
Good morning and welcome to the closing day of the first Global Cement CCS conference hosted by *Global Cement Magazine*.

My name's Robert Jutson and I'm Managing Director at Griffin Capital Partners. We're a project finance advisory firm based in London, New York, and Dallas. We've advised cement companies and energy and resource developers across the Americas and Eurasia for over 30 years.

Let me first thank our hosts and sponsors from Pro-Global Media Limited and *Global Cement Magazine*, Heidelberg Materials, Aker Solutions, and the innovative technology providers tackling the challenges of carbon capture.

In particular, let's give a shout-out and salute Norway and its Ministry of Energy for their leadership in the *Longship* endeavor.

[CUE SLIDE #2]

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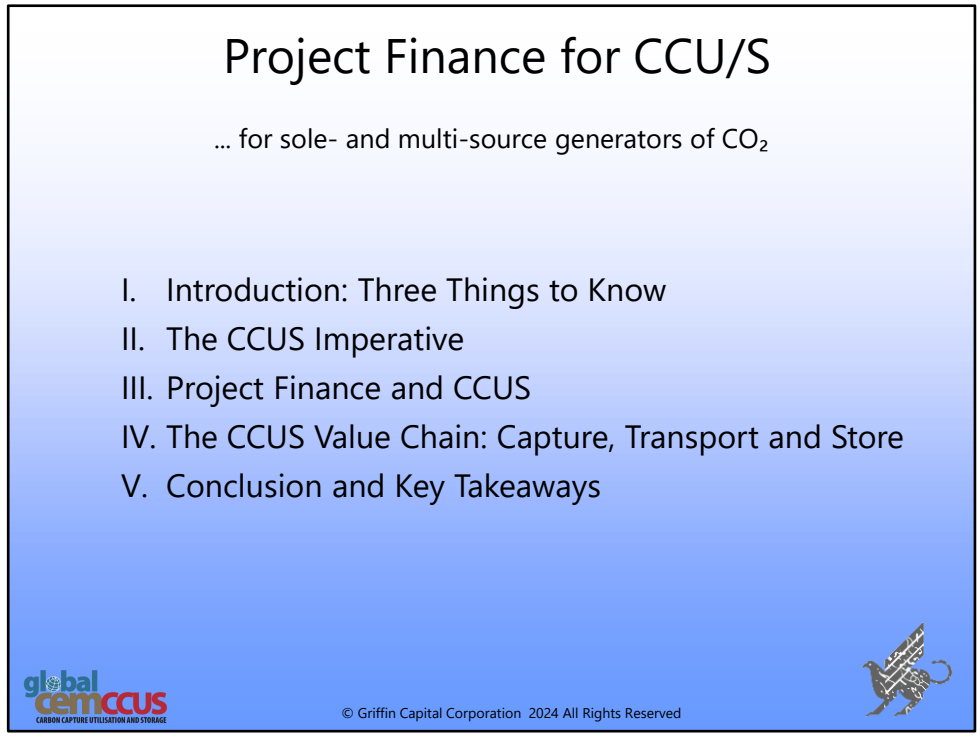


## I. Introduction: Three Things to Know

In the next twenty minutes, we'll discuss how project finance can make a CCS project bankable without relying on project sponsors' balance sheets or host country governments' annual budgets. That'll be followed by about ten minutes of Q&A.

While almost all funding for CCS projects today relies heavily on public subsidies, we believe market-based project finance schemes can achieve FID once CCS business models mature. This will occur when the avoided cost per tonne of captured $CO_2$ declines (as does the cost of capture tech) while the value of $CO_2$ increases under the EU ETS and similar cap-and-trade schemes.

Outside the oil and gas industry, most large-scale CCUS projects result from partnerships between governments and industry leaders in hard-to-abate sectors like cement and steel. This reduces risk and socializes cost. Such partnerships also increase the practical knowledge base of industry and policymakers responsible for delivering "net zero" solutions.

So, let's hop to it. Here're three things to know about Project Finance: [SLIDE #3]

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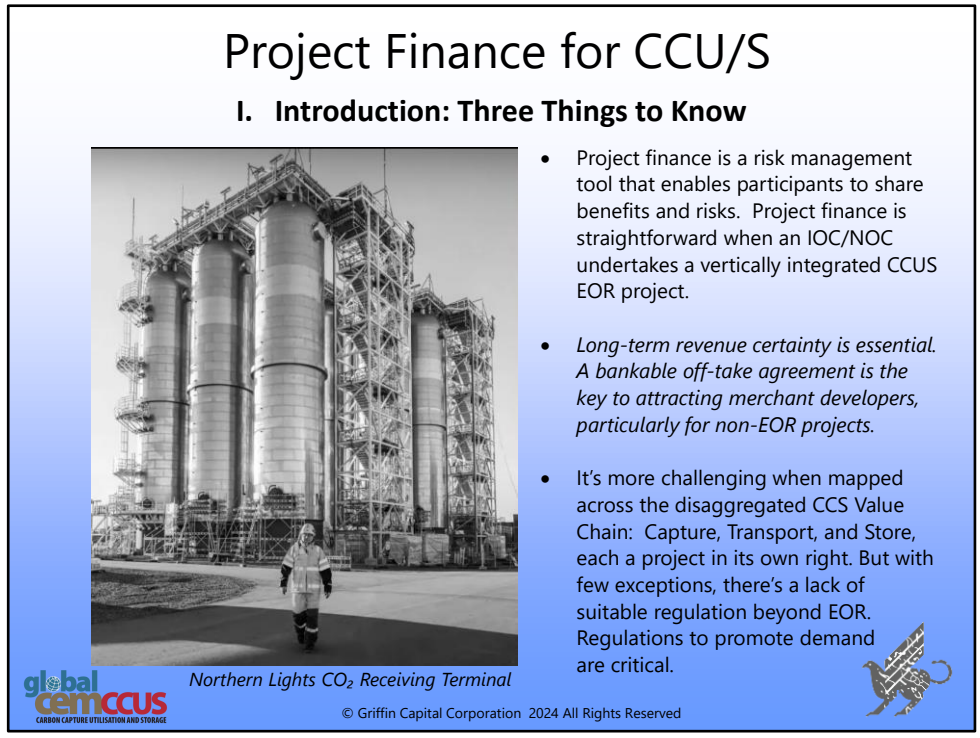


## I. Introduction: Three Things to Know

Here are three things to know about Project Finance:

- It's a risk management tool that enables project participants to share benefits;
- A bankable off-take agreement is essential to attracting capital, particularly for non-EOR projects; and
- It maps neatly onto the CCS Value Chain: Capture, Transport, and Store, each a project in its own right.

A well-designed project finance scheme will enable project sponsors to sell down project company equity, reduce their balance sheet exposure and farm-out project capacity. [CUE SLIDE #4]

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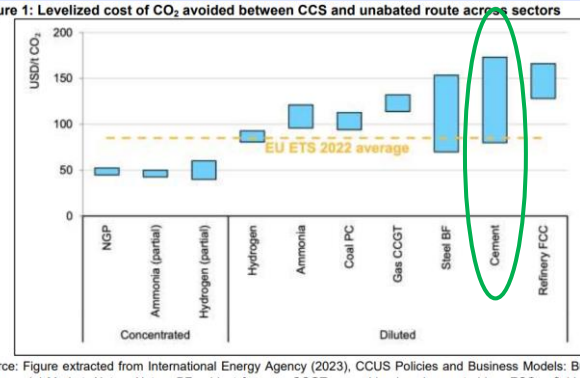
# Project Finance for CCU/S

## II. The CCUS Imperative

***"CCUS is virtually the only technology solution for deep emissions reductions from cement production."***

*-IEAA's Sustainable Development Scenario*

**Figure 1: Levelized cost of $CO_2$ avoided between CCS and unabated route across sectors**




Source: Figure extracted from International Energy Agency (2023), CCUS Policies and Business Models: Building a Commercial Market. Notes: Notes: BF = blast furnace; CCGT = combined cycle gas turbine; FCC = fluid catalytic cracker; NGP = natural gas processing; PC = pulverised combustion.

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In addition to your usual day-to-day activities, many of you are called upon to embrace sustainability initiatives important to stakeholders and lenders. Top of mind are initiatives that call for reducing emissions.

