

TNO

Solvent based CO₂ Capture activities

CATO event 2023

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Energy Cave, Rijswijk**



The topics discussed today:



Emission control



Solvent management



Mobile CO₂ Capture pilots



Concept studies



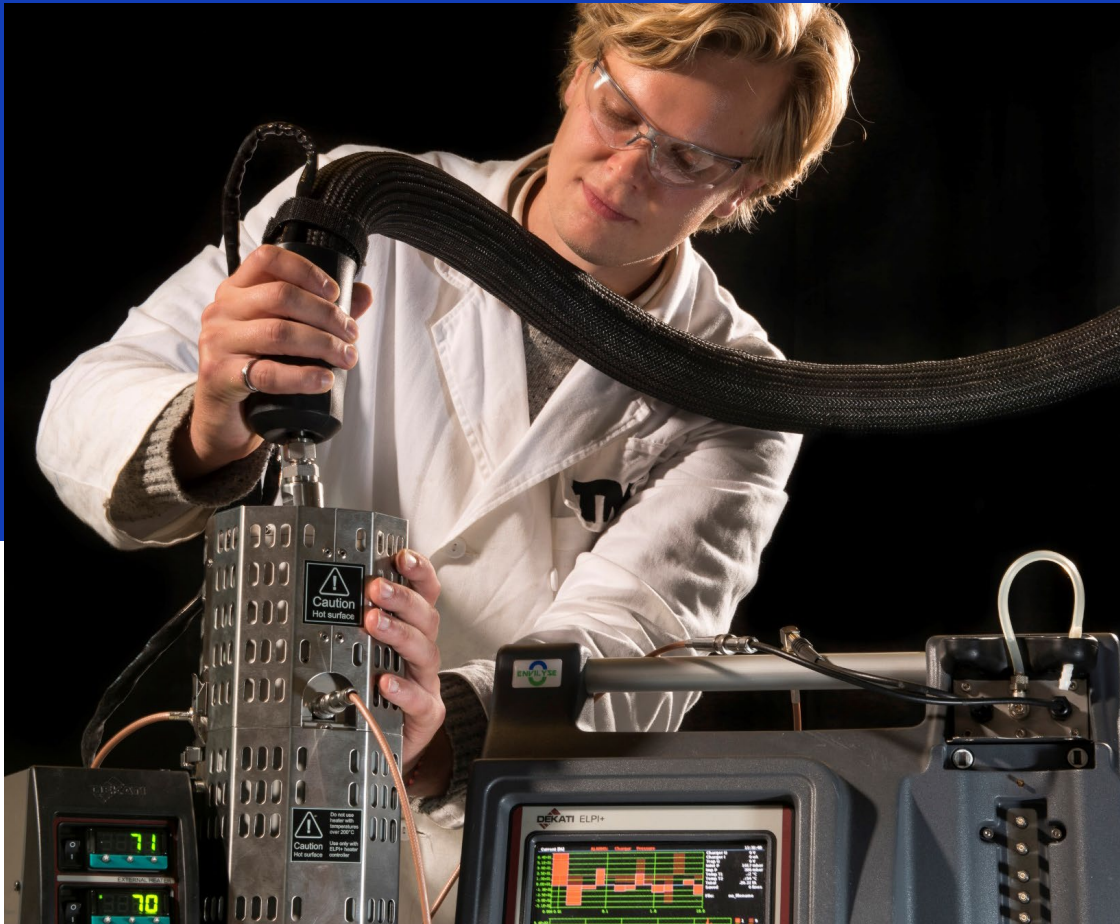
Ship based Carbon capture



Cluster Tool



Emissions monitoring and control



- Volatile and aerosol emissions during plant operation should be controlled
- Emission mitigation tools: (double) water wash, acid wash, dry bed, Brownian Demister Unit (20 configurations)
- Test of emission mitigation tools at CO₂ capture rates: 90, 95 and 98%
- Test campaigns at different solvent aging: 500, 5000 and >10000h solvent
- Instruments: FTIR, particle size distribution (ELPI and optical particle counter)
- More information:

