Carbon Capture and Storage in Norway

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Presentation for BI-Oslo
Feb 15, 2022

Outline

- Introduction
- CCS projects in Norway
- Research opportunities
- Summary

This is NGI

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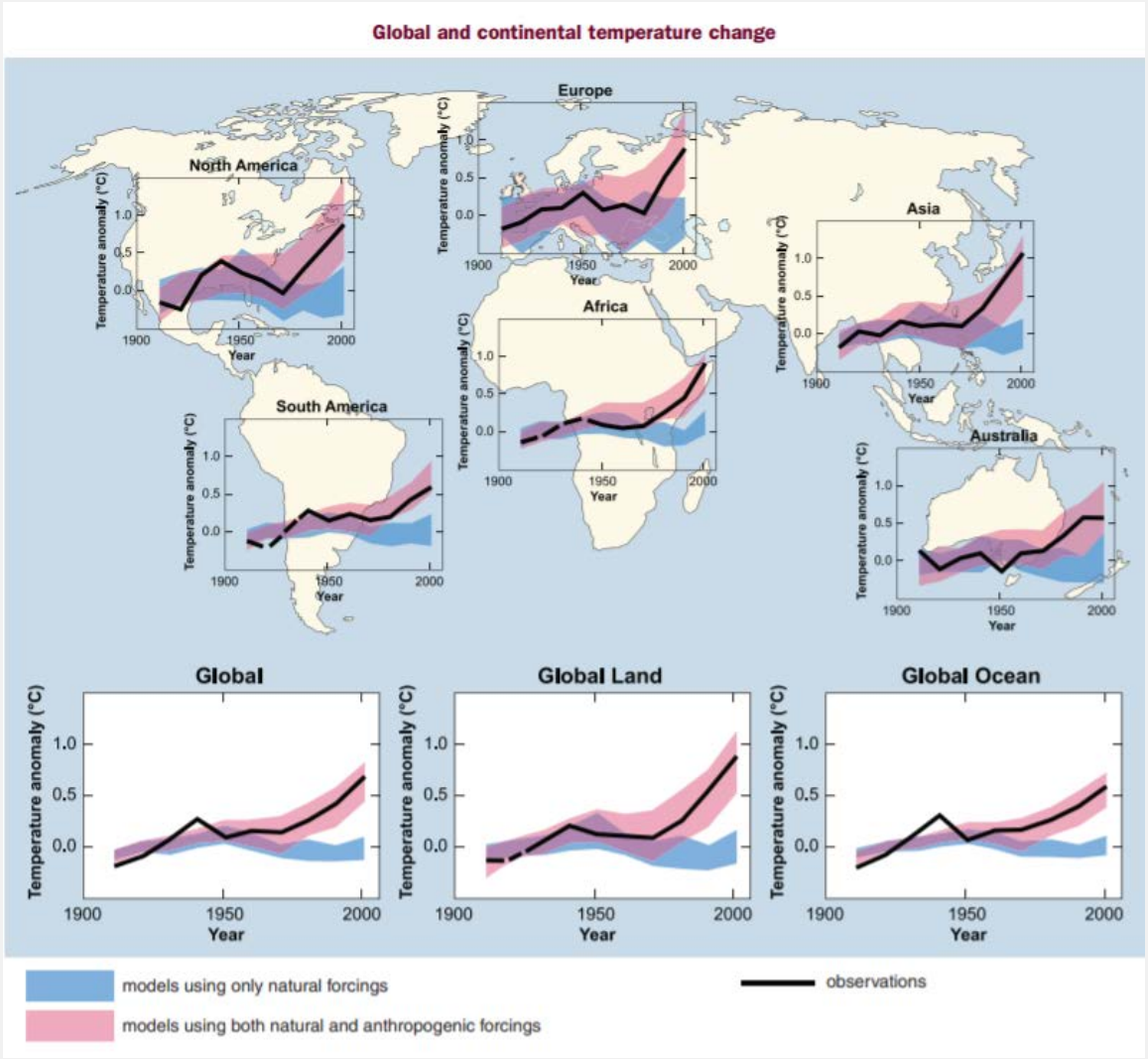
- NGI is Norway's **largest geotechnical specialist community** and a leading centre of research and consultancy in engineering-related geosciences.
- We are a **private commercial foundation** with head office and laboratories in Oslo.
- We work within the fields of **Offshore Energy**; **Building, Construction and Transportation**; **Natural Hazards**; and **Environmental Engineering**.
- Our social mandate dictates that we conduct **applied research**, **technological development and innovation**, and that we contribute to **development and education** within geotechnical and related geosciences.
- We research and develop **solutions** for industry and society, ensuring that we live and **build on safe ground**.

