



MemCCSea

Innovative membrane systems
for CO₂ capture and storage at sea

MemCCSea: Carbon Capture at sea

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Innovative membrane systems
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Project duration
1/11/2019 – 30/4/2022 (30M)
Extension to 31/10/2022

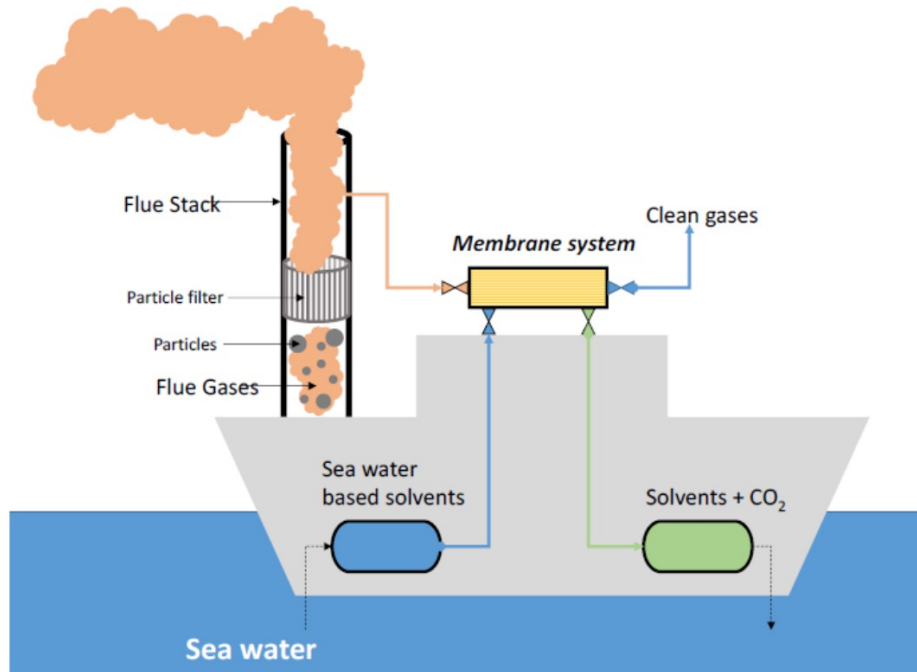
Budget
1.98 M€



Project Concept & Key Objectives

The MemCCSea Concept

Development of **hyper compact membrane systems** for flexible operational and cost-effective **post-combustion CO₂ capture** in maritime and off-shore applications.



Key Objectives

- Provide a **reduction of operating costs greater than 25%** compared to a conventional amine-based scrubbing system.
- **Optimize the process** to achieve **high CO₂ capture efficiency** and **low energy consumption**.
- **Reduce the water footprint** and **improve the overall environmental performance** of the system.
- **Overcome the limitations of conventional CO₂ capture technologies** by developing **advanced membrane systems** and **performing detailed performance assessments**.
- **Analyze the market potential** and **identify the hazards** associated with the proposed technology.
- **Manage the project** and **disseminate the results** to the industry and the public.

WP1. Process requirements and specifications

WP2. Materials development

WP3. Experimental test campaign

WP5. Market analysis and hazard identification analysis

WP6. Management and dissemination

WP4. Modelling of advanced membrane systems and performance assessment

Project Impact

GHG emissions from international shipping **have risen by more than 30%** over the last 30 years, a larger increase compared to every industrial and transport sectors except international aviation, with **increases up to 250%** compared to current levels expected until 2050.

Strict regulations for CO₂ emissions from shipping (40% reduction of GHG emissions by 2030, 11% reduction in carbon intensity by 2026) and are reflected in updated calculation of key efficiency indices (EEDI, EEXI, CII)

Active participation of industry & classification society



Leading crude oil tanker shipping company worldwide



Leading EU classification society

Active participation in related CCS projects for energy-intensive industries



Carbon capture and mineralization in the cement industry



CERESIS



Membrane-based CO₂ separation processes in the biofuels production industries

EPS AND VALUE MARITIME ANNOUNCE AGREEMENT 2022

Eastern Pacific Shipping and Value Maritime team up to install the first carbon capture solution onboard a pair of tankers

The Singapore-based tonnage provider will retrofit two MR tankers with carbon capture systems, making them the largest ocean-going vessels fitted with carbon capture technology to date

