Sustainable Markets Initiative

# Unlocking Private Capital

## Scaling Investment in the CCS Sector

Undertaken by

Baringa

# Purpose of the Report

This report is intended for the financial services sector, policymakers, project developers, and public finance bodies involved in global Carbon Capture and Storage (CCS) deployment. It aims to accelerate private capital mobilisation by identifying investment barriers – commercial, regulatory, and financial and educational – and proposing three integrated recommendations for the financial services sector.



We explore how the financial services sector can collaborate with governments and industry to build scalable business models and funding structures, fostering greater understanding and capability across the CCS value chain. The three integrated recommendations address not only financial mechanisms but also the importance of education, awareness and capacity building to help create opportunities to unlock billions in CCS investment across capture, transport, and storage.

Produced under the Sustainable Markets Initiative Financial Services Taskforce (SMI FSTF) CCS Lighthouse Project, led by **Barclays** and **BNP Paribas** and delivered by **Baringa Partners**, the report reflects close collaboration with SMI member banks and stakeholders across the CCS value chain (including SMI industry partners). It contributes to the SMI's mission to drive practical climate action by showing how finance can support steps towards catalysing net zero through CCS.

## Approach

This report draws on international case studies and bilateral engagements across the industry, including senior-level workshops held during London and New York Climate Weeks. It highlights lessons from successful CCS projects and outlines innovations needed to scale investment.

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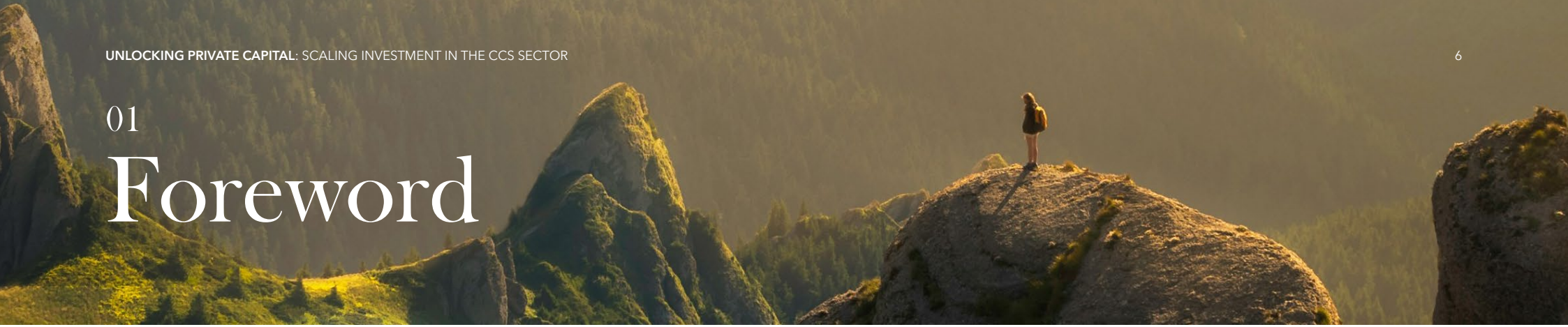


01

# Foreword

Global demand for energy continues to increase, spurred by population growth, the industrialisation of developing economies, and the expansion of data centres and other digital infrastructure. Meeting this demand, while avoiding the far-reaching consequences and risks posed by climate change, requires an unprecedented transformation of our energy systems.

It is estimated the global transition will depend on trillions of dollars of investment every year into clean energy projects[1] and the financial services sector, by mobilising the necessary capital, will play a fundamental role. The Sustainable Markets Initiative's Financial Services Task Force brings together representatives from across financial services to drive the collective effort needed to facilitate a transition that is both resilient and economically sound.

The Task Force recognises Carbon Capture and Storage (CCS) technology as a vital enabler of the transition. It is widely understood that, to achieve net zero by 2050, carbon capture technology and infrastructure will be indispensable by providing dispatchable low carbon power, decarbonising industry, and removing $CO_2$ from the atmosphere[2]. The CCS sector also has the potential to contribute significantly to growth and prosperity: in the UK, for example, CCS could support tens of thousands of jobs and contribute billions in economic value[3].

The technical performance of CCS is reasonably well proven and, in key markets such as the UK, Norway, the Netherlands, the US and Canada, commercial and policy frameworks are in place to connect supply and demand. However, more work is needed to ensure financial firms are comfortable with the market risks involved, by demonstrating proof of credible revenue models. Getting projects operational will be critical in speeding up learning cycles and providing further reassurance about the technology.

The challenge, therefore, for the accelerated deployment of CCS at scale is enabling an influx of capital – and this will need to come from the private sector. This report proposes practical actions to catalyse that investment.

Producing this report has been a truly collaborative effort and we want to thank the SMI for commissioning the report, Baringa for producing the report, and the members of the Task Force, and other partners, that have contributed their time and expertise.

We hope this report will encourage renewed efforts by stakeholders – financial institutions, governments, developers, and industry – to work together to accelerate the sector's vital contribution to a more sustainable future.

**C.S. Venkatakrishnan**

Group Chief Executive of Barclays, Chair of the SMI's Financial Services Task Force

**Emmanuelle Bury-Lucas**

UK Country Head of BNP Paribas. Co-lead on SMI Financial Services Task Force CCS Lighthouse Project

1 BloombergNEF, "The $7 Trillion a Year Needed to Hit Net-Zero Goal", 2022

2 IEA, "Energy Technology Perspectives", 2020

3 Department for Business, Energy & Industrial Strategy (BEIS), "Energy Innovation Needs Assessment – Carbon Capture, Utilisation, and Storage", 2019

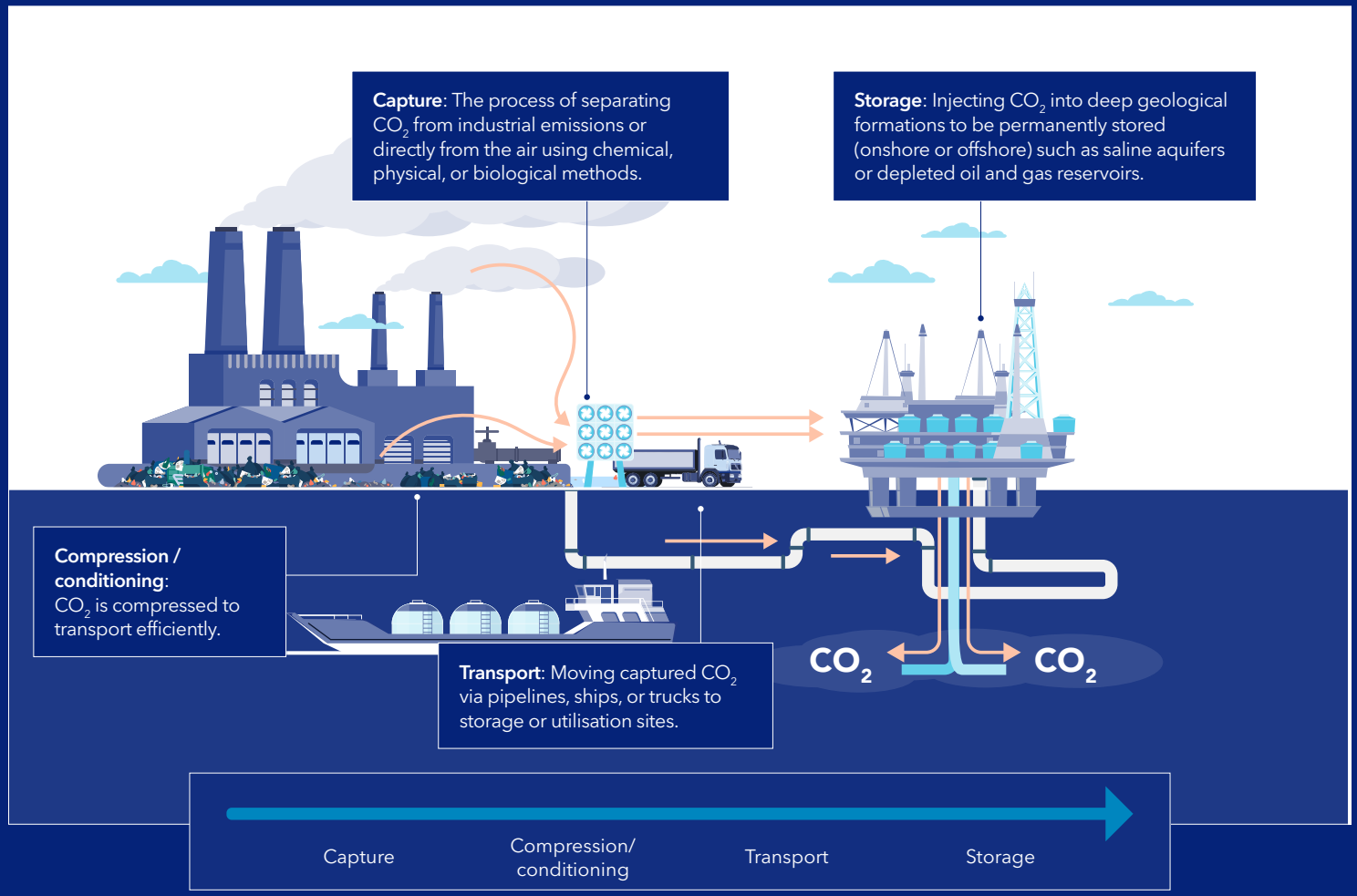
# Carbon Capture and Storage (CCS) is a critical technology for achieving net zero

## *What is CCS?*

Carbon dioxide ($CO_2$) emissions from sources such as industrial facilities and power plants are captured and stored underground to prevent atmospheric release. It also enables carbon removal services when paired with technologies such as direct air capture (DAC) or bioenergy with carbon capture and storage (BECCS).

## *Why does it matter?*

CCS is vital for decarbonising hard-to-abate sectors (e.g. cement) and achieving net zero. However, financing remains challenging due to cross-chain risks and uncertain long-term revenue streams.
The financial services sector can unlock capital to realise this major investment opportunity.



# Unlocking private capital: Scaling investment in the CCS sector

## *CCS is at a critical turning point*

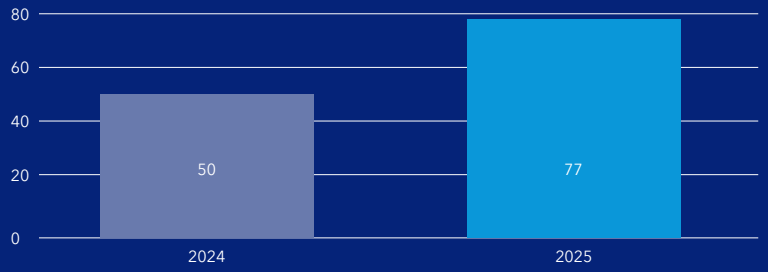
Carbon capture and storage (CCS) brings a new and fast growing investment opportunity whilst being critical to global decarbonisation:

*8%*
global emissions reduction

CCS is a vital technology for achieving global net zero ambitions by 2050. The International Energy Agency (IEA) estimates that CCS could deliver up to **8% of global emissions reductions from 2022-2050**, around ~ 6 $GtCO_2$/yr by 2050, or equivalent to taking **every car and van on earth off the road, more than one and a half times over.**

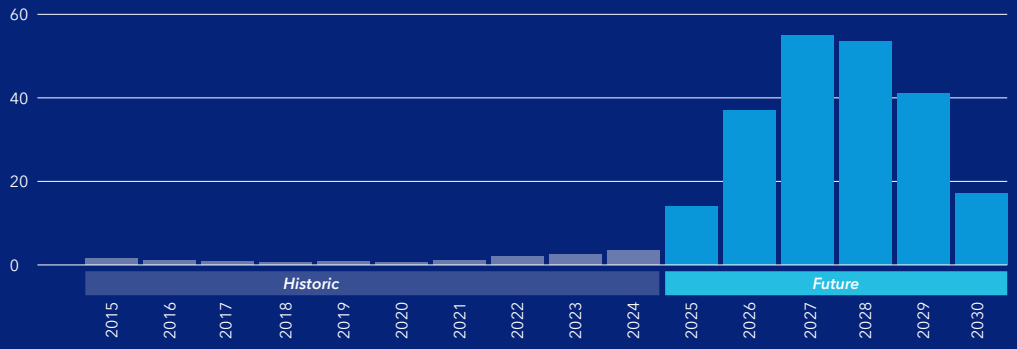
Operational facilities up

*54%*
year on year




Number of operational facilities, GCCSI, "Global status of CCS", 2025

CCS represents a **multi-billion-dollar investment opportunity**. Annual investment could increase tenfold over the next two to three years from the $4 billion recorded in 2024.




Annualised investment based on current and future pipeline ($billion, 2024 prices), IEA, 2025

This project was facilitated by the Financial Services Task Force of the Sustainable Markets Initiative (SMI FSTF) to improve information and capital flows in the CCS sector.

## *Objective*

How can the financial services sector work with industry and governments to create scalable business models, develop innovative funding structures, improve information flows, and mitigate risks to unlock billions of private capital in CCS deployment?

## *SMI FSTF CCS Lighthouse Project*

1. Unpack lessons and problems from investment case studies
2. Engage leading institutions and sector experts for solutions
3. Develop recommendations
4. Test and refine recommendations

## *Engagement*

*70+*

participants at London Climate Action Week workshop unpacking investment case studies.

*30+*

bilateral sessions with developers, banks, insurers, and policymakers.

*75+*

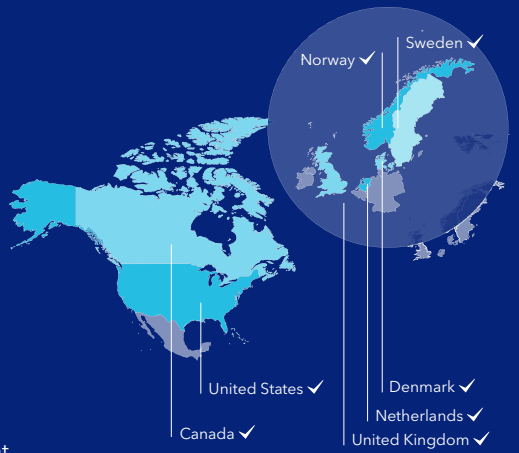
participants at NY Climate Week workshop with senior stakeholders stress-testing recommendations.

# A strategic pathfinder: Three integrated recommendations to increase the scale and pace of capital and information flows in CCS

## *Improving market fundamentals*

Our assessment of recent case study transactions show **market fundamentals are improving** across jurisdictions: policy support is expanding, carbon prices are expected to rise, core transport infrastructure is in place, and green premiums and decarbonisation credit markets are beginning to emerge.

**Capital** is available in the financial services sector, though attracting private investment at the necessary scale requires projects to offer credible returns, stable revenues, robust risk allocation, and downside protection.