ALIGN_{CCUS}

LAUNCH

SCOPE

Operation of a BDU at Twence



16th International Conference on Greenhouse Gas Control Technologies **GHGT-16**

23-27th October 2022, Lyon, France

Aerosol and volatile emissions control in an amine-based CO₂ capture plant

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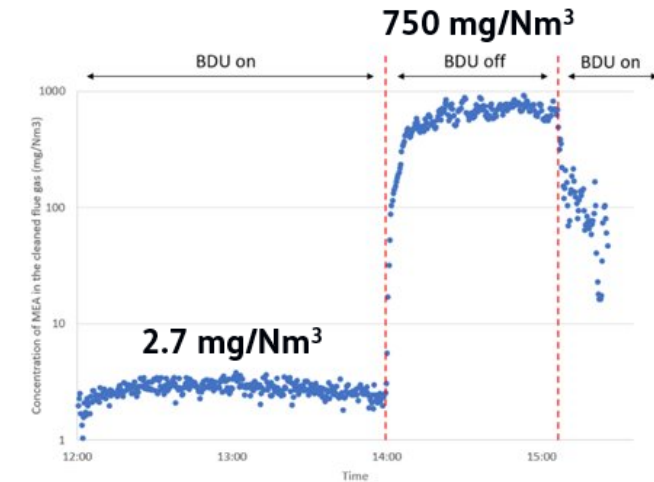
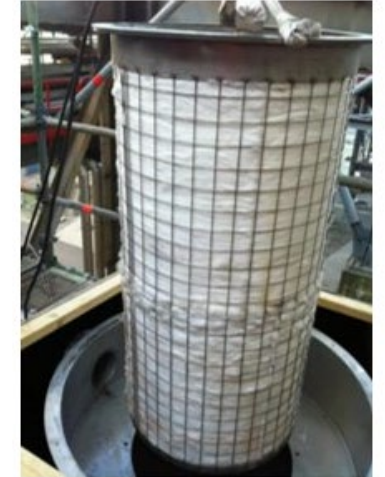
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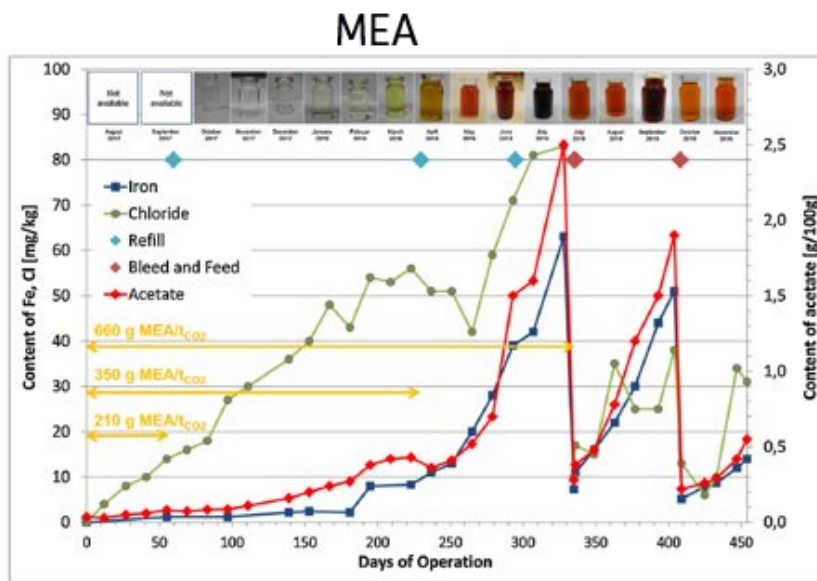
Commercial operation
of BDU for aerosol
emission mitigation

