Financing CCUS at Scale

How to mobilise private capital

International Energy Agency

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Abstract

Carbon capture, utilisation and storage (CCUS) is an important area of attention for governments and financiers as both look to balance policy and investment goals. Recent financial investment decisions of major projects show promise in a sector that is gaining momentum, but its future success depends on viable business models and effective risk allocation across the value chain.

In this context, *Financing CCUS at Scale* is the IEA's latest report on what it takes to move CCUS projects from the drawing board to operation. Building on expert interviews with leading financial institutions, the report investigates the distinctive economic and financial characteristics of CCUS projects, the impact of business models on commercial viability, and how CCUS projects have been financed to date. Based on these insights, the report provides targeted recommendations for policymakers on how to design policy, regulatory and financial frameworks that can more effectively crowd in private capital.

The handbook is supported by the IEA CCUS Projects Database and complements the IEA CCUS Handbooks on CCUS Policies and Business Models, Legal and Regulatory Frameworks for CCUS and on CO_2 Storage Resources and their Development.

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Executive summary

The current wave of investment in carbon capture, utilisation and storage (CCUS) is larger and more geographically diverse than ever before. Momentum in private capital flowing into projects is reflected in the more than 30 final investment decisions (FIDs) that have been reached in the past 2 years alone, particularly in Europe and North America, and in key sectors including transport and storage, industry, and power. Investment has grown more than 15-fold since 2020, reaching over USD 5 billion in 2025. The pipeline of projects currently under construction suggests that after years of incremental capacity additions, operational capture capacity is set to nearly double by 2030 – and even more projects are at the planning stage.

These developments represent significant milestones for a sector in which projects are complex, difficult to finance and faced with unique risks. At its core, the challenge for CCUS is commercial viability. In contrast to other clean energy technologies, CCUS manages CO_2 – a product with little intrinsic market value and limited standalone demand. This fundamental constraint is compounded by several distinctive risks. As new business models develop around hubs or CCUS services, project developers must co-ordinate capture facilities, transport infrastructure and storage sites across a connected value chain, creating cross-chain risks and complex contractual relationships. Long-term liability for stored CO_2 raises questions about how risks should be allocated over time. Although the operational track record is growing – with more than 9 000 km of CO_2 pipelines and over 70 large-scale capture facilities in operation – projects remain relatively bespoke, and some risks, such as long-term monitoring and post-closure storage liability, have limited real-world precedents. All of these factors complicate risk assessment and financing.

Scaling CCUS will require financing approaches that can accommodate new project structures and a wider set of financiers. As CCUS moves into new business models, financing must adapt to a widening set of project sponsors with limited balance-sheet capacity, and to hub-based joint ventures that require robust risk-allocation arrangements. Project finance is emerging as a solution to allow firms to preserve capital and distribute risks: more than USD 15 billion in commercial debt has been raised over the past 2 years, primarily through a handful of landmark non-recourse transactions in Europe and North America. Venture capital and growth equity have also supported technology and infrastructure developers, but project-level private equity investment remains limited and largely concentrated in North America. Unlocking large-scale private capital will require widening the pool of participating investors and lenders, from commercial and development banks to insurers and institutional investors.

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Interviews conducted by the IEA with a dozen financial institutions indicate that appetite for CCUS is increasing among financiers, but participation remains concentrated because these structures depend on predictable revenue models and clear risk-allocation frameworks across the value chain.

Targeted policy support and carefully designed risk-allocation frameworks have helped several projects to reach FIDs. Governments have earmarked more than USD 50 billion in public support for CCUS projects over the past 3 years, a record amount, and early signs of regional differentiation in financing approaches are beginning to emerge. In Europe, the shift towards long-term revenue and risk-sharing mechanisms rather than upfront grants is enabling a new phase of CCUS deployment, with multiple projects advancing to construction or operation, including several early project-financed transactions. In North America, many risks are addressed commercially, but revenue support through tax credits and long-term agreements for carbon credits – combined with experience and infrastructure from the oil and gas sector – has enabled several projects to move forward, including CO_2 transport networks serving bioethanol plants in the United States. Elsewhere, private finance participation remains limited, with state-backed companies integrating CCUS development into oil and gas value chains, notably in the Middle East and Asia Pacific.

Ensuring that the current momentum extends beyond a small number of projects will require policy support that supports viable business models. Around 90% of projects announced for 2035 have yet to reach FID, and a number of projects have already been cancelled or withdrawn from government tenders in the face of uncertain financing conditions. Projects targeting carbon dioxide removal and hydrogen production with CCUS, in particular, have struggled to secure offtake agreements, leading to project cancellations in many regions. In Denmark, 80% of industrial bidders pulled their proposals from consideration in a recent auction after cross-chain risks could not be managed.

Given the limits to government funding, support must become more targeted as the operational track record builds. Early-stage public funding remains essential, particularly where private investors are unwilling to assume first-of-a-kind risks. Over time, however, support mechanisms may evolve from direct grants and capital funding toward more focused risk-sharing instruments, such as long-term revenue guarantees or liability frameworks that remain on public balance sheets. This would enable funding to be targeted where it is most efficient. Risk allocation is also likely to shift as new actors enter the sector and operational experience grows. In some parts of the value chain and in certain jurisdictions, public involvement may remain necessary to underpin investment, while in others, private actors could increasingly assume operational and financial risks. Identifying which actors can step in, and what conditions are needed to enable them to do so, will be critical for scaling CCUS deployment in the years ahead.

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Policy priorities to scale and mobilise finance for CCUS

Scaling CCUS will require aligning business models, policy frameworks and financial structures. The recommendations below highlight actions governments and financial actors can take to strengthen project bankability, reduce uncertainty across the value chain and build the foundation for a sustainable market for CCUS.

1. **Support bankable business models and viable risk-sharing mechanisms**. Governments can strengthen business models via stable carbon pricing, support for low-emissions products, and targeted instruments such as contracts for difference or tax credits. Clear risk allocation among stakeholders is essential; some risks, such as long-term storage liability, are likely to require ongoing public backstops in some jurisdictions.
2. **Ensure legal and regulatory frameworks are fit for purpose**. Durable frameworks provide certainty and regulatory clarity. They must evolve with operational experience, addressing emerging issues like third-party access, liability allocation and carbon market interactions. For cross-border projects, regional alignment on liability and carbon accounting will be important.
3. **Harmonise definitions and standards across the value chain.** Consistent standards, monitoring, reporting, verification and carbon accounting help to build credible markets for low-emissions products. Harmonised CO_2 specifications for transport and storage reduce operational risk and improve bankability.
4. **Strengthen risk assessment through data-sharing and early collaboration.** Operational data is critical for financiers and insurers, and structured data-sharing from public projects can improve transparency. Early collaboration among developers, governments, financiers and insurers clarifies risk allocation and supports the creation of tailored financial and insurance products.
5. **Increase development funding resources to assess CO_2 storage resources.** Limited knowledge about geological storage limits deployment, especially in emerging markets, but site characterisation can be costly. Multilateral development banks, development finance institutions and export credit agencies can provide support to unlock private investment.
6. **Recognise CCUS in sustainable finance taxonomies and transition finance frameworks.** This would expand the investor base and access to instruments like green and sustainability-linked bonds. Clear eligibility criteria across regions can also boost credibility and broaden access to capital, including across borders.
7. **Learn from other capital-intensive sectors.** Lessons from renewables, electricity networks and oil and gas show that long-term contracts, regulated returns and capacity booking systems can provide revenue certainty for large infrastructure. Adapting these approaches to CCUS can manage volume risk, co-ordinate infrastructure and support financing of transport and storage hubs.

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The strategic challenge of financing CCUS at scale

CCUS plays an important role in reducing emissions

Carbon capture, utilisation and storage (CCUS) encompasses an important suite of technologies that could help deliver a low-emissions, secure and affordable energy system. In several key sectors, targeted CCUS deployment is crucial to enable emissions reduction and support competitive low-emissions industrial production, and to help align investment strategies with corporate sustainability goals. One of the most important roles is the capture of hard-to-abate process and combustion emissions in industries such as cement, steel and chemicals, where alternative technology pathways can be more costly or are less available. CCUS can also enable the low-emissions production of hydrogen.

In some contexts, and under certain technical conditions, CCUS can represent an important economic option to sustain the operation of young, fossil-based power assets with lower emissions, helping maintain affordability, jobs and competencies in emerging economies, which are home to much of this capacity. It can also represent a business alternative for countries with depleted oil and gas fields, offering extensively studied options to permanently store CO_2 while leveraging the knowledge of the existing workforce.

CCUS also includes several approaches that enable CO_2 removal from the atmosphere – such as the capture and storage of emissions from bioenergy (BECCS), or direct air capture (DAC). When paired with permanent CO_2 storage, these technologies can balance the residual emissions from industry, agriculture and long-distance transport, which are particularly costly to abate, as well as reduce the carbon that is already in the atmosphere. When the captured CO_2 from these sources is utilised instead of stored, it can provide a non-fossil source of carbon in sectors to substitute fossil carbon as a feedstock in the production of chemicals and synthetic fuels for long-distance transport.

Apart from captured CO_2 used for enhanced oil recovery (EOR), projects linked to dedicated, permanent storage have relied on some level of public funding. This is not surprising: in the absence of a natural market for stored CO_2, governments have stepped in to support projects. Multi-billion-dollar funding packages are now supporting first-of-a-kind (FOAK) projects in the United Kingdom, Norway and European Union. The level of public funding going to CCUS projects over the long-term remains uncertain, but the need to move to a more commercial market is

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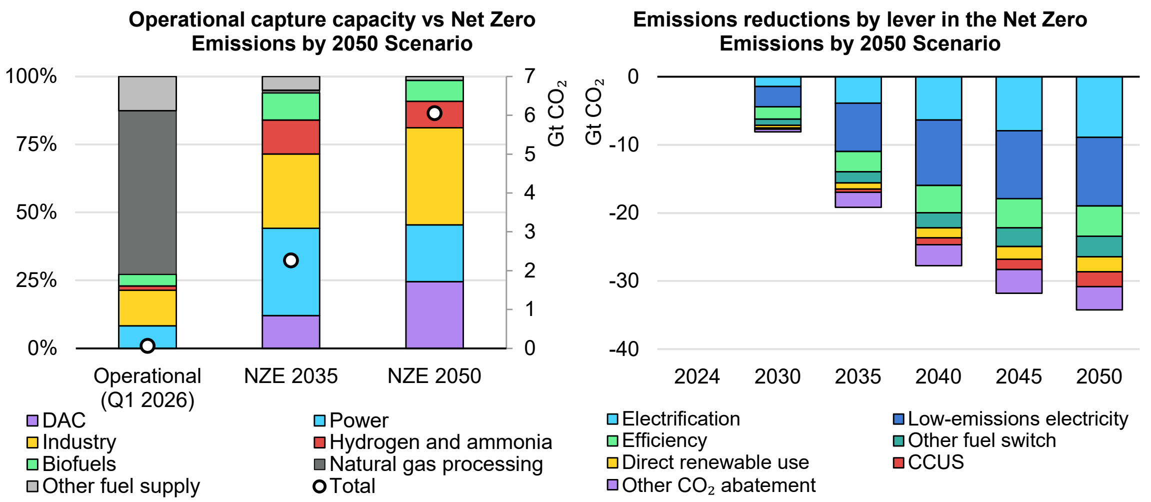
widely recognised. Bankable business models and more sources of finance will be needed to sufficiently scale CCUS beyond the 50 Mt per year of operating capture capacity today.

In the IEA's exploratory scenarios – the Current Policies Scenario (CPS) and the Stated Policies Scenario (STEPS) – CCUS growth remains modest, reflecting today's policy momentum and support levels. Capacity is several orders of magnitude lower than the capacity levels in the IEA Net Zero Emissions by 2050 Scenario (NZE Scenario), in which billions of tonnes of CCUS capacity are deployed in the next couple of decades (see box below).

While recent momentum has put CCUS on a more positive trajectory, the gap to the IEA NZE Scenario pathway remains very large, and a far greater level of investment will be required for the technology to scale in a meaningful way.

The role of carbon capture, utilisation and storage in IEA scenarios, 2030-2050



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Notes: DAC = direct air capture; CCUS = carbon capture, utilisation and storage; NZE = Net Zero Emissions by 2050 Scenario..

Sources: IEA analysis based on IEA (2026), CCUS Projects Database; IEA (2025), World Energy Outlook.

Given that CCUS primarily targets decarbonisation, deployment is very dependent on policy support; in IEA scenarios, its role is largest in the NZE Scenario.

CCUS in IEA scenarios

The role of CCUS in the future energy system will largely depend on policy choices. The CPS and STEPS do not target any particular outcome but rather offer different possible views of future energy systems based on policies. The CPS is anchored in enacted laws and measures, while the STEPS has a more dynamic reading of policy

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settings that may include measures that have yet to be formally adopted, subject to relevant market, infrastructure and financial constraints.

In the CPS and STEPS, deployment is low and limited in scope. Capacity scales up to around 150-160 Mt by 2035 and 270-300 Mt by 2050, with gas processing making up around 20% of capacity in 2050.

In contrast, the NZE Scenario represents a pathway to reducing global energy-related CO_2 emissions to net zero by 2050. In this scenario, capture capacity scales up from around 60 Mt CO_2 per year in 2025 to 2.3 Gt by 2035, and 6.1 Gt by 2050, providing around 6% of global emissions reductions relative to the current level by 2050.

Beyond the major difference in scale, the NZE Scenario also represents a sectoral shift, as CCUS expands from historical deployment focused on low-cost, high-concentration sources paired with EOR, to newer, higher-cost applications paired with dedicated CO_2 storage. While natural gas processing makes up around 60% of the 60 Mt CO_2 of operating capture capacity today, biogenic and air capture, industry, fossil power and hydrogen make up 99% of deployment by 2050.

Global investment needs to scale across a range of scenarios

Global annual investment in CCUS has grown sharply, from around USD 0.3 billion in 2020 to more than USD 5 billion in 2025,[1] driven by a renewed interest in CCUS from governments and companies across several sectors. This exceeds investment in the previous wave of the early 2010s, when CCUS was poised for a major expansion as a result of public economic stimulus packages to address the 2008-2009 financial crises. In the end, few projects reached commissioning and spending plummeted in 2017 after several countries withdrew their support.

Importantly, the current wave of investment is also significantly broader than before, with projects now spanning multiple sectors, including those that typically involve more dilute CO_2 streams and therefore higher capture costs, or the development of transport and storage infrastructure. The past 2 years have seen several milestones, including final investment decisions (FIDs) on the world's first natural gas power plant with carbon capture and storage in the United Kingdom and the world's largest CO_2 removal facility in Sweden. CCUS deployment in the cement sector is also accelerating, with the biggest capture facility ever applied to a cement plant starting operation in Norway and an even larger capture facility

[1] Estimated annualised investment over the construction time of projects, assuming investment starts the year of final investment decision.

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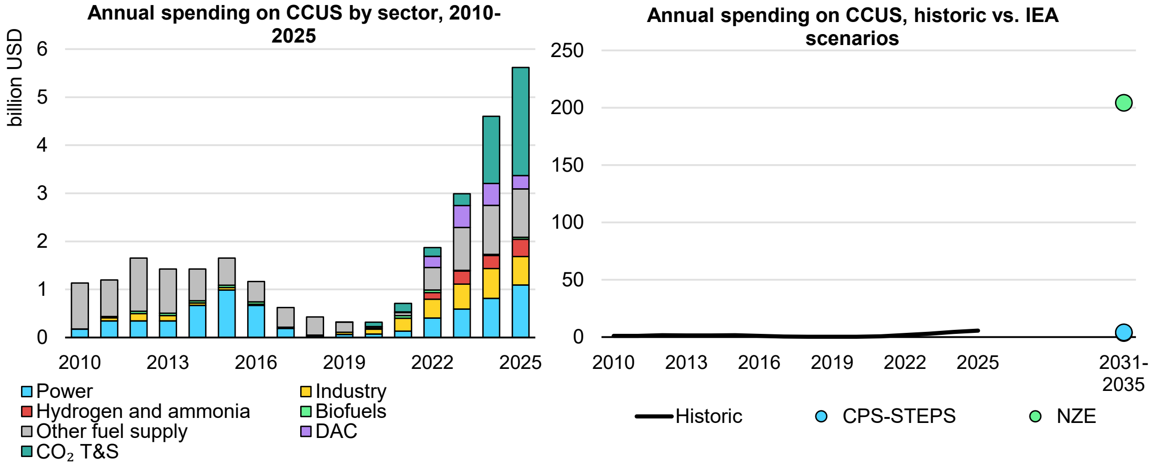
reaching FID in the United Kingdom. In addition, two large CO_2 storage projects in Norway and Australia began operations, and Europe's second storage hub is expected to start operations later this year in the Netherlands.

