



The CCS chain reaction:

Managing key risks can unlock decarbonization at scale

Tightening decarbonization obligations and limited abatement options for heavy industry have pushed carbon capture and storage (CCS) from a long-term aspiration to an immediate delivery priority.

Multiple hub-based and cross-border projects are now moving into late-stage development, bringing first-of-a-kind commercial and operational risks into sharp focus. While government support has reduced some early uncertainty, it will not persist indefinitely. For CCS to scale sustainably, every link in the value chain (capture, transport, and storage) must be commercially robust, contractually aligned, and capable of operating in a post-support environment.

Key takeaways:

- Governmental/policy long-term support is underpinning the CCS market, without incentives, the project economics don't stack up
- High levels of interdependency between links in the value chain means the entire chain needs to be examined as a risk ecosystem, not in silos
- Contractual/liability alignment throughout the chain is critical for success

Making CCS project economics stack up: The critical issue

The relative abundance of CO₂ and its low inherent value mean the numbers don't align. CCS models should not be commercially feasible on paper. To overcome

this and facilitate transition pathways, governments have introduced mechanisms (typically carbon taxes or compliance cost regimes) to make CCS commercially viable. These policy frameworks remain the primary driver of project economics.

Without sufficient throughput, CCS projects struggle to achieve viable cost per ton. The underlying commercial proposition is simple: storing CO₂ must remain cheaper than the financial penalties for emitting it. But this relies heavily on policy and carbon pricing stability. Any sustained shift in government stance undermines the market overnight.

Governments also seek assurance that stored CO₂ remains securely contained. As a result, CCS projects must absorb long tail liabilities, including the risk of future releases, potential revocation of carbon credits, and obligations to re capture and re store any leaked CO₂. These exposures significantly narrow the pool of organizations willing to participate.

Hub and cross-border models both face the added complexity of aligning contractual liabilities across multiple parties and sometimes differing legislative frameworks.



With substantial uncertainty and long-duration risks, success hinges on ensuring that risk allocation is clear, consistent, and appropriately mitigated across the value chain



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CCS value chain stage one: Emitters

Emitters form the first building block of the CCS chain, but final investment decisions will only progress once management teams can understand and manage the associated technical, financial, and counterparty risks. Some exposures are familiar to insurers but new to emitters; others are entirely novel and require bespoke risk-transfer solutions.

Key considerations for emitters include:

- **High CAPEX and increased OPEX:** Developing new capture facilities or retrofitting existing plants requires significant capital investment. Capture operations are energy-intensive, driving materially higher operating costs that must be absorbed or hedged
- **Construction delays:** Delays in commissioning capture units may reduce access to expected tax incentives or expose emitters to compliance penalties if emissions exceed regulated thresholds during the transition period
- **Capture performance risk:** Under-performance, whether due to lower-than-modelled capture rates or CO₂ that fails to meet required specifications, reduces financial benefit and may trigger penalties. Clearly defined responsibilities and liability frameworks around capture performance are essential

- **Counterparty dependency:** Emitters are heavily reliant on transport and storage (T&S) operators. If CO₂ cannot be off-taken as planned, whether due to constrained injection rates, offshore outages, or port bottlenecks, the full value of the capture investment cannot be realized. In some jurisdictions, local emissions limits may even require emitters to curtail operations until the network returns to service

Collectively, these factors shape the bankability of capture investment and underscore the interdependence between emitters and the wider CCS chain.

CCS value chain stage two: Transport

The transport phase introduces a broad spectrum of risks — commercial, operational, environmental, and regulatory. Misaligned interfaces or unclear liability allocation can disrupt the entire chain, underscoring the need for precise contracting from receipt to delivery.