Carbon capture and storage (CCS/CCUS) is an established tool complementing other mitigation strategies. CCS is essential for the cement industry (and other hard-to-abate industries) to attain net-zero emissions. That's simply due to its very high levelized cost of $CO_2$ avoided – and its potential value under the EU ETS:

[CUE SLIDE #5]

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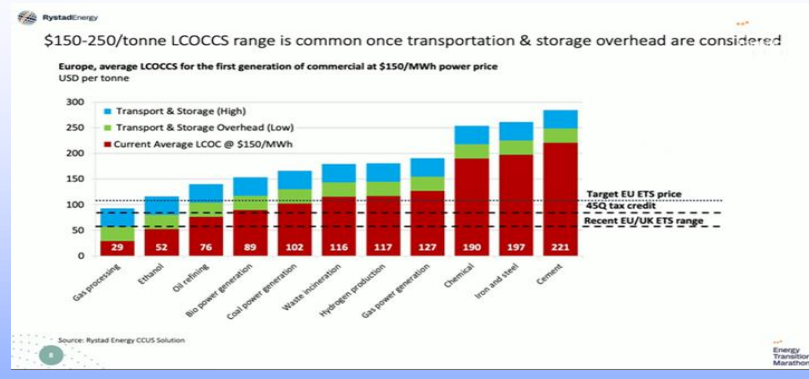
# Project Finance for CCU/S

## II. The CCUS Imperative




*"Oil and gas and other traditional resources are going to be around for a while" – Rob Barnett, Senior Energy Economist, Bloomberg Intelligence*

*"We need to pass through shades of brown to shades of green." - Larry Fink, Chairman and CEO of BlackRock*

global cemCCUS CARBON CAPTURE UTILISATION AND STORAGE

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Risk Capital is increasingly available to fund CCS projects if the value chain of "capture, transport, and store" supports a commercial use case. (Annual venture capital investment in CCUS projects and companies, 2015-2022 – Charts – Data & Statistics – IEA). At this point in its evolution as a "net zero" strategy, a CCS project requires a public-private partnership approach with government subsidies combined with private sector infrastructure and geological resources. Just like the *Longship*/*Northern Lights* project.

That's because the economic feasibility of CCS projects hinges on the uncertain long-term value of abating or removing $CO_2$. And that's where government policy comes into play.

[CUE SLIDE #6]

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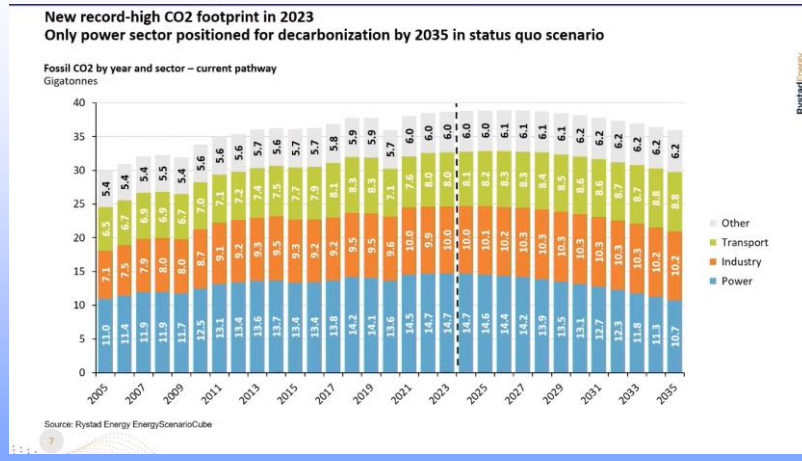
# Project Finance for CCU/S

## II. The CCUS Imperative




*Only the power generation sector's positioned for decarbonization by 2035 – Rystad Energy*

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At the present time, only the power generation sector's likely to achieve its decarbonization targets by 2035 …

[CUE SLIDE #7]

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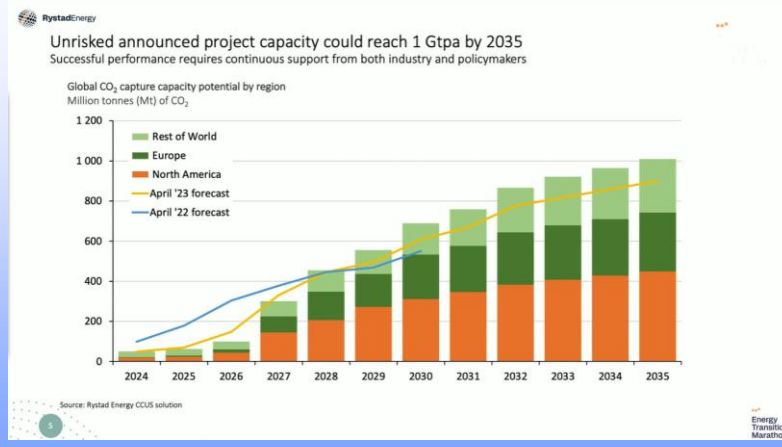
# Project Finance for CCU/S

## II. The CCUS Imperative




*CCU/CCUS will contribute significantly to achieving national commitments – if industry and government pull together … demand-based policy is essential.*

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… and that's only because, through a combination of carrots and sticks, the power industry and governments have agreed to reduce the use of coal for power generation … primarily where renewables and cheap natural gas are available at scale.

So, … why is this?
[CUE SLIDE #8]

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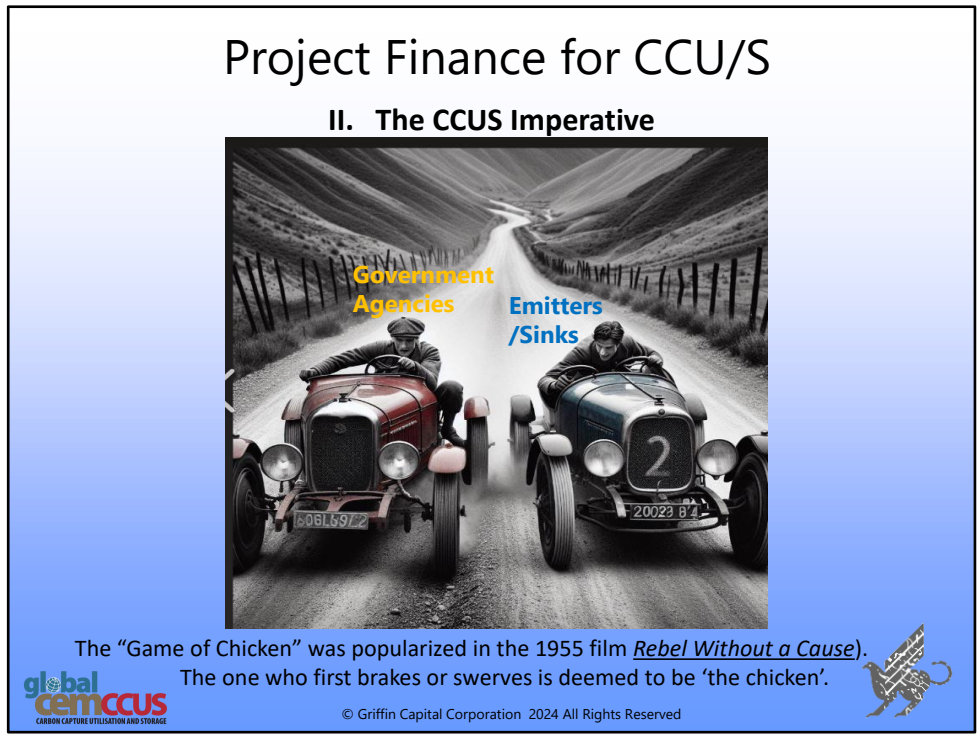


Bertrand Russell famously compared nuclear brinksmanship to the game of Chicken where neither driver lets off as they careen toward the mouth of a narrow, single-lane bridge (the game was popularized in the 1955 film *Rebel Without a Cause*). The one who first brakes or swerves is deemed to be 'the chicken'.

Some in the ESG world believe this apocryphal metaphor applies to CCS where time is of the essence. In the case of CCS, the "game of Chicken" between policymakers and industry is about who bears the risk of that uncertain value of abating or removing $CO_2$. That's a tough call for projects that take 3 to 5 years to construct – after years of technical and environmental assessments, design, and license and permit proceedings. In the present case, Norcem Brevik took about eight years to complete. *Northern Lights*, the first operating transport and storage hub in Europe, also took about eight years to commission.

