Carbon Transport Ship (CTS) project – Baltic and Black sea scenarios

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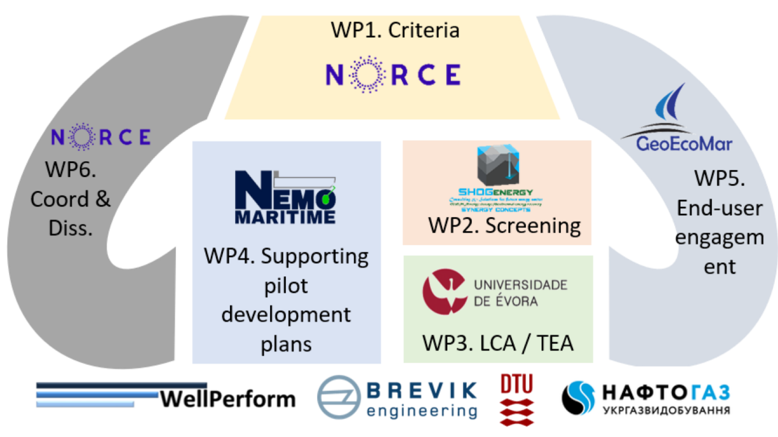
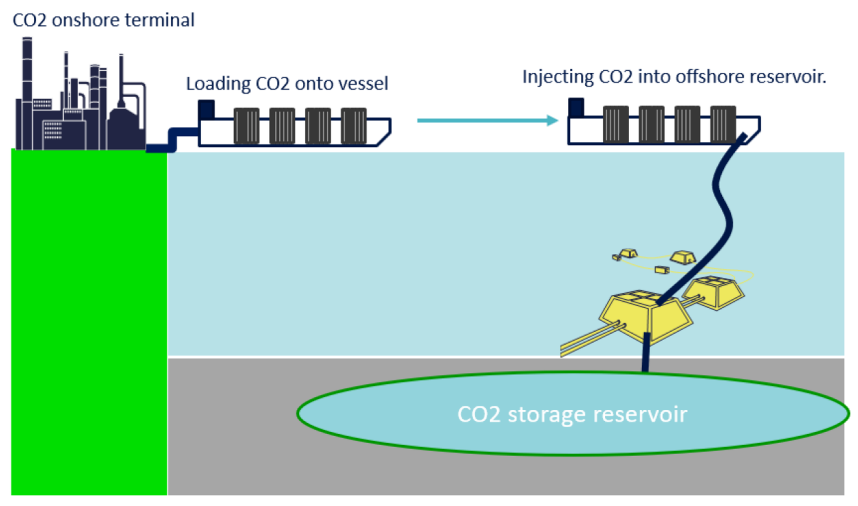
CO2 Transport and Storage directly from a ship: flexible and cost-effective solutions for European offshore storage.

