Advanced multitemporal modelling and optimisation of CO_2 Transport, stOrage and utilisation Networks

WP 5. Task 5.5. - ROMANIAN CLUSTER

General Assembly ACTiON Project
DELFT November 2023

STATUS OF CCUS IN ROMANIA

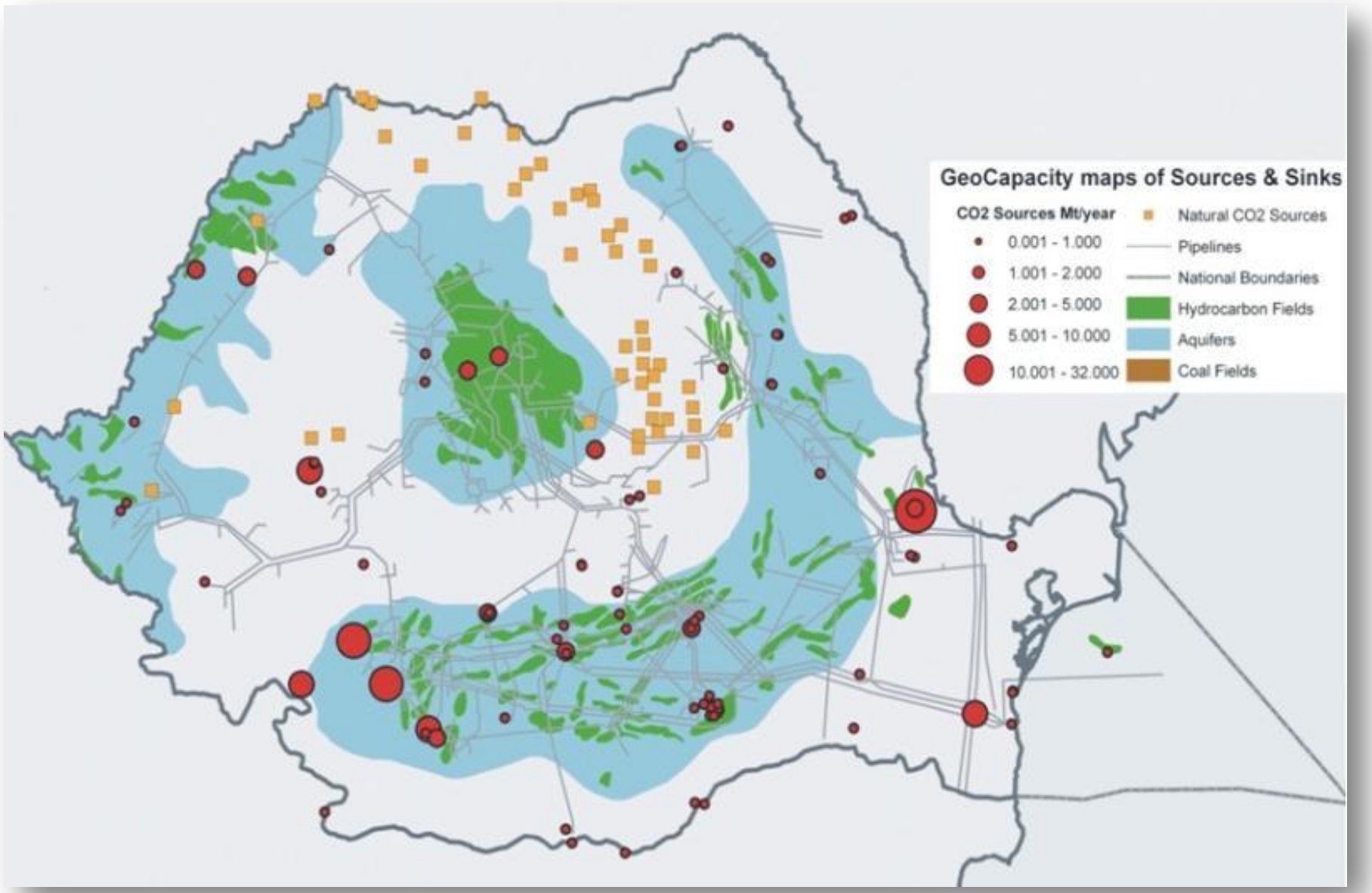
Work related to the CO_2 geological storage began in Romania with the affiliation of the GeoEcoMar to ENeRG in 2002 and continued with participation of the institute in international and national projects related to CCS:

- subcontractor in "CASTOR" project,

- partner in "EU GeoCapacity", "CO_2 Net East", "Impact of communication", "CGS Europe", "CO_2 Stop" European projects,

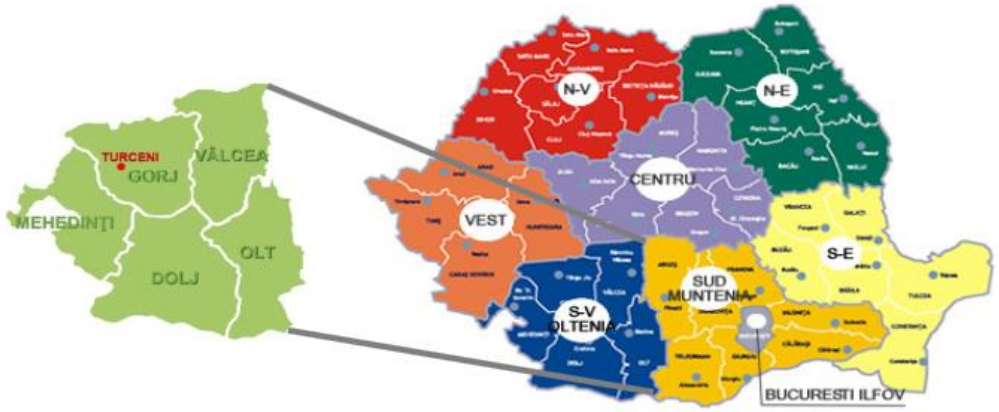
- partner in similar national projects: "The National Program of Carbon Capture and Storage for 2011-2020 period" and "Geological storage" section of the Feasibility Study for the "Getica CCS" Demonstration Project.

