

LLOYD'S

Risk revealed by Lloyd's

Clean technologies and
hard-to-abate sectors



AON

CCUS



Carbon capture
utilisation storage

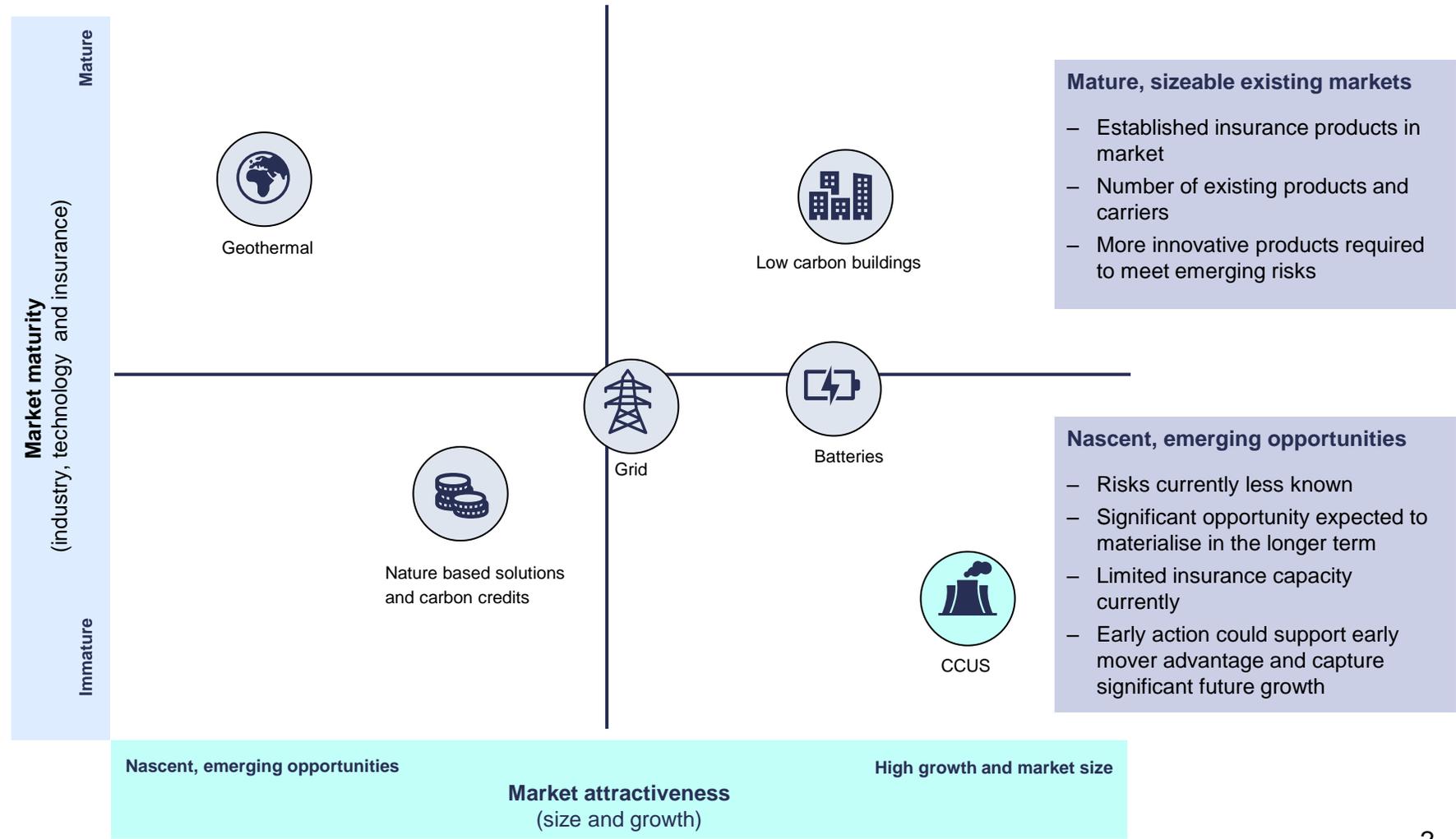
Building a larger presence in emerging 'transition' technologies could help the insurance industry to lead innovation and grow sustainably

Opportunity assessment

The relative positioning of opportunities for the insurance industry have been weighted by:

- 1. Attractiveness**, which considers both the growth and size of the market, and
- 2. Maturity**, which takes into account both the wider industry and insurance market

