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CARBON CAPTURE UTILISATION AND STORAGE

Project Finance for CCU/S

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Project Finance for CCU/S

... for sole- and multi-source generators of CO_2

I. Introduction: Three Things to Know
II. The CCUS Imperative
III. Project Finance and CCUS
IV. The CCUS Value Chain: Capture, Transport and Store
V. Conclusion and Key Takeaways

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I. Introduction: Three Things to Know

Northern Lights CO_2 Receiving Terminal

- Project finance is a risk management tool that enables participants to share benefits and risks. Project finance is straightforward when an IOC/NOC undertakes a vertically integrated CCUS EOR project.

- *Long-term revenue certainty is essential. A bankable off-take agreement is the key to attracting merchant developers, particularly for non-EOR projects.*

- It's more challenging when mapped across the disaggregated CCS Value Chain: Capture, Transport, and Store, each a project in its own right. But with few exceptions, there's a lack of suitable regulation beyond EOR. Regulations to promote demand are critical.

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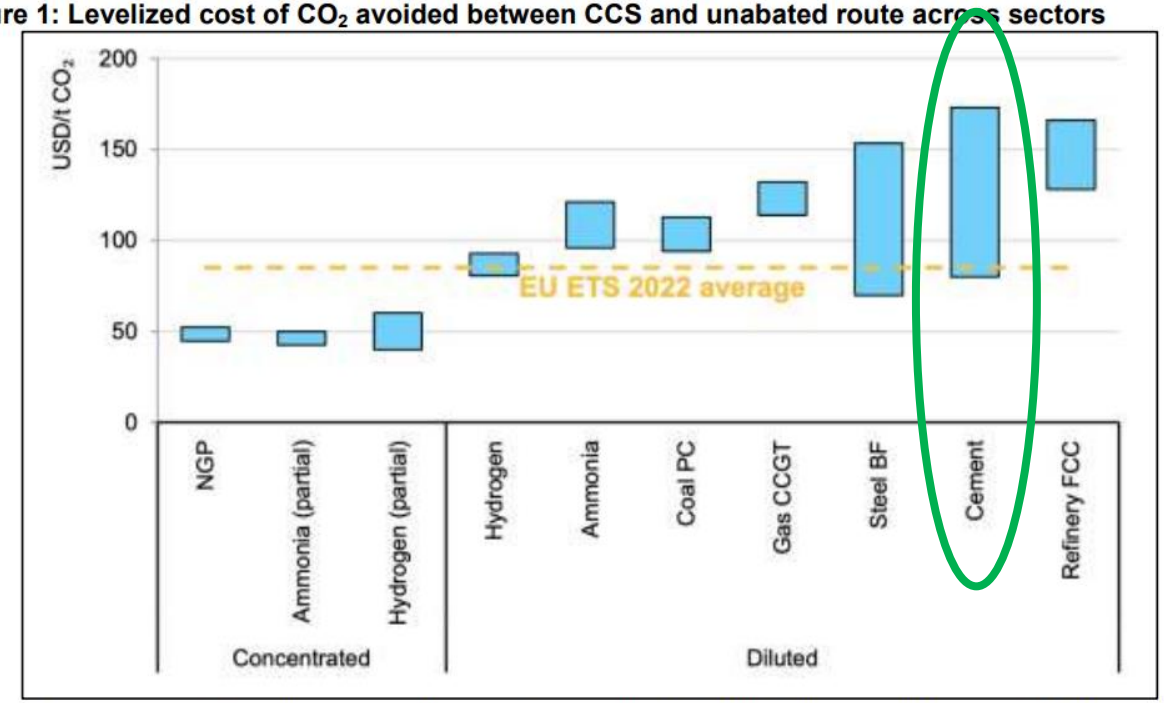
II. The CCUS Imperative

"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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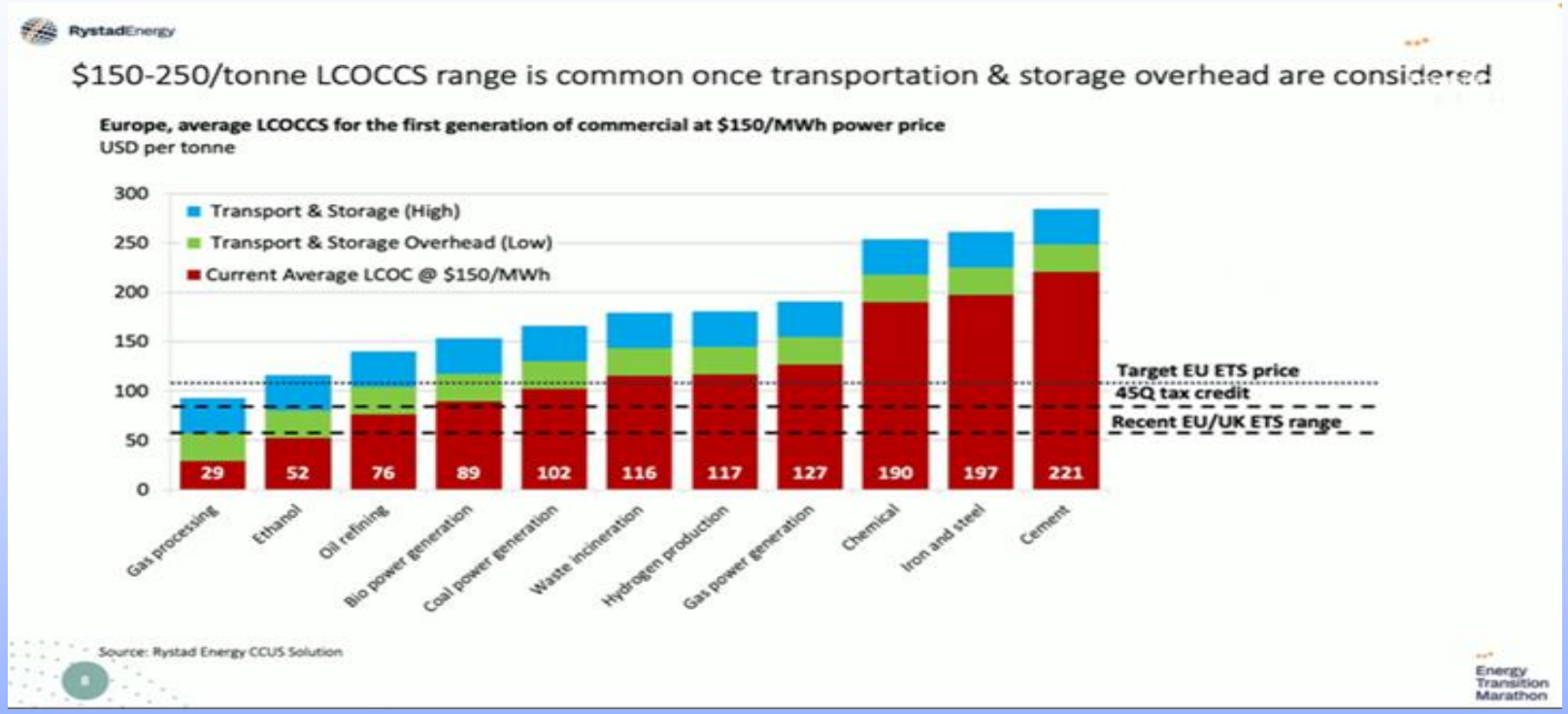
II. The CCUS Imperative



