CO_2ASTS

Carbon capture, storage and transfer in shipping
A feasibility study

Workshop Alternative Fuels - 5 & 6 June - Hamburg/Leer

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co2asts
CO_2 ABFANG, SPEICHERUNG UND TRANSFER IN DER SCHIFFFAHRT

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ROLF JANSSEN GMBH
ELEKTROTECHNISCHE WERKE

Hafenwirtschaftsvereinigung Leer e.V.

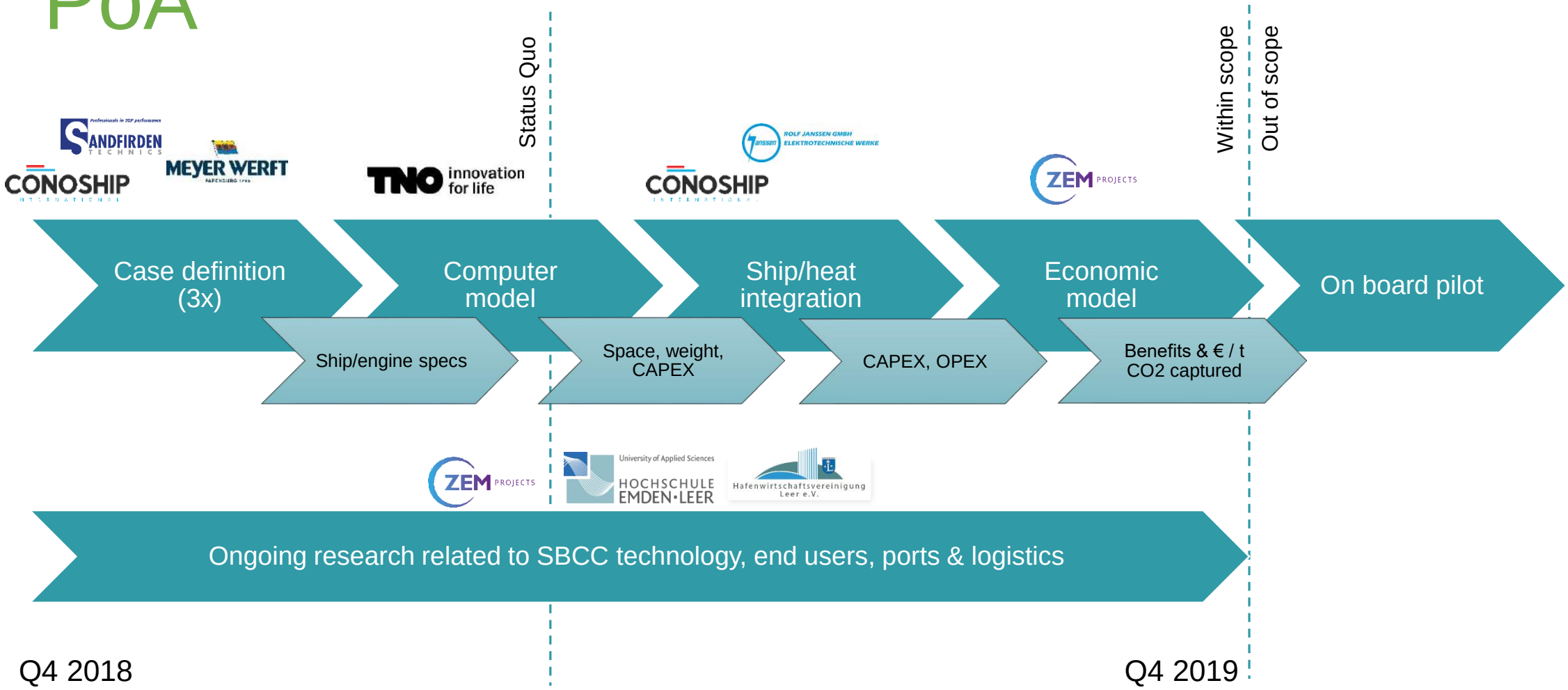
Our mission

A technical and economical feasibility study of SBCCS - Ship Based Carbon Capture and Storage

- Duration project: until end of 2019
- Focus on inland/short sea navigation
- LNG as fuel
- Primary goal: minimal costs / kg CO_2
- Secondary goal: maximum capture of CO_2
- 3 use cases:
    1. Sea river cargo vessel, 3000 t, LNG, 3 x 350 kW (new build)
    2. Ecodelta - dredger, dual fuel, 4 x 2 MW (retrofit ánd potential launching customer)
    3. Cruise ship, 70.000 t, 4 x 9 MW (new build)
        a) LNG fuelled
        b) Methanol fuelled (small assessment only as promising future fuel)
- Off the shelf components

