Multimodal Transport of CO_2 - A solution for South-East Europe and, why not, for a large part of Europe

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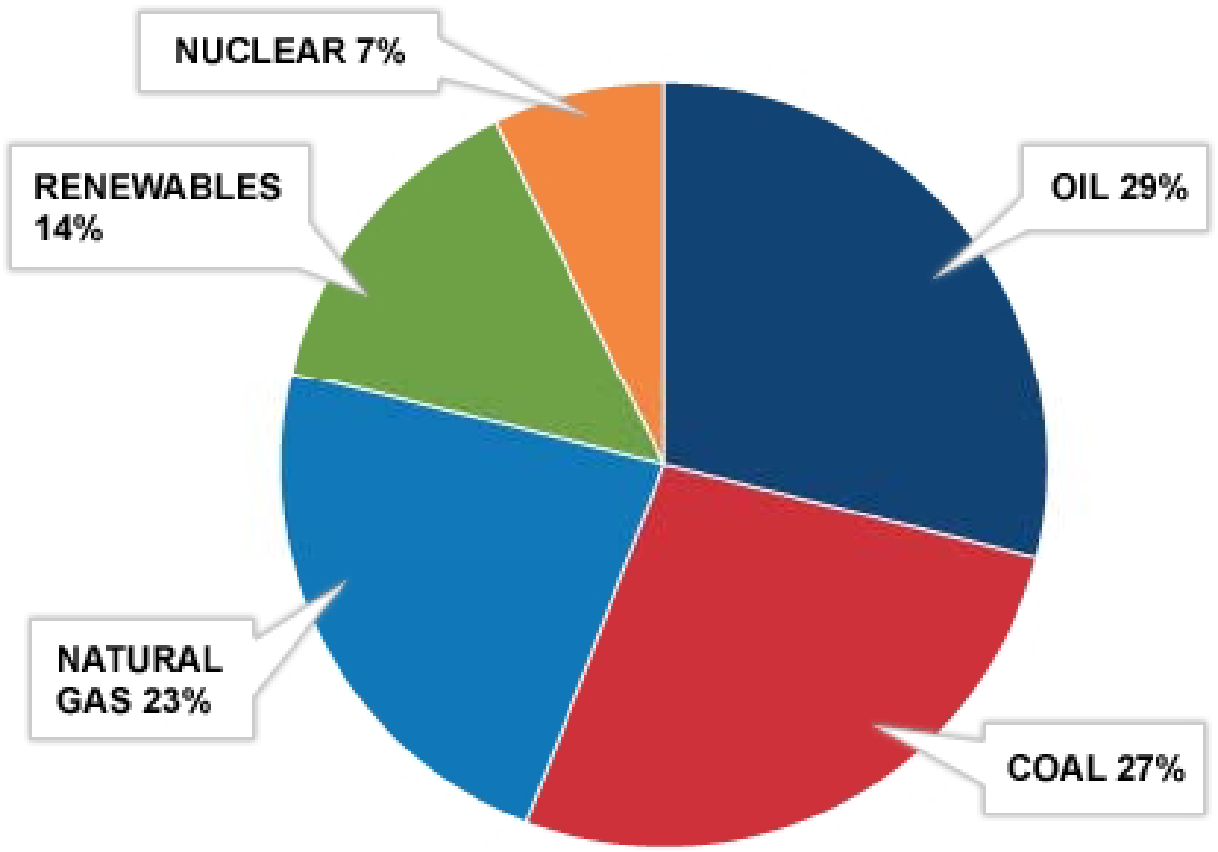
Energy and Climate change

World Energy Council
CONSEIL MONDIAL DE L'ENERGIE

2013 World Energy Issues Monitor

- Even with improvements in energy efficiency, we expect global energy demand to double by 2050.
- This is the inevitable consequence of global population growth, global economic growth, continued urbanization, as well as the resulting increased demand on mobility and other energy dependent services.
- During the same period we will need to reduce global greenhouse gas emissions by half if we want to keep a global temperature increase below two degrees Celsius.