"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

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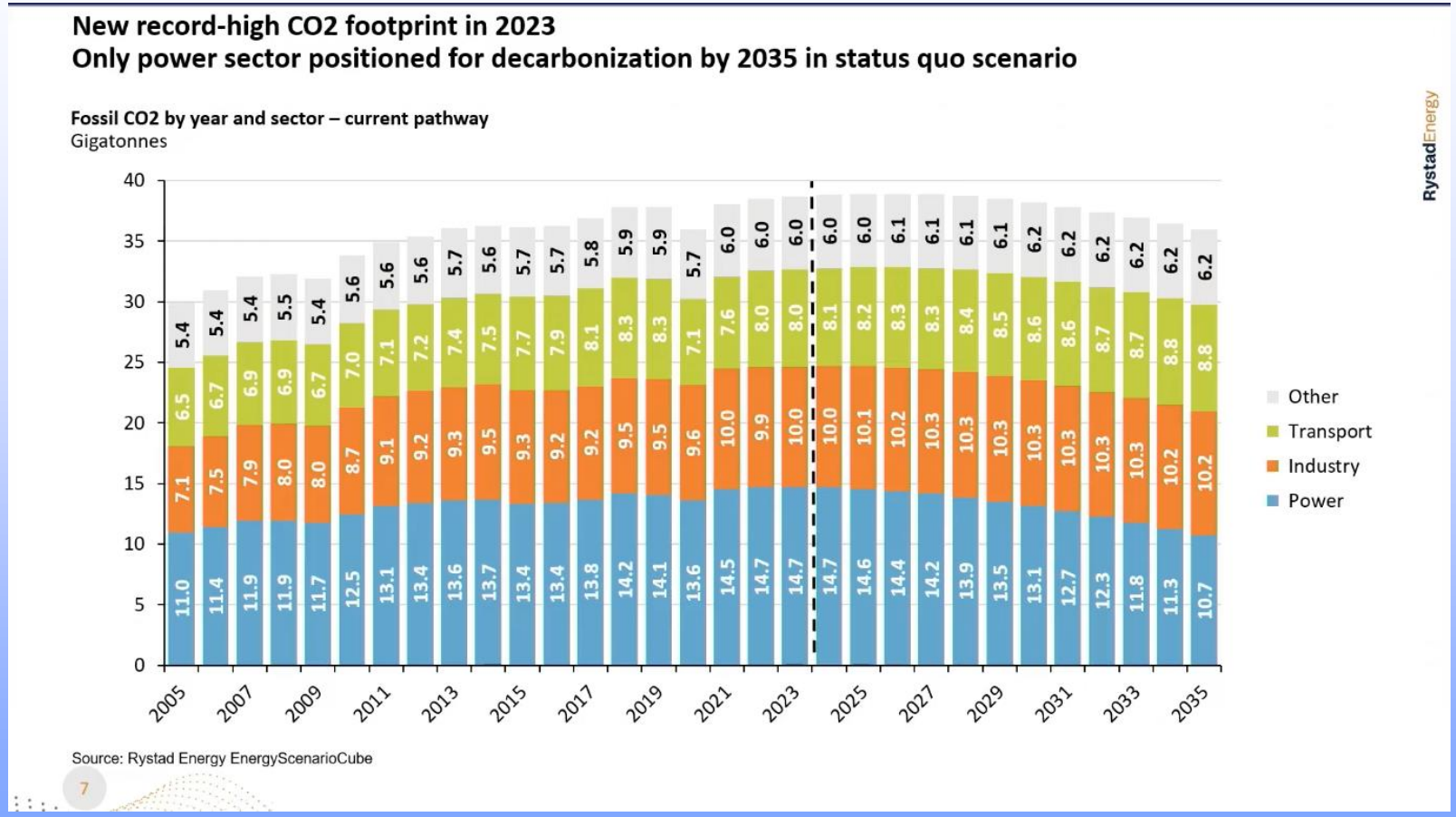
II. The CCUS Imperative



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

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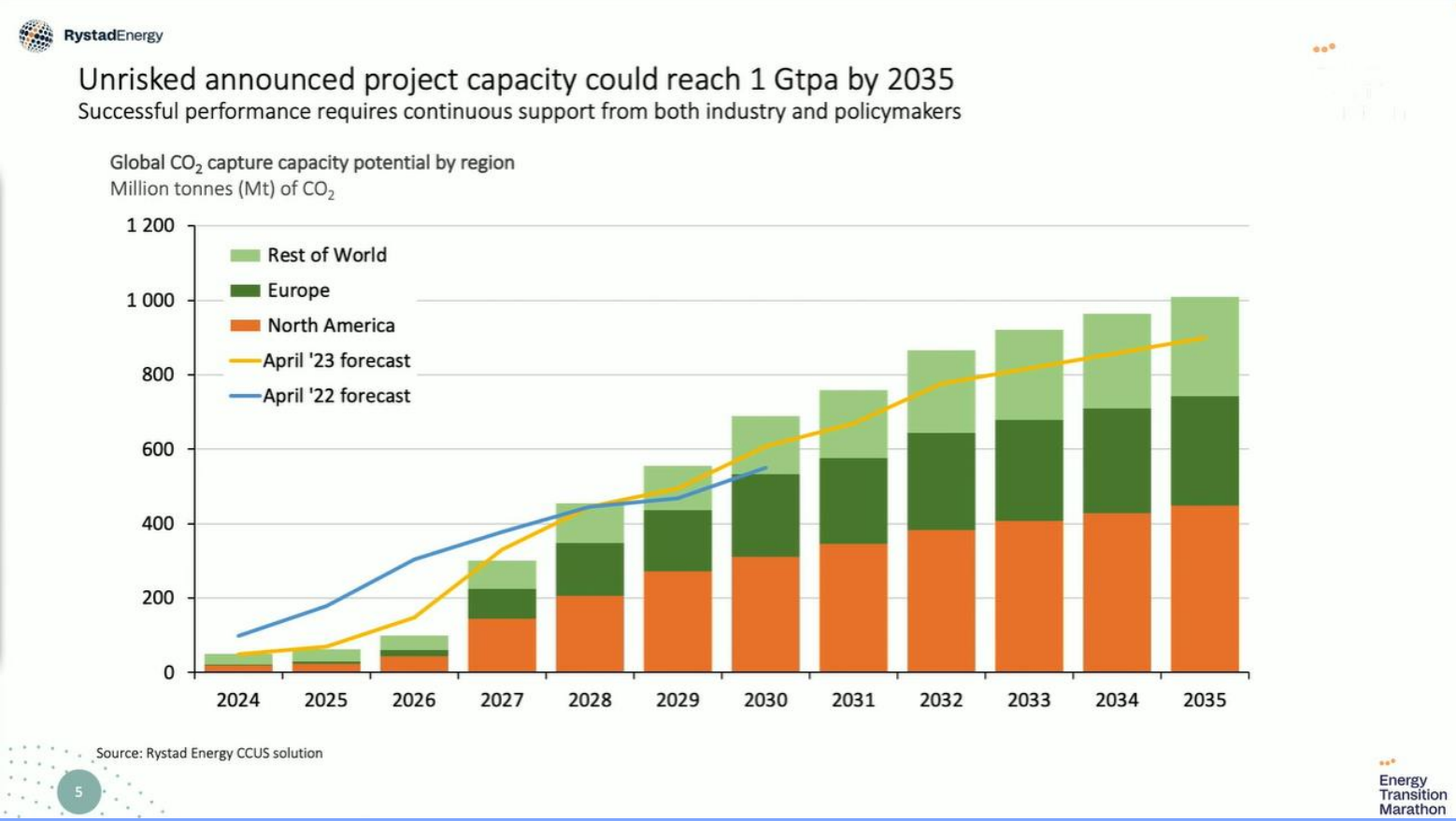
II. The CCUS Imperative



