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

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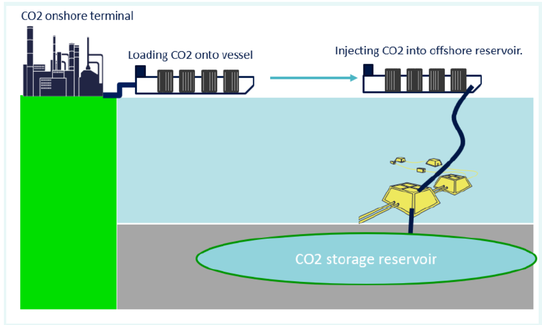


Concept of direct ship injection as presented by NEMO Maritime

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 the **CCUS potential and speed up deployment of CCUS technologies.**

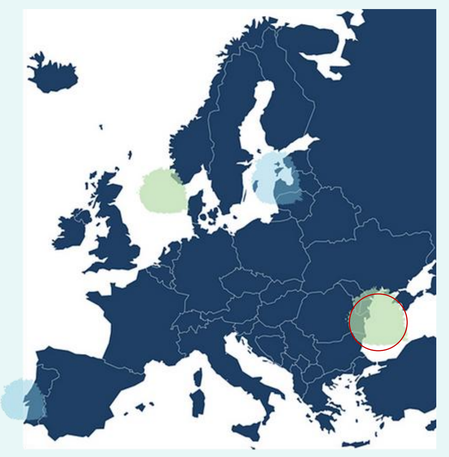


Image from VectorStock

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

Emission clusters

Călărași

- S.C. SILCOTUB S.A., S.C. SAINT-GOBAIN GLASS ROMÂNIA S.R.L.
- Approx 0.15 Mt/CO_2 in 2023

Constanța

- ROMCIM S.A., S.C. CELCO S.A. , S.C. Termocentrale Constanta S.R.L., S.C. Rompetrol Rafinare S.A., Rompetrol Energy S.A.
- Approx 2.033 Mt/CO_2 in 2023

Transport – multimodal approach

- Short pipeline or rail connections –Călărași emitters-Călărași port, Celco- Midia, Termocentrale Constanța-Midia
- Danube/fluvial transport between Călărași-Medgidia-Midia
- 3 offshore scenarios: conventional shipping, pipeline, NEMO direct injection

Design of Romanian CTS scenario

Offshore storage solutions

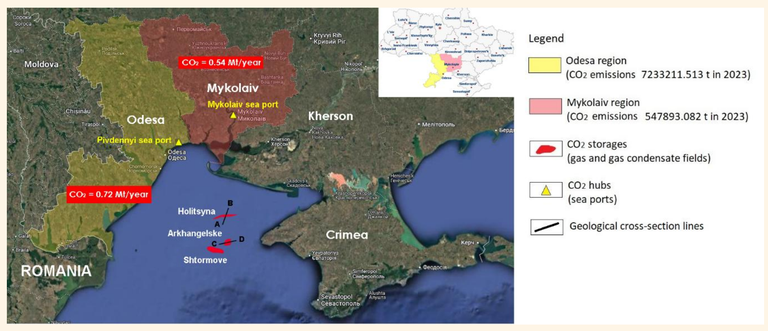
Deep saline aquifers

Name	Area (sq km)	Reservoir formation	Storage capacity (Mt)
Iris	22.1	Albian	29
Venus	16.55	Eocene	18
Tomis	17.59	Albian	33
Lotus	16.05	Albian	28
Total capacity			108

Hydrocarbon fields

Name of the structure	Area (sq km)	Target reservoir	Storage capacity (Mt)
Lebăda Est	21.78	Albian	25
Lebăda Vest	10.13	Albian	25
Sinoe	11.89	Eocen	9
Total capacity			59

Ukrainian scenario



Location of Ukrainian CTS scenarios

Emissions clusters

- Key industrial areas — Odesa, and Mykolaiv regions (approx. 1.26 Mt/CO_2 in 2023 and 3.7 Mt/CO_2 in pre-war 2021);
- Two major seaports — Pivdennyi and Mykolaiv ports are positioned as CO_2 hubs;
- Major industrial emitters (energy, steel, and cement, etc.)

Transport

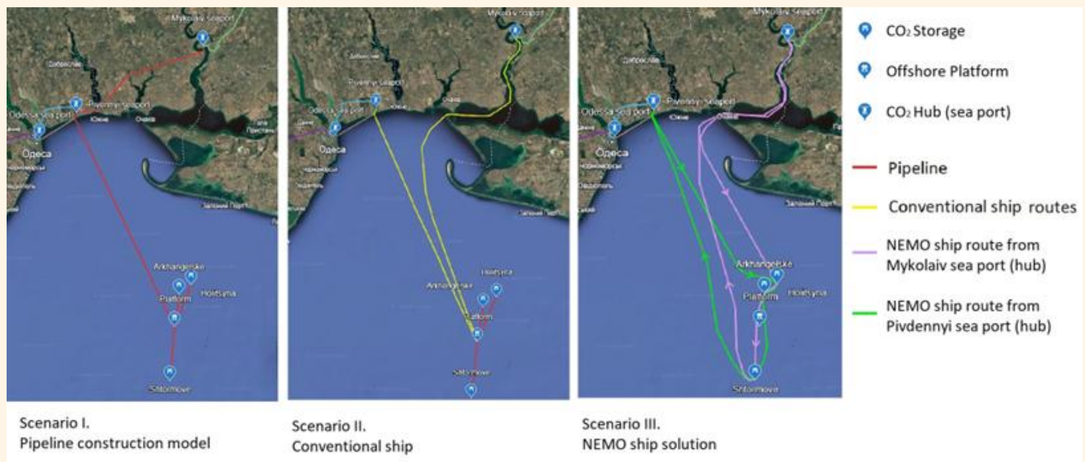
3 scenarios:

- Combined onshore and offshore pipeline system connecting CO_2 hubs to offshore platform;
- Conventional ship;
- NEMO ship solution.

Offshore storage solutions

- Holitsyna, Arkhangelske, and Shtormove gas and condensate fields – CO_2 offshore storage sites.
- Conservative storage capacity estimated at approximately 55.14 Mt.

Ukrainian CTS scenarios



CO_2 storage solutions – hydrocarbon fields

Field and reservoir name	Area, (km^2)	Depth (m)	Av. thickness, (m)	Target reservoir	Caprock	MCO_2, Mt
Holitsyna (П-XI reservoir)	43.17	2155	80	Lower Paleocene (limestones, marls, sandstones)	Clays	14.57
Arkhangelske (M-V reservoir)	28.6	915	36	Maykop (clay and sandy siltstones)	Clays	9.74
Shtormove (П-XI reservoir)	20.25	986	50	Lower Paleocene (Microcrystalline fractured limestones)	Clays	30.83
						55.14

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.

Acknowledgement: This research was funded by CETPartnership, the Clean Energy Transition Partnership under the 2022 CETPartnership joint call for research proposals, co-funded by the European Commission (GA N°101069750) and with the funding organizations detailed on https://cetpartnership.eu/funding-agencies-and-call-modules."

CET Partnership grant # Cetp-2022-00138

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