PROJECTED WORLD ENERGY MIX, 2035

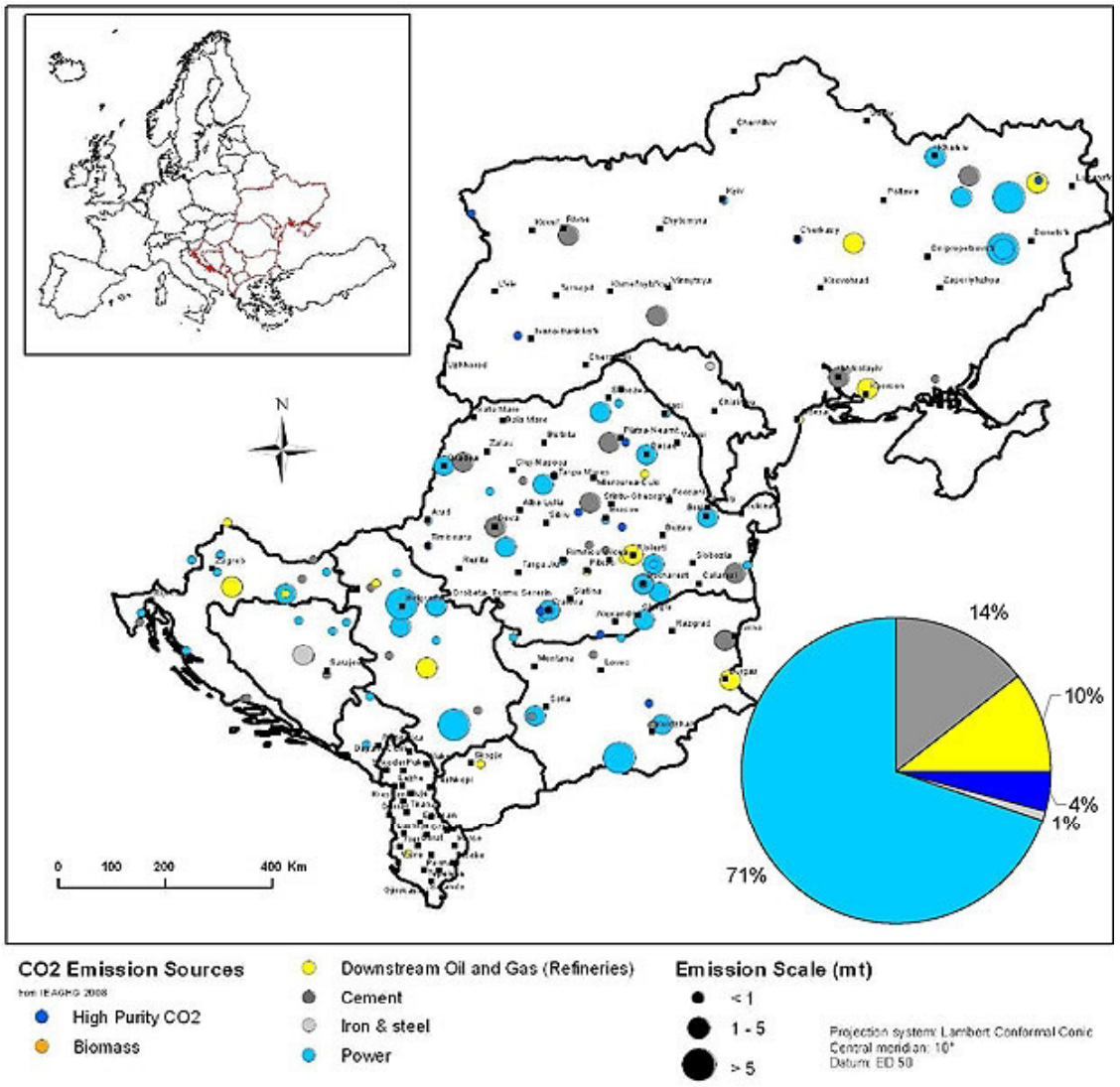


SOURCE: EIA

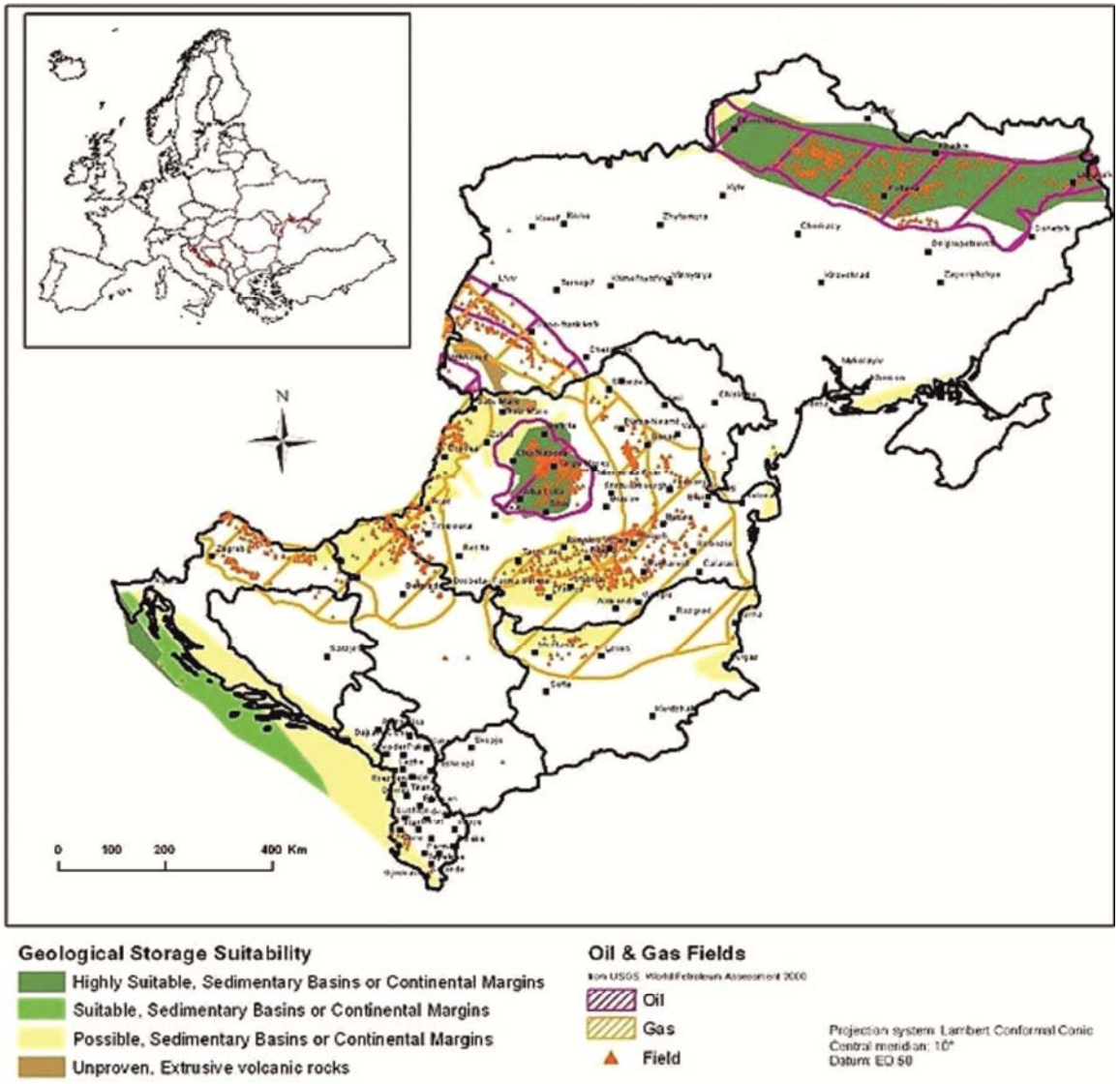
As, any prediction on world energy mix for 2050 and even for 2100 mentions important usage of the fossil resources, including coal, taking into consideration, apart the numerous scientific and technical studies, the exceptional important Agreement of COP 21, it is obvious that CCS technology have to be developed and applied worldwide.

Global Industrial CCS Technology Roadmap, Source-to-Sink Matching

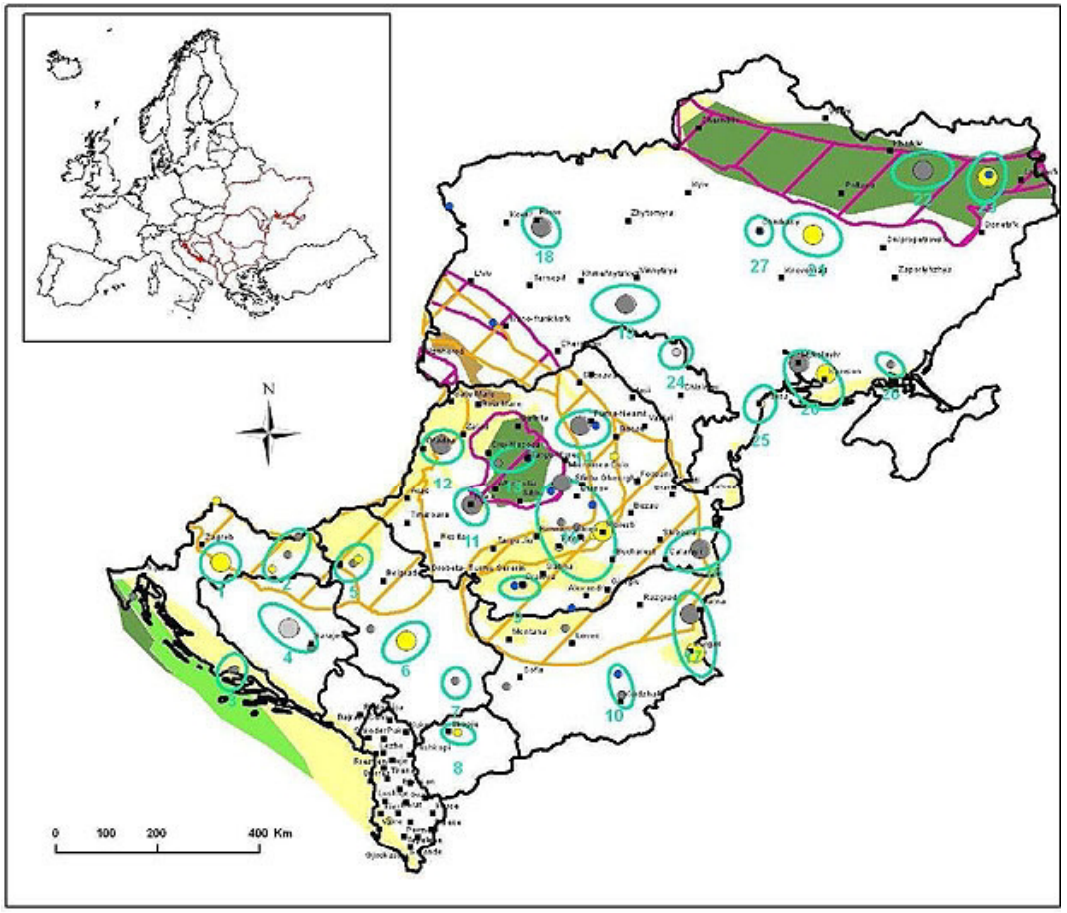
CO_2 Major Emissions Sources South-East Europe