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

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II. The CCUS Imperative

The "Game of Chicken" was popularized in the 1955 film *Rebel Without a Cause*).
The one who first brakes or swerves is deemed to be 'the chicken'.

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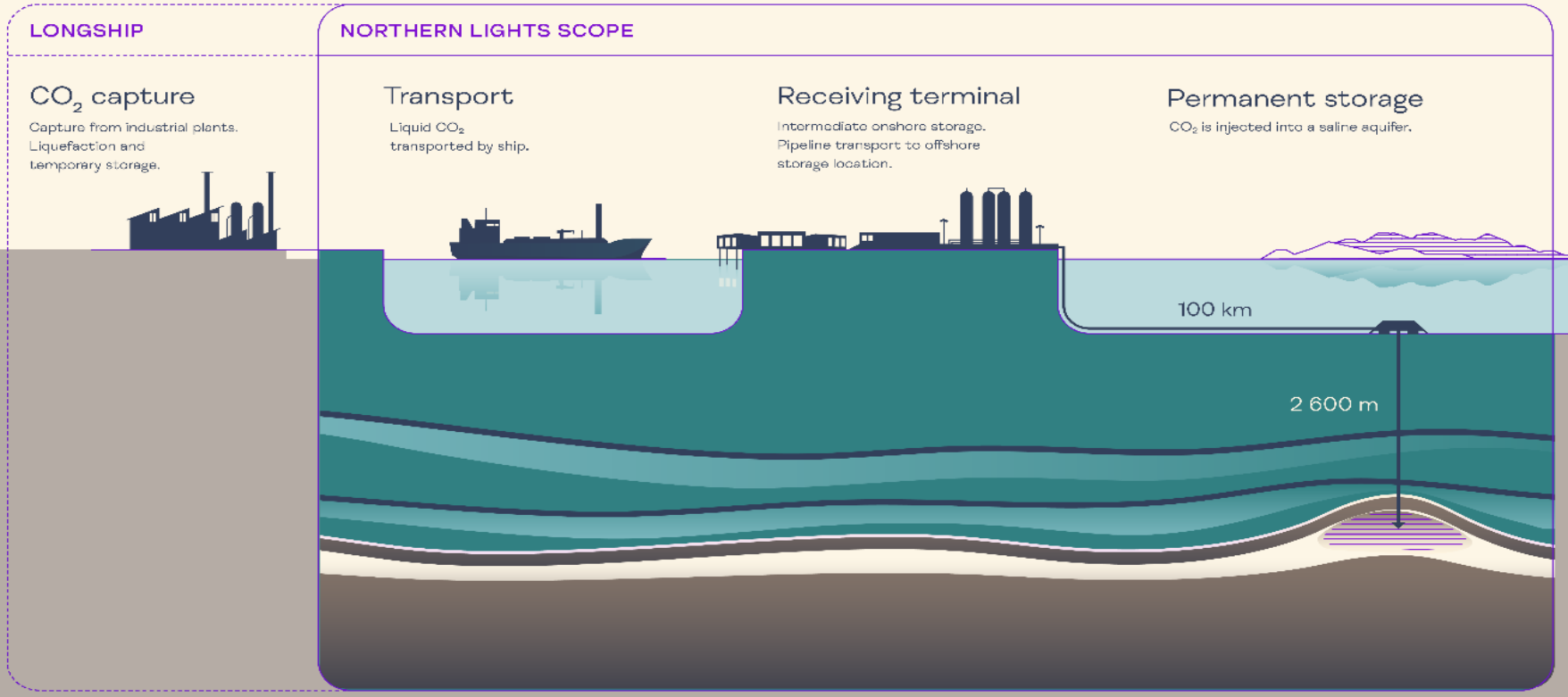
II. The CCUS Imperative



Norway is showing the world how to address these interwoven challenges through its thoughtful leadership of the *Longship* project.

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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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II. The CCUS Imperative

Longship'/Northern Lights is the world's first cross-border CO2 transport and storage facility, open to third parties. (Illustration by Gassnova)

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II. The CCUS Imperative

Longship'/Northern Lights is the world's first cross-border CO2 transport and storage facility, open to third parties. (Illustration by Equinor)

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II. The CCUS Imperative

Northern Lights CO_2 Receiving Terminal

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 might policy stimulate demand? How can project sponsors minimize their balance sheet or agency budget exposure when developing CCS projects?

Finally, how can project finance help ensure CCS projects are bankable so sponsors can farm out capacity and reduce equity?