17 MAY 2022

2x MR TANKERS TO BE FITTED WITH CARBON CAPTURE SOLUTION

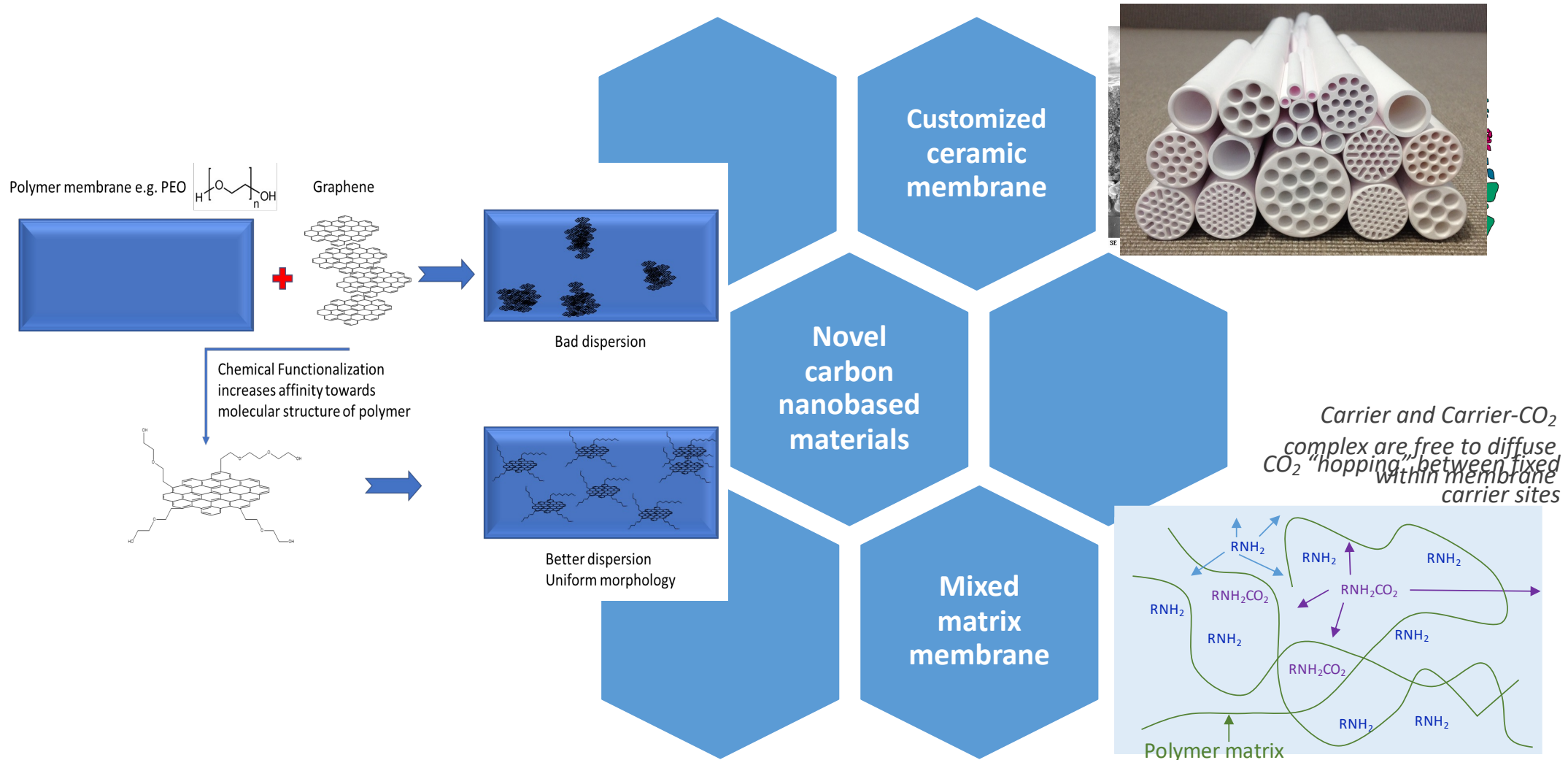
EASTERN PACIFIC SHIPPING | VM | Value Maritime

Japanese shipbuilding giant Mitsubishi announced on Monday (31 August) that it will build and test a carbon-capture system for ships, aimed at significantly reducing the emissions of the maritime sector.



Project Technology

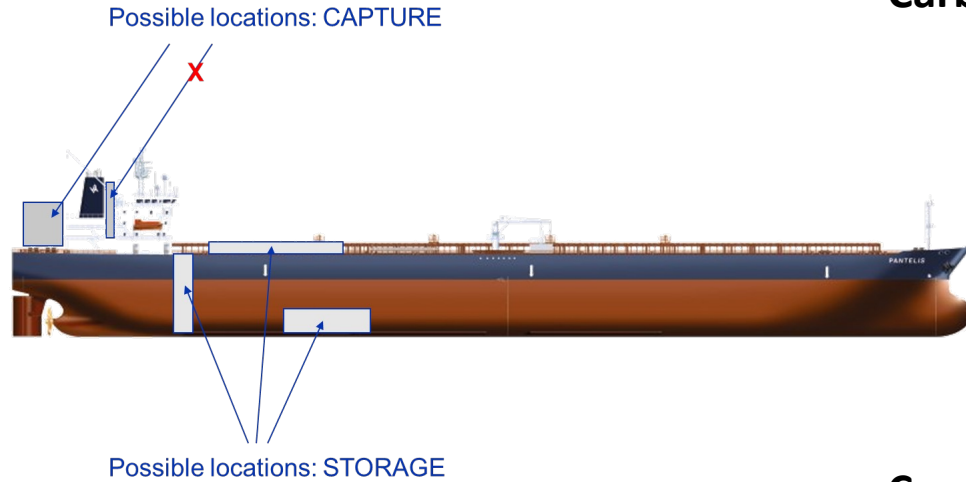
Re-design and optimization of membranes materials and processes