Key transport-specific risks include:

- **Low utilization levels:** Throughput is central to the economics of transport assets. Underutilization caused by issues upstream at the capture site or downstream at the storage facility can lead to disputes over tariff payments and threaten the revenue base required to justify large upfront CAPEX. Transport operators

typically seek contractual protection against this risk, with implications for emitters and storage providers

- **Off-spec CO₂:** If CO₂ fails to meet agreed specifications and is rejected, throughput drops and similar revenue and contractual issues arise. Clearly defining responsibility for damages or remediation associated with off-spec CO₂ is a critical component of any transport contract
- **Leaks and ruptures:** Release events can trigger environmental liabilities, create operational downtime, and disrupt the entire value chain. Pipeline depressurization, temporary blockages, and required inspections or repairs can all lead to extended outages with financial implications for multiple parties
- **Maritime conventions:** When CO₂ is transported by ship, additional regulatory obligations apply, including compliance with International Maritime Organization (IMO) rules and liability conventions. These risks differ from pipeline exposures and require tailored contractual and insurance responses
- **Interface misalignment:** Transport systems rely on clearly defined handover points, metering arrangements, and volume/quality acceptance criteria. Misalignment can create gaps in liability, disputes over performance, or mismatches in the risk assumed by each party

- **Cross-border regulation:** International movement of CO₂ adds another layer of complexity, particularly where jurisdictions differ in how they classify CO₂ (e.g., waste vs commodity) under frameworks such as the [London Protocol](#). Divergent regulatory regimes can influence permitting timelines, liability transfer, and long-term compliance obligations

The transport phase embodies a wide spectrum of risks ranging from off-spec CO₂ to international regulatory exposure. A clear understanding of responsibilities from receipt to delivery, supported by aligned contractual risk allocation, is fundamental to project success.

CCS value chain stage three: Storage

As the long-term custodian of injected CO₂, the storage operator carries the greatest concentration of regulatory and long-tail liability risk. Their ability to demonstrate geological performance, manage pressure, and satisfy monitoring obligations directly affects the credibility and bankability of the overall project.

Key storage-related risks include:

- **Throughput dependency:** Injection into subsurface formations is slow and continuous, making predictable feedstock volumes essential. Any disruption upstream

reduces utilization, increases operating costs, and can undermine the commercial assumptions underpinning the storage facility

- **Geological constraints:** Even with extensive seismic studies, modelling, and test injections, reservoirs do not always behave as anticipated. Lower-than-expected injectivity or storage capacity can reduce total available volumes for storage, extend project timelines, or drive significant OPEX increases for pressure management or well interventions
- **Pressure management and plume migration:** Storage operators must actively monitor reservoir pressure and track plume development. Elevated pressures can restrict injection rates or require additional operational measures, while unexpected plume migration can jeopardize permit compliance and trigger remediation or redesign requirements
- **Long-term oversight:** Depending on the jurisdiction, operators may be required to monitor, verify, and maintain site integrity for decades after closure. Demonstrating long-term financial capacity to meet these obligations remains a key concern for investors and insurers and is often a precondition for regulatory approval
- **Regulatory requirements:** Storage operators must validate injected CO₂, comply with monitoring and reporting obligations, and meet all conditions





The blend of first-of-a-kind risks, differing regulatory frameworks, and divergent contractual structures across projects creates systemic challenges that investors and insurers need to assess holistically. As a result, every part of the value chain is scrutinized for clarity on liability transfer, revenue certainty, and counterparty resilience. The most successful projects recognize this early and design their frameworks to ensure clear interfaces, aligned risk allocation, and robust mitigation from the outset.



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attached to their storage permit. They must also ensure that post-closure monitoring is completed to the regulator's satisfaction so that long-tail liability can be transferred to the state at the appropriate time. Any failure to demonstrate permanence or maintain compliance can result in penalties, corrective actions, or delayed liability transfer

The storage operator acts as the crucial interface between the government and the wider value chain, carrying significant operational and long-term responsibility. Their ability to manage these risks effectively is fundamental to the credibility and bankability of the entire CCS project.

Looking ahead: The need for a comprehensive risk solution

For CCS projects to remain viable, each building block of the value chain must operate in a coordinated and resilient manner. If any link fails, whether through operational disruption, misaligned liabilities, or regulatory non-compliance, the entire chain can quickly unravel.

The interdependence of CCS projects creates unique risks for every participant, but these exposures can be managed effectively. The insurance industry is innovating

comprehensive solutions to eliminate gaps in coverage and support the entire network of risks across the CCS value chain.

As the market matures, greater standardization and familiarity will reduce uncertainty, improve bankability, and ultimately unlock easier access to investment and insurance capacity.

To find out how insurance can help to keep the entire value chain moving, contact:



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This update analyses our observations of the current global market conditions for renewable energy insurance and the impact this has on insurance buyers. This update is based on our observations of the market for our WTW clients and is not a whole of market review.

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