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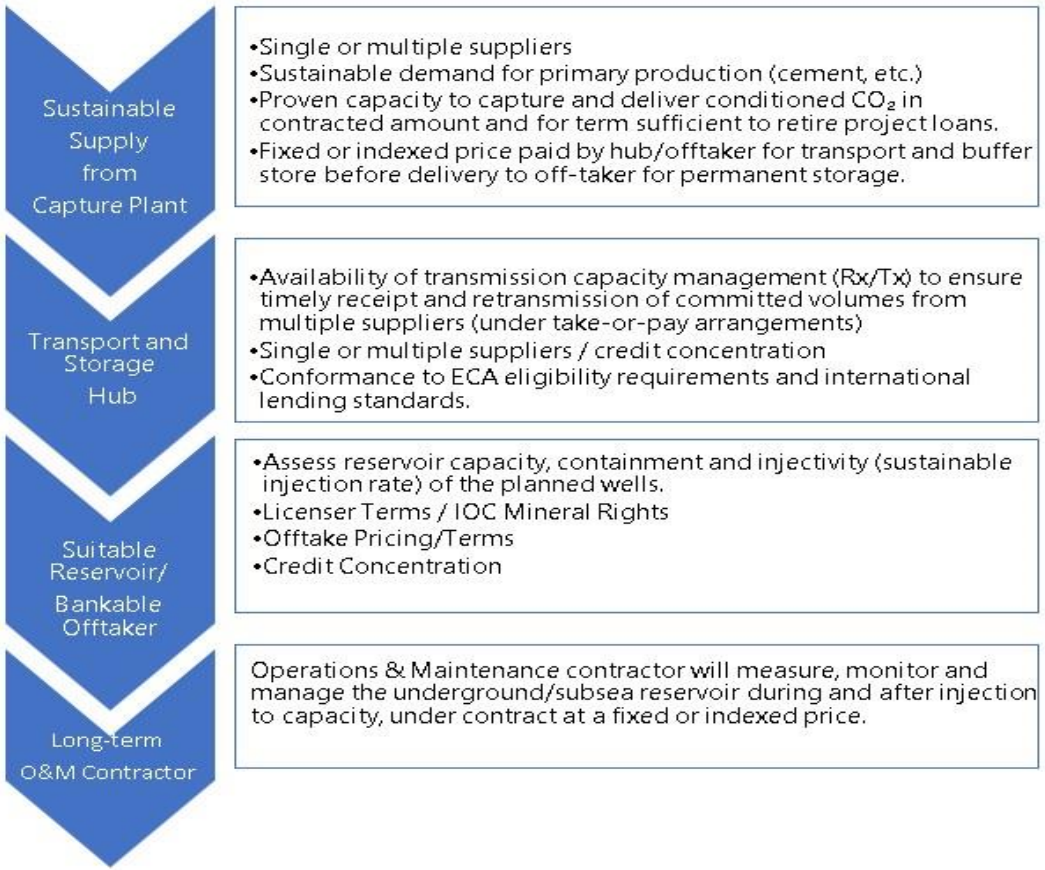
III. Project Finance and CCU/S



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.

Beyond traditional CO_2-EOR schemes, CCS project economics remain a challenge. Demand for storage and how to price it are “chicken and egg” issues.

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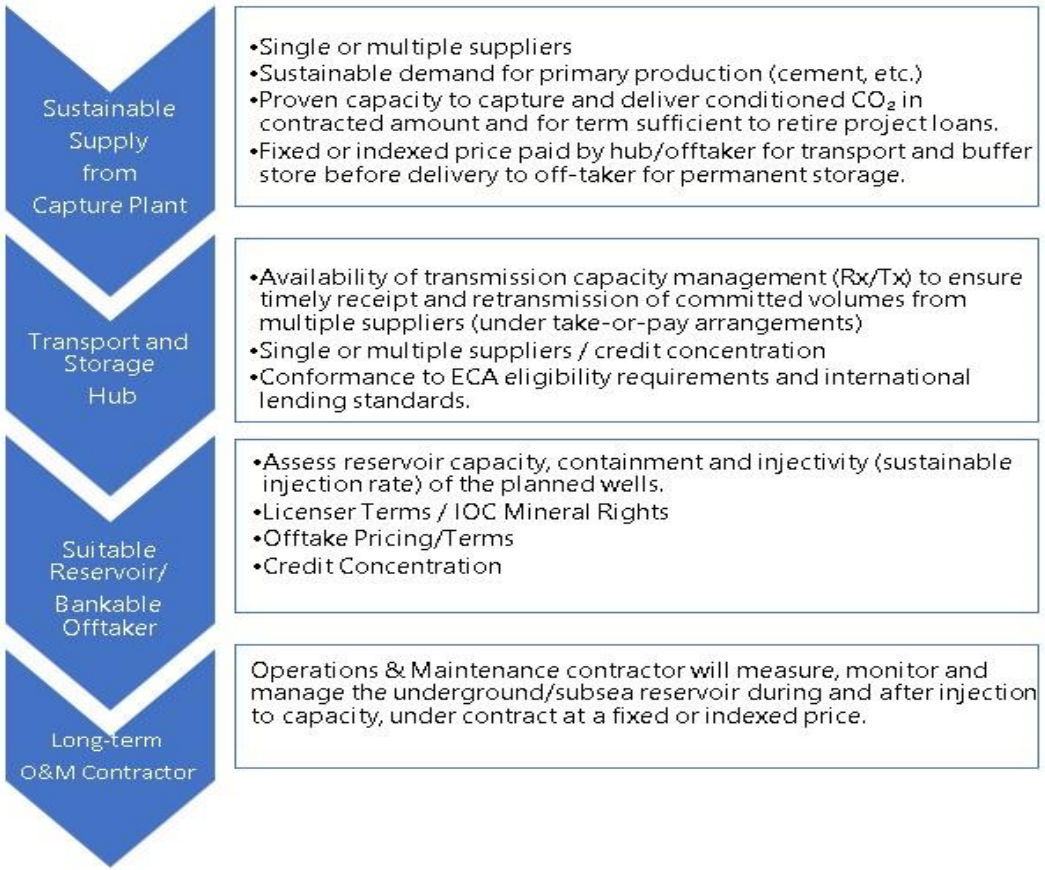
III. Project Finance and CCU/S



