GEOSTOR

Title: CO_2 storage in geological formations of the German EEZ in the North Sea

Overarching goal: Develop a roadmap for the implementation of a large-scale CO_2 storage project in the German sector of the North Sea

Topics

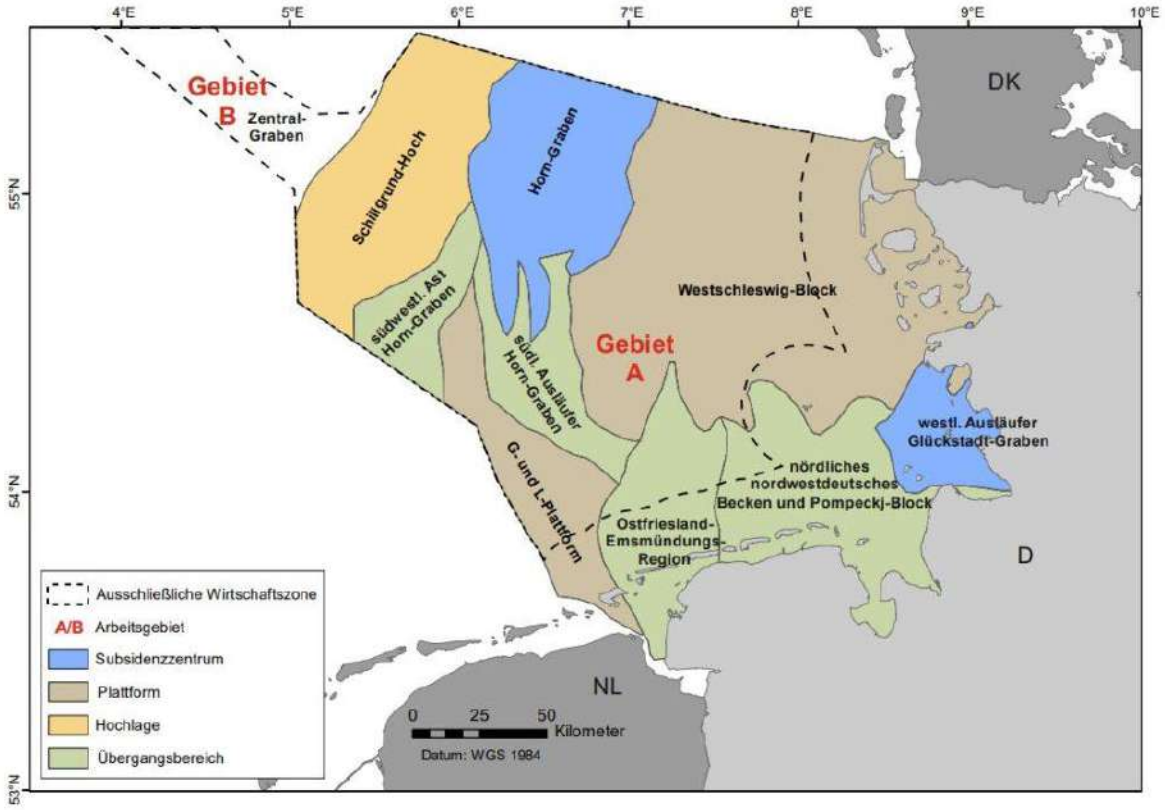
> Geology (storage capacity and suitable sites)

> Environmental risks (leakage, micro-seismicity, noise)

> Monitoring (passive- seismic approach)

> Marine spatial planning and legal framework

> Technical set-ups and costs for transport and storage



Geological map of the German sector of the North Sea (BGR)

GEOSTOR

Project partners

GEOMAR

BGR Bundesanstalt für Geowissenschaften und Rohstoffe

CAU Kiel University Christian-Albrechts-Universität zu Kiel

Deutsches Meeresmuseum Stralsund

UHH Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG

FICHTNER

KUM

TRUEOCEAN

First phase: Aug. 2021 – July 2024, to be followed by second and third phase

Budget first phase: 5.7 Mio. € provided by BMBF via DAM

Background

CCS (Carbon dioxide Capture and Storage), process chain:

