



CO₂ sustainable transportation

IENE Workshop on CCUS Technologies in Greece and SA Europe
Athens, 10 October 2023

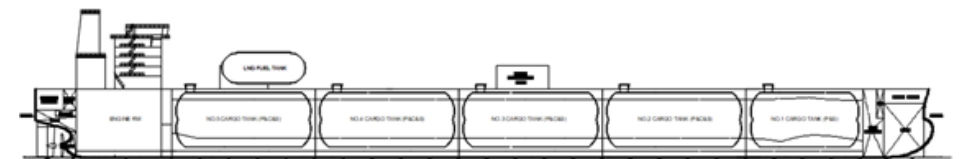
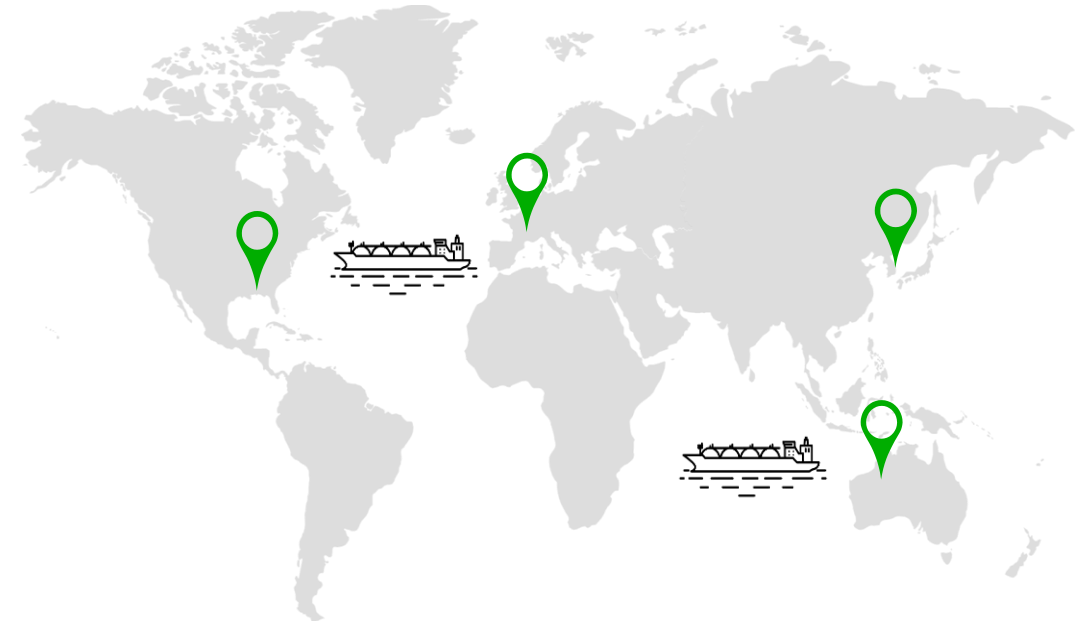


A global midstream CO₂ transport network at scale

ECOLOG is a mid-stream CCUS service provider safely connecting emitters to lowest cost CO₂ storage with Ships and Terminals

