Ship based carbon capture – SBCC

ACT Knowledge Workshop 2022

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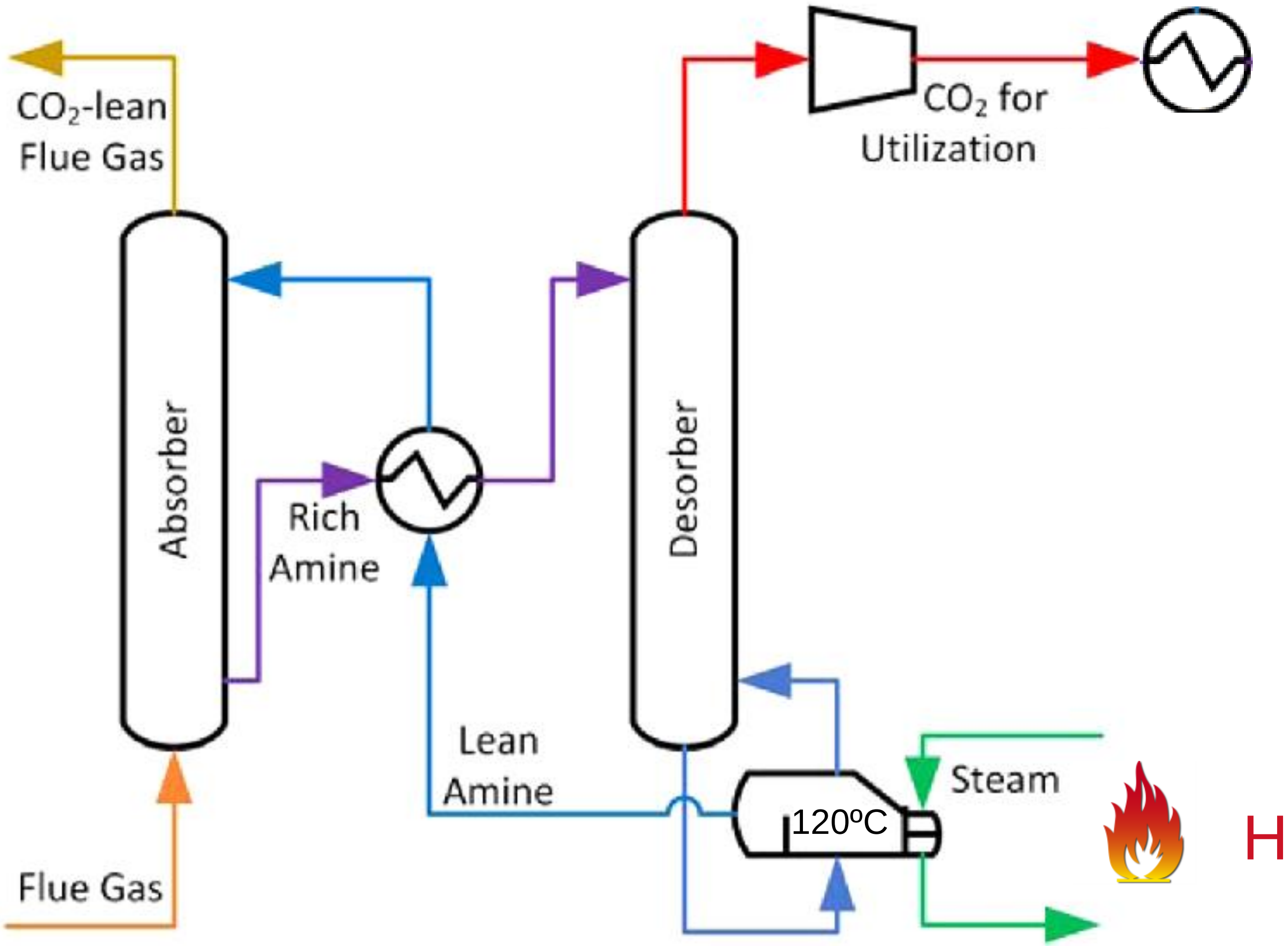
Partners