10,000+ hours of
operation, sustained
efficiency

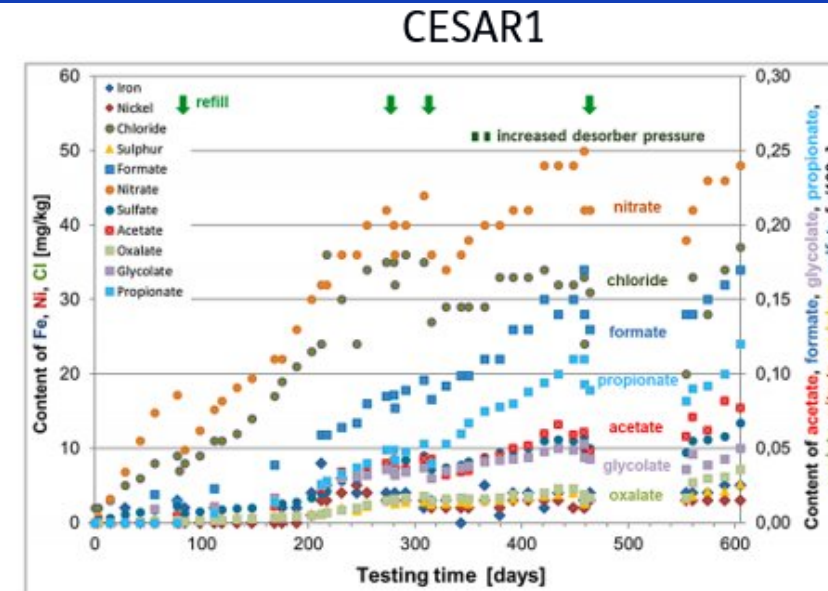


J. Monteiro *et al.*, "Aerosol emission at a post combustion CO₂ capture plant at Twence (WtE facility), 2021.

Solvent management strategies



Source: P. Moser *et al.*, "Results of the 18-month test with MEA at the post-combustion capture pilot plant at Niederaussem – new impetus to solvent management, emissions and dynamic behaviour," *Int. J. Greenh. Gas Control*, vol. 95, p. 102945, Apr. 2020, doi: 10.1016/j.ijggc.2019.102945.



Source: P. Moser *et al.*, "ALIGN-CCUS: Results of the 18-Month Test with Aqueous AMP/PZ Solvent at the Pilot Plant at Niederaussem – Solvent Management, Emissions and Dynamic Behavior," *SSRN Electron. J.*, 2021, doi: 10.2139/ssrn.3812132.

Solvent degradation is a well known issue in CO₂ capture plant operations that can lead to corrosion of materials, foaming, the need to replace solvent, **increase in waste management**, equipment failure and emissions.

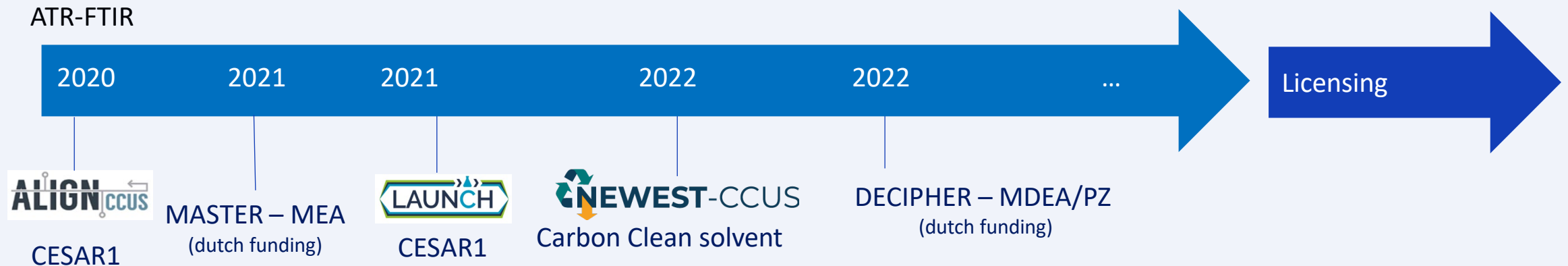
Solvent management strategies



- **Solvent management technologies tested by TNO:** bleed and feed, NO_x removal, quench operation, reclaiming, activated carbon bed and DORA (TNO technology).
- Monitoring the solvent quality is essential during operation. TNO is developing an **online solvent monitoring tool**.

Online solvent monitoring

- Technology in early stage of development
- Connect to lean and rich solvent lines
- Preliminary tests in the lab with different solvents
- Integral part of a solvent management system, which also includes degradation models and control technologies

