



DAN-UNITY CO<sub>2</sub>



 DAN-UNITY CO<sub>2</sub>  
*Enabling Zero-Emissions*



Dedicated to a sustainable future through our commitment to development and operation of critical infrastructure and solutions for CCS projects, assisting governments and private actors alike in reaching national and international climate goals and targets.



## *Table of contents*

Part I: Abstract

Part II: Overview of CCUS and role of shipping

Part III: Challenges in CO<sub>2</sub> maritime transportation: Technical & Commercial

Part IV: Our Vessel Design

Part V: Dan-Unity CO<sub>2</sub>

Part VI: Carbfix Solution

Part VII: Project Greensand

Part VIII: Victrol

Part IX: Summary



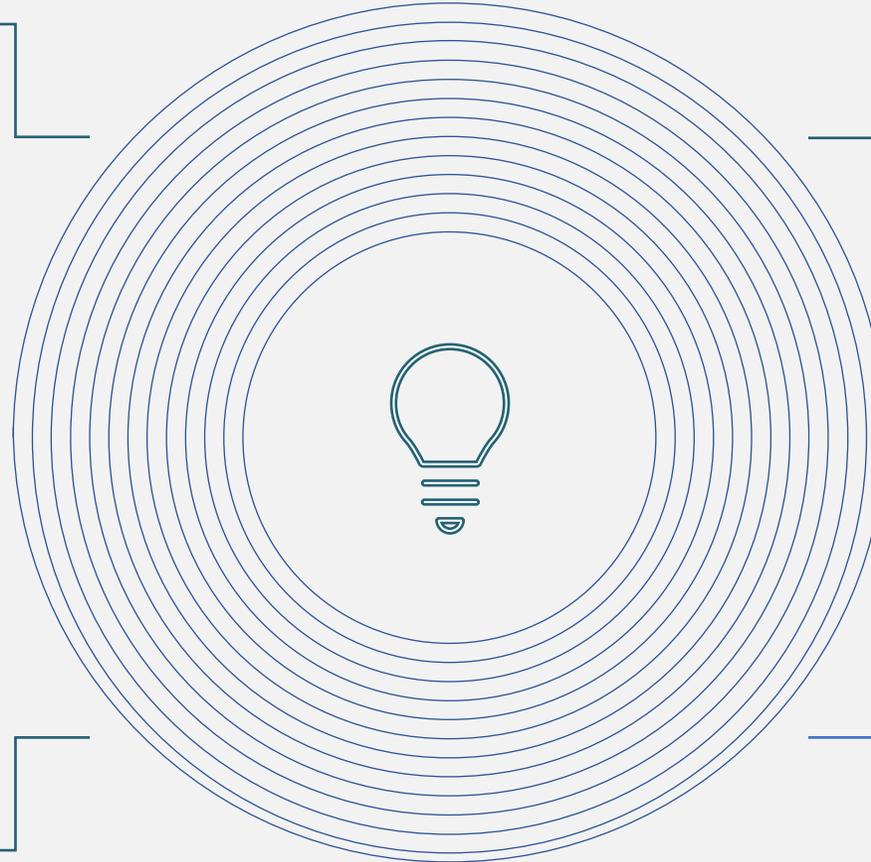
## Part I: Abstract

The focus of today: Reducing greenhouse gas emissions, but current initiatives might not be enough.

Carbon capture and storage (CCS) can be an enabler of net-zero and ships will be needed to unlock value.

CO<sub>2</sub> is different from any other commercially traded gas; hence no ship exists to do it at a large scale.

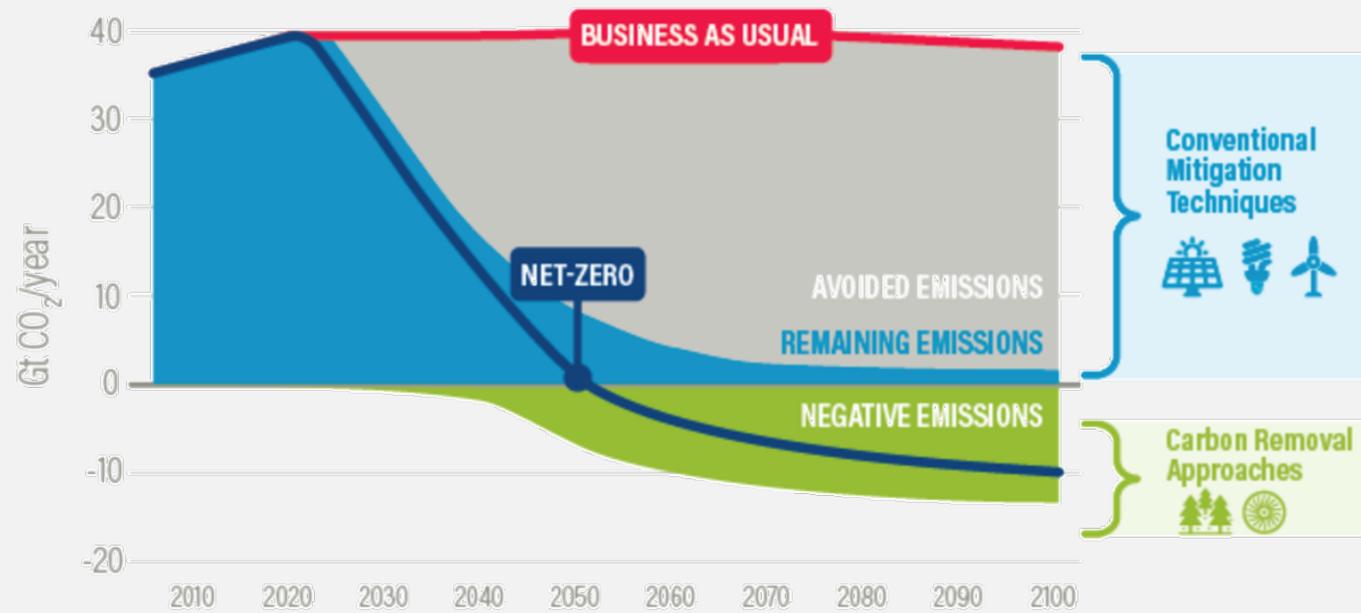
Purpose of keynote: To provide overview of philosophy of CO<sub>2</sub> carriers and provide ideas to CCS industry.