*Case studies from projects that have taken FID.*

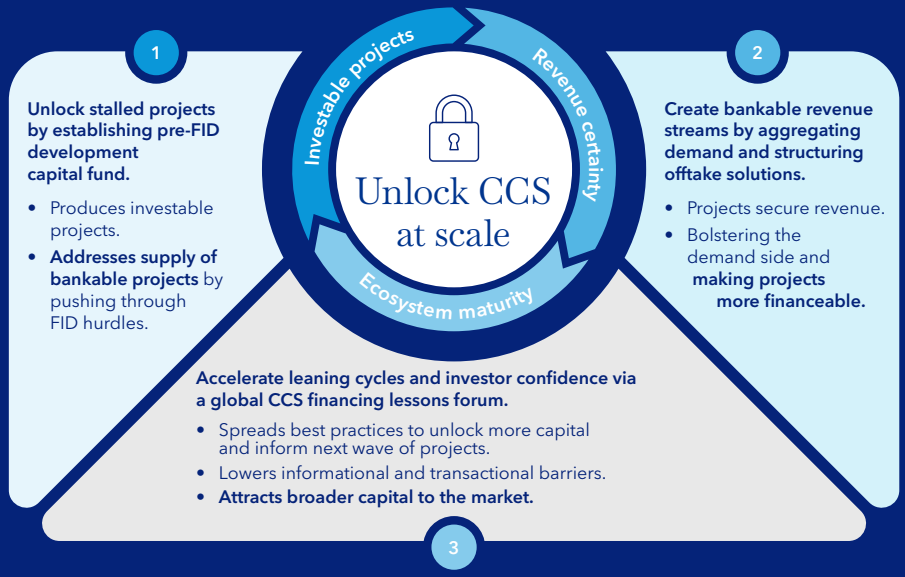
## *Persistent barriers remain*

Consistent barriers to financing remain across jurisdictions, driven by market risks (missing money gap, credible project offtake) and physical risks (cross chain risk, technical challenges, treatment of storage liabilities) leading to:

| | Problem |
|---|---|
| 1 | 91%[1] of capture projects targeting 2030 operation globally have not taken financial investment decision (FID). |
| 2 | Projects must stack multiple revenue streams to cover costs; government subsidies (in the context of fiscally constrained governments); carbon pricing; and voluntary offtake premiums creating uncertainty and undermining bankability. |
| 3 | Development cycles take 5-10 years and only a handful of concentrated large- scale CCS projects have reached FID to date. |

1 Baringa Analysis, "IEA Project database", 2025

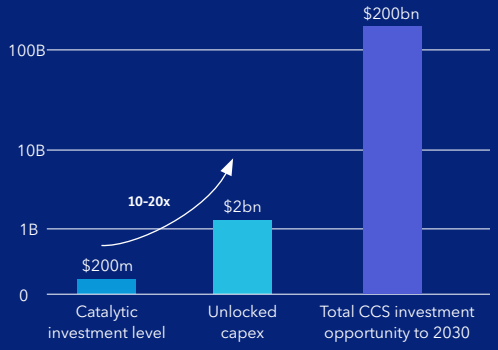
## *Three integrated recommendations*



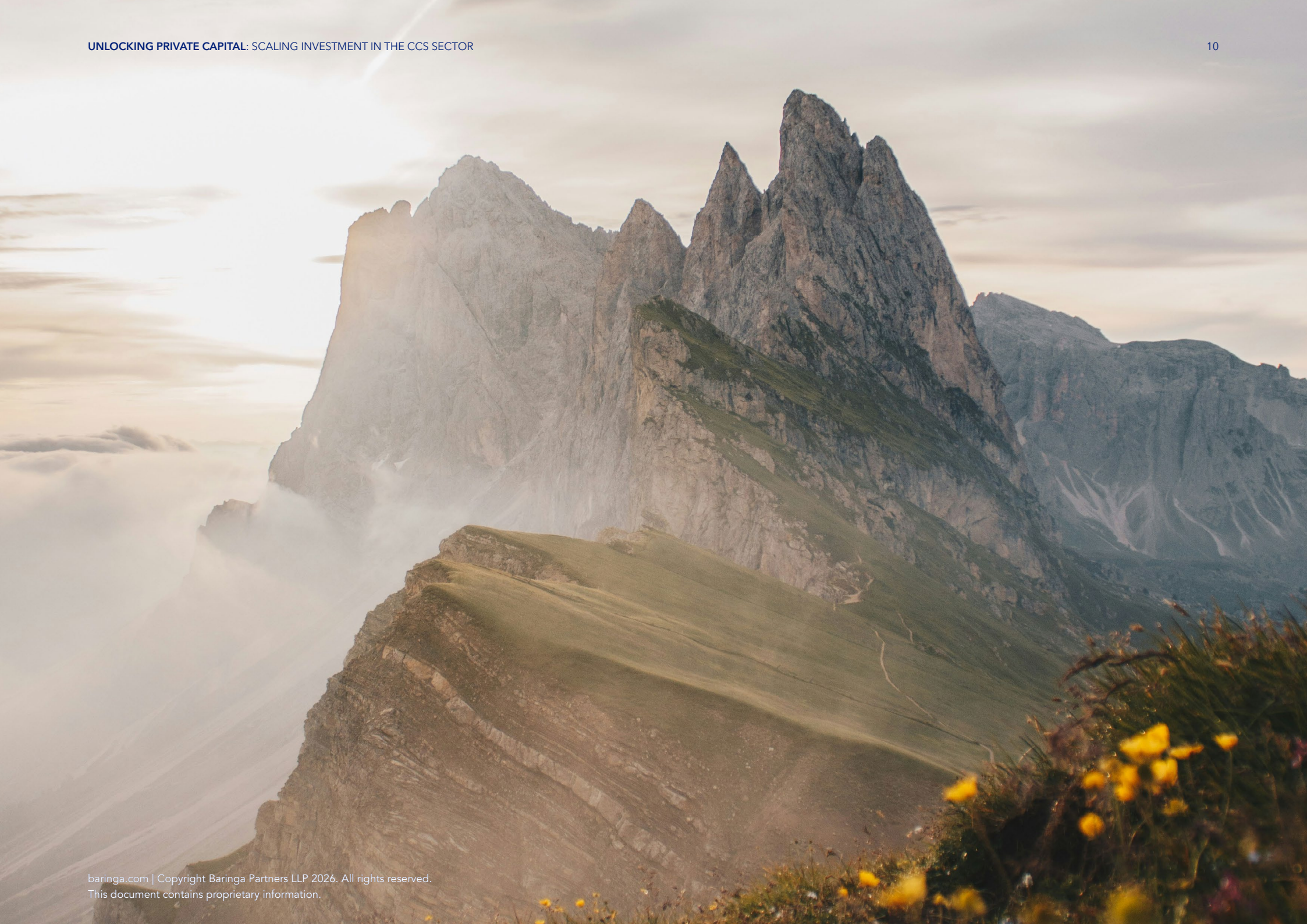

The recommendations work individually and in unison to increase the flow of capital and information in the CCS sector.

## *Coherent, catalytic impact*

The development fund can drive investment in near term projects, which has catalytic impact by unlocking downstream capex, and the larger investment opportunity. This, combined with more certain offtake and improved information flows can support the overall investment potential being achieved.




*Baringa Analysis, Illustrative impact of pre-FID development fund, logarithmic scale.*



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# Executive summary

## A critical turning point for Carbon Capture and Storage

Carbon Capture and Storage (CCS) is an vital technology for achieving global net zero ambitions by 2050.

The International Energy Agency (IEA) estimates CCS could deliver up to 8% of global emissions reductions between 2022 and 2050[4], particularly in hard-to-abate sectors such as cement and steel. This represents around 6 gigatonnes of $CO_2$ per year by 2050 ($GtCO_2$/yr) – equivalent to removing every car and van from the world's roads more than one and a half times over. The sector is now at a critical juncture: the technology is proven, market fundamentals are strengthening, and the project pipeline is accelerating rapidly.

This report, produced under the Sustainable Markets Initiative Financial Services Taskforce (SMI FSTF) CCS Lighthouse Project, addresses the central challenge facing the sector:

**How can the financial services sector work with industry and governments to create scalable business models, develop innovative funding structures, improve information flows, and mitigate risks to unlock billions of private capital in CCS deployment?**

The scale of the opportunity is immense. With operational facilities up 54% year-on-year[5], and 117 projects targeting Final Investment Decision (FID) before 2027[6], CCS represents a multi-billion-dollar investment opportunity. However, to realise this pipeline, annual investment must increase tenfold over the next two to three years from the $4 billion recorded in 2024[7].

To date, governments have played a crucial role, committing approximately $50 billion[8] in 2023-2024 to landmark first-of-a-kind (FOAK) projects. For instance, in the UK up to £21.7 billion[9] has been made available to enable the deployment and growth of the first two CCS clusters over the next 25 years. Of this amount, £9.4 billion[10] has been allocated in the current spending review period (to 2029/30), which has catalysed more than £10 billion in private debt for the first clusters. Yet, as public budgets face increasing fiscal constraints, the sector must transition towards building robust revenue models anchored in $CO_2$ cost savings and the intrinsic value of carbon credits, thereby reducing reliance on government support mechanisms.

While capital is available in the financial services sector, attracting private investment at the necessary scale requires projects to offer credible returns, stable revenues, robust risk allocation, and downside protection.

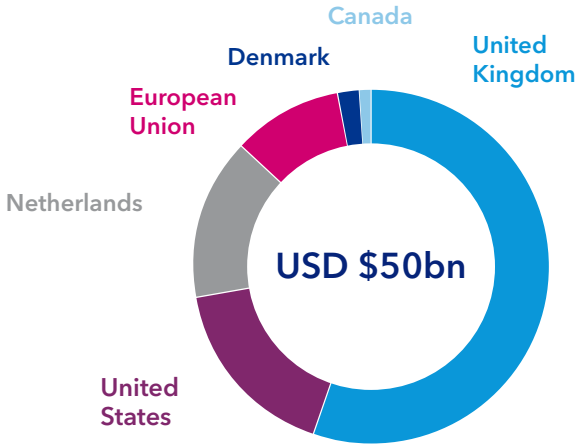



**Figure 1**: Public funding earmarked to CCS projects in 2023-2024[8], selected countries

4 IEA, "Net Zero Roadmap", 2023 update
5 GCCSI, "Global Status of CCS", 2025
6 Baringa Analysis, "IEA Projects Database" 2025
7 IEA, "World energy investment" 2025
8 IEA Workshop "Catalysing private investment in CCUS" 10-11 June 2025
9 DESNZ, "Government reignites industrial heartlands 10 days out from the International Investment Summit", 2024
10 UK Government, "Spending Review 2025", 2025

# Persistent investment barriers

**Market fundamentals are improving:** policy support is expanding, carbon prices are expected to rise, and green-premium and decarbonisation credit markets are beginning to form. Yet despite progress – more operational projects, falling technology costs, and favourable global policy – a structural financing gap remains.

**Persistent investment barriers are slowing deployment**, underscoring the need for intelligent risk capital and better information flows to turn the project pipeline into bankable opportunities that can access the deep pool of available capital.

### 1. The pre-FID financing gap

A persistent shortage of late-stage development capital is preventing projects from progressing to Financial Investment Decision (FID). As such, 91%[11] of capture projects targeting 2030 operation remain pre-FID. This is largely because Front-End Engineering and Design (FEED) studies, permitting, and commercial structuring require significant investment while exposing capital providers from the financial services sector to concentrated technical, regulatory, and commercial risk at this stage. Without mechanisms to share this risk or offer greater certainty on long-term returns, the financial services sector hesitate to commit, leaving otherwise viable projects unable to advance.

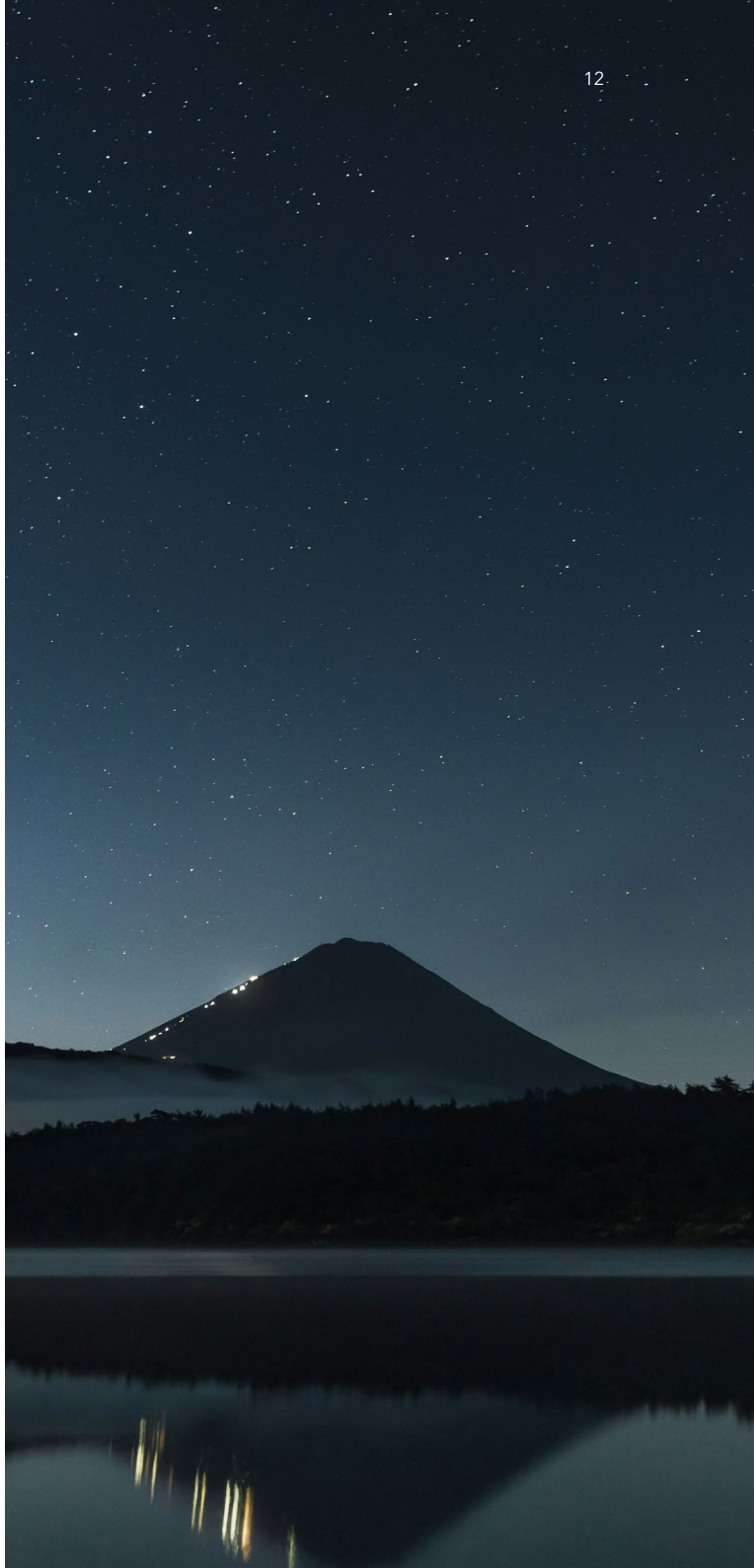
### 2. Uncertain revenue streams

This financing hesitation is compounded by highly uncertain project revenues. CCS projects currently rely on stacking multiple revenue streams which often combine subsidies from fiscally constrained governments, volatile carbon pricing, and thin voluntary offtake premiums. This complexity creates significant uncertainty and undermines project bankability, making it difficult for the financial services sector to price risk effectively.

### 3. Long development cycles and closed-loop information

Adding to these challenges, development cycles for CCS projects typically span five to ten years. Crucially, information regarding risk allocation and financing structures remains concentrated among a small group of stakeholders, which limits market confidence and hinders the ability of new financial services organisations to enter the market and accurately price risk, thereby further constraining the flow of private capital.

Only tailored, risk-tolerant, and patient financial innovation can bridge this structural financing gap.



11 Baringa Analysis, "IEA Projects Database", 2025 (>0.1 $MtCO_2$/yr, excludes EOR projects)

# A strategic path forward: Three integrated recommendations

This report outlines an integrated strategy for the financial services sector and its partners to unlock substantial private capital. The following three recommendations are actionable, mutually reinforcing, and designed to catalyse CCS deployment across the entire value chain.

1. **Unlock stalled projects by establishing a pre-FID development capital fund**

   **The challenge**: The majority of early-stage capture projects stall due to a lack of late-stage development capital. This is particularly true for independent projects in sectors such as cement, hydrogen, and bioethanol, spanning North America and Northern Europe.

   **The solution**: Establish a dedicated fund to provide late-stage development capital for credible, independent capture projects where the investment fundamentals are positive except for temporary blockers.

**Key actions**:

- **Targeted screening**: Baringa analysis has identified over 130 near-term projects (total capture volumes of ~170 $MtCO_2$/yr) that could benefit from this funding (***Figure 2***). These projects were systematically screened from the global pipeline[12] to prioritise credible capture-side opportunities. The results indicate the opportunity for the fund currently sits with volumes predominantly in the North Sea and North American regions.
- **Catalytic impact**: Providing a funding facility for up to 20 of these projects could crowd in two to three times additional development funding and unlock ten to twenty times the construction capital expenditure (CAPEX), effectively converting stalled projects into investable opportunities.

**Near term priorities**: Achieve the first close of the fund, with a series of supported projects advancing to FID. This will demonstrate a replicable model that can crowd in further private capital.