SBCC Technology: CO_2 capture



Cooling demand

Liquid CO_2

-50ºC
-20ºC

Heat demand

SBCC: Heat integration

Vaporizer

LNG evaporation
From -160ºC to 0-30ºC

← Heat

CO_2 liquefaction
From 40ºC to -20ºC

Reboiler

Exhaust cooling
From 380ºC to 40ºC

Heat →

Amine regeneration
At 120ºC

Activities

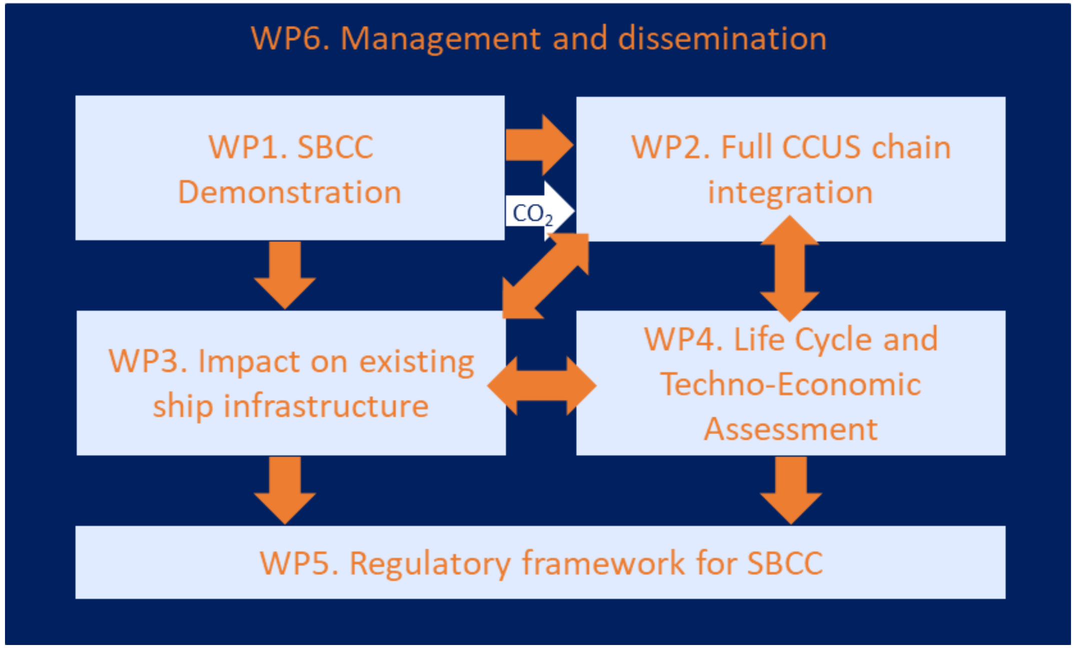
WP1: Demonstration of SBCC prototype onboard of 2 ships
- Design and build prototype
- Demo at Heerema's Sleipnir and TOTAL's LNG carrier

WP2: Full CCUS chain integration
- Develop offloading strategies & connection to planned storage infrastructure
- Roadmap towards European off-loading network/Interoperability Industry Group
- Investigate connection with storage and utilization projects/activities

WP3: Impact on existing ship infrastructure
- Two cases studied in detail (Sleipnir, TOTAL): conceptual design

WP4: Life cycle and techno-economic assessment
- For the 2 detailed cases
- TEA: 1st of a kind, Nth of a kind (standardization)

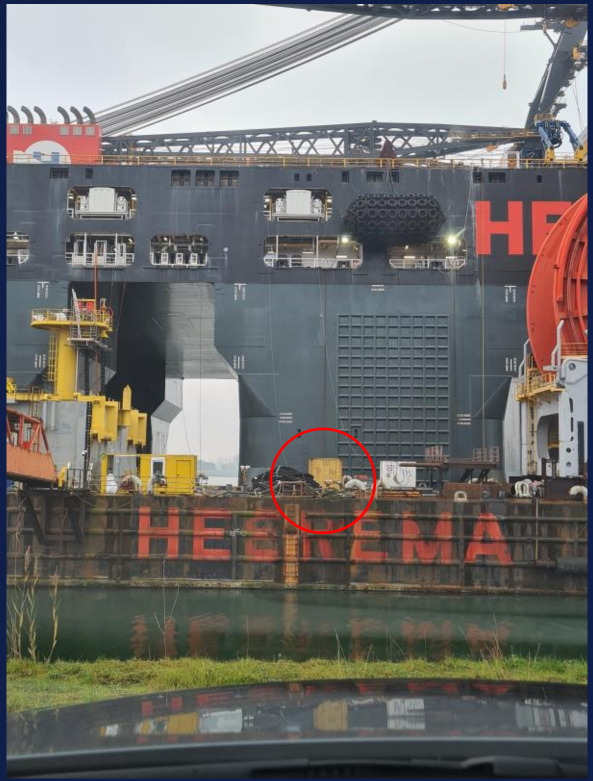
WP5: Regulatory framework for SBCC
- Gap analysis in existing regulation
- Risk analysis (HAZID, HAZOP)
- Disseminate SBCC among international regulatory regimes



WP1 structure

- Task 1.1 - Piloting of TNO small scale CO2 capture plant on-board of the Sleipnir ship
- Task 1.2: Design of the SBCC prototype
- Task 1.3: Prepare ships for demonstration
- Task 1.4: Realization of containerised prototype
- Task 1.5: Continuous operation of containerised prototype

Task 1.1- Piloting of TNO small scale CO2 capture plant on-board of the Sleipnir ship