## Part II: Achieving Net-Zero

### Staying Below 1.5 Degrees of Global Warming



Source: Adapted from IPCC 2018.  
20.05.26

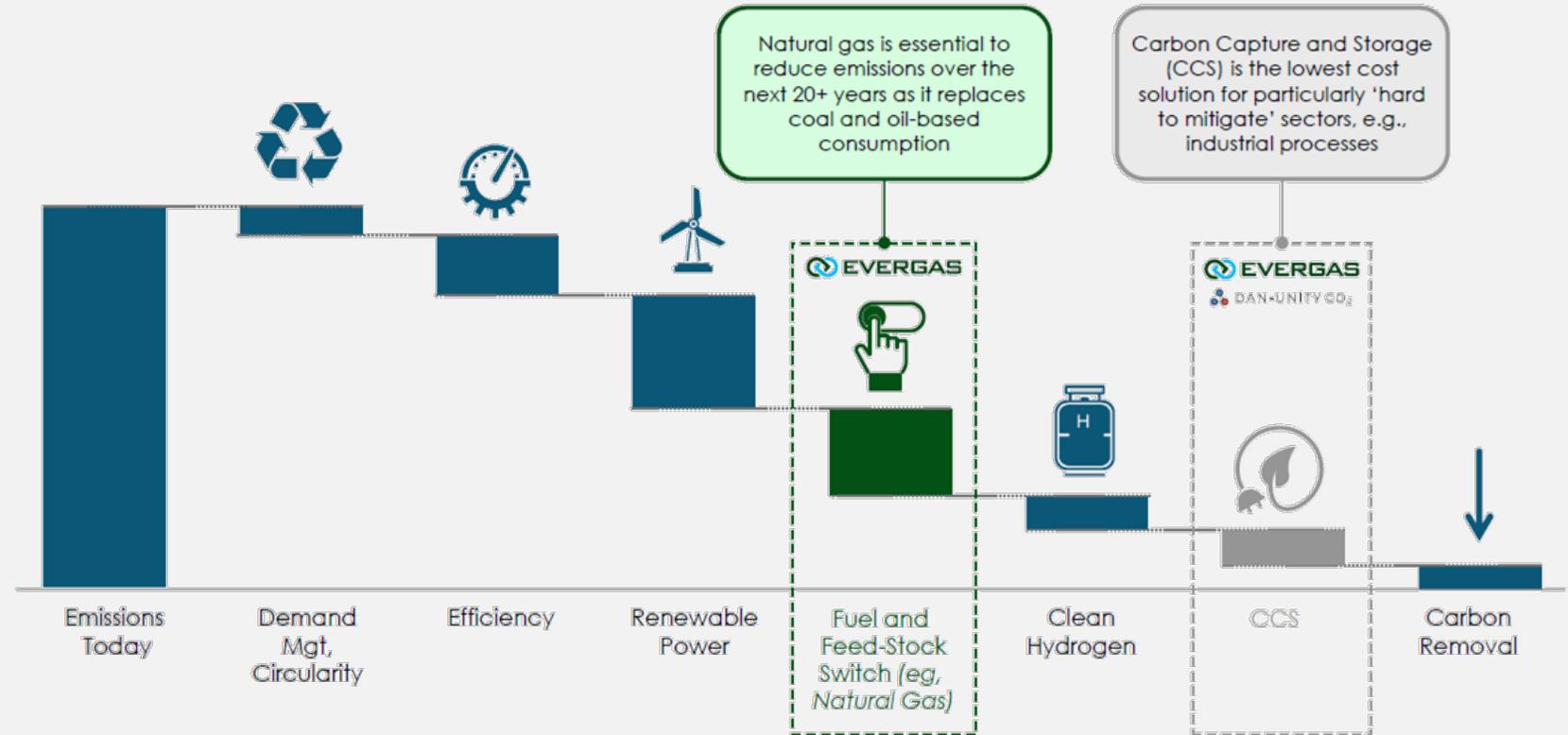
 WORLD RESOURCES INSTITUTE



## Part II: Achieving Net-Zero

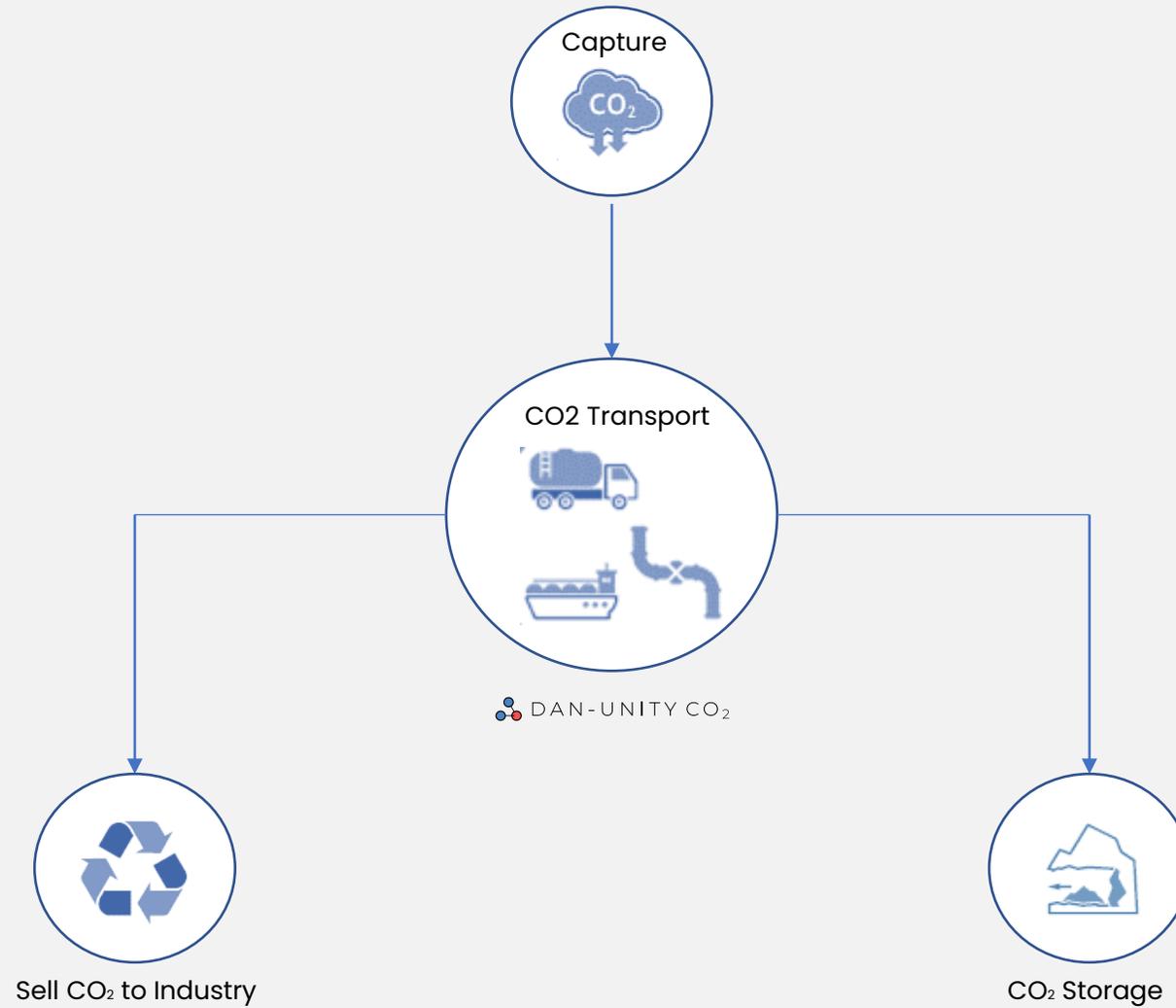
There are three broad approaches for bridging the mitigation gap:

1. **Abate:** Techniques that avoid CO<sub>2</sub> emissions from energy, industrial and other practices.
2. **Capture:** Techniques that can capture carbon dioxide at the source before emission into the atmosphere.
3. **Remove:** Techniques that can remove CO<sub>2</sub> from the atmosphere once it has been emitted.