Historical annual spending on carbon capture, utilisation and storage by sector, and annual spending compared to investment needs in the different scenarios, 2010-2035



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Notes: DAC = direct air capture; T&S = transport and storage; CPS = Current Policies Scenario; STEPS = Stated Policies Scenario; NZE = Net Zero Emissions by 2050 Scenario. Estimated spending annualised over the construction time of projects. 2031-2035 represents annual average spending between 2031 and 2035.
Source: Analysis based on IEA (2026), CCUS Projects Database.

Investment in CCUS has increased more than 15-fold since 2020, but would need to increase 35-fold to reach average annual spending in 2035 in the NZE Scenario.

Deployment is also widening geographically. In 2020, close to 60% of all projects in operation and under construction were located in North America, but today that share has fallen to around 45%, reflecting the sector's growing international reach. Europe has emerged as a key hub, with major developments underway in Denmark, Italy, the Netherlands, Norway and the United Kingdom. Indonesia has reached its first FID for a large-scale project, while both the Middle East and China now have as much or more CO_2 capture capacity under construction as Europe. In India, which currently only has a handful of small-scale pilot projects operating, the government has announced plans to allocate USD 2.2 billion over the next 5 years as part of its 2026-27 federal budget.

While these levels are consistent with the CPS and STEPS, far greater investment would be needed for CCUS deployment in the NZE Scenario. In the latter scenario, average annual spending on CCUS projects around the world would need to scale to over USD 200 billion between 2031 and 2035, requiring significantly higher levels of private capital.

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Private capital can help fill the financing gap

Public funding has been central to recent progress, with governments committing more than USD 50 billion in support over the past 3 years specifically to CCUS projects. Yet, while important, it is clear that such historically high levels of public finance are unlikely to continue in the longer-term, underscoring the need to target public support to the areas most needed and to develop bankable business models for CCUS to attract greater private capital.

Historically, CCUS projects have relied on a business model underpinned by EOR. The costs for constructing and operating CCUS facilities were supported by the cash flows from the underlying oil and gas project itself, or through the additional sales resulting from increased oil production. Put simply, early projects benefited from the sale of a tangible item – oil in this case.

However, the sector is evolving. CCUS projects are increasingly expanding beyond EOR to dedicated storage sites in saline aquifers and depleted oil and gas fields. While only 20% of operating storage capacity today is for dedicated sites, the project pipeline shows that this could jump up to over 90% by 2035. This puts pressure on projects to present a viable business model. Unlike the EOR-based business model, dedicated storage projects do not produce a standalone commodity and currently there is little appetite among off-takers to pay a premium for low-emissions products enabled by CCUS.

Recent FIDs show that a business case for projects linked to dedicated storage can be made in the right policy environment and with the right risk-sharing mechanisms. Projects in the United Kingdom benefited from strong government backing to cover revenue and cross-chain risks, while in Sweden the sale of carbon removal credits enabled a project to move ahead. However, replicating these models at scale remains challenging. Scaling them across more projects will require government policy that supports a competitive business case and clear risk-allocation mechanisms among stakeholders. Around 90% of projects announced for 2035 have yet to reach FID, and a number of projects have already been cancelled or withdrawn from government tenders in the face of uncertain financing conditions, including in Denmark, Sweden and the United Kingdom.

Greater use of public funding in more capital-efficient forms will also be critical. This includes shifting from upfront grants towards instruments such as long-term revenue guarantees, contracts for difference (CfDs), or other contingent support that can be held on public balance sheets rather than immediately disbursed. As the market continues to evolve, governments may look for ways to support CCUS from the public balance sheet. This would allow for a reduction in the government's financial burden while maintaining the necessary risk mitigation required for private sector participation.

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Mobilising private capital at scale will also require attracting a broader range of financial actors over the full project lifecycle. Early-stage development faces persistent financing gaps and revenue support discussions remain behind – particularly in emerging and developing economies which make up two-thirds of cumulative CO_2 captured to 2050 in the NZE Scenario. However, once projects are operational and risks are reduced, there is greater scope for institutional investors, such as pension funds, and other private financiers to play a larger role in refinancing and long-term ownership.

Ultimately, scaling private investment in CCUS will depend on a clear and shared understanding of the risk-adjusted returns across different markets and project stages, and how these risks can be appropriately allocated across the value chain and over time between public and private stakeholders.

Purpose and contribution of this report

This report aims to assess how more private capital can be leveraged to finance CCUS projects. Unless otherwise stated, much of the report covers projects that capture and store CO_2, rather than those that utilise or remove it.

The report first investigates the distinctive economic and financial characteristics of CCUS projects, and the impact of business models on commercial viability. It then examines how CCUS projects have been financed to date, including the roles of public support and finance structures.

Building on this analysis, the report identifies priorities for risk mitigation and allocation, drawing on evidence from recent FIDs, project structures and the emerging operational track record of CCUS projects. Based on these insights, the report provides targeted recommendations for policy makers on how to design policy, regulatory and financial frameworks that can more effectively crowd in private capital.

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Distinctive economic and financial factors for CCUS projects

The bankability of CCUS projects depends on the underlying business model

The fundamental challenge for CCUS is commercial viability. Unlike other clean energy technologies, CCUS does not produce a standalone commodity: there is no natural market for captured and permanently stored CO_2, and its use is currently limited to niche markets. Revenues must instead be created through policy mechanisms, linked industrial outputs or ancillary markets. As a result, the choice of business model is central not only to cash flow generation, but also to how risks materialise and propagate across the value chain, and who is best placed to manage these risks.

The primary difference between projects comes down to the objective – i.e. whether the purpose is to increase the production of hydrocarbons, such as through enhanced oil or gas recovery (EOR/EGR), or emissions reduction via dedicated CO_2 storage. This determines how projects generate revenue, and in turn, the level of public support needed.

Earlier business models relied heavily on revenues from selling captured CO_2 for EOR. This approach provided a clear commercial anchor, with oil production revenues improving debt serviceability and supporting early deployment, particularly for low-cost capture projects. However, the model is exposed to commodity price volatility and changing market conditions. The temporary shutdown of the Petra Nova project in the United States illustrates how reliance on oil-linked revenues can undermine project economics when market conditions change. In addition, the link to hydrocarbon production may constrain participation by climate-focused investors.

By comparison, the financing challenge for CCUS instead relates to business models for dedicated storage, which currently lacks a natural commercial revenue stream.

Projects could generate revenue through the sale of low-emissions products, such as through sale of near-zero emissions cement and steel or low-emissions fuels enabled by CCUS. While some early movers are willing to pay the price premium for these products, the market remains niche today. For projects that turn captured CO_2 into usable products, such as fuels, chemicals or materials, revenues are derived from product sales rather than storage services. Carbon intensity requirements for globally traded products, such as a carbon border adjustment

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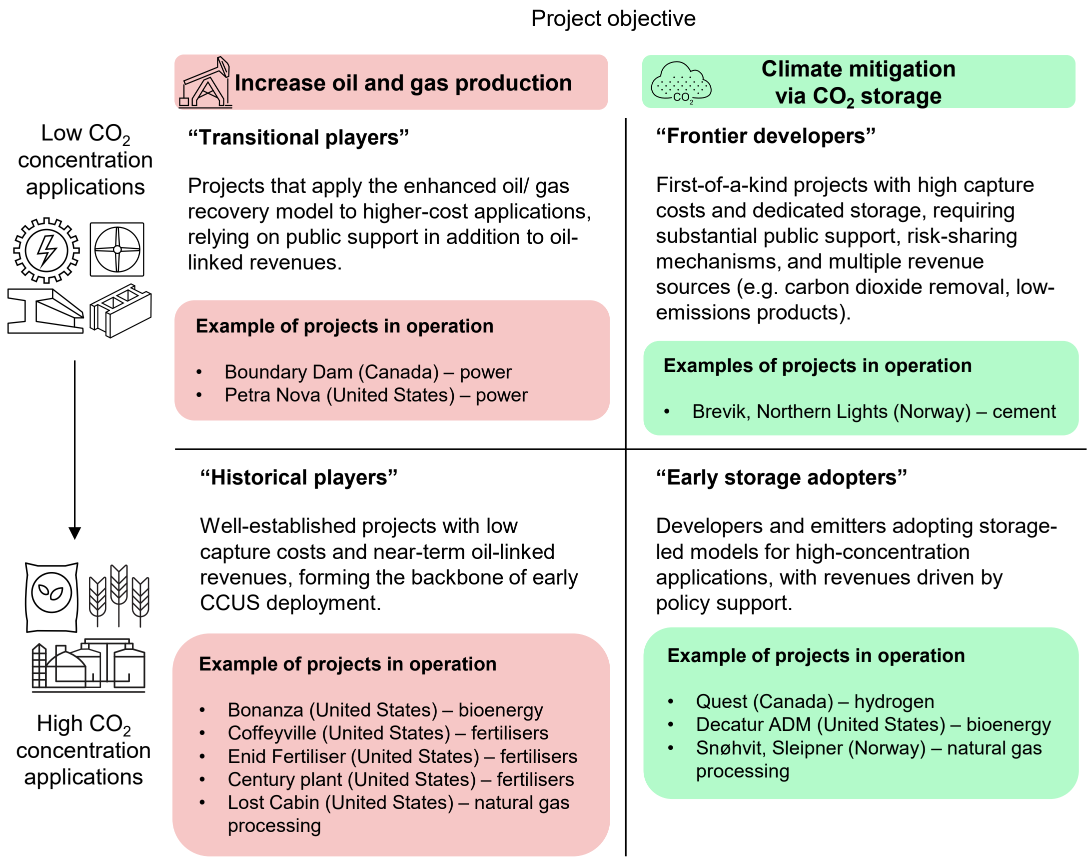
mechanism, could put pressure on export markets to invest in cleaner alternatives, although the ultimate impact on CCUS remains unclear.

Projects could also generate revenue through carbon markets. Within this framework, carbon dioxide removal (CDR) is emerging as a complementary business model that strengthens dedicated storage economics. Where captured CO_2 is of biogenic or atmospheric origin and permanently stored, projects can generate verified removal credits for voluntary carbon markets, creating an additional – often higher-value – revenue stream alongside policy incentives and contracted payments. The two main technology-based CDR options include bioenergy with carbon capture and storage (BECCS) and direct air capture with storage (DACS). While both can benefit from the sale of removal credits, DACS remains at an earlier commercial stage with continued reliance on targeted support and advance purchase agreements. Overall, CDR-based revenues can materially improve project economics but remain policy- and market-dependent, with activity concentrated among a limited number of buyers.

Examples of different business models for carbon capture, utilisation and storage projects



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Note: CCUS = carbon capture, utilisation and storage.

CCUS business models depend on whether project revenue is linked to increased oil and gas production or to dedicated CO_2 storage, influencing the level of public support and need for additional revenue sources.

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Compliance carbon markets, long seen as the long-term market driver for dedicated storage projects, have yet to provide material support, as CO_2 prices remain too low. The one exception is the Sleipner project in Norway, where the country's carbon tax played an important role. Further incentives for the development of dedicated storage projects could come from Article 6.2 of the Paris Agreement, which allows countries to exchange carbon credits. In 2025, Switzerland and Norway became the first countries to sign a deal on sharing carbon removal credits under this framework.

Public support mechanisms shape bankability

Absent a natural market for stored CO_2, public intervention plays a central role in shaping viable CCUS business models. Support can be delivered by a range of public actors, including national governments, sovereign wealth funds and state-owned banks, multilateral development banks (MDBs) and development finance institutions (DFIs), state-owned enterprises (SOEs), and export credit agencies (ECAs). Their interventions can be grouped into three broad areas: enabling conditions, capital support and risk-sharing mechanisms.

Enabling conditions facilitate CCUS deployment, rather than subsidise it, providing a supportive environment for projects and a platform to build from. This is the primary role of national governments, which establish clear legal and regulatory frameworks that provide a legal basis for CCUS activities, including the licensing, monitoring, and safe and secure storage of CO_2. Governments also negotiate and implement international agreements that enable cross-border projects, such as those under the London Protocol, and co-operation mechanisms under Article 6 of the Paris Agreement, which clarify how stored CO_2 and mitigation outcomes are accounted for between countries.

Capital support mechanisms are particularly important for FOAK projects and shared infrastructure with large upfront costs. Governments may provide grants directly, while sovereign wealth funds, state-owned banks, and MDBs or DFIs can offer concessional loans, long-tenor debt or blended finance structures. SOEs may also invest directly in strategic infrastructure. These instruments reduce upfront capital intensity and help absorb early-stage development and construction risks. This does not solve the long-term revenue challenges, but it can materially improve project economics and crowd in private co-financing once core regulatory conditions are in place.

Risk-sharing mechanisms can more directly address bankability constraints. Governments typically deploy contracts for difference, reverse auctions or regulated tariffs to reduce revenue risk and improve cashflow visibility. Public–private partnerships and direct equity participation by governments or SOEs can help manage cross-chain interface and performance risks. MDBs and DFIs may provide guarantees or political risk insurance, particularly in emerging markets,

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while ECAs support projects through export guarantees tied to equipment supply. While these tools do not eliminate risk, they redistribute it, often shifting low-probability, high-impact risks, such as policy discontinuity or long-term storage liability, towards the public sector, which is typically better placed to manage them.

Public support mechanisms for CCUS projects

Category	Policy instrument	Public entities	Examples
Enabling conditions	• Legal and regulatory frameworks • International agreements		Frameworks in Europe and parts of the United States, Canada and Australia have provisions for the **long-term liability** of stored CO_2. Agreements between countries are needed under the **London Protocol** and **Article 6** of the Paris Agreement.
Capital support	• Grants • Equity stakes • Loans		The **Innovation Fund** and **Connecting Europe Facility** are major grant programmes for CCUS in the European Union. The **European Investment Bank** and **Nordic Investment Bank** offered loans to a BECCS project in Sweden.
Risk-sharing mechanisms	• CfDs, reverse auction, regulated tariffs • Public–private partnerships • Offtake agreements • Export guarantees		The **Canada Growth Fund** can provide concessional debt or equity, CfDs, anchor equity and offtake agreements. **SOEs** in the Netherlands (EBN, Gasunie, Port of Rotterdam), Norway (Gassnova) and United Arab Emirates (ADNOC) help reduce cross-chain and performance risks.

Public entities				
Government	Sovereign wealth fund/ state-owned bank	Multilateral development bank/development finance institution	State-owned enterprise	Export credit agency

Note: For a more comprehensive view of government policies to support CCUS, please see IEA (2023), CCUS Policies and Business Models Report.

Risk considerations across the value chain

The CCUS value chain brings together multiple technologies, regulatory systems and commercial actors, each with its own risk profile. Furthermore, the technologies used vary and are still evolving, and each project's risk profile will depend on the technology's maturity, scale and whether it is a new build or retrofit, among other parameters.