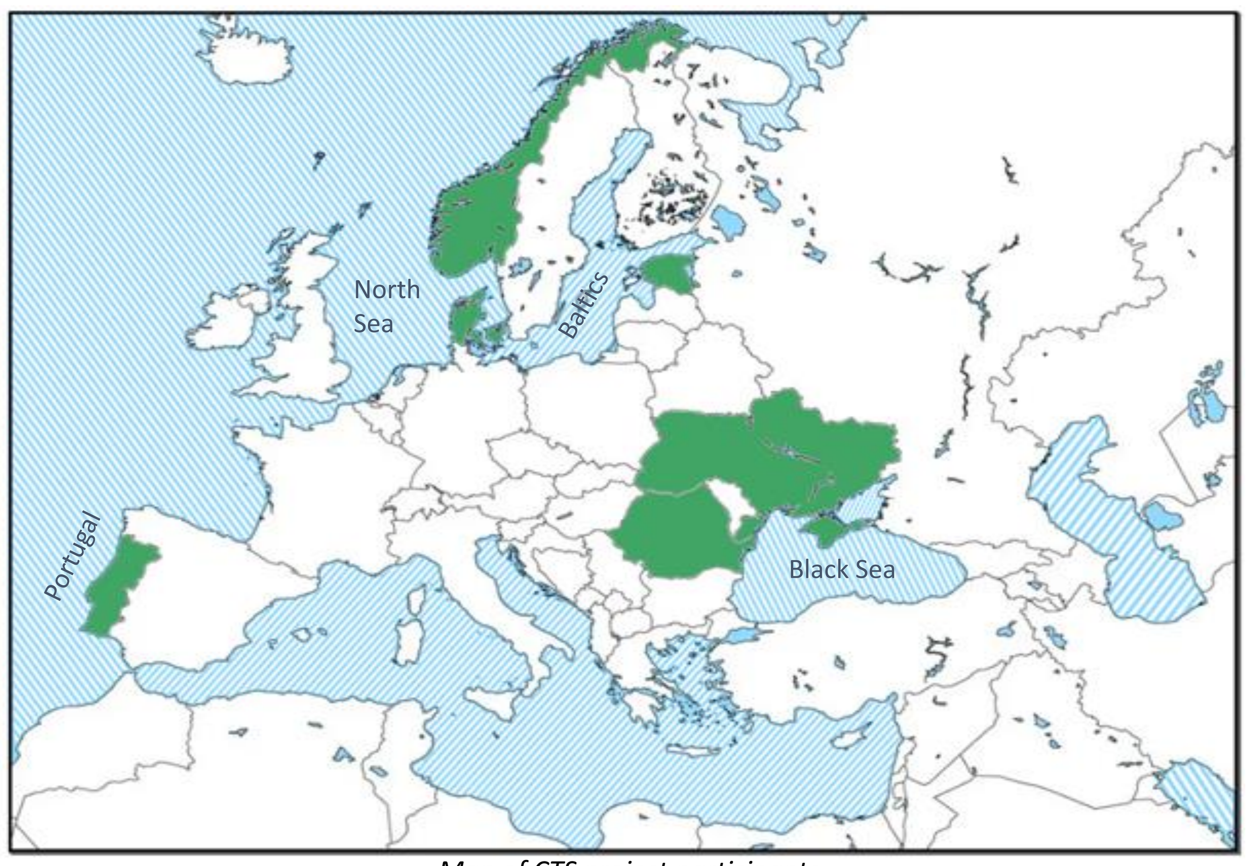
CET Partnership grant # Cetp-2022-00138



Traditional solution for offshore storage comprises onshore terminals and hubs and pipelines connecting these to subsurface templates or offshore hubs. Ships are usually considered solely as the transport solution for gathering the CO2 at ports and delivering to the above-mentioned hubs. CTS (CO_2 Transport and Storage directly from a ship: flexible and cost-effective solutions for offshore storage) project will investigate the possibility to use ships as injection vessels. The CTS project will evaluate the global potential of this technology for facilitating permanent CO_2 storage using case studies from offshore on the Norwegian Continental Shelf, Baltics, Black Sea and Atlantic coast of Portugal, and conduct Life Cycle Assessment/ Technical Economical Assessment (LCA / TEA) analysis that compares the direct ship injection to traditional approaches using fixed infrastructure.



Concept of direct ship injection as presented by NEMO Maritime.



Map of CTS project participants

Why? Large costs and complexity of CCUS value chains hinder spread of technology especially for smaller emitters and storage operators. The CTS team will investigate how using ships as transport and injection vessels can unlock CCUS potential and speed up deployment of CCUS technologies

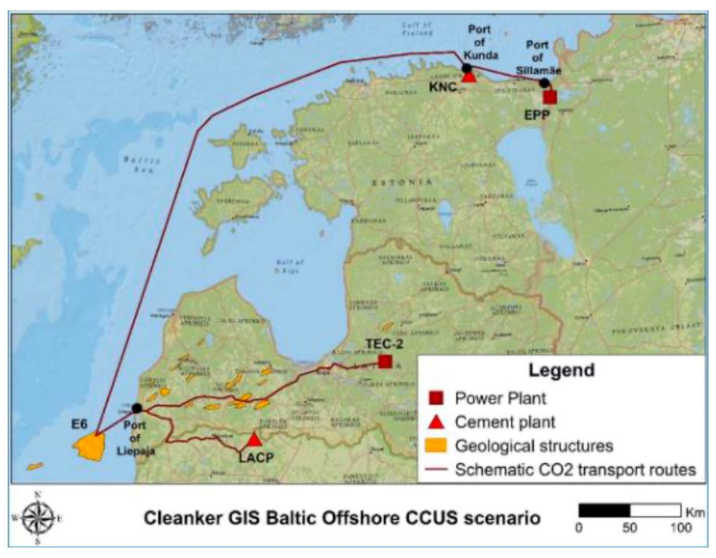
How? What are the main benefits of injecting CO_2 from a ship?