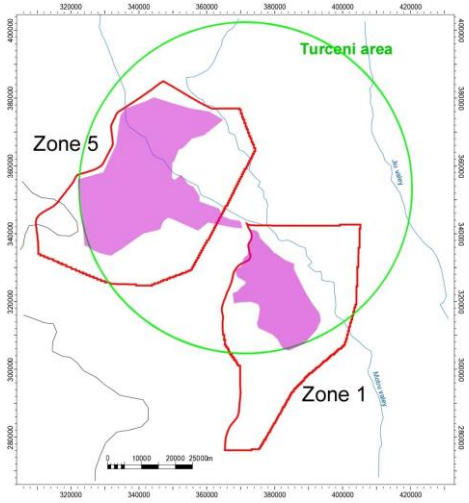
After accesion to the CO_2 GeoNet Association on 2013, GeoEcoMar is participating in the "ENOS" HORIZON 2020 project for 2016-2020 period. Since 2017 GeoEcoMar was partner in ACT projects: "ALIGN CCUS", "ECO-BASE", " REX-CO_2", as well as, since 2022, in ACTiON project.



CO_2 Major Emissions and the Geological Storage Capacity in Romania

GETICA CCS DEMONSTRATION PROJECT

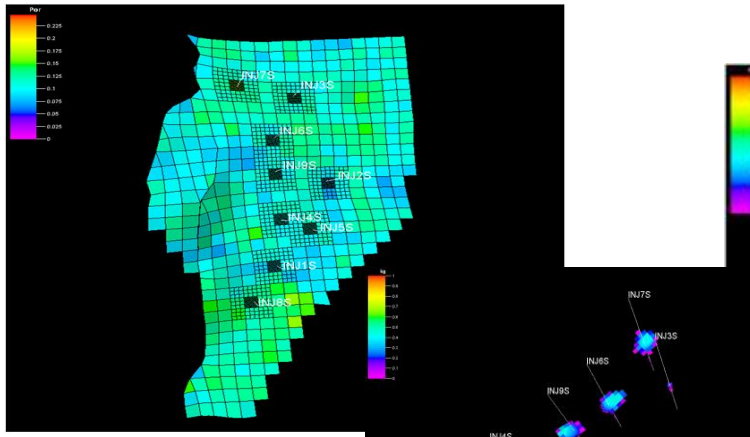




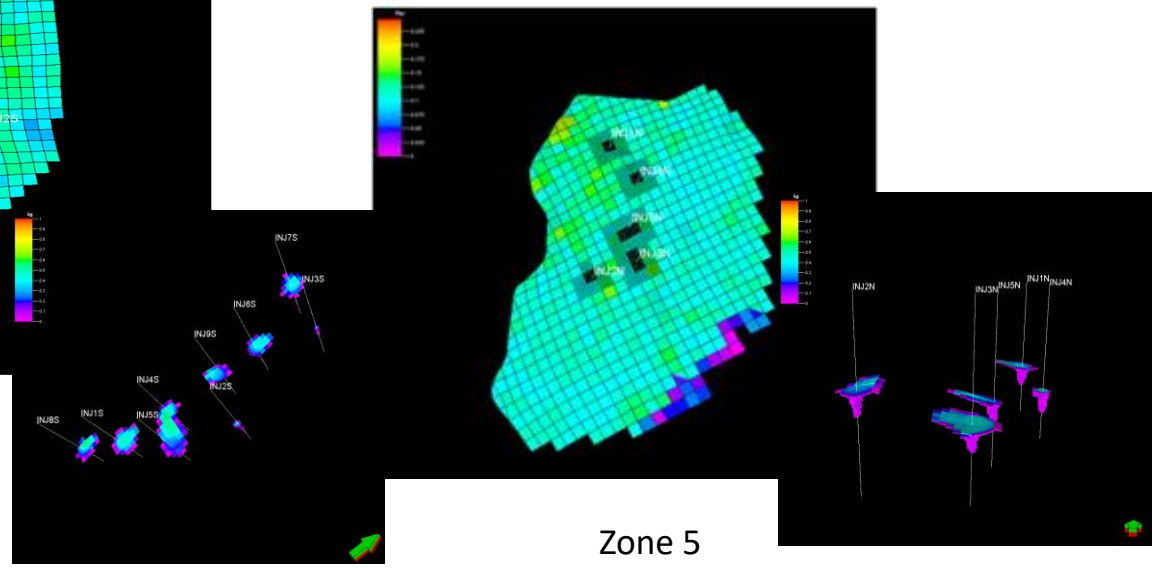
2 zones have been selected as best candidates for storage

- **Approx 2000 m depth**
- **Reservoir: Sarmatian sandstone formation from Getic Depression**
- **Caprock: UpperSarmatian shaly formation**
- **Static and dynamic modelling**

- **Capture: Turceni powerplant**
- **Transport: onshore pipelines**
- **Storage: 1.5 Mt of CO_2 to be stored in deep saline aquifers**
- **Planned to start injection at the end of 2015**
- **Project competed for NER 300, high scored, on the waiting list**
- **Loss of governmental support lead to stalling the project**