[CUE SLIDE #9]

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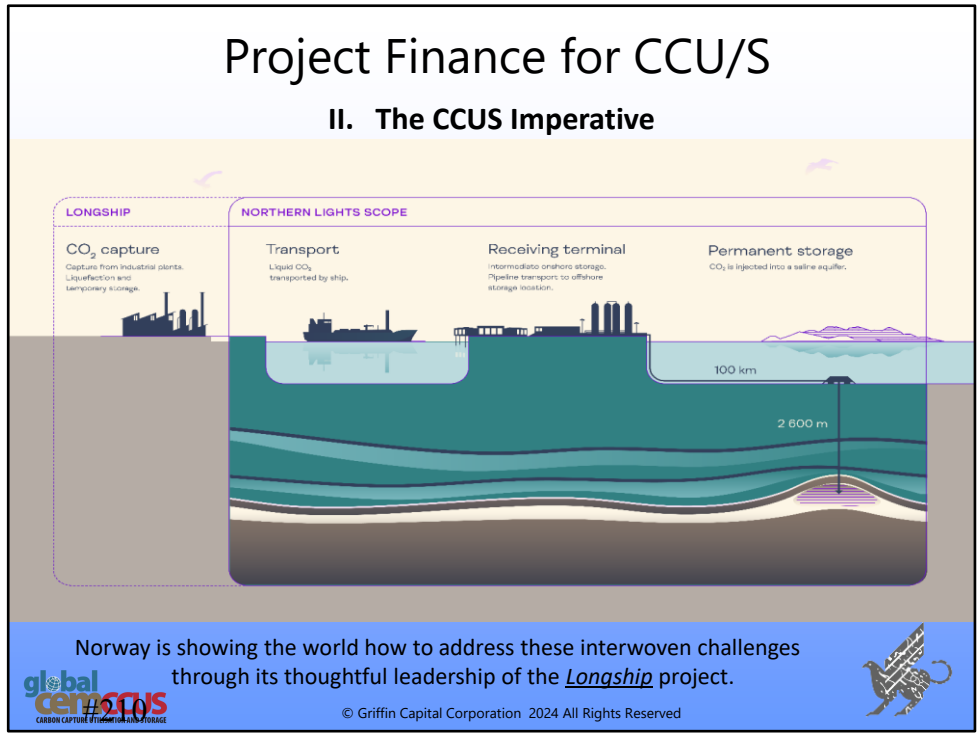


Once commissioned, a CCS project must then operate – safely as licensed and permitted – for 20 to 30 years. That is the economic life necessary to retire most long-term project debt.

Then there're other questions: Who indemnifies CCS project sponsors against the cost in the unlikely event of leaks decades later? Norway is showing the world how to address these interwoven challenges through its thoughtful leadership of the *Longship* project.
[CUE SLIDE #10]

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## Project Finance for CCU/S

**II. The CCUS Imperative**

*Northern Lights* is responsible for developing and operating $CO_2$ transport and storage facilities, open to third parties, as a part of ***Longship.***

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The *Northern Lights* project is a combined transport hub and storage solution, managed by Northern Lights JV DA. That entity's a Norway registered and incorporated General Partnership with Shared Liability (DA) owned equally by Equinor, Shell and TotalEnergies.
[CUE SLIDE #11]

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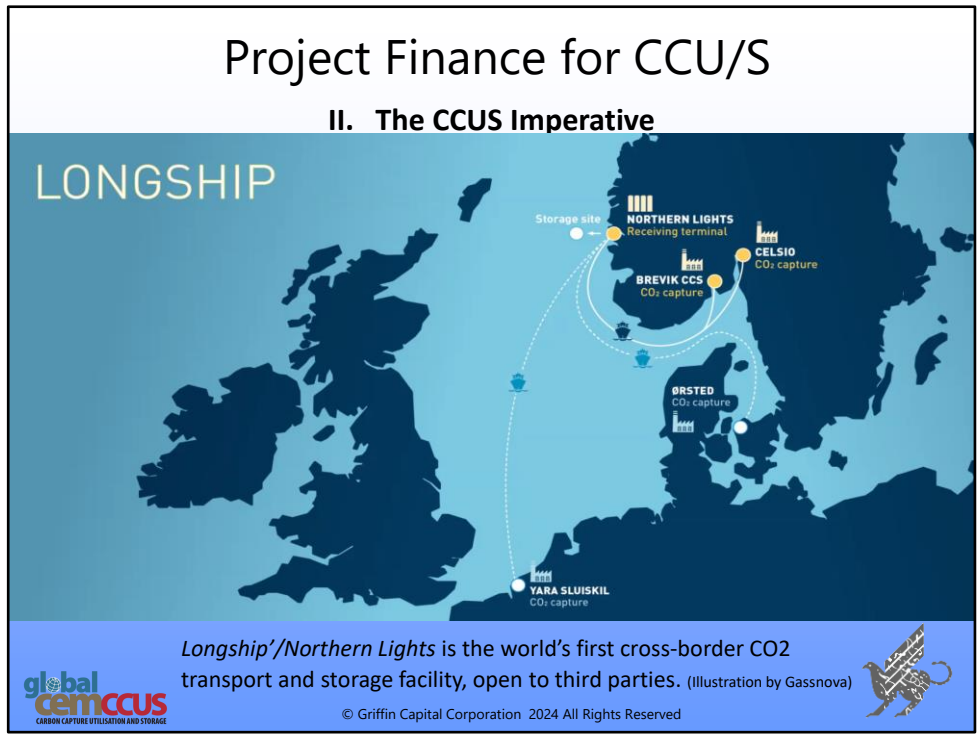


*Northern Lights* is responsible for developing and operating $CO_2$ transport and storage facilities, open to third parties, as part of *Longship*, Norway's overall full-scale carbon capture and storage project. As such, you could think of *Northern Lights* as a project within a project.

[CUE SLIDE #12]

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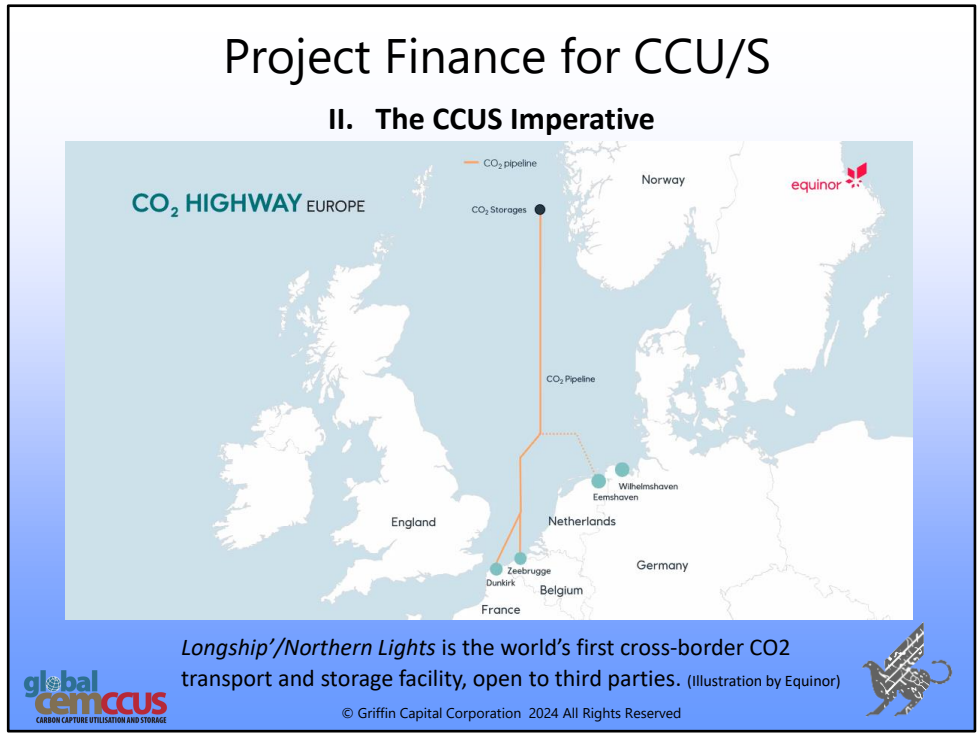


*Northern Lights* is an aggregator with the world's first open-source $CO_2$ transport and storage infrastructure, initially serving three emitters.

It will store about 0.8 Mtpa of $CO_2$ from Brevik and a municipal waste-to-energy plant (Hafslund Oslo Celsio) in its first phase.

From early 2025, and as the world's first cross-border CCS value chain, another 0.8 Mtpa of $CO_2$ will arrive at the *Northern Lights* terminal from Yara Sluiskil, an ammonia and fertilizer plant in the Netherlands.

Other emitters in France and Belgium are also expected to contribute.

[CUE SLIDE #13]

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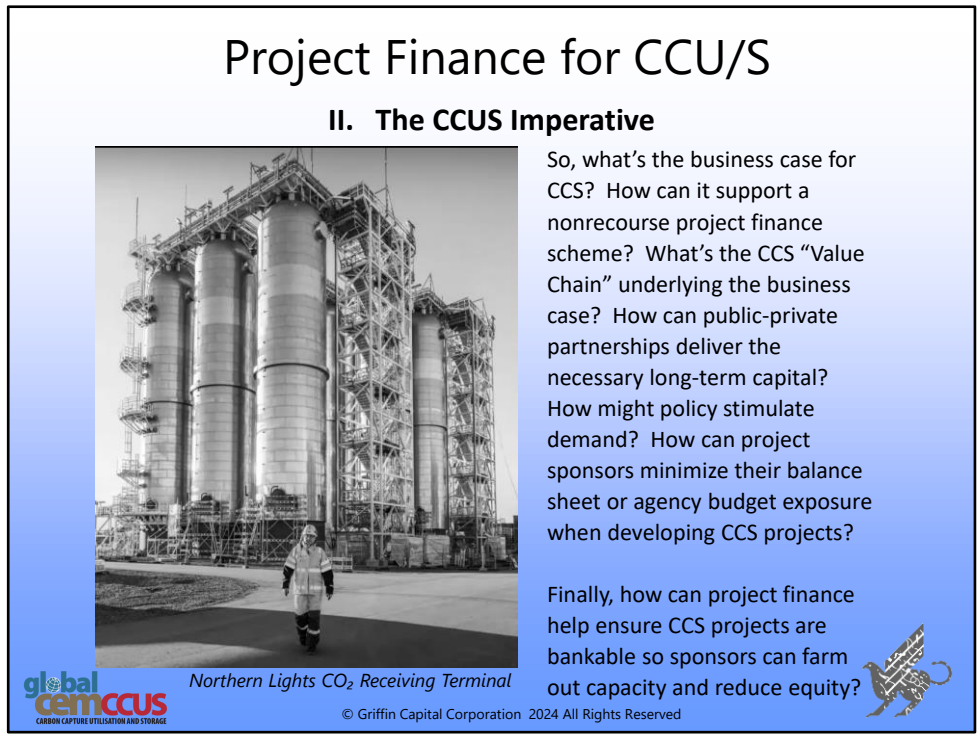


So, what's the business case for CCS?