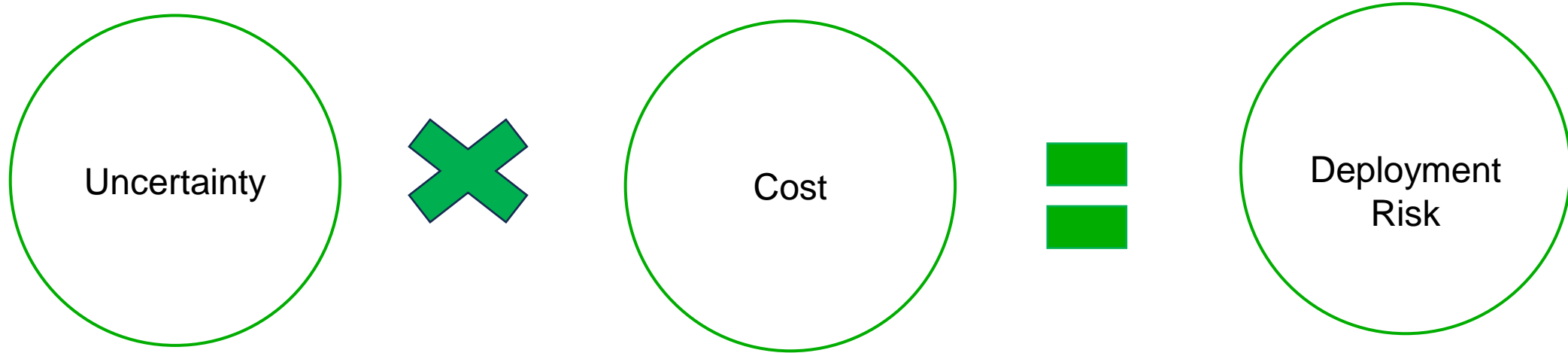
SHIPPING and TERMINALS, transporting CO₂ at scale offering modular platform to fit any industrial energy transition plan

ECOLOG collaborates with classification societies, design houses, EPCs, shipyards and makers, engineering CO₂ cargo challenges since 2021 and **advocates** the transborder movement of CO₂



Liquid CO₂ Carriers ranging from 12,000m³ to 90,000m³
Low to no carbon emission propulsion








Why uncertainty?

Carbon pricing	Funding	Legal framework	Social perception
<p>Fundamentals: energy demand, interest rates</p> <p>Politics: Cap or baseline, free allocations, carbon targets</p> <p>Hedging</p>	<p>State tax, funding</p> <p>Financial Institution</p> <p>Bank</p>	<p>Infrastructure permitting</p> <p>Cross-border transport</p> <p>Ownership & Custody transfer</p> <p>Long-term liability</p>	<p>State commitment</p> <p>CCS- societal value</p> <p>Awareness - Consultation</p> <p>Project transparency</p> <p>Academia advocacy</p> <p>Workforce competency</p> <p>Polluter funding</p>

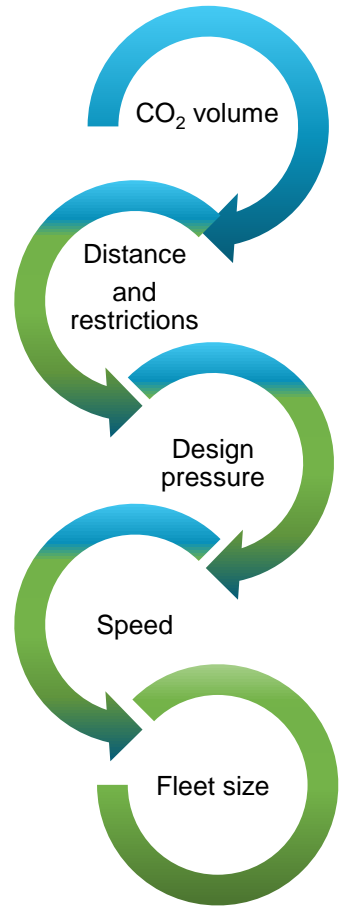
Cost - commercial exposure

Shipping	Emitter	Lack of standards	Storage
<p>New design</p> <p>Cargo tanks</p>	<p>Carbon capture system</p> <p>Dispersed site</p> <p>Aggregation</p>	<p>Additional complexity</p> <p>P-T-p operational envelop</p> <p>CO₂ cross-streaming</p>	<p>Maturity in scale</p> <p>Permitting</p> <p>Subsea purpose screening</p> <p>Pore analysis</p> <p>Geological data collection</p> <p>Investment-drilling</p> <p>Long term liability</p>

- MP & LP shipping solutions studied by ECOLOG with confidence on the basis of extensive HAZOP-HAZID studies: **210 hazards, 132 recommendations, over 1000 manhours**
- LP CO₂ carriage at scale improves unit cost

Ship Design		Tank Design
High Pressure		Smaller tanks & low cargo density
Medium Pressure		Up to ~30k cbm cargo
Low Pressure		12.5k to over 70k cbm cargo