Task 1.1 - Piloting of TNO small scale CO_2 capture plant on-board of the Sleipnir ship

- Work performed in December 2021
- 225 hours of campaign, using MEA (benchmark solvent to be used in the prototype)
- Capture efficiency between 72% and 63% with different settings
- Lessons learned → incorporated in the design of the prototype unit

Video

Task 1.2: Design of the SBCC prototype

- Scale:
    - 250 kg/day of CO_2 captured (10,4 kg/h)
    - 100-150 Nm^3/h of exhaust gas
    - Up to 95% capture efficiency possible

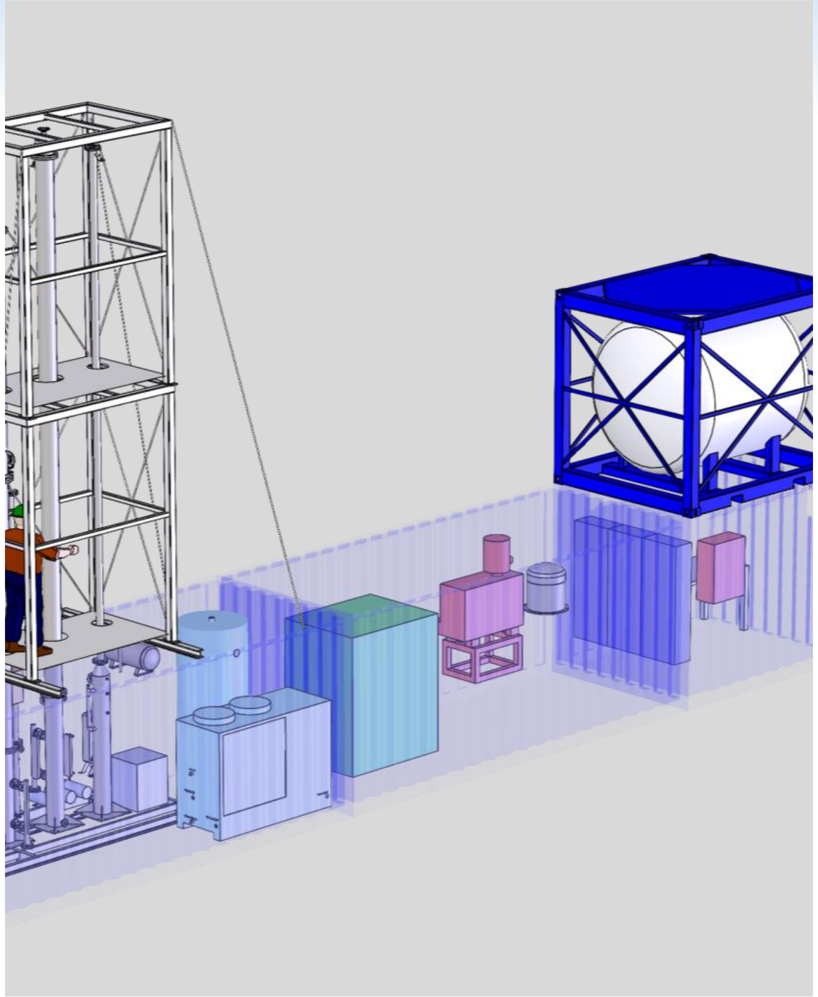
- Sizes of main elements (columns, pumps, compressors, heat exchangers) defined

