CTS Project: CO_2 transport and storage solutions in the Black Sea

CTS - CO_2 Transport and Storage directly from a ship: flexible and cost-effective solutions for European offshore storage

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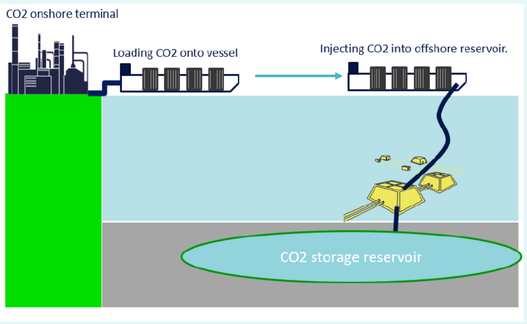
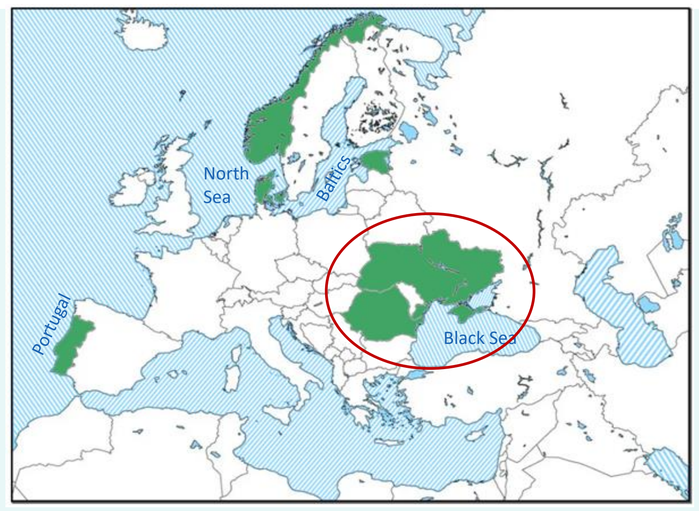


Concept of direct ship injection as presented by NEMO Maritime

Traditional solution for offshore storage requires large, costly infrastructure with immense footprints. The costs and complexity of CCUS value chains hinder spreading technology to smaller emitters and storage operators. The CTS team will investigate if, by using ships as both transport and injection vessels (based on Nemo Maritime AS technology), we can unlock a the **CCUS potential and speed up deployment of CCUS technologies.**



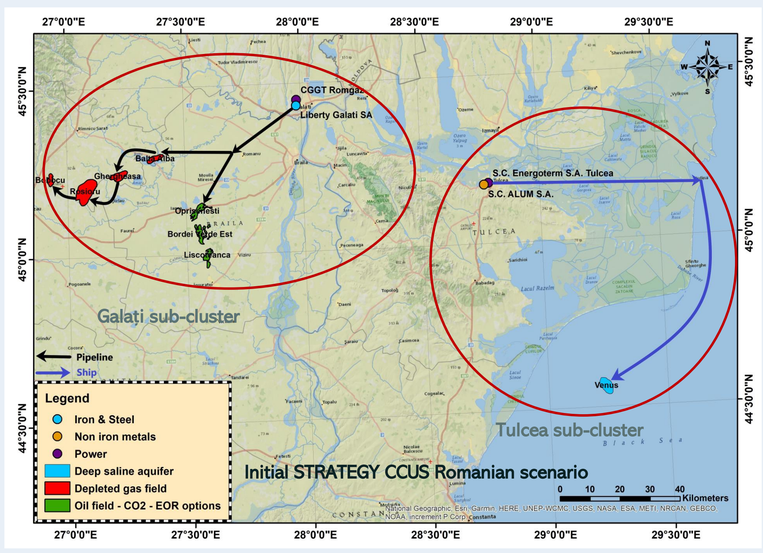
Map of CTS scenarios. Black Sea scenario location is figured with a red circle.

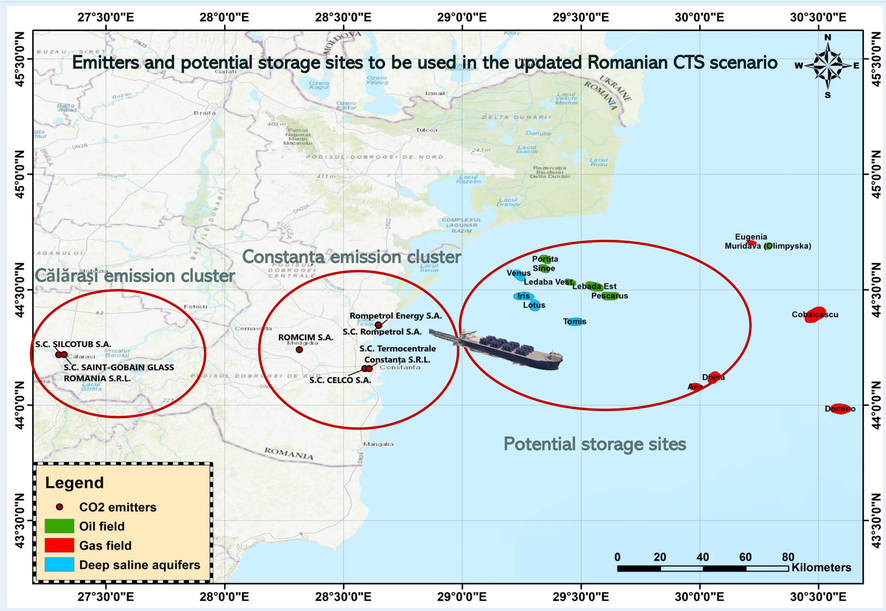
CTS studies how direct injection from ships impact the overall CO_2 capture and storage clusters by developing CCS scenarios in four different offshore regions in Europe: Norwegian Continental Shelf, Baltics, **Black Sea** and Atlantic coast of Portugal. **The Black Sea scenario** combines the interlinked Romanian and Ukrainian scenarios.