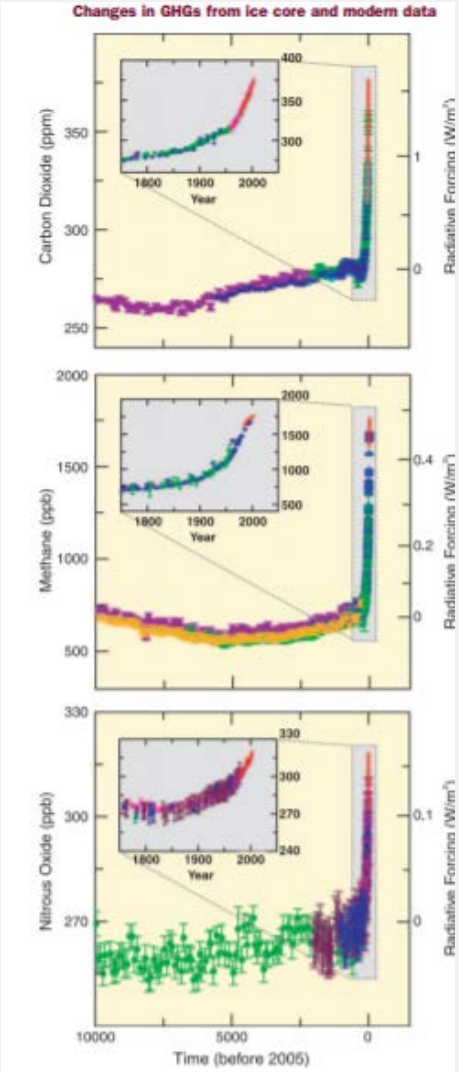


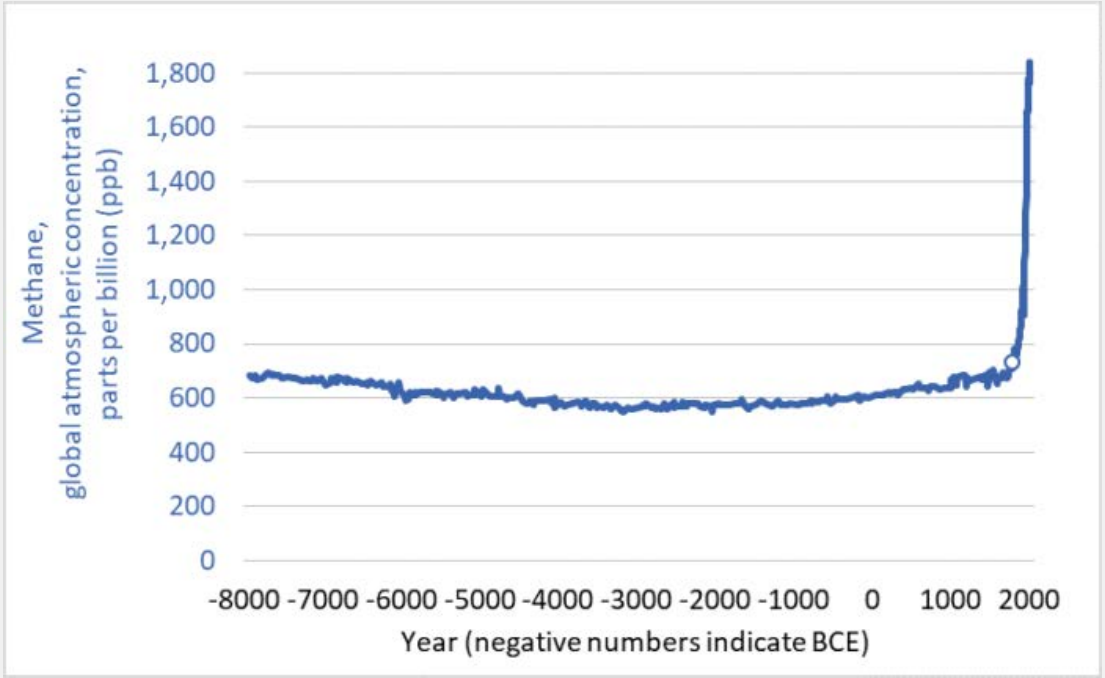

IPCC, 2007

Global temperature rise



Greenhouse gases & methane in the atmosphere





https://www.darrinqualman.com/methane/