Existing technology

PoA


Status Quo
Within scope
Out of scope
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Case definition (3x)
Computer model
Ship/heat integration
Economic model
On board pilot
Ship/engine specs
Space, weight, CAPEX
CAPEX, OPEX
Benefits & € / t CO2 captured
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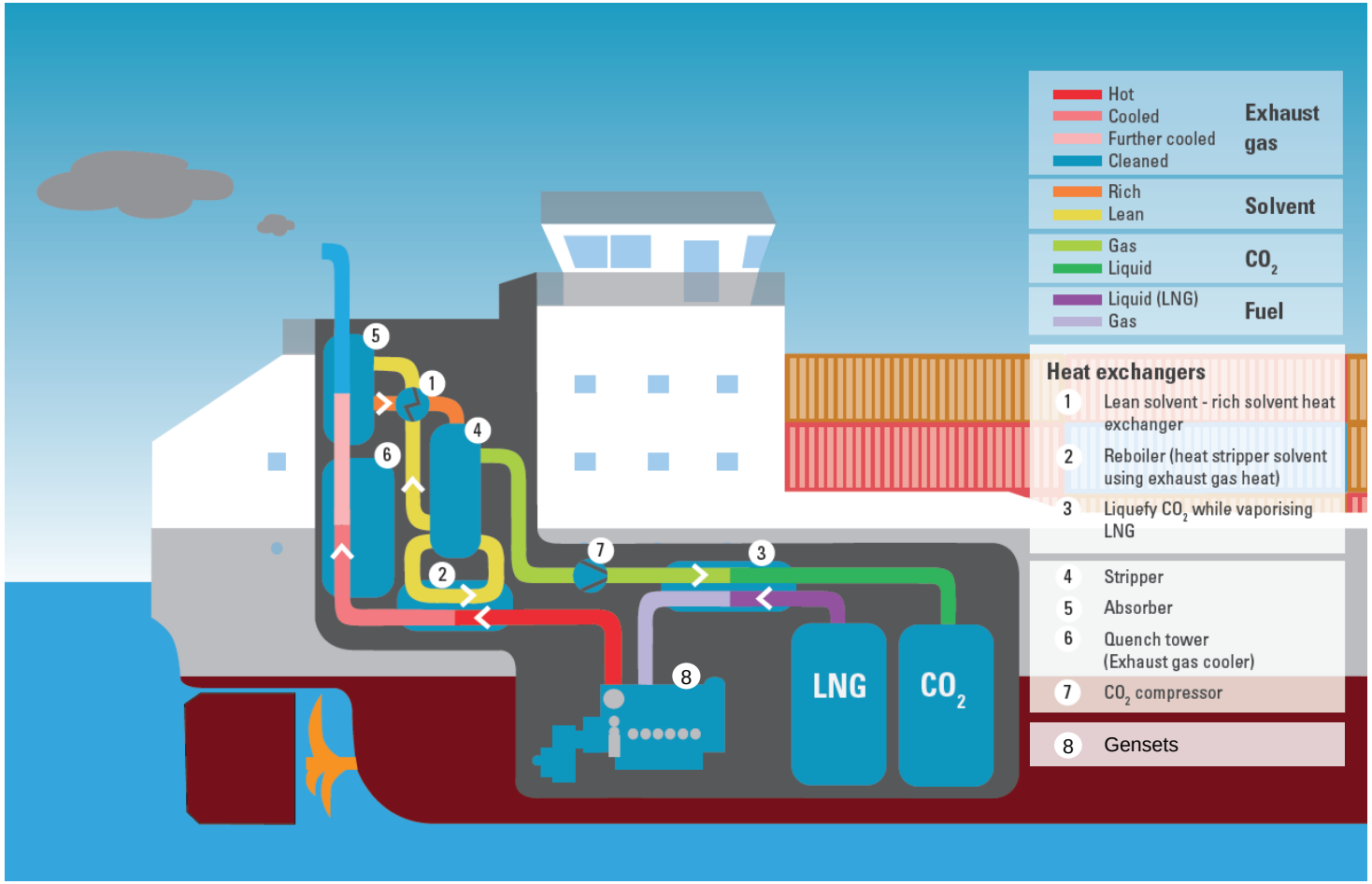
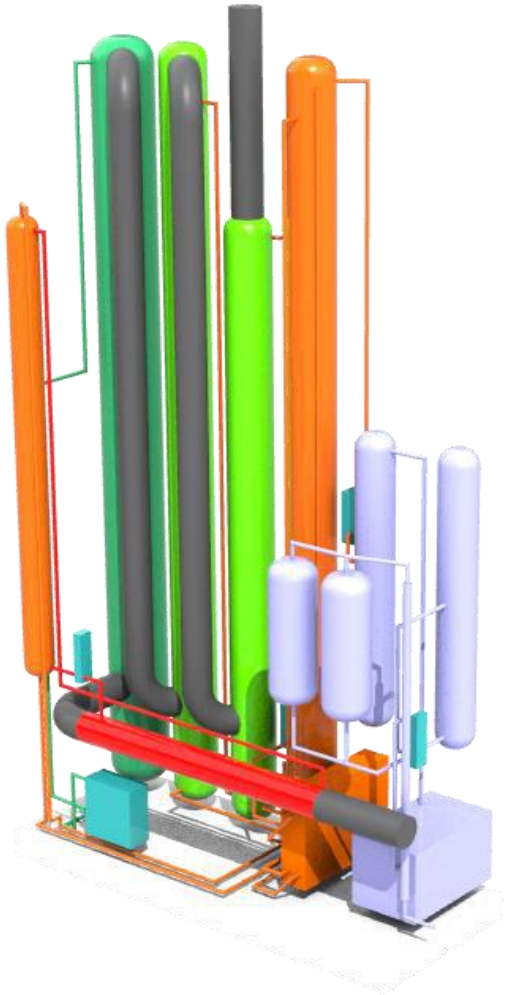
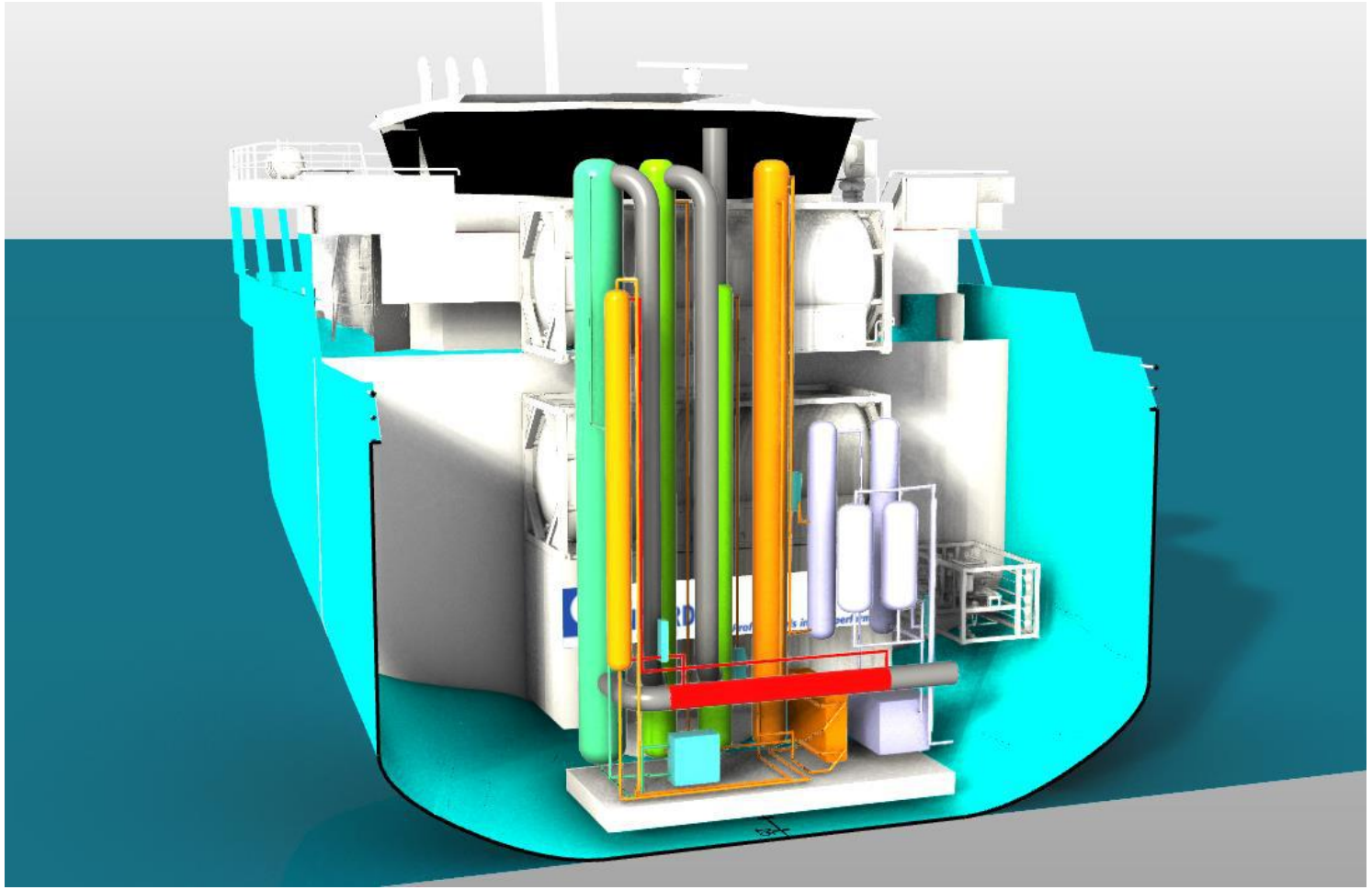
Ongoing research related to SBCC technology, end users, ports & logistics
Q4 2018
Q4 2019