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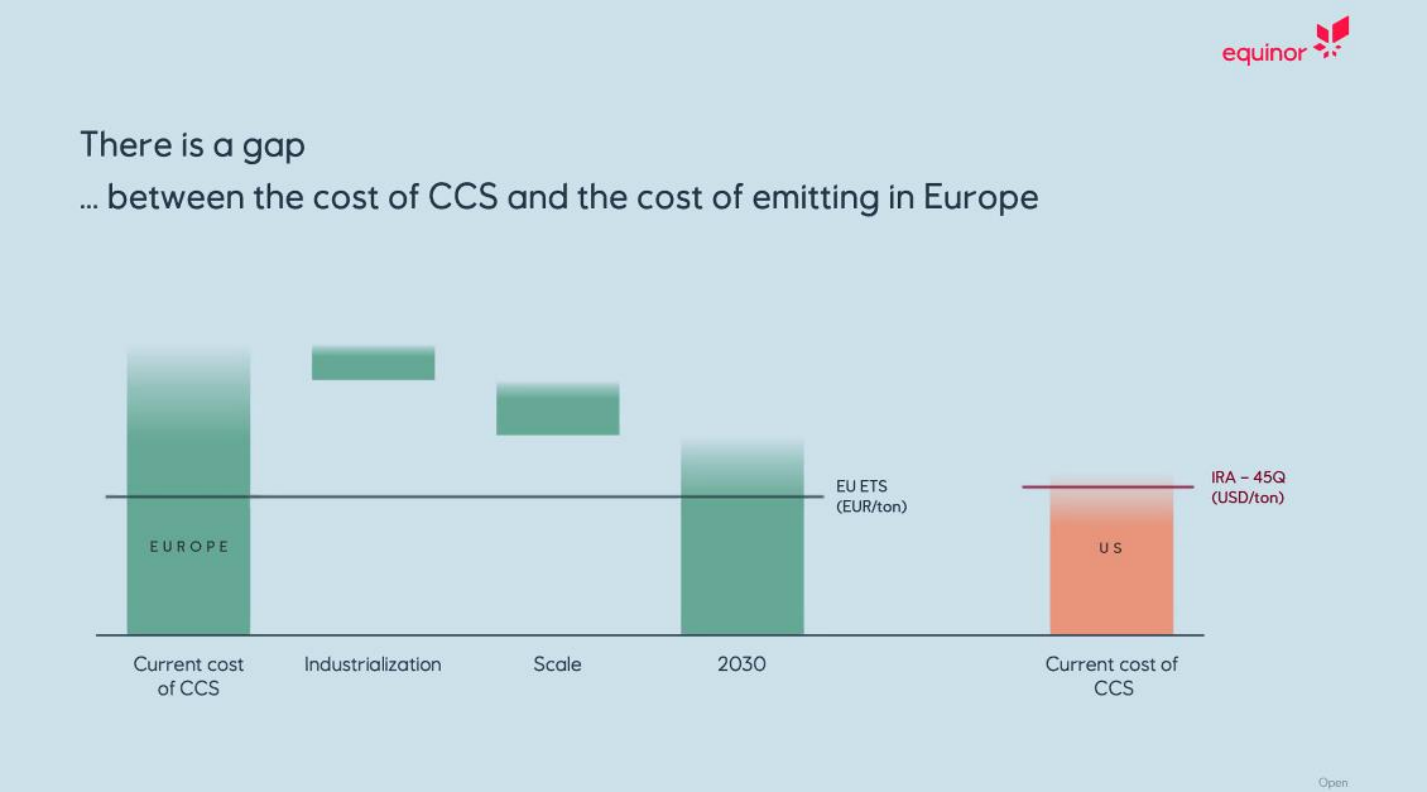

As Ola Terjeson Miljeteig, Equinor's VP CCS Solutions recently showed, there's a gap between the ***cost of capture tech (<u>$40-120/t CO_2 for cement per IEA including compression)</u> and the cost of emitting as tracked by the <u>exchange-traded EU ETS market price</u>.*** The latter has averaged €56.13/t CO_2 over the twelve months to 1 May 2024.

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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.

Bloomberg Intelligence/BNEF

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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.

Bloomberg Intelligence/BNEF

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III. Project Finance and CCU/S

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***.

A CCfD contract entitles the beneficiary to a payment equal to the difference between a fixed "strike" price set by contract and a variable reference price – such as the exchange-traded EU ETS market price.

Canada Growth Fund's testing this thesis. It's agreed to a $200 million investment in CCU company Entropy, Inc. using a fixed-price carbon credit purchase agreement ("Carbon Credit Offtake Commitment" or "CCO") at C$86.50/t for up to 1 million tpa.

The features of the CCO – it's large-scale and long-term fixed-price – are a global first in compliance markets. This financeable structure helps to de-risk and accelerate private CCS investments by delivering carbon price certainty. Canada's reserved C$7 billion for this important demand-focused initiative.

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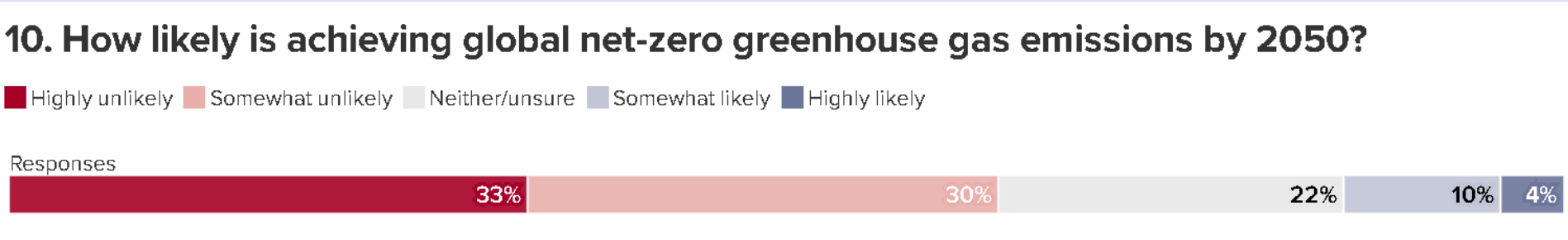
III. Project Finance and CCU/S

