUS potential***	***Challenging geographic adopters***	***Skeptical slow movers***
Conducive geology, capability and policy, with existing investment	*Well positioned to host cross-border CCS with limited activity thus far.*	*Hard-to-abate industry; often with a storage partner.*	*Dispersed sources, limited storage; lean toward utilisation over storage.*	*Yet to embrace CCUS; a shrinking group as the market matures.*
E.g.: Norway, Netherlands, Denmark, UK	*E.g.: Malaysia, Australia*	*E.g.: India, Singapore*	*E.g.: Finland*	

d) ***Article 6 Linkage***: *CCUS projects, especially cross-border capture and storage, can potentially generate Internationally Transferred Mitigation Outcomes (ITMOs) under Article 6.2/6.4, enabling credit transfer between countries (still evolving).*

OTHER COMPLIANCE/REGULATORY SCHEMES

- ***Fiscal incentives / subsidies***: *Government-backed mechanisms such as tax credits, grants, or contracts-for-difference provide direct, predictable revenue to CCUS projects, improving bankability and reducing investment risk.*
- ***CO_2 utilisation markets***: *Captured CO_2 can be sold as a commercial input for applications such as enhanced oil recovery, fuels, chemicals, and building materials, generating commodity-based revenue streams.*
- ***Transport and storage infrastructure markets***: *Dedicated pipelines, shipping networks, and storage hubs operate on a "storage-as-a-service" model, where emitters pay for CO_2 transport and permanent geological storage.*
- ***Industrial / product markets***: *Demand for low-carbon products such as cement, steel, and hydrogen creates indirect CCUS value, as carbon capture can reduce embedded emissions and meet corporate or regulatory requirements.*

APPLICABLE STANDARDS & METHODOLOGIES

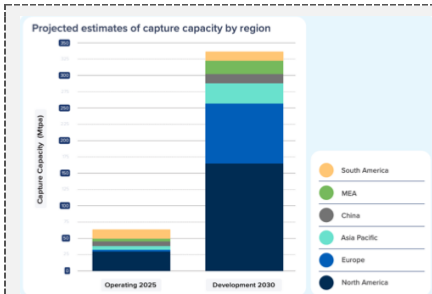
STANDARDS

- *ISO 27914: CO_2 geological storage*
- *ISO 14064: GHG accounting for organisations*
- *IEA-GHG: technical guidelines*
- *British Columbia CCS Protocol (v1.0)*
- *BSI Flex for DACCS and BECCS*
- *Alberta CCS Quantification Protocol (v2.0)*
- *CDM / ACM0014: EOR methodology*
- *ACR: Carbon Capture and Storage Projects (v2.0)*
- *Verra: VM0049 Carbon Capture and Storage (v1.0)*
- *GCC: GCCTT001 - Guidance for Geological CO_2 Storage*
- *Puro.earth: Geologically Stored Carbon (v5.0)*
- *India: MoPNG & MoEFCC guidelines (under development)*

MARKET SNAPSHOT – KEY STATS

77 Operational projects	**~64 Mtpa** Capture capacity today
47 Projects under construction	**650+** Pipeline projects

GEOGRAPHIC DISTRIBUTION



Source: *Global CCS Institute (2025)*

PRICE TRENDS

Compliance carbon price, what emitters pay	**~$20 -75 / t**
Cost of CCUS, point source to storage	**~$72 - 190 / t**

Generally, project finance needs supplementary support in addition to carbon finance/markets. The cost of capturing, transporting and storing a tonne of CO_2 is in most circumstances higher than the prevailing carbon price. Additional policy is being applied to help bridge financing gaps:

- ***Technology at scale**: Capture is advancing, but transport and storage (T&S) remain hard to scale economically.*
- ***Uncertain economics**: Costs are unlikely to fall steeply; without support, investment waits for break-even.*
- ***Cross-chain risk**: Emitters need reliable storage; T&S providers need consistent volumes from a small customer base.*
- ***Cross-border frameworks**: Outside common carbon areas (such as the EEA), bilateral and multilateral rules for exporting and storing carbon are still missing.*

***Three potential deployment models**:*

Model	Advantages	Challenges	Examples
Point-to-Point	*Simplicity: a direct link between one emitter and one storage site. Targeted technology.*	*High cost: dedicated infrastructure per source, but future expansion and collaborations may be constrained. Easier to finance but potential barriers for smaller facilities.*	*Gorgon (AU); Sleipner (NO)*
Hub-and-cluster	*Cost efficiency and scale: shared pipelines and storage across many nearby emitters. Multi nodes with non-pipeline transport.*	*Complexity: multiple connections and participants. Has potential to move to mature network model. Harder to finance in early stages.*	*Northern Lights (NO); HyNet cluster (UK); Portos (NL)*
Networks	*Flexibility: competing supply, common carriage, with established third-party access rules, and multiple stores serving varied purposes. Shared infrastructure lowers cost.*	*Restrictive and uncertainty: complete ownership discretion; weaker long-term planning.*	*Western U.S. States; Alberta Carbon trunkline (CAD)*

DEMAND BY SECTOR

Today, the operational base is concentrated. Natural gas processing is by far the largest application (>60% of operating capture capacity) because it is one of the lowest-capture-cost sectors. The remainder is spread across power, cement, chemicals, iron, steel, and hydrogen.

By 2030, the mix is expected to diversify. Hydrogen and ammonia production, CDR (DAC and BECCS), and hard-to-abate industry together make up more than half of the project pipeline expected to come online by 2030, and natural gas processing's lead is projected to pass to low-carbon hydrogen and ammonia.

Source: IEA, 2025

What will drive the next decade of growth:

(a) ***Carbon price evolution**: Robust carbon pricing and growing interplay between compliance and voluntary markets create a more interconnected global market that pulls in investment*

(b) ***International collaboration**: CO_2 shipping linked with storage-rich nations with high-emission economies. The Project Greensand offshore tanker shows the model becoming real*

(c) ***Technological innovation**: Ongoing research improves capture efficiency, lowers cost, improves storage techniques and strengthens the economics of utilisation pathways*

(d) ***Dynamic/Adaptive policy**: Governments refine instruments using lessons from early projects, sustaining a policy environment that keeps capital flowing*

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IETA CARBON MANAGEMENT BUSINESS BRIEF SERIES

PURPOSE & OVERVIEW

This IETA Carbon Management Business Brief Series aims to provide market clarity on CCUS and engineered CDR pathways from market participants and stakeholders. IETA's suite of business briefs, covering nearly all compliance carbon markets, is publicly available.