	Criteria	Weighting
Market attractiveness	Growth	50%
	Size	50%
Market maturity	Maturity of industry	25%
	Maturity of tech	25%
	Insurance capacity	25%
	Insurance product maturity	25%



Carbon capture technology development is gaining momentum, with up to 200 projects planned by 2030, many of which require both standard and specialist insurance products

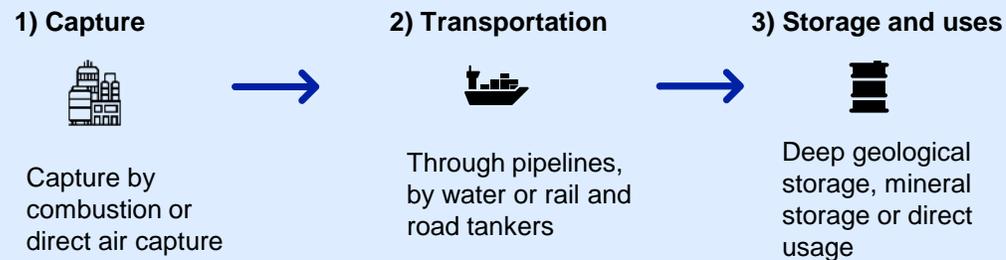
Industry and insurance market dynamics

- CCUS refers to a suite of technologies that enable mitigation of CO₂ emissions from large point sources such as power plants, refineries, and other industrial facilities
- In the IEA Clean Technology Scenario, which sets out a pathway consistent with the Paris Agreement, CCUS contributes almost one-fifth of the emissions reductions needed across the industry sectors, particularly in hard-to-abate areas
- **The development of the CCUS market varies greatly across regions where North America sees a proliferation of smaller projects, whilst Europe and Asia see fewer, larger projects**

200+

The IEA project pipeline includes announced ambitions for 200 new carbon capture facilities to be operating by 2030 capturing over 220MT CO₂ per year

The CCUS process involves CO₂ capture, transportation and storage in geological formations or use in certain industries (e.g. food). There are several key stakeholder types throughout the CCUS process which will may have differing insurance requirements



Key growth drivers



Government regulation



Provides an emissions stopgap



Headwinds



High cost of production



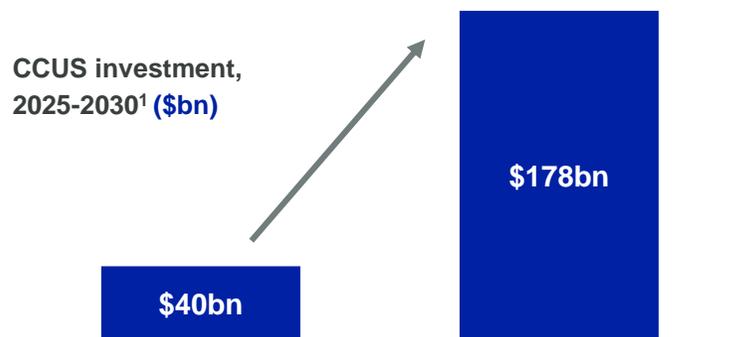
Technological maturity



Public perception

Investment in CCUS is expected to grow significantly towards 2030 as it becomes more commercially viable through policy change, incentives and technology maturity

Global investment breakdown



Current market trends

- CCUS project performance remains uncertain – as of 2022, research globally notes that 80% of projects have either failed to launch, or failed after launch
- Global policy changes are garnering increasing interest in CCUS:
 - **US – \$3.7bn** investment in CO₂ removal projects under the Biden administration
 - **UK – £1bn** CCS Infrastructure Fund formed (CIF)
 - **APAC – \$1.2bn** investment, largely from projects in Australia and Malaysia



Growth drivers



Government regulation - Stronger climate targets and investment incentives through government regulation have injected new momentum into the market e.g. UK CCF Infrastructure Fund, \$3.7bn Biden administration investment



Provides an emissions stopgap - CCUS provides fast temporary solutions to allow nations to continue to use high emitting industries whilst still limiting their emission



Headwinds



High cost of production - CCS technologies remain costly to implement, construct and operate. Additionally, the cost of infrastructure to support CCUS including pipelines and storage sits remains expensive, especially in regions where alternative lower-cost technologies are available



Technological maturity - Next-generation carbon capture technologies are seeking to use less energy, be lower cost and enable the large-scale capture of CO₂