Zone 1



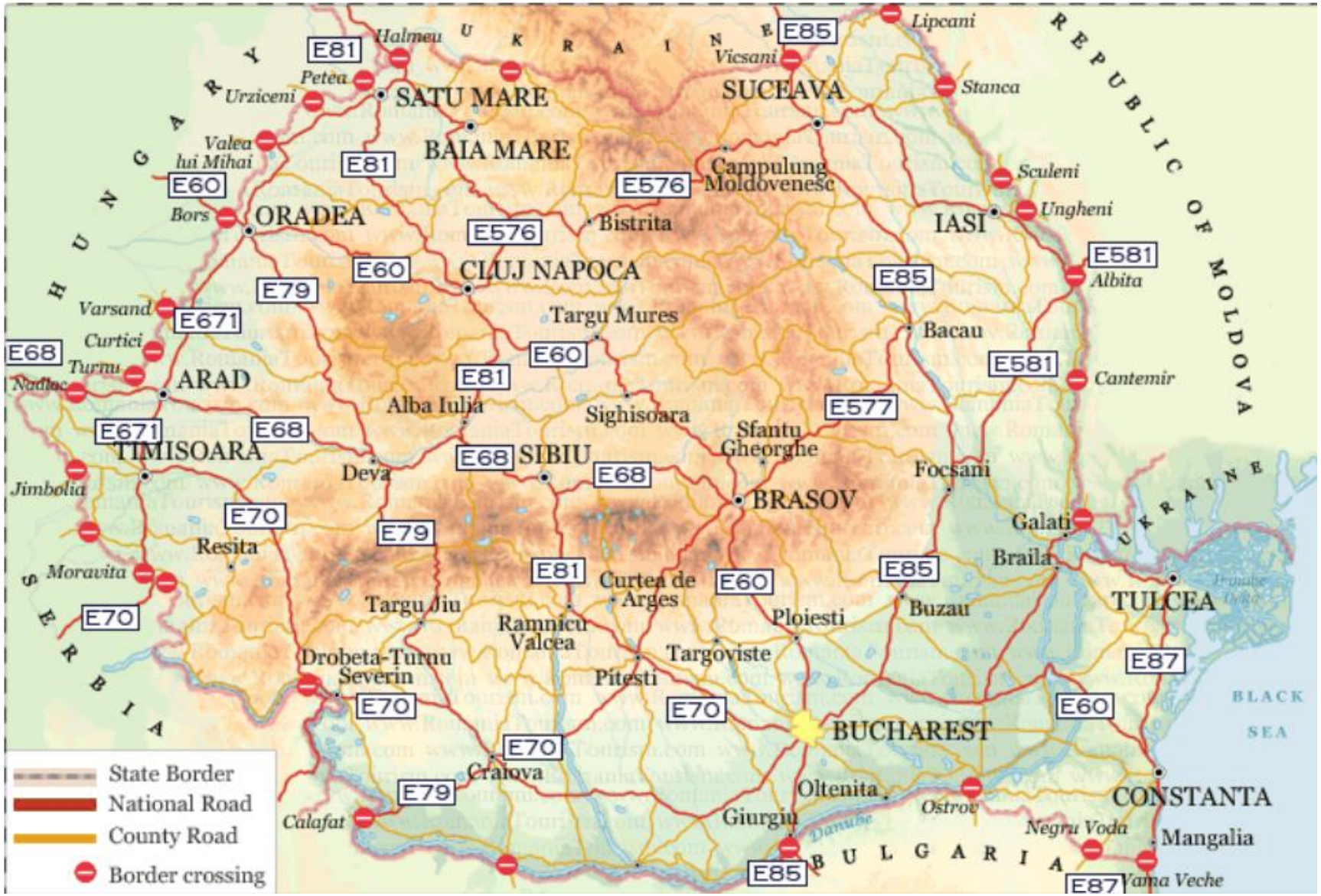
Zone 5

MULTIMODAL TRANSPORT OF CO_2

The development of a CO_2 transport infrastructure is essential for speeding up the implementation of CO_2 capture and storage technologies in Romania. This infrastructure does not necessarily rely on onshore pipelines only depending on the height of the capital costs for developing such an infrastructure versus the investments in ship transport.

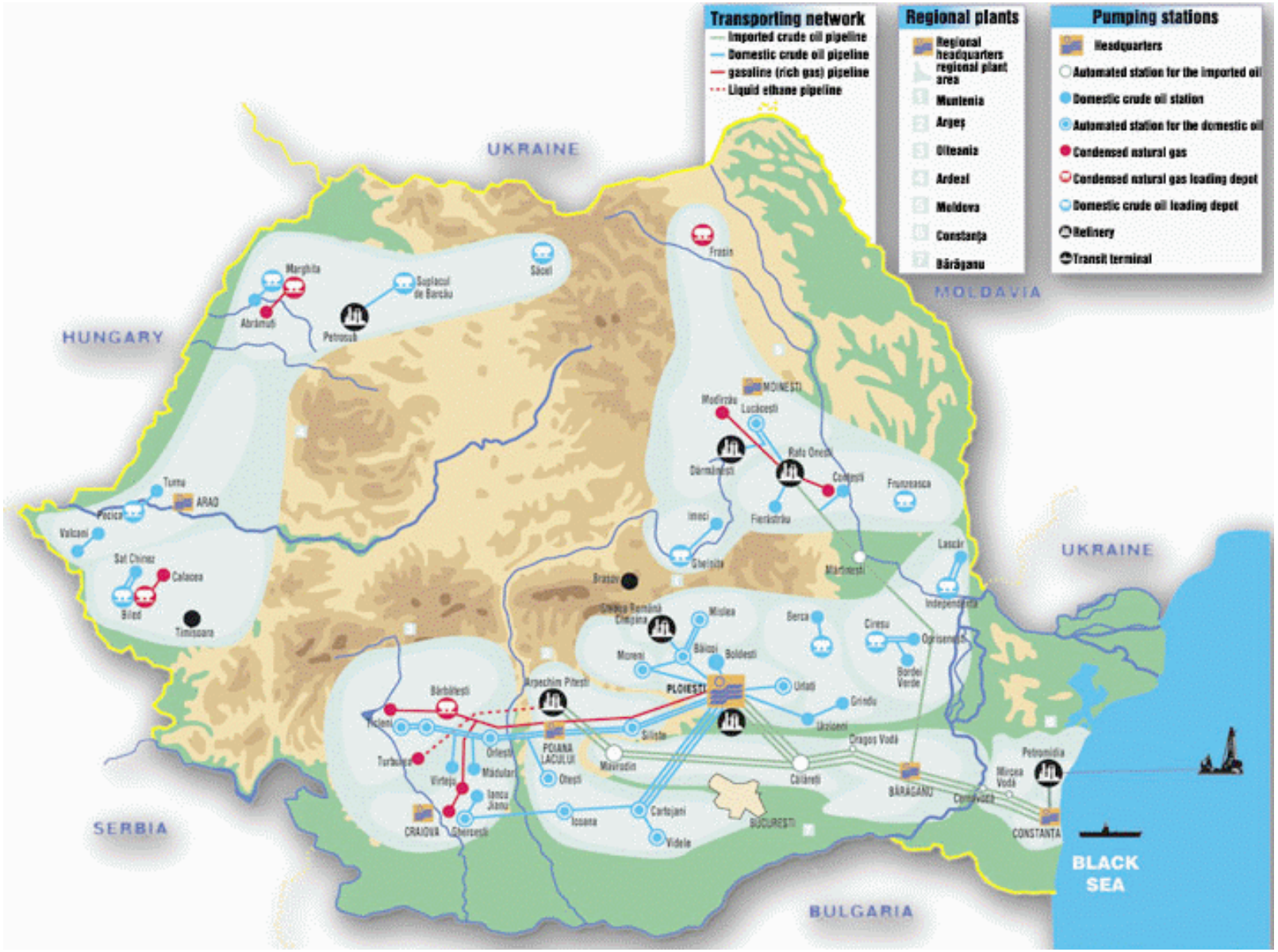
The best solution would be to combine transport by pipeline with transport by vessels. This is also an option for Romania, taking into account the existence of the Danube, of the Danube - Black Sea Canal and the opening to the Black Sea where good storage reservoirs have been identified.