How can it support a nonrecourse project finance scheme?

What's the CCS "Value Chain" underlying the business case?

How can public-private partnerships deliver the necessary long-term capital?

How can project sponsors minimize their balance sheet or agency budget exposure when developing CCS projects? Finally, how can project finance help sponsors ensure their CCS projects are bankable so investors can reach a final investment decision (FID)?

[CUE SLIDE #14]

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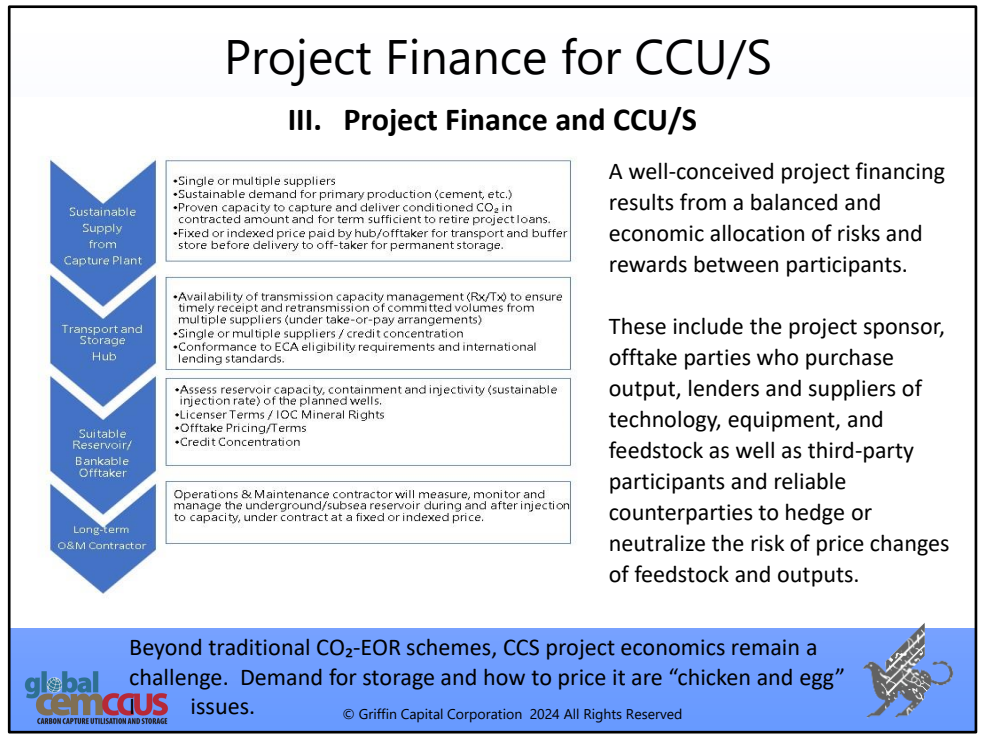


Project finance is a risk management tool used by private enterprises and government agencies. They use it to finance long-lived, capital-intensive projects without exposing their balance sheet or agency budget. It's a very helpful approach to funding CCS projects that don't rely on an off-take agreement with an EOR party.

A well-conceived project financing results from a balanced and economic allocation of risks and rewards between participants. These include the project sponsor, offtake parties who purchase output, lenders and suppliers of technology, equipment, and feedstock as well as third-party participants and reliable counterparties to hedge or neutralize the risk of price changes of feedstock and outputs.

While every project finance structure is unique, they all have one element in common: *the financing is based on the economics of the project and not dependent on the credit support of the sponsor*.

[CUE SLIDE #15]

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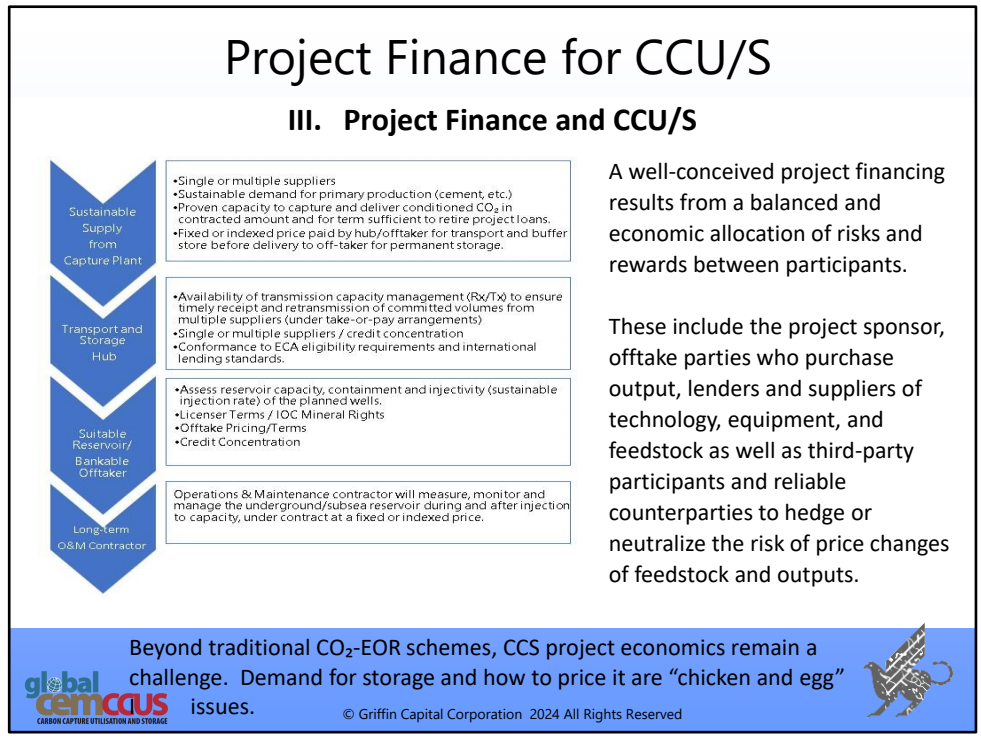


As a practical matter, this means – ideally – that the economic output of the project must yield a predictable amount of cash resulting from take-or-pay contracts.

In the case of a CCS project, such take-or-pay contracts should provide for a carbon contract for difference (CCfD). A CCfD contract entitles the beneficiary to a payment equal to the difference between a fixed "strike" price agreed by contract and a variable reference price – such as the exchange-traded EU ETS market price.

The term and value of such take-or-pay contracts are the primary source of security pledged for term loan(s). The resulting capitalization of net income provides maximum sustainable leverage under stressed scenarios and thus minimal equity at risk for the sponsor.

But beyond traditional $CO_2$-EOR schemes, CCS project economics remain a challenge. Why is this true today? [Cue Slide 16]

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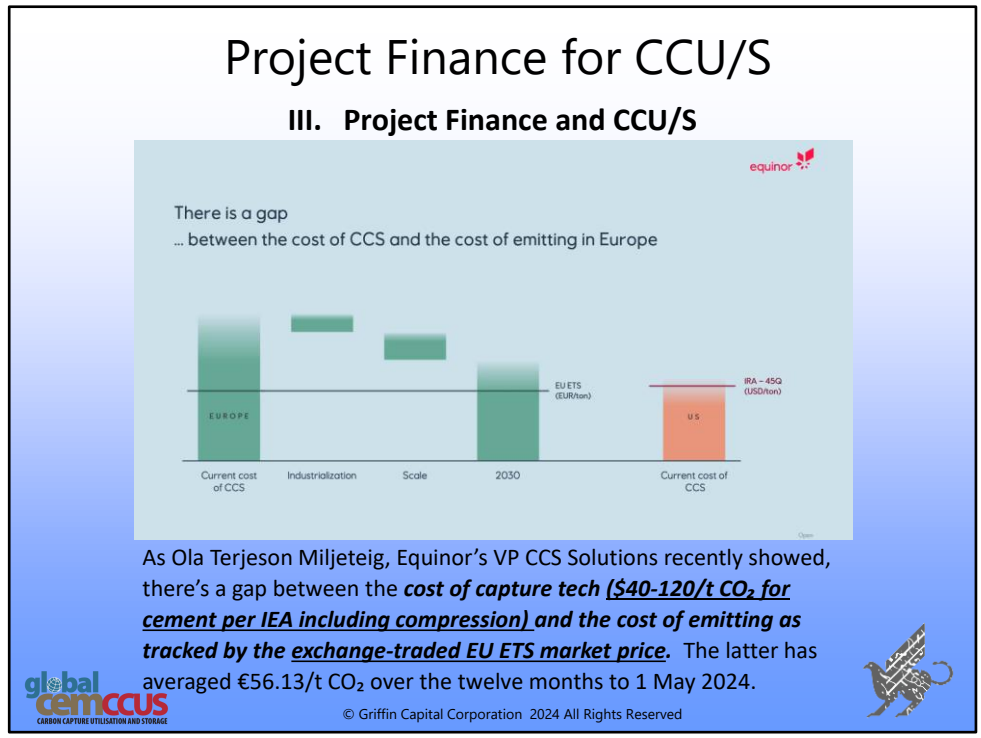