- Decentralized, flexible and effective matching emitters and storages.
- Faster deployment and circumventing limitations of pipeline transport
- Enhanced CCUS adoption by smaller emitters / storage operators
- Ease creation of European (and global) on-demand CO_2 storage market

The project builds on previous projects such as ACT ECO-BASE, H2020 Strategy CCUS and the existing collaboration between NORCE and NEMO Maritime in the NEMO IPN project supported by Research Council of Norway. CTS will study the impact of direct injection from ship on the definition of capture clusters and storage facilities to provide a low-cost, scalable and flexible solution by developing CCS scenarios in four different offshore regions in Europe. Two of the represented regions – Baltic and Black Sea regions creates alternatives for the Eastern Europe industries. Once the area in each region is identified, data on capture, utilization and storage facilities will be collected into the Strategy CCUS Scenario tool.

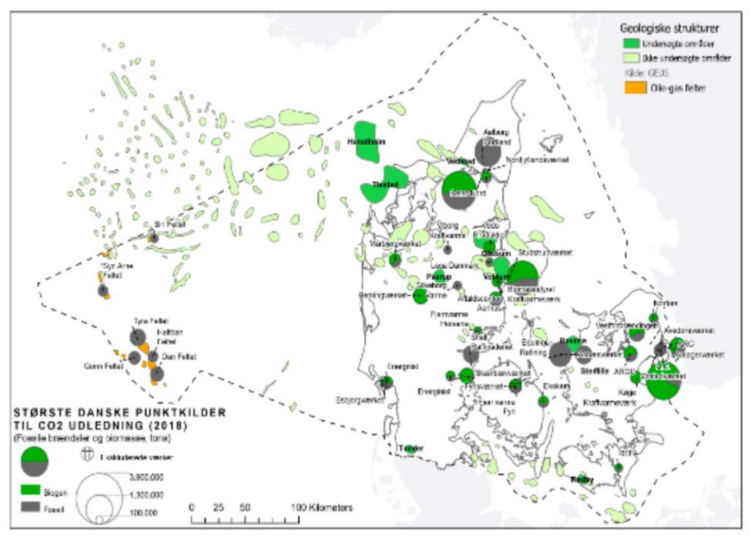
The best geological conditions for CO2 storage in the **Baltic States** are within the Cambrian Deimena Formation sandstones in Latvia. The E6 structure, located 30 km offshore Latvia, has the largest CO_2 storage capacity in the Deimena Formation saline aquifer at the depth of 850 m (thickness 50 m). The structure has been studied in the previous projects by SHOGEnergy team with geological model of the target formation constructed in PETREL. In the current scenario CO2 is transported from the emission sources using a combination of pipelines and ship transport from the largest CO2 emission sources from Estonia, Latvia and Lithuania, including power, chemical and cement industry, refineries and waste-to-energy plants, including fossil and bio-CO2 emissions.

The **Black Sea** scenario will explore potential links and synergies in the North-Western part of the Black Sea between Romania and Ukraine for implementation of CCUS technology. It will be built from a modified Romanian scenario analysed within STRATEGY CCUS project, involving implementation of CCUS in South-Eastern part of the country, using multimodal transport and offshore storage in deep saline aquifers and depleted hydrocarbon fields from Black Sea. Due to landscape features and industry distribution the pipelines construction in the region will be considered. The CO2 utilization options for ammonia or methane production in Ukraine could also be considered as alternative long-term scenario.