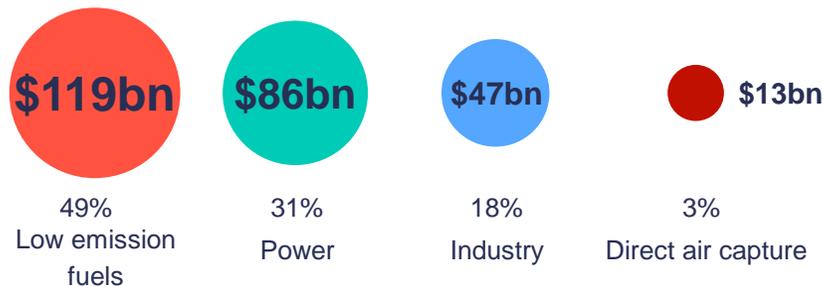
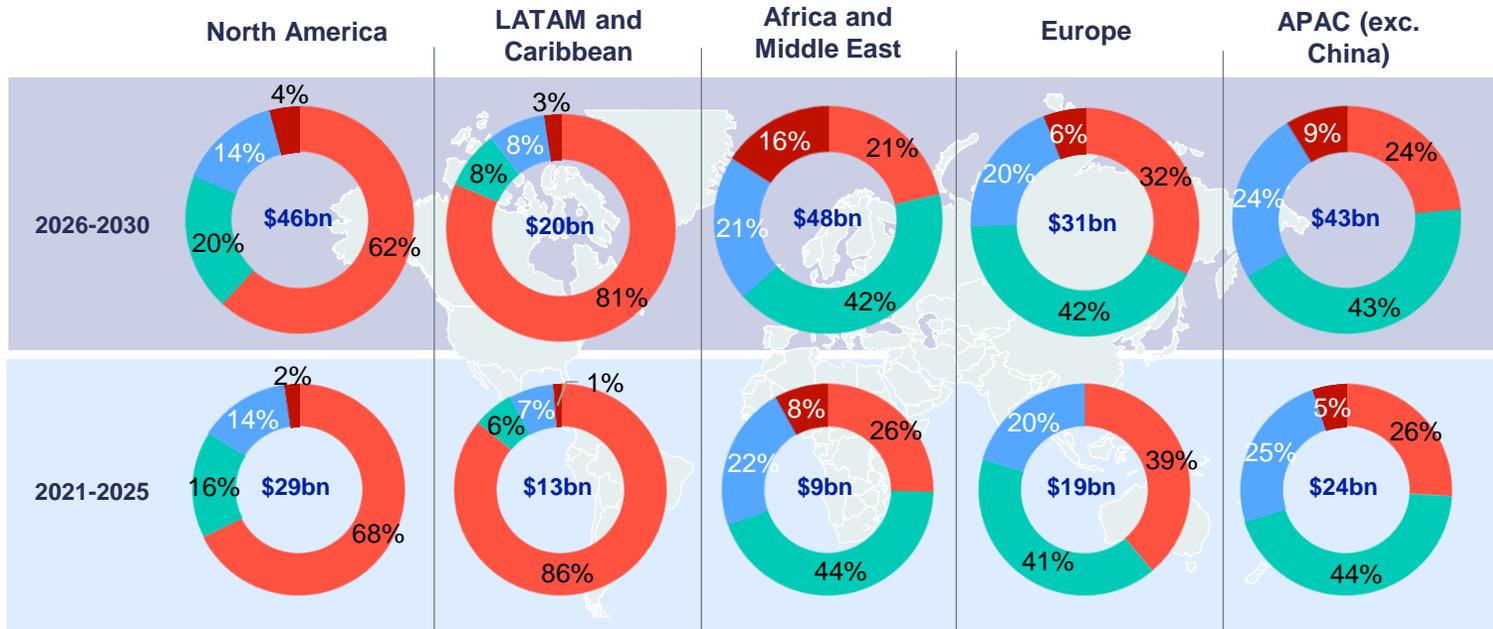


Public perception - The public remain concerned around the capture and storage of CO₂ and the potential for leakage risks and environmental impacts. Governments and other actors are seeking to address these concerns through education and engagement

The US is the global CCUS leader, with regulated industries driving investment in CCUS to limit overall carbon emissions