Geological Storage Suitability in South-East Europe



CO_2 Major Emissions and Geological Storage Suitability in South-East Europe

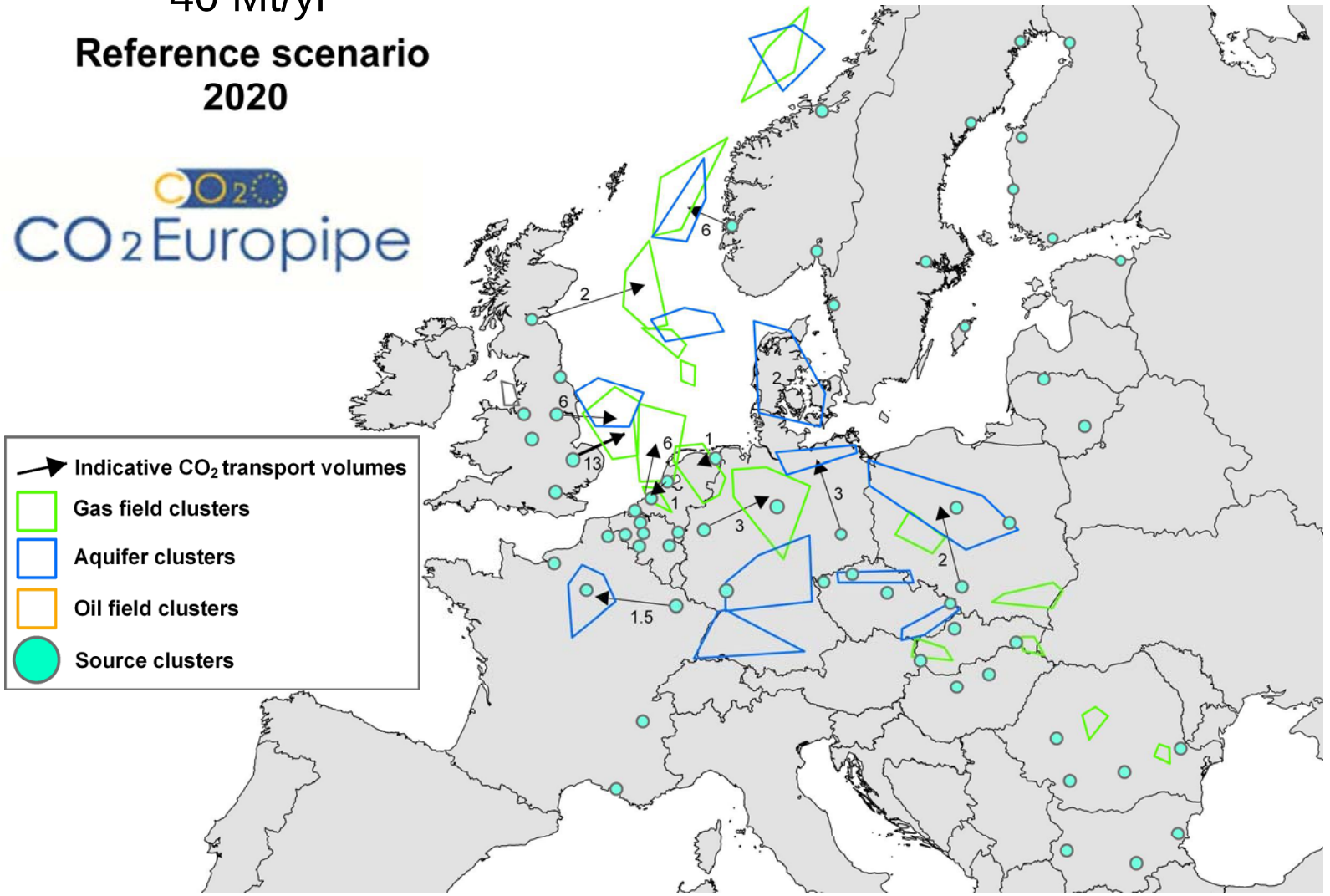


CO_2 EUROPIPE FP7 Project

Onshore + offshore storage

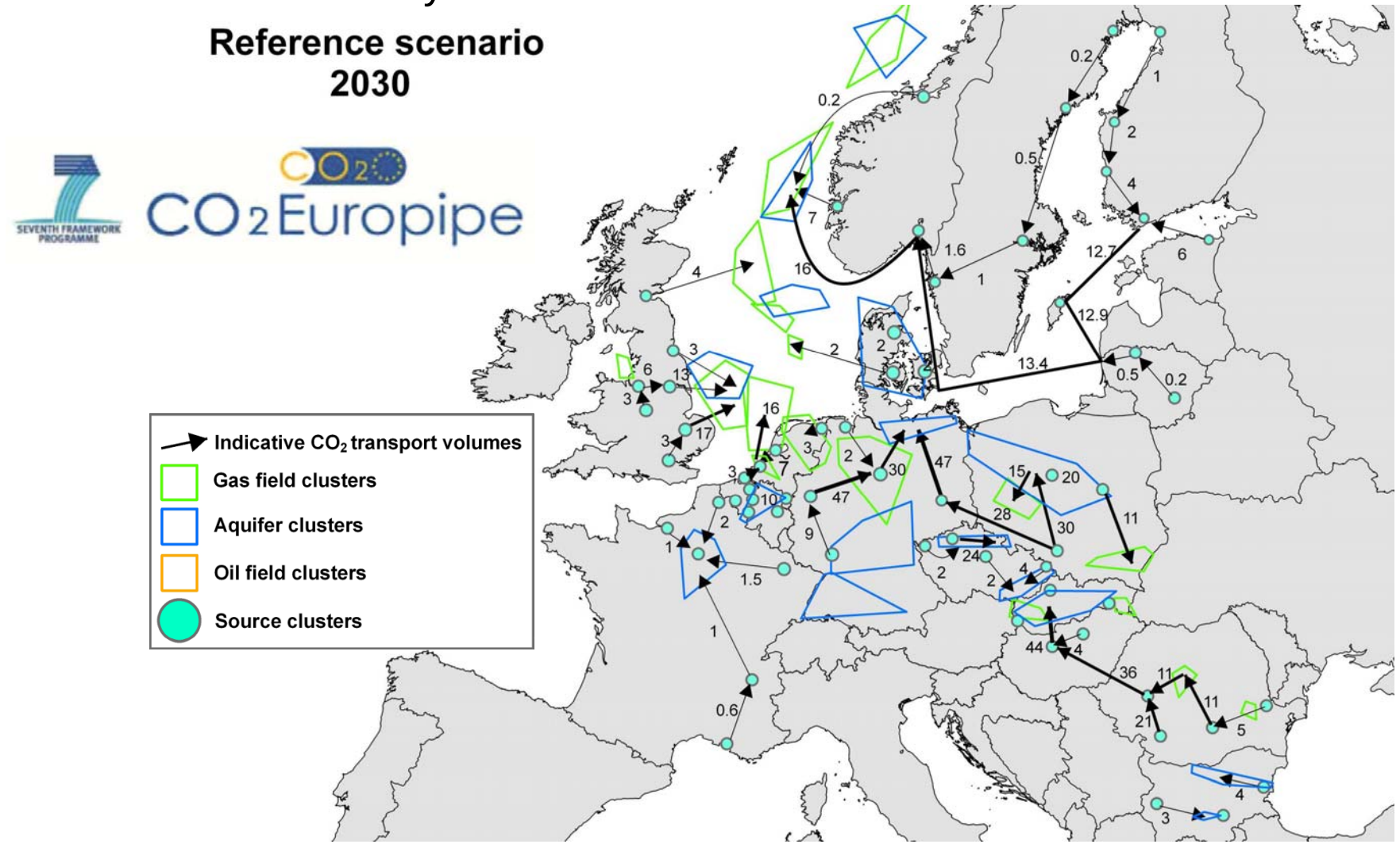
~ 40 Mt/yr

Reference scenario 2020



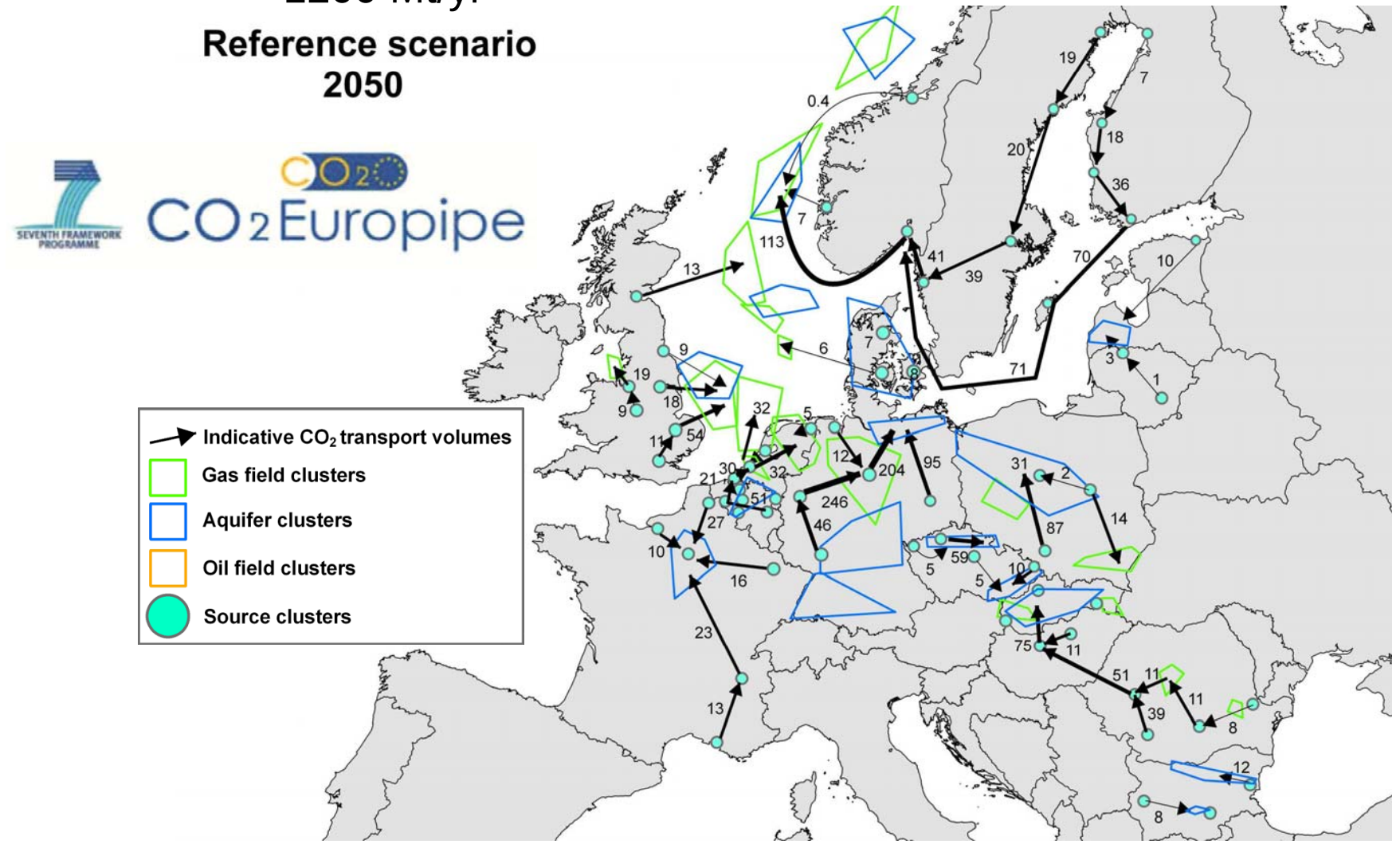
Onshore + offshore storage