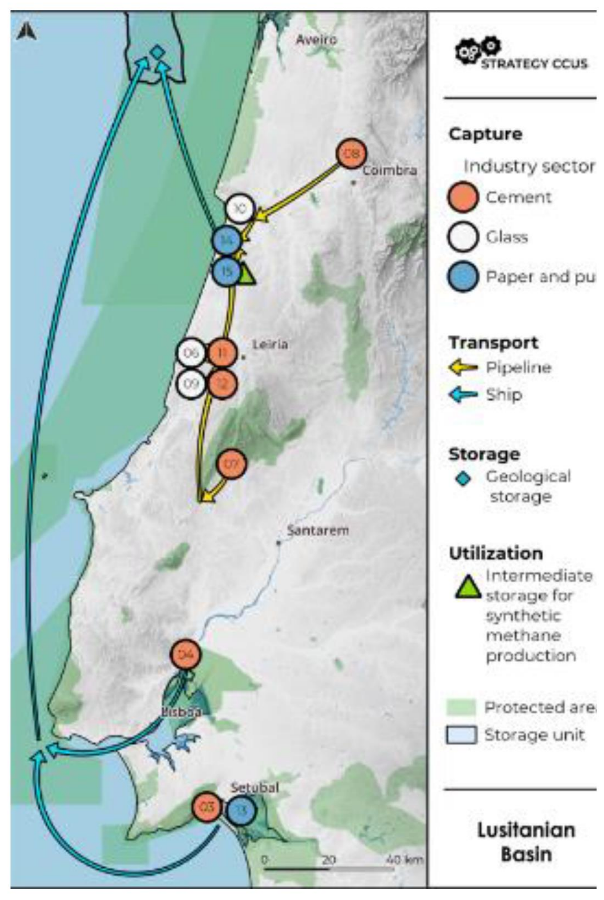
Baltic CCS scenario from CLEANKER[7] project

7 The CLEANKER project has received funding from the European Union's Horizon2020 research and innovation programme under Grant Agreement N° 764816

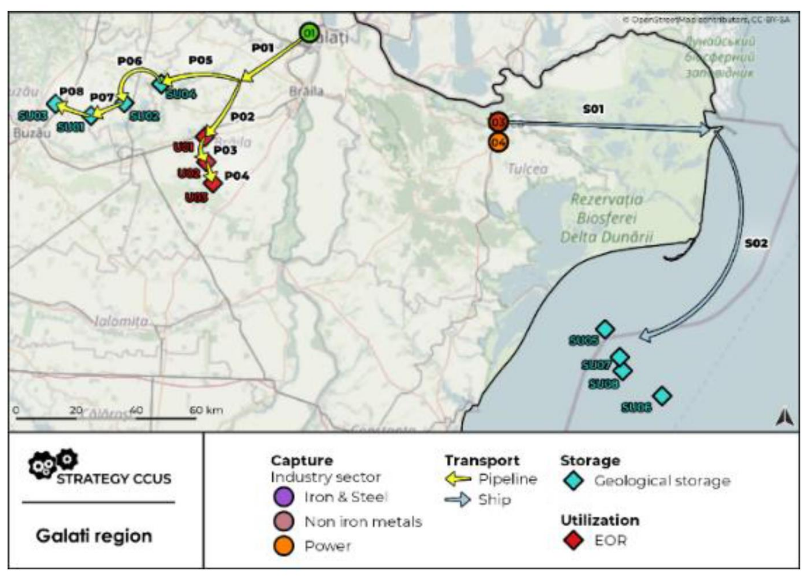


Danish point sources and storage locations[8]

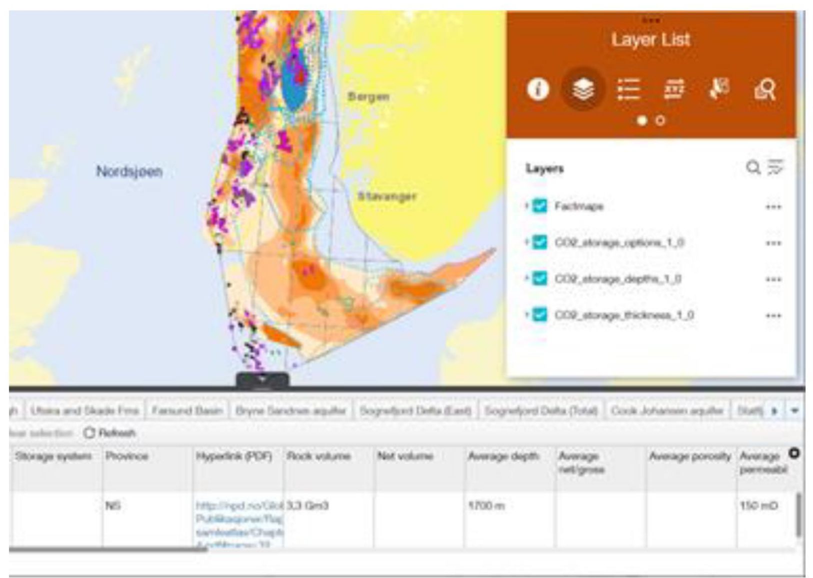
8 More information available from Danish Energy Agency under ccs information page