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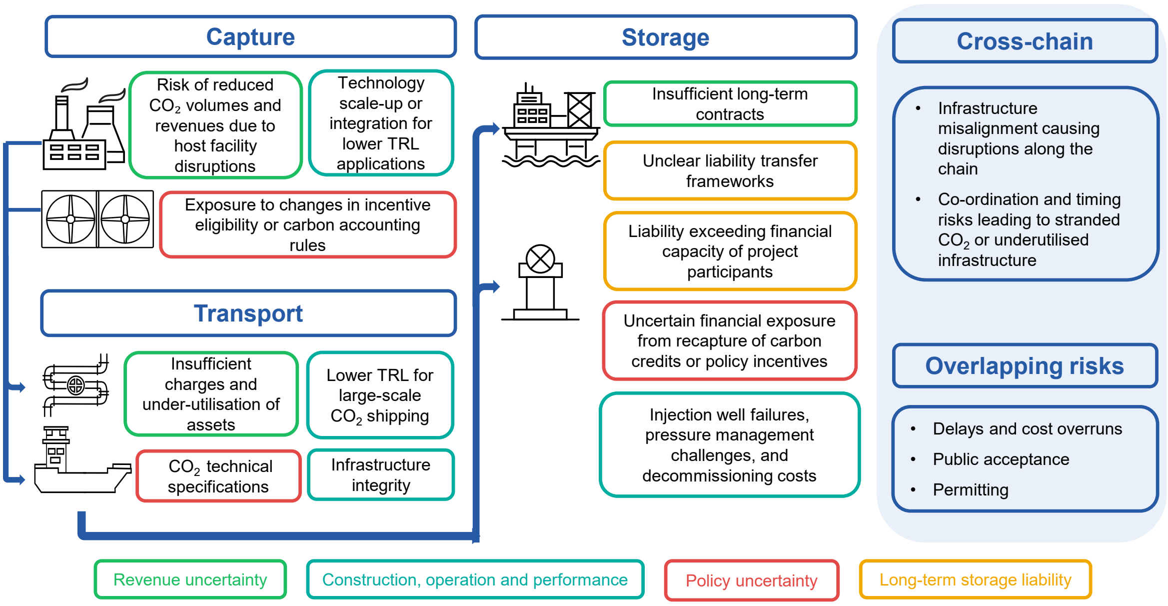
Financing CCUS requires confidence that each part of the value chain will perform reliably and in sync over long periods of time. For hubs, this also means a need to ensure a sufficient portfolio of supply from a range of emitters that enables the system to operate reliably. Yet each segment can face distinct sources of uncertainty, and risks in one part of the chain can quickly disrupt the viability of the others. Because the chain is only as strong as its weakest link, investors must consider how risks accumulate, interact and propagate across the value chain. Effective risk management and allocation is critical in this regard. The main categories of risks faced across the CCUS value chain are summarised below.

Overview of risks across the value chain for CO_2 capture, transport and storage



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Note: TRL = technology readiness level.

Each segment of the value chain has risks that can affect the viability of other parts of the chain, and investors must consider how these risks interact and spread.

Capture risks are primarily linked to the performance and reliability of capture equipment integrated into facilities

If the host facility reduces output, shuts down or experiences operational disruptions, CO_2 volumes available for capture may fall below contracted levels. Reduced capture efficiency can lead to missed emissions targets, lower revenues from policy incentives or carbon markets, and potential regulatory non-compliance. Operational downtime at the capture unit can also disrupt the overall project economics, particularly where revenues depend on continuous capture volumes. The operational track record of projects is covered in more detail in a dedicated section of this report.

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Technology maturity is an additional consideration. While several capture technologies are commercially proven in specific applications, others, particularly those applied to dilute emissions streams or new industrial processes, remain at earlier stages of deployment. FOAK installations can therefore face greater uncertainty around scale-up, integration with existing industrial processes and long-term operational performance. This increases lender scrutiny of performance guarantees, insurance coverage and contingency provisions during early deployment.

Construction and commissioning phases introduce additional uncertainty, though these risks are not necessarily specific to CCUS. Projects may face delays linked to equipment delivery, defects in manufacturing or installation, or safety incidents such as fires or explosions, while commissioning can reveal operational challenges that affect capture rates or reliability. Performance guarantees from technology providers and the availability of insurance coverage are therefore critical considerations for lenders.

Transport risks focus on the integrity, utilisation and reliability of the CO_2 network

For pipeline systems, potential issues include corrosion, material fatigue, third-party damage and leaks. Product quality risks, particularly related to CO_2 impurities, must also be managed to protect infrastructure integrity and ensure compliance with transport and storage specifications.

Transport assets are also exposed to utilisation risk. Pipelines, shipping terminals and compression facilities are capital-intensive and require sustained CO_2 volumes to recover costs, making their economics sensitive to delays or underperformance in upstream capture projects. Where infrastructure is developed ahead of expected demand to benefit from economies of scale, investors must rely on policy support, tariff structures or long-term contracts to ensure cost recovery.

Alternative transport modes such as CO_2 shipping are emerging as an important option for linking dispersed emitters to offshore storage sites or enabling cross-border value chains. While shipping relies on established technologies used in other liquefied gas markets, large-scale CO_2 shipping systems remain at an earlier stage of deployment. As a result, financiers may view them as carrying higher technology and integration risks.

The long-term storage of CO_2 raises important questions about liability and exposure

Long-term liability associated with the permanent storage of CO_2 represents one of the most distinctive and challenging risks for CCUS projects. Unlike most

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infrastructure assets, CCUS entails potential exposure extending decades beyond the operational phase, including risks related to leakage, remediation and environmental damage. While commercial agreements and regulatory frameworks can allocate responsibility among project participants, the economic consequences of these liabilities are difficult for lenders to quantify and could be beyond the financial means of the companies entering into commercial agreements.

For banks and long-term investors, uncertainty around long-term liability creates risks that cannot be easily priced, insured or managed on private balance sheets, leading to a higher cost of capital. Even where the probability and magnitude of leakage is low, the potential financial impact could be quite large if the project is required to compensate for released CO_2, or to surrender credits and policy payments previously received. Adding to this uncertainty, project developers and financiers do not know in advance what this might cost. Although insurance markets are evolving and can cover construction and operational risks, coverage for long-term storage liability remains limited, expensive or subject to exclusions.

In addition to liability, there are technical risks associated with CO_2 storage. While manageable through testing and proper site selection and monitoring, this includes injection well failures, pressure management difficulties, and the possibility of subsurface leakage through geological faults or poorly sealed wells.

Cross-chain risks are amplified by the complexity and interdependency of projects

CCUS project risks are amplified by the strong interdependencies across the capture, transport and storage components of the value chain. The viability of each component depends on the timely delivery and continued operation of the others – capture facilities could be stranded without transport and storage infrastructure, while infrastructure providers depend on sustained CO_2 volumes, and potentially planned future volumes, to recover their capital-intensive investments.

Across the CCUS chain, policy and regulatory risks stem largely from a lack of clarity and durability. Changes in eligibility for incentives can reshape the economics of capture facilities, CO_2 purity requirements for transport and storage remain inconsistent across jurisdictions, and long-term liability for stored CO_2 is often undefined or split between operators and governments. These uncertainties complicate project planning.

Building on this uncertainty, economic and market risks centre on revenue sufficiency and demand visibility. Key questions include whether transport and storage tariffs will fully recover costs, how utilisation rates should be forecast for shared infrastructure, and whether storage developers can secure long-term contracts to underwrite capital investment.

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From a financing perspective, this interdependency across elements of the value chain introduces interface risk that must be clearly allocated. Lenders must assess not only the performance of individual assets, but also the robustness of contractual and regulatory arrangements linking multiple counterparties. Delays, outages or underperformance in one part of the chain can cascade across the system, disrupting revenues and potentially affecting debt service. Hub and cluster models can help spread risk by aggregating emitters and building redundancy, although they also increase complexity and exposure to project-on-project risk.

Cross-border projects introduce additional co-ordination challenges but can strengthen the overall economics of the system. In countries where domestic capture costs are high but geological storage resources are available, imported CO_2 may play an important role in the development of storage hubs. These systems depend not only on domestic policy support but also on international frameworks such as the London Protocol, bilateral agreements, and co-ordinated development of transport and storage infrastructure.

Unresolved cross-chain risk remains a key constraint to bankability, particularly for early projects for which contractual precedents are limited and revenue models are still maturing. The need to co-ordinate investment decisions across multiple assets and parties, while not unique to CCUS, carries the risk of increasing development timelines and raising transaction costs.

Insights from the financial sector

The IEA conducted a series of consultations with nearly a dozen financial institutions in preparation of this report. These included commercial banks, MDBs, DFIs and insurance providers, covering a range of portfolio sizes, risk appetites and geographies.

While the investment mandates of each institution differed, several overarching findings emerged:

1. **The challenges of financing CCUS do not relate to technology, but rather to markets, policy and risk allocation.** Technology risk is generally not a major barrier when technologies are already proven at smaller scales or have been demonstrated in other sectors. Constraints are primarily around a lack of durable revenue models, unstable policy environments, cross-chain complexities and liabilities. However, projects relying on very new capture technologies can face greater financing challenges, leading to the development of specialised insurance products for FOAK operational risks.

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2. **Bankability depends on de-risking, and governments can provide an important backstop in some cases for FOAK projects.** Such projects often rely on government-backed revenue support, risk assumption (e.g. long-term liability), or regulated infrastructure models. Public intervention is typically the most credible and cost-effective backstop for early projects.
3. **Revenue uncertainty is the core risk for project finance.** Without long-term offtake agreements or predictable revenue streams, projects struggle to attract debt or equity. Though currently niche, revenue stacking remains a key tool for improving project economics.
4. **Value chain interdependence requires a clear allocation of risks**. The interdependence of capture, transport and storage infrastructure means the failure of one component can strand others. Risks must be allocated through regulation or contracts. Hub and cluster models can effectively distribute risk among participants, but they may also introduce greater complexity in contracts and interfaces. Insurance brokers can play a key role in navigating this complexity and help to design shared coverage solutions.
5. **Sponsor quality is key**. Strong sponsors, including SOEs, industrials or energy majors, enhance confidence among financiers. The creditworthiness of emitters and transport and storage providers directly affects debt pricing and capital availability.
6. **Insurance is necessary but not sufficient**. Insurance can cover traditional construction, operational and some political risks, and new products tailored to CCUS, such as off-specification CO_2 liability coverage, and carbon offset and credit reversal, represent advances. However, premiums can be high and operational data limited. Narrowing the “risk perception gap” between developers and insurers requires increasing transparency through more effective data-sharing and early engagement with insurers’ risk engineers to improve collaboration between risk-taking parties.
7. **The financing gap persists, requiring a broader set of capital providers**. Early-stage development, particularly for storage in emerging economies, remains capital-intensive and high-risk. DFIs and MDBs are active but insufficient; additional concessional, philanthropic, and private capital is needed. Long-term investors could play a larger role as projects reach stable operations.

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CCUS financing structures and trends

New business models require new sources of capital

CCUS projects can be financed through a combination of public and private capital using both equity and debt instruments, structured either on a corporate balance sheet or through standalone project finance vehicles. The mix of capital and financing structures used depends on project maturity, policy support, revenue certainty and risk allocation across the value chain.

Historically, many CCUS projects that relied on the commercial value of CO_2 were financed through balance sheet financing by large private or state-backed companies, involved as sponsors in CCUS projects, using internal cash reserves and retained earnings. In instances where CCUS projects were FOAK applications or featured important technical risks, public funding has also played a critical role through grants, concessional debt and guarantees.

As CCUS expands into business models that are directly tied to the value of emissions reductions – such as CO_2 transport and storage as a service – and as projects increasingly take the form of multi-user hubs, a broader set of actors is entering the market. These include industrial emitters, infrastructure developers and technology providers, many of whom do not have the balance sheet capacity of large oil and gas companies. In addition, hub-based structures typically involve joint ventures across multiple segments of the value chain, requiring clear allocation of construction, volume and revenue risks among multiple counterparties.

Project finance offers a potential solution to these evolving project structures. By ring-fencing risks within dedicated special purpose vehicles (SPV) and structuring debt and equity around the project's own cash flows, project finance allows firms to preserve capital, distribute financial risk among partners and potentially reduce their investment. However, this model requires robust contractual frameworks and predictable revenue streams to satisfy lenders. In instances where CCUS revenues are largely reliant on policy mechanisms, this model is contingent on certain, durable and predictable policy support.

Unlocking significantly larger volumes of private capital for CCUS will require expanding the range of participating financial actors and the set of financing instruments deployed across the project lifecycle. To date, financing has been concentrated among a narrow group of sponsors and lenders, reflecting the capital intensity, complexity and risk profile of projects. As CCUS matures, broader participation from banks, insurance companies and other institutional investors, and public finance institutions will be critical to scale deployment.

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Map of public financing actors and their involvement in large-scale CCUS projects

Public entity	Financial instruments	Involvement to date and expansion potential
Government	🟢 Grant, debt	Historical support through large grants, e.g. for Longship CCS (Norway), Boundary Dam (Canada), Petra Nova (United States) and the EU Innovation Fund. Some concessional loans in certain jurisdictions, e.g. Wabash Valley (United States).
	🟡 Risk Guarantee	Emerging long-term revenue and risk guarantees (e.g. CfDs, reverse auction, regulated tariffs) and public–private partnership risk-sharing structures in certain jurisdictions, e.g. the Track-1 CCUS programme (United Kingdom), BECCS Stockholm (Sweden), Kalundborg Hub (Denmark) and 45Q tax credit (United States) partially mitigating revenue risk.
Sovereign wealth fund	🟡 Equity, risk Guarantee	Emerging early-stage equity, e.g. Peak cluster (United Kingdom), and long-term revenue and risk guarantees, e.g. through carbon credit offtake agreement between the Canada Growth Fund and Entropy Glacier gas plant.
Multilateral development banks (MDBs), development finance institutions (DFIs).	🟡 Grant, Debt	Grants for studies and pilots, e.g. World Bank CCS trust fund; Asian Development Bank CCS fund. Emerging debt issuance to commercial projects with recent loans by the European Investment Bank and Nordic Investment Bank to the BECCS Stockholm project.
	🔴 Equity, risk guarantee	Potential to increase concessional debt and cornerstone equity for eligible projects (regional and sectoral constraints), potentially through blended finance solutions, and to expand portfolio guarantee facilities.
State-owned enterprises (SOEs)	🟢 Debt, equity, risk guarantee	Typically as project sponsors, using equity and corporate debt, e.g. Boundary Dam (Canada), Habshan CCUS (United Arab Emirates). Involvement of SOEs also allow for sponsors to accept lower returns e.g. Porthos and Aramis (Netherlands), or to bear cross-chain and performance risks, e.g. Northern Lights (Norway).
State-owned bank	🟡 Debt	Emerging commercial debt through project finance structures. Could expand longer-tenor commercial debt and blended finance structures.
	🔴 Risk guarantee	Expand guarantee programmes.
Export credit agencies	🟡 Risk guarantee, Debt	Some debt in selected commercial CCUS projects, e.g. Liverpool Bay CCS (United Kingdom), Petra Nova (United States), with potential to expand. Emerging export guarantees for capture technology providers, e.g. SLB Capturi capture unit (Norway) for Kalundborg hub (Denmark). Important potential role for insurance and interest rate support for CCUS projects in emerging economies, though no involvement to date.

Note: 🟢 = established; 🟡 = emerging in certain jurisdictions; 🔴 = no involvement yet.

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Map of private financing actors and their involvement in large-scale CCUS projects

Private entity	Instrument	Involvement to date and expansion potential
Philanthropic foundations	🔴 Grant, equity	Mostly research grants, little involvement in large-scale pilots or demonstrators. Could expand on first-loss capital through blended finance vehicles and programme-related investments using concessional debt, guarantees and catalytic equity.
Private company	🟢 Equity	Project sponsor, has typically provided large equity share of commercial CCUS projects to date.
Commercial banks	🟡 Debt	Involvement is emerging with major project-financed CCUS deals in jurisdictions where the business case is attractive, incl. through non-recourse debt with Trailblazer CO_2 pipeline (United States), Liverpool bay CCS (United Kingdom), Net Zero Teesside and Northern Endurance Partnership (United Kingdom), Protos CCS (United Kingdom) and BECCS Stockholm (Sweden).
Infrastructure funds	🟡 Equity	Emerging involvement with some growth equity in infrastructure developers with a CCUS portfolio, e.g. Tallgrass Energy (United States) and BKV (United States). Some project equity in CDR projects that can stack revenue streams, e.g. Vestforbrænding CCS (Denmark) and Stratos (United States).
	🟡 Debt	Some examples of term loans, e.g. Net Zero North (United States), with potential to expand debt products and mezzanine finance.
Insurance companies	🟡 Risk guarantee	Some insurance solutions already exist and are tailored to new or emerging risk exposures. Their role is particularly strategic to enable broader private capital participation, e.g. by commercial banks.
	🟡 Debt	Expand green bond purchases, e.g. Dai-iChi Life Insurance investing in Porthos. Bond market could play targeted role at the refinancing stage, once construction and FOAK risks are retired.
Pension funds	🟡 Equity	Involvement so far been limited to growth equity in infrastructure developers with a CCUS portfolio, e.g. Wolf Midstream (Canada) and Tallgrass Energy (United States), with potential to expand to project equity at the refinancing stage.
	🔴 Debt	Expand green bond purchase.