~ 400 Mt/yr



Onshore + offshore storage

~ 1200 Mt/yr



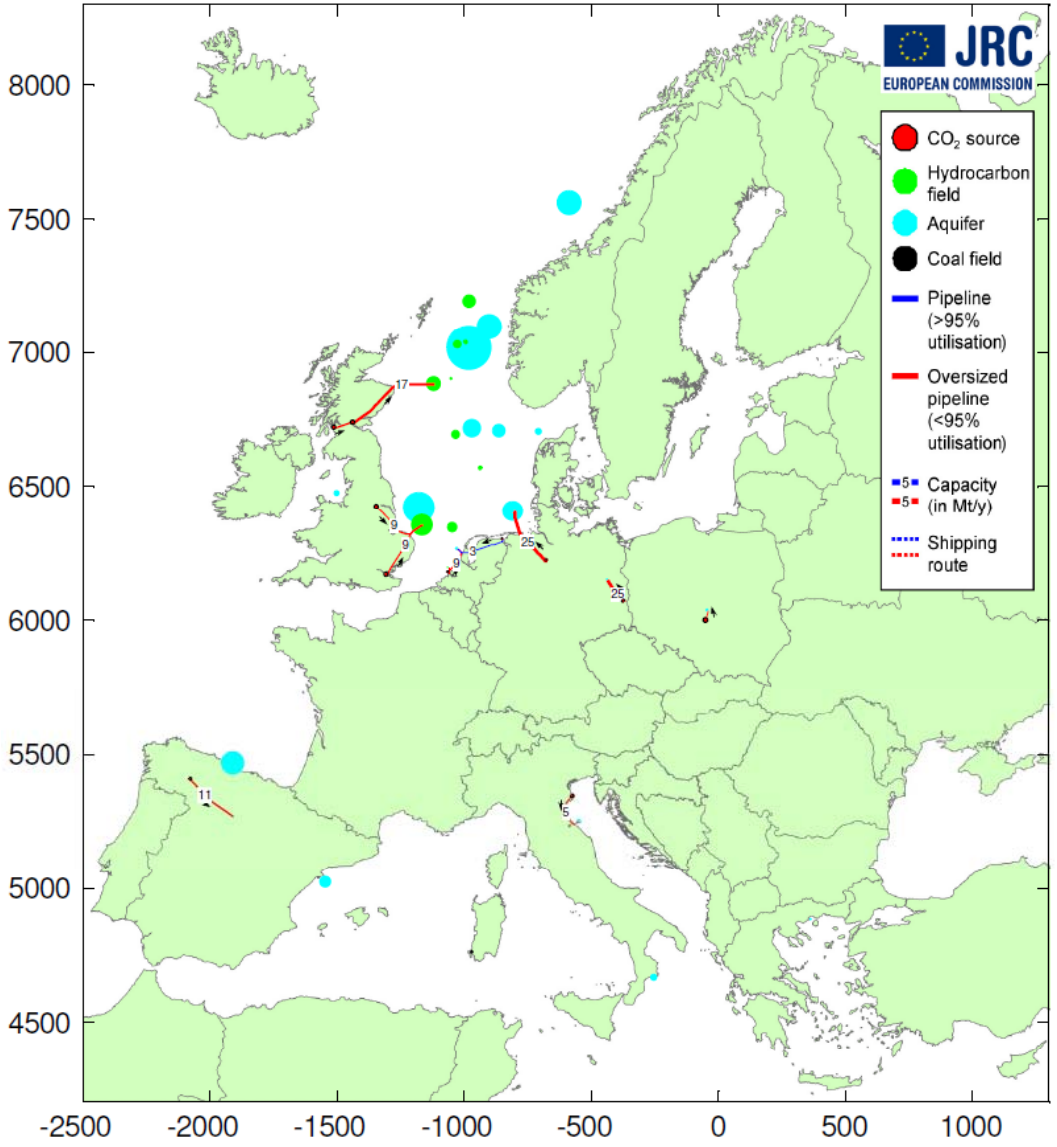
Investment Requirements for Trans-European CO_2 Transport Network

The evolution of the extent and the investment requirements of a trans-European CO_2 transport network

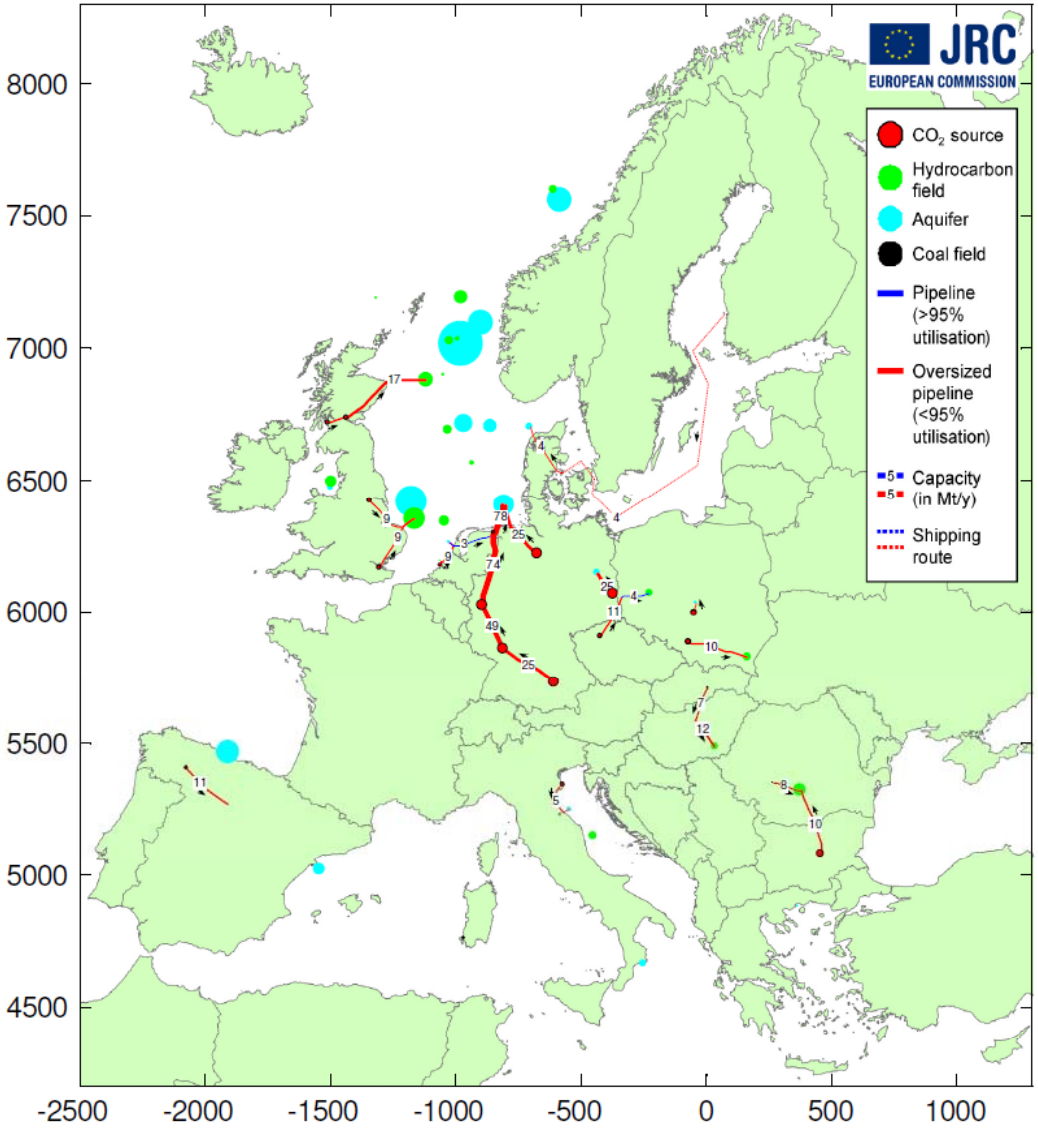
Joris Morbee, Joana Serpa, Evangelos Tzimas