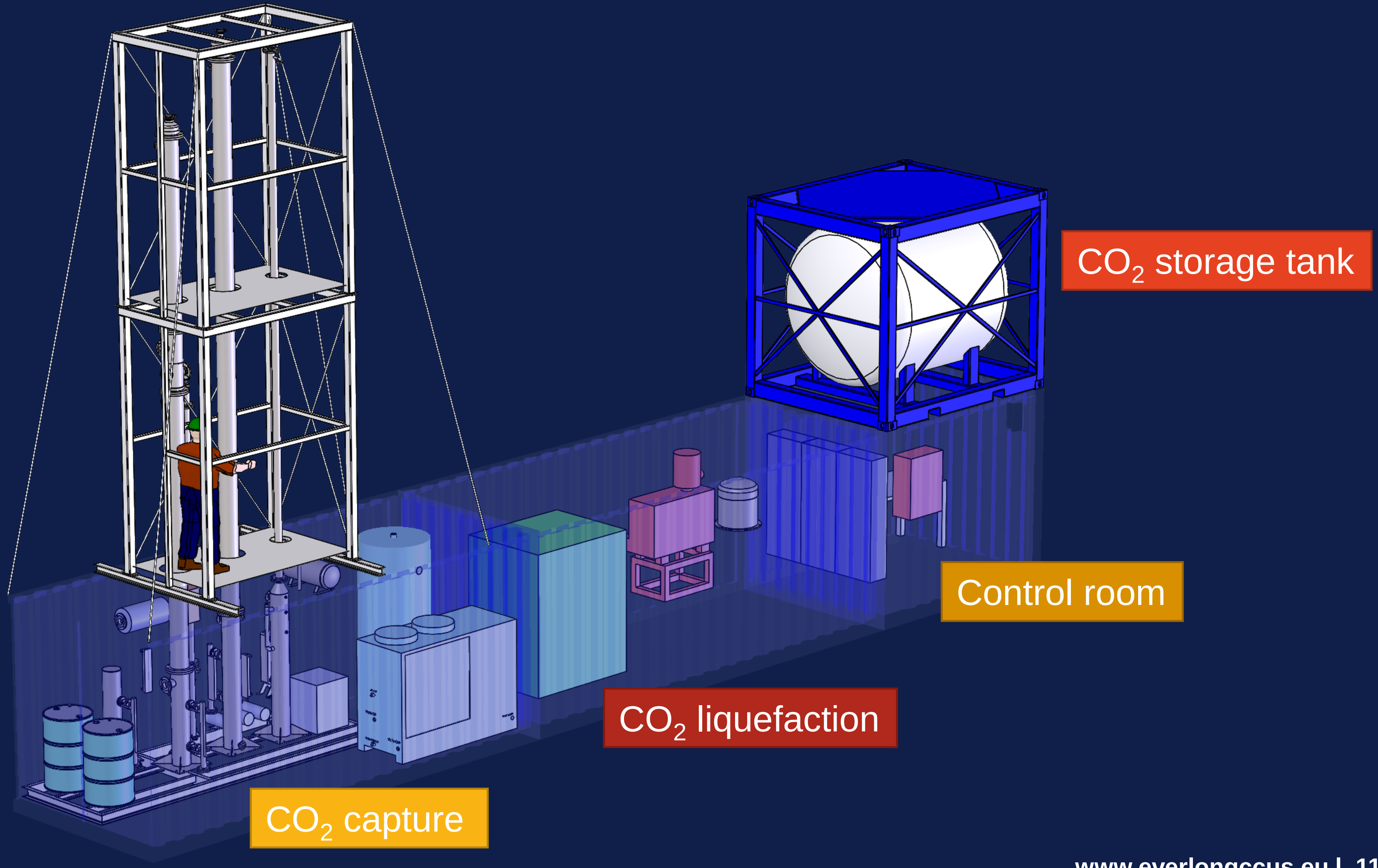
- HAZOP led by LR

Task 1.4: Realization of containerised prototype

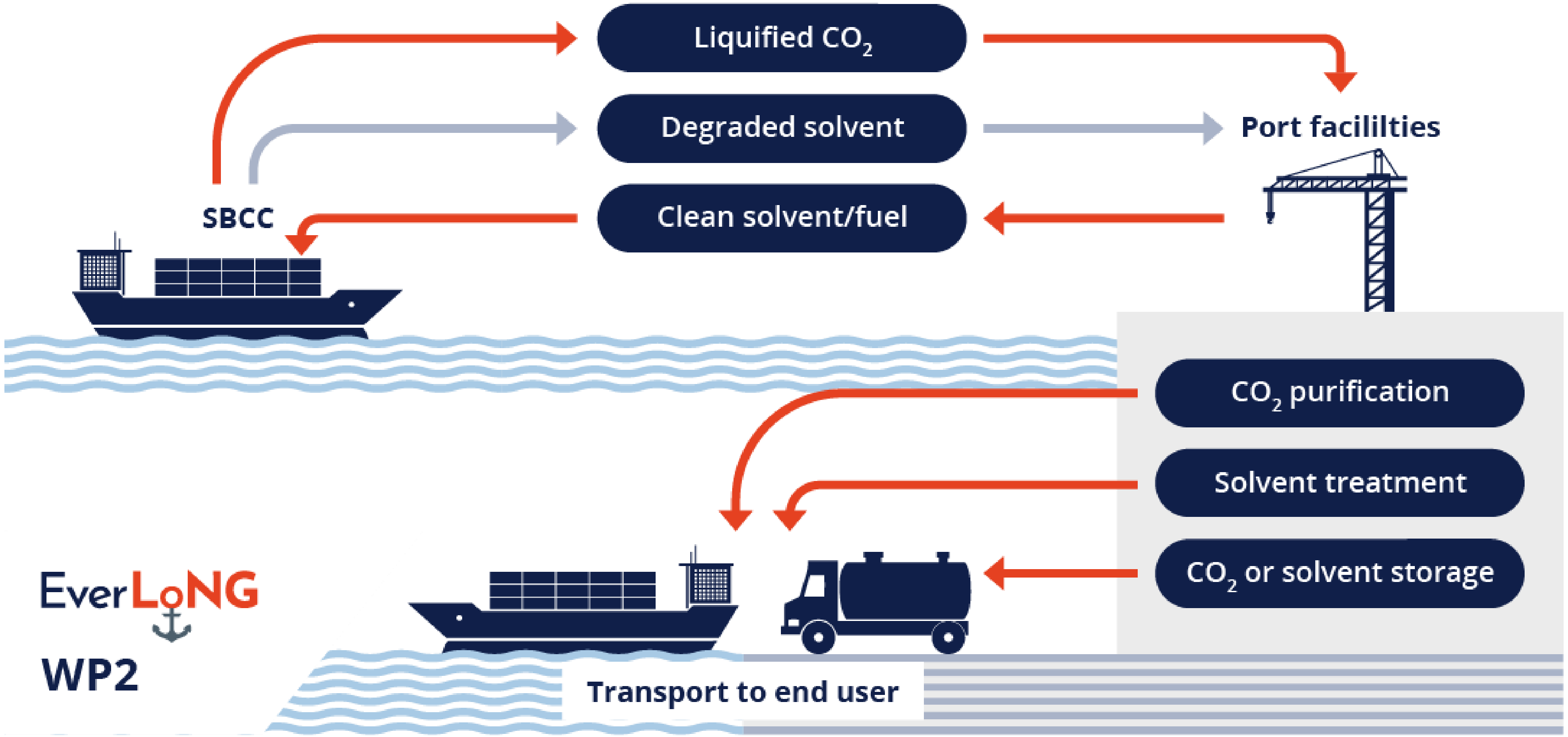
- Subtask 1.4.1 Engineering, procurement, construction and commissioning of the prototype