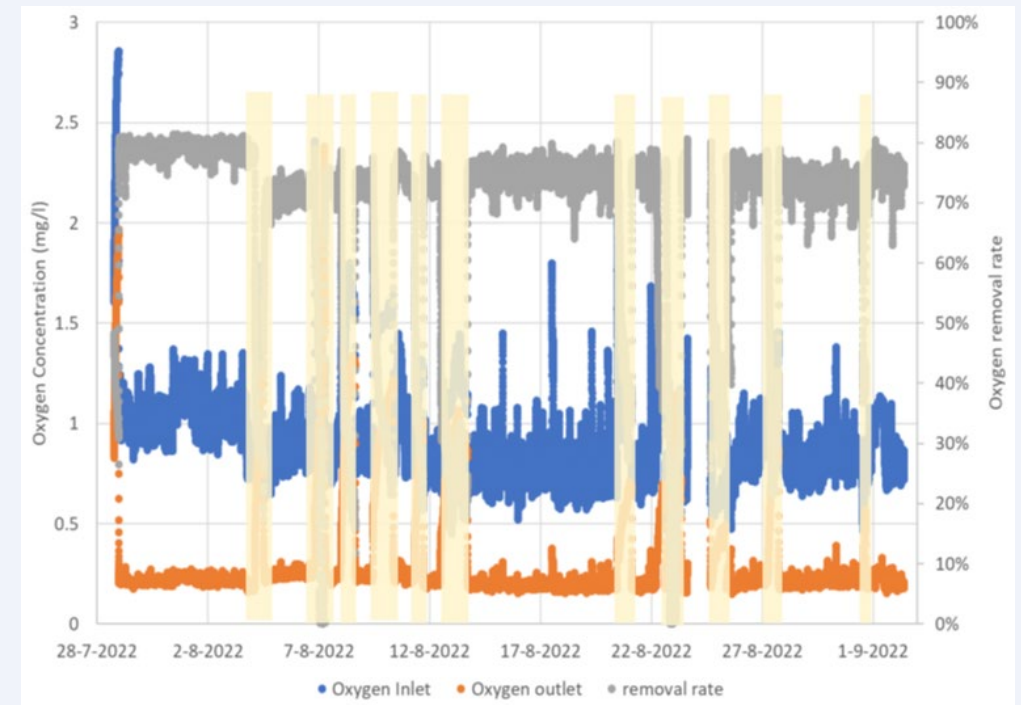


TNO's Oxygen removal technology

TNO is working on the DORA technology to remove dissolved oxygen using selective membrane removal in the rich solvent line. The current DORA skid is able to process 10-57 m³/hr and has been tested at the pilot CO₂ capture system at HVC, Alkmaar. These tests show significant oxygen removal from the rich solvent.



Oxygen removal with a membrane, DORA (TNO)



MeDO₂RA

Mobile CO₂ Capture Pilots

TNO Miniplants



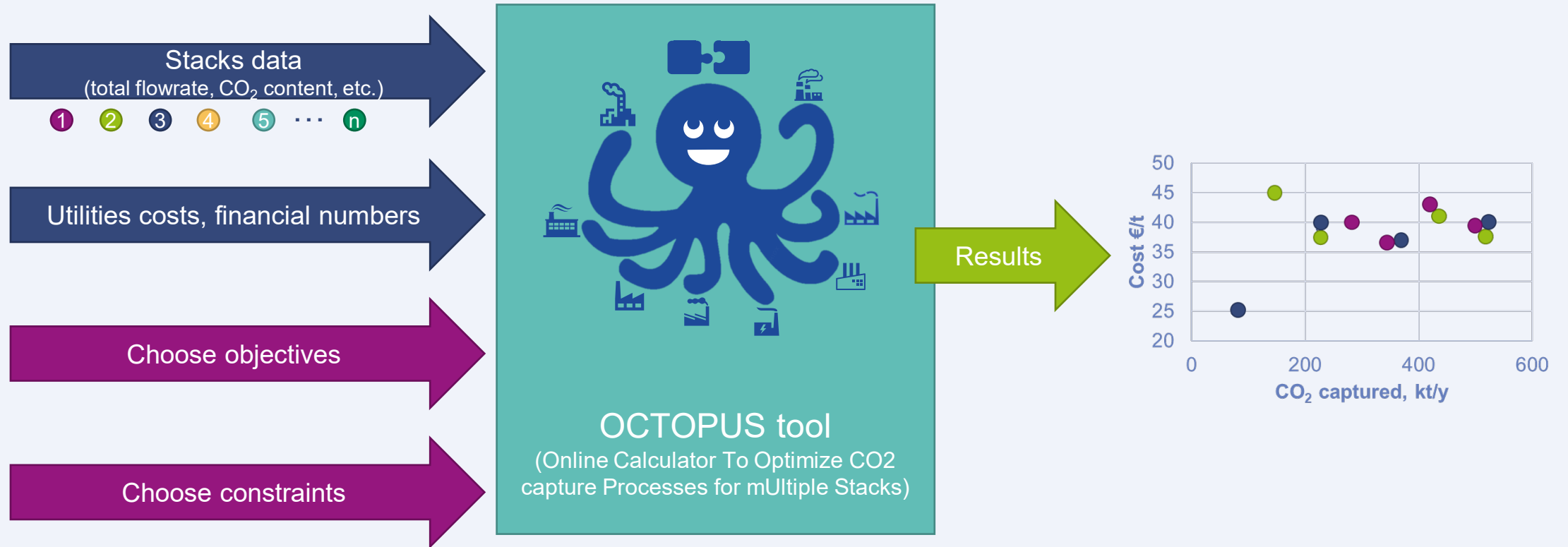
- Full cycle: absorption + desorption, continuous 24/7 operation
- Capacity:
 - 3-5 Nm³/h of gas (synthetic gas mixtures, real flue gases)
 - Up to 25 kg/h of solvent circulation
- Example of research targets:
 - De-risk operations with novel solvents, bring technology to TRL6
 - Quantify foaming tendency, corrosivity, and degradation rate of solvents
 - Verification of thermodynamic models for cyclic capacity
 - Initial verification of energy numbers
 - Quantify emissions (volatile- and aerosol-based) and test emission mitigation technologies
 - Provide crucial information for potential buyers of scaled up plants through ON SITE testing