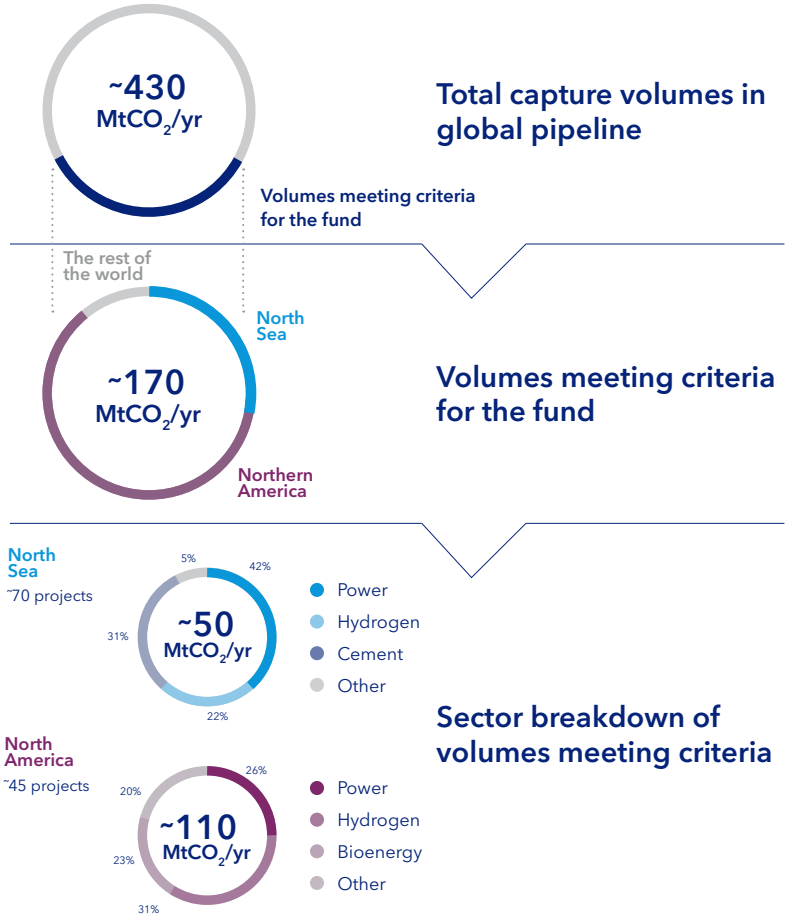



**Figure 2**[13]: Capture volumes ($MtCO_2$/yr) and projects suitable for the fund based on the filters

12 The assessment focused on factors such as advanced development status, strong market fundamentals in the project location, and removing projects that already have strong sponsorship by strategic developers with the balance sheet capacity and commercial capability to deliver projects.

13 Baringa Analysis, "IEA Project Database", 2025. Filters include capture projects minimum scale (≥0.1 $MtCO_2$/yr), dedicated geological storage only, suitable regions, and projects targeting operation by 2030. Further exclusions removed projects already under construction, cancelled, or led by large integrated exploration and production sponsors due to likelihood they are well capitalised, resulting in a shortlist of over 130 credible projects most likely to benefit from development capital.

**2. Create bankable revenue streams by aggregating demand and structuring offtake solutions**

**The challenge**: The primary barrier to attracting private debt and equity for CCS projects is the lack of long-term, bankable revenue streams.

**The solution**: Leverage existing banking client relationships and wider SMI membership to aggregate demand and structure credit-enhanced offtake agreements.

**Key actions:**

- **Aggregate demand**: Launch a buyer coalition to aggregate demand for CCS-enabled products and services.
- **Standardisation**: Develop Environmental Attribute Certificates (EACs) and standardised offtake templates to accelerate market development and replication.
- **Priority focus**: Focus on projects generating $CO_2$ removal credits, low-carbon materials (e.g. cement), and firm low-carbon power. This is especially relevant in markets with emerging compliance frameworks and major corporate buyers such as hyperscalers in the United States.
- **Risk transfer**: Integrate insurance risk transfer solutions to secure revenue streams and enhance bankability.

**Near term priorities**: Launch a buyer coalition, publish standardised offtake templates with agreed standards for EACs, and advance a transaction for at least one substantial offtake agreement for low-carbon power.

**3. Accelerate learning cycles and investor confidence via a global CCS financing lessons forum**

**The challenge**: Slow learning cycles and concentrated information limit investor confidence and the ability to accurately price risk, deterring new capital from the financial services sector.

**The solution**: Launch a neutral forum to convene experts from across the financial services sector, alongside developers, policymakers, insurers, and legal/advisors to share insights from executed deals and standardise best practices.

**Key actions:**

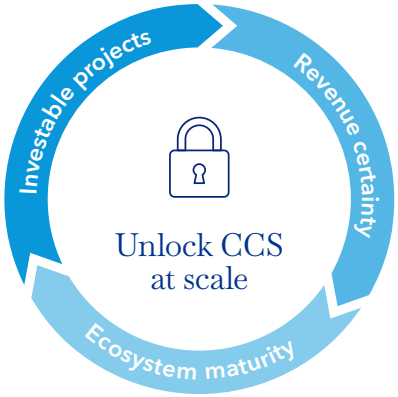
- **Knowledge sharing**: Share insights on risk mitigation approaches and financing structures from executed deals, ensuring full compliance with competition law and confidentiality.
- **Efficiency**: This low-cost, high-value intervention will shorten learning cycles, improve risk management and pricing, and attract new capital providers.
- **Central repository**: Establish a central repository of case studies and tools to improve market confidence.

**Near term priorities**: Hold one to three forums in key regions (Europe, US, and Asia Pacific region (APAC)) and synthesise lessons learned from five to ten key financing deals to date, enabling faster FID in the future.

# Conclusion: Mobilising investment for scalable solutions

These three integrated recommendations are designed to be mutually reinforcing. Our recommendations work individually and in unison to increase the flow of capital and information in the CCS sector. The development fund increases the supply of bankable projects, buyer coalitions secure demand and revenue, and the lessons forum strengthens the ecosystem, enabling more efficient financing for future projects. Together, they provide a practical roadmap to broaden sources of capital, improve project investability, and accelerate early deployment.

**CCS is at a turning point**. The next leap, from dozens to hundreds of projects, depends on smart capital deployment, risk identification and sharing, and innovation. This is the moment for the financial services sector to move from supporting individual projects to shaping an investable asset class. By acting now, the industry can help CCS evolve into a commercially viable solution, creating opportunities to unlock billions in private investment and delivering both climate impact and strategic returns.



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# Mapping the landscape

## 3.1 There is a significant CCS financing opportunity

**Carbon capture and storage (CCS) is a critical technology to meet net zero goals and is required to play a rapidly increasing role to support global decarbonisation**. This role is especially important in hard-to-abate sectors such as cement and energy from waste where CCS is the only viable solution to directly reduce process emissions (or via CCS-enabled hydrogen).

Today, almost 65 million tonnes of $CO_2$ per year ($MtCO_2$/yr) of capture capacity is in operation[5], which is set to increase to nearly 430 $MtCO_2$/yr by 2030 based on the announced project pipeline. Meanwhile, storage capacity could reach 670 $MtCO_2$/yr by 2030[14], meaning there will be a need for large-scale investment to realise this pipeline, let alone what is required for net zero.

Importantly, CCS offers not just emissions reduction but potential **carbon removal**. When applied to bioenergy with carbon capture and storage (BECCS), direct air capture (DAC) or energy from waste, CCS can generate carbon removal services. Many national net zero strategies assume significant carbon removal services will be needed to offset residual emissions in 2050. For example, Baringa's Global Transition Model suggests this could be as much as 300 $MtCO_2$/yr globally in 2030, of which 50 $MtCO_2$/yr is in Europe[15] and the European Commission assumes a significant role for DAC and BECCS with up to 75 $MtCO_2$/yr of removals expected by 2040[16] to balance remaining emitters. This creates a new market for carbon removal credits, adding to the long-term revenue streams that can support CCS projects.

**Based on the announced pipeline, IEA analysis suggests an investment opportunity of over $200 billion[7] from 2025 to the end of the decade**. In the short term, this will require annual investment to jump roughly tenfold over the next three years (***Figure 3***). This will require a fundamental change in the role that capital plays in CCS and creates an opportunity for the financial services sector to enable the step change in project delivery required.

In this context, **the financial services sector is ready to back CCS projects where the business case presents a credible proposition**. As such, there is not a lack of capital. Financing depends on credible project business cases proposed by creditworthy counterparties with an acceptably de-risked business model and a competitive return.

Projects must demonstrate profitability, stable revenue streams, and sound risk identification and quantification. When these elements are in place, the financial services sector can deploy capital at scale, catalysing further investment through syndication, credit enhancement, and co-financing. As public funding becomes increasingly fiscally constrained, the financial services sector will play a central role in developing robust commercial cases to support the development and liquidity of carbon markets, as well as providing capital directly to projects when the commercial thresholds are met. For example, leveraging insurance risk-transfer solutions can help improve lender confidence and bring projects closer to these minimum thresholds.

In summary, CCS represents a multi-billion-dollar investment domain over the next few years. Capturing this opportunity requires overcoming near-term barriers so that capital can flow at scale.

14 IEA, "IEA Project Database", 2025
15 Baringa Analysis, 2024
16 European Commission, "COM/2024/63 (Part 3 - Annex 8)", 2024

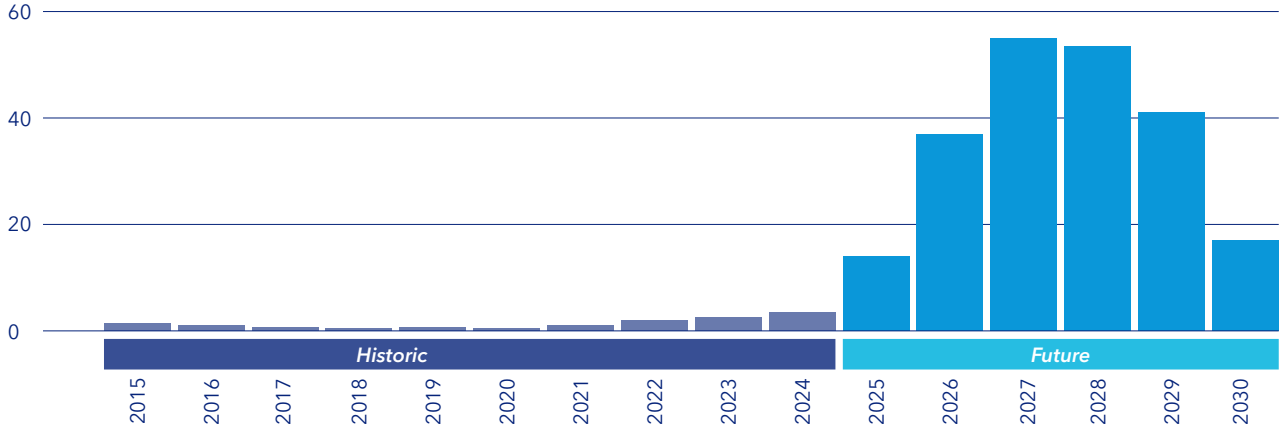
# 3.2 CCS financing needs to navigate a complex set of risks

**As is the case with emerging infrastructure asset classes, CCS projects require careful coordination across complex value chains**. Capture plants, $CO_2$ transport networks, and storage sites must all operate in unison to enable decarbonisation. However, the leap from policy ambition to investable reality remains constrained by persistent structural barriers.

These barriers emerged consistently across bilateral engagements with over 30 stakeholders spanning the financial services sector, CCS industry and government, reflecting the lived experience of those trying to deploy capital into CCS today. Accessing capital for CCS hinges on overcoming a set of interrelated risks that traditional infrastructure financing is not yet equipped to fully underwrite without additional protections. We outline five key risk categories below that are limiting project bankability.

**Firstly, CCS carries physical risks (Table 1)**: These include technical, operational, and long-term structural risks linked to the underlying business or asset. Mitigating these typically requires time, experience, and often public sector involvement. Encouragingly, as more projects reach FID and commercial operation, technical and operational risks are beginning to ease, supported by real-world performance data and a growing track record.

**Secondly, there are market-based risks (Table 2)** arising from external market movements influenced by broader economic factors, pricing, demand, and policy environments that may strengthen over time and reduce as drags on underlying business cases.




Annualised investment based on current and future pipeline ($bn, 2024 prices), IEA, 2025[7]

**Figure 3**: Successfully delivering the announced CCS pipeline will require investment to increase tenfold over the next c. 3 years

**Table 1: Physical risks**

| Physical risk | Description | Insights from stakeholders |
|---|---|---|
|  Coordinating cross-chain risks across complex value chains | **Each part of a CCS value chain is reliant on others' performance**. Transport and storage (T&S) providers require a steady stream of $CO_2$ from emitters, whilst emitters require dependable storage facilities. This creates financing challenges; long-term outages in one segment of the chain can strand assets elsewhere, especially if cross border.<br><br>**These risks are heightened as new value chains seek to mobilise**. Project timelines and responsibilities need to be coordinated so that emitter and T&S projects are aligned. Networks also need to consider how to size initial capacity with an eye to future market growth. | **Clear risk allocation frameworks** are critical as they help investors, lenders and insurers understand risk exposure. Divergent approaches are being taken internationally. These risks are materially reduced as anchor transport infrastructure and storage assets are built.<br><br>**Insurance availability is increasing**, but some risks will always need to be managed through supplier arrangements and project delivery. A track record of performance data in the coming years will help further increase insurance availability. |
|  Technical challenges in deploying new CCS solutions at scale | **CCS at scale, especially with innovative solutions, brings performance risk**. CCS is a proven technology, but more data is needed to see how multi-project networks will perform over time and the long-term capture rates that can be sustained.<br><br>**Deploying innovative tech at scale, especially in a multi-stakeholder value chain, brings construction risk**, which can drive higher cost of capital requirements. | **Track record performance data** can help to strengthen the understanding of technology risk and allow investors/lenders/insurers to better price this. For example, technology performance insurance can be used to support this scale-up challenge.<br><br>**The supply chain can help address performance risk** through product guarantees and technical assurance; however, transferring significant risk to Engineering, Procurement and Construction (EPC) contractors currently remains costly, given their limited track record in CCS. This approach increases upfront capital expenditure and widens the subsidy gap; however, these costs should decline as experience builds and delivery models mature. |
|  Treatment of storage liabilities | **Ongoing monitoring is required after $CO_2$ is injected underground, which can last for decades after a store closes.** There are remote risks of future leakage events or the need for remediation activities. These risks are unfamiliar to lenders in particular and often beyond what they can underwrite.<br><br>**Important questions arise regarding the implications of leaks from storage facilities**, particularly in terms of allocating liabilities across the value chain and the availability of insurance to cover $CO_2$ leakage. This includes environmental damages and third-party financial losses, such as loss of carbon credits or the requirement to buy replacement credits. | **Credible sponsors with geological expertise** build confidence in T&S projects.<br><br>**Policy frameworks that mitigate this risk** have enabled private finance, especially when addressing stranded asset risks in the absence of suitable commercial insurance products. |

**Table 2: Market-based risks**

| Market-based risk | Description | Insights from stakeholders |
|---|---|---|
|  Project economics often mean projects face a 'missing money' gap | **The cost of capturing and storing $CO_2$ is often higher than users are willing to pay**. Avoided compliance costs (in the form of carbon pricing) and additional revenue streams are often not high enough to cover CCS costs. Capture costs are highly varied but typically range from $90-$330 per tonne $CO_2$[17].<br><br>**Without subsidies or more aggressive and reliable carbon pricing, CCS projects face a revenue gap**, that has typically been filled by policy support (grants, tax credits, carbon prices) to make projects financially viable. | **The missing money gap remains the key challenge** in enabling projects to reach FID from a developer perspective, and to enable project lending from a financing perspective.<br><br>**If not explicitly addressed through government policy**, potential investors/lenders require visibility of firm commercial arrangements, given the uncertainty in carbon price scenarios. |
|  Projects face challenges in securing credible offtake and revenue streams | **CCS projects often face difficulties in securing the offtake** of low-carbon goods and services. The products of CCS such as $CO_2$ storage services, carbon credits, or low-carbon product premiums are unpredictable and don't yet have deep liquid markets. Many deals are short-term, and depend on agreements with a scarce pool of significant voluntary buyers or government support. Lenders struggle to underwrite projects without predictable, long-term (15+ year) revenues or guarantees. | **The availability of longer-term offtake agreements for low-carbon goods and services differs by emitter type**. Carbon dioxide removal (CDR) agreements are being driven by hyperscalers, whilst there are signs of growing demand linked to low carbon products and services, including gas-powered CCS and cement.<br><br>**Elsewhere, demand remains fragmented** and challenging to underwrite projects on. |

**Section 4** discusses how these risks have been managed at multiple CCS projects that have reached FID in recent years, frequently with support from government initiatives. Continued development of markets is needed to create and implement mechanisms for agreed risk allocations, that can facilitate additional private investment in the sector.