Note: 🟢 = established; 🟡 = emerging in certain jurisdictions; 🔴 = no involvement yet.

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Public funding remains crucial and is evolving

Public funding has played and continues to play a critical role in pushing CCUS projects from concept to deployment. Between 2023 and 2025, more than USD 50 billion was earmarked globally for CCUS projects. In addition, industrial decarbonisation packages that are either specific to CCUS or that include CCUS in their scope have been recently announced in various regions, including Germany (~USD 7 billion), India (~USD 2.2 billion) and France (~USD 1.9 billion).

Public funding is particularly critical at the pre-commercial stage, where projects face high levels of technical, regulatory and commercial uncertainty. These conditions place activities such as R&D, feasibility studies, front-end engineering and design, pilot projects and CO_2 storage appraisal largely outside the risk appetite of private investors, aside from selective venture capital (VC) involvement. In particular, grants or direct financial support for the commercial demonstration of FOAK technologies play a critical role in overcoming early deployment barriers, and are most impactful when provided early in the development process.

At the commercial stage, public funding is now evolving in scale and form. Earlier support was predominantly provided through direct expenditures such as capital and operational grants, often as part of innovation programmes to deliver FOAK projects, such as those offered under the EU Innovation Fund, the EU Connecting Europe Facility and Norway's Longship programme, some of which also supported pre-construction activities. More recently, governments have increasingly shifted to long-term frameworks that support revenues and help de-risk investment. Announced "funding" may therefore include contingent commitments that only materialise under specific conditions. In the United Kingdom, for example, the USD 28 billion commitment to the first two CCUS hubs includes a mix of direct capital expenditures and funds to support long-term contracts for difference, regulated transport and storage tariffs, and risk guarantees. These mechanisms limit near-term public spending while playing a decisive role in improving bankability and crowding in private capital.

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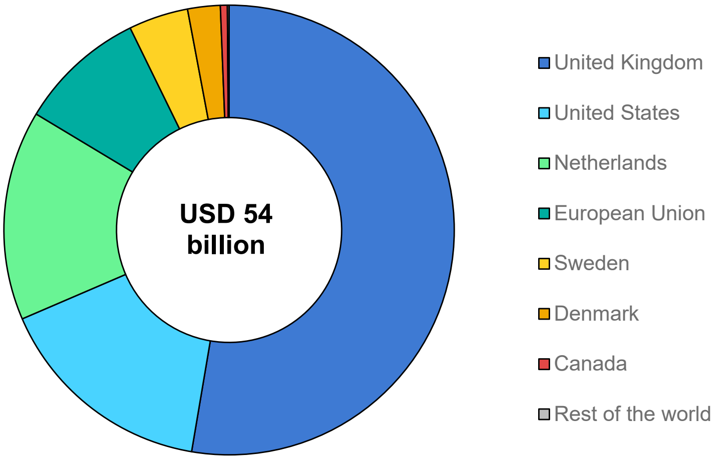
Public funding earmarked to carbon capture, utilisation and storage projects announced between 2023 and 2025



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Notes: Includes funding announcements that have been earmarked for CCUS. Excludes packages for which CCUS projects are eligible, unless funds have been allocated to specific CCUS projects.

Governments have earmarked over USD 50 billion of funding to CCUS projects in the past 3 years, in the forms of grants, long-term revenue support and guarantees.

Debt is starting to flow into CCUS projects in jurisdictions and sectors with attractive business case

Over the past 2 years, more than USD 15 billion in commercial debt has flowed across a small number of CCUS-related transactions, predominantly structured as non-recourse project finance. The United Kingdom accounts for a significant share of this total, with a single large-scale financing deal in 2024 exceeding USD 10 billion for a gas-fired power CCUS project and associated CO_2 transport and storage infrastructure. This deal marked a step-change in non-recourse debt flowing into CCUS projects, as the first large-scale project finance CCUS initiative, illustrating the scale that can be achieved in a conducive policy and regulatory environment. Other notable transactions include financing for the Trailblazer CO_2 pipeline in the United States, and the BECCS Stockholm project in Sweden, reflecting growing lender appetite when revenue support and risk-allocation frameworks are sufficiently robust.

Despite these positive signals, debt financing remains highly concentrated in a few jurisdictions and sectors, and the current pipeline of deals is still too limited to constitute a broad market trend. Important barriers to scaling up the participation of private lenders remain in place. Even in jurisdictions with major deals, future FIDs for emitters will be contingent on continued government support for emitters to decarbonise.

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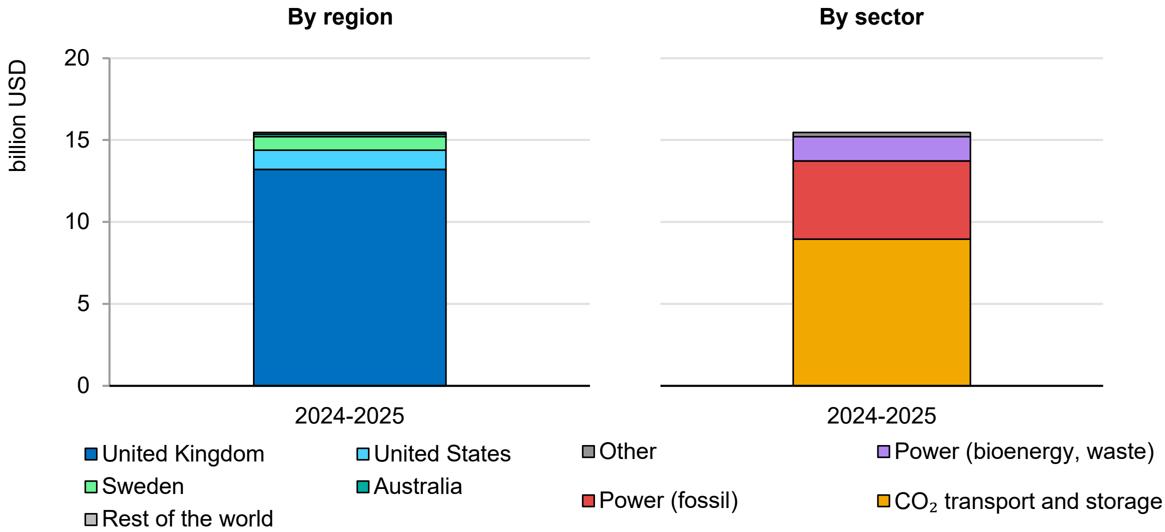
In addition, given the capital intensity of CCUS and persistent risk perceptions, transactions typically require large lending syndicates, as exemplified by the 15-20 commercial banks participating in the recent financial closes in the United Kingdom. While syndication allows lenders to diversify and reduce their exposure to single projects, and to gain experience in new types of projects, it also limits scale-up.

Beyond providing large volumes of debt, commercial banks bring experience in assessing complex infrastructure projects and encouraging discipline in project structuring. Their involvement helps create clearer documentation, more consistent approaches to risk allocation and greater transparency around costs and revenues, making subsequent projects easier to finance. As the operational track record builds, banks typically gain greater confidence in base-case assumptions, which can translate into higher gearing and lower contingency requirements. This can help broaden lender participation and gradually reduce financing costs, provided revenue frameworks and long-term risks remain clear and stable.

Commercial debt in carbon capture, utilisation and storage projects by region and by sector, 2024-2025



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Source: IEA analysis based on IJGlobal (accessed 2026).

Over USD 15 billion of commercial debt has been raised by CCUS projects in the past 2 years, overwhelmingly in the form of non-recourse debt in the United Kingdom.

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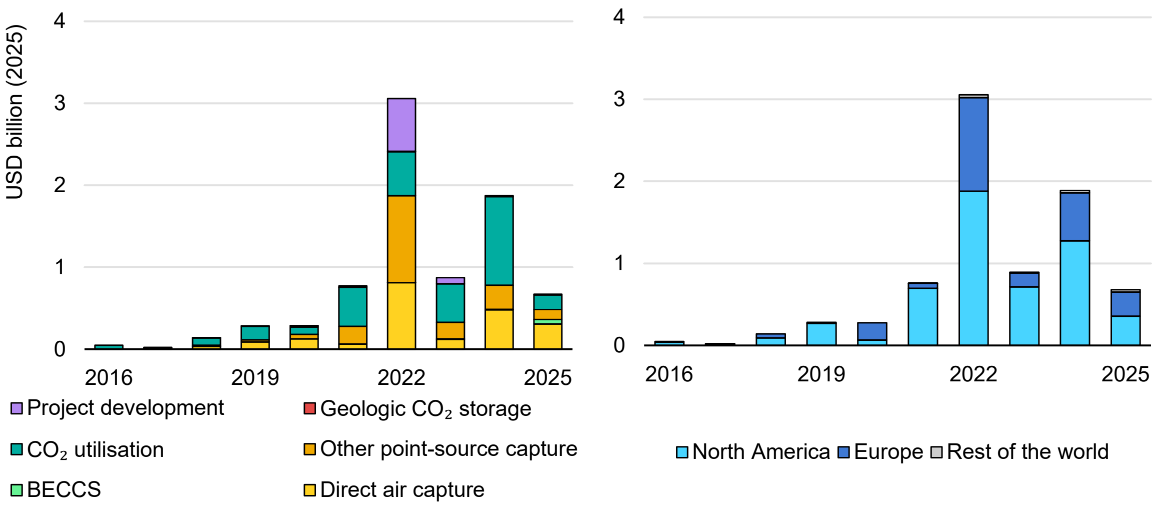
Involvement of private equity and infrastructure investors remains limited

Alongside traditional corporate sponsors, private equity investors are already involved in advancing CCUS-related companies well before FIDs are taken, primarily through VC and growth equity. These investments typically target CCUS technology or solution developers allowing investors to gain exposure to multiple projects while avoiding single-asset risk. This approach aligns well with the current maturity of the sector, where portfolios and optionality are often more attractive than individual projects.

Venture investment has expanded rapidly in companies developing innovative capture and utilisation technologies, growing sevenfold between 2019 and 2024. This upward trend continued even without considering 2022, which was a peak year for VC investment across all sectors, before overall VC declined in 2023 as rising interest rates reduced the relative attractiveness of VC compared to other asset classes. While VC in CCUS continued to grow through 2023-24 – supported by high-growth segments such as DAC and CO_2 utilisation – it fell by 60% in 2025, in line with broader energy VC. This drop was partly fuelled by policy uncertainty, and partly as capital was increasingly redirected towards sectors with higher expected returns, notably artificial intelligence.

Annual venture capital investment in carbon capture, utilisation and storage projects and companies, 2016-2025



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Notes: BECCS = bioenergy with carbon capture and storage. Includes all private equity finance for start-ups before they are publicly listed or acquired (including growth and equity stage). "Project development" includes companies specialising in the development of CCUS solutions as a service, including CO_2 transport and storage infrastructure.
Sources: IEA analysis based on data from Clean Tech group (2025) and Crunchbase (2025).

VC investment in CCUS has risen since 2016 across North America and Europe, led by DAC and advanced capture and utilisation, but slowed down in 2025.

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Growth equity, meanwhile, has supported the scale-up of selected developers and infrastructure platforms, often involving private equity firms, infrastructure funds and pension funds seeking long-term exposure to decarbonisation assets. As projects mature and move into stable operations, some equity investors are beginning to consider direct project exposure. This most often occurs through joint ventures with experienced developers or industrial sponsors, where private equity capital helps fund early construction, scale-up or pre-FID activities that are difficult to finance with debt alone. In these cases, equity investors are drawn by the potential to shape project design, secure early exposure to emerging revenue streams, and benefit from policy support mechanisms, while relying on partners with operational expertise to manage risks. However, such investments remain limited and are typically contingent on strong contractual frameworks and public risk-sharing mechanisms.

Selected growth and project equity deals in CCUS

Type of actor	Financing	Year	Country	Description
Pension fund	Growth equity	2015	Canada	Canada Pension Plan Investment Board (CPP Investments) and Canadian company Wolf Infrastructure created Wolf Midstream in 2015 to develop energy midstream assets, including the Alberta Carbon Trunk Line (ACTL).
Pension fund	Growth equity	2024	Canada	Canada Pension Plan Investment Board (CPP Investments) invested USD 843 million in US CO_2 infrastructure developer Tallgrass Energy.
Sovereign wealth fund	Growth equity	2023	Canada	Canada Growth Fund made a USD 150 million investment in Entropy coupled with a fixed-price carbon credit purchase agreement of up to 1 Mt CO_2 per year.
Infrastructure equity fund	Growth equity	2019	United States	Blackstone Infrastructure Partners purchased a controlling interest in US infrastructure developer Tallgrass Energy, with plans to expand CO_2 management businesses.
Private equity	Growth equity	2022	Canada	Brookfield Energy Transition Fund invested USD 230 million in Canadian CCUS developer Entropy.
Infrastructure equity fund	Growth equity	2025	United States	Copenhagen Infrastructure Partners (CIP) invested USD 500 million in a joint venture with CO_2 storage hub developer BKV.
Infrastructure equity fund	Growth equity	2025	United Kingdom	Global Infrastructure Partners (BlackRock) acquired a 49.99% stake in oil company Eni's CCUS business holding.
Infrastructure equity fund	Project equity	2023	United States	Blackrock formed a joint venture with oil company Occidental to inject USD 550 million in the STRATOS DAC hub in the United States.

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Type of actor	Financing	Year	Country	Description
Bank	Project equity	2024	Canada	Mizuho invested USD 3.7 million in Bison Low Carbon Ventures, to develop Bison's Meadowbrook CCS hub in Canada.
Sovereign wealth fund	Project equity	2025	United Kingdom	National Wealth Fund invested USD 39 million in UK project Peak cluster to cover pre-FID costs, with FID expected by 2028.
Infrastructure equity fund	Project equity	2025	Denmark	CIP and Vestforbrænding partnered to create Danish biogenic CCS JV to develop a 500 000 tonnes per year BECCS project at the Glostrup waste-to-energy plant in Denmark.
Infrastructure equity fund	Project equity and term loan	2025	United States	Orion Infrastructure Capital provided a USD 105 million secured term loan and USD 5 million equity to company Gevo for the USD 210 million acquisition of the Net Zero North project, the bioethanol-with-CCS plant formerly owned by Red Trail Energy.

Note: Country indicates where the company receiving the investment is headquartered.

Multilateral banks can step in earlier in the project lifecycle

Multilateral development banks (MDBs), development finance institutions (DFIs) and export credit agencies (ECAs) operate at the intersection of public policy and private capital, working with governments, state-owned enterprises (SOEs), corporates and international partners to advance complex infrastructure projects.

MDBs and DFIs can play an important role in filling in the financing gaps through a wide range of different financial products and services across the project development timeline. At the early stages, MDBs and DFIs can provide technical assistance support to help countries to build institutional capacity and regulations that act as the bedrock on which projects are formed, and assist in the development of public–private partnership structures to initiate projects. Once a project has been formed, MDBs and DFIs can also provide a range of debt, grant, equity and guarantee solutions to projects, particularly at the prefeasibility stage.