- Capture of pure CO_2 stream at industrial facilities (separation from other gases employing e.g. amines)
- Compression (CO_2 gas is converted into liquid CO_2)
- Transport of liquified CO_2 via pipeline or ship to storage formation
- Injection in suitable geological formation (after site characterizing and selection)
- Monitoring of storage sites

Background

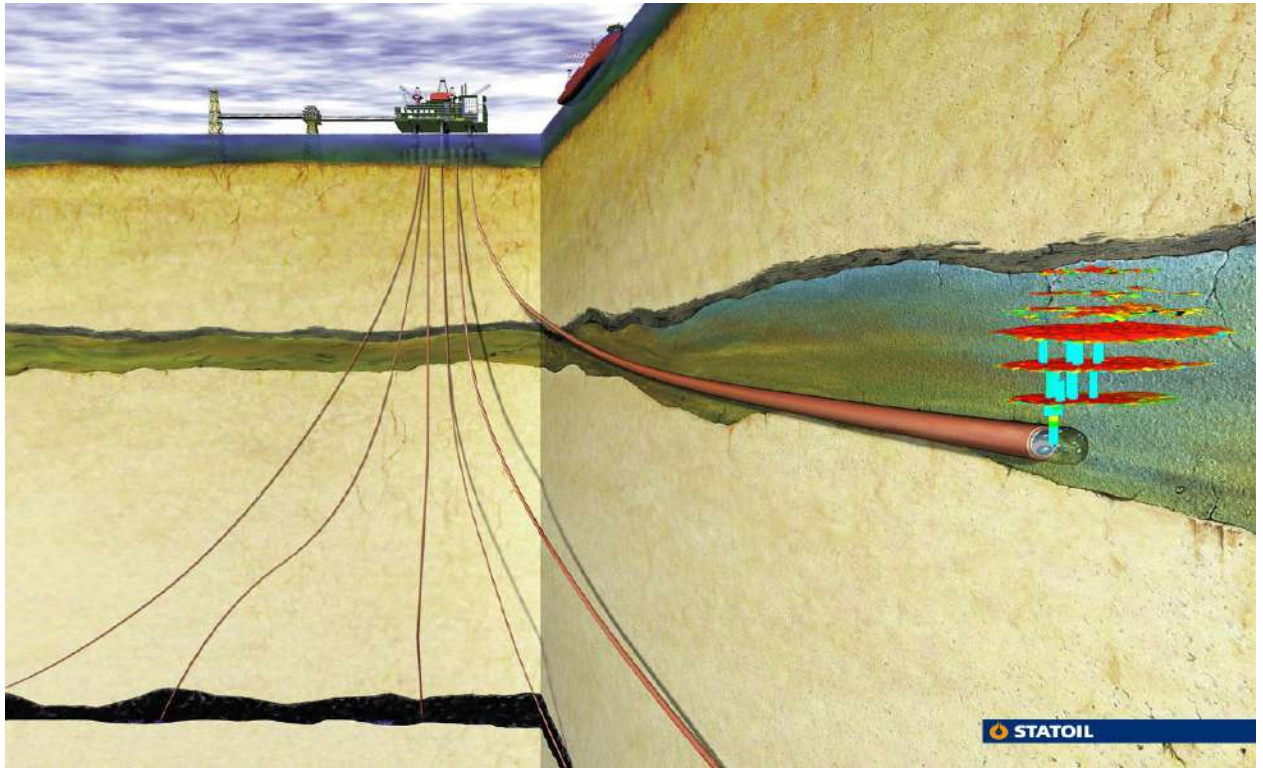
Possible CCS applications in Germany:

- Industrial facilities (cement production, steel production, fertilizer production, refineries, etc.)
- Natural gas power plants
- Blue hydrogen
- Municipal waste combustors
- Negative emissions (BECCS, direct air capture)