17 Baringa Analysis, 2024

04

# Early projects and market evolution

**Section 4.1** shows how public risk absorption unlocked early CCS deployment and maps where that support sits in the project lifecycle.

**Section 4.2** explains why conditions are improving for private capital, highlighting where the financial services sector can scale participation as policy, shared T&S and offtake models mature.

**Annex: Section 7** shows the detailed cases for each of these high-profile projects.

# 4.1 Public risk sharing has unlocked early CCS investment

**In recent years, several high-profile CCS projects have reached FID**, offering examples of risk management approaches that facilitated financing. In these FOAK ventures, public sector support or strategic corporate balance sheets played a significant role[18].

**UK clusters (HyNet and East Coast)**: The UK's first two CCS clusters reached FID in 2024/2025, securing more than £10 billion in private debt, the first large-scale non-recourse CCS financings, underpinned by up to £21.7 billion of government funding, contract for difference (CfD)-style contracts, and a Regulated Asset Base (RAB) model for T&S. This approach, combined with major sponsors' balance sheets, unlocked early projects but raises questions on scalability as the UK seeks to transition toward a more market-led model.

**Norway (Longship and Northern Lights)**: The Phase 1 operation was completed in August 2025, with approximately 67% state funding and the state's assumption of long-term storage liability resulting in minimal external project finance to date. In March 2025 the T&S joint venture (JV) took FID on an expansion to 5 $MtCO_2$/yr on more commercial terms, supported by contracts with overseas emitters such as Stockholm Exergi in Sweden (0.8 $MtCO_2$/yr for 15 years) and EU Connecting Europe Facility (CEF) funding.

**Netherlands (Porthos)**: Reached FID in 2022, with permits cleared in 2023, supported by €2.1 billion in Stimulation of Sustainable Energy Production and Climate Transition (SDE++) one-way CfDs (€57/t for 37 $MtCO_2$ over 15 years), enabling four capture projects, while a state consortium is delivering approximately €1.2 billion of T&S infrastructure, including a €102 million European Investment Bank (EIB) grant. Operations are targeted in 2026, with state led T&S reducing cross chain risk and enabling oversizing for future project expansion (e.g. the Aramis project).

**United States (45Q led)**: A market driven model using 45Q tax subsidy ($85/t storage; $180/t DAC) has seen FOAK projects financed mainly on corporate balance sheets with tax equity and stacked revenues e.g. Occidental's DAC project (~1 $MtCO_2$/yr) took internal FID in 2022, combining 45Q, an approximately $100 million Department of Energy (DOE) grant, and multi year CDR offtakes. Permitting of Class VI wells remains a bottleneck for projects, although state primacy in states such as Wyoming, with the support of financial assurance provided by insurance is speeding approvals.

**Canada (Entropy)**: A modular project of around 0.18 $MtCO_2$/yr in Alberta stacking: federal investment tax credit (ITC) with up to 50% for capture and 37% T&S; Alberta Technology Innovation and Emission Reduction (TIER) system; C$200 million from the Canada Growth Fund (convertible debenture) and a 15 year fixed price carbon credit offtake at $86.50/t for up to 1 $MtCO_2$/yr, alongside Brookfield Private Equity providing revenue certainty for Phase 2.

**What governments did:**

**Bridged the cost gap** through subsidies and/or carbon pricing mechanisms.

**Coordinated capture and T&S** to reduce cross chain risk (e.g. UK cluster model).

**Provided state backed revenue contracts** (e.g. fixed storage fees, carbon credits, or CfD style support).

**Assumed or insured long term liability** where the private market could not (e.g. state assumption after site closure).

**Table 3** summarises how public interventions de risked different categories (missing money, cross chain risk, revenue, delivery, long term storage liability) across jurisdictions.

**Figure 4** reinforces the pattern: jurisdictions with stronger public backing have seen more private transactions to date, with the UK a notable outlier for non recourse debt given its policy underwrite.

18 Sources and detailed case studies found in section 7 – Annex.

**Table 3: Government involvement in de-risking across the jurisdictions**

| Risk | Missing money | Cross chain risk / coordination | Offtake / revenue uncertainty | Technology and execution | Long term storage liability |
|---|---|---|---|---|---|
|  | ✓ **Government**<br>Up to £21.7bn made available. | ✓ **Government**<br>Full chain. | ✓ **Government**<br>15-yr CfD, RAB model. | × **Project sponsors**<br>EPC guarantees. | ✓ **Government**<br>Government Support Package (GSP). |
|  | ✓ **Government**<br>For example, 67% of total costs of Longship phase 1. | ✓ **Government**<br>Government integrated capture and storage synchronisation + no exposure to counterparty default. | ✓ **Government**<br>State pays significantly towards opex costs for both capture and T&S projects for 10 years. | ✓ **Project sponsors**<br>Government and experienced industry took all performance risk. | ✓ **Government**<br>Law stipulates government assumes long-term liability. |
|  | ✓ **Government**<br>€2.1billion SDE++ contracts, flowed through to guaranteed storage/stable revenues. | ✓ **Government**<br>Public consortium for T&S with government assuming volume risk. | ✓ **Government**<br>15-yr CfD, SDE++ mechanism. | ✓ **Public entities**<br>Public involvement reduces uncertainty. | ✓ **Government**<br>State entity-owned, with the state assuming liability after the site closure compliance period. |
|  | ✓× **Reliant on market**<br>45Q provides some revenue certainty, but doesn't close the gap for most projects. | × **Projects**<br>Must self-synchronise. | ✓× **Government and developer**<br>Revenue depends on tax credits (expire after 12 yrs), volatile voluntary $CO_2$ markets, low carbon fuels standards, and international mandate standards (e.g. CBAM for export). | × **Projects**<br>Bear execution risk. | ✓× **Developer**<br>Though in some cases liability transfers to the state. |
|  | ✓× **Investment Tax Credit**<br>(Up to 60%), partially de-risks (application dependent). | × **Projects**<br>Must self-synchronise. | ✓× **Government and developer**<br>15-yr CfD, Canadian growth fund mechanism. | × **Projects**<br>Bear execution risk. | ✓× **Typically, the developer**<br>However, varies by province. For example, the Government of Alberta provides coverage via a statutory fund. |

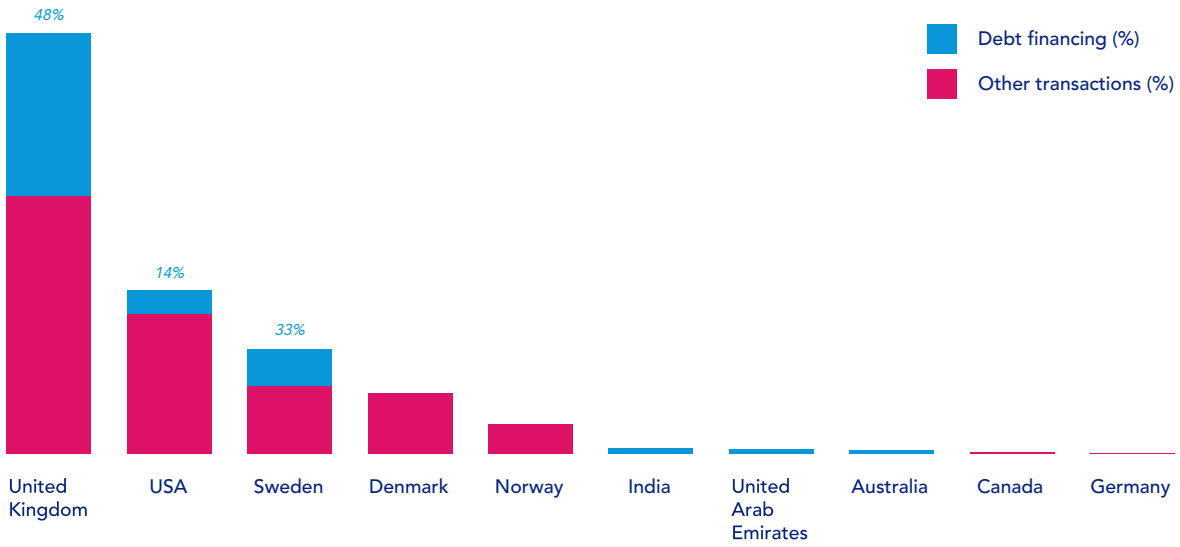



**Figure 4**: CCS transactions have so far seen a limited role for debt financing, with a notable exception in the UK, where strong policy and government risk underwriting has enabled over £10 billion of debt raising[19]

Jurisdictions with stronger public backing have seen more private transactions to date, with the UK a notable outlier for non recourse **debt**, given its policy underwrite, as shown above.

**However, public budgets are finite**, and several governments have signalled that initial projects would rely more on state support, with later waves expected to draw progressively on private finance once shared infrastructure and frameworks are in place (e.g., the UK clusters). Norway's Longship model also shows how significant subsidy and state liability can kick-start the chain, but this is not easily replicated everywhere.

Early experience highlights a key lesson: understanding where public risk absorption sits across the project lifecycle. While initial reliance on government funding and liability has proven effective in kick-starting projects, the shift to sustainable private investment, especially at earlier stages, depends on tackling the next major hurdle – uncertainty in future revenues. Without clear mechanisms for risk allocation and robust insurance solutions, many initiatives remain stuck at the pre-FID stage, underscoring the need for frameworks that unlock construction finance and enable later refinancing.

19 Infralogic and Baringa Analysis, 2025

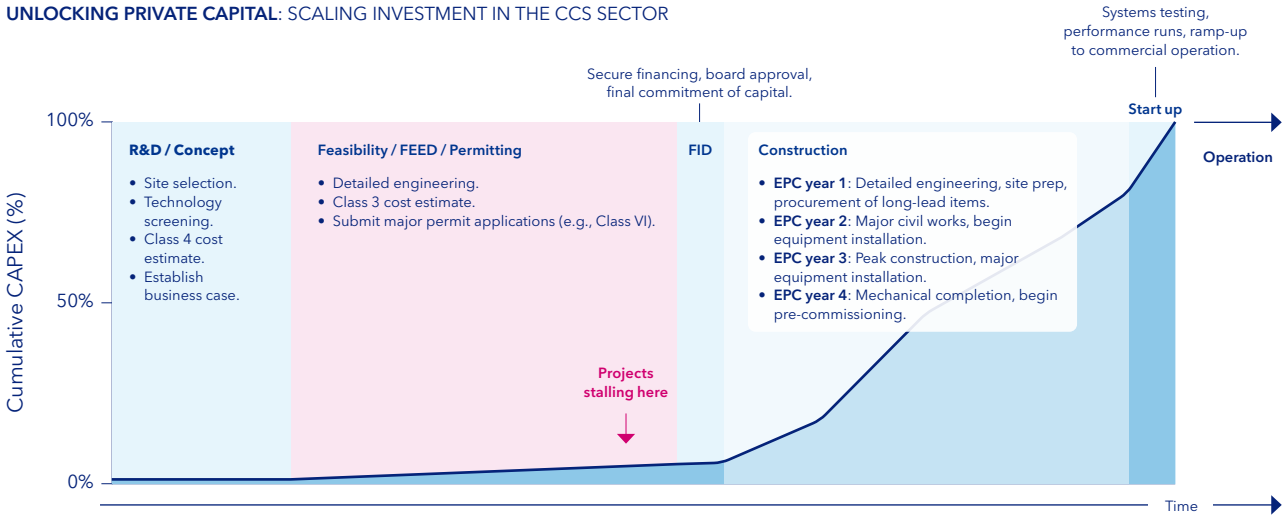



**Figure 5**: Cumulative capex and activities leading to operation[20]

| Stage | Research and development (R&D) / Concept | Feasibility / FEED / Permitting | FID / Construction | Operation |
|---|---|---|---|---|
| Time | 1-3 years, commercial development up to 10 years for early stage | 2-4 years | 3-5 years | 20-30 years |
| Financing mechanism | • Government grants<br>• R&D tax credit<br>• Strategic partnerships<br>• VC funding | • Public-private partnerships<br>• Development banks<br>• Early project finance | • Project finance<br>• Green bonds<br>• Carbon credit pre-sale | • Traditional project finance<br>• Infrastructure funds<br>• Corporate balance sheet |

Time →

| | | | | |
|---|---|---|---|---|
| Primary financier | **Government**<br>Grants and R&D funding per project, usually de-risks | **Developer, government**<br>Development capital, development grants | **Commercial banks, government**<br>Project finance, Capital investment | **Pension funds, infrastructure (infra.) funds**<br>Long term infra equity, Operational assets equity |
| Active participant | **Developer**<br>Strategic R&D investment, Internal funding | **Private Equity (PE)**<br>Growth capital, High technical and regulatory risk | **Developer**<br>Equity investment, JV and balance sheet funding | **Commercial banks, PE**<br>Refinancing, Divestment or secondary sales (exit) |
| Limited / emerging role | **Venture capital (VC)**<br>Early stage tech investment, Equity investment | | **Pension funds**<br>Infrastructure debt, Limited participation | |

Capital Recycling patterns:

**VC exit** → PE / strategic buyers | **PE value creation scale** → infra investors | **Development bank de-risk** → Syndicate to commercial | **Infra funds hold in construction** → yield investors | **Bank recycling originate loans** → securities institutional investors | **Pension buy stabilised assets** → hold for long term yield

**Figure 6**: Capital types across project lifecycle[20]

**Figure 5 and 6** show how and where capital typically enters a CCS project from early development through to operations. In the earliest stages, where FEED, permitting and commercial risks are highest, funding is largely provided by strategic developers and government programmes.

As projects advance, CAPEX continues while developers navigate lengthy permitting, negotiations and cross-chain dependencies (for example, capture projects waiting for a T&S system to come online). These delays increase risk and often cause projects to stall before FID: the stages that most need capital are the ones where private investors are least able to engage until risks are reduced and project structures are clearer.

To transition from a government-led model to a more private led approach, we examine the positive market trends now emerging that support this shift.

20 Baringa research and analysis, 2025

# 4.2 Conditions are improving for accessing private capital

**With policies maturing**, shared T&S networks being commissioned, and clearer offtake options emerging, the next phase of CCS can draw a larger share of private finance across development, construction and refinancing. After a decade of false starts, the sector has seen a surge in activity: operational facilities are up 54% year on year (***Figure 7***), and in 2023 alone, announced capture capacity for 2030 increased by 35%, and storage capacity by 70%[21], with 117 projects targeting FID before 2027[6].

This section explores how these factors are starting to create conditions that will help accelerate the role of private capital.

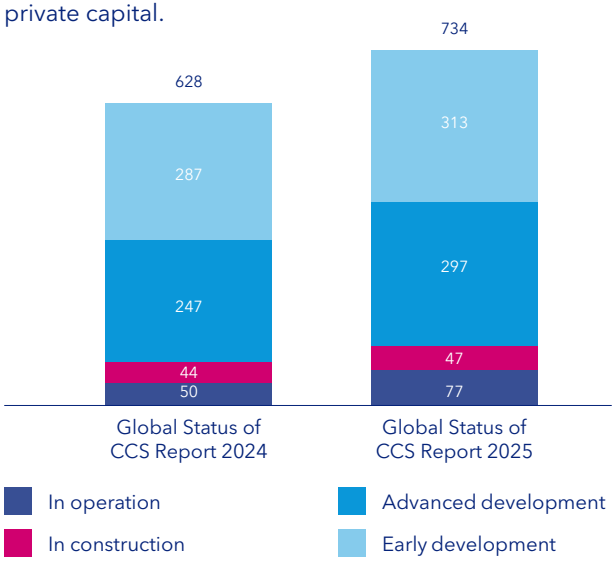



**Figure 7**: Number of facilities, GCCSI, 2025[5]

## 4.2.1 Stronger policy tailwinds are pushing CCS forward in key regions

At the time of writing, policy developments in key jurisdictions continue to strengthen the case for CCS and are creating conditions that will further enhance the sector's viability in a fast-evolving policy landscape. Recent examples include:

- **Carbon price developments are strengthening CCS project economic in some regions.** For example, the EU Emissions Trading Scheme (ETS) currently maintains carbon prices near €70/tonne[22], while policy developments, such as the Carbon Border Adjustment Mechanism (CBAM), will create further incentives for industrial emitters to adopt CCS solutions and create upwards pressure on carbon pricing.
- **Germany has recently passed legislation to enable CCS**, alongside the launch of a Carbon CfD scheme targeting industrial decarbonisation. In 2024, the CfD programme awarded its first contracts, with a maximum funding volume now increased to €4.1 billion[23], supporting long-term price guarantees for industrial emitters investing in low-carbon technologies, including CCS.
- **At the EU level**, the Commission's Carbon Management Strategy and the Net Zero Industry Act (NZIA) now requires all member states to develop national carbon management plans, and storage obligations are being placed on major oil and gas producers, signalling a coordinated push to scale CCS across Europe.
- **The UK ETS Authority** has confirmed its aim to legislate to integrate engineering Greenhouse Gas Removals (GGRs) into the emissions trading scheme by the end of 2028[24].
- **Canada increased the federal tax credit available for carbon capture projects.** These credits are worth up to 60% of capture equipment costs for DAC, and 50% for other capture applications[25].
- **The US confirmed the continuation of the federal 45Q tax credit scheme for CCS**, with credits for Enhanced Oil Recovery (EOR) now equivalent to those available for carbon sequestration at $85/tonne, as well as 16 states with clean power plans[26] (e.g., The Colorado Clean Energy Plan targeting 80% emissions reduction by 2030 (vs 2005)).
- **Policy frameworks continue to mature in a range of Asia-Pacific countries**, with notable progress made in Indonesia, Malaysia, Singapore, Australia and Japan to enable greater CCS development.