Ship Based Carbon Capture & Storage





Ship integration



20-ft ISO container footprint

Equipment height limited to 10 m (use case 1)

Compression up to 7 bar and liquefaction at -50℃

Capture rate 75%

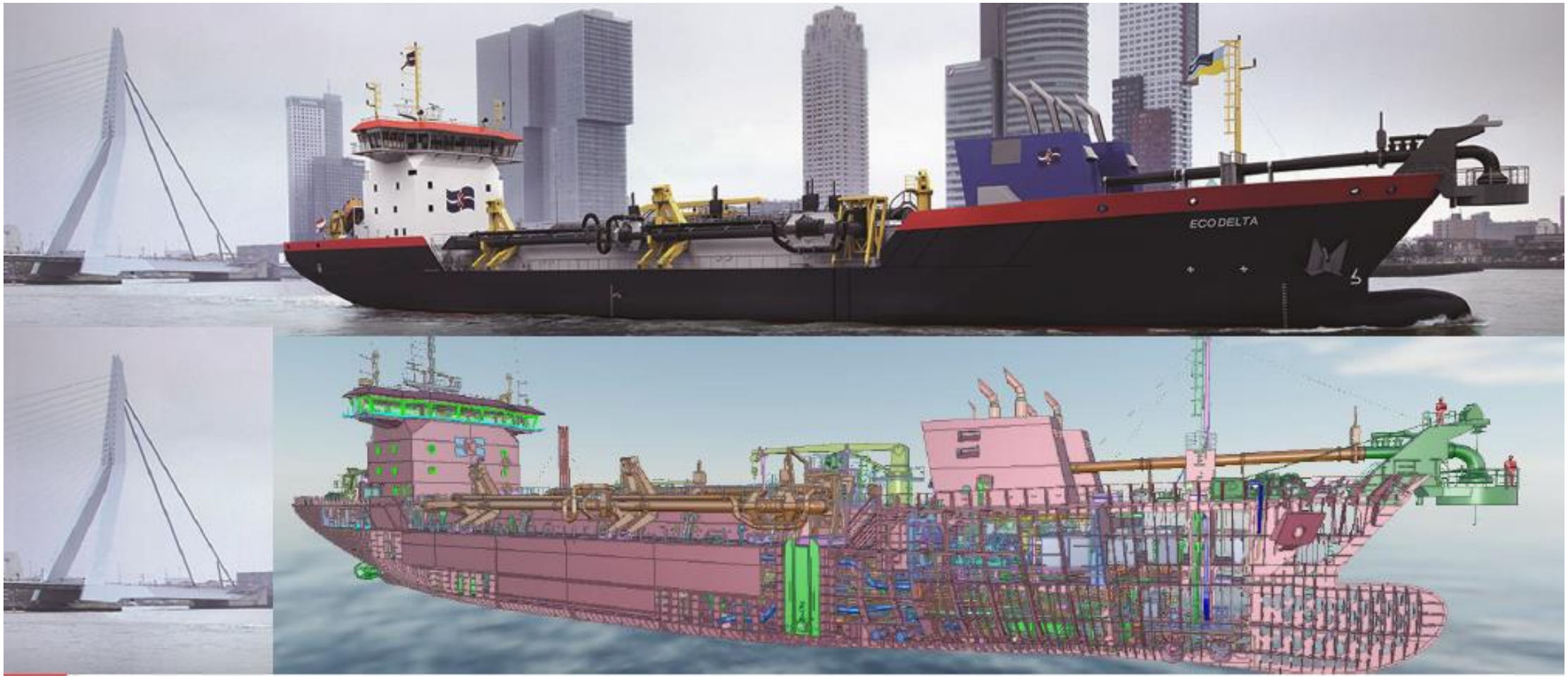
15 days of storage

~1.200 tpa (use case 1, depending on load/sailing profile)

Food grade

Total equipment costs ~1.300 kEUR (use case 1)

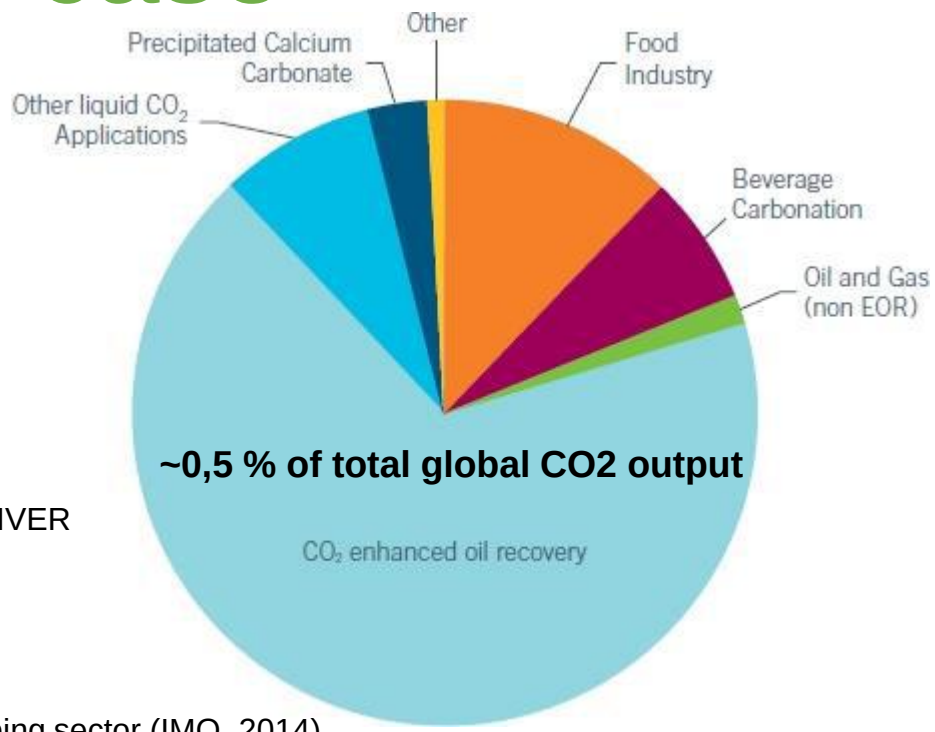
2019: Ecodelta 5500 m3 TSHD on LNG



Market analysis & business case

Status quo

- Annual worldwide total anthropogenic CO2 output (2010) ~30Gtpa
- Global shipping responsible for 3,1% of global CO2 emissions with 938 Mt in 2012 (IMO, 2014)
- Current global demand for CO2 is estimated at ~130 Mtpa
- CO2 price ~EU 30,- / ton (OCAP)
- IMO strategy (2018) reduce GHG gases by 50% by 2050 (compared to 2008)
- Up till now efforts on effciency, cleaner/low carbon fuels
- CCU projects e.g. OCAP Netherlands (green houses), AVR/Air Liquide, Twence mineralization, RIVER
- CCS projects e.g. Porthos Rotterdam