## Part II: Achieving Net-Zero



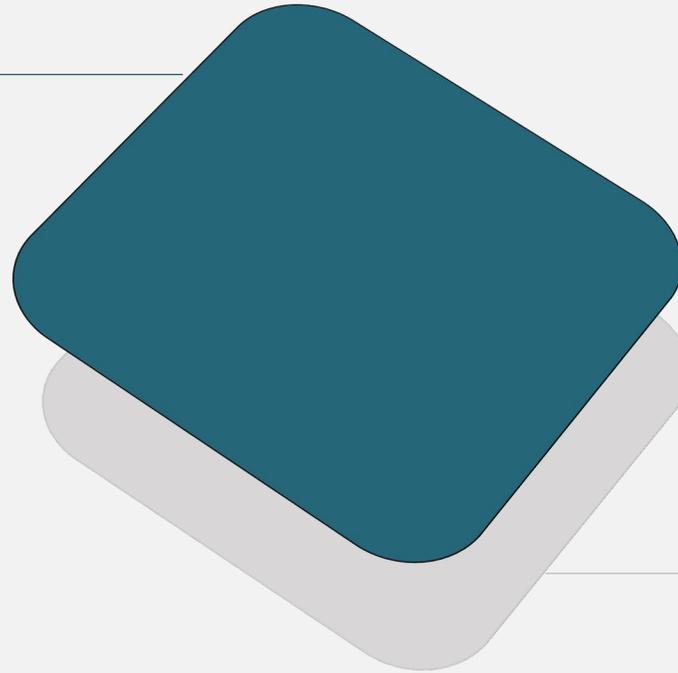


## Part III: Maritime Transportation – Technical Challenges

H

### Health

- Asphyxia
- Static electricity generation
- Unfamiliarity
- Cryogenic cargo



C

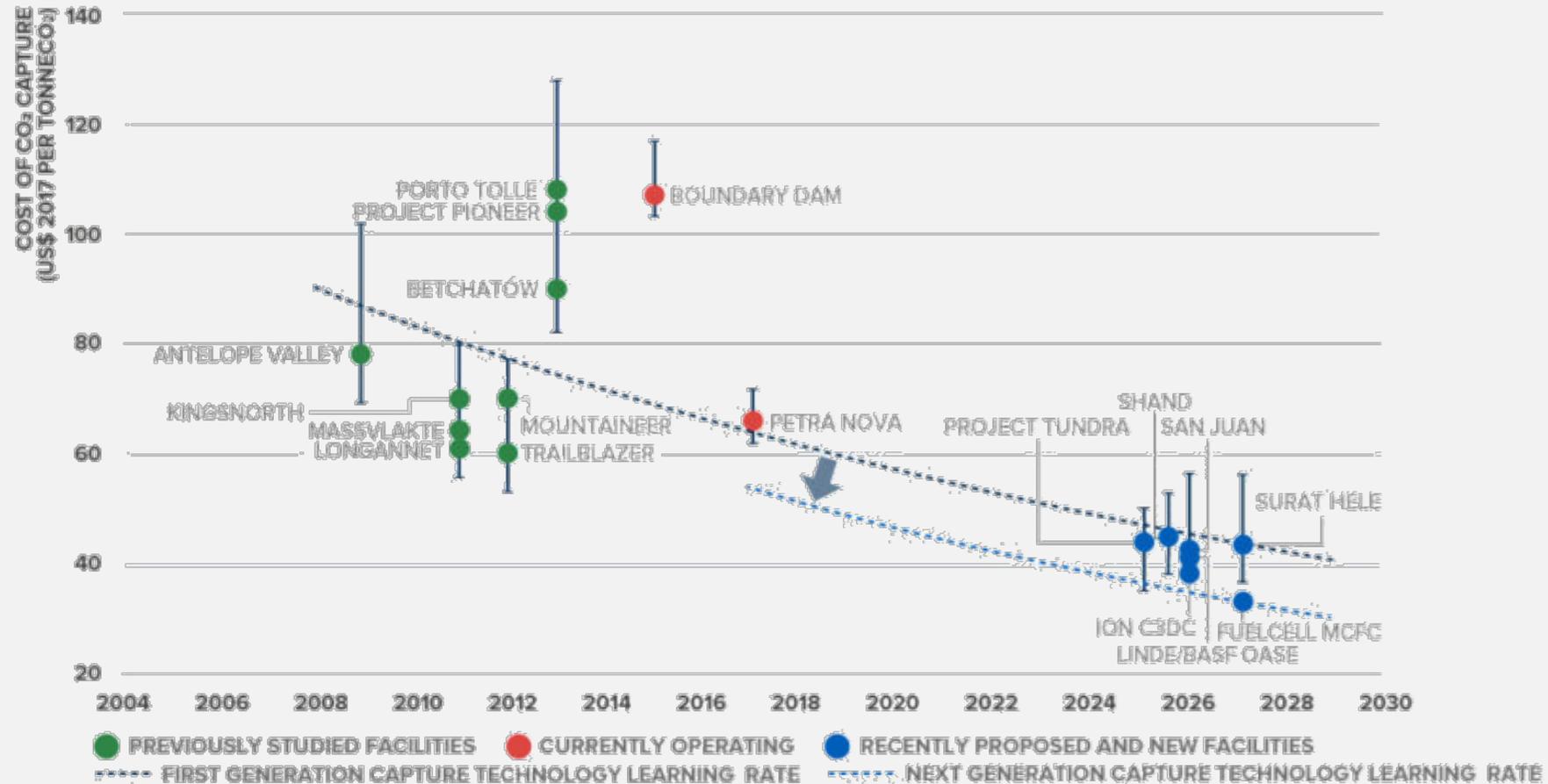
### Cargo

- Density
- Triple point
- Dry ice formation
- Liquid hammer
- Solvent properties in super critical phase
- Corrosion
- Impurities



## Part III: Maritime Transportation – Commercial Challenges

### Cost of Carbon Capture



Source : Global CCS Institute



## Part III: Maritime Transportation – Commercial Challenges

### Cost of ETS



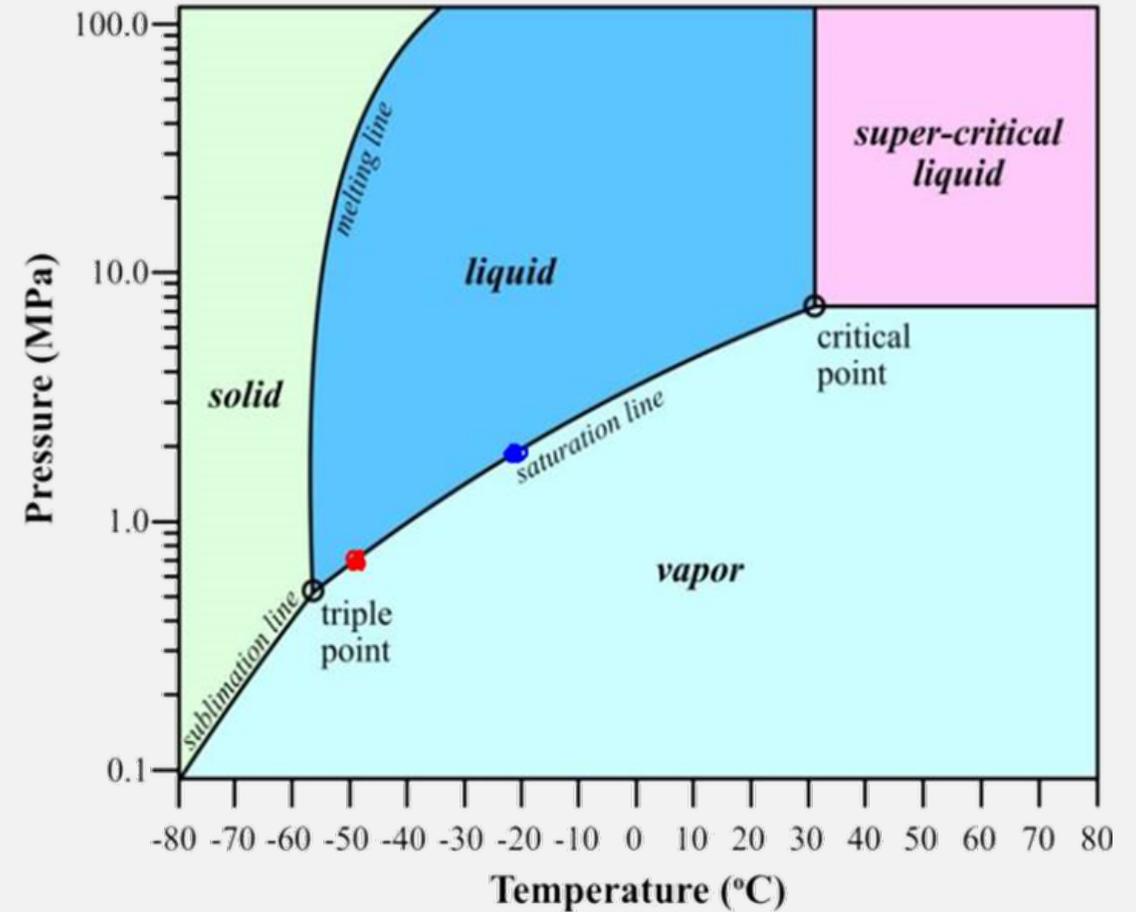
Based on the price of ICE EUA Dec 22 futures. Trading View



## Part IV: Our Vessel Design

What are the drivers towards our chosen design?