Virtual pipe modelling

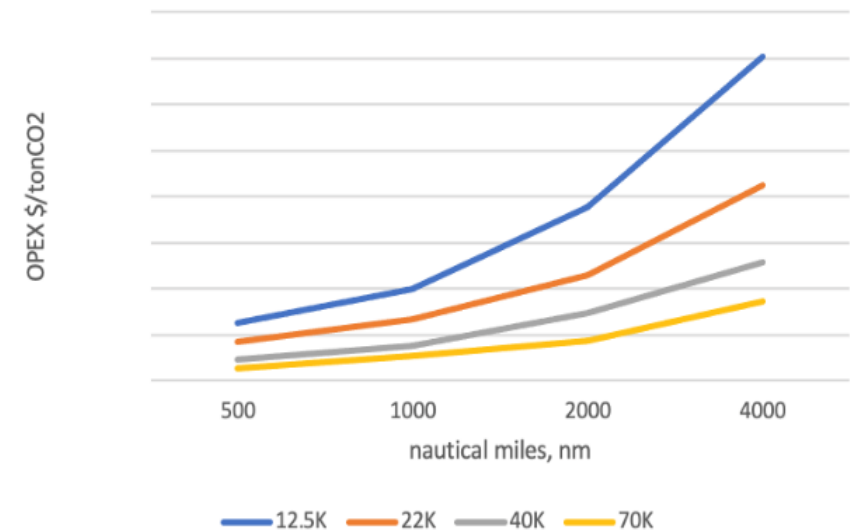
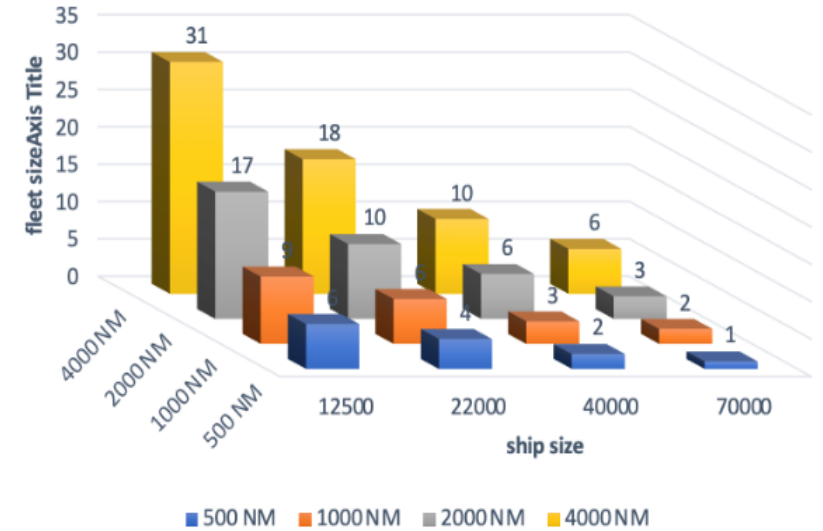


Modelling of portfolio of CO₂ sources

Embedded calculation for ship's minimum power and multiple bunkers CO₂-eq emissions

Address fleet resilience against single point failure

Scaling cost impact achieved through volume transported on number of ships,



Transportation Criticalities

Triple Point

Purity

Design
P-T-ρ

Dry-ice formation
Structural failure
Pressure & flow
acceleration procedural
considerations

HSE
Phase change behavior
Transport properties
Corrosion
Infrastructure capacity

Containment	Cargo handling
Material	Complex design
Volume	BOR

- **CCUS will play a pivotal role in the materialization of the Paris Agreement.**
- **State aid with respect to funding and regulatory framework will incentivise stakeholders and investors.**
- **Shipping is a decarbonization enabler for fast CCUS deployment that can reduce cost and uncertainty by providing scale and ensuring the supply chain integration.**
- **ECOLOG has undertaken in depth studies on the safe and efficient design and operation of the CO₂ supply chain and are confident of a successful application of CCUS in Greece.**

Thank you