Global carbon capture investment

Overall global CCUS investment, \$bn 2021-2030



Regional region regulatory outlook

North America

The US is the global CCUS leader, accounting for 60% of current and 50% of planned future capacity, with 85% of emissions coming from plants located within 100km of a planned CCUS site

Mexico developed a legal framework through a study supported by World Bank to test and identify adjustments for their current legal process

LATAM and Caribbean

Trinidad and Tobago are looking to replicate the same model as the UK and become a carbon hub for the region

EU

Most of Europe's offshore CO₂ storage capacity is in the North Sea, where there are numerous oil and gas fields and saline aquifers

In the EU, the CCS directive provides a comprehensive legal framework ensuring fair and open access to CO₂ storage sites

APAC ex. China

Indonesia is a front-runner in Asia with regards to creating regulatory frameworks for CCUS activities

Australia is planning to scale up its CCUS capabilities to meet demand from top buyers such as Japan and Korea

Middle East & Africa

C. 90% of power in South Africa is generated through fossil fuels, of which 72% is coal. Two power stations are now equipped with CCUS

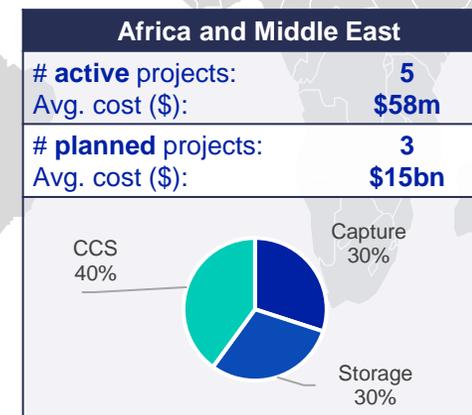
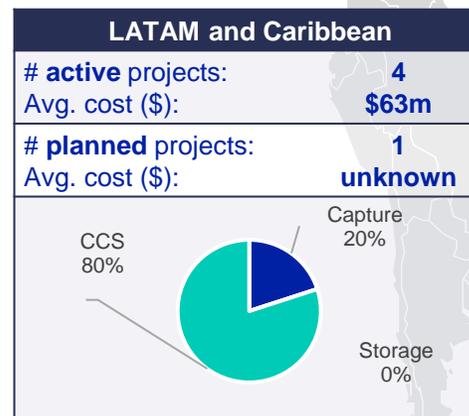
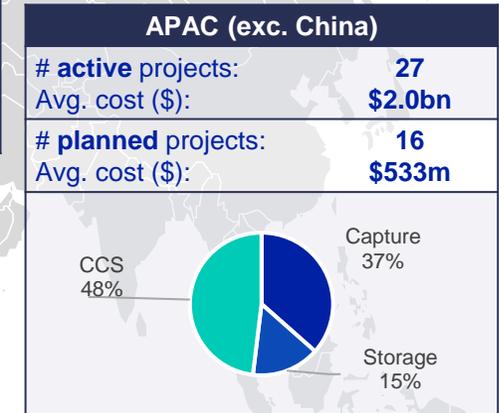
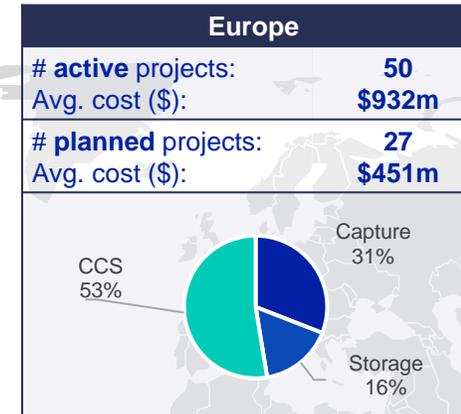
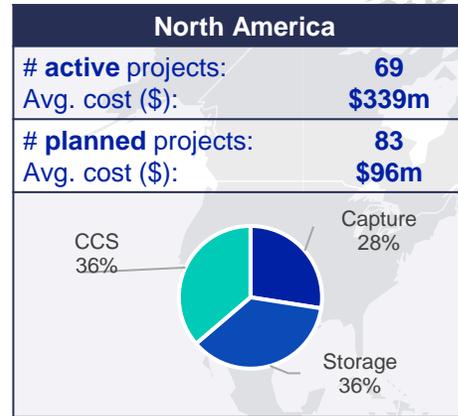
Middle East currently has 3 operational CCUS facilities, 2 CO₂-EOR projects in Saudi Arabia and Abu Dhabi and a CCS project in Qatar