In part, that's because the levelised cost of carbon capture for cement production can vary significantly based on the concentration of CO2 in the emissions. According to the International Energy Agency (IEA), the cost ranges from **USD 40 to USD 120 per tonne** of CO2 for processes with "dilute" gas streams, such as those found in cement production. This cost includes the expense of compression, and the estimates are based on data from the United States.

These costs can fluctuate depending on technological advances, the scale of implementation, and regional factors. The IEA also highlights that carbon capture, utilization, and storage (CCUS) technologies are crucial for achieving clean energy transitions and that dismissing the technology based on cost alone would ignore its unique strengths and potential competitiveness in key sectors like cement production[2].

[CUE SLIDE #17]

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# Project Finance for CCU/S

### III. Project Finance and CCU/S

European ETS prices are subject to considerable fluctuation. While they approached €100/t $CO_2$ in Q3 2022, they were €66.45/t on 1 May 2024. *Energy Aspects* foresees a return to €100/t $CO_2$ in 2027 and €120/t in 2030.


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*Bloomberg Intelligence/BNEF*

To complicate matters further, European ETS prices are subject to considerable fluctuation. While they reached €100 per ton of $CO_2$ in Q3 2023, they fell to about €66.45/t on 1 May 2024.

The consultants *Energy Aspects* foresee a return to €100/t $CO_2$ in 2027 and €120/t in 2030. Absent an enforceable CCfD regime, such volatility undermines the commercial case for CCS and CCS project finance.

In fact, this makes the purchase of certificates to emit $CO_2$ a competitive option to CCS for finance directors of hard-to-abate industries.

[CUE SLIDE #18]

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# Project Finance for CCU/S

### III. Project Finance and CCU/S

Such volatility undermines the commercial case for CCS and CCS project finance *absent an enforceable CCfD regime*. It makes certificates to emit $CO_2$ a competitive option to CCS for Finance Directors of hard to-abate industries.


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*Bloomberg Intelligence/BNEF*

These are nontrivial concerns when sponsors approach FID on various carbon capture technologies and CCUS projects.

All of which puts a premium on the evolution and durability of policy and regulations and creative capitalization solutions.

[CUE SLIDE #19]

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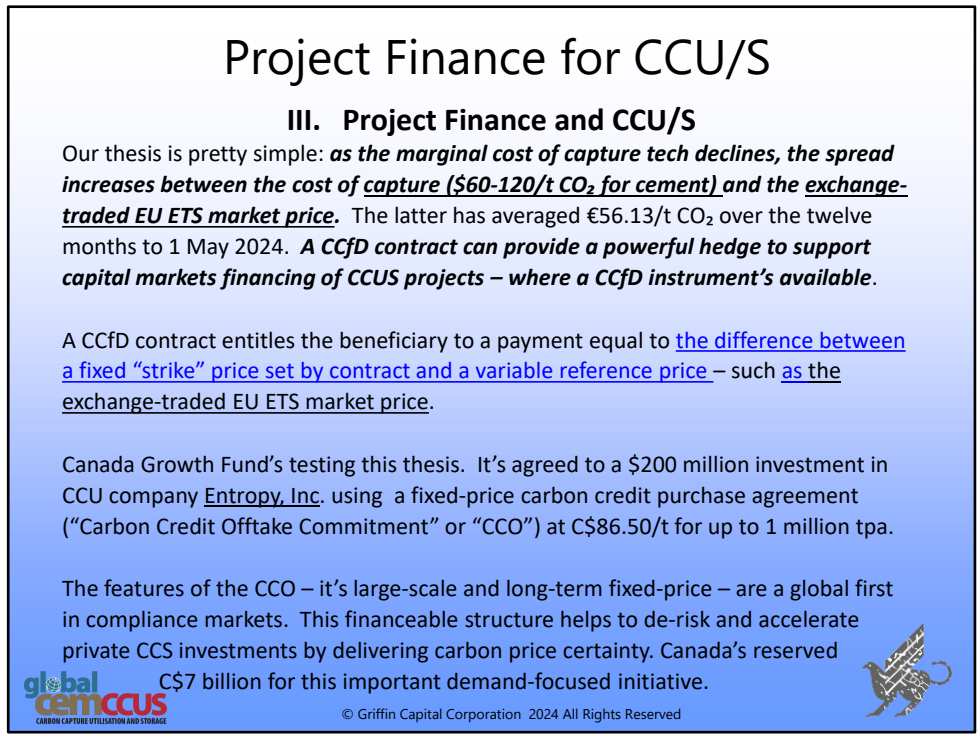


Our thesis is pretty simple: ***as the marginal cost of capture tech declines, the spread increases between the cost of capture ($60-120/t $CO_2$ for cement) and the exchange-traded EU ETS market price.*** The latter has averaged €56.13/t $CO_2$ over the twelve months to 1 May 2024.

***A CCfD contract can provide a powerful hedge to support capital markets financing of CCUS projects – where a CCfD instrument's available***.

Present, then [CUE SLIDE #20]

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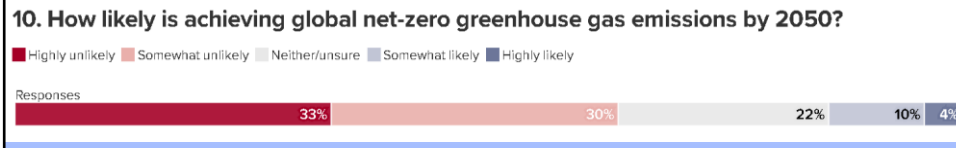
# Project Finance for CCU/S

### III. Project Finance and CCU/S

Nevertheless, in the face of this challenge, in its "Baseline Scenario 2050", *BloombergNEF* predicts there will be "almost no emissions abatement from industry" without significant technological and policy changes. A recent survey by the *Atlantic Council* concurs:




The industrial boom in India and other emerging economies with growing middle classes compounds the policy challenges. As one example, our former client JSW Group's subsidiary JSW Cement plans to invest $2.17 billion to more than triple its cement production capacity to 60 million tons per year by 2028.

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… but the challenge is significant … [CUE SLIDE #21]

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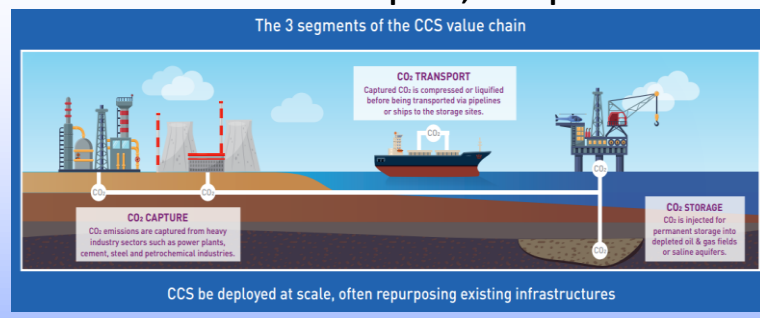
# Project Finance for CCU/S

## IV. The CCS Value Chain: Capture, Transport and Store




CCUS projects traditionally include three activities undertaken by one IOC/NOC. Today, many CCS projects are undertaken by separate entities:

- Capture and condition $CO_2$ and separate it from other gases at the source;
- Transport the liquefied $CO_2$ to a storage site, ideally of an aggregator; and finally
- Store $CO_2$ in an underground reservoir – and manage it for the life of the project or license.

global cemCCUS
CARBON CAPTURE UTILISATION AND STORAGE

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Injecting $CO_2$ into an underground oil reservoir increases its pore pressure, yielding more oil. This enhanced oil recovery technique ($CO_2$-EOR) has for decades extended the output and productive life of oilfields around the world.

Beyond fizzy drinks, $CO_2$-EOR is one of the few well-established industrial uses of $CO_2$. That's why CCUS has attracted criticism from environmental groups who see it as a way for the oil industry to prolong the use of hydrocarbons.