- CO<sub>2</sub> pressure and temperature during carriage versus its triple point.
- Tank wall thickness & production challenges.
- Tank steel weight & impact on Vessel costs.
- Operating envelope for CT pressure - BOG management.
- Abate/capture CO<sub>2</sub> produced during transportation.

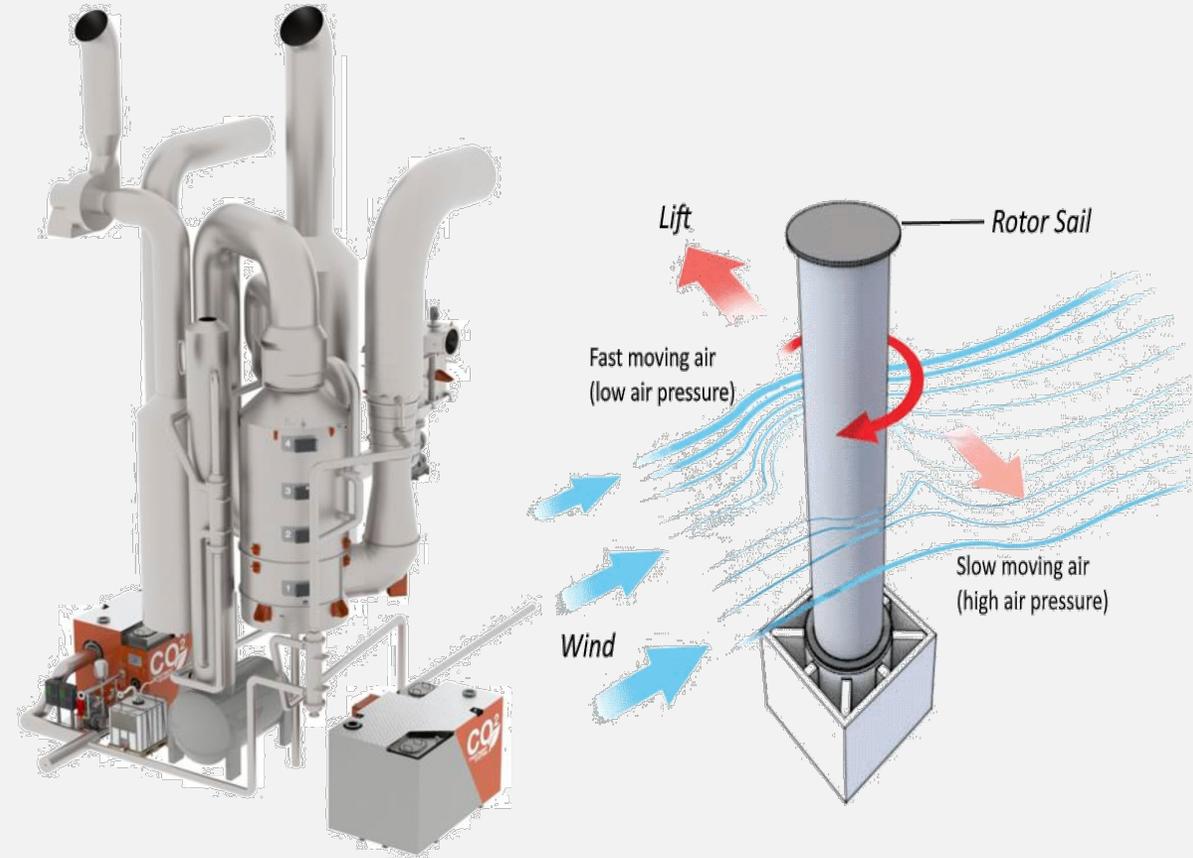




## Part IV: Our Vessel Design

### Key characteristics and advantages of our design

- Approx. 7 bar and -50 deg C
- Reduced thickness of cargo tank steel = less deadweight
- CO<sub>2</sub> carried at approx. 10% higher density than high pressure designs giving increased carrying capacity.
- Scalable designs; carrying capacity can be adopted as per project specs
- Propulsion system designed to use green fuel.
- Considering CCS on board, Rotor sails, shore power, air lubrication amongst other technologies to reduce emissions of vessel
- For specific projects, we are considering DP2 and bow loading