Romanian scenario

Offshore Black Sea geological structures were assessed within the STRATEGY CCUS project focused on the Galați and Tulcea subclusters. The original scenario contained both subclusters with different emitters, transport and storage solutions. Due to regional industrial decline, exemplified by the planned closure of Alum Tulcea, the current assessment will include emitters both **able** and **willing** to decarbonize. Such emitters were identified near **Constanța** harbour, the main Romanian Black Sea harbour and near **Călărași,** an important Danube port.

To check the feasibility of using direct ship injection into Black Sea geological storages, we started with the Tulcea subcluster in the previous STRATEGY CCUS project. A standard transport and storage option will be compared to direct ship injection and storage.



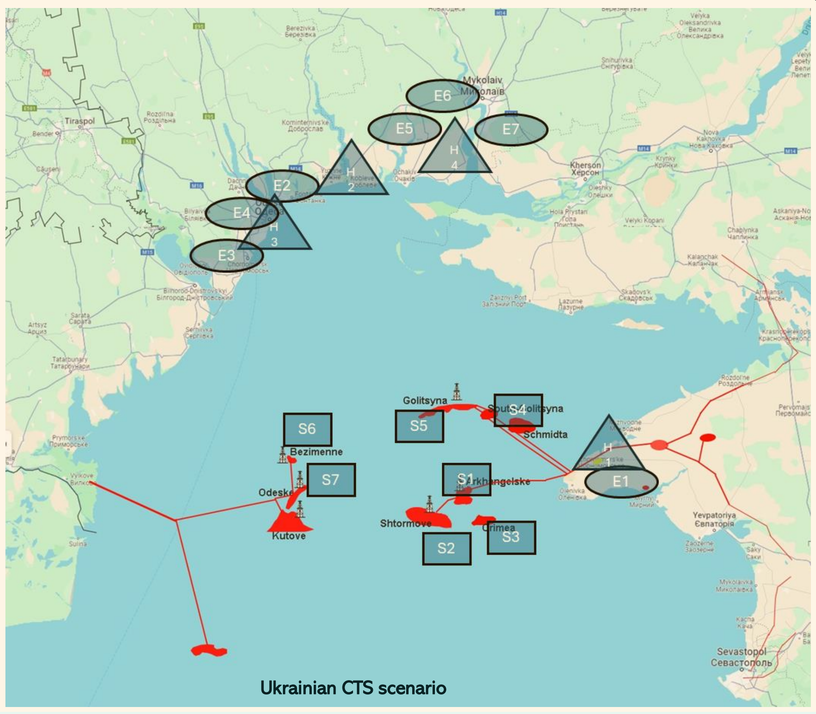


To identify the cheapest and feasible transportation option, several transport modes will be analysed: Conventional ship transport, offshore pipelines and direct ship injection. Storage is envisaged in the Black Sea deep saline aquifers (Venus, Iris, Tomis, Lotus) and nearly depleted hydrocarbon fields (e.g. Lebăda East and West, Sinoe).

Ukrainian scenario

The project aim at developing CO_2 capture and storage (CCS) strategy for the Ukrainian Black Sea. The plan involve key industrial areas (Odesa, Mykolaiv and Crimea) home to major industrial emitters (energy, steel, and cement, etc.) as well as being the Southern oil and gas region with an extensive network of pipelines, gas processing facilities and reservoirs that can be matured into CO_2 storages.

The captured CO_2 will be transported to Black Sea offshore storage sites suitable for long-term sequestration in the Ukrainian sector. Depleted gas and gas condensate fields (Arkhangelske, Shtormove, Crimea, Schmidta, Holitsyna, Bezimenne, Odeske) were identified primarily within Maykop and Lower Paleocene formations consisting of clay-rich carbonate (limestones, marls), and terrigenous (sandstones) sediments.



Ukrainian CTS scenario

E-emitters, S-storage, H-hub

Crimea target region:
E1 – Chornomarnoftogaz, energy
H1 – Evpatoria sea port

Odesa target region:
E2 – Odesa Port Plant PJSC, chemical
E3 – Odesagaz JSC, energy supply
E4 – Shlyahovyk-97, mahufacturing
H2 – Pivdennyi sea port
H3 – Odesa sea port

Mykolaiv target region:
E5 – Yugcement JSC, cement
E6 – Mykolaiv Alumina Plant LLC, Alumina Production
E7 – Mykolaivgaz, Energy supply
H4 – Mykolaiv sea port

S1 - Arkhangelske
S2 - Shtormove
S3 – Crimea
S4 – Schmidta
S5 – Holitsyna
S6 – Bezimenne
S7 – Odeske

Major sea ports, Odesa, Mykolaiv and Crimean port, are assessed as transportation hubs.

Through techno-economic analysis we will compare direct CO_2 ship injection into the seabed (NEMO solutions) with conventional pipelines and ship-based CO_2 injection, typically through offshore platforms. Economic feasibility and operational efficiency will be assessed to identify cost-effective and sustainable solutions for large-scale carbon storage in the Black Sea.

Black Sea scenario

The Black Sea integrated scenario merges the Romanian and Ukrainian scenarios. All emissions are envisioned to be stored into Romanian and potential Ukrainian storage sites. The simulations will be used to analyse benefits and potential bottlenecks of cross-border projects, including regulatory aspects. Synergies from cross border cooperation will be estimated in the coming steps.

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