The US's mature fossil fuel industry combined with investment from the DOE's Office of Fossil Energy has resulted in a strong pipeline of lower cost CC projects

Regional considerations

- **United States:** leaders in CCUS due to an abundance of oil and gas reserves, 45Q tax credit incentives for CCUS projects and public partnerships driving technology development
- **Australia:** gas companies need to quickly adopt to CCUS to continue operating under Australia's ambitious 2030 GHG reduction target (26-28%)
- **Canada:** hopes to capture and store 15 million tons of CO₂ per year by 2030. This is expected to contribute to the country's goal of reducing GHG emissions by 40–45% from 2005 levels
- **Norway:** initiative "Longship" is solely committed to facilitating a cost-effective solution to CCUS, with up to 2/3rds of funding for CCUS projects being provided by the government
- **United Kingdom:** government approach sets out the plan to deliver 4 CCUS low carbon industrial clusters. The North Sea offers high potential for storage due to extensive reservoirs, good geology, existing infrastructure with appropriate regulations and low Nat Cat exposure
- **Japan:** is a global leader in the manufacturing industry, and CCUS could help keep many of its thermal power generation assets online while achieving their ambitious 2030 GHG targets (31% to 37% below 2013)

Regional plant size and status



CCUS provides a near-term solution for carbon emissions control in hard-to-abate sectors, insurance needs for stakeholders across the value chain are expected grow

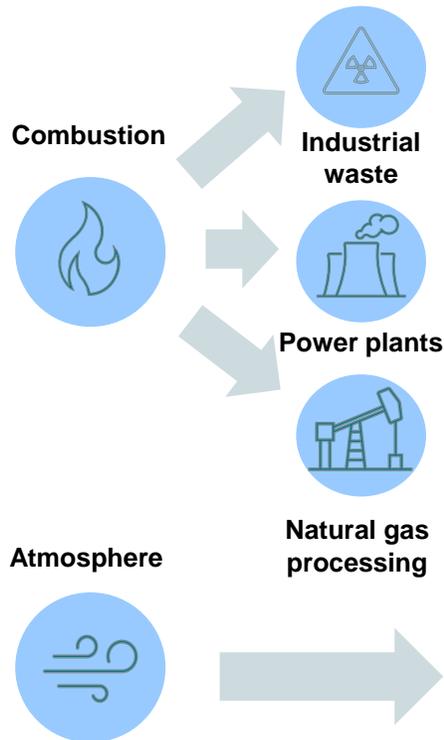
Overview

Investment

Value chain

Insurance COB

Insurance offerings



Post-combustion

- CO₂ is captured from the exhaust gases and most used by power plants

Pre-combustion

- Traps the CO₂ before burning the fossil fuel by using a gasifier to form synthetic gas. The hydrogen produced from this can be used as fuel, the production of fertiliser, chemical gas fuel, and power production

Oxyfuel combustion

- Burning the fuel in pure oxygen instead of air, produces only water and CO₂ allowing easy filtration. Used by modern power stations

Direct air capture

- It is possible to scrub CO₂ from the open atmosphere, but efficient processes are still being researched. The estimated energy needed is only slightly more than for capture from large emission



Pipelines

Pumping through pipelines is the cheapest and most reliable technology



Water



Rail and road tankers

Deep geological storage

- Also known as 'geo-sequestration', storage in deep geological formations such as: Sedimentary rocks, 'Un-mineable' coal and Saline aquifers

Mineral storage

- Captured CO₂ is reacted with naturally occurring iron (Fe), magnesium (Mg) and calcium (Ca) minerals.

Uses

- Power Stations: Enhanced oil recovery
- Food Industry: using CO₂ in soft drinks, dry ice for transportation
- Feedstock: convert to polymers, building materials, chemicals, and synthetic fuels
- Combine with hydrogen to produce fuel by combining it with hydrogen "Power-to-X" solution

Key stakeholders

- Power plants
- Steel, concrete manufacturers
- Refineries
- Food industries

Sourcing, processing/preparation, and storage are largely handled by the same stakeholders, with occasional specialist support

- Oil production companies
- Food industries
- Chemical plants
- Private fuel companies

Whilst the CCUS market is still developing, there is a clear opportunity for insurers to use their experience in tailoring standard products to transition innovation