As a promising way to reduce and sequester GHG emissions, the CCS value chain represents multiple distinct, but linked enterprises, operating in tandem over extended geographies. The CCS value chain embodies the compound technical, operating, commercial, and legal risks embedded in each link of a CCS project.

Historically, a CCS facility was vertically integrated – a single $CO_2$ capture plant with dedicated $CO_2$ compression, pipeline, and storage systems. CCS was typically undertaken by upstream energy companies for their EOR projects. Now, CCS hubs and networks are attracting considerable interest from "net-zero" policymakers. These hubs promise to dominate CCS deployment for hard-to-abate industries. However as the IEA stated, while the shift toward a CCUS hub model provides many benefits, the resulting interdependent project structures are increasingly complex, with implications for risk, timing, coordination, and social acceptance. [CUE SLIDE #22]

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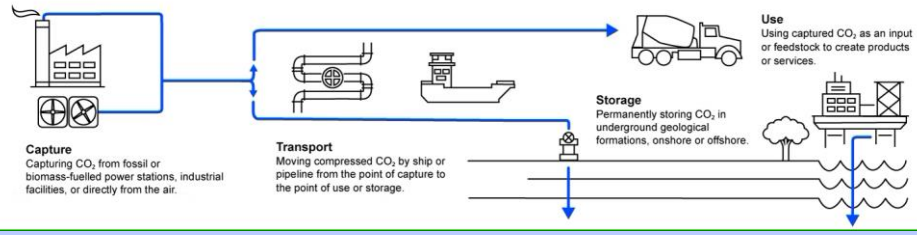
# Project Finance for CCU/S

## IV. The CCS Value Chain: Capture




**Capture:** As we've seen over the past few days, carbon capture technology can be retrofitted onto existing plants or integrated into new plants.

Deciding which approach is best requires a broad assessment of the available technology, project economics, a suitable storage site, and a favorable CCS regulatory environment. Aker's Carbon Capture was the technology of choice at Norcem Brevik.

Chosing the right capture tech's essential . But for emitters and project sponsors, that's the easy part.

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Discuss [CUE SIDE #23]

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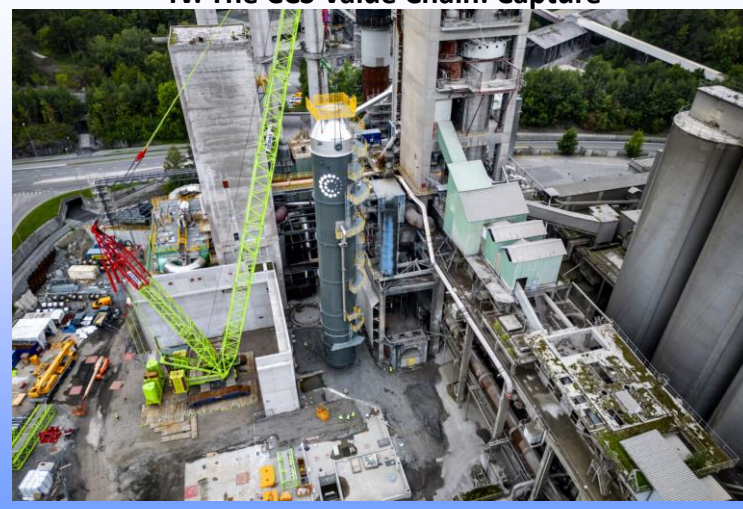
# Project Finance for CCU/S

**IV. The CCS Value Chain: Capture**



**Capture:** Aker Carbon Capture Underway at Norcem Brevik (2023)

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Highlight Aker Capture Tech … installed by Heidelberg [CUE SLIDE 24]

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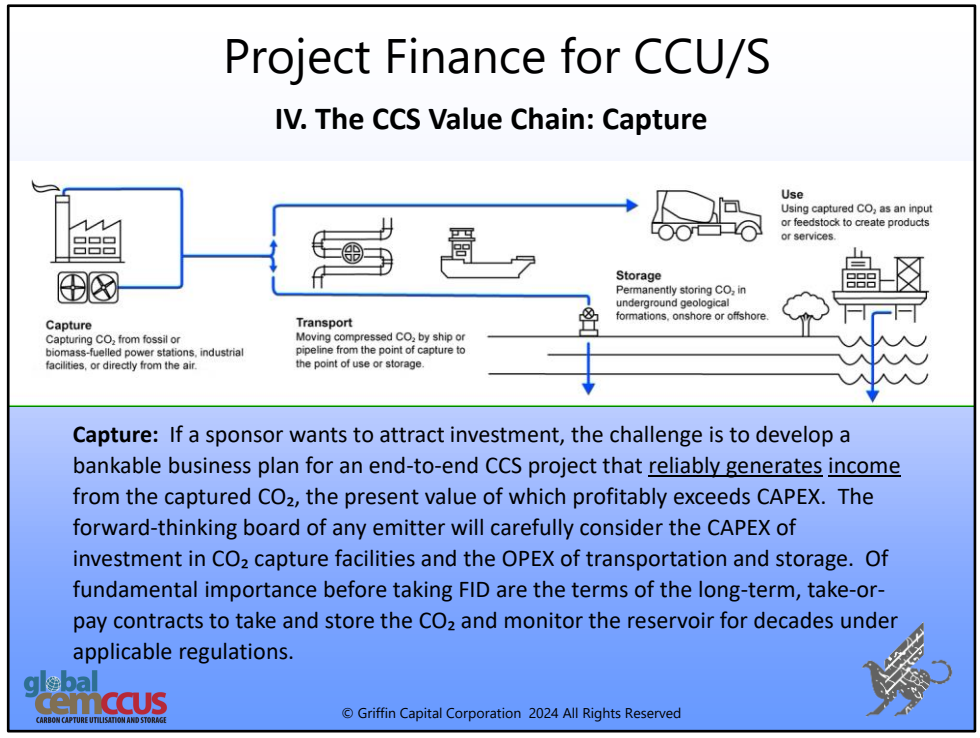


Norway's funded about $2 billion of *Longship*'s end-to-end project cost, covering about 80% of the cost of *Northern Lights'* aggregation and transport hub through various state aid agreements.
[CUE SLIDE #25]

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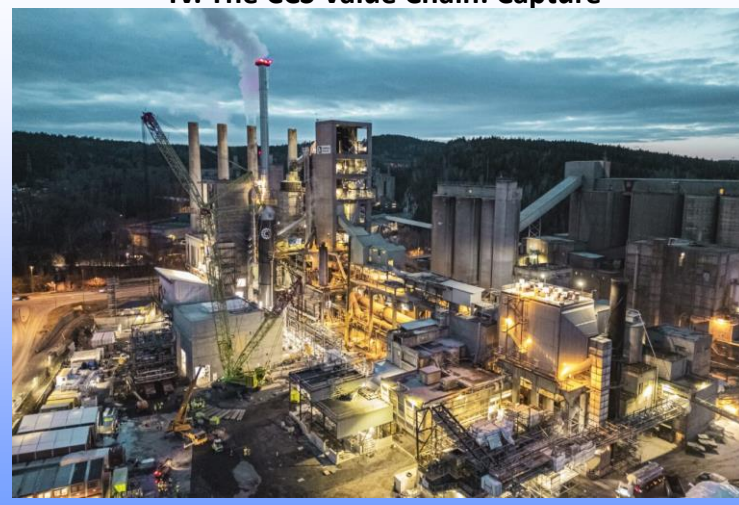
# Project Finance for CCU/S

**IV. The CCS Value Chain: Capture**



**Capture:** Aker Carbon Capture Underway at Norcem Brevik (2024)

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Highlight Aker Capture Tech … installed by Heidelberg [CUE SLIDE 26]

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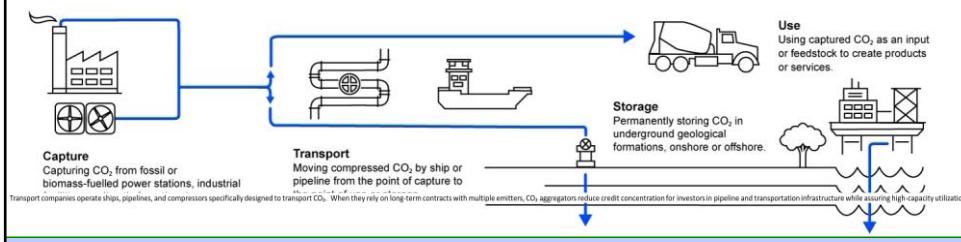
# Project Finance for CCU/S

## IV. The CCS Value Chain: Transport




**Transport:** Norway's funded $2 billion of Longship's end-to-end project cost, covering about 80% of the costs of Northern Lights' aggregation and transport hub through various state aid agreements.

As the operator, *Northern Lights* will be liable for funding 30 years of storage Monitoring, Measurement, and Verification (MMV) costs. That cost must be funded upfront.