Background , storage projects

Sleipner (North Sea)

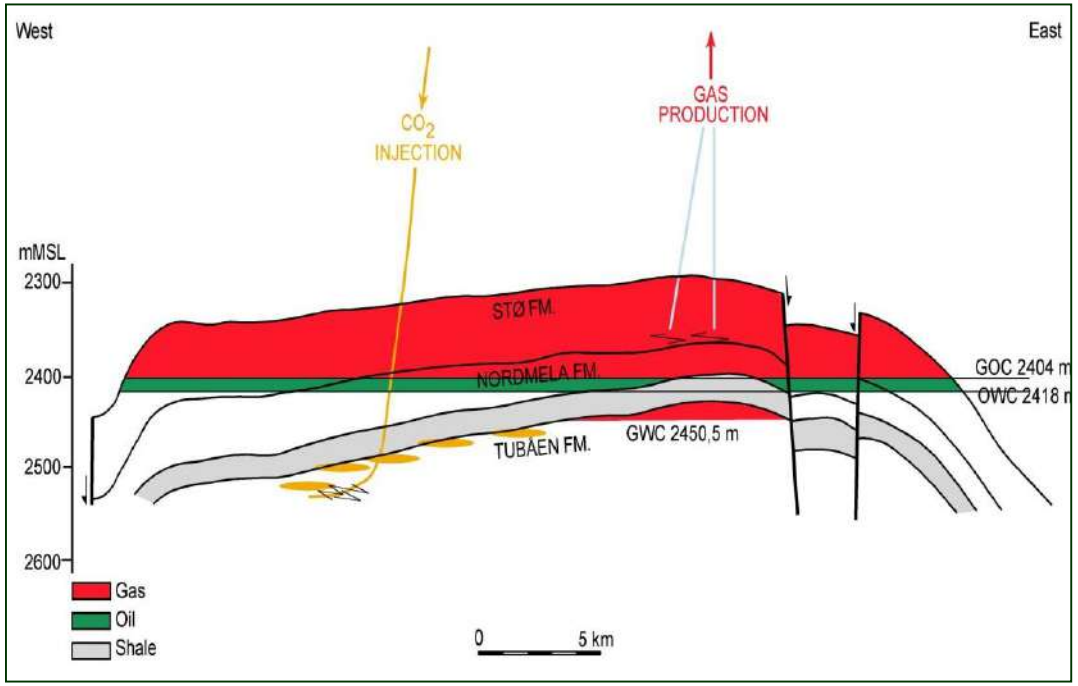
CO_2 separated from natural gas, ca. 0.9 Mt yr^{-1} since 1996, depth of Utsira storage formation (saline aquifer): ca. 900 m, water depth: ca. 80 m



Background , storage projects

Snohvit (Barents Sea)