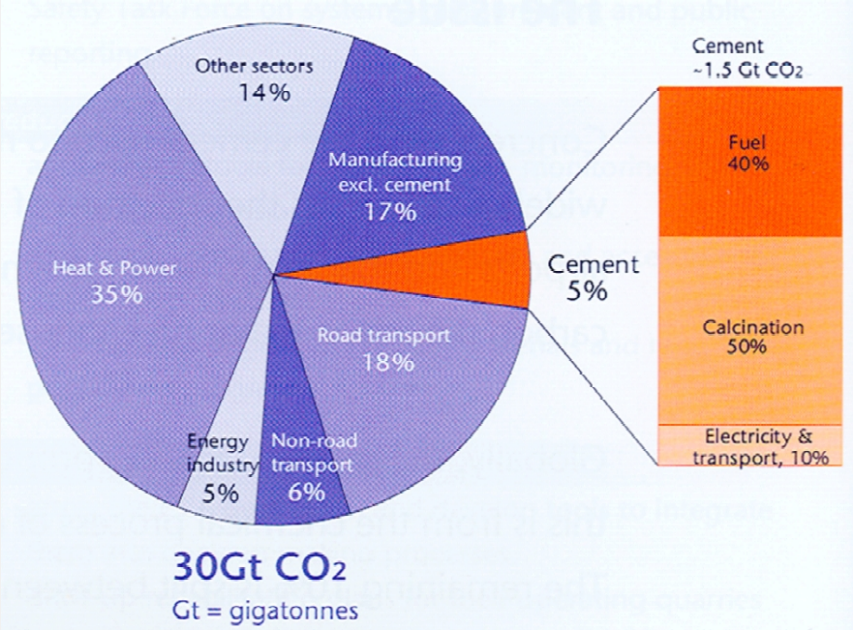
Global CO_2 emission

https://youtu.be/AL5Hjg30b_M

CO_2 emission from industrial processes

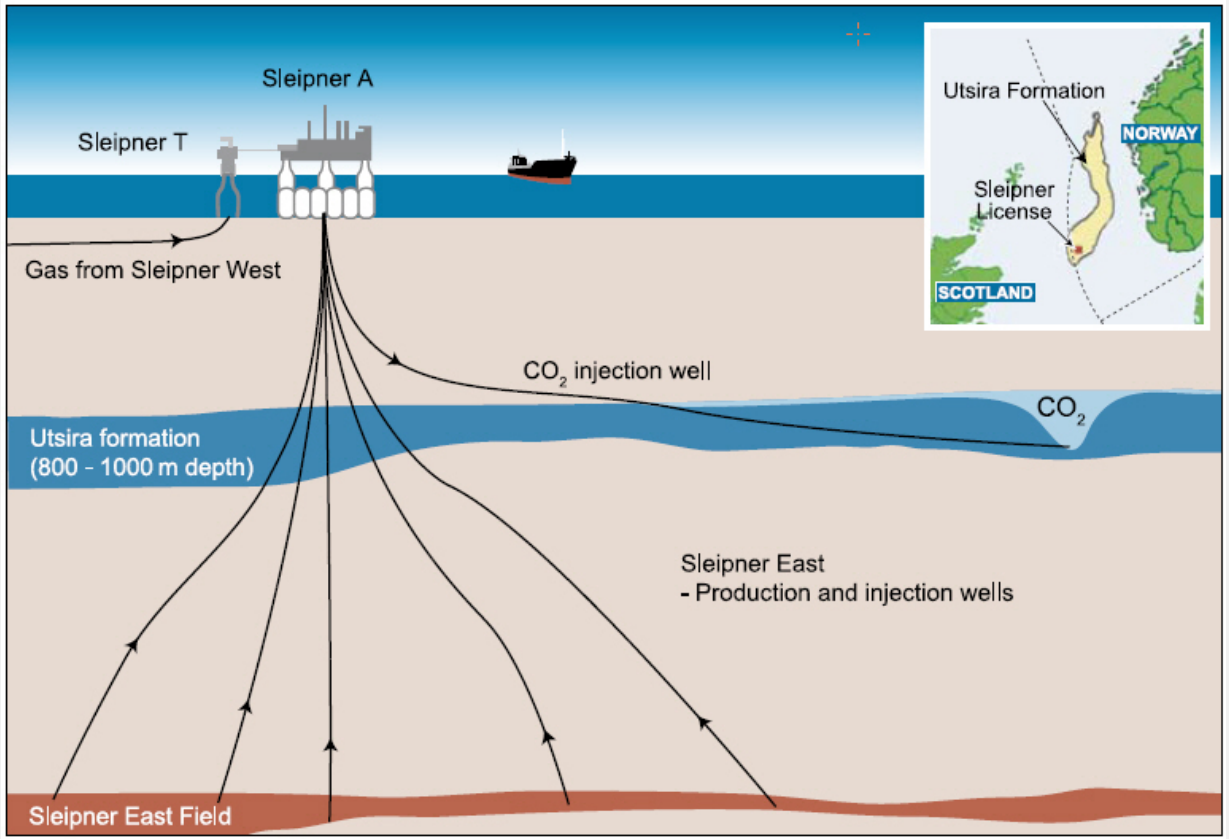
Cement production; double emissions, ca. 1500 Mt/y of CO2