So, multimodal transport of CO_2 consists in a smart usage of pipelines and ships. Instead of a unique network of pipelines, multimodal transport of CO_2 means a large ussage of specialized ships on the inland waterways, and short pipelines between the emission sources as well as suitable storage locations with the closest harbours.

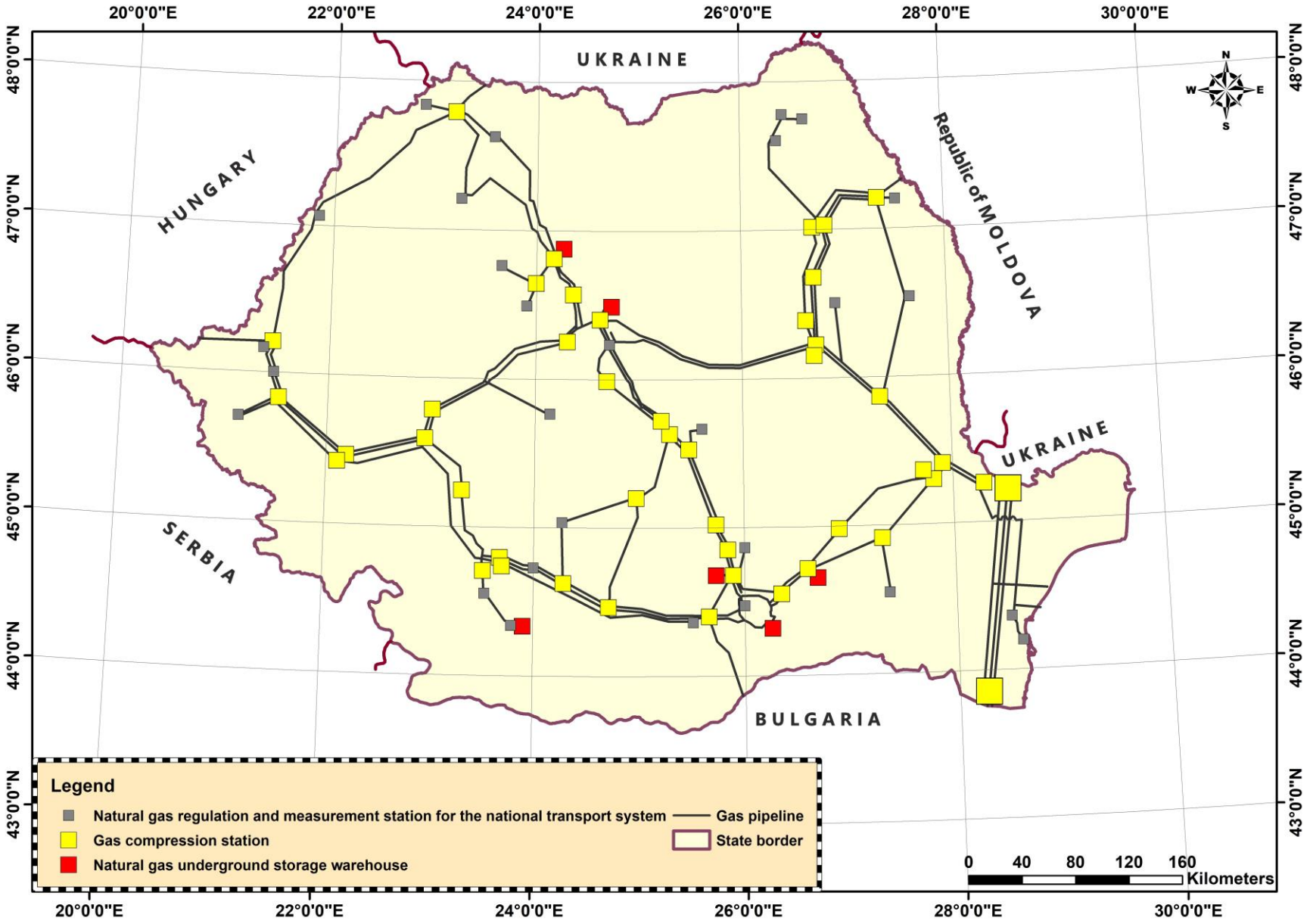