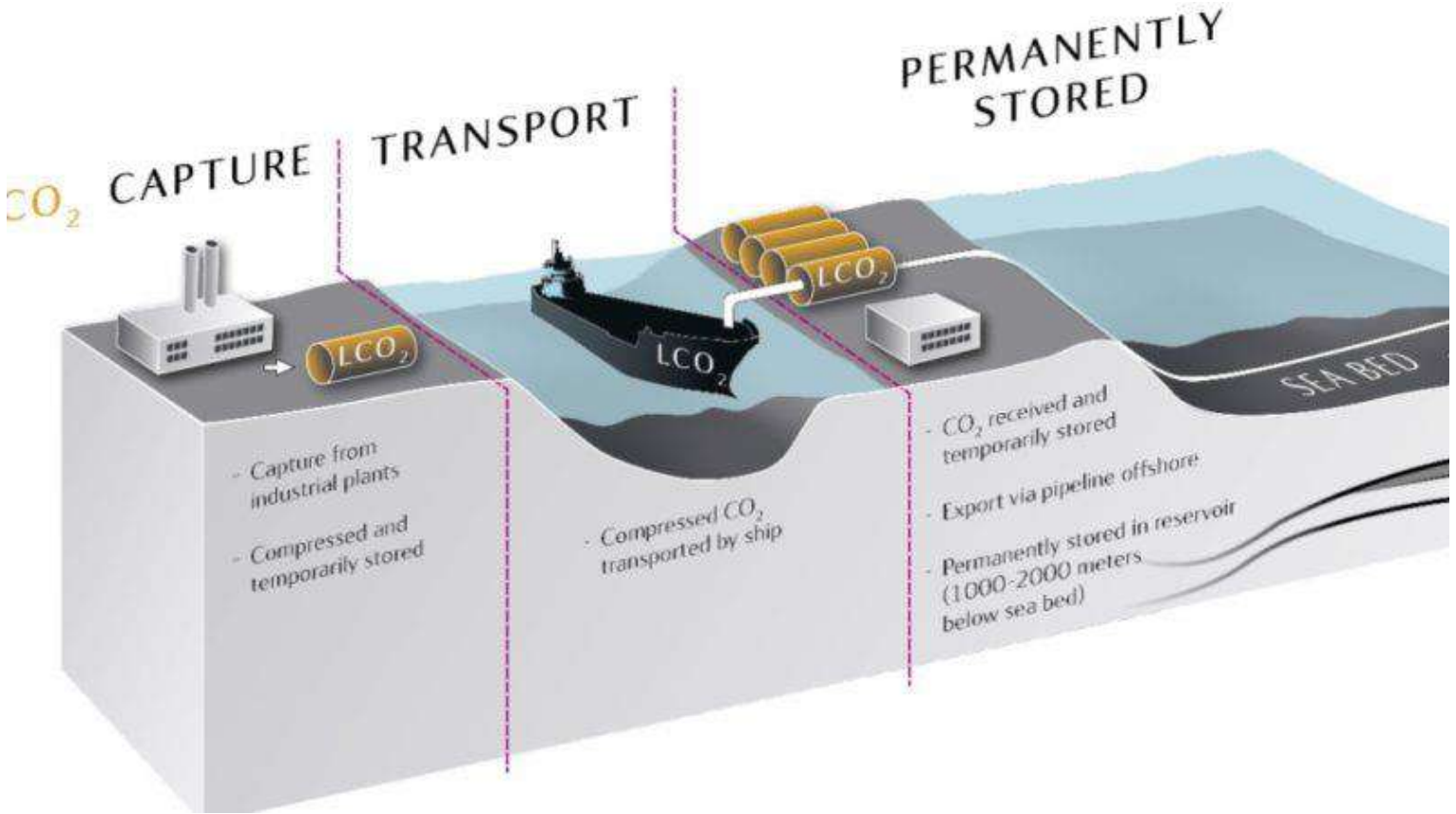
CO_2 separated from natural gas, ca. 0.7 Mt yr^{-1} since 2009,
depth of storage formation (saline aquifer): ca. 2500 m, water depth: ca. 350 m



Background , storage projects

Norwegian Shelf (North Sea, Northern Lights)