- calcination of limestone: $CaCO_3$ → $CaO + CO_2$ (≈ 50%)
- Heat production from fossil fuel → CO_2 (≈ 40%)



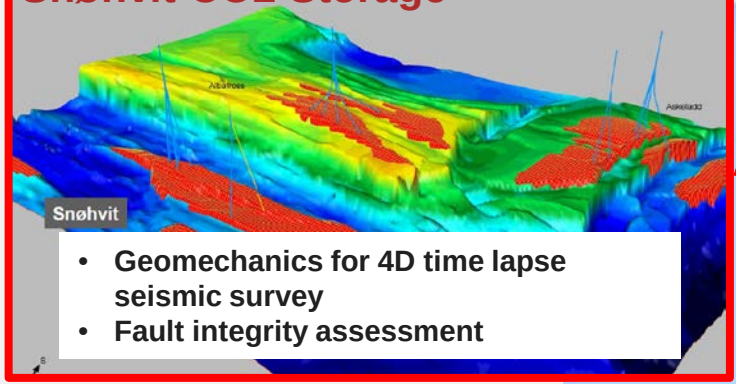
CO2 Sequestration in geological formations

- Sleipner CCS project injects 1 million tons CO2 per year (since 1996)



CO_2 storage projects

Snøhvit CO2 Storage

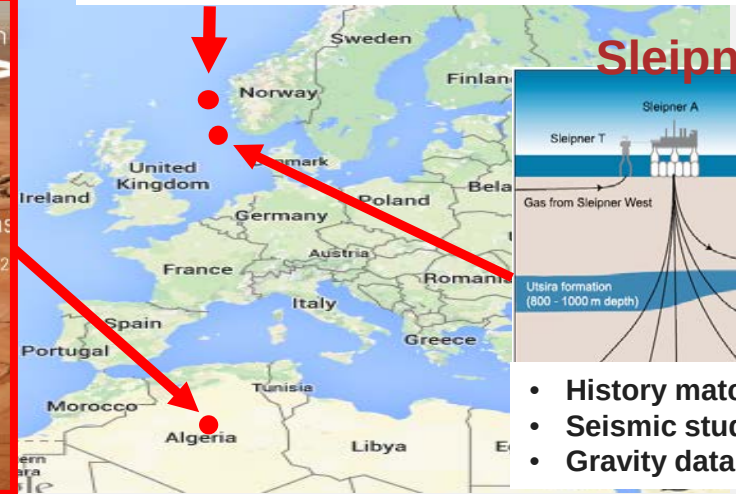


- Geomechanics for 4D time lapse seismic survey
- Fault integrity assessment

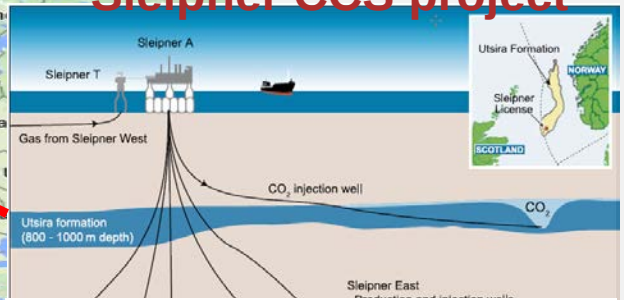
Longyearbyen CO2 lab

- Geomechanical interpretation of microseismicity
- Potential for aseismic events