In particular, MDBs and DFIs can add value by absorbing risks that commercial lenders are reluctant to take, especially in FOAK projects or early-stage developments (see box Insights from the financial sector). DFIs are often willing to take longer tenors, subordinated positions or higher exposure during early phases, provided governments demonstrate clear commitment to CCUS through targets, regulatory frameworks or financial support.

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Nevertheless, several structural constraints continue to hold back wider MDB and DFI participation. Early-stage development costs, particularly for CO_2 storage characterisation, often remain too high for MDBs, DFIs and private sponsors to cover. In addition, these institutions have restraints on the types of projects they can and cannot support, such as those linked with EOR or fossil energy production.

ECAs complement the role of MDBs and DFIs by supporting the deployment of CCUS through guarantees and insurance linked to equipment supply and engineering, procurement and construction (EPC) contracts, particularly where capture technologies or compressors are sourced internationally, or to enhance political risk coverage. While their use has been limited to developed markets so far, they could play an important role for insurance and interest rate support for CCUS projects in emerging economies.

Green bonds could offer a new avenue for sustainable debt for institutional investors

The green bond market could offer additional sources of debt financing for projects alongside commercial banks, as it has for other energy technologies such as solar and wind. Sustainable finance criteria – set out in voluntary market standards (e.g. the International Capital Market Association Green Bond Principles) and regulatory frameworks (e.g. the EU taxonomy for sustainable activities and Associate of Southeast Asian Nations [ASEAN] Taxonomy for Sustainable Finance) help define which activities are eligible for green bonds proceeds. While certain applications of CCUS are typically ineligible in some taxonomies (e.g. CCUS applied to coal-fired power generation), many applications may qualify under pollution prevention or GHG control, provided that monitoring, reporting and verification is in place to demonstrate emissions reductions.

Many green and sustainability-linked bonds issued by major utility, chemical, materials, and oil and gas companies have explicitly referenced CCUS activities among the use of proceeds. In 2025, the world's first bond dedicated specifically to CCS was issued by the Dutch developer Port of Rotterdam Authority to finance the Porthos project in 2025, with Japanese life-insurer Dai-ichi investing around USD 30 million. However, most issuance to date has been concentrated in corporate-level instruments rather than project-level financing, as bond investors typically avoid deferred-drawdown structures required during long construction periods. Once projects are operational and construction and FOAK risks are retired, the bond market could play a more targeted role in refinancing, providing long-tenor, lower-cost capital against de-risked revenue models.

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Selected corporate bonds issuance with proceeds explicitly mentioning CCUS activities

Type	Issuer	Market	Issue date	Base currency	Value (million USD)	Proceeds coverage of CCUS
Dedicated to CCS	Port of Rotterdam	Japan	Dec-25	JPY 9 billion	58	Specific to CCUS project Porthos
Green	Heidelberg Materials	Europe	Jan-26	EUR 600 million	699	Eligible
Green	Heidelberg Materials	Europe	Sep-24	EUR 500 million	555	Eligible
Green	Heidelberg Materials	Europe	Jun-24	EUR 700 million	750	Eligible
Green	Stockholm Exergi	Sweden	Nov-25	SEK 1.2 billion	132	Eligible
Green	Stockholm Exergi	Norway	Jul-25	NOK 500 million	50	Eligible

CCUS financing structures remain highly market-specific

North America

North America remains the largest market for CCUS, with more than 40% of capture and storage capacity either in operation or under construction. Deployment has been supported by extensive oil and gas infrastructure and tax credit regimes, notably the US 45Q incentive. Many earlier projects in established industrial sectors – such as fertilisers and refineries – were tied to EOR revenues and financed on corporate balance sheets.

FOAK projects involving dilute CO_2 streams, dedicated geological storage, or multi-emitter hubs have typically required substantial public support, with grants in some cases covering up to two-thirds of capital costs. In Canada, a first generation of projects such as Quest, Boundary Dam, and the ACTL received significant government backing through upfront capital grants and operational subsidies, combined with revenues from carbon storage credits. In the United States, Petra Nova was among the earliest large-scale CCUS projects financed through a dedicated SPV. The project was supported by revenues from EOR and tax credits, as well as large public grants.

Private capital participation is now increasing, particularly in two segments: projects with low capture and transport costs that can rely primarily on tax credit revenues, and projects stacking multiple incentives and contracted product revenues, including the sale of carbon removal credits. Bioethanol with CCS sits at the intersection of these trends and has attracted both lenders and private equity. Recent transactions illustrate growing lender confidence and financing diversity. In 2025, the Trailblazer CO_2 pipeline project developed by Tallgrass

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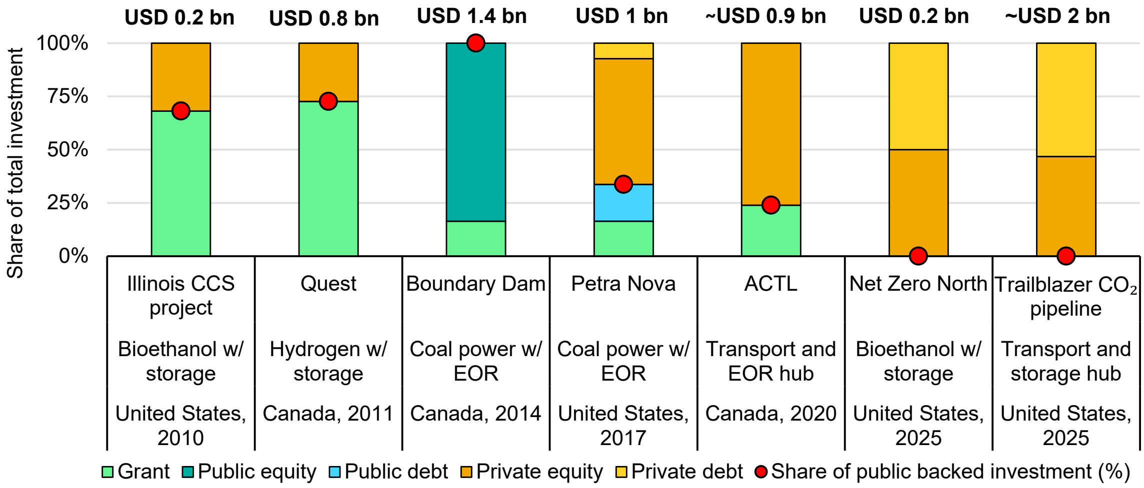
Energy raised over USD 1 billion of commercial debt to convert existing gas infrastructure for CO_2 transport and storage from bioethanol plants, relying in large part on tax-credit-backed revenues. Gevo's acquisition of the Net Zero North bioethanol and CCS project closed with a 50:50 debt-to-equity structure involving private investors and lenders. Transferable tax credits are also supporting new structures, such as the Bank of America's purchase of USD 205 million worth of 45Q and 45Z tax credits from the Blue Flint ethanol CCS project.

Canada has also seen a few major FIDs in the past years, including on Shell's Polaris hydrogen plant, the Atlas carbon storage hub, Entropy's Glacier Phase 2 facility, and the next phase of the ACTL system. A combination of federal and provincial government frameworks and sovereign funds have supported these developments, including Canada Infrastructure Bank's Green Infrastructure Fund, the Canada Growth Fund's allocation for carbon contracts for difference, a federal CCUS investment tax credit, and grants from Alberta's Carbon Capture Incentive Program. A number of hubs supported by Alberta's competitive process for carbon storage hubs are also under development but have yet to reach FIDs.

Financing structure and estimated investment for selected carbon capture, utilisation and storage projects at the time of financial close in North America



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Notes: CCS = carbon capture and storage; EOR = enhanced oil recovery; ACTL = Alberta Carbon Truck Line; bn = billion. Trailblazer CO_2 pipeline equity investment was estimated based on estimated total project investment of around USD 2 billion and total debt raised, at just below USD 1.1 billion. ACTL equity investment was estimated based on total project investment of around CAD 1.2 billion (Canadian dollars) and capital grant support of CAD 285 billion. Boundary Dam equity investment was estimated based on total estimated capital expenditure (CAPEX) of CAD 1.47 billion and a government capital grant of CAD 240 billion. Quest equity investment was estimated based on total estimated CAPEX of CAD 790 million and government capital grants of CAD 570 million. Chart only includes CAPEX (capital cost) financing, exclusive of any operational grants or subsidies.

Sources: IEA analysis based on IJGlobal (accessed 2026), FitchRatings (2024), S&P Global (2025), Gevo (2025), US Department of Energy (accessed February 2026) Clean Air Task Force (2024), International CCS knowledge centre (2018), Natural Resources Canada (2013), UK Department for Energy Security and Net Zero (2013).

CCUS financing in North America is shifting from grants and corporate finance to tax credit-enabled private finance, with a focus on low-cost and revenue stacking projects such as bioethanol CCS.

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While these trends illustrate how carbon removal credits constitute additional revenue streams that can help attract financiers, involvement remains limited to a few large-scale projects, with a notable financing gap for lower-scale projects (see Box: The financing gap of carbon dioxide removal). A number of FIDs have also been reached for low-emissions ammonia and hydrogen production – though efforts remain mostly corporate financed with government backing. Some low-emissions power projects are advancing through long-term power purchase agreements with data centre operators, including the agreement between Google and Broadwing Energy for a CCS-equipped gas-fired plant in Illinois. Whether projects materialise largely hinges on converting these agreements into firm offtakes, and off-takers' willingness to pay a premium for low-emissions and firm power. Outside these segments, projects remain more difficult to finance due to higher costs and weaker revenue certainty. Permitting timelines for CO_2 storage also remain a major bottleneck. In the United States, while states with Class VI primacy are moving more quickly, slow federal permitting elsewhere continues to delay projects and constrain the pipeline of investable opportunities.

Europe

CCUS deployment in Europe is entering a new phase, with multiple projects reaching financial close and beginning operations in Denmark, Greece, Italy, the Netherlands, Norway, Sweden and the United Kingdom. Recent milestones include financial close across several capture projects and transport and storage hubs, and the start of operations at Norway's Northern Lights project, receiving CO_2 from the Brevik cement plant for offshore storage. Europe now represents around 12% of global capture capacity and 17% of storage capacity in operation and under construction.

This recent momentum has replaced a long period of limited progress. For decades, Europe's only large-scale projects were Norwegian offshore CO_2 reinjection facilities financed by Equinor and supported by the Norwegian CO_2 emissions tax. Earlier UK CCUS funding competitions were cancelled after negotiations failed over subsidy levels and long-term risk allocation. The financial decision on the Longship project in Norway, for which the Norwegian government agreed to fund around 80% of capital and operating costs, marked a turning point in CCUS deployment in Europe.

Recent progress reflects a fundamental shift in the policy and financing frameworks for CCUS in Europe. Governments are moving away from reliance on one-off capital grants towards mechanisms that provide long-term revenue certainty and risk mitigation. Another important differentiating factor from the first wave of projects in the late 2000s and early 2010s, is that this new wave of projects is supported by significant learning effects and risk reduction from early projects

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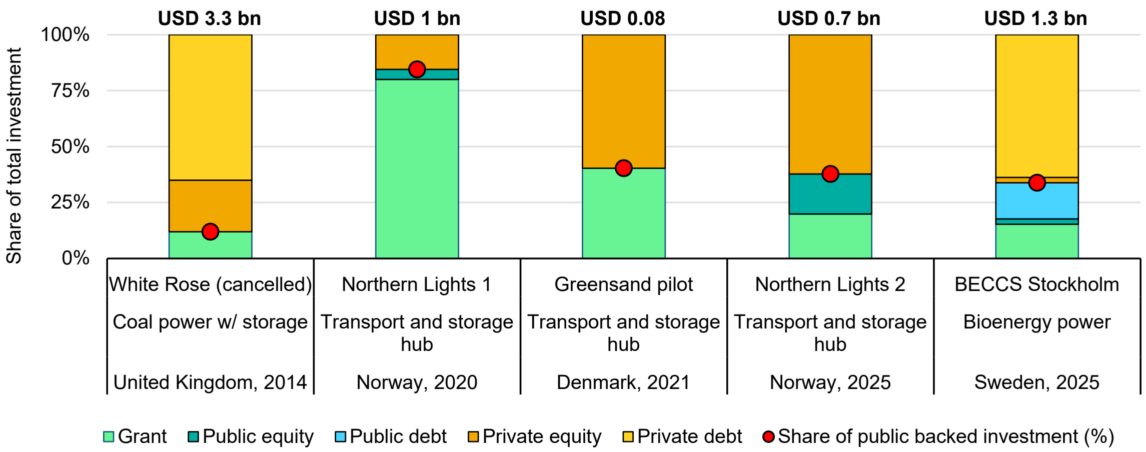
in Norway and from more mature CCUS deployment in North America, which have improved confidence in technology performance.

Recent financings include more than USD 10 billion in commercial debt raised for the Net Zero Teesside and Northern Endurance Partnership projects in the United Kingdom – the first large-scale project-financed CCS transaction globally – alongside the state-backed EUR 639 million investment in the Dutch Aramis project and the world's first CCUS bond issuance by Porthos. In Sweden, Stockholm Exergi raised over USD 1 billion of debt for its BECCS Stockholm project, thanks to the staking of government grants, reverse auction subsidies, and long-term forward purchase agreements from the voluntary carbon market. Together, these transactions illustrate how risk-sharing frameworks are translating into bankable structures.

Financing structure and estimated investment for selected carbon capture, utilisation and storage projects at the time of financial close in Europe



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Notes: The White Rose project was one of the contenders for the UK government GBP 1 billion CCS competition, which was cancelled in 2015. White Rose equity investment is estimated based on project investment estimated at around GBP 2 billion, and planned debt of 65% of project cost. Northern Lights phase 1 government investment funding share is assumed to be 80%. Northern Lights phase 2 equity investment is estimated based on a total NOK (Norwegian Kroner) 7500 million investment and a EUR 131 million grant. BECCS Stockholm equity investment was estimated based on total estimated investment of USD 1.3 billion and received loans and grants.

Sources: IEA analysis based on IJGlobal (accessed 2026), Stockholm Exergi (2025), Northern Lights (2025), INEOS (2021), Norwegian Ministry of Petroleum Energy (2020), UK Department for Energy Security and Net Zero (2013).

Several project-financed CCUS transactions mark a new phase of deployment in Europe, with government support increasingly centred around revenue and risk guarantees rather than upfront grants.

Rest of the world

Elsewhere, CCUS deployment is progressing under a narrower set of financing models, with most projects funded on sponsor balance sheets and limited use of project finance. Outside of China, activity is currently concentrated in oil and gas and selected industrial applications.

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The Middle East accounted for around 15% of global capture capacity in operation or under construction in early 2026, with large-scale CCUS projects in operation in Qatar, Saudi Arabia, and the United Arab Emirates. Across the region, major projects in development included the Jubail CCS hub in Saudi Arabia, the Abu Dhabi National Oil Company (ADNOC)'s Habshan CCUS project in the United Arab Emirates, and Qatar's Blue Ammonia 7 facility. Projects are primarily led by national oil companies and state-backed sponsors. Financing relies largely on corporate funding, supported by hydrocarbon operations and anticipated demand for low-emissions fuels and materials, including exports to markets affected by carbon border measures such as the EU Carbon Border Adjustment Mechanism. However, the conflict in the Middle East that began in late February 2026 may have implications for the progress of these projects.

China is today one of the fastest growing regions for CCUS, with just under 10% of capture and storage capacity either in operation or under construction. In 2025, China continued to scale CCUS across multiple sectors – including power, steel, cement and chemicals – with several world-scale facilities entering operation or construction. Projects were primarily developed by state-owned enterprises (SOEs) under national demonstration programmes, rather than through market-based financing structures.

Australia is one of the few markets with private lender involvement, though still under balance sheet financing. The Moomba CCS project, which reached FID in 2021, is supported by Australian Carbon Credit Units, government grants and strong oil and gas sponsors, and raised around USD 150 million in corporate debt. Activity in Australia is also supported by emissions regulation policies such as the Safeguard Mechanism, which requires large industrial facilities to reduce emissions in line with declining baselines or purchase offsets. This has created a business case for abatement solutions including CCUS.