- Subtask 1.4.2 Prototype validation campaign
  - 100h campaign to validate the system in the lab




CO_2 storage tank
Control room
CO_2 liquefaction
CO_2 capture

WP2 – Full CCUS chain integration



WP2 – Full CCUS chain integration

- Task 2.1 "Develop offloading strategies and connection to planned storage infrastructure"
- Task 2.2 "CO2 shipping interoperability and port readiness"
- Task 2.3 "Roadmap towards a European off-loading network"
- Task 2.4 "Demonstration of CO2 storage and/or utilization“

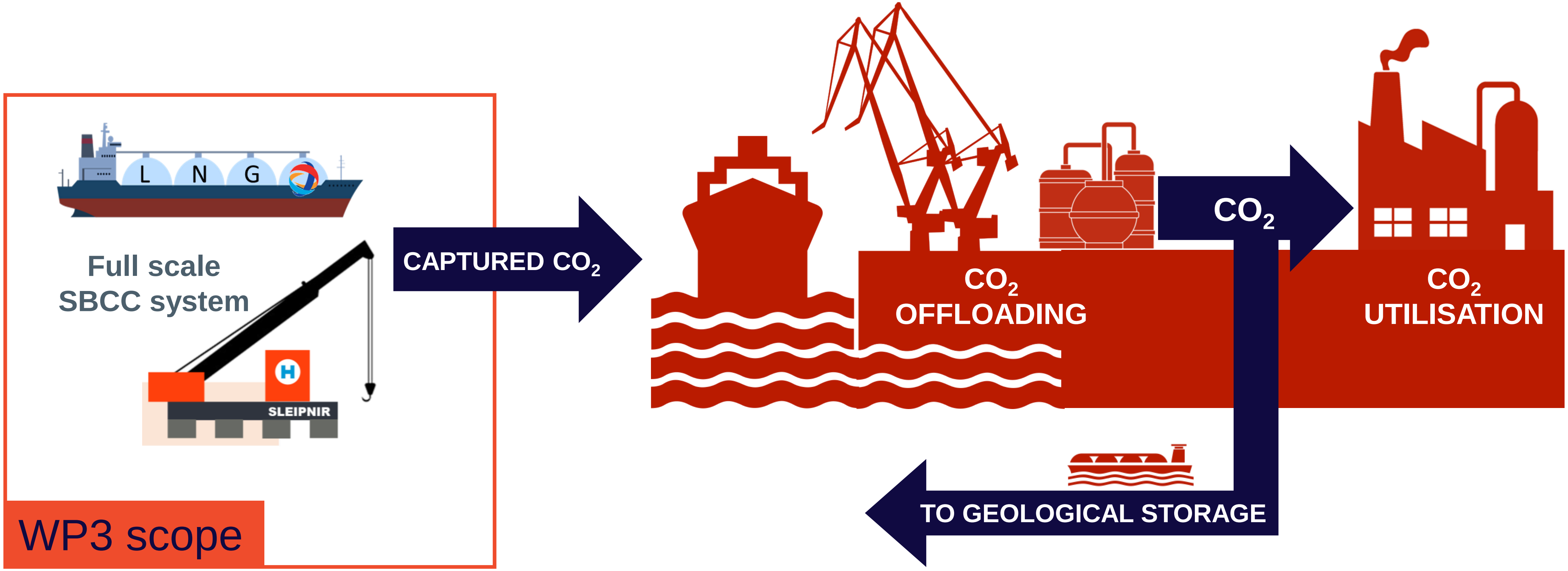
- As part of Task 2.1:
  - Define full CCUS chain cases
  - Investigate rich solvent/liquid CO_2 offloading alternatives
  - CO_2 reconditioning and solvent reclaiming port facilities