- **Longship-Northern Lights Project**



Sleipner CCS project

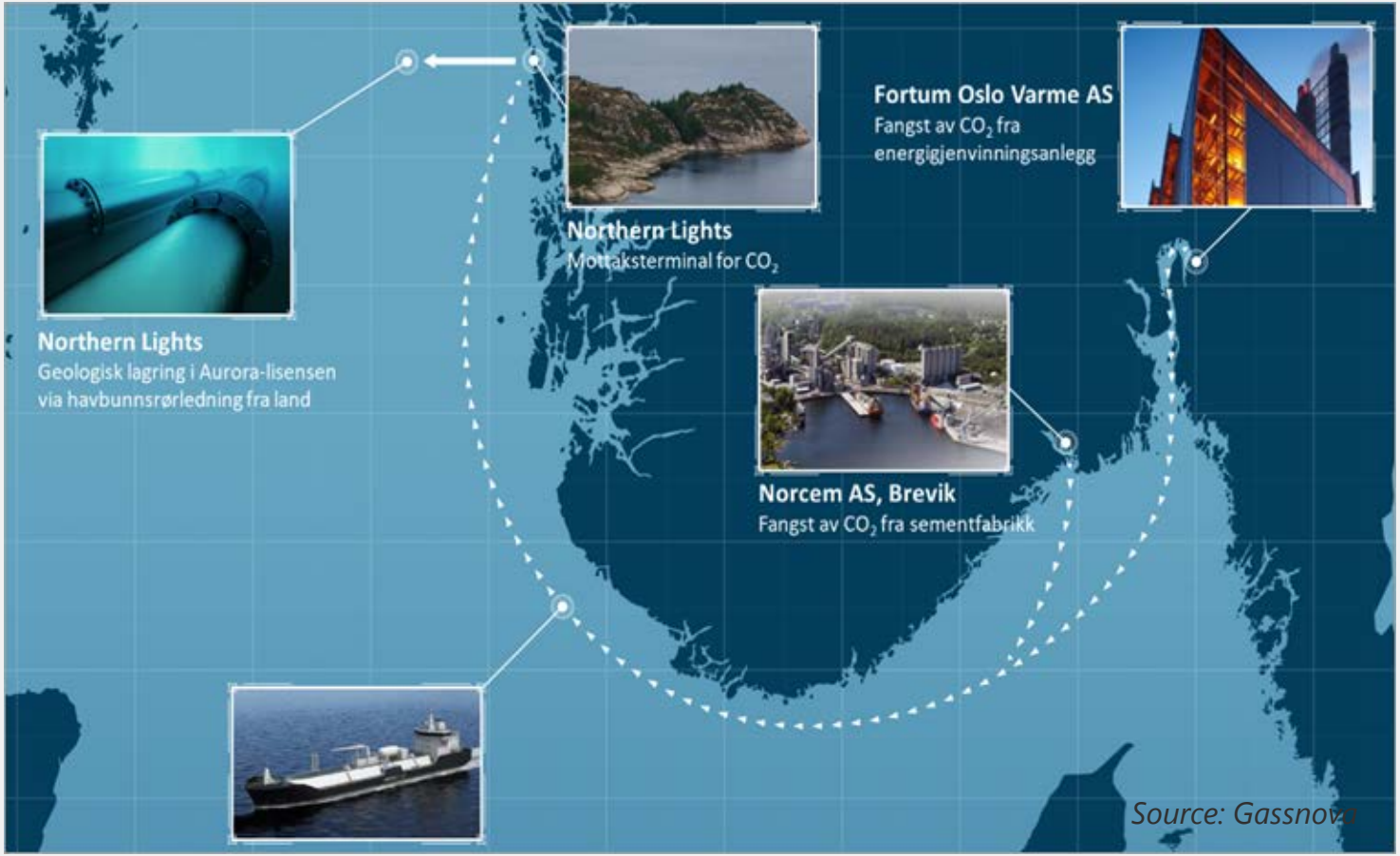


- History matching
- Seismic studies
- Gravity data

In Salah Gas, Krechba, Algeria

- Cap-rock integrity vs microsesimicity
- Geomechanical interpretation
- Injection history analysis
- InSAR data analysis

The Longship project: Full CCS chain



Source: Gassnova

The Longship project

Langship Partners: Equinor, Total, Shell