EUR 24566 EN - 2010

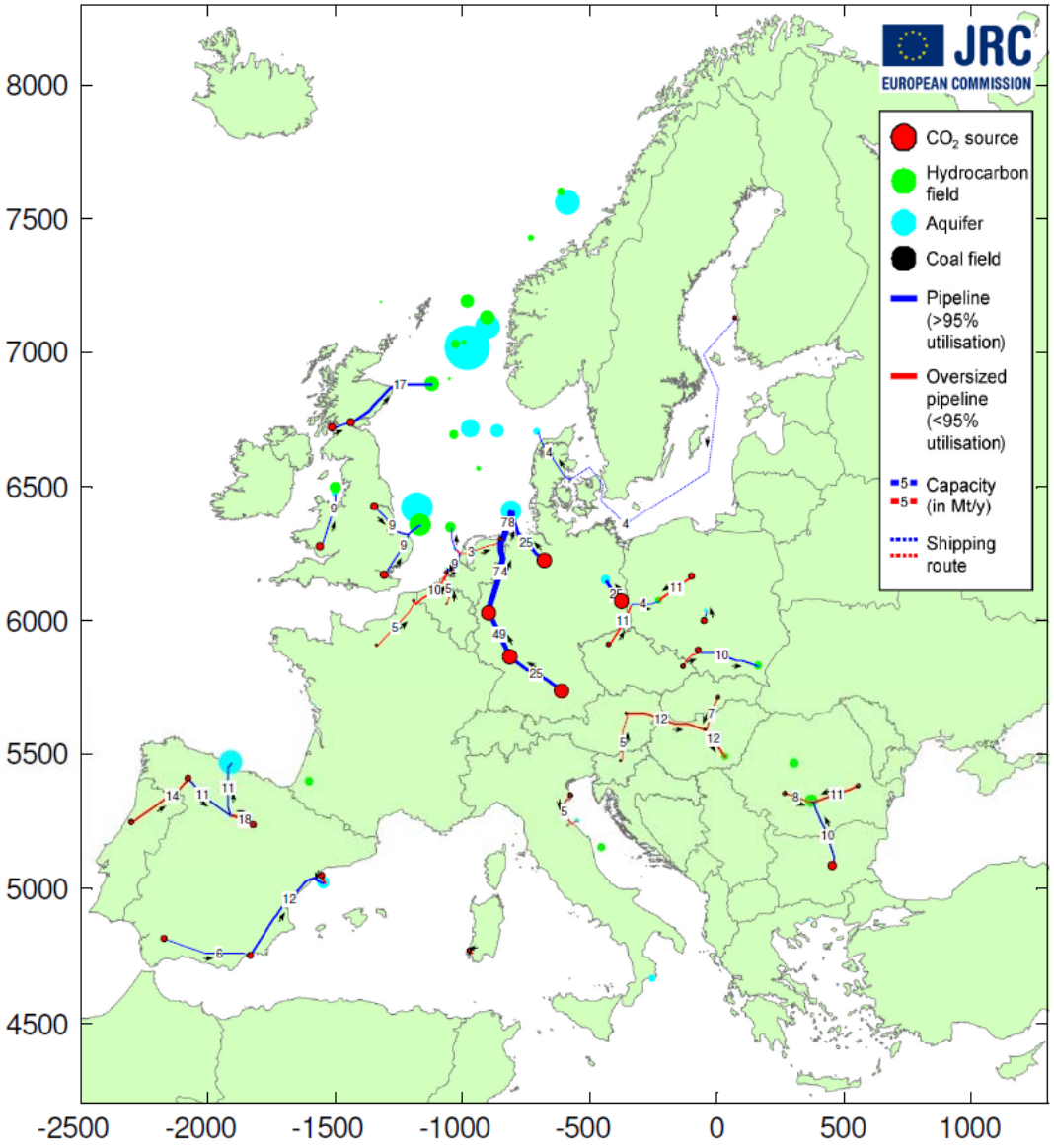
YEAR 2020 - 2005km network - 2.5 billion EUR cumulative investment

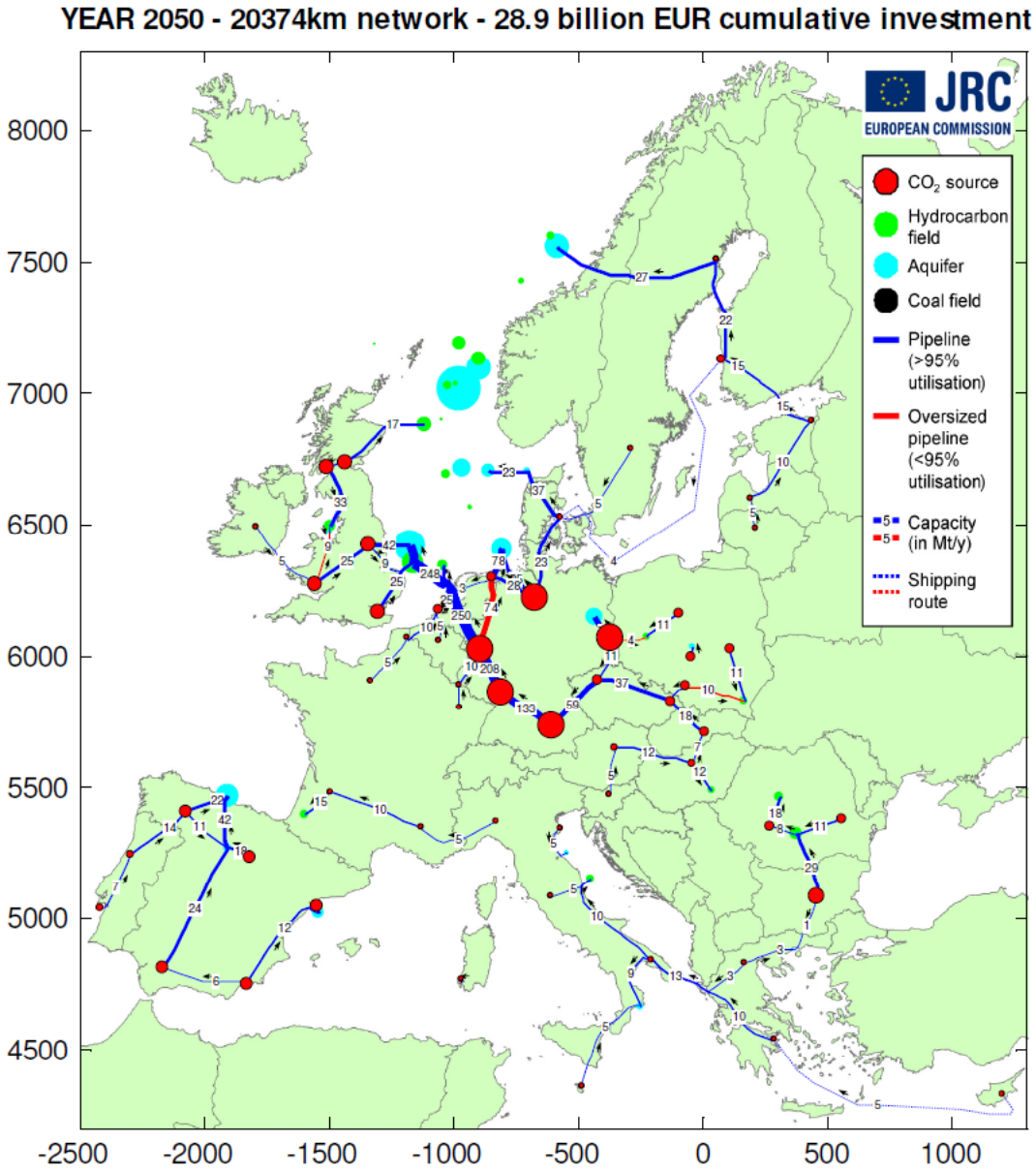


YEAR 2025 - 5607km network - 5.8 billion EUR cumulative investment



YEAR 2030 - 8803km network - 9.1 billion EUR cumulative investment




YEAR 2050 - 20374km network - 28.9 billion EUR cumulative investment
JRC
EUROPEAN COMMISSION
CO2 source
Hydrocarbon field
Aquifer
Coal field
Pipeline (>95% utilisation)
Oversized pipeline (<95% utilisation)
Capacity (in Mt/y)
Shipping route
8000
7500
7000
6500
6000
5500
5000
4500
-2500
-2000
-1500
-1000
-500
0
500
1000

Important notes

- The above results should only be seen in the context of the assumptions made for the execution of such a broad analysis. Use of alternative scenarios for the evolution of captured CO_2 quantities in Europe or different hypotheses for the availability of onshore aquifers for CO_2 storage will produce a different set of results.
- The error margin of optimisation is of the order of 25%. This is the possible deviation that should be considered in the reported pipeline lengths and implicitly on costs.
- The locations of CO_2 emission sources and sinks have been considered in the analysis with an accuracy of ±100 km, which may induce additional deviations in the reported lengths. Furthermore, points on the map should not be identified with specific CO_2 sources or sinks.
- Since cost estimates for CO_2 pipelines and CO_2 shipping show large scatter, the real costs may differ from the results of this analysis, which is based on 'typical' cost values.