National road network

National railways network

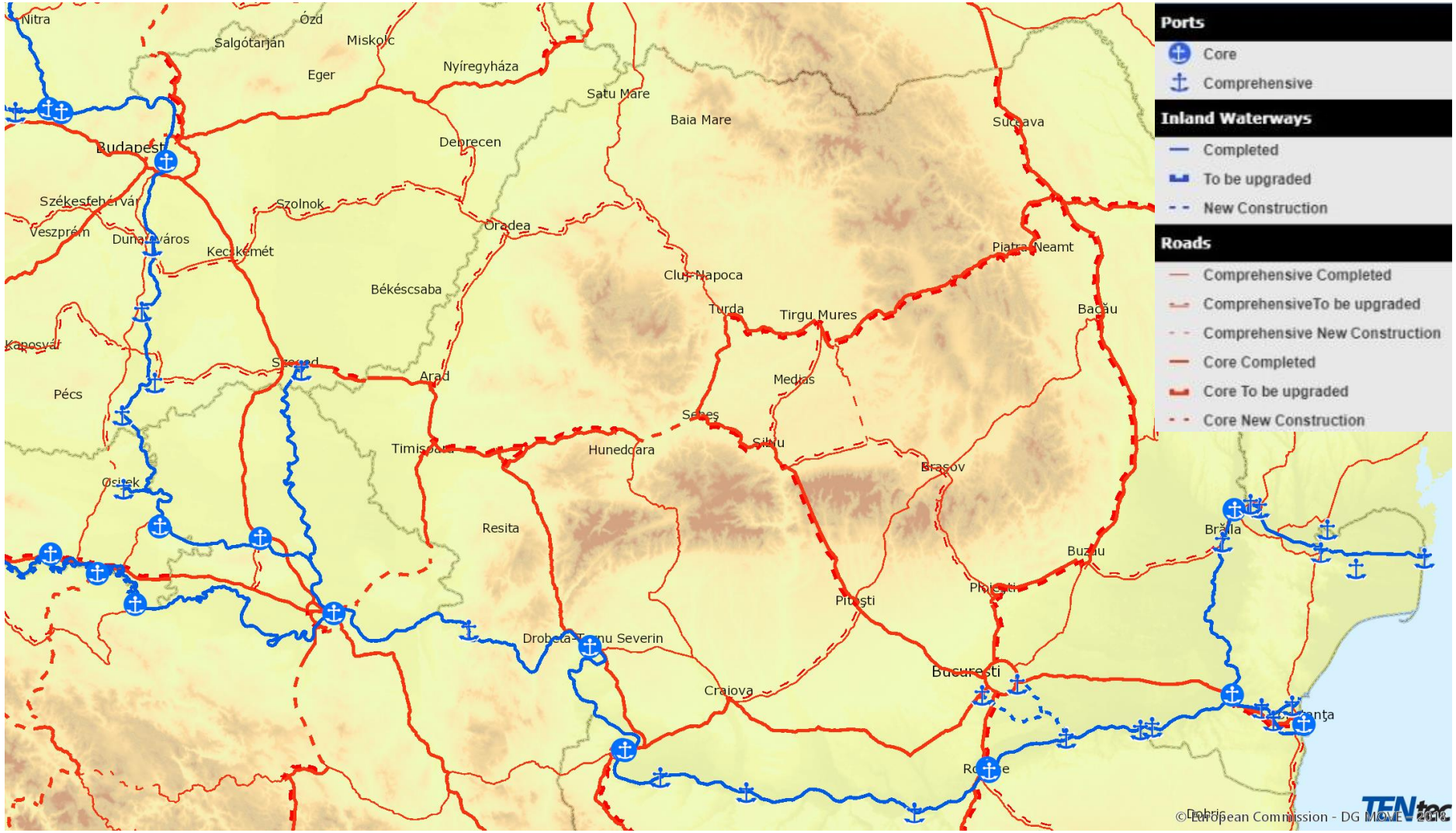


Romanian Oil Pipelines



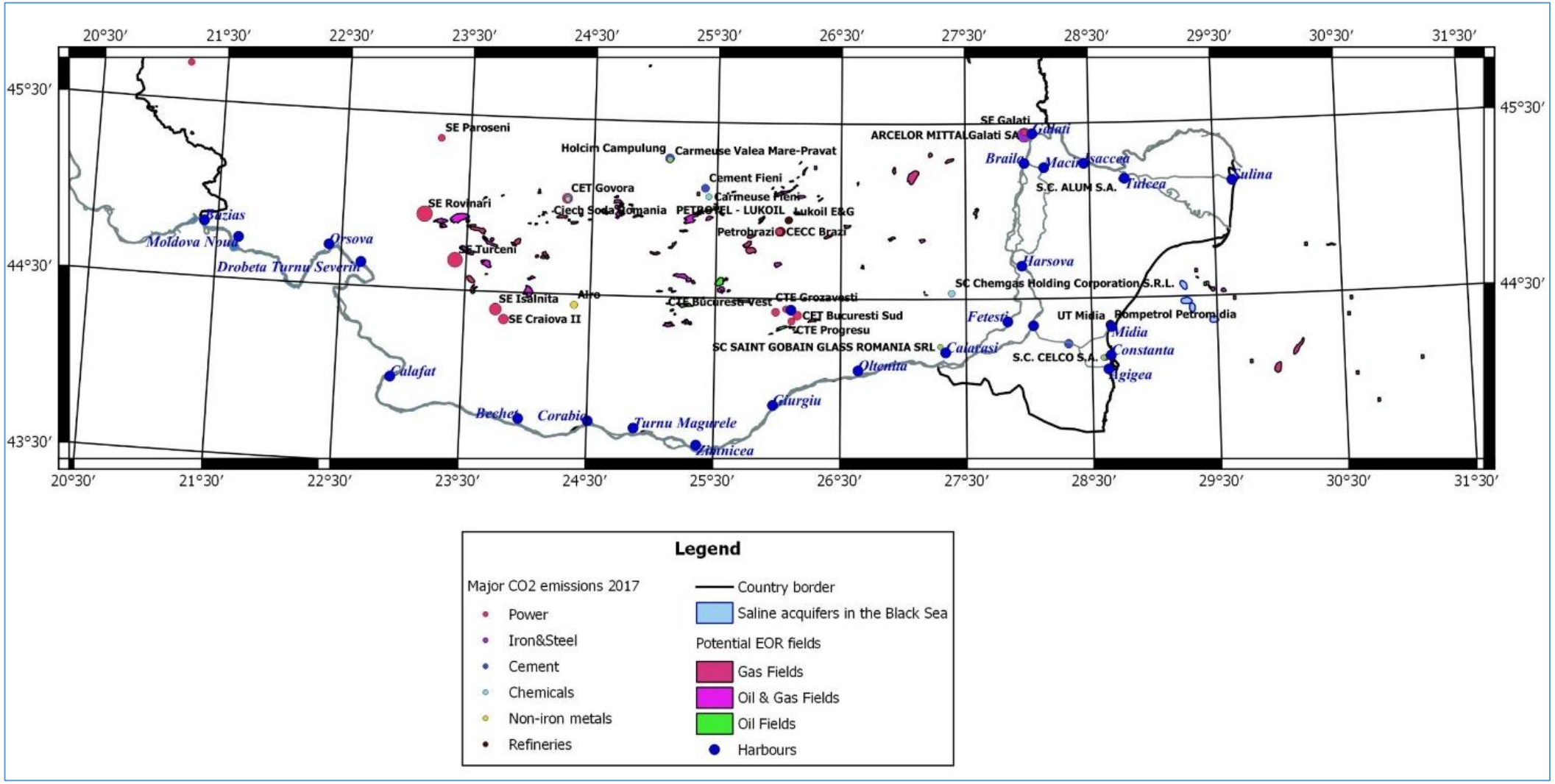
Romanian Gas Pipelines

Originating in Germany, the Danube flows southeast for 2,850 km, passing through or bordering:
- Austria, Slovakia, Hungary, Croatia, Serbia, Romania, Bulgaria, Moldova, and Ukraine.