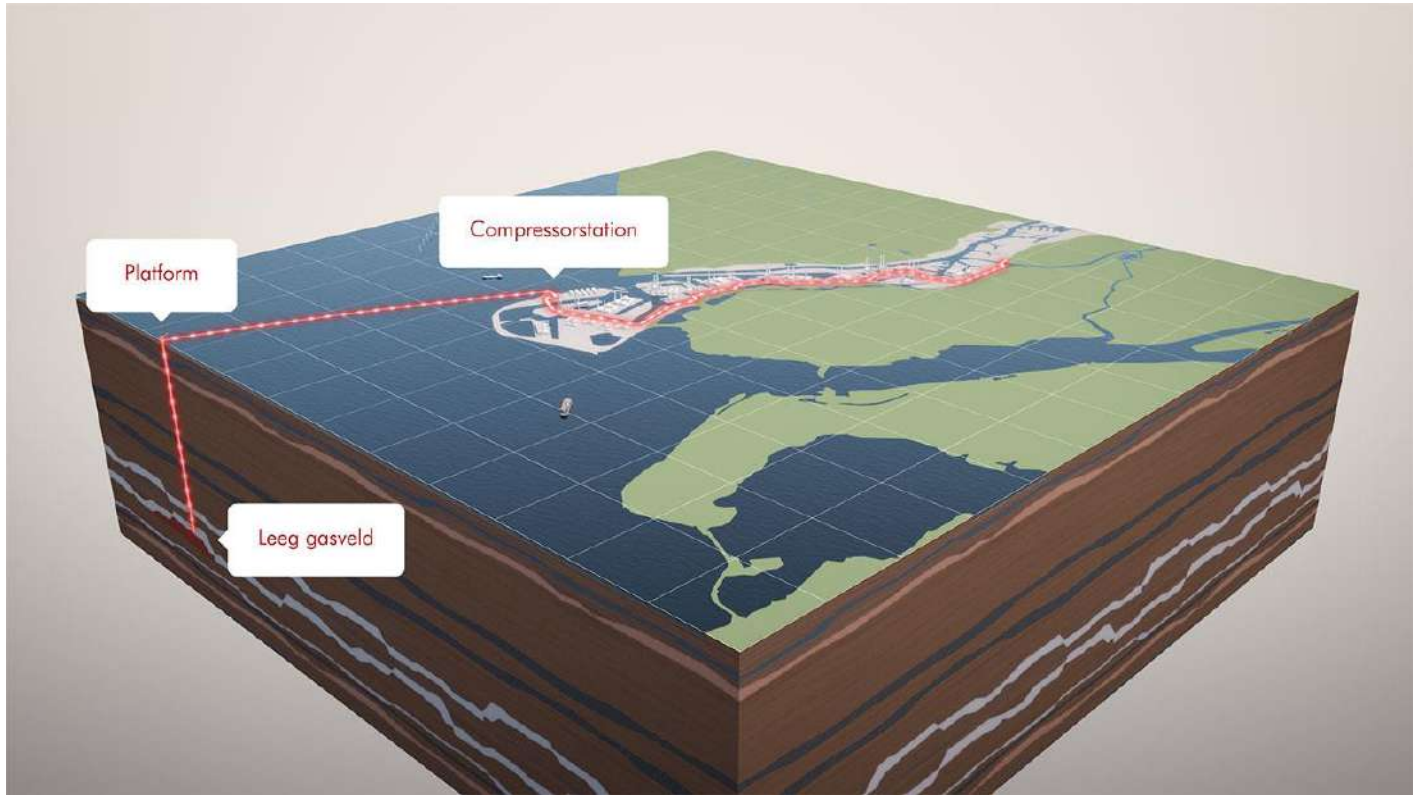
CO_2 from cement production and a municipal waste combustor in Oslo, additional CO_2 from European industries transported by ship. Start scheduled for 2023.



Background , storage projects

Rotterdam Harbor (North Sea)

CO_2 from regional industrial sources, storage in depleted gas reservoir, additional CO_2 from European industries transported by pipeline. Start scheduled for 2024.



Background , storage projects

Two UK projects (North Sea)