Rotterdam CINTRA Project

ROTTERDAM CINTRA

Carbon in Transport

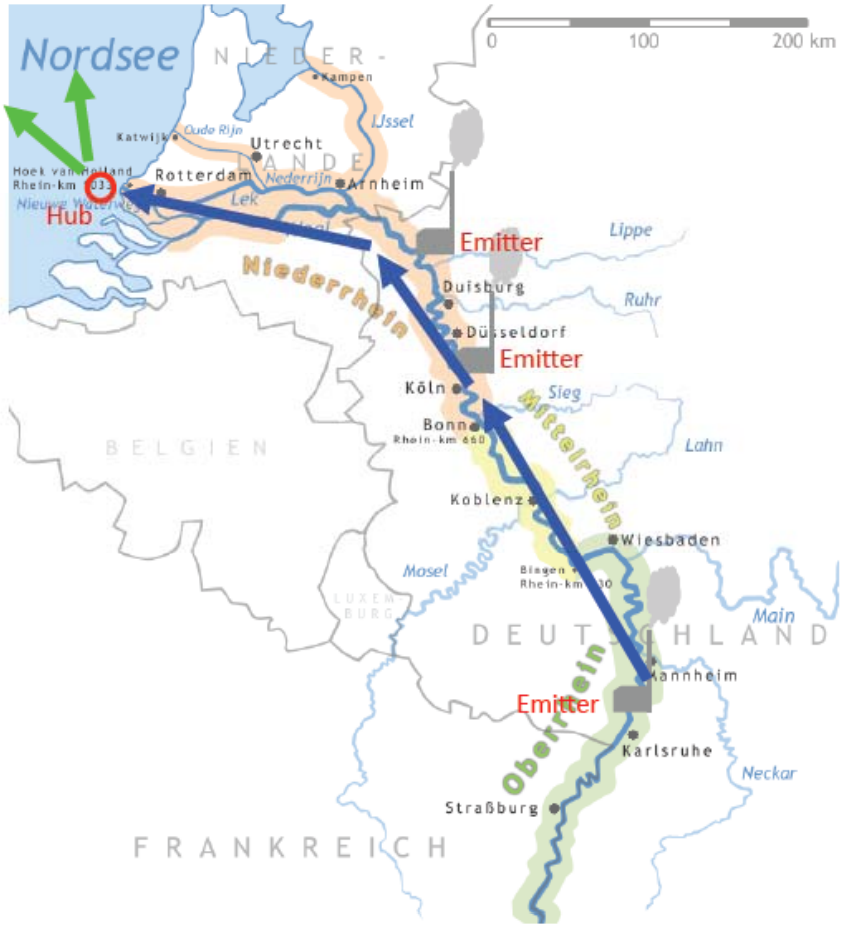
Rotterdam Cintra Project
Liquid CO_2 Logistics

ZEP Presentation, GG Meeting #23
Brussels
January 18, 2012

Ernest Groensmit

Connecting Hinterland Barges to CO_2 Hub in Rotterdam

- Liquefaction of CO_2 at site
- River barges transport liquid CO_2 over Rhine
- Cargoes from several sources can be combined: economies of scale
- Capacity on Rhine is abundant vs. pipeline hardly feasible



19-01-12

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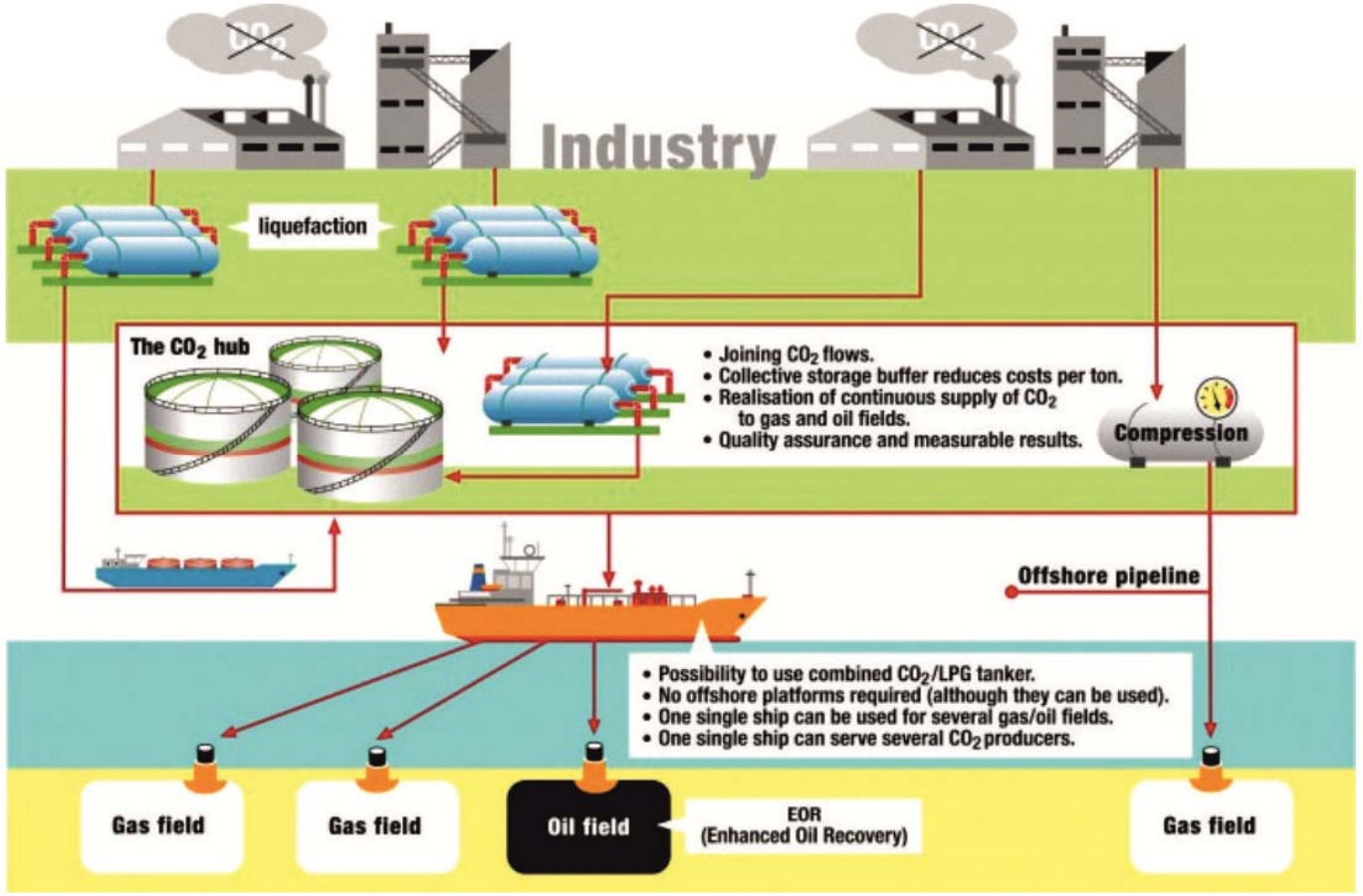
CINTRA *facts and figures*	
Type of project	Ship transport and CO_2 hub facilities
Start operation	2015 – with first NER300 and EEPR projects
Capacity	Initial throughput flows are expected to be around 1.5 Mton/y, growing to a potential of 10 Mton/y or more in 2025