Transport to Cologne (RWE)

https://rotterdam.navigate-connections.com/network

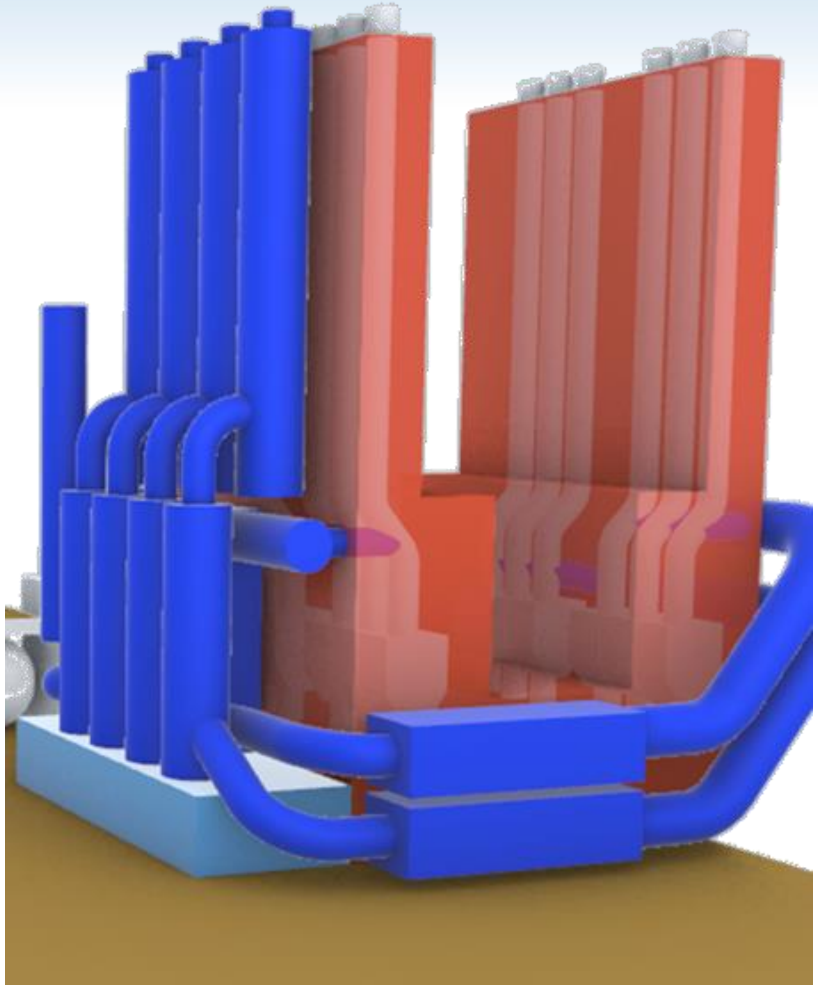
Direct connections for Port of Rotterdam (693 unique locations)

WP3 – Impact on existing ship infrastructure



WP3 – Tasks

- Task 3.1: Concept analysis of the full scale systems
- Task 3.2: Analysis of heat integration between SBCC and the ship's systems
- Task 3.3: Research on the integration and impacts of full-scale SBCC on the ships
- Task 3.4: Concept development of (criteria for) standardized full scale SBCC systems



WP4 – Life cycle and techno-economic assessment

Objective:

Assessment of ecological impacts and the costs of SBCC on the full CCUS chains to verify the achievement of the CO_2 emission reduction and cost-effectiveness targets in EverLoNG

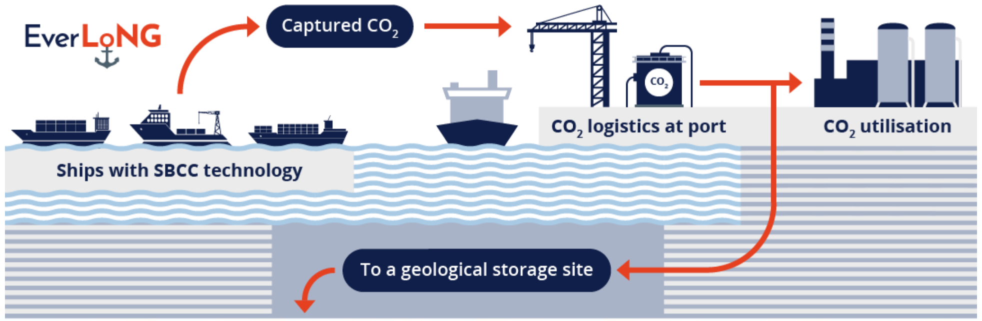
Tasks:

- LCA of SBCC with geological storage and LCA of SBCC with utilization
- Techno-economic assessment of the full-scale SBCC and of the full CCUS chains

Working group defining system setups for process routes

1st Workshop for Agreement has been taken place on Process Chain Designs and Structure

Definition of: Process chains, Technology status-quo, System boundaries, Framework conditions, Benchmark technologies, Data exchange



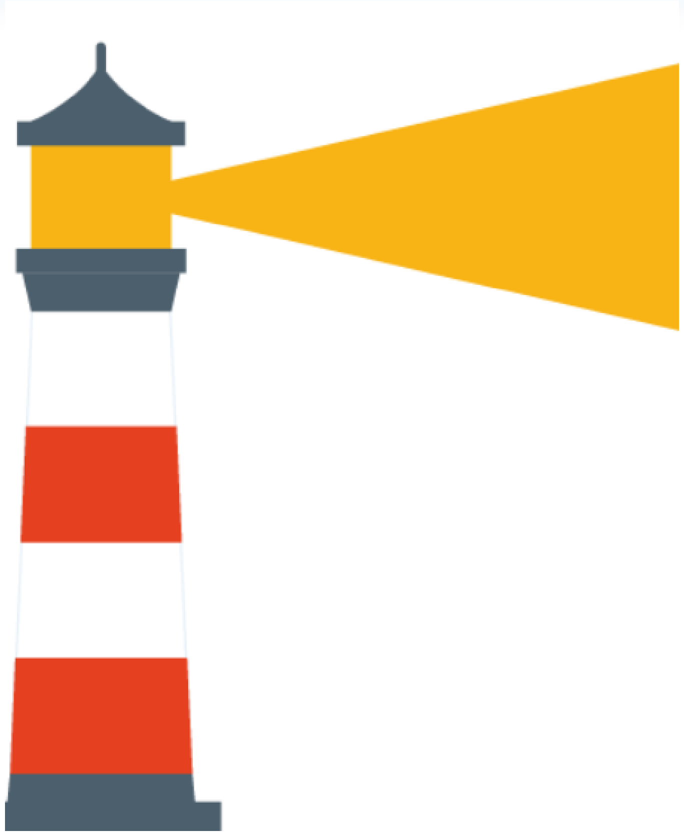
WP5 – Regulatory framework for SBCC

- Analyze & review the Ship-Based Carbon Capture (SBCC) technology to determine **safety challenges** for the use cases identified in WP3.

- Address the **alternative design and arrangements** for the novel SBCC technologies on LNG fueled ships (EverLoNG) with the design process, see WP1, WP2 and WP3.

- **Disseminate** the insights created during this work package to the relevant international bodies to educate and inform the wider maritime industry of the SBCC technology.

- *Note: Class and Regulatory approvals are beyond the scope of this research project*