Across the rest of Asia Pacific, several large projects are advancing, though with limited third-party capital participation. Indonesia's USD 2.6 billion Tangguh CCUS project reached FID in 2024 on a fully corporate-financed basis linked to enhanced gas recovery revenues. Investor interest is also emerging in small-scale utilisation projects, in which captured CO_2 is sold into downstream markets such as fuels and chemicals, as illustrated by a commercial bank financing a waste-to-energy capture project in Singapore. Japan has multiple CCUS initiatives under development, though none have yet reached construction. Nine joint ventures between emitters and transport and storage providers are advancing at pre-commercial stage, some exploring cross-border CO_2 transport with Malaysia. The Japanese government plans to support selected projects through auctioned carbon contracts for difference, including for power CCUS projects as part of the Long-Term Decarbonized Power Source Auction.

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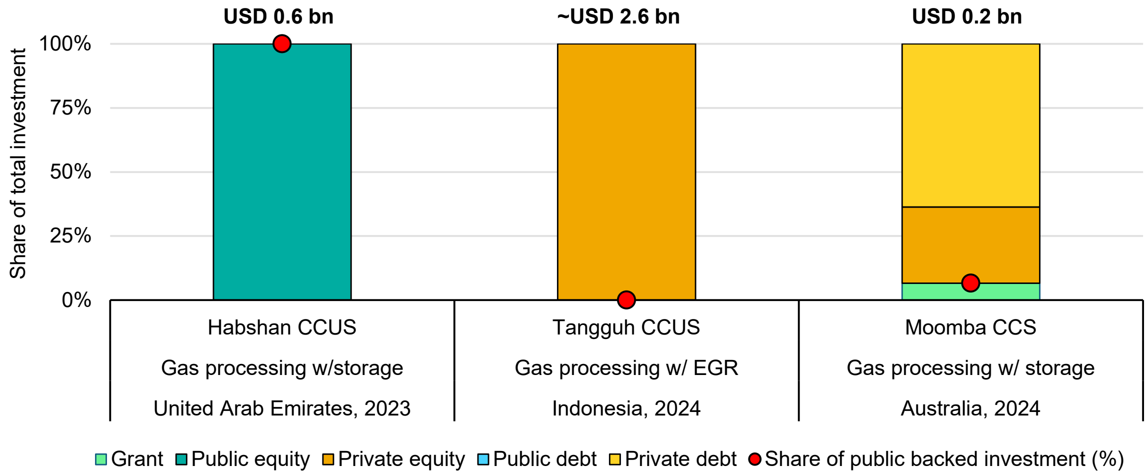
Financing structure and estimated investment for selected carbon capture, utilisation and storage projects at the time of financial close in the Middle East and Asia Pacific



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Notes: CCUS = carbon capture, utilisation and storage; EGR = enhanced gas recovery; bn = billion.
Sources: IEA analysis based on IJGlobal (accessed February 2026), Santos (2024), Gasworld (2023), Petrofac (2023).

In the Middle East and Asia Pacific, CCUS development is largely driven by state-backed, corporate-financed projects integrated into oil and gas value chains, with commercial lender participation emerging in specific contexts.

Elsewhere, deployment remains limited and financing largely sponsor- or venture-funded. In South America, Petrobras' Santos Basin gas processing and CO_2 injection project in Brazil is still the only large-scale facility in operation. In Africa, a small-scale DAC project in Kenya has been funded through early-stage VC and does not yet represent a scalable financing model.

The financing gap of carbon dioxide removal (CDR)

The CDR sector – which includes BECCS and DAC technologies alongside a broader range of approaches – faces a distinct financing gap for projects that have moved beyond the early stages but are not yet bankable, creating a "missing middle".

Over the past 5 years, VC has played a critical role in scaling the sector: VC investment grew sevenfold between 2019 and 2024 and the number of start-ups developing engineered CDR solutions increased fivefold. Most of this capital has supported pilots, demonstrations and early commercialisation, with the largest facilities removing 15 000 – 40 000 tonnes of CO_2 per year. VC investment slowed, however, in 2025, dropping around 50% as VC investment in energy scaled back globally.

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At the opposite end of the spectrum, a small number of large-scale, later-stage CDR projects (typically with the capacity to remove over 500 000 tonnes of CO_2 per year) have begun attracting private capital, supported by diversified and policy-backed revenue streams in certain jurisdictions.

In the United States, bioethanol CCS offers attractive economics, with the USD 85 per tonne 45Q tax credit potentially enough to cover capture, transport and storage in certain project configurations, and the potential to stack carbon removal credit sales, as exemplified by the Trailblazer CO_2 pipeline deal. In Europe, multiple revenue streams, including low-emissions heat generation, long-term revenue support, and carbon removal sales to Microsoft and Frontier supported the BECCS Stockholm project. Direct air capture (DAC) projects can also benefit from advanced purchase agreement for carbon removal, with prices historically averaging USD 500/t CO_2 on voluntary markets, combined in the United States with the USD 180/t CO_2 45Q tax credit. This contributed to Occidental's USD 1.1 billion acquisition of Carbon Engineering in 2023, and its subsequent USD 500 million joint venture with BlackRock to develop a 500 000 tonnes/yr DAC facility in Texas.

Despite these landmark financings, uncertainty over long-term demand and the lack of liquidity of long-term contracts to match debt tenors – in what remains a concentrated voluntary carbon market – continues to weigh on large-scale CDR investment. This is illustrated by the recent cancellations of BECCS projects in Sweden, despite government backing.

Meanwhile, medium-scale projects (USD 10–100 million) are typically too large for venture funding yet too small or insufficiently proven to attract traditional project finance or private equity. To bridge this gap, banks are developing trade-finance-style structures that monetise the future value of contracted offtake agreements. Impact private equity funds have also started to step in with debt financing to back the delivery of offtake agreements.

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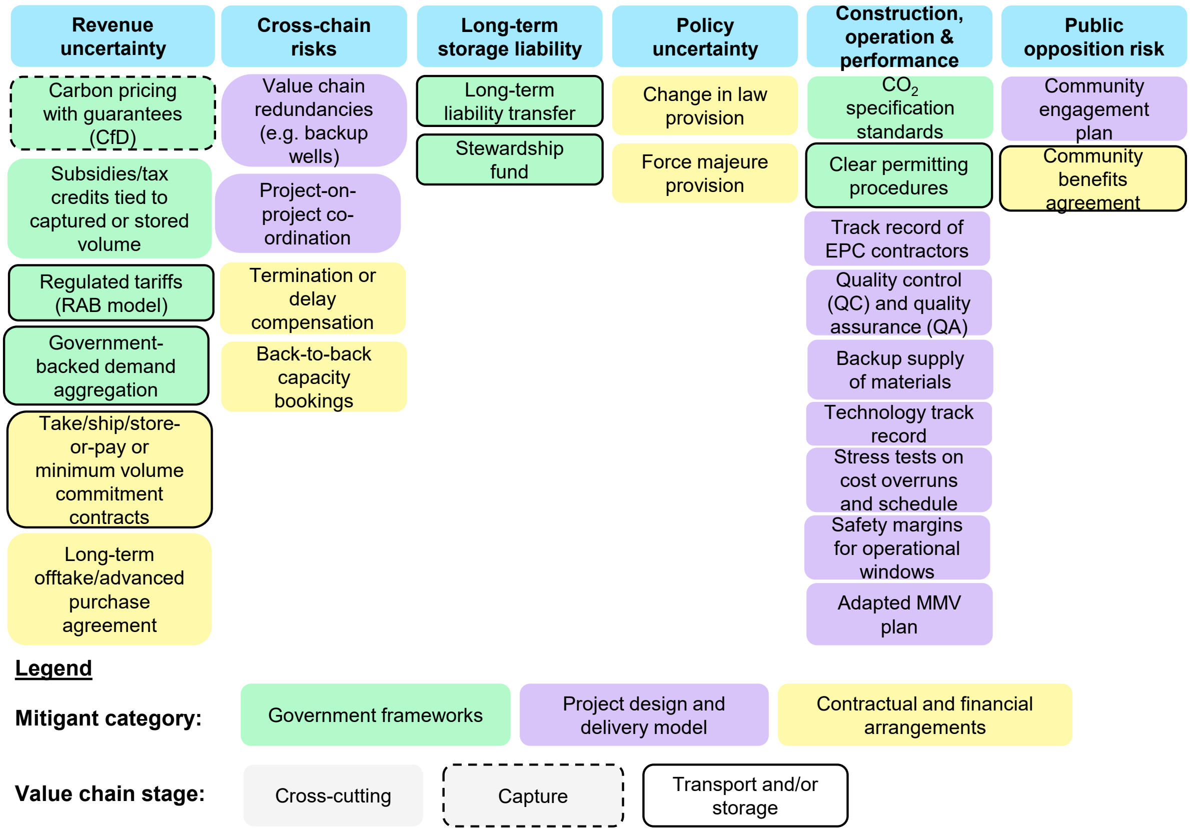
Priorities for risk mitigation, allocation and assessment

Mitigation and allocation strategies are central to securing financing

Risk mitigation in CCUS projects takes multiple forms and operates at different levels – through government frameworks, project-level design, and contractual and financial arrangements between project stakeholders. These instruments do not eliminate risk, but they make risks more predictable, measurable and allocable. This is a precondition for attracting private capital, as lenders and investors require clarity on how key risks are governed, shared and managed over the project lifecycle, and need a reward that is commensurate with the risk.

Overview of key mitigants and addressed risks in carbon capture, utilisation and storage projects



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Notes: CfD = contract for difference; RAB = regulated asset base; EPC = engineering, procurement and construction; MMV = measurement, monitoring and verification.

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In practice, bankable CCUS projects typically combine instruments across all three layers: Public frameworks reduce unpriceable tail risks, contractual structures allocate operational and commercial risks, and project design choices strengthen confidence in delivery. The interaction of these mitigation approaches determines how risks are ultimately allocated – and, therefore, which sources of private capital are able to participate.

Government frameworks reduce revenue, operation and long-term liability risks

Most CCUS projects that have secured financing have been supported by various levels of government frameworks that reduce revenue risks and clarify operating and liability risks. These frameworks have helped manage the types of risks that private actors cannot efficiently absorb on their own.

The lack of a natural market for stored CO_2 has meant that governments have had to step in and provide certain assurances to address revenue uncertainty. Carbon contracts for difference (CCfD) and regulated tariffs, or regulated asset base models for pipeline transport and storage, mitigate risk by improving revenue predictability and reducing exposure to carbon price and demand volatility. CCfD-type instruments are now being adapted for CCUS in several jurisdictions, including Canada, France, Germany, the Netherlands, Japan and the United Kingdom. They have been instrumental in the successful FIDs of major projects in Europe. The United Kingdom is applying the regulated asset base approach to develop regional CO_2 transport and storage networks, whereby private entities will own and operate onshore and offshore pipeline networks and storage sites in exchange for a regulated revenue that enables the operator to cover costs and earn a reasonable rate of return. This approach then sets transparent and fair tariffs that CO_2 capture plants must pay to use the infrastructure.

In addition to revenue risk, the long-term liability of stored CO_2 is a risk that several governments have taken on. In some legal and regulatory frameworks, liability is transferred to the state, typically 10-20 years after the storage site stops injection, and only after the operator can show there is no significant risk of leakage. This is the case for most jurisdictions in Europe, Australia and parts of the United States and Canada. Stewardship funds and financial security requirements help ensure that monitoring and remediation obligations can be met over time. In most cases, operators are subject to financial security requirements during the project's operation – this is typically done through the contribution to a long-term fund or through financial instruments such as insurance, credit lines or surety bonds.

Governments can also reduce construction, operational and performance risks by establishing clear technical and operational standards aligned with international best practices, while allowing flexibility in implementation. Transparent and

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predictable permitting frameworks are also essential, as regulatory scrutiny currently varies significantly across jurisdictions both before and after CCS permits are granted. Strengthening administrative capacity and technical expertise within regulatory authorities can further accelerate approval processes and provide greater certainty for project developers and financiers.

Contractual and financial arrangements allocate cross-chain and commercial risks

Contracts play a central role in allocating volume, availability and interface risks among capture facilities, transport operators and storage providers. Because CCUS projects depend on co-ordination across capture, transport and storage segments, contractual design translates technical and cross-chain risks into defined commercial obligations.

Common tools include long-term take-or-pay or store-or-pay contracts, back-to-back capacity bookings across the value chain, and contractual allocation of delivery and availability obligations. Financing agreements may also require maintenance reserve accounts, contingency buffers and continuity or transition plans to protect against operational disruption. Credit support and guarantee structures between counterparties can further reduce counterparty risk.

Oil and gas projects provide long-standing examples of how contractual structures support investment in complex value chains. Liquefied natural gas (LNG) and pipeline developments have relied on take-or-pay contracts and minimum volume commitments to underpin revenues for capital-intensive midstream assets. These arrangements allocate volume risk across counterparties. While there are important differences between CCUS and oil and gas projects – CO_2 disposal carries long-term liability rather than intrinsic market value, and the counterparties involved (e.g. industrial emitters) can have very different credit profiles – similar mechanisms can be adapted to provide some level of revenue assurance for CO_2 transport and storage operators.

In the Netherlands, the Porthos and Aramis CO_2 transport and storage project allocates costs and risks among the various entities in the value chain through integrated commercial contracts for transport and storage. In Denmark, cross-chain risks are handled commercially. Take-or-pay and minimum volume commitment contracts (MVC) were critical to reduce volumetric risks in the recent FIDs reached on the Tallgrass Energy Trailblazer CO_2 pipeline project (United States) and the expansion phase of Northern Lights (Norway). Whereas these contracts do protect the transport and storage provider, they generally do not cover the contingent liabilities faced by an emitter, for example if transport and storage is down.

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When governments are amongst project partners, contractual arrangements may take the form of government backstops. For example, the United Kingdom provides a backstop to cross-chain risks under certain conditions, in which mechanisms are included under the transport and storage agreement to cover compensation for unpredictable project delays, unavailable storage capacity, and cost recovery in the event of infrastructure failure. For example, if a capture project is ready before the transport and storage network, it may receive extra construction time or financial compensation. Similarly, if the capture project is delayed, the transport and storage operator will be allowed to earn higher revenues in future years to account for lost revenue.

Project structure and delivery models strengthen execution and performance confidence

Project structure and delivery model choices also have an important impact on risks. Investors and lenders assess not only the external framework and contracts, but also the intrinsic resilience of the project. Risk can be reduced through diversified project configurations, such as hub models serving multiple emitters, which lower single-counterparty and volume risks.

The strength and experience of sponsors, EPC contractors and technology providers is a central credit factor, as proven delivery track records and commercially demonstrated technologies reduce construction and performance uncertainty.

Supply chain redundancies, including alternative transport or storage options and backup suppliers for critical materials, can limit exposure to bottlenecks and disruptions. Execution risk is further mitigated through contingency planning, schedule and cost stress-testing, and phased development approaches.

Meaningful consultation and engagement prior to project demonstration is an important approach to mitigating public acceptance risks. In the United States, Tallgrass Energy established FOAK community benefits agreements with landowners.

The insurance sector is a crucial enabler and partner in projects

Insurance plays a crucial role in supporting CCUS projects, by providing assurance to lenders and investors that key risks will not threaten project revenues. Insurance can also help operators manage long-term liabilities, including well integrity and post-closure monitoring, and meet regulatory financial assurance requirements for long-term CO_2 storage site stewardship.

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Insurance frameworks typically complement government support mechanisms. In many jurisdictions, legal and regulatory frameworks fully address risks such as the surrender of credits under carbon pricing schemes, creating a role for insurance solutions. In some cases, access to government backstops is conditional on project developers securing commercial insurance coverage, while governments act as an insurer of last resort, providing protection against low-probability but high-impact risks, such as CO_2 leakage.

While the CCUS value chain is complex, many of its risks align with those traditionally underwritten by energy, marine and construction insurers once projects are broken down into their component parts. Insurance can therefore play a role across all phases of project development – from design and construction to operation, closure and post-closure monitoring.