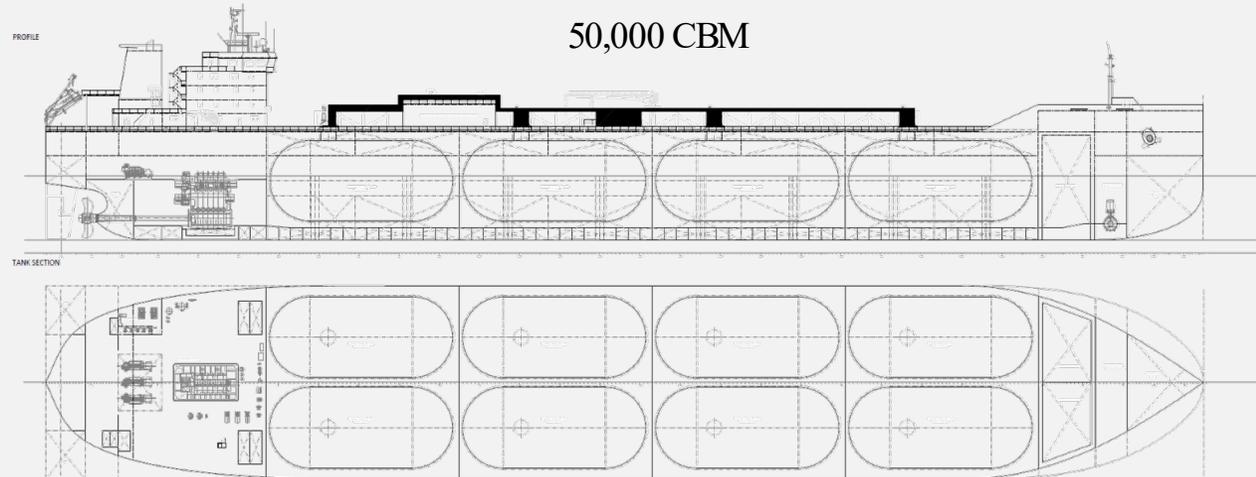
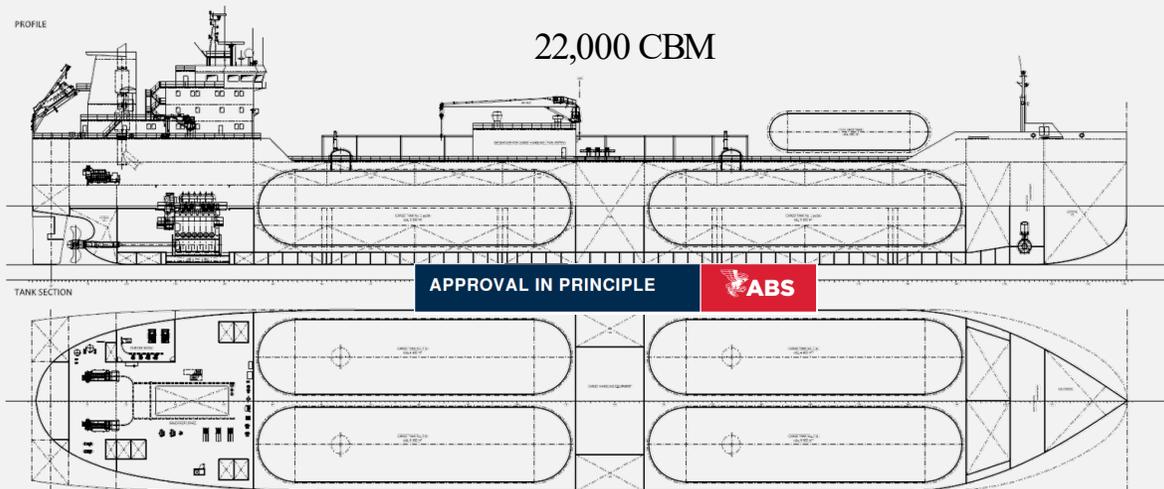
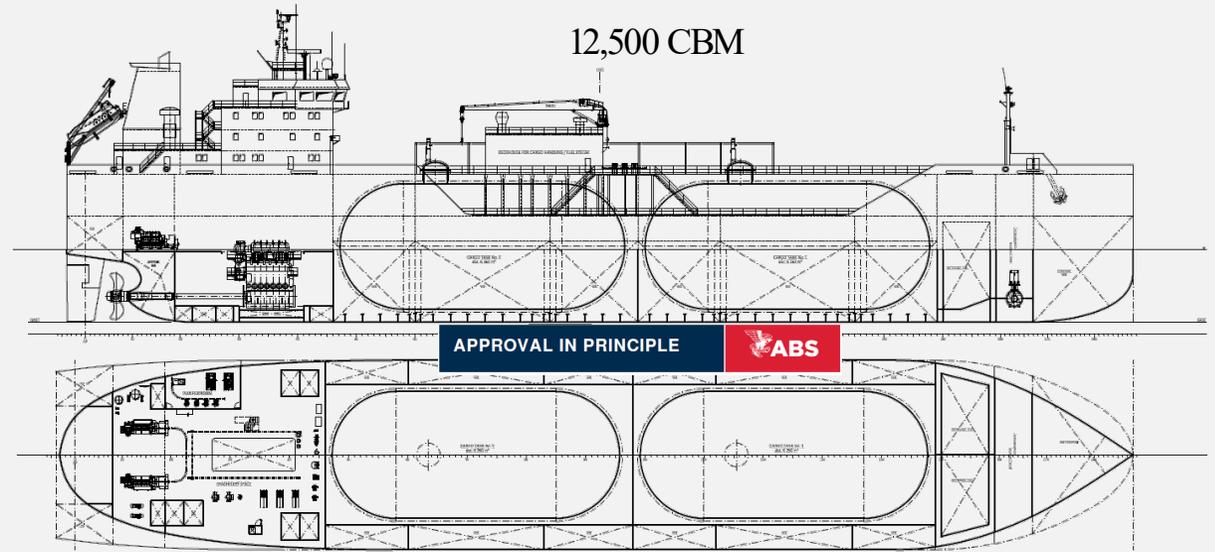
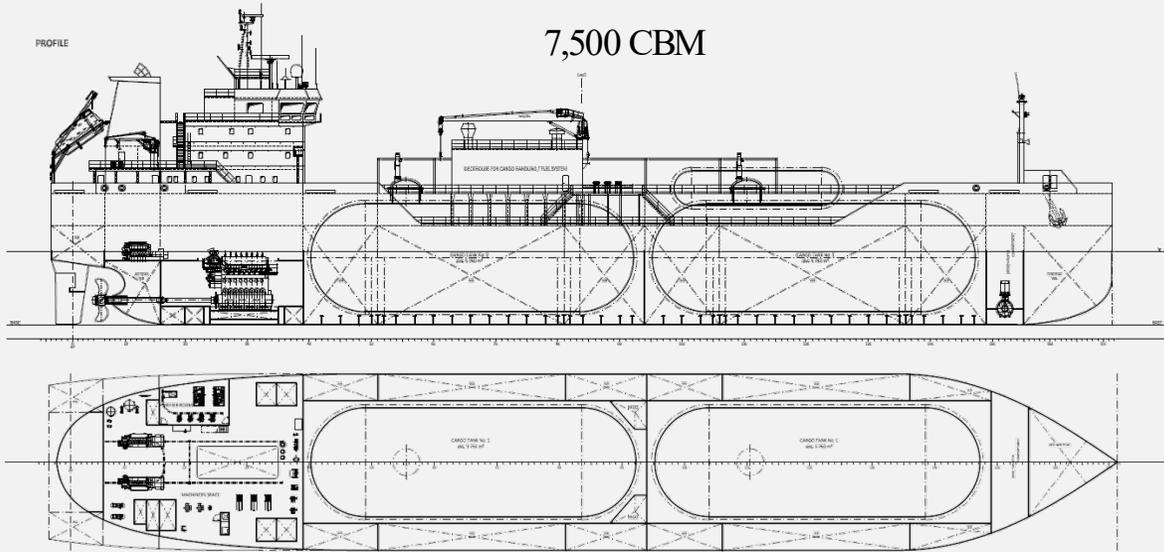




## Part IV: Our Vessel Design

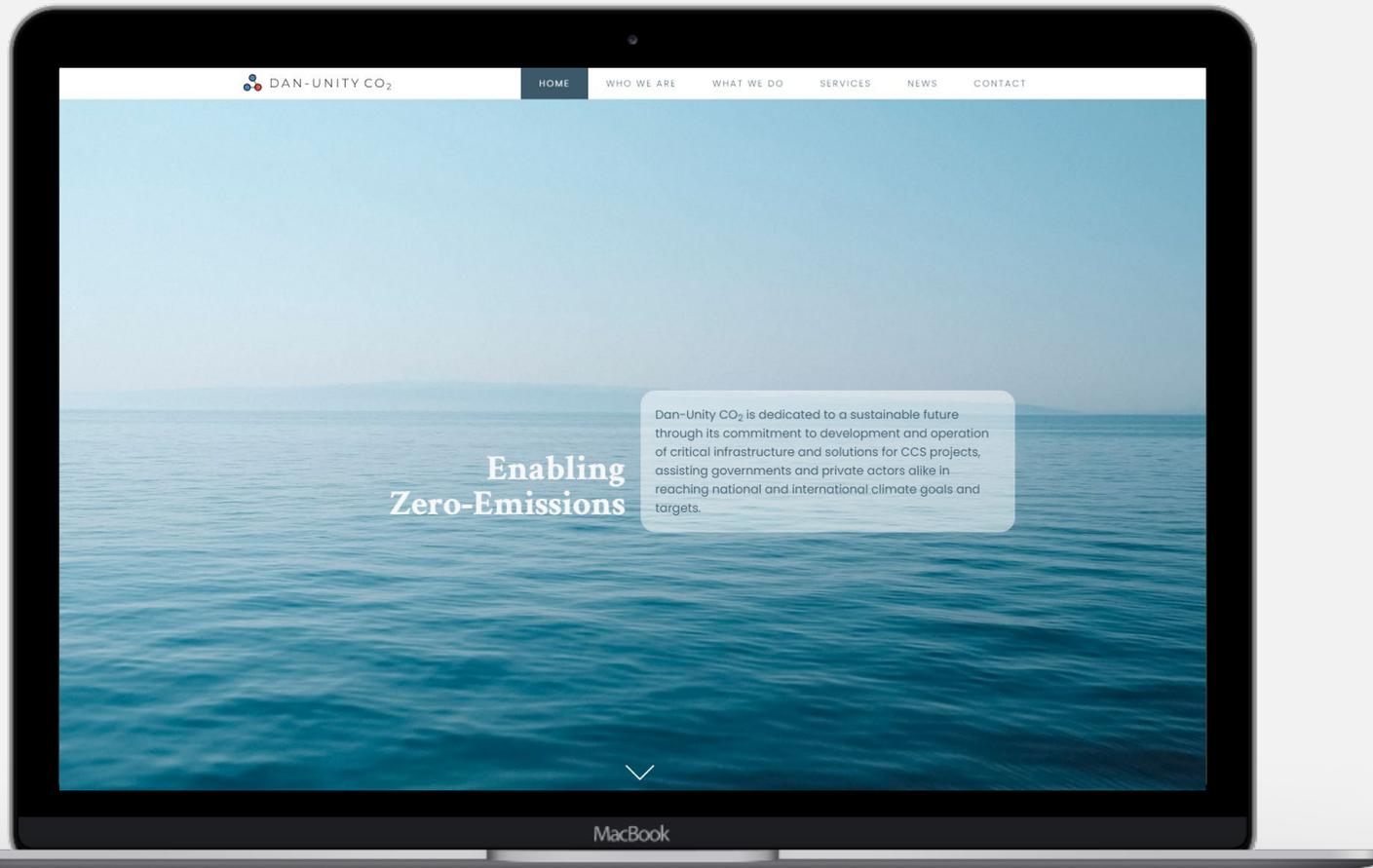
We have developed our own four vessel designs with support from the Danish Maritime Fund:

7,500 cbm, 12,500 cbm, 22,000 cbm and 50,000 cbm





## Part V: Dan-Unity CO<sub>2</sub>



- ❖ Dan-Unity CO<sub>2</sub> is established by the two Danish shipping companies Evergas and Ultragas – each a market leader within their respective segments of transportation of liquefied gasses.
- ❖ Standing on the shoulders of the two companies' rich histories, Dan-Unity CO<sub>2</sub> is leveraging the experiences and innovative spirits to tackle the challenges of today to create a better tomorrow.
- ❖ In combining the forces of Evergas and Ultragas, Dan-Unity CO<sub>2</sub> is the world's first carbon capture and storage (CCS) specific shipping entity.



## Part V: Dan-Unity CO<sub>2</sub>–What We Do

According to the UN's Intergovernmental Panel on Climate Control (IPCC), it will be almost impossible to achieve net-zero greenhouse gas emissions let alone reaching international climate targets for 2030 and 2050 without carbon capture and storage (CCS).



Technology for capturing and storing CO<sub>2</sub> exists and is tested and proven. The challenge lies in designing and executing a cost-efficient transport of CO<sub>2</sub> between the capture site and the storage site as these are seldom closely located to each other.



The properties of CO<sub>2</sub> make it technically difficult to transport as a liquid as it will only remain liquid in a very narrow window of specific conditions in-between being a gas and being a solid mass. It is of utmost importance to ensure the right conditions throughout the entire operation, something almost no ships are capable of today.



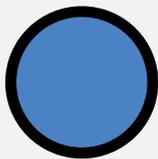
Dan-Unity CO<sub>2</sub> is your partner for seaborne transportation of CO<sub>2</sub> and CCS solutions, drawing upon our extensive knowledge and expertise in the shipment of liquid gasses along with our shipyard relations to design, build, and manage the pioneering transportation solution required for your CCS project in any regard.



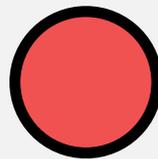
Transporting CO<sub>2</sub> by sea allows for maximum flexibility and multiple sourcing points thus unlocking economies of scale for any CCS project. And at the same time delivering a lower \$/ton cost compared to transport via pipeline.



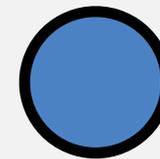
### Our Full Scope of Services



Project Development & Consulting



Newbuilding



Technical & Operational Management

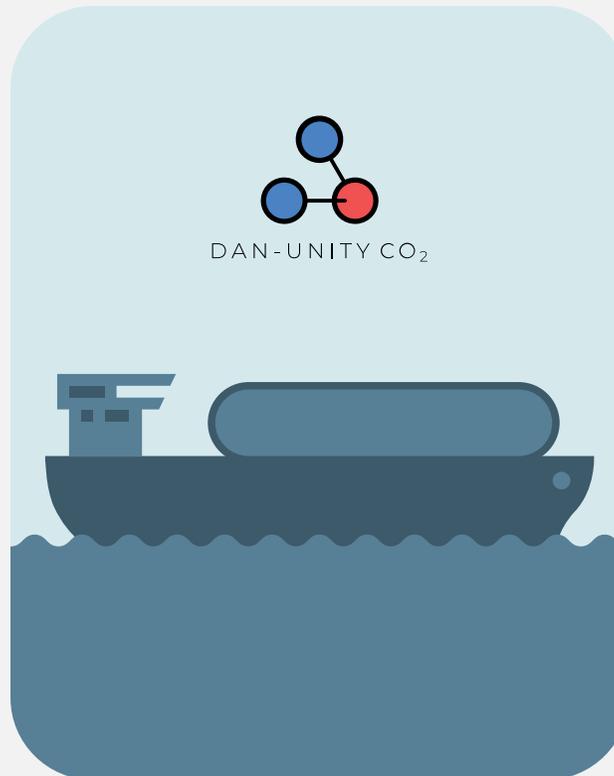
 *Part V: Dan-Unity CO<sub>2</sub>–Unlocking Value in CCS*

Capture, shipment or storage is worth nothing in isolation if they cannot be linked together. And as the capture and storage sites are seldom closely located, shipment becomes an important factor to unlock the value of CCUS chains. Unlike most commercial trades where the cost of shipment is only a fraction of the overall cost of the good, CO<sub>2</sub> shipment adds up to a substantial part of the value chain cost, as CO<sub>2</sub> requires purpose-built ships with little or no value outside of the CO<sub>2</sub> trade, giving it a high residual risk. Shipment thus needs to be carefully integrated at an early stage to maximize efficiency and minimize costs.

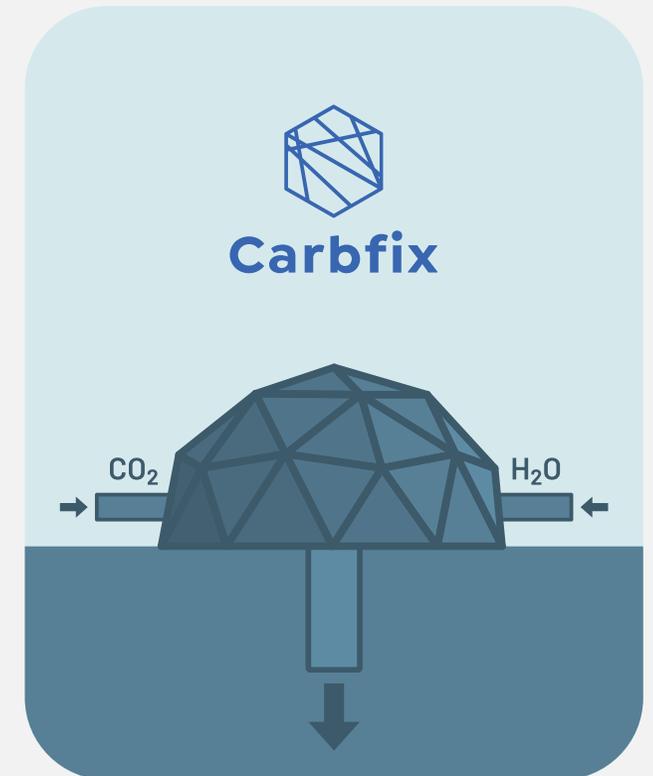
## CAPTURE



## SHIPMENT



## STORAGE





## Part VI: Carbfix Solution

- Plans for a major CCS hub in Straumsvik, Iceland
- CO<sub>2</sub> to be permanently stored using Carbfix's mineralization process.
- Storage sites onshore in nearby basaltic formations adjacent to the harbor, where drilling operations are less expensive.
- Plans for expansion of harbor to accommodate larger vessels goes hand in hand with Carbfix's hub concept where network of wells can be gradually expanded over time.
- Landfills and injection well drilling expected to commence the coming Summer.
- Storage capacity will gradually increase to 3 Mtpa CO<sub>2</sub> by 2030 with essentially no upper limit to further storage capacity increase
- Cost of storage with Carbfix is at €15/ton, with the cost decreasing as it scales