Portuguese scenario from Strategy CCUS[2]



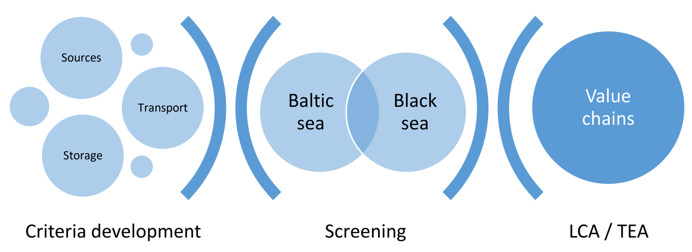
Romanian scenario from Strategy CCUS[2]



CO_2 storage atlas by NPD, NCS[5]

2 Research Council of Norway NEMO CLIMIT program (project 332165) owned by NEMO Maritime AS
5 https://www.npd.no/en/facts/publications/co2-atlases/co2-atlas-for-the-norwegian-continental-shelf/

External criteria	*Internal criteria*
ESG • Social Impact Assessment • Environmental Impact Assessment • Engagement with stakeholders	**Stage of permitting process**: • Exploration permit • Environmental permits (water, forests..) • Land use • Subsoil permits • Construction license
Legislation • national, • regional and • international scale	**Maturity/** Stage of project: • exploration, • design, • planning, • construction, • development, • production
Economic and Financial • construction cost • CO2 price • Tax rules and discounts	
Overlap with other economic activity	
Emitters/Supply	
Volume of supply	
Number of Suppliers Clusters/Single	
Reliability of Supply	
Timeline (productivity, remaining operating period..)	
Origin of the source: • Cement • Metallurgy • Mining • Oil and gas • etc	
Level of «CTS friendly enterprises»	
Transportation	
Distance to port	Vessels characteristics: • Type of vessel • Number of vessels • Vessel capacity
Accessibility of infrastructure to the port	
Port Capacity	
Sailing Distance	
Storage	
Origin of the source	Storage capacity
Type of storage: • onshore • offshore	Injectivity
Reservoir characteristics	Access to the reservoir



CTS Criteria

- common criteria, which are assessed for the entire process chain and as well as for each part separately.
- individual criteria that are important for an individual part of the process
- Common criteria - used for each link separately but here the criteria are combined into one group because the list is the same for each link. First we form an assessment of each part, then an overall assessment of the project.
- External criteria - determined by reasons not related to the project activities itself and not subject to the direct influence of a given economic entity.
- Internal criteria - is caused or generated by the activities of the project itself.

Like with any other new technology, one of the key factors for successful rollout of direct injection of CO2 from ships is to find an applicability sweet spot. What is the optimal emitter size? Distance to offshore fields? Storage size? Ship displacement and capacity? How to put the optimal value chain together? CO2 purity restrictions? What are the technical, regulatory and contractual necessities and peculiarities for direct CO2 injection from the ship? Scenarios of Baltic and Black Sea will be following to recent or ongoing projects (ECO-BASE, Strategy CCUS, CLEANKER, PilotStrategy and CCUS ZEN).

The project team is expecting significant progress in further research of CCUS with deeper understanding of life cycles and economics of potential projects, but also to stimulate implementation of CCUS in Baltic and Black Sea regions.

The main impact of the project is to provide a technology that will allow to decrease costs, reduce conflicts with other marine activities and increase flexibility for early start of CO2 injection in offshore regions, therefore addressing some of the major issues that can hinder the deployment of CCS in Europe on a scale able to deliver required mitigations before 2030.

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