Concept studies

The goal is to help companies enter the CO₂ Capture market with the necessary knowledge to guide all decision making during the process towards implementation including the permitting process

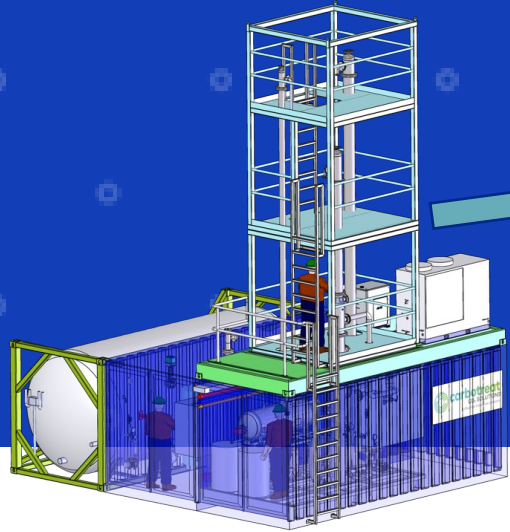
- Define boundary conditions and requirements for the pilot capture plant
- Flue gas data acquisition and evaluation
- Simulations of the pilot capture plant for optimization and sizing of the process
- Overview of emission and solvent management strategies, in relation to the flue gas
- Advice with solvent selection
- Create the final process flow diagram (PFD) for the capture plant
- Estimate CAPEX and OPEX costs, footprint ect.
- Education of the customer

Octopus tool

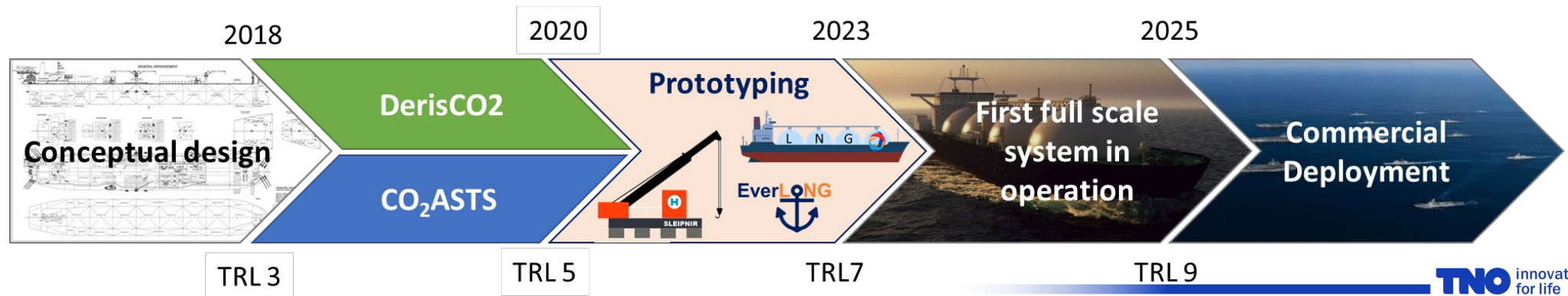


Ship Based Carbon Capture

EverLoNG



ReMarCCAbLE (Realising Maritime Carbon Capture to demonstrate the Ability to Lower Emissions)



Thank you for your attention!