A broad range of financial, regulatory, technology and safety and operational risks can be covered by insurance products which already exist, while others can be covered with adaption or tailoring of existing products. For example, tax insurance markets are well established, and insurance can protect revenues linked to policy incentives, including events that could trigger the credits being rescinded, such as the United States' 45Q. Insurance products commonly used in the oil and gas sector can also be adapted for CO_2 transport and storage, subject to additional due diligence requirements related to long-term integrity of the storage site. Leakage events may lead to remediation costs or regulatory penalties, which can be addressed through instruments such as environmental liability insurance. There are also several products available to support confidence in purchasing credits from the voluntary carbon market, providing security to recover the value of credits. In addition, specialised insurance is beginning to emerge to address risks associated with FOAK technology deployments and potential environmental damage or revenue losses associated with sudden or gradual CO_2 leakage.

Despite these developments, several challenges remain for the insurance market in underwriting CCUS risks, including fragmented risks across the value chain, difficulties in allocating liability across multiple actors, the long-tail nature of post-injection liabilities, and the lack of standardised policy wording. Addressing these challenges will likely require additional innovative approaches to insurance design. Many CCUS risks cannot be fully addressed through traditional insurance structures alone and may require new products, tailored coverage structures or blended solutions involving both public and private actors. Early-stage collaboration between project developers, governments, insurers and reinsurers will be important to ensure that risk allocation, coverage structures and financial assurance requirements are aligned with project design. Improved data availability and sharing will also be critical, as limited operational experience and subsurface uncertainty currently constrain the ability of insurers to assess and price risks effectively.

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Selected gaps in CCUS underwriting

Gap	Description
Fragmented coverage across the value chain	Risks can become fragmented across the value chain when multiple parties are involved. Exposures such as cross-chain delay in start-up or business interruption may only be partially covered.
Cross-chain liability allocation	The allocation of liability remains a challenge in multi-emitter and multi-injector systems, as there is currently no standardised approach for sharing liability or sharing storage capacity.
Long-tail liability after injection	Long-tail liability presents a distinctive challenge, particularly during the post-injection period when project proponents may still hold liability but no longer receive revenue. This creates a mismatch between the duration of liability and the period during which insurance can be funded.
MMV regulatory interpretation	Uncertainties in measurement, monitoring and verification (MMV) regulatory interpretation mean that few products specifically address these risks.
Lack of streamlined wording	Traditional policies do not map neatly to CCUS risks, requiring bespoke wording to avoid coverage gaps and ensure clarity.
Evolving risk profile and insurance renewal	The risk profile of a CCS project also evolves over time, requiring clear definitions of material change, agreed reporting triggers and clarity on when coverage should be maintained or renegotiated. For developers, the annual renewal structure of most insurance policies can expose projects to changes in insurer risk appetite or pricing following a claim.

Risk allocation models that differ between the private and public sector will evolve as the market matures

Recent CCUS investments show that partnerships – either between private entities or through public–private partnerships (PPPs) – are an effective delivery model for managing project complexity and risk. CCUS projects require co-ordination across multiple assets, long development timelines and exposure to policy, market and technical risks that are difficult for a single entity to manage alone. Partnerships allow risks, responsibilities and capital requirements to be distributed across actors according to their capabilities, improving bankability while accelerating project delivery. In particular, PPPs combine government frameworks with project-level contractual risk-sharing arrangements, and have been a successful hybrid delivery model in specific markets, addressing cross-chain risk, long-term liability exposure and revenue uncertainty that would otherwise constrain private investment.

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Overview of risk-allocation approaches for recent final investment decisions

	Revenue uncertainty	Cross-chain risks	Long-term storage liability	Policy uncertainty	Construction, operation & performance
NZT (**power**) & NEP (**T&S**) **United Kingdom**	Long-term revenue guarantees (CfD-type, RAB)	Compensation for under utilisation and counterparty default	Liability transfer after 15 years Leakage cap mechanism	Compensation in case of change in law	Risk-sharing between sponsors, EPC, and authorities
Porthos (**T&S**) **The Netherlands**	Long-term revenue guarantees (CfD)	Volume risks taken by government	Liability transfer after 15 years	State-owned enterprise as sponsor	State-owned enterprise as sponsor
Longship CCS **(full chain) Norway**	~80% of capital and first 10 years of operation covered	Co-ordination, compensation for counterparty default	Liability transfer after 15 years	State-owned enterprise among sponsors	State-owned enterprise among sponsors
BECCS Stockholm **(power) Sweden**	Long-term revenue guarantee (reverse auction)	Contractual arrangement with storage provider		Jointly-owned enterprise as sponsor	Jointly-owned enterprise as sponsor
Glacier **(power)**, **Canada**	15-year CO_2 credits offtake agreement at fixed price	Contractual arrangements	Post-closure stewardship fund (Alberta)		Contractual arrangements
High Plains CCS **(bioethanol)**, Trailblazer (T&S) **United States**	Partially covered by government operational tax credit	Contractual arrangements	Post-closure stewardship fund (Wyoming)		Contractual arrangements

Risk allocation **Public** **Shared** **Private**

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Notes: BECCS = bioenergy with carbon capture and storage; CCfD = carbon contract for difference; CCS = carbon capture and storage; CfD = contract for difference; FOAK = First-of-a-kind; NZT = Net Zero Teesside; NEP = Northern Endurance Partnership; RAB = regulated asset base; T&S = transport & storage.

Sources: IEA analysis, adapted from Sustainable Markets Initiative (2026); UK Parliament (2024); IEA (2022); Norwegian Ministry of Petroleum Energy (2020).

In North America, partnerships have evolved through market-led private collaboration and targeted public involvement, reflecting a financing environment anchored primarily in tax incentives rather than regulated revenue frameworks. In the United States, private partnerships between emitters, storage developers and infrastructure operators have been sufficient to advance projects with relatively low capture costs and clear revenue models, particularly where eligibility for the 45Q tax credit underpins project cash flows. Public programmes play a targeted role in addressing risks that private markets struggle to absorb, particularly related to CO_2 storage. For example, US Department of Energy initiatives such as CarbonSAFE support feasibility studies, site characterisation and permitting of large-scale storage resources, reducing subsurface and regulatory uncertainty. However, the process of obtaining Class VI well permits remains a key bottleneck in several states and depends on both regulatory approval and engagement with local communities.

In the United Kingdom, a cluster-based approach relies on public–private partnerships across the CCUS value chain. Private developers build and operate capture facilities and transport and storage infrastructure, while government support mechanisms play a central role in bearing long-term liability and system-

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level risks that private actors are not well-positioned to manage. Revenue and policy risks are addressed through long-term contractual arrangements, including dispatchable power agreements and a regulated asset base model for transport and storage, combined with force majeure and change-in-law protections that improve lender confidence. Technology and delivery risks are allocated contractually among project sponsors, EPC contractors and public counterparties, rather than concentrated on a single entity.

A complementary model comes from the Netherlands, where SOEs play a central role in developing open-access CO_2 transport and storage infrastructure, while capture projects are privately developed. Revenue support is delivered through the SDE++ carbon contract for difference mechanism, which covers the gap between the cost of capture and transport and the EU Emissions Trading System carbon price, while the state assumes some volume risks and long-term liability of stored CO_2.

In Sweden, the government provides long-term revenue guarantees for negative emissions through reverse auctions for carbon removal credits, assuming carbon price risk. In the case of the BECCS Stockholm project, Stockholm Exergi, which is partly owned by the state (50% owned by the City of Stockholm), acts as project sponsor, strengthening credit quality and execution capacity. Transport and storage risks are managed contractually through agreements with the Northern Lights storage project, rather than through direct government ownership of infrastructure.

The operational track record can help with risk assessment, but more transparency is needed

Using data and transparency to reduce risk premiums

While not specific to CCUS projects, technical and operational risks are a central consideration for financial institutions. At the point when lenders, investors, and insurers are asked to commit capital – typically prior to construction or early in project development – there is not yet any project-specific operational data to rely on. Instead, risk assessment is based on a combination of engineering studies, the technical credibility of the sponsor and subcontractors, modelling, academic research, and the operational track record of comparable facilities elsewhere. These inputs are used to assess whether capture facilities, host plants, transport systems, and injection sites are likely to operate as intended – achieving designed capture rates and capacity factors, maintaining containment integrity, and reliably detecting and managing any leakage events through appropriate monitoring systems. As projects enter operation, operational data also becomes a critical

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input into risk reassessment, influencing insurance terms, refinancing conditions, and the cost of capital for expansions or follow-on projects.

Although CCUS is often perceived as an emerging technology, many components of the value chain have decades of operational history that can inform pre-construction risk assessment. In the United States, CO_2 has been separated from industrial process streams, transported over long distances, and injected underground for enhanced oil or gas recovery since the 1970s. In Europe, CO_2 has been captured from gas-processing facilities and injected into depleted gas fields for dedicated storage since the mid-1990s.

Despite this experience, the observable track record for CCUS remains uneven across technologies, applications and scales. As a result, financiers may apply higher risk premiums and contingencies than would be implied by the available evidence – particularly when performance data are fragmented, proprietary, or inconsistently reported.

Transparent reporting of key performance indicators – such as volumes of CO_2 captured and injected, system availability, and leakage rates – can materially reduce perceived risk. However, much of this data remains owned by project operators. For sponsors with long operating histories, such data is a valuable asset that strengthens both project-level bankability and sponsor credit assessment. By contrast, newer developers – particularly those without prior experience in capture, transport, or storage – may face higher financing costs due to limited observable performance data.

For publicly supported projects, governments are uniquely positioned to facilitate data-sharing and standardised reporting. By ensuring that performance data from commissioned projects are made available – subject to appropriate safeguards – public authorities can help reduce the cost of capital for subsequent projects. National reporting frameworks, such as the US Greenhouse Gas Reporting Program and Canada's Greenhouse Gas Reporting Program for capture, transport, utilisation, and storage activities, already play an important role in improving transparency. Similarly, initiatives such as the London Register of Subsurface CO_2 Storage, which tracks cumulative CO_2 injected for storage across dedicated storage and EOR sites, rely on mandatory company reporting under specific legal and regulatory frameworks.

What the operational record tells us about capture performance

The existing operational track record for CO_2 capture provides significant insights into technical performance, integration challenges and system interactions, with important technical, legal, and regulatory learnings, contributing to improved standards and more robust regulatory frameworks for subsequent CCUS

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developments. At the same time, its applicability to new projects is bounded by sectoral differences, FOAK characteristics, and the historical policy context.

The existing project track record on CO_2 capture is most directly applicable to applications characterised by high-concentration CO_2 streams, as can be found in bioethanol, hydrogen, and gas-processing facilities. In these contexts, operational experience provides a meaningful basis for assessing technical performance risk. Available data indicate that capture systems in such applications generally operate in line with their original design assumptions, with several facilities consistently achieving capture rates above 90% of targeted streams and, in some cases, annual average capture rates exceeding 95%.

However, many CCUS projects seeking financing today represent either new applications of existing technologies – e.g. capture on more dilute CO_2 streams – or significant scale-ups from prior installations. As a result, these projects retain FOAK elements, even where underlying capture technologies are well understood. Even when operational experience is available, projects are typically designed as tailored, bespoke installations, limiting the degree to which their performance can be generalised. Canada's Boundary Dam project illustrates these early-development challenges. As the first large-scale facility to apply capture to a coal-fired power plant, it encountered a number of design and operational issues during its initial years of operation, which required system modifications and corrective actions.to improve capture plant availability. Many of the most valuable lessons emerged from unforeseen operational challenges that were resolved through operational experience over time. While these issues do not indicate fundamental shortcomings in capture technology, they reflect the integration and design challenges typical of FOAK projects.

Moreover, few CCUS projects were designed or operated to maximise overall CO_2 capture from a host facility. Instead, capture systems were typically configured to target specific, high-concentration streams, reflecting limited policy incentives and weak economic drivers for capturing emissions from more dilute sources. In several cases, lower-than-expected capture volumes resulted from factors unrelated to capture technology performance. Reduced utilisation or unplanned outages at host facilities – such as power plants or industrial units – directly constrained capture output, as observed at projects including ADM Decatur and Boundary Dam. In other cases, capture operations were suspended for economic reasons, most notably at Petra Nova, where lower oil prices undermined the EOR-based revenue model and led to a multi-year shutdown of the capture plant.

Finally, many CCUS projects were developed as fully integrated value chains, with capture, transport, and storage components closely coupled. In this configuration, technical or operational issues downstream – particularly in storage – directly reduced capture rates or forced temporary shutdowns of capture facilities. The

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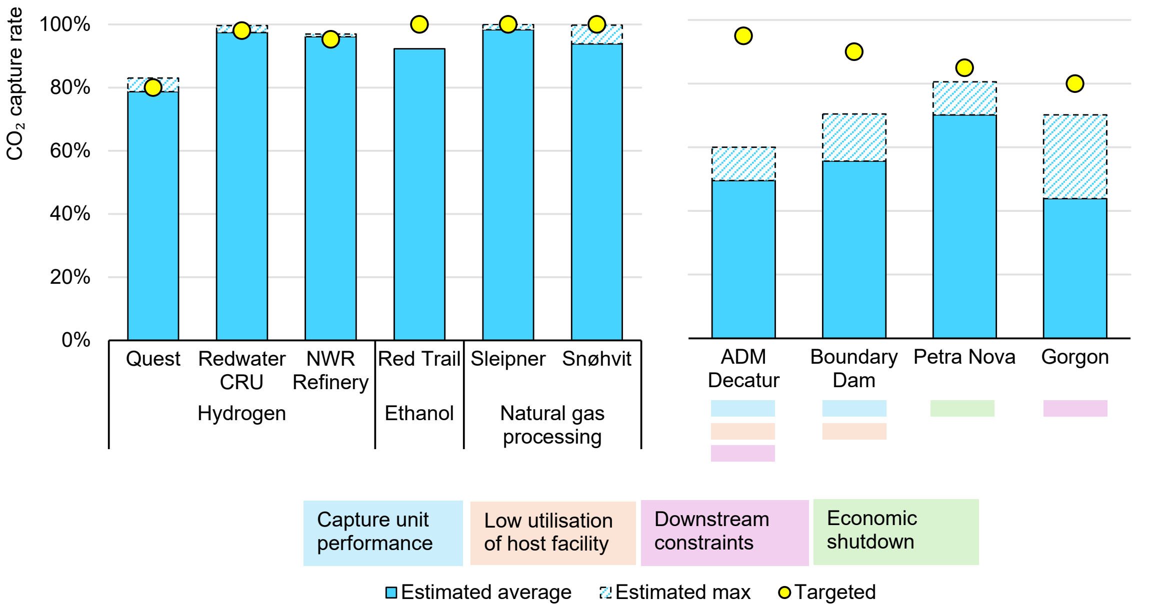
Gorgon project in Australia has faced challenges related to reservoir pressure management, while ADM Decatur has experienced issues related to CO_2 purity, well clogging, and corrosion.

Estimated CO_2 capture rate for selected operational carbon capture, utilisation and storage projects



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Notes: ADM = Archer Daniels Midland; NWR = North West Redwater; CRU = CO_2 recovery unit. CO_2 capture rates are estimated by dividing the mass of CO_2 separated in the capture plant (and therefore not emitted) by the total mass of CO_2 produced in the gas stream of the host facility to which the capture plant is fitted. It therefore reflects both technical performance and operational factors (e.g. utilisation) of the capture system. Estimated average corresponds to the entire operational period to date. Estimated max corresponds to the highest rate achieved so far in a single year of operation.

Sources: IEA analysis based on IEAGHG TCP (2019); Alberta Department of Energy (2024); Enhance Energy (2024); US Environmental Protection Agency (2023); IEA Bioenergy TCP (2023); Red Trail Energy (2022); Giannaris, S. et al. (2021); Chevron (2024); Petra Nova Parish Holdings (2020).

Operational capture data are most informative for high-concentration CO_2 streams, where projects have generally performed in line with design expectations.