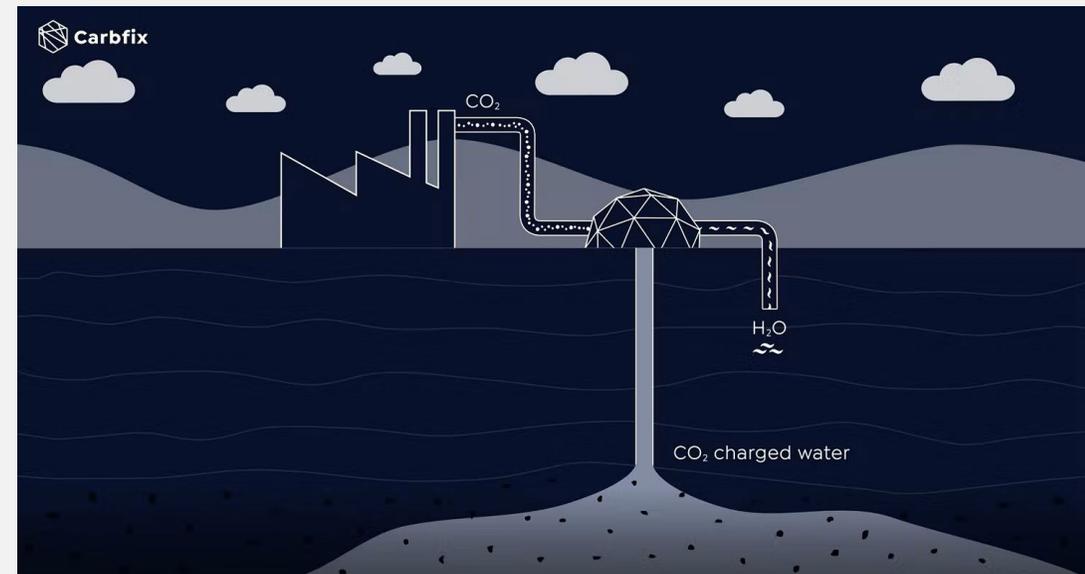


Image source: Carbfix



## Part VI: Carbfix Solution

- High public acceptance
- Risk of leakage eliminated
- CO<sub>2</sub> is permanently removed
- Economic Drilling operations and well material
- Low financial risk
- Low operational risk
- Network can be gradually expanded over time
- On-site storage for a single source emitter
- Long-term monitoring not needed
- No defined upper storage limit

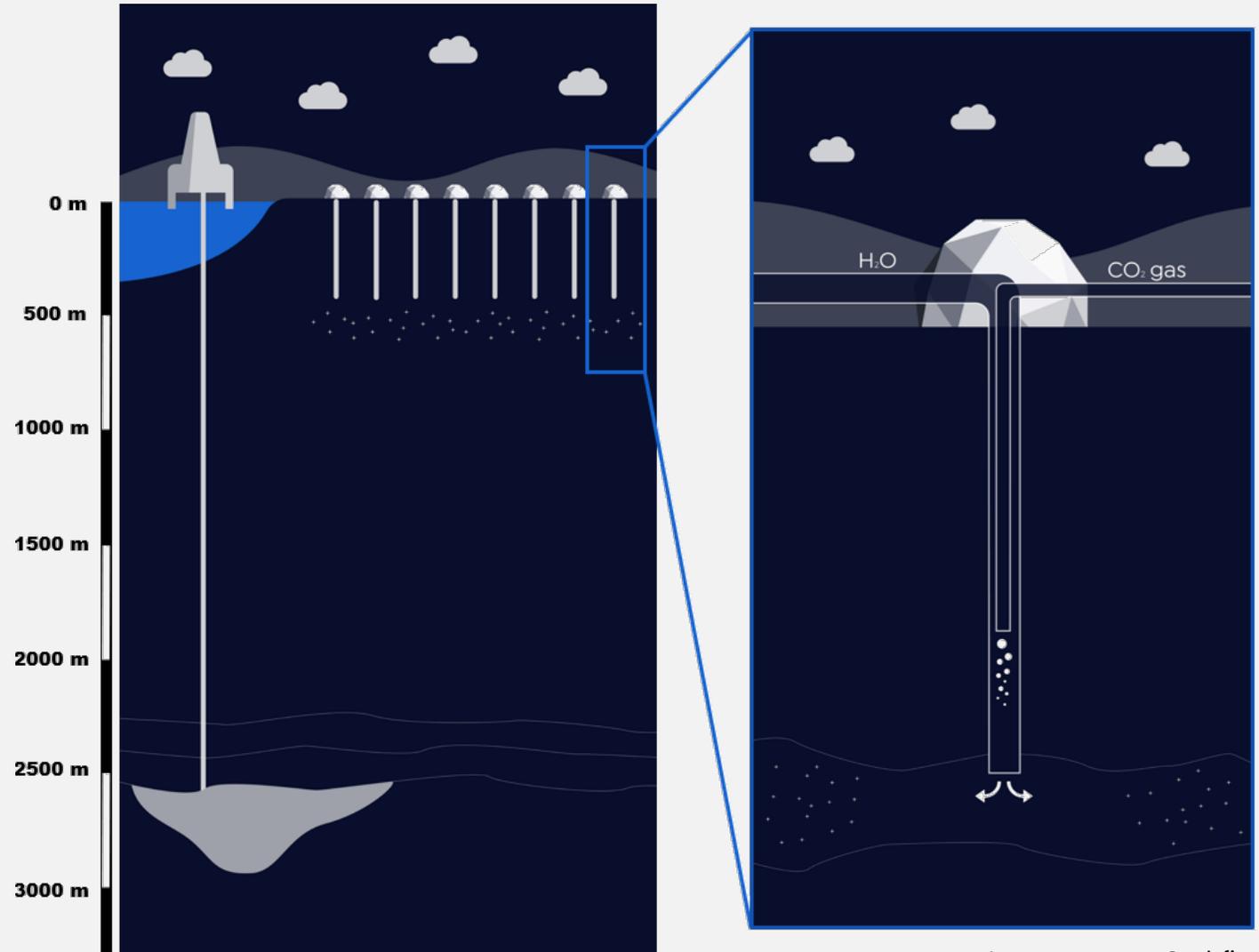
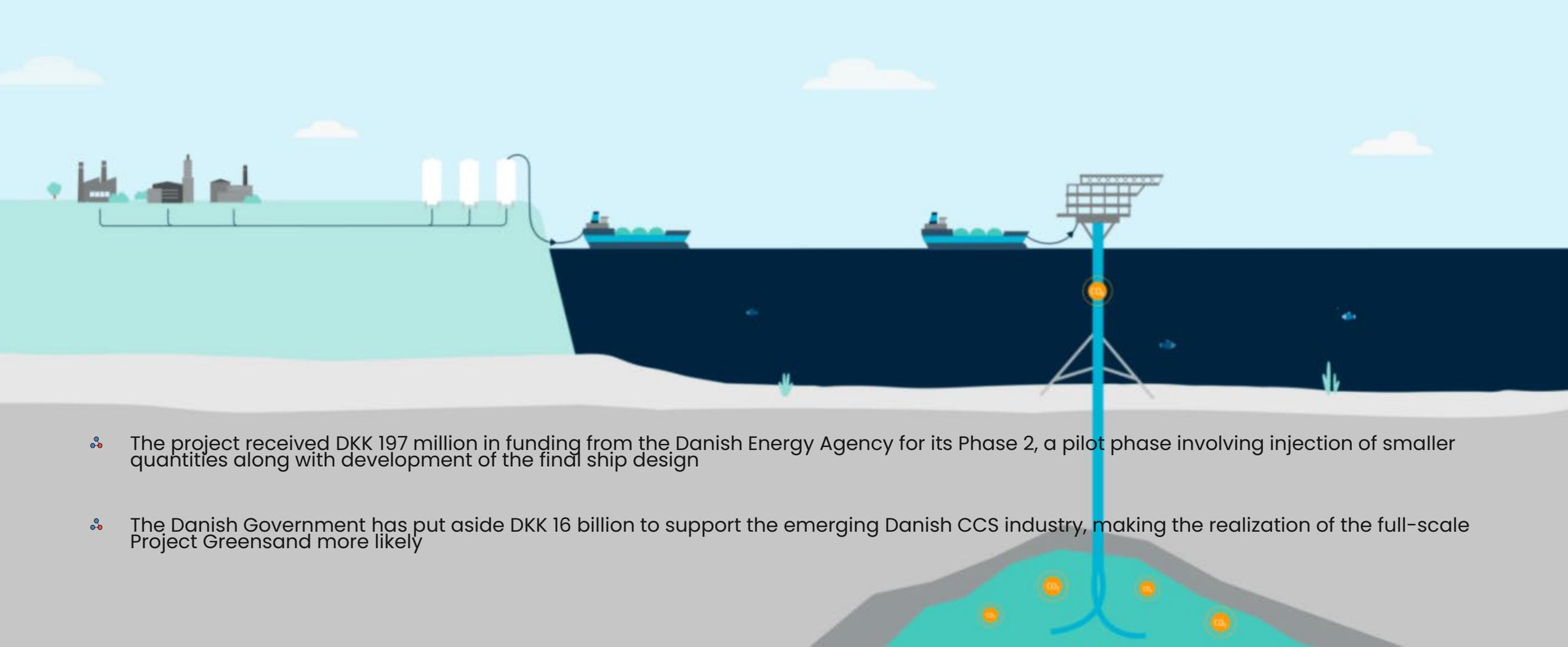