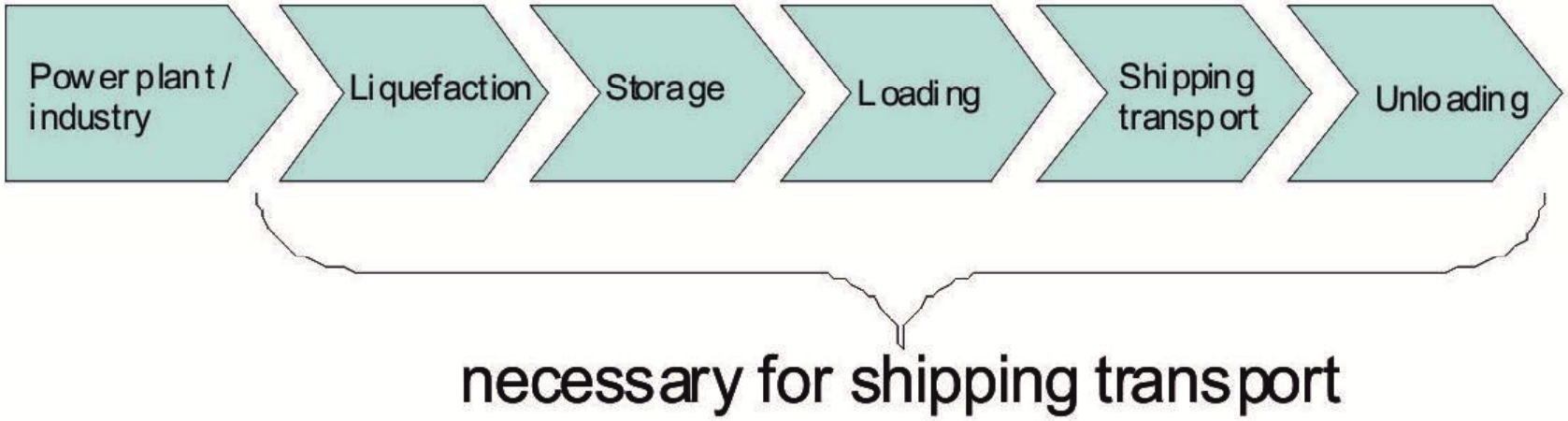
www.cintra.nl *

TNO Vision on Shipping Transport Process

Shipping transport process

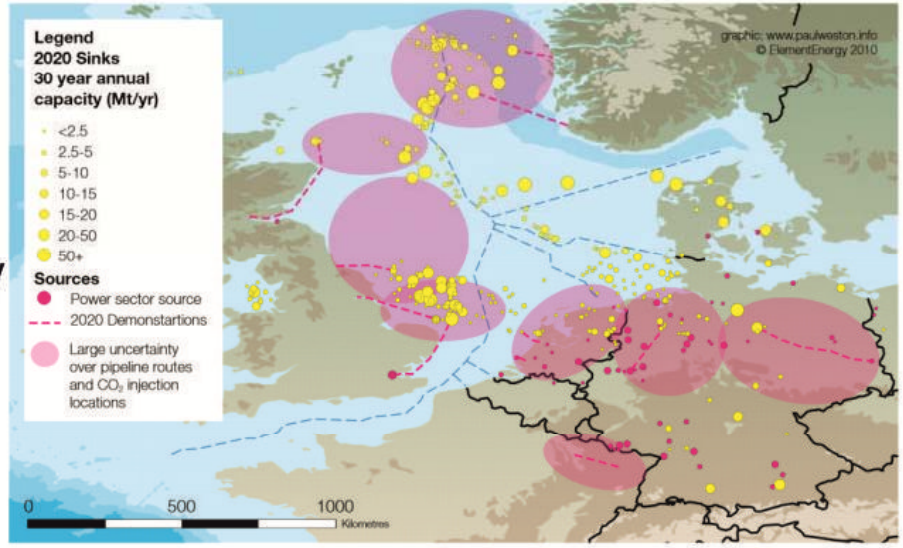


Shipping transport process

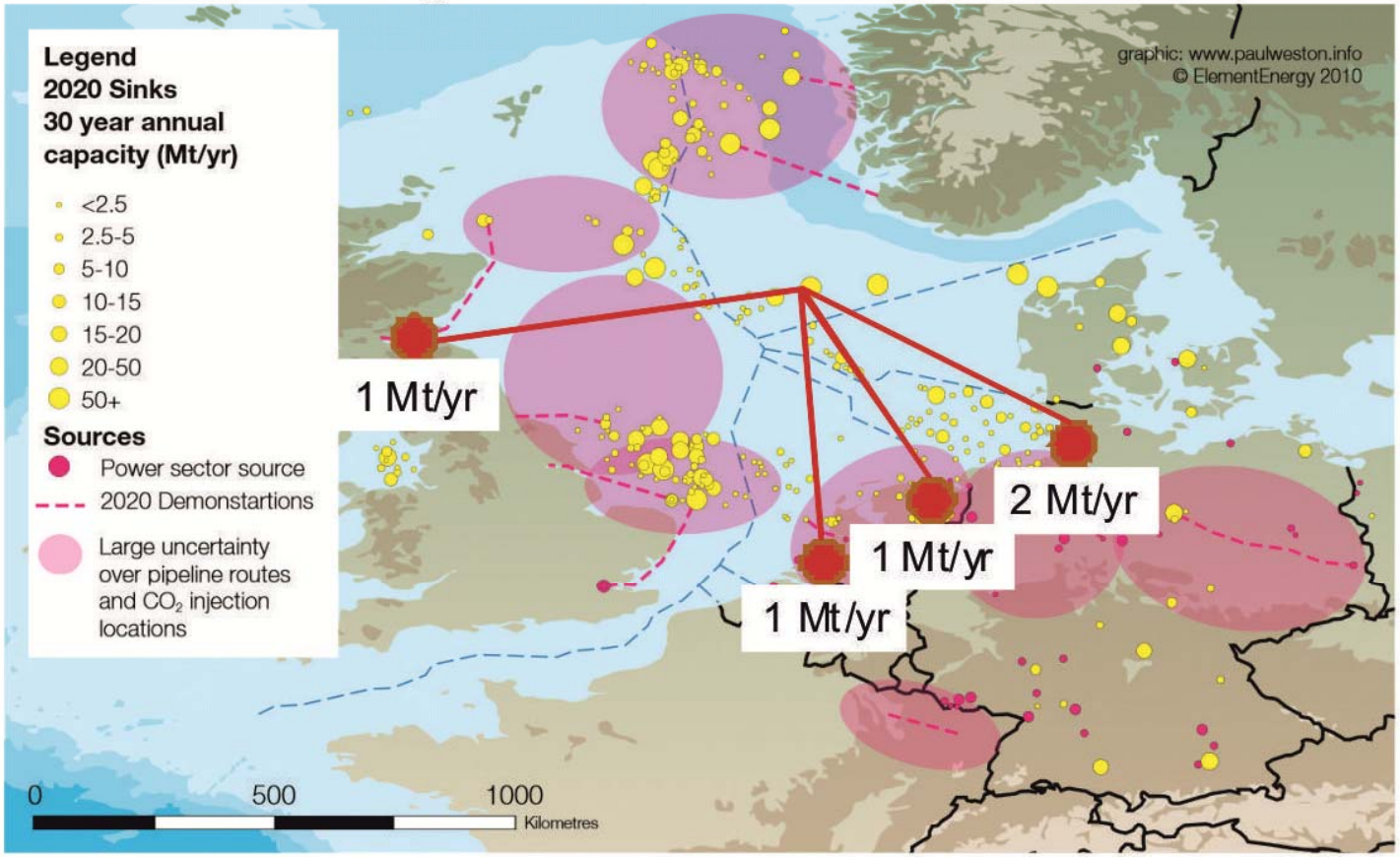


Ship transport
Kick-start CO_2-EOR in North Sea?

1. CCS in NW Europe: focused on North Sea for storage
   - Early projects: small volumes (1-2 Mt/yr)
   - Construction of long pipelines unlikely
2. Oil fields: CO_2-EOR feasible, if sufficient CO_2 available
   - Volumes required typically 5 Mt/yr
3. Ship transport can focus several small volumes



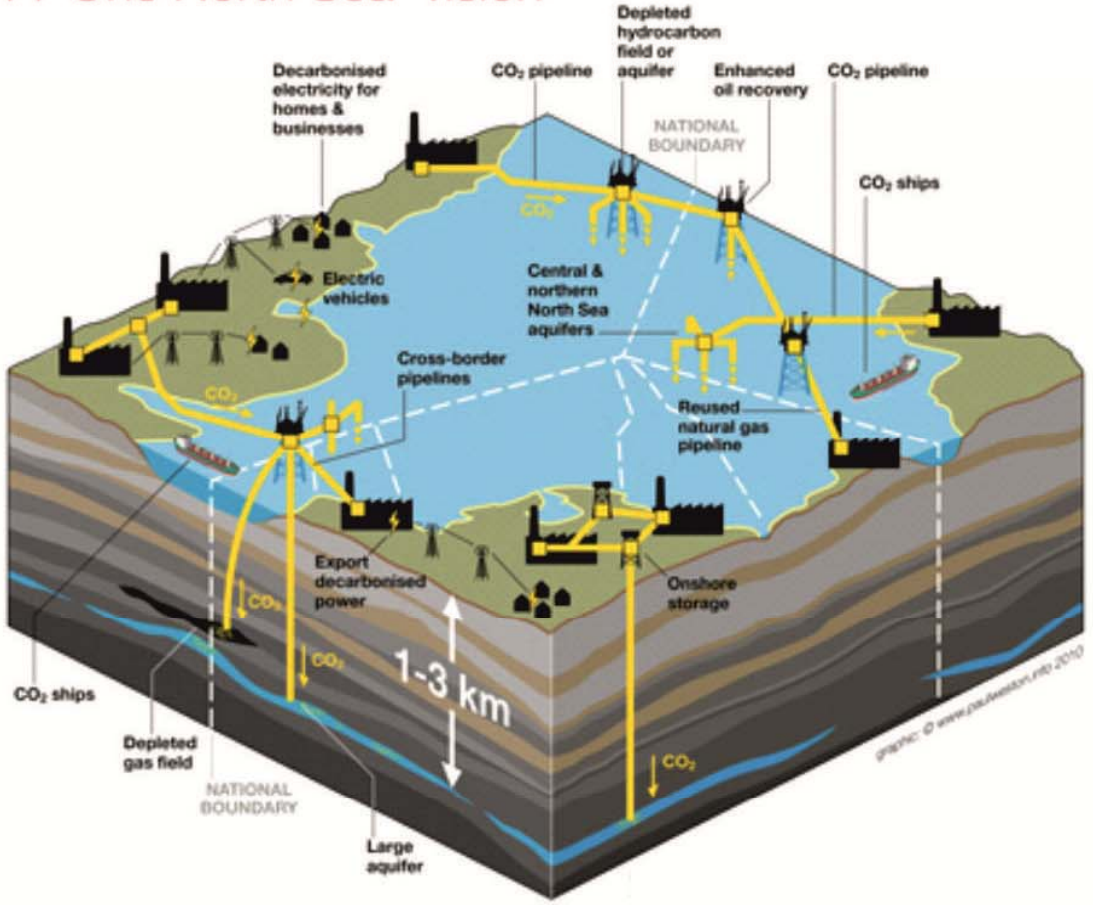
Ship transport
Kick-start CO_2-EOR in North Sea?



Long-term view

A 'One North Sea' vision

Long-term vision for North Sea includes pipelines. These are only feasible with long-term supply of large volumes of CO_2 and are difficult to include in early phase of large-scale CCS.



In conclusion, the captured CO_2 must be transported from the emission source to a suitable storage location. This transport takes place in pipelines, or by ship. CO_2 will be stored in geological formations deep below the earth surface or the seabed.