21 IEA, "Carbon Capture Utilisation and Storage; Energy System", 2025
22 European Commission, "Trends in Carbon Intensity and the Macroeconomic Role of the EU Emissions Trading System", 2024
23 Federal Ministry for Economic Affairs and Climate Action (BMWK), "First Round of Carbon Contracts for Difference Launched", 2024
24 UK Government, "UK Emissions Trading Scheme (UK ETS): A Policy Overview", 2024
25 Government of Canada, "Clean Technology Investment Tax Credit: CCUS ITC – Multimedia Resources", 2024
26 State Climate Policy Dashboard, "Clean Energy Plans", 2025

## 4.2.2 Offtake and revenue certainty is strengthening in key segments

The credibility of the underlying offtake for CCS projects (encompassing both carbon removal credits and demand for low-carbon products) and the certainty of revenue streams remain critical enablers for investment. Today, many successful projects must stack multiple revenue streams to close the commercial gap. In certain emitter segments, there is evidence of these offtake and revenue streams' maturity, providing credible future cashflow streams that can facilitate private capital entering projects. This includes cement and lime, and power via gas CCS, as outlined below:

### Cement and lime

Cement accounts for approximately 7%[27] of global $CO_2$ emissions. Without CCS, the sector faces barriers to decarbonisation, due to the process emissions associated with limestone. By nature, cement production and consumption tend to be co-located in confined geographical areas, due to the inability to transport the product over long distances.

This creates a greater opportunity to pass green premiums to end users, compared to goods that can be easily substituted with imports. Premiums could be sizeable, with analysis cited by the IEA suggesting premiums of around 35-50% have been achieved to cover the additional costs of near zero emissions cement or concrete[28]. However, this translates to a 1-2% premium when included in the cost of a bridge or building[29]. Projects are already being mobilised on this basis. For example, Norway's Norcem Brevik cement-CCS project (0.4 $MtCO_2$/yr) is now in operation with government support.

Demand for low-carbon cement is also being driven by green public procurement. The Netherlands, Sweden, Germany, France, UK and the US were identified in a policy analysis from the World Economic Forum and Global Cement and Concrete Association (GCGA) as frontrunners in the adoption of regulation on low-carbon concrete and construction[30]. Together, this suggests that in certain markets, low-carbon **cement can achieve market premiums**, thereby improving bankability, especially when combined with grants and carbon price evolution.

### Low-carbon power enabled by gas CCS plants

Natural gas-fired power stations with CCS can provide reliable, dispatchable generation with 90-95% less $CO_2$ than their unabated counterparts. With intermittent renewable generation growing across power grids internationally, demand remains high for firm dispatchable power to support system stability. In specific markets, especially where new projects face connection delays, commercial developers are increasingly seeking dedicated low-carbon power sources to support their business growth. The UK's Net Zero Teesside project illustrates this growing opportunity: it was the first major CCS power project to reach FID (with the potential to capture up to 2 $MtCO_2$/yr) and remains one of a handful of projects globally to secure significant non-recourse debt (*see* ***Section 4.1***).

In the US, with its relative abundance of affordable natural gas, conditions are in place to stimulate the role of power CCS. Hyperscalers are driving a significant increase in power demand and are often seeking low-carbon solutions to meet their Scope 2 targets. The top four US hyperscalers have contracted over 84 gigawatts (GW) of clean energy globally and are expanding into firm power[31]. With the presence of the 45Q tax credit, this can create strong investment opportunities, which are already being realised:

- ExxonMobil[32] has already progressed FEED on a plan to develop a 1.5 GW gas CCS facility that would provide electricity to a data centre.
- Frontier Infrastructure[33] has announced a partnership with Baker Hughes that will see the development of behind-the-meter generation capacity, including a 256 MW gas CCS facility to meet increasing demand across Wyoming and Texas linked to data centres.

27 IEA, "Cement Industry Analysis", 2023
28 IEA, "Demand and Supply Measures for the Steel and Cement Transition", 2025
29 Roussanaly, S. et al., "Progress in Energy", 2025
30 World Economic Forum, "6 Countries Taking Action to Solve Concrete's Emissions Problems", 2022
31 S&P Global, "Nuclear Bolsters Top US Hyperscalers' Clean Energy Portfolio, Now Over 84 GW", 2025
32 ExxonMobil, "Steel, Ammonia and AI? Oh My! What Can't Our CCS Help Decarbonize?", 2024
33 Frontier Infrastructure, "Baker Hughes, Frontier Infrastructure Announce Partnership to Accelerate Development of Carbon Capture and Storage, Data Center Projects in the US", 2025

**Standardising treatment of environmental attributes to accelerate markets further**

Standardisation is key to scaling CCS in these segments. A common framework that recognises the environmental attributes and supports the realisation of green premiums will help to further accelerate these positive trends. For example, in the case of gas CCS plants, environmental attributes akin to a renewable energy certificate that corporates can purchase to offset their Scope 2 emissions are beginning to emerge. Most corporate low-carbon sourcing frameworks still focus narrowly on renewables rather than a broader set of low-carbon technologies. If cement and power can pave the way with more transparent pricing for decarbonised products and services, these frameworks could be brought to new sectors and support the emergence of further green premiums and revenue streams for CCS projects.

## 4.2.3 Anchor transport infrastructure being built today will enable future scaling

The coordination and cross-chain risks facing capture projects are mitigated where they intend to connect to existing $CO_2$ T&S networks, rather than both projects attempting to develop in tandem. The FIDs reached in the 2020s are creating the networks for the future:

- In Europe's North Sea region, open-access $CO_2$ storage hubs such as Norway's Northern Lights, the Netherlands' Porthos, and the UK's East Coast Cluster are designed to enable multiple capture sites to connect over time. For example, Northern Lights Phase 1 was built with oversized infrastructure capable of handling up to 5 $MtCO_2$/yr. Initially, it will take 1.5 $MtCO_2$/yr from Norwegian emitters, with the remaining capacity contracted commercially in Phase 2 through cross-border agreements with various emitters—most notably the Yara fertiliser plant in the Netherlands, Stockholm Exergi's BECCS facility in Sweden, and Ørsted's Kalundborg plant in Denmark. **The upfront commitment to enabling infrastructure in Phase 1, significantly supported by government funding, has been critical in de-risking and unlocking further network expansion for Phase 2, which took FID earlier this year on purely commercial terms.**
- The US Gulf Coast benefits from over 50+ years of $CO_2$ pipeline and injection experience (mainly for EOR purposes). Companies like ExxonMobil are leveraging this to propose new CCS hubs. The $4.9 billion acquisition[34] of Denbury's $CO_2$ pipeline network by ExxonMobil underscores the value of having pipeline capacity ready for new capture projects, **ensuring enabling infrastructure is in place to serve future demand.**

The existence of anchor infrastructure strengthens the credibility of business cases for new capture projects, especially where agreements are in place or being formalised to secure future capacity. Policy developments in some regions will also help to further leverage the benefits of this infrastructure. The EU's draft framework would allow third-party access and regulated tariffs for $CO_2$ networks in the 2030s[35].

Overall, these developments paint an improving picture: policies are **de-risking revenues**, early demand is beginning to **validate the market for low-carbon outputs**, and infrastructure is **reducing cross-chain integration risks**. Whilst challenges remain for CCS projects, these areas demonstrate opportunities in the short term where growth can be enabled. The next section sets out how the financial services sector and partners can help unlock that next wave of investment.

34 Exxon Mobil, "Exxon Mobil completes acquisition of Denbury", 2023

35 Publications Office of the European Union, "EU Regulation for the Development of the Market for $CO_2$ Transport and Storage—Terms of Reference", 2023

05

# Three integrated recommendations

CCS is entering a critical phase: the technology is proven and market fundamentals are improving, yet most projects still face financing challenges through traditional channels.

Against this backdrop, we propose a strategy built on **three integrated recommendations for the financial services sector** and its partners to pursue. The approach focuses on creating opportunities to unlock private CCS finance at scale by targeting the supply of investable projects, the demand for $CO_2$ offtake, and the broader ecosystem of financial and technical expertise.

Each action can be implemented immediately and scaled in the short term as part of an integrated package to catalyse CCS investment:

- First, **inject development catalytic late-stage capital** and expertise to bring more CCS projects to investment readiness, addressing the supply of bankable projects.
- Second, **aggregate and guarantee offtake demand for CDRs, or low carbon products and services** to secure revenue for those projects, bolstering the demand side.
- Third, **share knowledge and standardise best practices** from early projects to continually improve risk assessments policy frameworks, strengthening the overall ecosystem.

# 5.1 Recommendation 1: Unlock stalled projects by establishing a pre-FID development capital fund

| Recommendation 1 | The financial services sector (including banks, funds and insurers), along with partners could commit funding to a CCS pre-FID development capital fund, offering catalytic funding and potential hands on structuring support to credible capture projects approaching FID. |
|---|---|

**Purpose**: Many technically viable CCS projects stall before FID due to a lack of late-stage development finance, particularly for FEED studies, permitting, and commercial structuring. Stakeholders consistently flagged a "missing" financing gap, especially for independent capture-side developers, which account for a large share of early-stage capture projects across cement, hydrogen and bioethanol. This fund would directly fill this space, unlocking a pipeline of investable projects.

| Needs addressed | **Independent capture-side developers face an investment gap to reach FID**:<br><br>• **Under-capitalised**: Developers in heavy industry are often less well capitalised and less experienced than large integrated oil and gas sponsors. Additionally, in the US context, the withdrawal of $3.7 billion in DOE funding has impacted 24 CCS developments[36], further highlighting the vulnerability of under-capitalised projects.<br>• **Investment gap**: Even where market fundamentals are improving through emerging demand signals, provision of enabling infrastructure, and supportive policy, these projects face an investment gap to reach FID. 91% of capture projects targeting 2030 operation globally have not reached FID[11].<br>• **Knowledge gap**: Such developers may also lack the experience in commercially structuring complex projects of this nature. |
|---|---|

36 US Department of Energy, "Secretary Wright Announces Termination of 24 Projects Generating Over $3 Billion in Taxpayer Savings", 2025

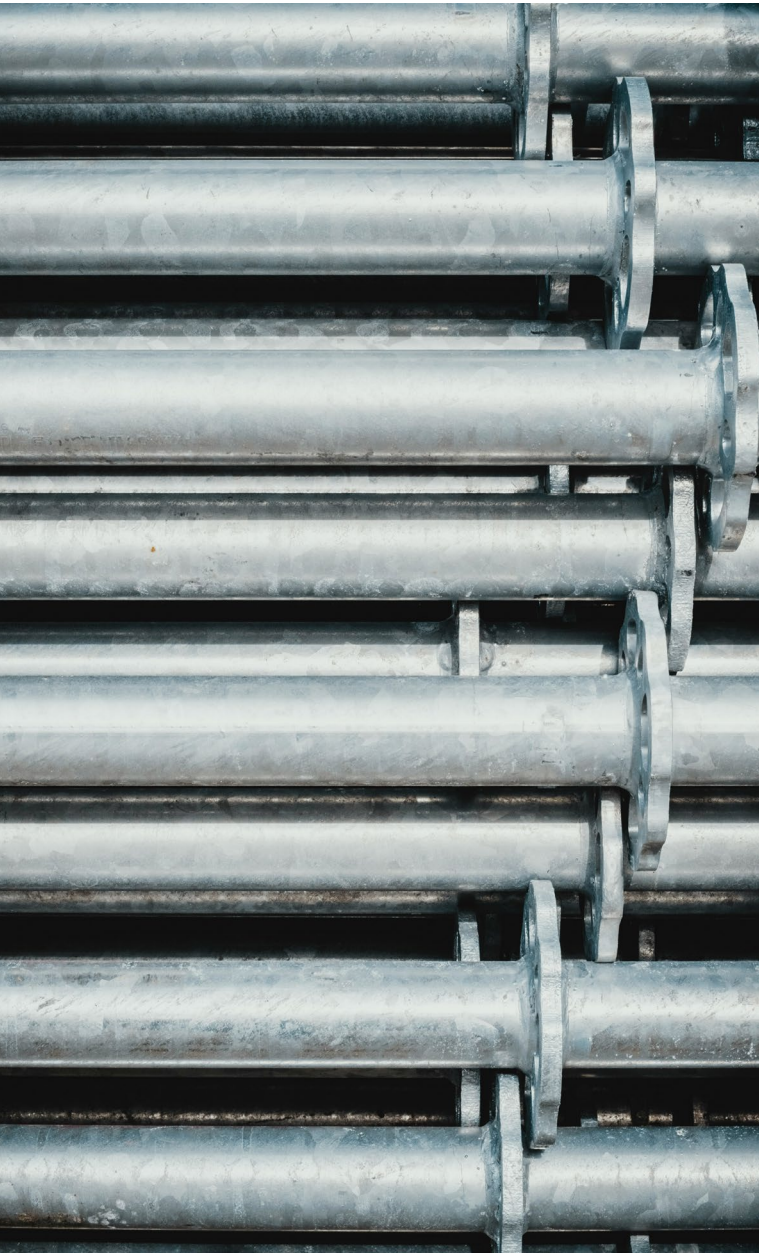
**How it could look in practice**: The following outlines a potential structure for the development fund, illustrating how concessional capital from contributors could be deployed to unlock stalled CCS projects and crowd in additional investment.

*Note: This is an illustrative example to show the potential impact of a fund and does not imply any commitment of the SMI or its members.*

## Fund Structure

- **Size**: Target fund size of around $100-200 million, sufficient to support an estimated 20 credible small-scale capture projects with total capex of $100-150 million[37] each, assuming development costs are 5-10% of capex, and 50% development costs covered by the fund.
- **Potential for concessional capital**: Concessional capital deployment can be made directly or as a junior tranche in a blended fund. Potential to invest alongside public capital (in appropriate and select jurisdictions). This funding should be tailored to provide a bridge to wider financing opportunities for construction programmes following FID through instruments (e.g., taking on a risk profile) with capped but still meaningful upside, or using debt instead of equity to achieve impact.
- **Capital recycling**: Funding should be structured to enable recycling upon FID, with terms of repayment that allow for supporting future projects still in the development pipeline. Recycling capital can support a larger number of projects over time.
- **Fund model**:
  - **Option A**: This fund could be linked to a single General Partner (GP) with a strong sector presence and pipeline. This may allow the concessional funding to be mobilised faster, especially if collaborating with a GP that brings a viable pipeline of projects. The GP will determine the appropriate products to use for deploying the concessional capital, considering equity, debt, guarantees, or hybrids based on individual project needs.
  - **Option B**: Create a standalone fund with multiple parties collaborating to oversee the deployment of capital. This would involve greater work to mobilise, but could broaden access to projects across the pipeline.

37 Capture capacity for projects in this capex range will vary by technology. For example, CarbonFree's SkyCycle project in the US will see 50,000 tonnes captured annually at an existing steel plant for an estimated cost of $150 million, whilst CCS investments at the Glacier natural gas plant in Canada will see capacity of 160,000 tonnes per annum after a second phase for estimated costs of $120 million.