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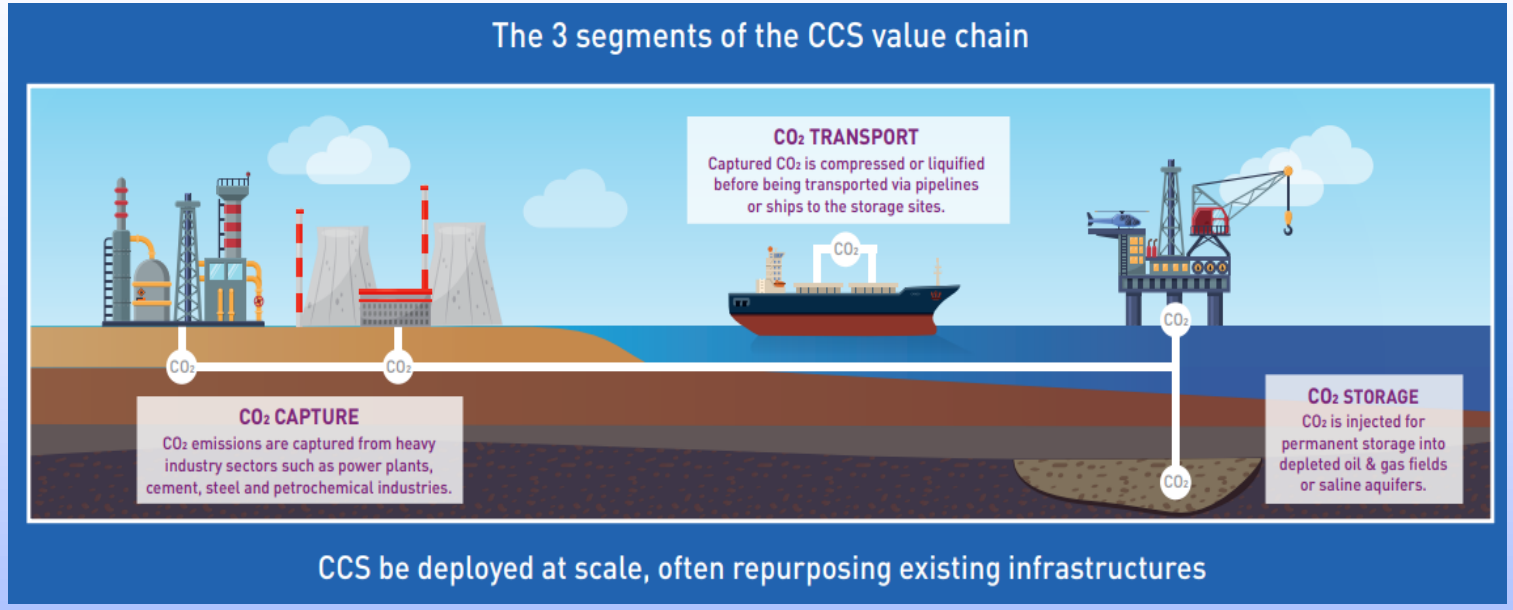
IV. The CCS Value Chain: Capture, Transport and Store



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.

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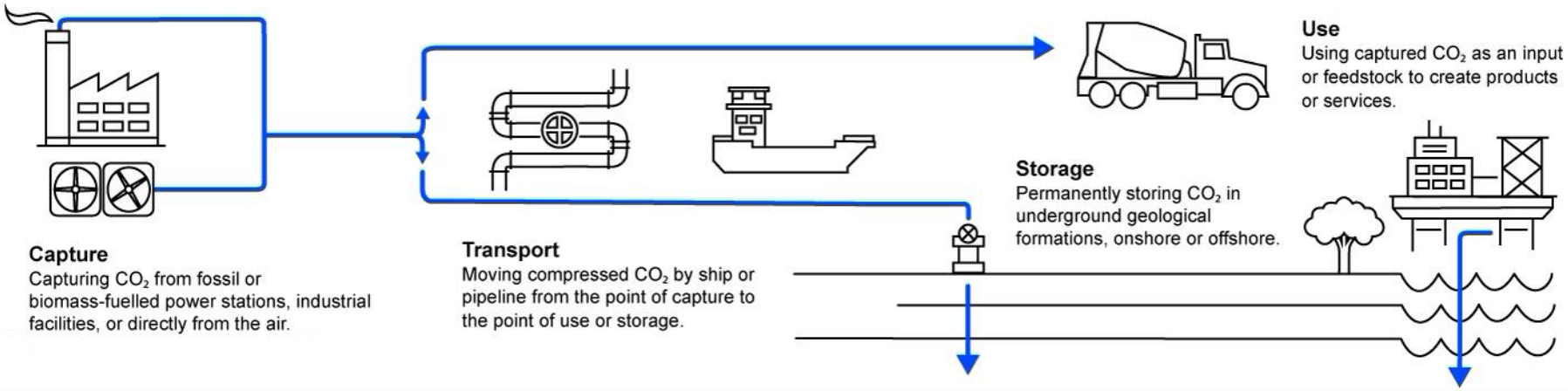
IV. The CCS Value Chain: Capture



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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IV. The CCS Value Chain: Capture

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

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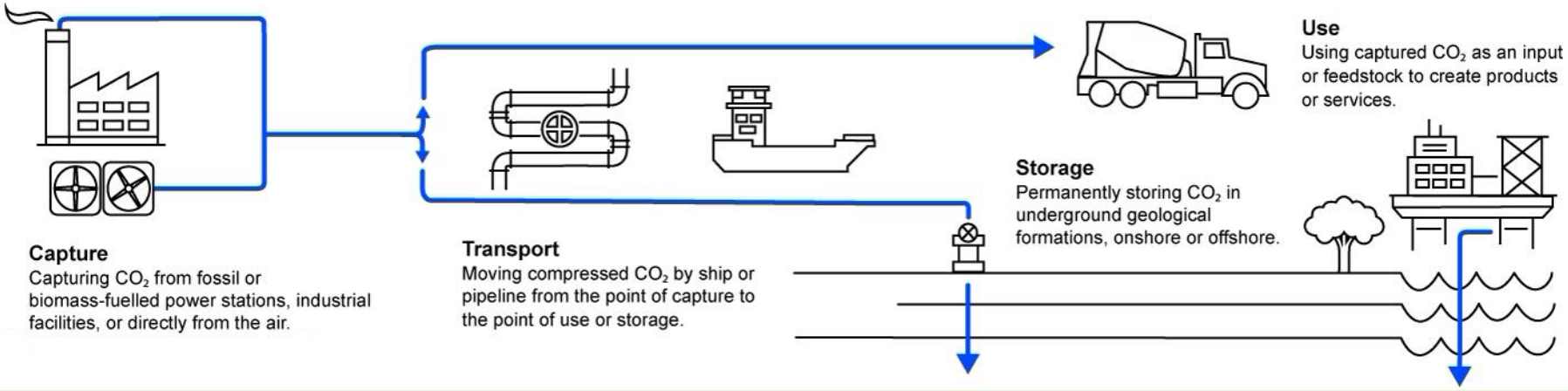
IV. The CCS Value Chain: Capture



Capture: If a sponsor wants to attract investment, the challenge is to develop a bankable business plan for an end-to-end CCS project that reliably generates income from the captured CO_2, the present value of which profitably exceeds CAPEX. The forward-thinking board of any emitter will carefully consider the CAPEX of investment in CO_2 capture facilities and the OPEX of transportation and storage. Of fundamental importance before taking FID are the terms of the long-term, take-or-pay contracts to take and store the CO_2 and monitor the reservoir for decades under applicable regulations.