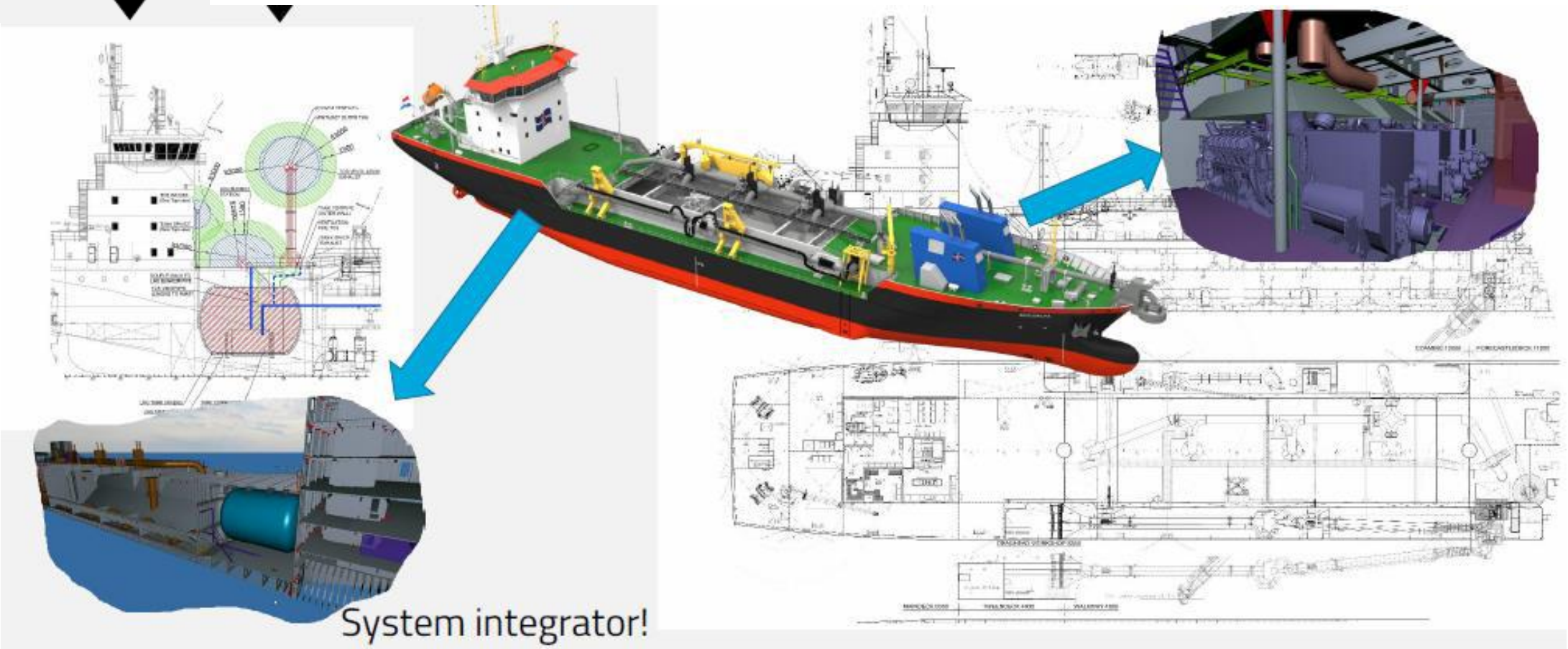


Existing bulk CO2 market (2011, Global CCS Institute)

Future

- Overall shipping CO2 emissions projected to rise with 50-250% up to 2050 due to growth of shipping sector (IMO, 2014)
- Future global demand for CO2 is expected to rise and estimated at ~140 Mtpa in 2020 (Global CCS Institute)
- **Hydrogen-based E-fuels: synthetic methane & methanol (H2 + CO2 → CH4 / CH3OH => close carbon loop)**
- CCU projects e.g. BioMCN (methanol) pilotplant Delfzijl, pilot methanol Antwerp, R&D synthetic kerosene
- CCS projects e.g. CO2 shipment Groningen – Norway & Basel – Rotterdam
- CO2 tax / monitoring / emission costs / market pricing?

Ecodelta: TSHD on LNG → H2 ready



Questions? / Statements:

“Ship based carbon capture is a future **license to operate** and it is feasible”

“But needs a **non-conventional / practical approach: use available industry-standard CO2-equipment modules** to assure an acceptable CO2 reduction on many ships (CO2 foot print AND economic)”

“CO2 will be a feedstock for future H2-based synthetic fuels: capture it and sell it to the fuel-companies!”

“**Actual LNG-fuelled ships are H2-ready** (for liquified synthetic CH4) if CO2 capture and (liquid) storage can be fitted on board”