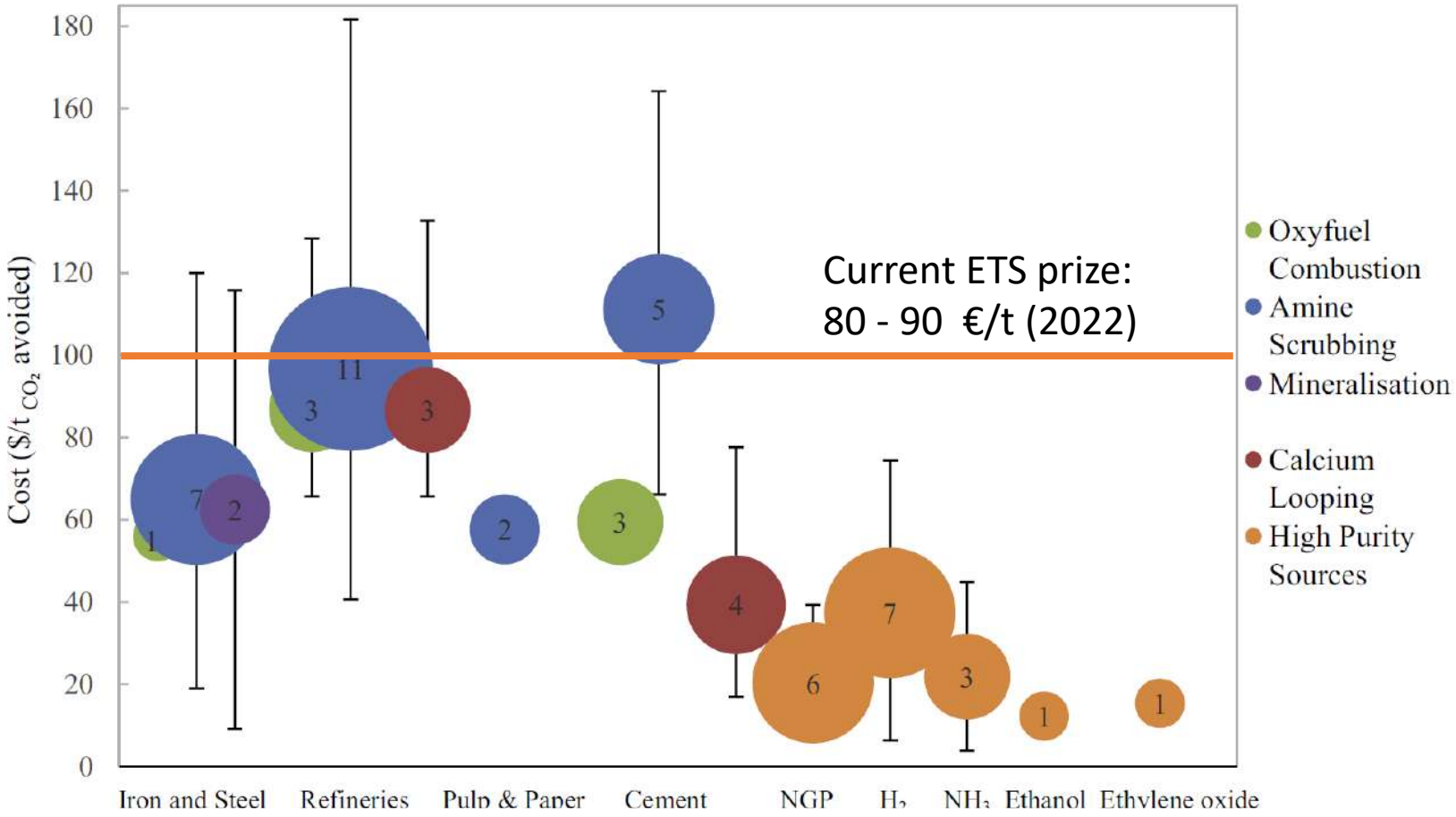
East Coast Cluster and **HyNet North West:** CO_2 from UK industrial sources and blue hydrogen, storage in depleted gas reservoirs and saline aquifers. Transport by pipeline using existing infrastructure. Start planned for 2025.

Two Danish projects (North Sea)

Greensand and **Biofrost**: CO_2 from Danish industrial sources, storage in depleted gas reservoirs. Transport by pipeline using existing infrastructure. Start planned for 2025.