- **Deployment focus**:
  - **Target market**: High-impact regions with strong fundamentals emerging in the next 2-4 years. Examples include Europe and the US, where public finance is either limited (e.g., federal funding) or available to combine with this fund (e.g., the UK National Wealth Fund, the EU EIB).
  - **Use of funds**: Late-stage development costs including FEED, permitting, commercial structuring and bankability (e.g. offtake, insurance/guarantees, T&S interface, monitoring, reporting and verification). Additionally, targeting development activities with long lead times that need to be in place to enable FID, for example, work related to energy connections or construction components with long delivery timelines.
  - **Who to back**: Independent capture developers and industrials deploying capture technology, beyond the more well-capitalised oil & gas majors, where fundamentals are strong but there are blockers and/or delays to investment in the short term. These players remain credible, with proven track records, governance, and bankable project concepts (including approaches to offtake). It should exclude early-technology readiness level (TRL) technology. A robust selection criteria will minimise exposure to underperforming projects and support overall returns for the fund, whilst identifying projects that can catalyse wider investment opportunities in the $CO_2$ value chain.
  - **Opportunity set**: Baringa analysis identifies over 130 credible projects, mainly with volumes in North America (65%), Northern Europe (25%) and the rest of the world (10%) across the hydrogen, power, bioethanol and cement sectors. Projects were systematically screened using a series of filters[12, 13].

| | |
|---|---|
| | • **Embedded advisory team**: Potential GP led "Deal Enablement Pool" (this could include financial services sector secondments for a technical assistance facility) to support the structuring of offtake agreements and de-risk contracts, accelerating FID. This pool could also involve engineering firms and offtakers as investors or contributors, offering in-kind technical expertise to reduce development costs.<br>• Governance could rest with fund participants and/or the appointed GP. |
| Impact of action | • **Crowd in additional development funding**: Achieve a 2-3x multiple on initial development funding, enabling further financing opportunities by converting a pipeline of CCS projects into a bankable portfolio ready to reach FID. Bilateral engagements suggest that this could lead to further capital investment and increase the capital velocity of projects due to faster FID.<br>• **Unlock construction financing**: Progressing to FID could unlock a 10-20x multiple on the development fund by enabling construction capex worth approximately $1-2 billion. |

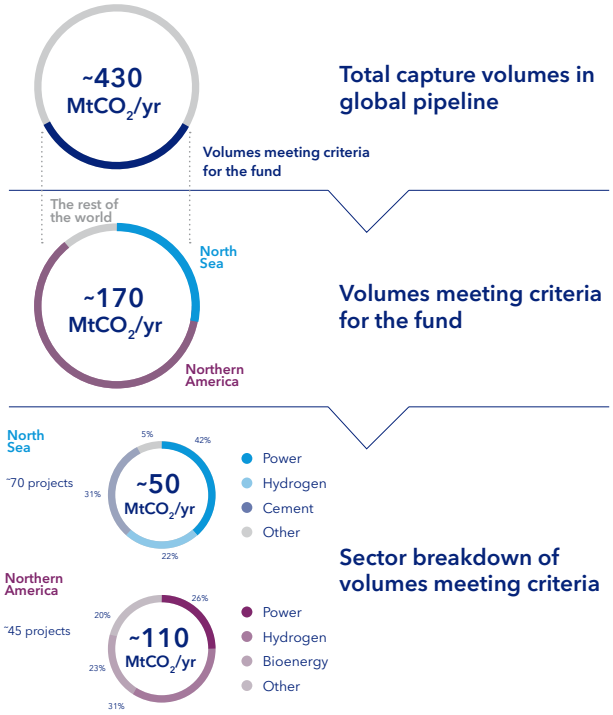



**Figure 8**[13]: Capture volumes ($MtCO_2/yr$) and projects and projects suitable for the fund based on the filters.

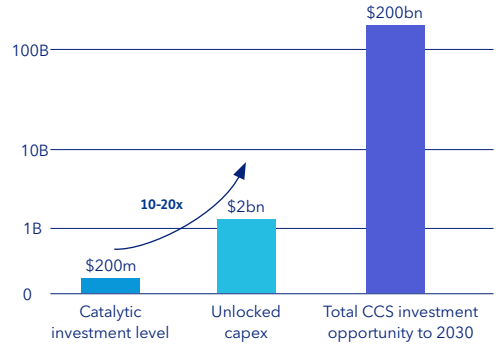



**Figure 9**: Illustrative impact of pre-FID development fund, logarithmic scale[38]

38 Baringa analysis based on IEA data and bilateral engagements, 2025

# Case Study – US Federal funding pauses and impacts on CCS projects progress[39]

Two large US CCS projects that initially progressed along comparable paths, each receiving early, high-profile conditional commitments from the DOE Loan Programs Office (LPO) have since diverged sharply. This contrast highlights where development-stage capital can be most effective in supporting credible projects that struggle to reach FID.

In late 2025, Wabash Valley Resources successfully reached financial close on a $1.6 billion LPO loan for its ammonia-with-CCS facility. With permits secured and diligence completed, the project moved into construction, demonstrating that large, complex CCS projects can progress through to close when permitting, commercial structure, and federal processes align.

By comparison, Summit Carbon Solutions, which also secured a major conditional commitment in 2024 for its multi-state $CO_2$ pipeline, remains unable to reach FID. The project continues to face extensive permitting and legal challenges, including repeated route denials in states such as South Dakota and new constraints on $CO_2$ pipeline siting. These delays have kept Summit in prolonged negotiation and re-scoping cycles, preventing progression from conditional status to a definitive loan agreement.

This divergence, Wabash moving ahead while Summit remains stalled, reflects a broader trend. Several other CCS projects, including Exxon Mobils ' Baytown CCS project, or the Lebec Cement plant have experienced similar delays or funding cancellations during federal spending reviews in 2025 (e.g. cancellation of $7 billion worth of projects across 223 clean energy projects in October). These cases illustrate how timing, permitting, and liquidity risks can disrupt and create a financing gap for well-developed credible projects, particularly when federal processes slow or shift.

**Importantly, they also demonstrate a clear opportunity**: targeted development-stage capital, structured with clear risk-sharing and commercial return expectations, could help credible projects nearing FID navigate delays in permitting, policy volatility, or extended negotiations, enabling them to reach bankability even when federal support is conditional or delayed.

Whilst provided on catalytic terms, the development fund could remain commercially focused and provides an opportunity to unlock additional private capital as projects mature through FID and commence construction. By accepting higher risk and lower return than standard terms in a targeted market segment, the financial services sector can crowd in others and move projects forward, either at the fund level or project level depending on fund structure. This directly tackles the early-stage financing barrier identified by stakeholders.

39 US Department of Energy, "Secretary Wright Announces Termination of 24 Projects Generating Over $3 Billion in Taxpayer Savings", 2025; US Department of Energy, "Energy Department Announces Termination of 223 Projects, Saving Over $7.5 Billion", 2025; US Department of Energy, "Sector Spotlight: Advanced Fossil", 2024; US Department of Energy, "LPO Role in Funding Carbon Management Projects", 2023; Centre for Public Enterprise, "A Brownout at the LPO?", 2025

# 5.2 Recommendation 2: Create bankable revenue streams by aggregating demand and structuring offtake solutions

| Recommendation 2 | The financial services sector could convene and structure replicable offtake solutions for CCS projects, focusing on $CO_2$ removal credits and low-carbon firm power solutions to serve data centre clients across attractive geographies. |
|---|---|

**Purpose**: Uncertain revenue streams and offtake arrangements were identified as critical financing barriers across stakeholders. Without assured buyers or price floors, projects struggle to attract lenders or equity investors. At the same time, many potential buyers (e.g. consumer brands seeking offsets, construction firms seeking low-carbon cement) are fragmented and often unable to provide sufficient demand that could be used to underpin a CCS project at scale alone.

In general, the financial services sector is not a large energy user and has limited scope 1 or 2 emissions; this alone is unlikely to bring significant primary demand for CDRs, decarbonised power or cement. However, they can play a catalytic role in unlocking offtake through targeted interventions to maximise impact.

## Needs addressed

**Immature offtake markets hinder CCS project bankability:**

- **Complex revenue structures**: Potential buyers, such as consumer brands seeking carbon credits or construction firms looking for low-carbon cement, are also fragmented and often unable to generate enough demand to underpin a project at scale. Targeted interventions, such as providing credit enhancements or anchor offtake agreements, could help bridge this gap and improve bankability.
- **Voluntary premium dependency**: Many CCS projects depend on voluntary premiums for decarbonised products or environmental attributes to close the economic gap. This is particularly challenging for globally traded commodities like steel or ammonia, where emitters struggle to pass on CCS costs without compromising competitiveness. These sectors currently likely require government intervention through subsidies or mandates.
- **Limited premium viability**: While voluntary premiums are more credible in regionally traded sectors like cement and power, scaling CCS here requires recognised standards to validate environmental attributes. For example, there is a limited equivalent to Renewable Energy Certificates (RECs) for CCS-enabled power, and corporate sourcing commitments remain narrowly focused on renewables.
- **Opaque monetisation pathways**: Investors and lenders struggle to assess value and risk due to limited transparency around credible buyers, standardised contracts, and long-term pricing.

**How this could look**: The following outlines a potential structure for how the financial services sector could aggregate and de-risk offtake demand to support CCS project bankability:

## Structure

- **Synergy with pre-FID development fund**: This solution could be implemented through a specialist trading team, directly creating offtake solutions for CCS projects using the range of tools outlined below. It could be deployed on a standalone basis or alongside the CCS development fund. Combining structuring expertise through this intervention with a pipeline of projects funded through the development fund would further strengthen the underlying business cases of supported projects.
- **Model options**:
  - **Option A**: Aggregate demand: Leverage borrower relationships to surface credible offtake interest and consolidate buyer pools into syndicated structures, supported by a central SMI coordination hub to convene buyers and developers and raise market awareness. This improves transparency, reduces binary risk, and by acting as a conduit for buyer intent enhances bankability to help developers understand demand signals more clearly.
  - **Option B**: Credit enhancement: The financial services sector can offer credit enhancement products such as bank guarantees, technology backstops, and carbon credit insurance to secure carbon revenue streams that "wrap" offtake agreements, simplify interfaces and mitigate counterparty risk. For example, if a buyer defaults, the bank or insurer could backstop the payment, ensuring the project continues to receive revenue. This transforms fragmented, voluntary commitments from corporates with varying credit quality into investment-grade cash flows.
  - **Deployment focus**: These enhanced offtake structures can be aligned with emerging compliance markets, where carbon removal credits are becoming formally recognised. By anchoring demand and offering financial instruments that reflect compliance value, the financial services sector can leverage this shift and establish price floors, reduce market exposure, and unlock new investment pathways for CDR projects.

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| | • **Support market development through standards**: SMI can collaborate with developers and industry bodies to pioneer standards that validate decarbonised products. A key opportunity is creating EACs for CCS-enabled outputs, like RECs for renewables, covering power, cement, and steel. These certificates can be unbundled from the physical product, enabling flexible contracting and scope 2 claims, particularly for hyperscalers and data centres. This approach enhances market transparency and connects projects with credible offtake.<br>• **Importance of carbon accounting**: Introducing and supporting robust carbon accounting can stimulate demand by enabling businesses to quantify their $CO_2$ exposure. Greater transparency on emissions creates accountability and drives purchasing decisions, as companies seek to manage and offset their carbon footprint. |
| Impact of action | • **Create credible demand**: Turn fragmented buyer interest into credible demand through pooled offtake (can be unbundled) and credit wraps.<br>• **Enable financing**: Convert demand into bankable, investment-grade revenue to unlock project funding.<br>• **Standardise and scale**: Codify learnings to support market-wide replication via third-party standards that provide market transparency by connecting projects with offtake. |

Importantly, the financial services sector does not necessarily spend directly on offtake, rather, it leverages its balance sheet to upgrade the credit quality of market commitments or provide bridging finance until policy kicks in (e.g. in some cases, banks might forward-purchase future compliance credits if they expect carbon removals to be regulated). This is a **market-making role** suited to the financial services sector, governed by an independent third party, that converts fragmented pledges into investable contracts.

# Example use case: Low carbon firm power as virtual PPAs in the US[40]

There is growing demand in the US for firm, low-carbon electricity, especially from hyperscalers and large tech companies seeking 24/7 clean power. One opportunity is to work with developers of near-term, financeable CCS-enabled (and other firm low-carbon) power projects to create bankable virtual power purchase agreements (vPPAs) that separate environmental attributes from physical generation. This can help standardise a product that buyers can adopt at scale, particularly in markets with abundant gas infrastructure.

**How it works**:

- Standardise vPPAs that unbundle environmental attributes from delivered power, enabling hourly or 24/7 matching where required.
- Pool multiple buyers into shared "clubs" to diversify counterparty risk and support larger contract volumes.
- Add credit enhancements such as guarantees or forward-purchase backstops to lift the buyer group to investment-grade, unlocking project debt.
- Market these products as low-carbon firm power for tech majors and hyperscalers that increasingly value time-matched, firm attributes over annual renewable certificates.

This structure overcomes geographic constraints while supporting decarbonisation of firm capacity, including CCS-enabled thermal generation, BECCS, advanced geothermal, and nuclear-backed products.

A recent example is Google's October 2025 agreement with the Broadwing project, which used the first standardised CCS EAC. The top four US hyperscalers have already contracted more than 84GW of clean energy globally, and are now expanding their focus beyond variable renewables into firm, low-carbon supply.

40 S&P Global, "Nuclear Bolsters Top US Hyperscalers' Clean Energy Portfolio, Now Over 84 GW", 2025; Carbon Direct, "Capture Committed: Google and Broadwing Sign Carbon Capture Power Deal", 2025; CCSEAC, 2025

# 5.3 Recommendation 3: Accelerate learning cycles and investor confidence via a global CCS financing lessons forum

| Recommendation 3 | Establish a global, financial services sector-led CCS financing knowledge forum (e.g., SMI FSTF-driven) to share lessons from successful transactions, improve investor confidence, risk pricing, and reduce reliance on government protections without breaching antitrust rules. |
|---|---|

**Purpose**: Even with stronger demand signals and project pipelines, CCS financing is slowed by limited market understanding of complex risks, particularly across capture, transport, and storage interfaces. As government support tapers, the financial services sector must absorb more risk but can only do so if they can confidently assess and price it. A dedicated financing lessons forum could shorten learning cycles and enhance understanding, information flows, and collaboration among the financial services sector (including banks, funds and insurers), developers, policymakers and legal advisors. By sharing insights from executed deals and standardising best practices such as risk pricing, mapping, and quantification, the forum would help attract new investors and improve market confidence. This can be actioned alongside the first two recommendations.