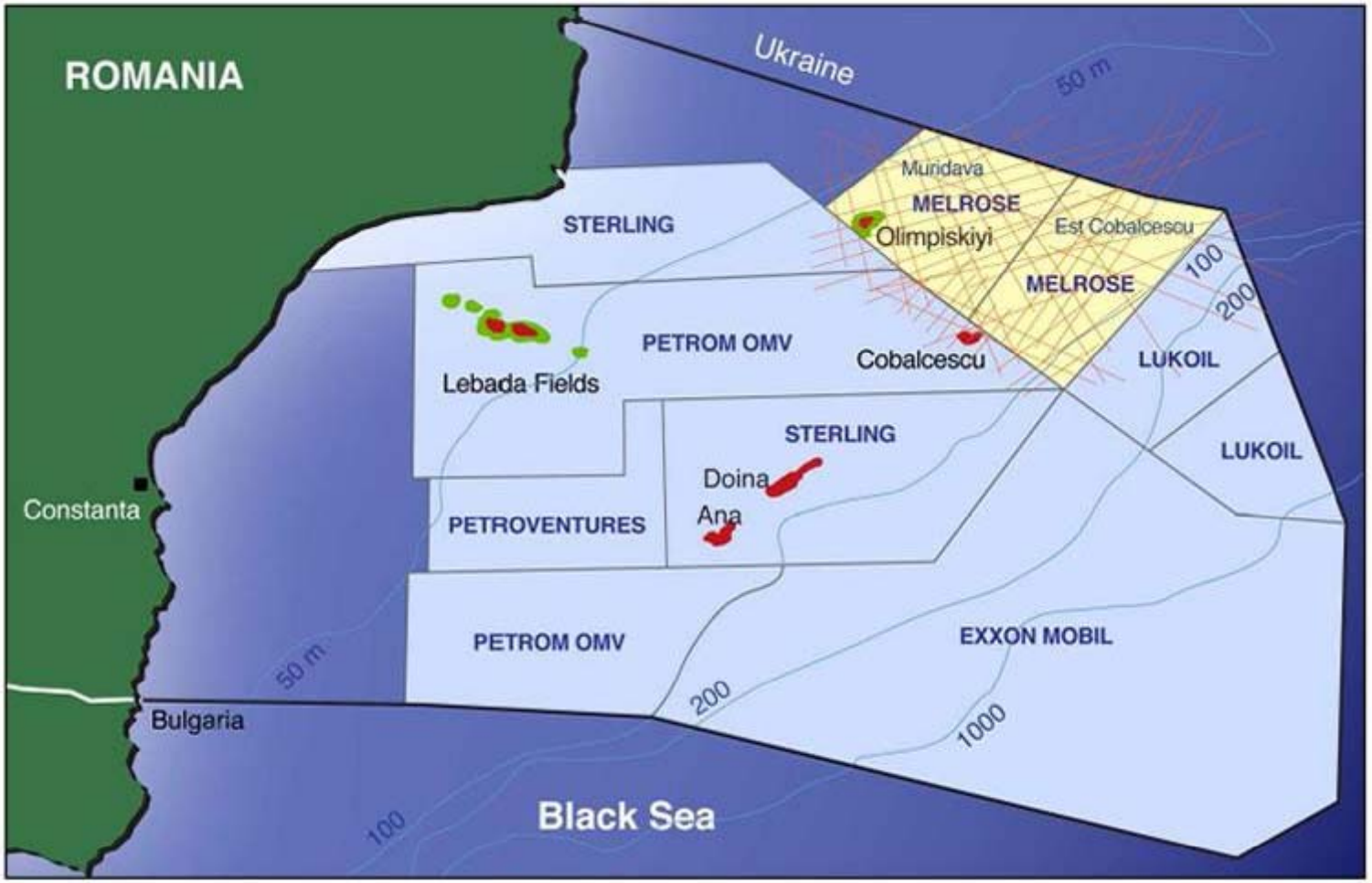
European Inland Waterways


Oslo
Tallinn
EST
Riga
LV
NORTH SEA
NORDSEE
DK
Kobenhavn
BALTIC SEA
LT
Vilnius
Minsk
BY
IE
Dublin
UK
IRISH SEA
Amsterdam
Berlin
Warszawa
PL
Kijv
UA
London
Bruxelles
ENGLISH CHANNEL
DE
Praha
LU
CZ
SI
Paris
Bratislava
MD
Wien
Budapest
Chişinău
AT
HR
RO
FR
SE
Genève
Ljubljana
Zagreb
GOLFE DE GASCOGNE
Bay OF BISCAY
BA
Sarajevo
Beograd
MARE ADRIATICO (ADRIATIC)
ME
RS
Sofija
BU
Podgorica
Skopje
IT
Roma
Tirane
MK
Madrid
PT
MEDITERRANEAN SEA
AL
GR
AEGEAN SEA
TR
Lisboa
ES
MARE TIRRENICO
TYRRHENIAN SEA
IONIAN SEA

EU Strategy for the Danube Region

EU Strategy for the Danube Region

Western Black Sea Oil and Gas Operations



KEY

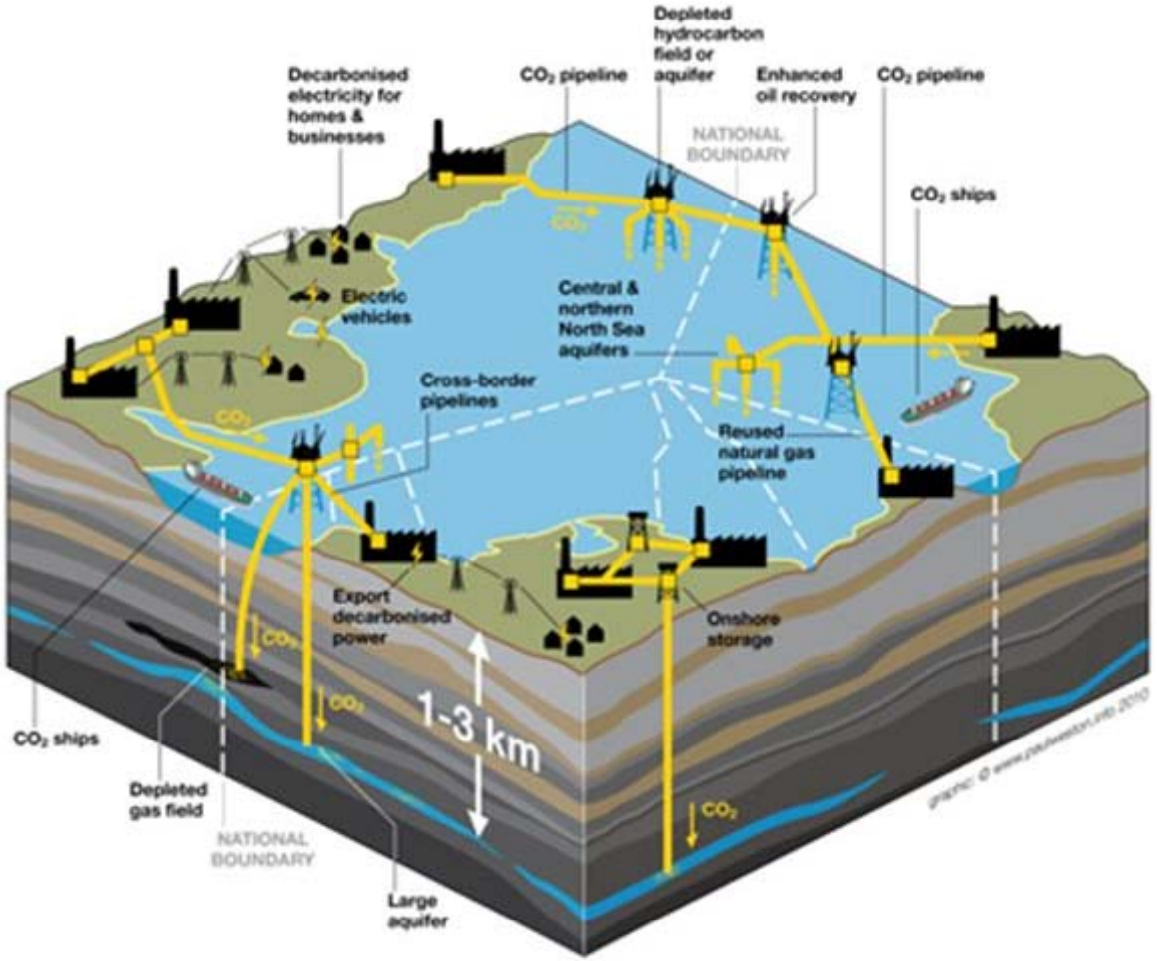
- Oil Field
- Gas Field
- Melrose
- Other blocks
- Maritime Boundary

Multimodal Transport of CO_2 - A solution for South-East Europe

Multimodal transport of CO_2 consists in a smart usage of pipelines and ships. At the scale of South East Europe and, why not, for a large part of Europe, promoting the multimodal transport of CO_2 could surpass the difficulties of building pipelines every where as well as, for exemple, those of public acceptance and transboundary cooperation, apart others. 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.

Key words:

- transport of CO_2 , on land and on water;
- CO_2 storage, on shore and offshore;
- EOR and EGR.



Western Black Sea have to follow North Sea!

Why not?

Thank you for your attention!