WP5 – Progress

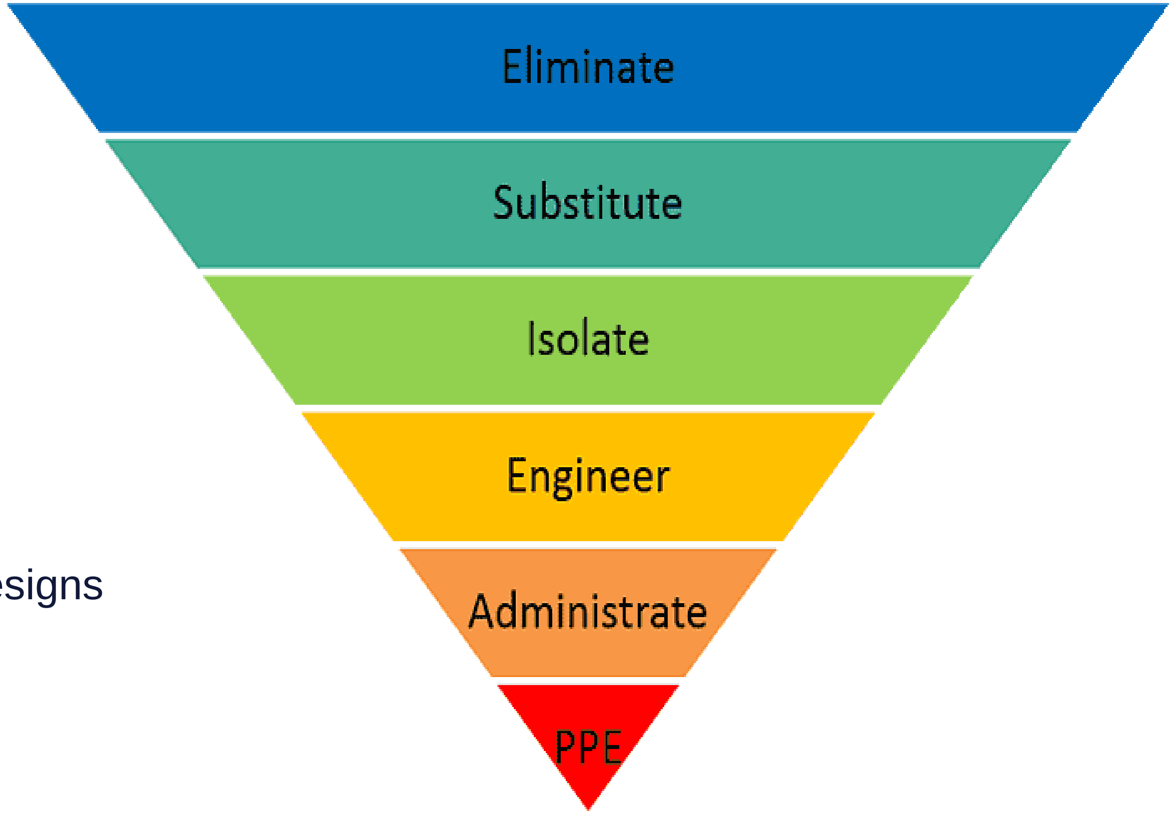
- *Technically **not** started*

However...

- Active involvement in risk assessments for WP1

Why?

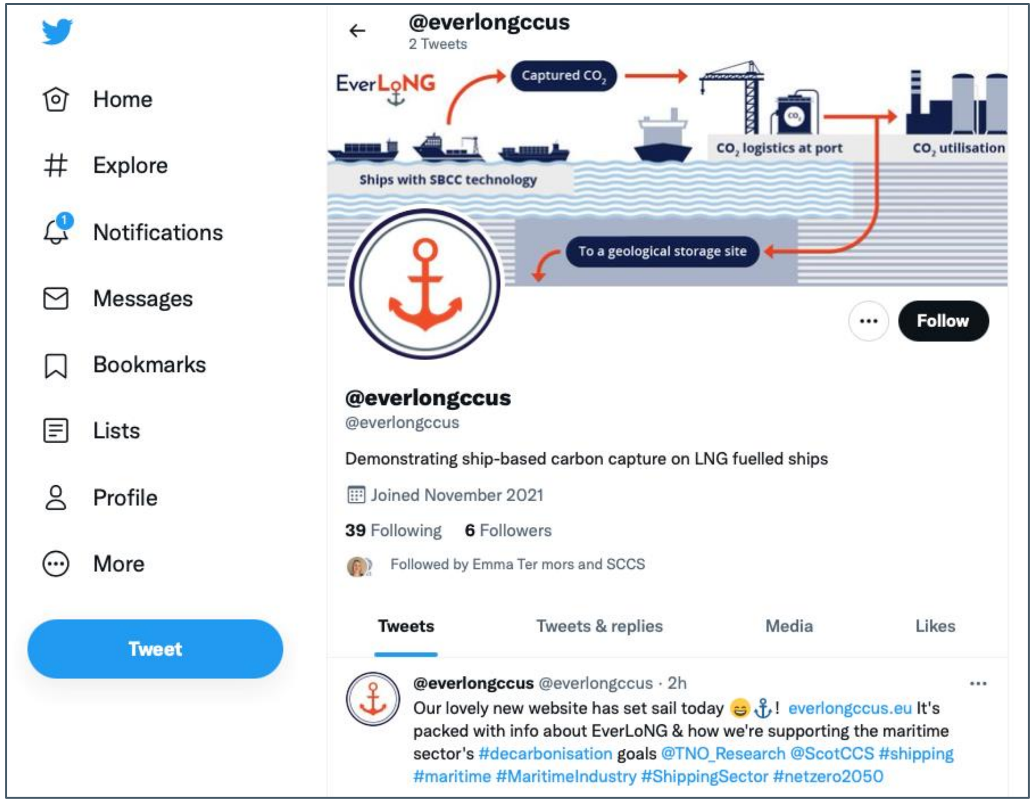
- Risk and design are strongly interlinked
- Early identification = Easier Control = Inherently safer designs
- Risk reduction is a process and a mindset



WP6 – Dissemination

Website & Social Media

- The website is live at everlongccus.eu
- Follow us on LinkedIn linkedin.com/company/everlong-ccus/
- Follow us on Twitter and Instagram searching the handle @everlongccus
- EverLoNG YouTube channel will host video material
- Subscribe to the project Mailing List using the form on the website



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Thank you for listening

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