(Re)insurance class of business impact



Accident and health



Casualty



Cyber



Financial lines



Marine, aviation, transport (MAT)



Motor



Property



Other

Impact

High Med Low -

Key coverage sought for CCUS projects

Other (construction): Construction/erection all risks (CAR/EAR), decennial liability and delay in start-up (DSU) coverage will become increasingly popular, as new projects exit design phases and begin construction in the coming years

Property: Operations cover related to business interruption and property damage

Environmental liability (casualty): Storage site leaks both onshore and offshore could impact the underlying ecosystem and cause environmental damage

Financial lines¹: Surety and trade credit coverages, e.g. for raw materials traded across international markets

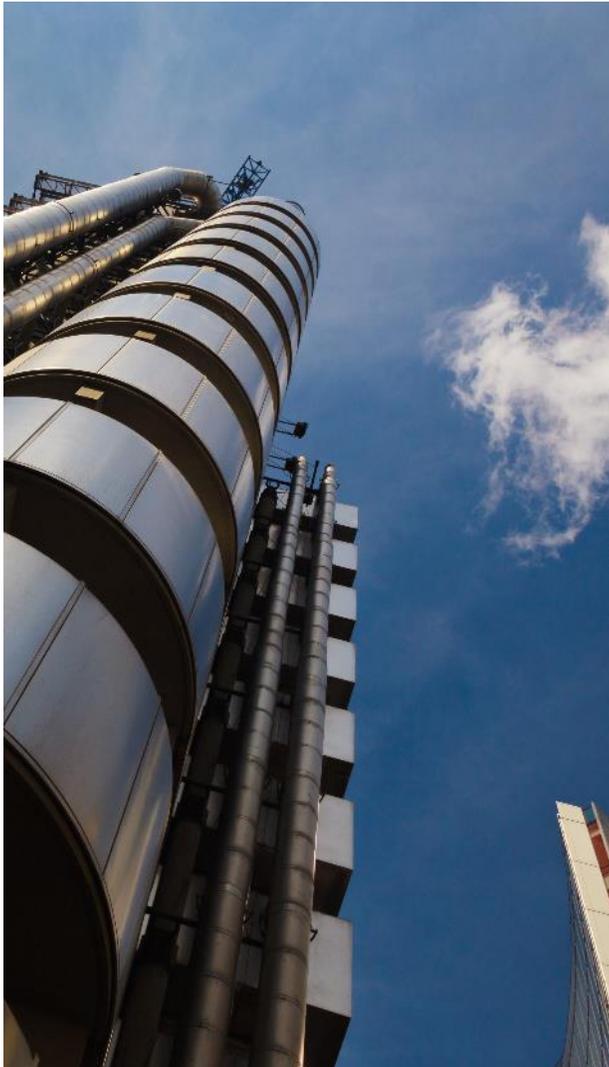
MAT: Pumping CO₂ through pipelines is the cheapest and most reliable technology, but there will also be instances of transportation on water or using rail or road tankers

Gaps in coverage currently offered

- **Construction** covers such as CAR/EAR, decennial, DSU and loss of well control are risks considered standard in the market and well covered by the construction market. However, as investment increases and the technology becomes more prolific there is like to be an increased need for specialist standalone insurance which is currently limited in the market
- Clusters, such as the East Coast Cluster in the UK, offer significant opportunity, as does the retrofitting of current processes for CCUS
- Few projects are expected to be **operational** in the short term, thus currently low demand exists for operational programmes
- The operational stage poses additional complexity due to variance in the business models of CCUS clients compared to traditional energy clients e.g. Exploration & Production (E&P) clients
- **Liabilities related to CO₂ storage** and “cavern integrity” have generally been considered “uninsurable” by the market with no insurance coverage available
- Additionally, there is **limited cover for CO₂ leakage indemnity** due to a lack of detailed understanding in the market of the geology
- Few carriers are offering third party liability, pollution clean-up under construction, operational, decommissioning and post-close phases
- Limited cover available in the market to cover **leakage risk and associated loss of carbon tax breaks or tax credits**
- Cover not generally available for revenue guarantee or technology performance issues
- **Pipelines cover** is available via natural resources teams and marine transport via marine teams

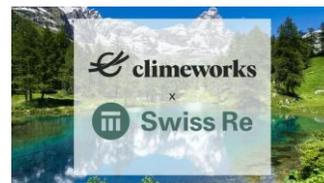
CCUS construction risks are typically well supported by the insurance industry, with new solutions emerging to cover more specific risks related to carbon capture