TEN-T road network and inland waterways on Romania and some of neighbouring countries

Romanian Danubian and maritime Ports

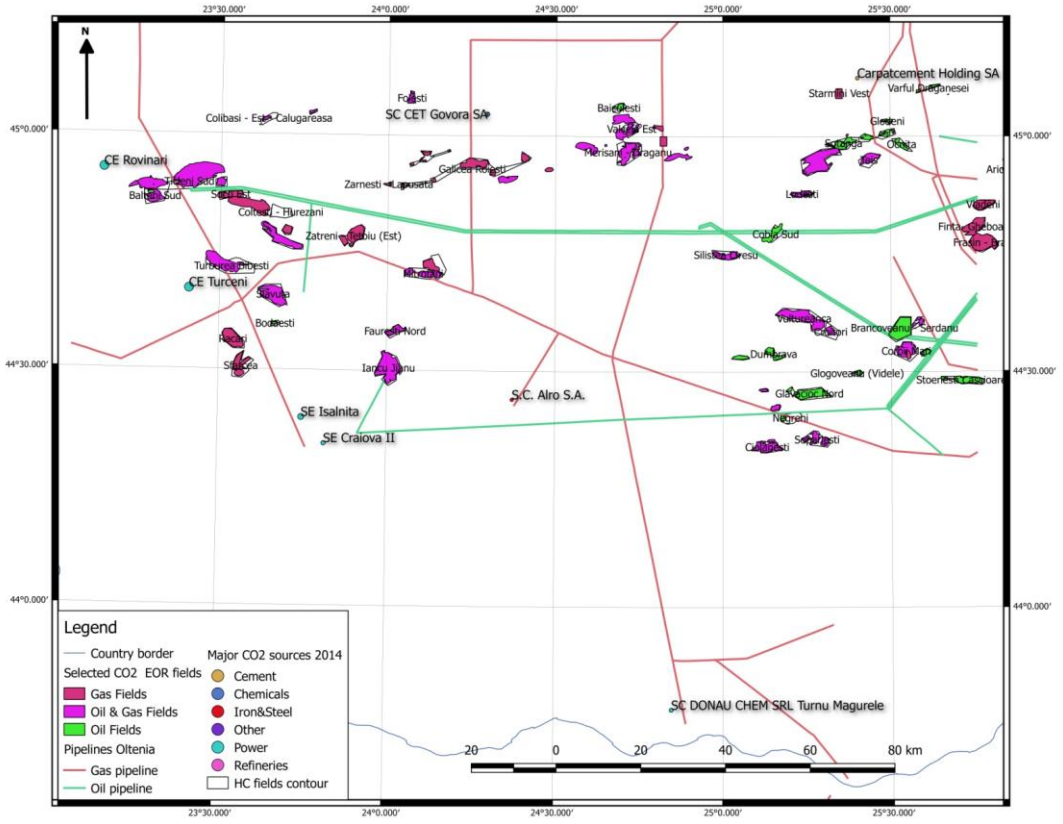


Map of ports on the Danube river, major CO_2 emissions on Southern part of Romania and hydrocarbon deposits suitable for EOR

ROMANIAN CCUS CLUSTER

From the analysis of major CO_2 emission sources in the southern part of the country, we can conclude that these could be grouped into a major cluster for the purpose of CO_2 transport.

In our vision, the best solution would be to design small segments of pipelines for the CO_2 transport from an individual source to a central or nodal point at which all the captured emissions are collected. The next segment of transport is also a pipeline, from the nodal point to a Danube harbour, at which the CO_2 will be transferred to a barge or vessel and transported by river to the offshore region where it will be injected for CO_2 EOR operations or for storage in deep saline aquifers.

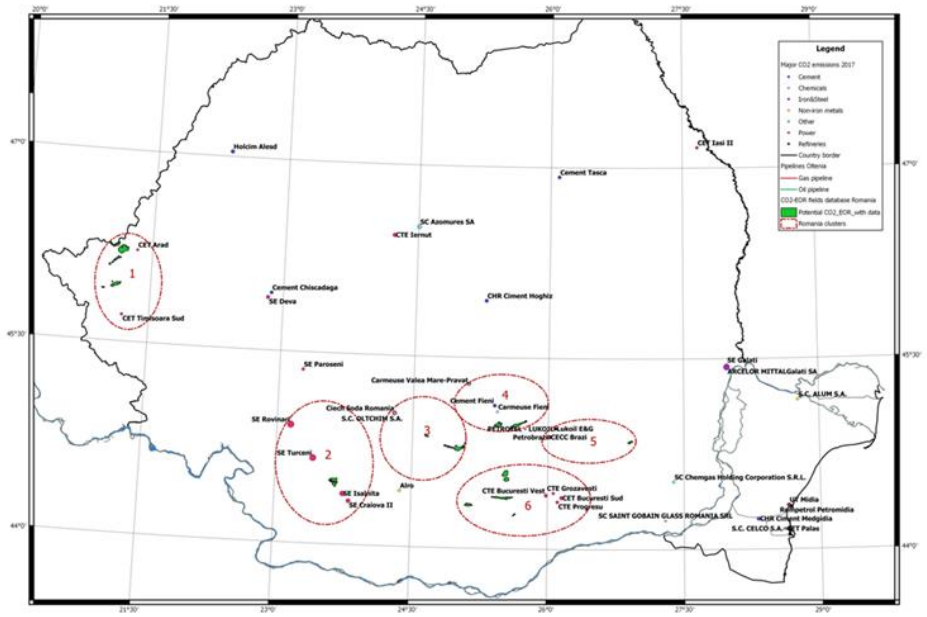


Oltenia CCUS Cluster

CCUS stands for Carbon Capture, Utilisation, and Storage. A CCUS cluster typically involves the integration of various components:

- **carbon capture facilities,**
- **transportation infrastructure for the captured CO_2,**
- **utilisation facilities where the CO_2 is put to use in industrial processes (such as in industrial processes or for enhanced oil recovery),**
- **storage sites for the secure and long-term underground storage of CO_2.**

The clustering of these elements allows for a more efficient and coordinated approach to carbon management, contributing to the reduction of greenhouse gas emissions and addressing climate change challenges.