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IV. The CCS Value Chain: Capture

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

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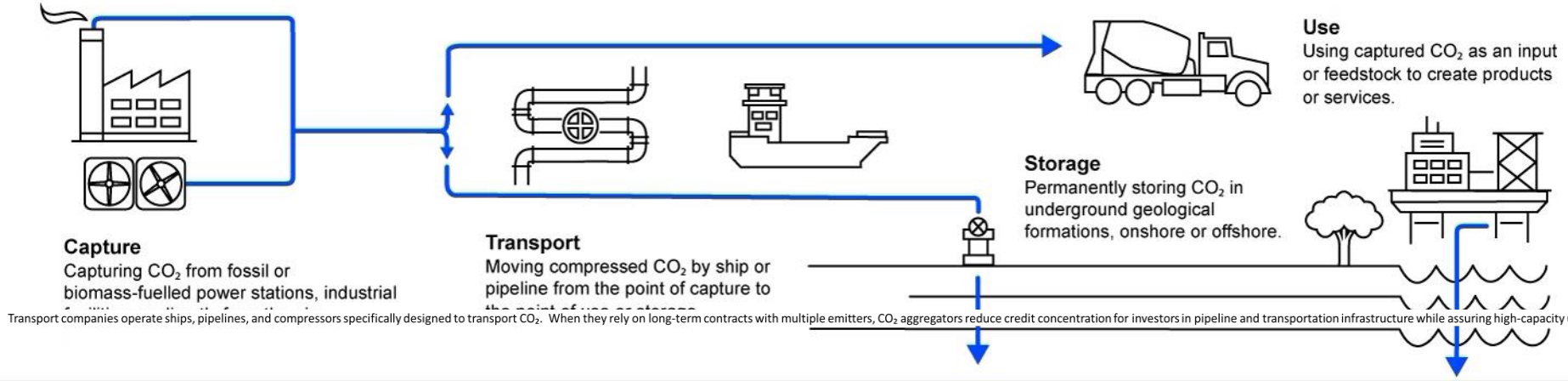
IV. The CCS Value Chain: Transport



Transport companies operate ships, pipelines, and compressors specifically designed to transport CO_2. When they rely on long-term contracts with multiple emitters, CO_2 aggregators reduce credit concentration for investors in pipeline and transportation infrastructure while assuring high-capacity utilization.

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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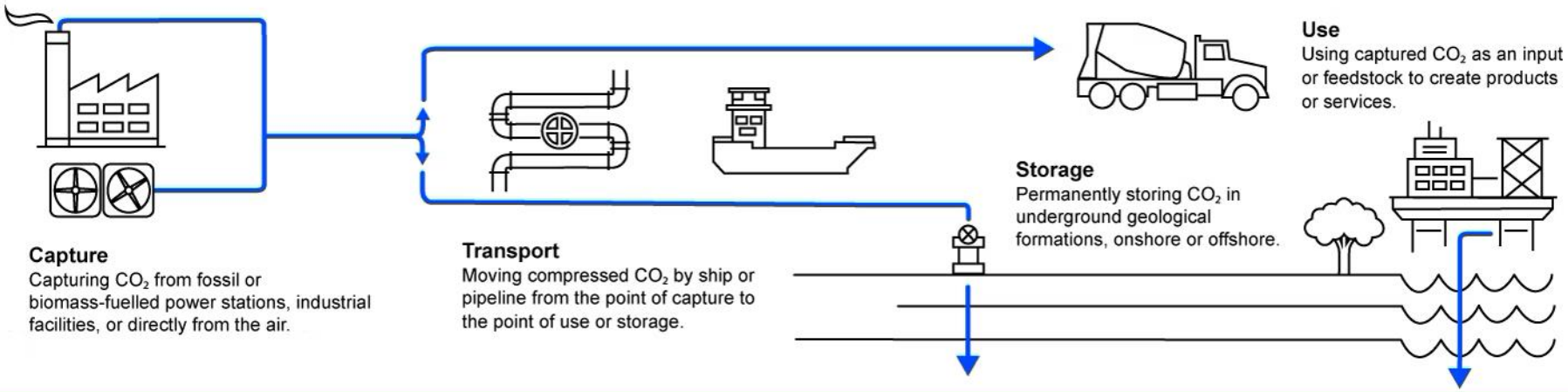
IV. The CCS Value Chain: Store



Store (and/or Utilize): The final stage of the CCS value chain is the storage of the captured and conditioned CO_2 in underground formations such as depleted oil and gas reservoirs or deep saline aquifers as is the case at the *Longship* and *Northern Lights* project as well as *Entropy Inc.*'s Glacier Phase II CCS project in Alberta, Canada. Coal seams may provide a third viable CO_2 sink. Coal seams are used by companies such as *CarbonGeocapture* at their closed-loop CCS project in the Powder River basin in the western USA.

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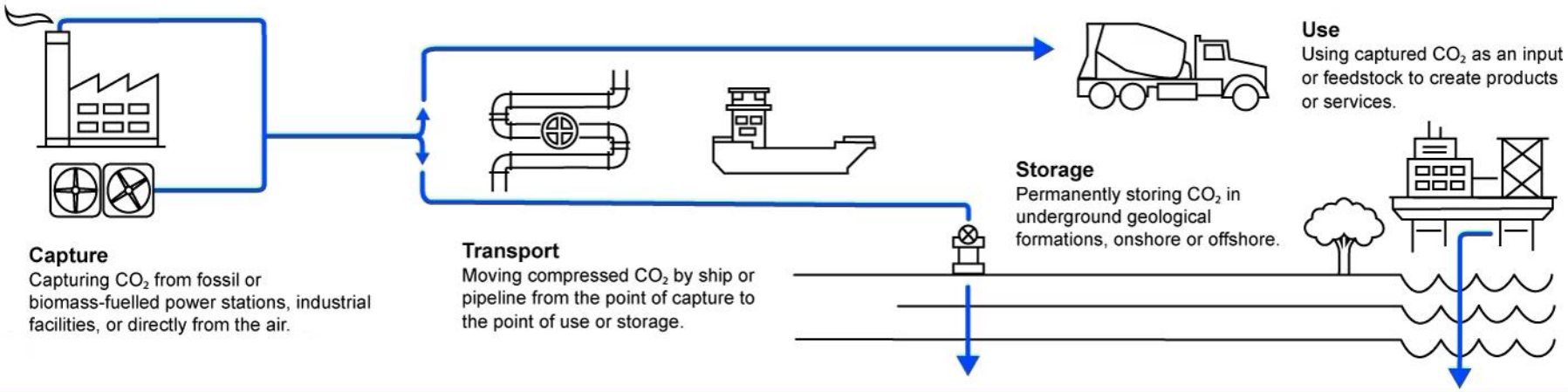
IV. The CCS Value Chain: Store