The US experience provides useful insights into the probability and impact of CO_2 transport leakage

There are currently close to 9 000 km of CO_2 pipelines in operation in the United States. Based on reported CO_2 pipeline incidents, around 370 000 barrels (~51 000-56 000 tonnes[2]) of CO_2 have been released since 2010 across 82 incidents.[3] Around 20% of this volume resulted from unintentional release, with

[2] Assuming pipeline operating pressures between 100 and 150 bar and temperatures between 10 and 20°C.

[3] While statistics have been available since 1988, since 2010 operators must differentiate between unintentionally and intentionally released CO_2 when reporting incidents. Statistics since 2010 are used in this section. Since 1988, around 440 000 barrels of CO_2 have been released across 124 accidents.

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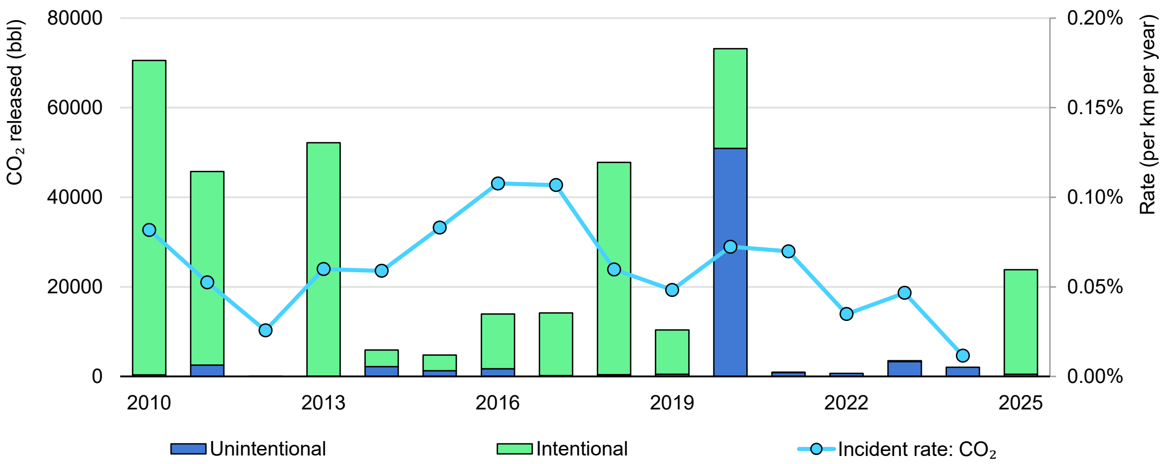
the remainder occurring during post-incident repairs and maintenance. This corresponds to an incident rate of around 0.06% per km of CO_2 pipeline per year. In terms of transported volumes, assuming an average annual throughput of approximately 66 Mt CO_2 (as of 2019), average annual leakage represents around 0.005% of total CO_2 transported. The economic penalties incurred due to these incidents amounted to approximately USD 8 million (2025 USD) since 2010, or about USD 97 000 per incident.

While these records provide a positive historical record of operational experience in managing CO_2 transport by pipeline, two caveats are important to note when applying this experience to future systems. First, the existing network – most of which was developed for EOR purposes – primarily transports relatively pure CO_2, with more limited experience transporting dense-phase CO_2 containing impurities. At the same time, many pipelines were developed with an emphasis on minimising transport, while CO_2 infrastructure for dedicated storage may adopt different specifications for materials, coatings, and operating conditions to address long-term storage and regulatory requirements, and minimise leakages.

CO_2 pipeline incident rate and volume of CO_2 released in the United States, 2010-2024



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Source: IEA analysis based on US Department of Transportation (accessed January 2026).

Pipeline incidents in the United States are infrequent: leaks amount to less than 0.01% of total CO_2 transported.

Research has a role to play where the track record is insufficient

For geological CO_2 storage, the operational record remains insufficient to precisely quantify the probability and potential impact of leakage across all storage contexts. As a result, uncertainty continues to be reflected in risk pricing.

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Extensive research has examined leakage mechanisms across both natural and anthropogenic pathways, including fault reactivation, caprock integrity, abandoned wells, and induced pressure effects. While research cannot fully substitute for long-term operational data, it provides a robust basis for bounding risks, informing monitoring requirements and supporting regulatory design. Over time, the combination of expanding operational datasets and targeted research is expected to further reduce uncertainty – and associated risk premiums – in storage projects.

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Recommendations

Support bankable business models and viable risk-sharing mechanisms

The fundamental backbone of financing a CCUS project remains its value proposition. In the absence of a mature commercial market for CCUS, governments have a key role in supporting business models that create value. In some cases, this may mean supporting a stable and long-term compliance market that places a price on CO_2 emissions; in others, it could be creating the regulatory conditions necessary to enable the adoption of low-emissions products. Both of these actions would send a market signal on the long-term value creation of CCUS. Where these market signals alone are not sufficient or are too nascent, some jurisdictions may also consider additional policies to reduce a project's revenue risk – examples highlighted in this report include CfDs and other operational subsidies such as tax credits.

Part of this equation is establishing the right balance of risk-sharing between project partners, including governments, developers, financiers and insurers. Each stakeholder has a differing tolerance for risk and ability to manage it. As the CCUS market develops, some risks may inevitably shift from the public to private sector. For example, some governments in Europe are taking a large share of cross-chain risk to deploy the CO_2 transport and storage infrastructure that can support future projects. As the market evolves, this risk may decline and shift to the private sector as supporting infrastructure is established and proven economically. In some jurisdictions and markets, certain risks may always require a government backstop – this could include the long-term liability associated with stored CO_2.

Ensure legal and regulatory frameworks are fit for purpose

Clear legal and regulatory frameworks are a foundation for investment in CCUS projects. While dozens of jurisdictions around the world have such frameworks in place, many lack well-defined rules, which can deter financing, raise the risk premium for lenders and insurers, or lead to fragmented regulatory approaches for projects. Frameworks must clearly outline the basis of CCUS activities, including identifying the relevant regulatory authorities, equipping them with the necessary expertise and resources, and ensuring a co-ordinated approach across government.

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Long-term visibility and stable frameworks are key to create a level of certainty and durability needed for investors. At the same time, regulatory frameworks should not be static. As governments gain experience from implementing regulations and learn lessons from early-mover projects, they will need to review their frameworks periodically to ensure that laws and regulations continue to support CCUS activities. Project developers, financiers and relevant authorities with first-hand experience of the regulatory process can provide valuable input to the regulatory development and review process. Questions around third-party access, ownership and liability are examples of how frameworks can adapt as new projects and business models arise.

Moving forward, frameworks – whether dedicated to CCUS or part of a broader emissions reduction policy – will need to account for the interaction between liability exposure and carbon markets once the CO_2 is stored. While frameworks generally require operators to show some level of financial security in the event of leakage or loss of containment, there are currently no clear mechanisms that assign a monetary value to the leaked CO_2 and how that is treated in jurisdictions with compliance markets.

Additionally, the emergence of cross-border CCUS projects brings into question the regional harmonisation of frameworks. For example, in Southeast Asia, long-term liability arrangement, carbon accounting alignment and multilateral risk-sharing mechanisms may be needed.

Harmonise definitions and standards across the value chain

Clear and harmonised definitions, standards and accounting frameworks across the CCUS value chain provide an important foundation for developing bankable business models, particularly in emerging markets such as low-emissions materials and CDR. While standards alone are not sufficient to create viable markets, they help establish the credibility and comparability needed for commercial transactions and financing. This is particularly relevant in the case of new chain-of-custody models that are emerging to track the carbon intensity of low-emissions materials. Robust and transparent measurement, reporting and verification (MRV) frameworks can support transparent carbon tracking across value chains, which overtime can stimulate demand for lower-emissions products and strengthen the underlying business case for CCUS investments.

Clear standards and harmonised regulatory frameworks also play a key role in reducing operational and financial risks. For example, CO_2 specifications for transport and storage that are designed to be technically robust but not overly restrictive for emitters can reduce uncertainty around pipeline integrity and storage performance, improving the bankability of transport and storage infrastructure.

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Similarly, consistent MRV and carbon accounting frameworks across jurisdictions provide assurance that emissions reductions or removals will be recognised and credited throughout the value chain. This becomes particularly important for cross-border CO_2 transport, where differences in regulatory frameworks, liability regimes and carbon accounting approaches can complicate project development and financing.

Strengthen risk assessment through data-sharing and early collaboration among governments, developers, financiers and insurers

Institutional capacity and access to high-quality data are critical enablers of investment in CCUS. Financial institutions and insurers must assess technical, commercial and operational risks before committing capital, yet operational data from CCUS facilities remain fragmented or proprietary, making it difficult for lenders, insurers and new developers to assess project performance. This raises perceived risk and constrains the development of tailored financial and insurance products.

Greater transparency and structured data-sharing could substantially improve risk assessment. Publicly supported CCUS projects offer an important opportunity to make anonymised or aggregated performance data available to regulators, financiers and future developers, while protecting intellectual property. Establishing common datasets and dedicated databases of performance data could support consistent underwriting standards and help develop more robust risk models. Over time, a stronger evidence base would reduce uncertainty around technology performance and storage integrity, making it easier for projects to secure commercial debt and insurance coverage on favourable terms.

Closer collaboration between project developers, governments, financial institutions and insurers is also needed from the early stages of project design. Engagement with insurers' risk engineers at an early stage can help identify and map risks across the CCUS value chain, clarify the roles and responsibilities of different stakeholders, and align risk mitigation approaches across the value chain. Initiatives such as the collaboration between the Clean Energy Ministerial CCUS Initiative, the Geneva Association and the Oil and Gas Climate Initiative, or the Asia CCUS Network Forum, provide useful platforms for this dialogue. Strengthening international co-operation through these initiatives can also help build consensus on data requirements, monitoring approaches and the attribution of emissions reductions across CCUS chains that span multiple jurisdictions in the case of cross-border CCUS projects.

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Increase development funding resources to map CO_2 storage potential

A major barrier to CCUS deployment is the limited availability of fully characterised CO_2 storage sites. While some countries benefit from domestically funded mapping efforts, or data gained through oil and gas industry experience, many do not have the funds available to conduct costly studies of potential CO_2 storage sites. This is particularly relevant in emerging markets and developing economies. While many of these countries have significant geological potential, subsurface data are often outdated, incomplete or entirely absent. Storage resource appraisal, which can include seismic surveys, exploratory drilling, reservoir modelling and permitting, can cost tens of millions of dollars, and may not lead to a viable project. These activities are high-risk and largely unrecoverable if unsuccessful, and therefore not attractive for private investors or commercial lenders. State-owned enterprises (SOEs) in the energy sector can play an important role in these initial stages, however, public budgets are also often constrained and must compete with other development priorities, making external support essential.

Multilaterals, development finance institutions and export credit agencies can address early-stage financing gaps. Their technical expertise, concessional capital and ability to absorb higher levels of early project risk make them well-suited to fund geological surveys, capacity building and storage readiness programmes. Institutions such as the World Bank, Asian Development Bank, European Bank for Reconstruction and Development and the Green Climate Fund already support early-stage CCUS studies in several regions, but the scale remains far below what is needed to meet long-term climate goals. Strengthening these programmes, potentially through dedicated storage mapping funds, could accelerate project pipelines and create the conditions necessary for private capital to participate.

Include CCUS in sustainable finance taxonomies and transition finance frameworks

Sustainable finance taxonomies and transition finance frameworks play an important role in shaping investment flows, as they guide banks, institutional investors and corporates in determining which activities align with climate objectives. Their effectiveness is closely linked to broader climate policy signals, such as clear recognition of CCUS in Nationally Determined Contributions and supporting national decarbonisation strategies. Including CCUS within taxonomies and frameworks would expand the range of financial instruments available to project developers, such as green, transition and sustainability-linked bonds, while reducing the reputational and regulatory uncertainty that currently limits the

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participation of some investors. This is especially important for industrial sectors where decarbonisation options are limited and CCUS represents one of the only viable pathways to deep emissions reductions.

Several jurisdictions are already developing or revising taxonomies and frameworks to incorporate CCUS. The European Union and Canada have integrated CCUS within elements of their sustainable finance frameworks, while Japan has incorporated CCUS in its transition finance framework and sovereign transition bond guidance. Regional initiatives are also emerging: the ASEAN Taxonomy for Sustainable Finance includes CCUS, and initiatives such as the Asia Zero Emissions Community recognise CCUS within transition finance guidance and technology lists. While promising, major differences in regional taxonomies and frameworks could pose challenges for cross-border financing.

Clear eligibility criteria within these taxonomies and frameworks, such as requirements for robust MRV, can build credibility while expanding financing channels. By creating a consistent signal across jurisdictions, inclusion in taxonomies would give project developers access to a broader investor base, lower financing costs, and scale the issuance of sustainable debt instruments that could accelerate the commercialisation of CCUS.

Draw on experiences from other capital-intensive sectors

Experience from other capital-intensive and network-based sectors shows that private capital follows only after governments establish clear frameworks for revenue certainty, risk allocation and long-term system planning. Renewable power provides perhaps the clearest precedent: early wind and solar projects faced high capital costs, limited operating track records, and exposure to wholesale market volatility. Deployment accelerated once governments introduced long-term support mechanisms such as feed-in tariffs and CfDs, which stabilised revenues and enabled the widespread use of project finance. While the revenue proposition is different from CCUS (wind and solar inherently generate a product, electricity), these instruments reduced perceived risk and unlocked large pools of commercial debt and institutional capital.

Gas and electricity networks also offer useful analogies for CCUS transport and storage. These sectors faced similar co-ordination challenges, including the need to build infrastructure before demand fully materialised, and to manage interdependencies across multiple users. Regulatory structures, such as regulated asset base models, cost-recovery tariffs and long-term capacity booking regimes, provided investors with predictable returns and helped ensure that critical infrastructure could be financed at scale. These mechanisms allowed private capital to participate in developing large distribution systems, despite uncertain utilisation in the early years.

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Oil and gas value chains illustrate how complex cross-chain and volume risks can be managed contractually. While the offtake and storage of CO_2 carries liability concerns rather than intrinsic market value, mechanisms such as long-term take-or-pay contracts, minimum volume commitments and back-to-back commercial structures have underpinned pipeline and LNG investments for decades. While these examples are particular to the oil and gas sector, similar arrangements can be adapted to the CCUS context and support bankability in CCUS hubs by giving transport and storage operators the revenue visibility needed to raise non-recourse debt.

Taken together, these sectoral experiences show that CCUS faces a familiar set of challenges, and that leveraging proven policy and regulatory tools can significantly accelerate private capital mobilisation.

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Annex

Abbreviations and acronyms

ACTL	Alberta Carbon Trunk Line
ADNOC	Abu Dhabi National Oil Company
ASEAN	Association of Southeast Asian Nations
BECCS	Bioenergy with carbon capture and storage
CAD	Canadian dollars
CAPEX	Capital expenditure
CCfD	Carbon contract for difference
CCUS	Carbon capture, utilisation and storage
CDR	Carbon dioxide removal
CfD	Contract for difference
CIP	Copenhagen Infrastructure Partners
CO2	carbon dioxide
CPS	Current Policies Scenario
DAC	Direct air capture
DACS	Direct air capture with storage
DFI	Development finance institutions
ECA	Export credit agencies
EGR	Enhanced gas recovery
EOR	Enhanced oil recovery
EPC	Engineering, procurement and construction
FID	Final investment decisions
FOAK	First-of-a-kind
GHG	Greenhouse gas
JPY	Japanese yen
LNG	Liquefied natural gas
MDB	Multilateral development banks
MMV	Measurement, monitoring and verification
MRV	Measurement, reporting and verification
MVC	Minimum volume commitment
NOK	Norwegian kroner
NZE	Net Zero Emissions by 2050 Scenario
R&D	Research & development
SEK	Swedish kronor
SOE	State-owned enterprises
SPV	Special purpose vehicle
STEPS	Stated Policies Scenario
TRL	Technology readiness level
VC	Venture capital

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Units of measure

°C	celsius
bar	bar
Gt	gigatonnes
GWh	gigawatt houe
km	kilometres
ktpa	kilotonnes per annum
Mt	million tonnes
Mtpa	million tonnes per annum
t	tonnes

See the IEA glossary for a further explanation of many of the terms used in this report.

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