Project Innovation - Process Marinization

Maritime CO₂ storage options (Task Leader: DNV)

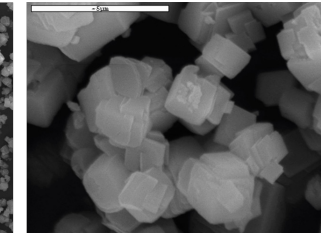
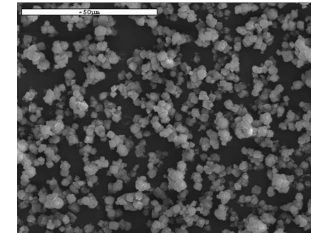
Carbon Capture and Storage options



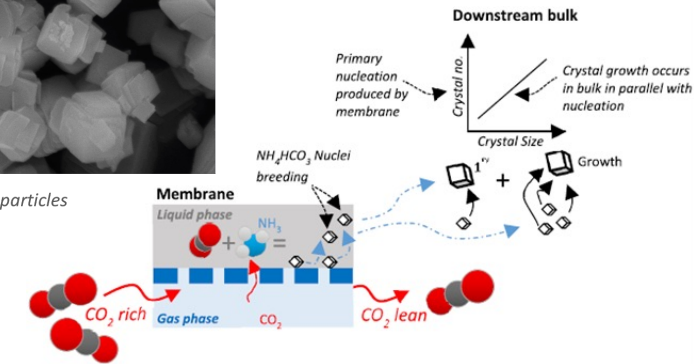
Carbon mineralization



Scanning Electron Microscopy – SEM



Homogeneous cubic Calcite particles

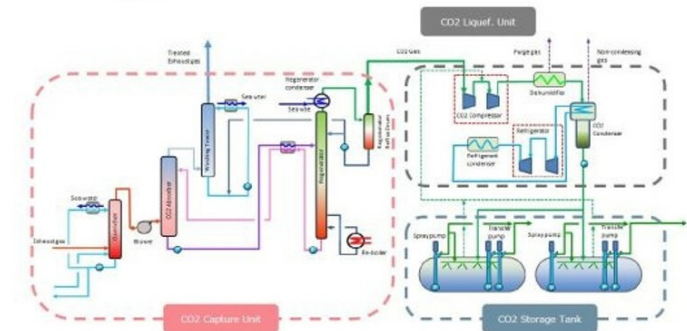


Liquefaction

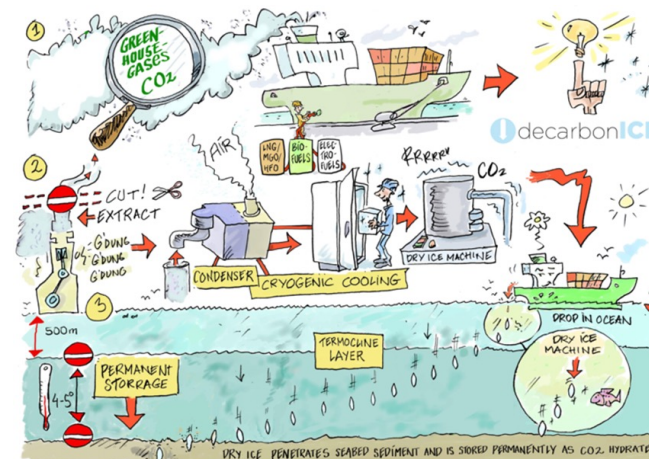
System Composition of CCS on board



- ◆ Liquid Amine absorption method CO₂ capture unit
- ◆ Liquefaction unit
- ◆ Storage tank



Conversion to hydrates



Carbon Storage Challenges

- Limited space onboard (cf. solidification)
- Sea motions (cf. liquefaction)
- Low CO₂ fractions
- Purity levels of the CO₂ product
- Seakeeping

Key Achievements

- A **case ship** for (virtual) membrane-based carbon capture system integration has been **selected** and **operating conditions and exhaust gas characteristics defined** (in close collaboration with **EURONAV**)
- **Selection, development and screening of membrane** (polymeric+graphene) & **solvents** (seawater, amine-based, metal hydroxides) for gas-liquid membrane capture.
- **Ceramic membrane** surface modification for **increased hydrophobicity** completed and evaluated.
- A **prototype pilot unit for ashore membrane testing** is being developed and **test protocols** for the experimental evaluation have been **defined**.
- **Process model for mass and energy balances** for membrane-based capture module assembly on-board ships scale-up.
- ✓ Recovery of the **main engine CO₂ emissions greater than 90%**
- ✓ **A 10-fold reduction of system volume** compared to a conventional amine-based scrubbing system.

Still pending:

➤ reduction of operating costs greater than 25%

➤ Overall CO₂ emissions reduction (including added emissions by the capture plant and utilities greater than 50%)