Example market offerings



Provider	Product description
	<ul style="list-style-type: none"> – Long-term insurance structures for the operation and maintenance of carbon capture, utilisation and storage infrastructure – Also provides insurance to cover the loss of value of the carbon captured if there is a failure of containment
	<ul style="list-style-type: none"> – Through its wholesale business arm, Ironshore, Liberty Mutual has expressed ambitions to broaden its environmental liability coverage to protect against CCS risks (through SPILLS¹ and CELL² product lines), which could include pollution cover, financial insurance, and tax credit cover – Liberty would evaluate coverage options on a risk-by-risk basis
	<ul style="list-style-type: none"> – Zurich offers Carbon Capture and Sequestration (CCS) liability insurance, which covers losses associated with these operations – It also offers 'Geological Sequestration Financial Assurance' which ensures a steady source of finance after a plant closes to "cap" the well and monitor the carbon stored
	<ul style="list-style-type: none"> – Aon is in the process of developing a variety of products to support the Construction and Operations lifecycle of CCS projects, with pre-and post-combustion capture technologies, Direct Air Capture and CO₂ Enriched Concrete, as well as other technologies in scope
	<ul style="list-style-type: none"> – Howden has launched a first-of-its-kind insurance facility covering the leakage of carbon dioxide (CO₂) from commercial-scale carbon capture and storage facilities

Example industry partnerships



Climeworks and Swiss Re strategic partnership

- Orca was the first Direct Air Capture (DAC) facility of scale in the world and is an initiative by Climeworks
- Swiss Re committed to its own net zero operational emissions by 2030 through a 10-year DAC and storage purchase agreement with Climeworks, along with agreement to collaborate on developing risk management knowledge and risk transfer solutions

Notes & Sources (1)

Page number	Source	Notes
3	IEA; International Council on Clean Transportation; McKinsey Insights: Scaling the CCUS industry to achieve net-zero emissions; Global Data; McKinsey; UN PRI	1. The total 2025 global market size estimates for both operational and capital expenditure were obtained from IEA Net Zero and UN PRI Forecast Policy Scenarios
4	IEA	1. According to the Base Case – Forecast Policy Scenario (UN PRI)
5	TFM Data; Global Data; IEA; IRENA	Investment figures shown are based on Base Case – Forecast Policy Scenario (UN PRI) only
6	GlobalData; US Department of Energy	Pipeline figures are based on projects completed but not currently in use, currently under construction and future projects that have been announced
7	Global Data; IEA; Company websites	
8	Global Data; IEA; Carrier websites	1. Subject to product designs adhering to regulatory guidance and requirements
9	Carrier websites; SMI ITF 2022 products and services showcase; Climeworks; UN PRI; IEA	1. SPILLS – Site Pollution Incident Legal Liability Select; 2. CELL – Contractors Environmental Legal Liability

Disclaimers

This document is not intended for distribution to, or use by, any person or entity in any jurisdiction or country where such distribution or use would be contrary to local law or regulation. It is the responsibility of any person communicating the contents of this document, or any part thereof, to ensure compliance with all applicable legal and regulatory requirements.

The content of this document does not represent a prospectus or invitation in connection with any solicitation of capital by Lloyds. Nor does it constitute an offer by Lloyd's to sell securities or insurance, a solicitation of an offer to buy securities or insurance, or a distribution of securities in the United States or to a U.S. person, or in any other jurisdiction where it is contrary to local law. Such persons should inform themselves about and observe any applicable laws.

This document has been produced by Lloyd's and Aon plc or its affiliates ("Aon") for general information purposes only and is not intended to address the circumstances of any particular individual or entity.

While care has been taken in gathering the data and preparing this document, Lloyd's and Aon do not make any representations or warranties as to its accuracy or completeness and expressly excludes to the maximum extent permitted by law all those that might otherwise be implied. Lloyd's and Aon accept no responsibility or liability for any loss or damage of any nature occasioned to any person as a result of the acting or refraining from acting as a result of, or in reliance on, any statement, fact, figure or expression of opinion or belief contained in this document. This document does not constitute advice of any kind.

No one should act on this document without appropriate professional advice after a thorough examination of the particular situation. Any recipient shall be entirely responsible for the use to which it puts this document. This document has been compiled using information available to us up to its date of publication.