Background , costs

Estimates of CO_2 avoidance costs (capture, only, in 2013$, Leeson et al. 2017)



Numbers indicate number of available cost estimates

Costs for transport, storage and monitoring (Smith et al. 2021):
10 – 30 $/t$CO_2$

"Low-hanging fruits":

- NH_3 (fertilizer production)
- Ethanol (biofuel production)
- NGP (CO_2 sep. from natural gas)
- H_2 (blue hydrogen)

Background , environment risks

Environmental risks of offshore CO_2 storage were investigated comprehensively in e.g. the European project ECO_2 led by GEOMAR. They include:

- Leakage of CO_2 and formation fluids

⇒ Impacts benthic ecosystems in the direct vicinity of leakage sites

- Seismicity (earthquakes) triggered by overpressures in the storage formation

⇒ Increases leakage risk, may affect on offshore infrastructures (e.g. wind mills)

- Noise induced by seismic exploration and monitoring

⇒ Affects marine mammals and other marine species

Overall environmental risk assessments:

Scientific community: **CCS is a low – moderate risk technology**

German public & policy makers: **CCS is a high-risk technology**

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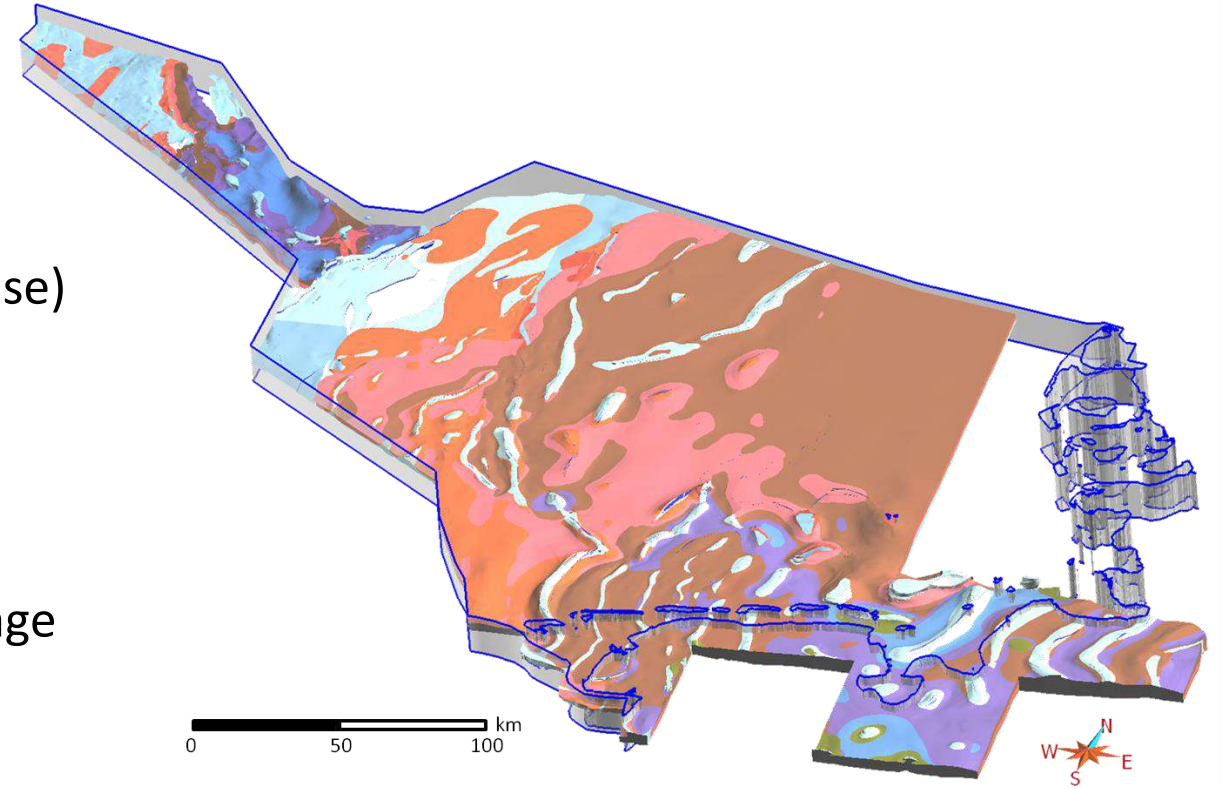

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