Image source: Carbfix



## Part VII: Project Greensand

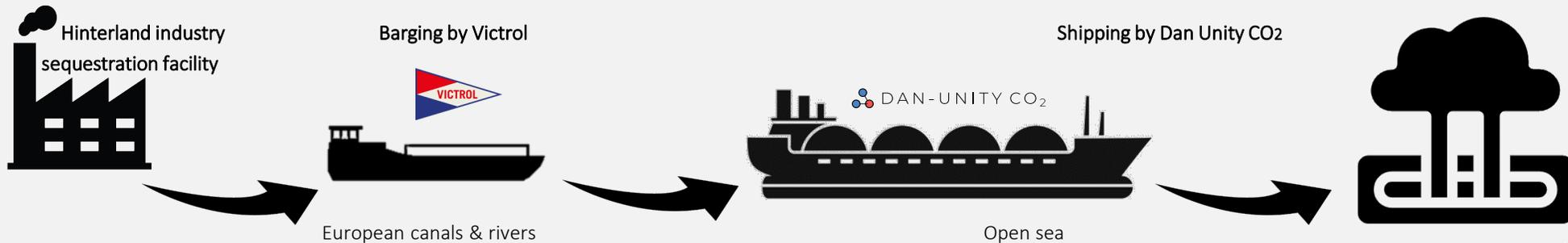
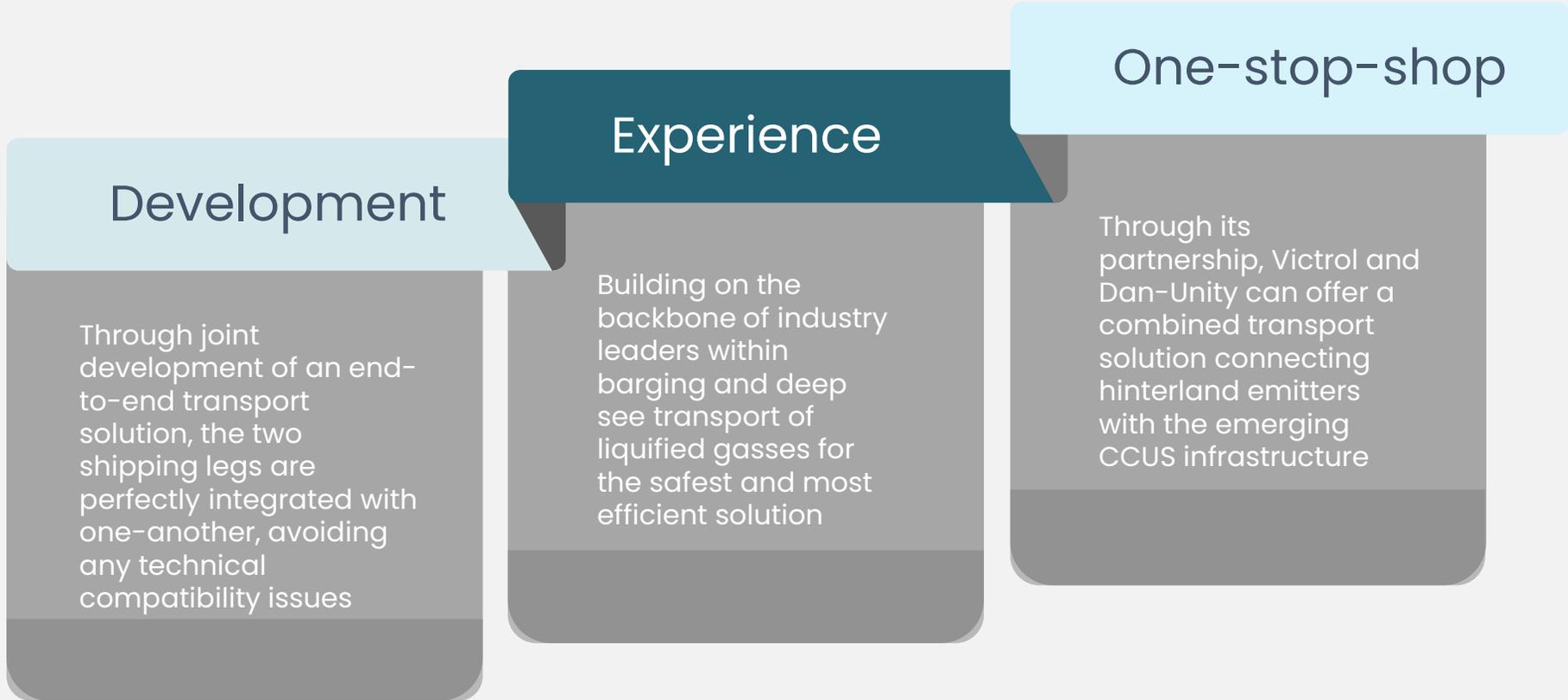
- A Danish CCS project with the goal of storing CO<sub>2</sub> in depleted oil fields in the Danish North Sea
- We are a part of the Greensand Consortium, consisting of more than 20 companies working together to develop the best end-to-end CCS value chain, where we are the only consortium partner for shipping



- The project received DKK 197 million in funding from the Danish Energy Agency for its Phase 2, a pilot phase involving injection of smaller quantities along with development of the final ship design
- The Danish Government has put aside DKK 16 billion to support the emerging Danish CCS industry, making the realization of the full-scale Project Greensand more likely



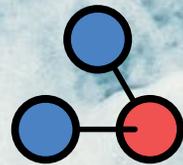
# Part VIII: Accessing Hinterland Emitters with Victrol





## *Part IX: Summary*

- We are both committed and well positioned to provide a transportation solution for our clients' ambition towards achieving net zero.
- We offer a fully integrated service living up to the highest of standards when managing CO<sub>2</sub> carrying vessels both from a technical and operational standpoint.
- All management is always carried out with safety and environmental protection as our number one priority and in strict compliance with international, regional, and national rules and regulations.
- Our services are built on decades of safe and efficient management of our fleets for some of the world's largest companies such as BP, Exxon, Total, INEOS, etc.



DAN-UNITY CO<sub>2</sub>