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Norway's funded about $2 billion of *Longship*'s end-to-end project cost, covering about 80% of the cost of *Northern Lights'* aggregation and transport hub through various state aid agreements.
[CUE SLIDE #27]

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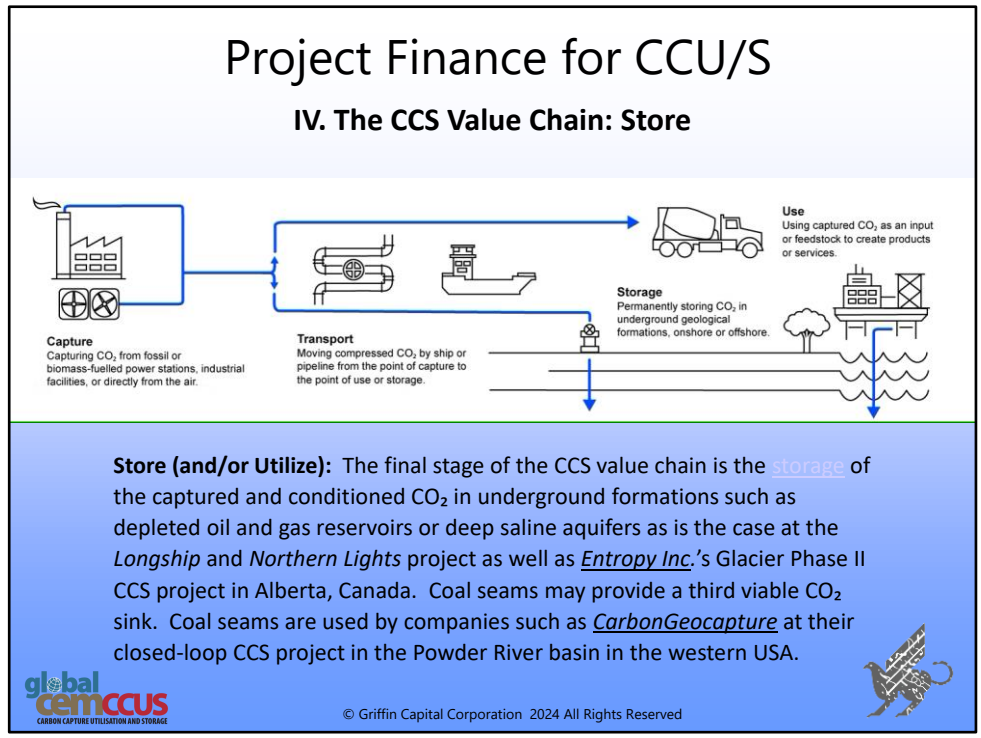


Sponsored in equal parts by Equinor, Shell, and TotalEnergies, *Northern Lights* is a project within a project. It's an aggregator with the world's first open-source $CO_2$ transport and storage infrastructure, initially serving three emitters. It will store about 0.8 Mtpa of $CO_2$ from Brevik and a municipal waste-to-energy plant (Hafslund Oslo Celsio) in its first phase.

From early 2025, and as the world's first cross-border CCS value chain, another 0.8 Mtpa of $CO_2$ will arrive at the *Northern Lights* terminal from Yara Sluiskil, an ammonia and fertilizer plant in the Netherlands.

Following the completion of the $CO_2$ injection to reservoir capacity, the storage license will be transferred to the state government no less than 20 years later. As the operator, *Northern Lights* will be liable for funding 30 years of storage Monitoring, Measurement, and Verification (MMV) costs. That cost must be funded upfront. [CUE SLIDE #28]

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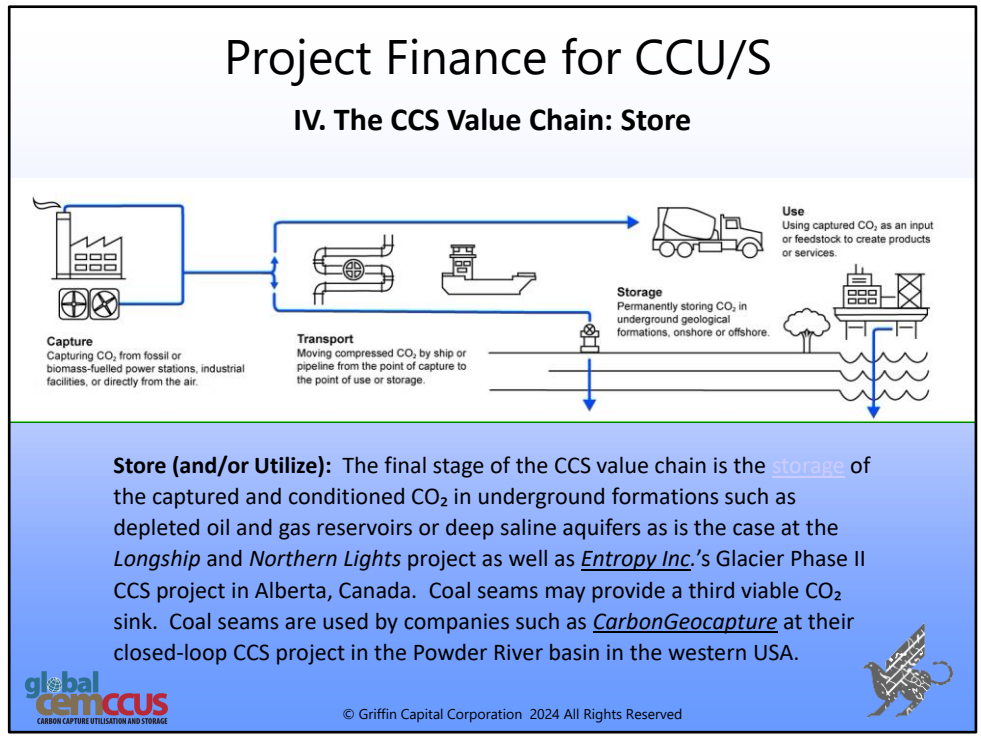


The geo-mechanics of any potential storage site must be carefully assessed by a project sponsor as a first matter. That reservoir assessment should include long-term plume migration modeling, characterization of the storage complex, and a conceptual development plan with performance modeling.

Companies such as Baker Hughes, Halliburton and Schlumberger have decades of experience preparing such assessments for CCUS projects including Energean's Prinos CCS project in the Mediterranean.

Furthermore, Schlumberger recently announced a deal to acquire 80% in Aker Carbon Capture Holdings. That deal will accelerate the application of CCUS capture technology to hard-to-abate industries. [CUE SLIDE #29]

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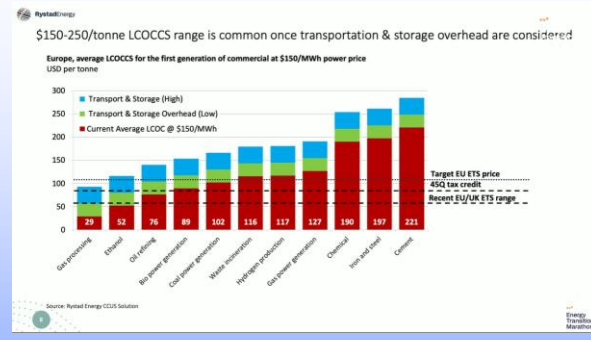
# Project Finance for CCU/S

## IV. The CCS Value Chain: Levelized Cost of CCUS




Depending on the operating scenario, 53 to 80% of the aggregated LCOCCUS can be attributed to the energy-intensive step of capturing the $CO_2$ (assuming an electricity cost of €73/MWh). ***The capture stage is where significant cost reductions, efficiency gains, and technological innovation can be realized, hence SLB's acquisition of Aker Carbon Capture***. After capturing and conditioning, only 10 to 23% of the cost is attributable to transport and 10 to 25% to the cost of storage.

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Realising a successful value chain depends on the ability of these business entities to collectively conclude long-term contracts that provide a fair and economic balance of risks and rewards along the entire value chain. An end-to-end CCS project necessarily creates a chain of long-term payment obligations between emitters, aggregators, transporters, and storage operators. The sufficiency and reliability of each party's payment obligation is the foundation of a successful project finance scheme.

*Rystad Energy* has estimated the aggregated levelized cost of CCS value chains in various scenarios. The levelized cost ranges from €130-€230/t $CO_2$ depending on the characteristics of the emitter and includes allocations of transportation and storage cost as well as other variables.