CO_2 EOR clusters

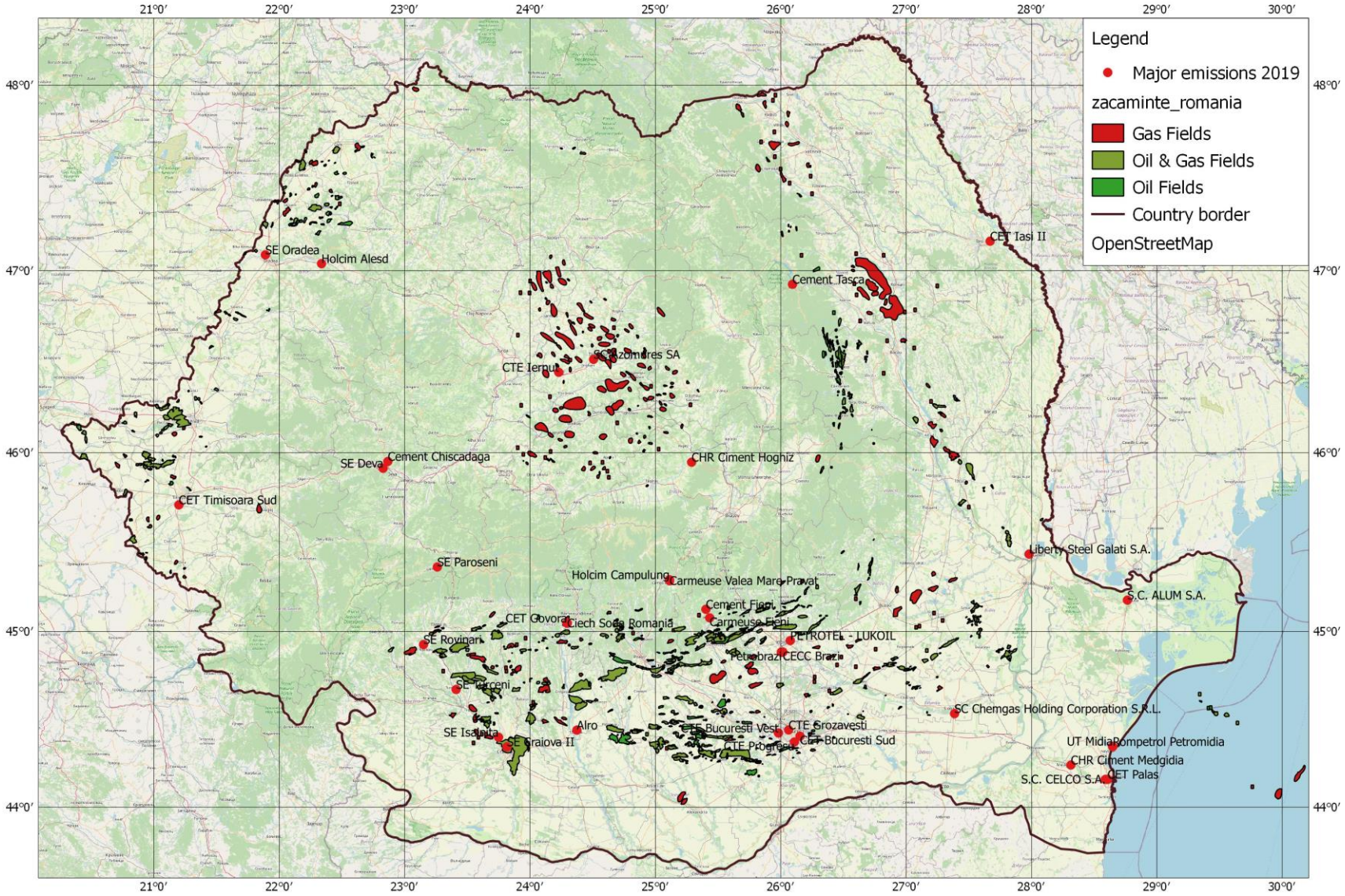
Also, a CCUS cluster involves collaboration between different industries, government bodies, and research institutions to develop and deploy these technologies on a larger scale, aiming to reduce greenhouse gas emissions and mitigate climate change.

The clustering of these activities allows for shared infrastructure, knowledge, and resources, making the overall implementation of CCUS more efficient and effective.

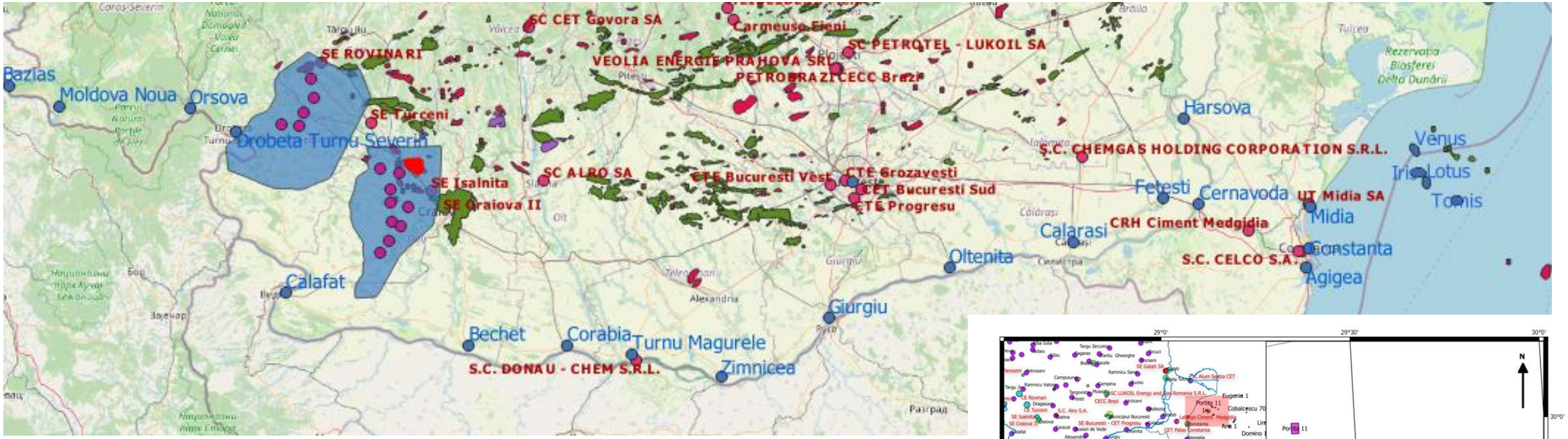
The blueprint for the Romanian Cluster refers to:

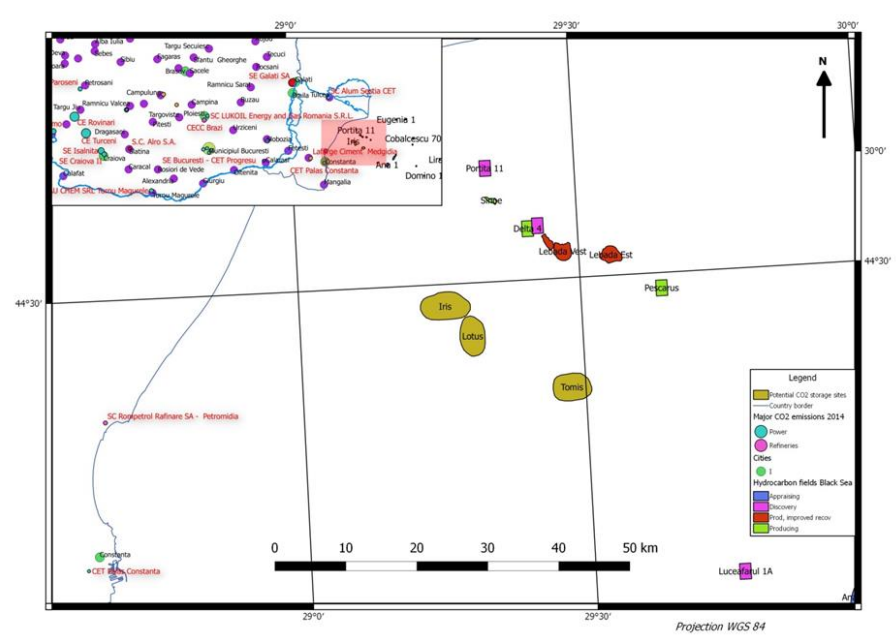
- **identification of the most feasible transportation routes for future captured CO_2,**
- **investigation of the geological storage solutions available, including the possibility to use the CO_2 for enhanced hydrocarbon recovery in the region.**

The existence of Danube at the southern border of Romania presents a very good opportunity for the transport of the captured CO_2 emissions toward the Black Sea.



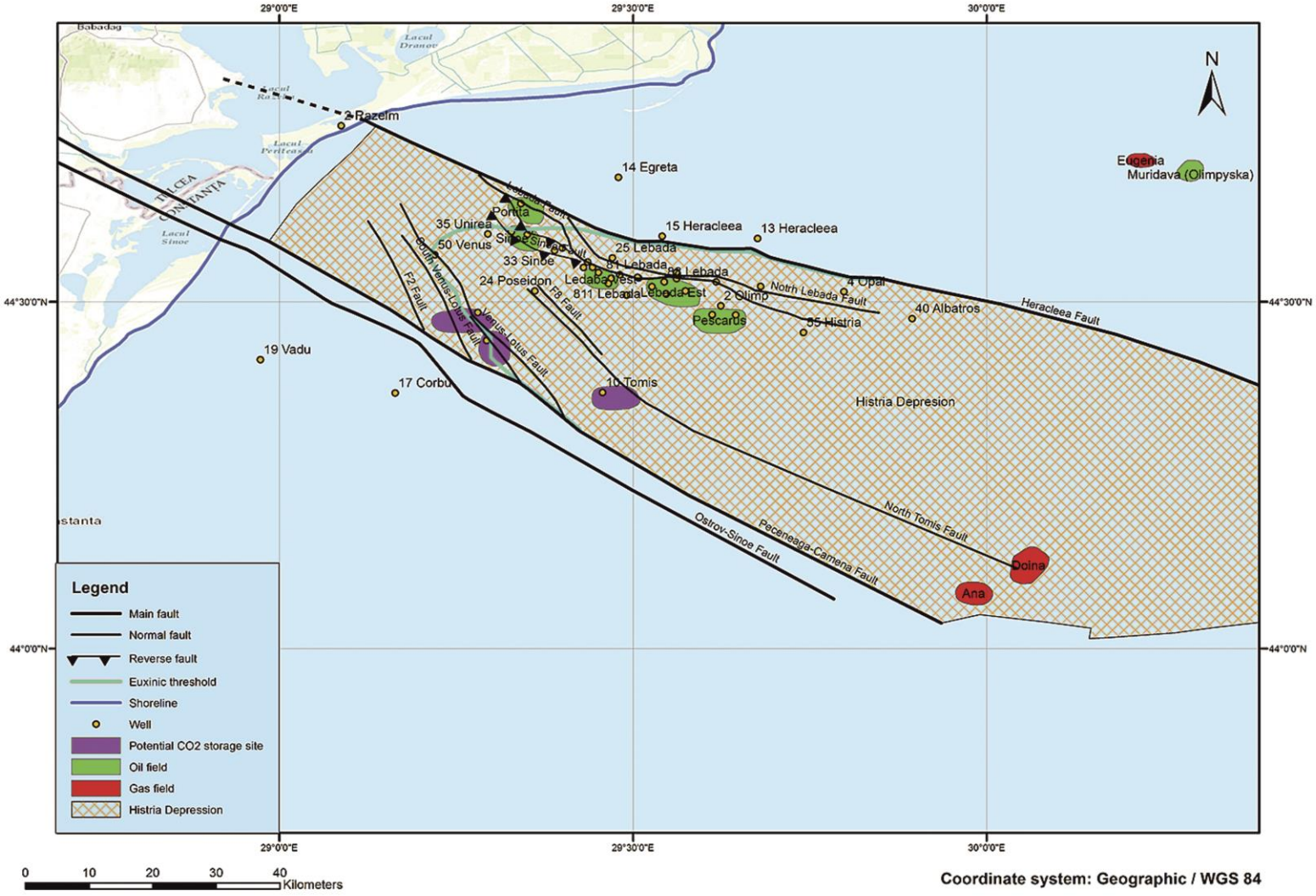
Major CO_2 Emissions and Hydrocarbon Deposits in Romania





- **Good connection for the southern part of Romania due to the proximity to the Danube**
- **Good connection to the Black Sea and its storage and EOR possibilities in the Histria Depresion area**

- **Opportunities in Histria Depression (Black Sea) - an important unit for hydrocarbon exploration and exploitation.**
- **Potential storage sites in deep saline aquifers *Iris*, *Lotus* and *Tomis*, located on the southern flank of the Histria Depression**
- **good reservoir formations in Albian, Lower and Upper Cretaceous and Middle Eocene. Protected by shale sequences on top and secondary by the Oligocene shale formation.**



ACKNOWLEDGEMENTS

This project is funded through the ACT - Accelerating CCS Technologies programme. Financial contributions by the Department for Business, Energy & Industrial Strategy UK (BEIS); the Ministry of Economic Affairs and Climate Policy, the Netherlands; Department of Energy-Office of Fossil Energy (DOE-FE); Emissions Reduction Alberta (ERA); the French Agency for the Environment and Energy Management (ADEME); the Executive Agency for Higher Education, Research, Development and Innovation Funding (UEFISCDI) are gratefully acknowledged. We also thank all our industrial partners for their contributions and the funding they provide towards ACTiON.

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