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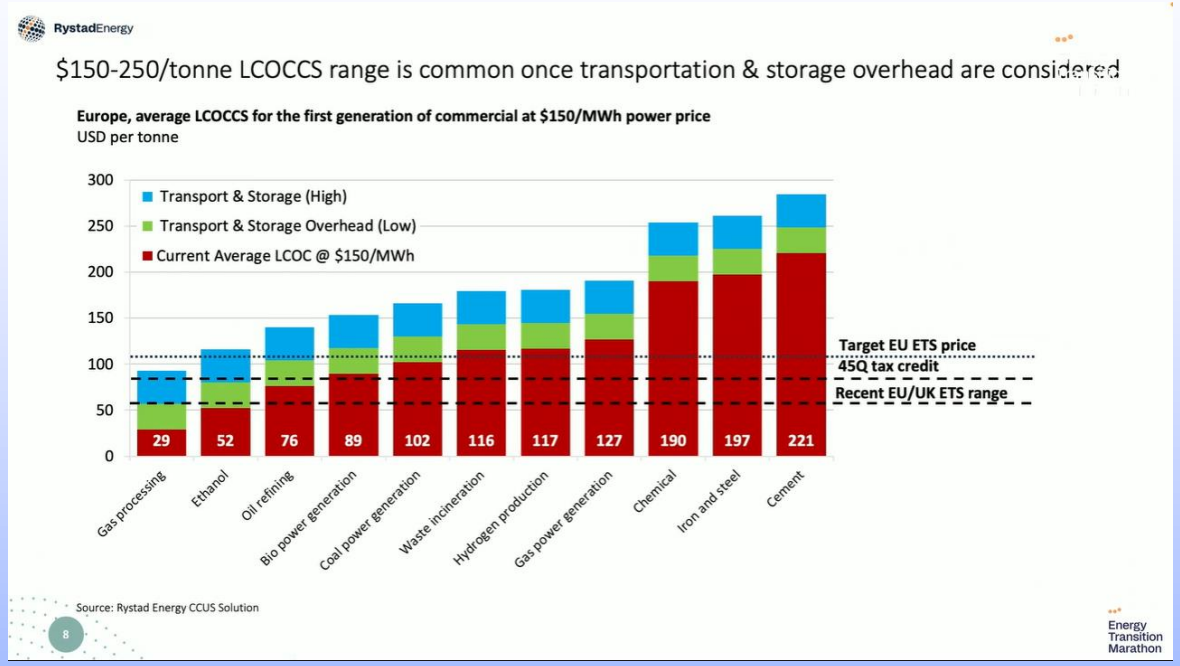
IV. The CCS Value Chain: Levelized Cost of CCUS



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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V. Conclusion and Key Takeaways

When planning a CCUS project, what factors should a sponsor first consider? We suggest the following along with the more comprehensive table on the next page:

- the proximity of the source to underground storage and access, whether by pipeline, ship, rail, or LPG truck;
- the geo-mechanical characteristics of the reservoir or "sink", in particular, the integrity of the seal and caprock and the depth of the caprock beneath any onshore potable water table;
- the costs of condensing and transporting the CO_2 from the capture plant to the aggregator (or to the injection well);
- the terms of the offtake contract (NB: Absent CCfD provisions, IOC/NOC storage providers may seek a call on intermittent CO_2 injection as the periodic economics of CO_2-EOR vary due to oil price movements);
- the renewal terms governing an IOC off-takers mineral rights to the reservoir;
- the creditworthiness of the offtaker; and
- Applicable statutory penalties, if any, for CO_2 leakage and the availability and terms of insurance.

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V. Conclusions and Key Takeaways

Financial and Operational Challenges for CCU/S

Capture	Transport / Hub Operation	Store
CAPEX (Capture Tech 50-80%, 2023) **OPEX** Costs of capturing, condensing and transporting the CO_2 from the capture plant to the hub/aggregator.	**CAPEX** (transportation and interim storage 10-23%, 2023) **OPEX P**roximity to the capture source and to underground storage reservoir, whether by pipeline, ship, rail, or LPG truck.	**CAPEX** (injection, storage and management:10-25%, 2023) **OPEX** Assess the geo-mechanical characteristics of suitable reservoirs or "sinks", in particular, the integrity of the seal and caprock and the depth of the caprock beneath any onshore potable water table. Characterize the capacity, containment and injectivity (sustainable injection rate) of the planned wells. The assessment should include long-term plume migration modeling, characterization of the storage complex, and a conceptual development plan with performance modeling.
Cost/Price: Low and variable CO2 price vs. available compensation for avoided cost or CCfD vs. EU ETS	**Cost/Price**: Variable transportation costs and special tariffs for transporting CO2 **Volume**: Transmission capacity management to ensure timely delivery of committed volume (under take-or-pay arrangements). Regulatory: Applicable statutory penalties, if any, for CO_2 leakage and the availability and terms of insurance	**Cost/Price**: Low and variable CO2 price vs. available compensation for avoided cost **Volume**: Reservoir capacity at maximum contracted injection rate and pressure. **Off-take**: The terms of the offtake contract (NB: Absent CCfD provisions, IOC/NOC storage providers may seek a call on intermittent CO_2 injection as the periodic economics of CO_2-EOR vary due to oil price movements); **Rights**: Renewal terms governing an IOC off-takers mineral rights to the reservoir; Variable term of NOC rights and call provisions . **Regulatory**: Measuring, Monitoring and Verification Provisions Applicable statutory penalties, if any, for CO_2 leakage and the availability and terms of insurance. **Regulatory**: Decommisioning obligations and costs. **Political**: Adverse public perception.

Project Finance for CCU/S

V. Conclusion and Takeaways

1. ***Time is of the essence***. Global emissions of fossil carbon dioxide (CO_2) hit a record 36.8 billion tonnes last year. There are a limited number of suitable sinks near capture plants or hubs. First movers are therefore more likely to find revenue-generating off-takers in the utilization market such as CO_2-EOR.
2. ***Size matters***. Large, well-conceived projects like *Longship/Northern Lights* will attract more competitive financing terms because scale begets marketability due to lower costs. This crowds out smaller projects and nascent technologies, however promising or heavily subsidized;
3. ***Shared feeder hubs reduce costs.*** Aggregating CO_2 capture plants across several industries enables an interlinked transportation network feeding a limited number of suitable storage sites. Despite the promise of reducing transport and storage costs for all project participants, it's a challenge to reach a bankable agreement between participants with varying priorities; therefore,
4. ***Leadership is essential***. Initiating a CCUS hub project requires the leadership of a dominant CO_2 producer and a high-capacity, reliable off-taker at the end of the pipeline feeding a carefully placed injection well(s).
5. ***Policy incentives must remain in place for decades*** … for the economic life of the CCUS project – about thirty years of operation.

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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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