**How this could look**: The following outlines a potential structure for the knowledge forum, showing how the financial services sector could lead a global effort to improve CCS financing fundamentals:

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| Needs addressed | **Limited market knowledge slows CCS capital deployment**:<br>• **Concentrated expertise**: Detailed understanding of CCS risk allocation, particularly across capture technology, transport, and storage infrastructure, is concentrated among a small group of advisors, financial service sector experts and project developers with experience from FOAK transactions.<br>• **Slow learning cycles**: Broader market understanding is lagging, particularly around critical issues such as EPC contracts, guarantees, and interface risks, which hinders capital deployment and could increase the cost of capital.<br>• **Government dependency**: Early CCS projects relied heavily on government underwriting, and in turn heavily on insurers. With fiscal constraints limiting future support, the private sector must absorb more risk but can only do so if they can reliably assess and price it. |
| Structure | • **Independent convening**: This forum would be organised by an informed third party (such as expert advisors in the sector or relevant think tank institutions, or private sector-led coalitions like SMI) with the ability to convene cross-sector stakeholders and drive finance-focused discussions.<br>• **Peer-to-peer learning**:<br>  • Convene genuine experts across the financial services sector, developers, policy and lawyers who have closed CCS deals. Focus on real-world lessons in risk allocation, financing structures and regulatory |

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| | engagement. For example, as evidenced by the representation of both UK Track 1 developers, insurance became the enabler for the GSP (specifically the Supplementary Compensation Agreement (SCA)) for T&S developers and also allowed project finance to become comfortable enough with the risk management and de-risking role that insurance played, to approve funding. When insurance is engaged early, either by developers, the financial services sector, and governments, risks for which there may be no existing or obvious solution can be worked through to develop and produce new, innovative solutions.<br>• **Open repository**: Host anonymised case studies, templates, and risk tools tailored to the financial services sector. Help developers meet knowledge-sharing obligations under public grant schemes.<br>• **Scalable focus**: Prioritise projects with replicable structures across regions and sectors. Highlight models that can be adapted to different policy environments.<br>• **Engage new capital**: Include infrastructure funds, institutional investors, and commercial lenders to broaden exposure and build confidence in CCS as a viable asset class.<br>• **Example**: Could be biannually focused on challenges of individual policymakers or governments. |
| Regional implementation | • **Global co-ordination**: Partnering with organisations with global reach will allow for tailoring of regional engagement strategies.<br>• **Policy influence**: Use deal insights to advise government (especially in emerging sectors) on structuring regulation and risk-sharing mechanisms. |
| Impact | • **Faster FID's**: Promotes efficiencies and optimal risk allocation strategies, lowering the cost of capital and shortening time to FID.<br>• **Attracting new capital**: Improves understanding of perceived risks and how to address them, enabling new regions and investors, such as infrastructure funds, to increase their exposure to CCS.<br>• **Supports replicability**: Encourages scalable models that can be adapted across geographies and sectors, reduce transaction costs and accelerate deployment. |

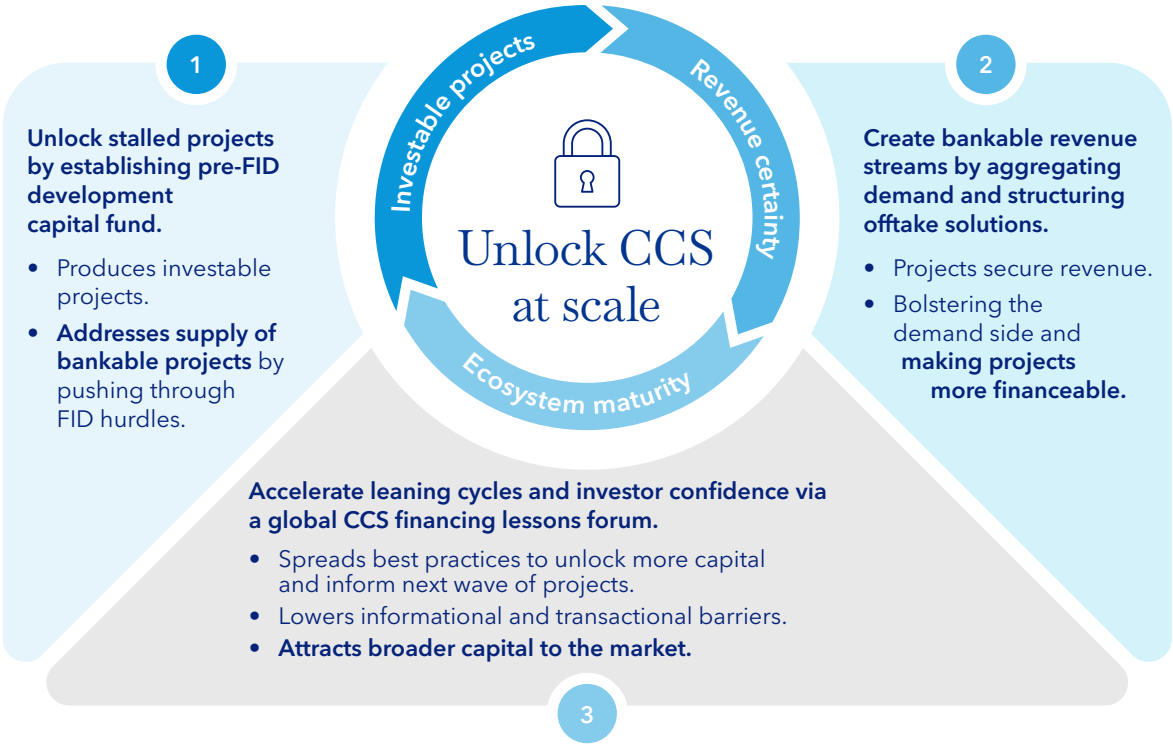
These recommendations form a cohesive package:

- The **development fund** increases the *supply* of bankable projects by pushing them through pre-FID hurdles.
- The **offtake coalitions** bolster *demand* for $CO_2$ storage and low-carbon products, creating secure revenues that make those projects financeable.
- The **knowledge forum** improves the *ecosystem* by lowering informational and transactional barriers, thereby attracting broader capital pools and enabling more efficient financing for subsequent waves.

**The financial services sector can implement these in a coherent and coordinated strategy**. For example, a project supported by the fund could benefit from an SMI-arranged offtake contract, with insights feeding into the forum to guide future deals. By taking these steps, the finance community can become **active shapers of the CCS market through innovation and thought leadership applied in tangible ways**, as seen in the successful case of renewables a decade ago. The potential impact is significant: the opportunity to unlock billions in private capital to finance projects with strong fundamentals, scalable business models, and long-term economic value.

**This is both climate mitigation and a strategic investment opportunity**. Finance can bring CCS to scale, closing the funding gap and unlocking new growth, innovation, and returns.

## Three integrated recommendations provide a practical starting point to broaden sources of capital, inform better policy and accelerate early deployment.



# 5.4 Conclusion: Mobilising private investment for scalable solutions

## CCS is at a turning point

Initial projects are mobilising. The next leap, from dozens of operational projects to hundreds, hinges on smart deployment of capital and risk sharing innovations.

This report outlines how three integrated recommendations by the financial services sector working in collaboration with governments and industry, offer a path to shift CCS from government-led deals to a private-capital-driven industry. Each action can be implemented immediately and scaled in the short term as part of an integrated package to catalyse investment.

**What this means for key actors**:

**For the financial services sector**: Now is the time to move from supporting individual flagship projects to interventions that can **create opportunities to actively shaping the sector's growth**. By championing development funds, offtake pools, and knowledge initiatives, and leveraging their relative strengths, the financial services sector can create the market conditions they need to invest at scale. This is prudent innovation, that has the opportunity to help unlock billions in investment over the next quarter-century, with returns anchored in policy frameworks and long-term infrastructure value. Early movers will gain a competitive edge in a growing market.

**For governments and public bodies**: Shift from direct funding to enabling frameworks. Engage with the financial services sector to co-design risk allocation mechanisms, such as carbon contracts or storage licensing regimes, that are bankable. Use public funds strategically to de-risk and crowd in private capital through guarantees, co-investment, and anchor offtake. Consider participating in the mechanisms outlined here, such as blended development funds or buyer coalitions. Above all, provide policy clarity and consistency on carbon pricing, liability transfer, and permitting to unlock investor confidence.

**For developers and industry**: Make projects investor-ready early. Engage proactively with the proposed initiatives, apply to the pre-FID development fund, signal interest in aggregated offtake, and adopt emerging standards for measurement, verification, and contracting. Form clusters and consortia (as evidenced by the UK and Dutch models) that allocate risk efficiently and are open to innovative financial tools such as insurance wraps, credit enhancements, and revenue swaps that align with investor expectations.

## Timing is of the essence

The next 2-3 years are not about building a fully mature CCS industry, but about laying the foundations for scalable, commercially viable growth. By acting on these recommendations now, the financial services sector can help accelerate CCS deployment, unlocking new infrastructure, investment opportunities, and long-term economic value.

This is not just climate action, it's a strategic investment opportunity. **With informed financial leadership, CCS can become a cornerstone of the future energy and industrial landscape**.

06

# Definitions and glossary

| Acronym/ term | Definition |
|---|---|
| BECCS | Bioenergy with Carbon Capture and Storage: A process that combines biomass energy generation with carbon capture and storage to remove $CO_2$ from the atmosphere. |
| CAPEX | Capital Expenditure: Funds used by an organisation to acquire, construct, upgrade, and maintain physical assets such as property, plants, or equipment. |
| CBAM | Carbon Border Adjustment Mechanism: A carbon tax or import duty on selected goods, based on the embedded greenhouse gas emissions of imported goods. |
| CCO | Carbon Credit Offtake: Agreements for the purchase of carbon credits generated by CCS or similar projects. |
| CCS | Carbon Capture and Storage: A technology to capture carbon dioxide emissions from sources like power plants and industrial processes, transporting it to a storage site and depositing it where it will not enter the atmosphere. |
| CCUS | Carbon Capture Utilisation and Storage: As above with the addition of $CO_2$ can also be used in industrial processes or products. |
| CDR | Carbon Dioxide Removal: Processes that remove $CO_2$ from the atmosphere, including BECCS and DAC. |
| CEF | Connecting Europe Facility: A key EU funding program designed to accelerate investment in essential transport,energy and digital infrastructure networks. |
| CfD | Contract for Difference: A financial contract where the government guarantees a fixed price for carbon or low-carbon products, making projects more bankable. |
| CGF | Canada Growth Fund: A Canadian government fund supporting decarbonisation projects, including CCS, through investments and offtake agreements. |
| DAC | Direct Air Capture: Technology that captures $CO_2$ directly from the ambient air. |
| DOE | Department of Energy (US): The US federal department responsible for energy policy and funding for clean energy projects. |
| EAC | Environmental Attribute Certificate: Certificates that represent the environmental benefits of low-carbon or renewable energy generation, including CCS-enabled products. |
| EIB | European Investment Bank: The European Union's nonprofit long-term lending institution, supporting climate and infrastructure projects. |
| EOR | Enhanced Oil Recovery: A process that uses captured $CO_2$ to increase the amount of crude oil that can be extracted from an oil field. |
| EPC | Engineering, Procurement, and Construction: A form of contracting arrangement used in large-scale infrastructure projects. |
| ETS | Emissions Trading Scheme: A market-based approach to controlling pollution by providing economic incentives for reducing emissions. |
| EU | European Union: A unique political and economic partnership of 27 European countries, governing common economic,social and security polices. |
| FEED | Front-End Engineering Design: The basic engineering phase conducted after conceptual design and before detailed design, crucial for project planning and cost estimation. |
| FID | Final Investment Decision: The point at which a project receives approval for full-scale investment and construction. |
| FOAK | First of a kind: Initial commercial-scale deployment of a new technology, product, or process, especially in clean energy and climate tech. |
| GGR | Greenhouse Gas Removal: Technologies or processes that remove greenhouse gases from the atmosphere. |

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| GP | General Partner: The managing partner in a fund or investment structure. |
| GSP | Government Support Package: A component of the T&S regulatory investment model designed to mitigate risks (like low usage or user default) by offering financial support to T&S companies as a last resort. |
| GW | Gigawatt: A unit of electrical power equal to one billion watts. |
| IIJA | Infrastructure Investment and Jobs Act: US legislation providing funding for infrastructure, including clean energy projects. |
| IRA | Inflation Reduction Act: US legislation with provisions for clean energy and climate investments. |
| ITC | Investment Tax Credit: A tax incentive for investments in clean energy technologies, including CCS. |
| JV | Joint Venture: A business arrangement in which two or more parties agree to pool their resources for a specific task or project. |
| $MtCO_2/yr$ | Million tonnes of $CO_2$ per year: A unit of measurement for the amount of carbon dioxide captured or stored annually. |
| MW | Megawatt: A unit of electrical power equal to one million watts |
| NZIA | Net Zero Industry Act: EU legislation to support the decarbonisation of industry. |
| O&G | Oil and Gas: Refers to the oil and gas industry. |
| OBPS | Output-Based Pricing System: A Canadian carbon pricing system for industrial emitters. |
| OPEX | Operating Expenditure: The ongoing cost for running a product, business, or system. |
| PE | Private Equity: Capital invested in companies not listed on public stock exchanges, sourced from institutional investors and high-net-worth individuals. |
| PPA | Power Purchase Agreement: A contract between two parties, one which generates electricity and one which is looking to purchase electricity. |

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| R&D | Research and Development: Early phase of technological advancement, involving basic/applied research, design, and testing to bring new solutions to market. |
| RAB | Regulated Asset Base: A model for infrastructure financing where returns are regulated and based on the value of the asset. |
| REC | Renewable Energy Certificate: A market-based instrument that certifies the bearer owns one megawatt-hour of electricity generated from a renewable energy resource. |
| ROW | Rest of World: Refers to regions outside the main focus areas (e.g., North America, Europe). |
| SCA | Supplementary Compensation Agreement: A contract that is part of the GSP, designed to cover financial losses for T&S from specific risks like $CO_2$ leakage. |
| SDE++ | Stimulation of Sustainable Energy Production and Climate Transition: Dutch subsidy programme supporting renewable energy and CCS projects. |
| SMI | The Sustainable Markets Initiative is the world's go-to private sector organisation for sustainable transition. |
| T&S | Transport and Storage: Refers to the transportation and storage components of the CCS value chain. |
| TRL | Technology Readiness Level: A measure of the maturity of a particular technology. |
| VC | Venture Capital: A type of private equity funding for high-growth potential startups, where investors typically give capital for an ownership stake (equity) to help them scale. |
| vPPA | Virtual Power Purchase Agreement: A financial contract for difference on electricity, allowing buyers to claim renewable or low-carbon attributes without physical delivery. |

07

# Annex: Regional case studies

*This annex provides detailed case studies of CCS projects and frameworks in key regions (UK, Norway, Netherlands, US, and Canada) to illustrate how risks have been managed and what lessons can be drawn. These showcase real-world examples of CCS financing structures.*

## 7.1 United Kingdom: A cluster-based approach with significant public backing

**Projects**: The UK has structured CCS deployment around two initial industrial clusters (East Coast Cluster and HyNet Cluster) which will combine power, industrial, and hydrogen capture projects linked to shared T&S infrastructure. These clusters were selected in 2021-2023 as part of the UK's strategy to develop four CCS hubs and capture and store 20-30 $MtCO_2$ by 2030[41]. This marked the third attempt to formally launch CCS commercially within the UK, with earlier iterations having faced funding challenges and barriers when negotiating risk allocation between developers and the Government.

**Financing and structure**: In late 2024, the Northern Endurance Partnership T&S infrastructure and Net Zero Teesside Power reached financial close within the East Cost Cluster. Financial close for the Liverpool Bay T&S infrastructure for the HyNet cluster occurred in early 2025, followed by financial close for the Protos and Padeswood capture projects in late 2025. These projects were largely financed through development via the balance sheets of oil and gas (O&G) major sponsors, alongside limited upfront grant awards from innovation funds. Upon financial close, these projects together have secured more than £10 billion[42] in private financing commitments through formal debt raise processes.

These are the first CCS projects globally to attract significant non-recourse debt financing. This was enabled by the UK Government's comprehensive CCS support package, which involved:

- **Up to £21.7 billion[9] made available to** enable the deployment and growth of the first two CCS clusters over the next 25 years.
- **Bespoke CfD-style agreements tailored to different capture business models** that offer support over a 10-15-year period. These models take into account revenues earned by the underlying business (for example, electricity generation under the Dispatchable Power Agreement for Power CCS), while also introducing fixed revenue components that bring greater certainty over the longer term.
- **A RAB model for the $CO_2$ T&S companies**, which provides developers with certainty that their efficiently incurred expenditure during the construction of the networks will be recovered once future users connect.
- **A range of government backstop arrangements and allocation of cross-chain risk within support contracts to mitigate many of the barriers developers face when investing in a complex value chain**. This includes a Revenue Support Agreement to ensure the T&S companies can recover their revenue if the network is underutilised, and a Government Support Package whereby protections are in place should the T&S network become stranded or commercially uninsurable due to offshore risks associated with leakage events.

41 UK Government, "Carbon Capture, Usage and Storage: A Vision to Establish a Competitive Market", 2023
42 Baringa Analysis of Infralogic data, 2025

### UK CCS key de-risking features[43]

| Risk | Missing money | Cross-chain risk/ coordination | Offtake/ revenue uncertainty | Technology and execution | Long-term storage liability |
|---|---|---|---|---|---|
| | ✓ **Government**<br>Up to £21.7 billion provided. | ✓ **Government**<br>Full chain. | ✓ **Government**<br>15-yr CfD, RAB model. | × **Project sponsors**<br>EPC guarantees. | ✓ **Government**<br>GSP. |

**Outcome and lessons**: The UK government has taken a significant role in coordinating cross-chain risk allocation, accepting risks itself that could not be managed by the private sector for FOAK projects, and providing a substantial funding commitment to CCS development. This approach has undoubtedly been pivotal in creating bankable business models that have attracted unparalleled levels of external debt financing.

The UK experience also shows the importance of experienced sponsors. The active roles of major companies, including bp, Equinor, Total, and Eni, with offshore expertise and strong balance sheets, enabled the private sector-led technical development of both clusters.