Depending on the operating scenario, 53-80% of the aggregated cost can be attributed to the energy-intensive step of capturing the $CO_2$ (assuming an electricity cost of €73/MWh***). The capture stage is where significant cost reductions, efficiency gains, and technological innovation can be realized***. After capturing and conditioning, only 10-23% of the cost is attributable to transport and 10-25% to the cost of storage. [CUE SLIDE #30]

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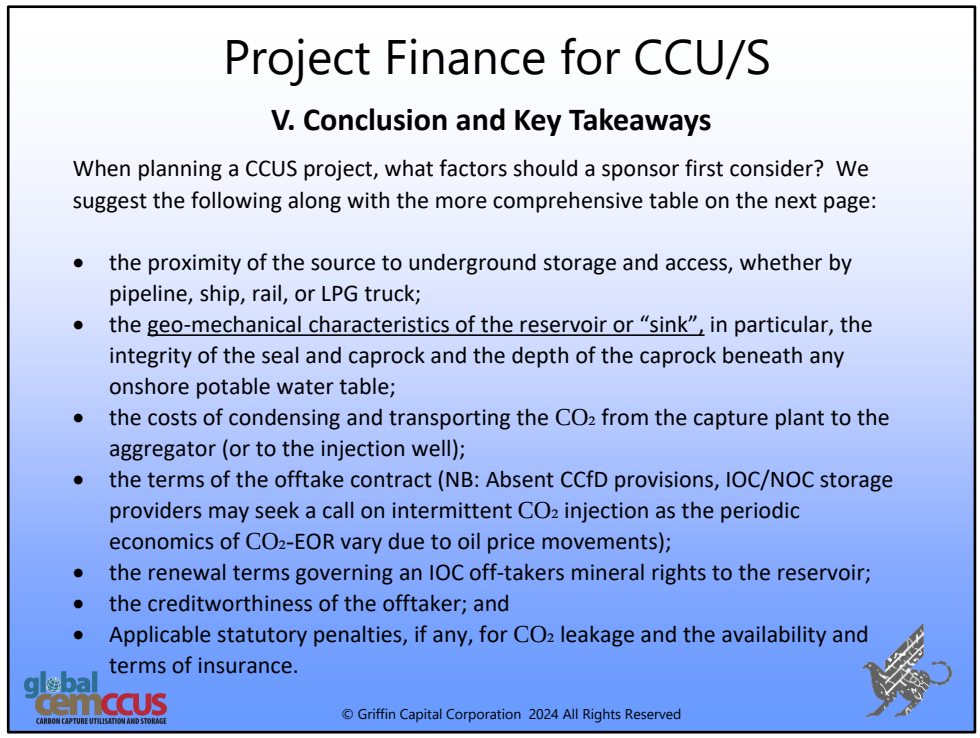


About half of CCS facilities in operation or under construction worldwide, either in number or in $CO_2$ capacity, use geological storage in which the buyers of the delivered $CO_2$ use it for $CO_2$-EOR (Enhanced Oil Recovery) (Global CCS Institute: Facilities List 2023). In China, this is the case for virtually all CCS facilities.

Financing CCS projects other than $CO_2$-EOR remains problematic due to a lack of enforceable long-term off-take agreements. This will require statutory policy commitments expressed through clear regulations as contemplated at COP28 (Dubai) in which Article 6 provided countries a mechanism to comply with their targets. And it will take some time. After all, the EU ETS and carbon credit markets, like Bitcoin, are rule-based systems designed to attribute value to something that previously had no value. And as the *Financial Times*'s Jemima Kelly wrote last month: "… it is precisely because crypto has no intrinsic value that its price can climb – and drop – so precipitously".

Policymakers and legislators have the wheel if their governments want to do more than talk about their climate commitments at COP29 (Baku).

[CUE SLIDE #31]

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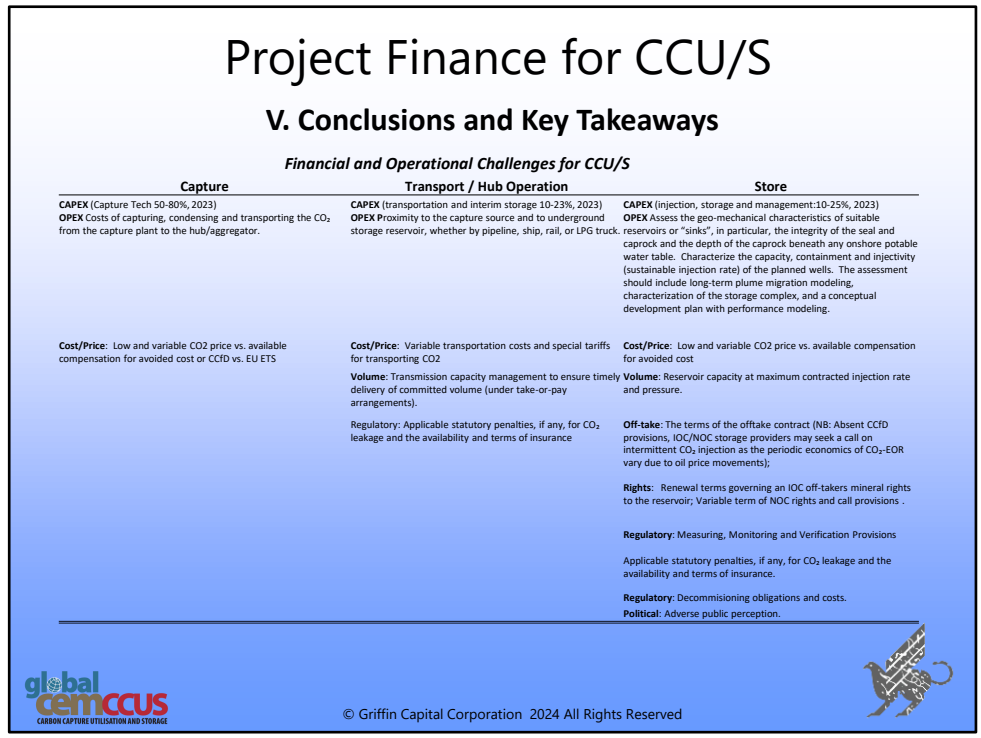


Cross-chain risk is a challenge. That makes collaboration key. Locating transport and storage infrastructure (a regulated business) near industrial clusters minimizes stranded asset risk and maximizes economies of scale. This table addresses some of these considerations across the CCU/S value chain.
[CUE SLIDE #32]

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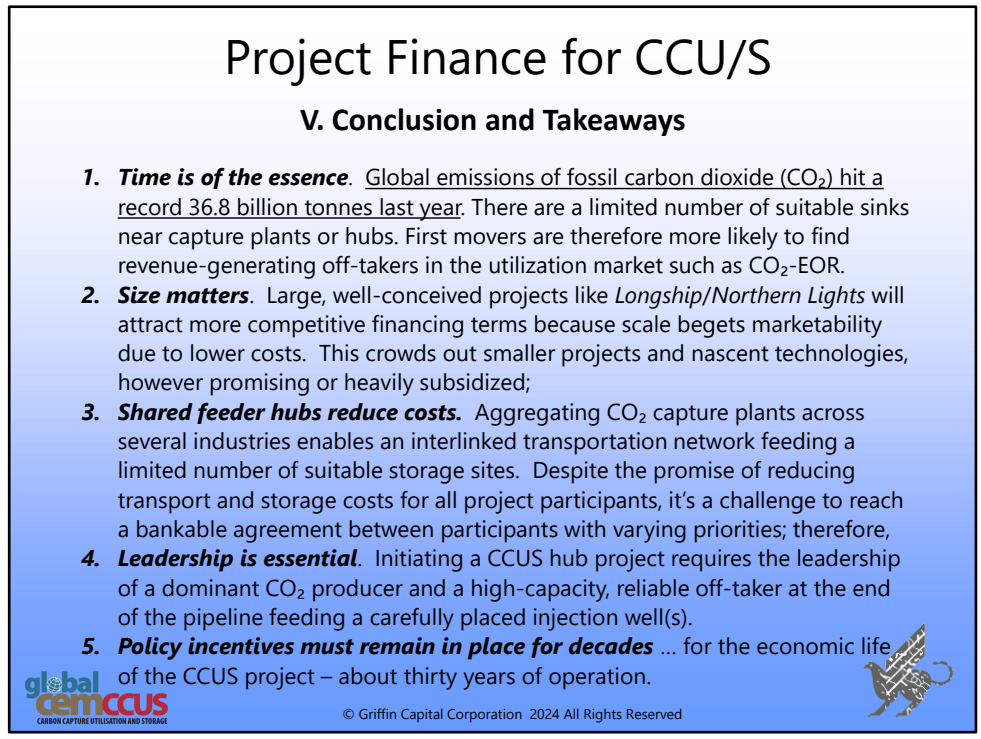


In conclusion, here are five takeaways:

1. Time is of the essence;
2. Size matters;
3. Shared feeder hubs reduce costs;
4. Leadership is essential; and
5. Policy incentives must remain in place for decades.

[CUE SLIDE #33 … AND ADJOURN]

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# Project Finance for CCU/S

**V. Conclusion and Takeaways**

***Bespoke solutions are essential as every capture plant and geological storage site is unique. Balancing the interests of $CO_2$ capture plant owners, hub operators, transportation providers, storage off-takers and lenders is essential to realizing a successful long-term sustainable CCU/S project.***

Learn more about our project finance experience in the cement and energy sectors at World Finance Review Sept_2014.indd (griffincap.com)

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Q&A (10'), ADJOURN

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