However, there are questions as to whether the UK can continue to scale the CCS sector beyond the first two clusters using the same approach, given the significant commitment it requires from the government balance sheet and the high levels of government involvement in selecting clusters and capture projects. The UK government has previously published a vision for the CCS sector, which envisages a maturing market that is eventually self-sustaining, with a less active role for the state.

43 UK Government, "Carbon Capture, Usage and Storage (CCUS) Business Models"; e.g., "CCUS business Models: Government Support Package Transport & Storage Commercial Principles (Annex B)", 2020

# 7.2 Norway: State-led full value chain (Longship and Northern Lights)

**Projects**: The Longship CCS project initially involves capture at two industrial sites (Heidelberg Material's capture facility at the Breivik cement plant and Hafslund Celsio's waste-to-energy plant in Oslo) and storage at the Northern Lights $CO_2$ storage (an open-access storage facility operated by Equinor, Shell, and TotalEnergies in the North Sea). Operations started in 2025 for phase 1, with a view to expand the open access model in phase 2 with contracted cross-border emitters already in place, notably Yara Fertiliser plant in the Netherlands, Stockholm Exergi bioenergy plant in Sweden, and Ørsted Kalundborg plant in Denmark.

**Financing and structure**: Longship is characterised by extensive government funding, with the Norwegian government covering approximately 67%[44] of the total capital and operating costs of the project:

- **For the capture facilities**: The government provides direct grants for approximately 2/3 of the capex and will pay operational support for 10 years to cover capture costs, under individual agreements with the two industrial emitters.
- **For Northern Lights T&S**: The Northern Lights JV received initial government funding of up to 80% of capital costs for the first project phase. The state also assumes long-term liability for the stored $CO_2$ post-operations and has agreed to cover 80-95% of operating costs over 10 years.

The significant contribution of the Norwegian government to the initial costs associated with developing both capture and storage projects in the first phase of the Longship project has resulted in no notable role for private external finance raises to date.

44 Northern Lights JV, "About the Longship Project", 2025

### Norway CCS key de-risking features[45]

| Risk | Missing money | Cross-chain risk / coordination | Offtake / revenue uncertainty | Technology and execution | Long-term storage liability |
|---|---|---|---|---|---|
| | ✓ **Government** Likely 67% of total costs of Longship phase 1. | ✓ **Government** Government integrated capture and storage synchronisation + no exposure to counterparty default. | ✓ **Government** State pays a significant portion towards opex costs for both capture and T&S projects for 10 years. | ✓ **Project sponsors** Government and experienced industry took all performance risk. | ✓ **Government** Law stipulates government assumes long-term liability. |

**Outcome and lessons**: Longship reached FID in late 2020 and is now moving into operations. The infrastructure being developed as part of the first project phase will create assets that support the future expansion of the project. To this end, in March 2025, the Northern Lights JV announced it has reached FID on an expansion that will deliver up to 5 $MtCO_2$/yr capacity, alongside the announcement of a cross-border commercial agreements, including with Stockholm Exergi to ship and store up to 0.8 $MtCO_2$/yr from 2028 for 15 years. This expansion has been driven by commercial investment from the Northern Light JV, alongside a grant received from the European Commission CEF rather than through direct support from the Norwegian government.

The key lesson from Norway is that full-value-chain integration and significant government funding can kick-start CCS even when commercial economics are initially absent. By financially enabling and significantly de-risking Phase 1, the Norwegian government has created the conditions for a Phase 2 to be driven on commercial terms. While other countries may not benefit from the same fiscal position as the Norwegian government to support an investment of this scale, the Longship project demonstrates the power of phasing CCS development.

Norway has also heavily promoted the development of the Longship project through Gassnova. This state-owned entity supports the coordination of the value chain, sharing technical and commercial lessons learnt throughout the project lifecycle.

45 Norwegian Ministry of Petroleum and Energy, "Whitepaper of Longship CCS", 2020; CCS Norway, "State Support Agreements in Longship", 2022



# 7.3 Netherlands: Porthos hub public-private hybrid model

**Projects**: Porthos (Port of Rotterdam $CO_2$ Transport Hub & Offshore Storage) will collect $CO_2$ from four hydrogen and refinery projects in the Rotterdam area and inject it into a depleted gas field offshore. FID was confirmed in 2022, and final permits were cleared in 2023.

**Financing and structure**: Porthos is noteworthy for its hybrid approach:

- **The T&S infrastructure** (onshore pipeline to port, offshore pipeline, and injection facilities) is being developed by a state-owned consortium (Port of Rotterdam, Gasunie, EBN) with costs estimated at around €1.2 billion[46]. This is largely financed by the Dutch government and the consortium members (EBN/ Gasunie, which are state entities). Additionally, the EIB provided a €102 million[47] grant to support the T&S infrastructure.
- **The capture projects** at the four participating companies (Air Liquide, Air Products, ExxonMobil, Shell) are understood to be balance sheet financed by sponsors, alongside critical subsidies received under the Dutch SDE++ programme. SDE++ is a one-way competitive carbon CfD: the projects bid for the level of subsidy per tonne they need (amongst other competing technologies). Porthos' emitters were awarded €2.1 billion[48] in total subsidies to be paid over 15 years for an expected ~37.5 $MtCO_2$ stored (i.e. about €57/t on average[46]). This subsidy effectively guarantees capture project revenues for capturing $CO_2$ – if the market carbon price is below a threshold, the subsidy makes up the difference.

Under contracts, the emitters will pay a fee to the T&S operator for each tonne stored. That fee plus the subsidy ensures the T&S operator can cover its costs. The Dutch state also ensured that the initial T&S system would involve an oversized onshore pipeline/compressor component, anticipating future expansion of the industrial area and a forward-looking investment.

46 Netherlands Court of Audit, "Carbon Storage Under the North Sea", 2024
47 Porthos, "102 Million Euros in Funding on the Horizon for Porthos", 2021
48 Porthos, "Dutch Government Supports Porthos Customers with SDE++ Subsidy Reservation", 2020

### Netherlands CCS key de-risking features[46, 47, 48]

| Risk | Missing money | Cross-chain risk / coordination | Offtake / revenue uncertainty | Technology and execution | Long-term storage liability |
|---|---|---|---|---|---|
| | ✓ **Government** €2.1 billion SDE++ contracts, flowed through to guaranteed storage/stable revenues. | ✓ **Government** Public consortium for T&S with government assuming volume risk. | ✓ **Government** 15-yr CfD, SDE++ mechanism. | ✓ **Public entities** Public involvement reduces uncertainty. | ✓ **Government** State entity-owned, with the state assuming liability after the site closure compliance period. |

**Outcome and lessons**: Porthos is on track to start operations around 2026, becoming one of Europe's first operating CCS hubs. It has demonstrated that a robust subsidy mechanism (in the form of a one-way CfD) can unlock private investment and a willingness of corporate sponsors to progress development underpinned by a long-term capture price commitment.

Porthos also provides an example of effective risk allocation. The state and state-backed entities took responsibility for the development of T&S infrastructure and providing access through a regulated charge, reducing cross-chain risk and commercial complexity for private sector capture projects. State involvement in shared infrastructure also enabled oversizing, which will benefit the development of the associated Aramis pipeline project nearby.

From a financing perspective, Porthos demonstrates the ability to utilise financing from institutions with a mandate for climate investment in CCS projects, such as the EIB. EIB's involvement signalled confidence and lowered financing costs for the project.
This approach could serve as a model for other industrial ports and clusters worldwide, particularly where a mix of state facilitation and market-based subsidy can be combined. For instance, an emerging economy might use development bank loans to build a $CO_2$ hub and use an auction to allocate storage contracts to industries to replicate the Porthos approach.

# 7.4 United States: Market-driven projects and the 45Q incentive

**Context**: Unlike the coordinated national CCS programmes seen in other regions, the US approach is more decentralised, as it relies primarily on tax incentives like the 45Q credit and targeted grant funding from the DOE to support privately-led projects. However, it's important to recognise that the US benefits from significant existing infrastructure in certain regions, particularly where CCS is linked to EOR. Additionally, the availability of onshore storage sites, often at lower cost compared to offshore alternatives, provides a distinct advantage. These factors have enabled a more distributed and commercially driven CCS landscape; however, challenges remain around project structuring, policy consistency, and scaling beyond early movers.

**Project example and financing structure**: One example is Occidental Petroluems' (Oxy) DAC Initiative in Texas. Oxy, through its subsidiary 1PointFive, is building what aims to be the world's largest DAC plant (around 1 $MtCO_2$/yr). Financing DAC is challenging due to high costs (approximately $230-$355[49] per tonne today). Oxy's approach has been to capitalise on multiple support streams: it secured $180/t from 45Q tax credits (for DAC), plus pre-sold some $CO_2$ removal credits to companies like Airbus, Shopify, and Microsoft, and is exploring selling some $CO_2$ for EOR. Additionally, it received an approximately $100 million grant from the DOE DAC hub programme. Alongside this, 1PointFive is in a partnership and evaluating a JV with ADNOC (through its investment arm, XRG) with an associated $500 million investment under consideration[50]. The remainder of the project cost is being funded by Oxy and partners (possibly with loan financing, although the details are private). The project FID was taken internally by Oxy in 2022. The key financing lesson here is about stacking incentives, as no single revenue source made the project commercially viable.

Combining a tax credit, voluntary carbon market offtakes, and even $CO_2$ sales created a stacked revenue model that attracted investment. The presence of a strong parent company (Occidental) willing to invest equity also underpins it.

49 Carbon Engineering, "Research: DAC Pathways", 2022
50 Occidental Petroleum, "Climate Report Summary", 2025

## US CCS key de-risking features[50]

| Risk | Missing money | Cross -chain risk / coordination | Offtake / revenue uncertainty | Technology and execution | Long-term storage liability |
|---|---|---|---|---|---|
| | ✓× **Reliant on market**<br>45Q provides some revenue certainty, but doesn't close the gap for most projects. | × **Projects**<br>Must self-synchronise. | ✓× **Government and developer**<br>Revenue depends on tax credits (expire after 12 yrs), volatile voluntary $CO_2$ markets, low carbon fuels standards, and international mandate standards (e.g. CBAM for export). | × **Projects**<br>Bear execution risk. | ✓× **Developer**<br>Though in some cases liability transfers to the state |

**Outcomes and lessons**: The US experience to date shows that market-based incentives can spur projects but may not guarantee financing until supplemented by additional components of a revenue stack to build a viable business case.

We see innovative financing in the form of tax equity partnerships to effectively utilise the 45Q tax credit, with projects often bringing in tax equity investors to monetise those credits in exchange for providing upfront capital. This model was effectively utilised in the renewable energy sector (for example, in wind and solar) and essentially converts the future stream of tax credits into present capital. For example, an illustrative CCS project expected to earn $500 million of 45Q credits over 12 years might attract a tax equity investor to contribute $300 million today, in return for which the investor receives the credits (and possibly some cash flow) over time. This reduces the upfront debt needed to enable construction. Such structures are complex and incur transaction costs, but they are a key financing tool in the US under the current 45Q regime.

Even with generous incentives, the US has seen projects delayed due to permitting and community concerns. Class VI well permits for $CO_2$ storage have been slow, with only a handful currently having Environmental Protection Agency (EPA) approval. This regulatory drag affects financing because lenders cannot commit until the necessary permits are in place. To address this challenge, some states (like North Dakota and Wyoming) have taken over as the permitting authority ("State Primacy") to accelerate the permitting process from over 3 years to under 1 year.

In summary, the US is demonstrating certain concepts (such as tax credit monetisation and multi-revenue stream models), but also illustrates the limits of a purely market-led approach: **complex financing structures are required**, and there is evidence that lower-concentration $CO_2$ projects are struggling to reach FID. The recent One Big Beautiful Bill developments for the Inflation Reduction Act (IRA) have kept the 45Q for CCS and achieved price parity for storage and EOR (85$/t). However, even with this, state-level support or private offtake contracts, such as long-term $CO_2$ purchases by corporations, are still needed to satisfy lenders for the most part.

51 US Congress, Congressional Research Service, "The Tax Credit for Carbon Sequestration (Section 45Q)", 2024

# 7.5 Canada: Layered incentives with market innovation

**Context**: Canada's CCS policy landscape is more coordinated than the US, with both federal and provincial governments actively shaping the investment environment. The federal government offers a CCUS ITC of up to 50% for capture equipment (60% for DAC), and 37% for T&S infrastructure, depending on the project type.

Canada also benefits from abundant onshore geological storage, particularly in Alberta and Saskatchewan, which significantly reduces costs compared to offshore alternatives. This geological advantage, combined with existing O&G infrastructure, creates favourable conditions for CCS deployment. Importantly, Canada has maintained a carbon pricing system since 2019, with a federal benchmark ensuring a minimum level of stringency across provinces. While the consumer-facing fuel charge is being phased out as of April 2025, the focus is shifting toward strengthening industrial carbon pricing systems to support large-scale decarbonisation. This includes mechanisms like the Output-Based Pricing System (OBPS), which applies to emissions-intensive, trade-exposed sectors and provides a stable price signal for investment.

**Project example and financing structure**:
Entropy is a natural gas-fired CCS facility, capturing 0.18 $MtCO_2$/yr with a modular architecture. Its financing model exemplifies how layered capital and policy instruments can de-risk CCS investments.

- **Private equity**: A strategic $300 million[52] (CAD) investment from Brookfield Global Transition Fund in 2022 laid the foundation for global expansion. In 2023, CGF committed an additional C$200 million[53] via a delayed draw convertible debenture, potentially giving CGF up to 20% equity in Entropy.
- **Carbon Credit Offtake Agreements (CCOs)**: CGF's commitment to purchase up to 1 $MtCO_2$/yr per annum of carbon credits over 15 years at a fixed price of $86.50/tonne[54] represents a global first in compliance markets. This structure provides long-term revenue certainty and absorbs carbon pricing risk, enabling Entropy to proceed with Glacier Phase 2 and underwrite future projects.
- **Government incentives**: Entropy is eligible for federal CCUS ITC and Alberta's Technology Innovation and Emissions Reduction (TIER) programme, which together can reduce upfront capital costs by up to 57%[55] when combining provincial and federal incentives.
- **Corporate buyers**: Voluntary market offtake agreements with companies like Shopify offer early revenue and validate the business model.

52 PR Newswire, "Entropy Inc. Announces $300 Million Investment Agreement with Brookfield Renewable", 2022
53 PR Newswire, "Canada Growth Fund Announces Strategic Investment in Entropy Inc. and Carbon Credit Offtake Commitment", 2024
54 Government of Canada, "Deputy Prime Minister Welcomes the Canada Growth Fund's First Carbon Contract for Difference", 2023
55 Canada Growth Fund. "Technical Briefing." 2023.

### Canada CCS key de-risking features[25, 53, 54, 55]

| Risk | Missing money | Cross-chain risk / coordination | Offtake / revenue uncertainty | Technology and execution | Long-term storage liability |
|---|---|---|---|---|---|
| | ✓× **Investment Tax Credit** (Up to 60%) partially de-risks. | × **Projects** Must self-synchronise. | ✓× **Government and developer** 15-yr CfD, CGF mechanism. | × **Projects** Bear execution risk. | ✓× **Typically, the operator** However, varies by province. For example, the Government of Alberta provides coverage via a statutory fund. |

**Outcomes and lessons**: Entropy's experience demonstrates how a well-structured combination of incentives can make projects financially viable, even at smaller scales. By layering tax credits, voluntary carbon market offtakes, and strategic equity investments, Entropy has created a replicable model that reduces risk and attracts capital. The company's modular technology design further enhances this model by enabling lower upfront costs and faster deployment across a range of industrial applications.

A key enabler of Entropy's success has been the introduction of long-term, fixed-price CCO agreements. These contracts, pioneered in partnership with the CGF, provide revenue certainty and effectively absorb carbon pricing risk, two critical barriers to FIDs in CCS. This approach has allowed Entropy to move forward with its Glacier Phase 2 project and plan for future deployments with greater confidence.

Moreover, Entropy's projects are helping to establish foundational infrastructure for $CO_2$ T&S in Alberta. As more T&S networks reach FID, future capture projects can be developed with the assurance that shared infrastructure will be available. This anchoring effect is vital for scaling CCS across the region.

Canada's broader policy framework, characterised by carbon pricing, geological advantages, and platform-based innovation, has played a pivotal role in accelerating CCS deployment. While challenges remain, particularly around permitting and standardising offtake agreements, Entropy's case illustrates how targeted interventions today can unlock scalable, bankable CCS solutions for the future.

# Sustainable Markets Initiative



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