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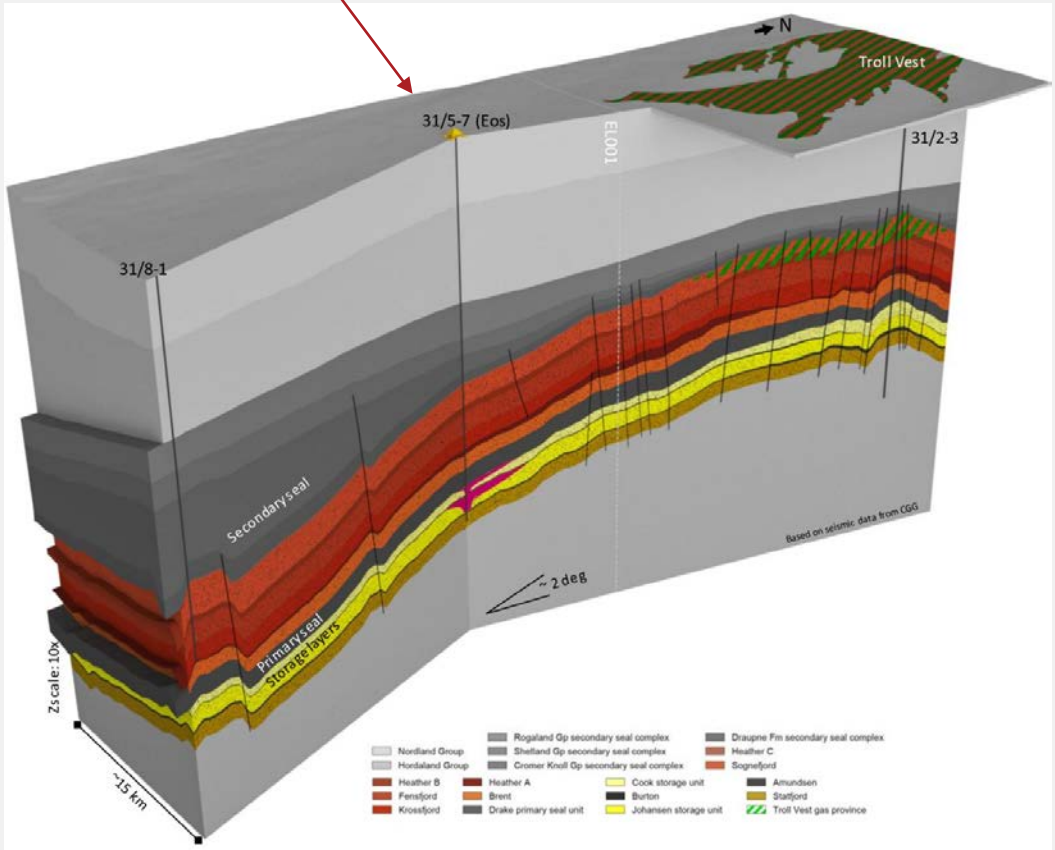
Aurora storage site and Eos well

- Well drilled January 2020, 2.6 km
- Confirms a good storage reservoir
- **The well logs and well tests are open access for research and further evaluations**

Ongoing work at NGI

- **Core material** at NGI for rock mech testing
- NGI studies **thermo-mechanical** simulations of the well/reservoir

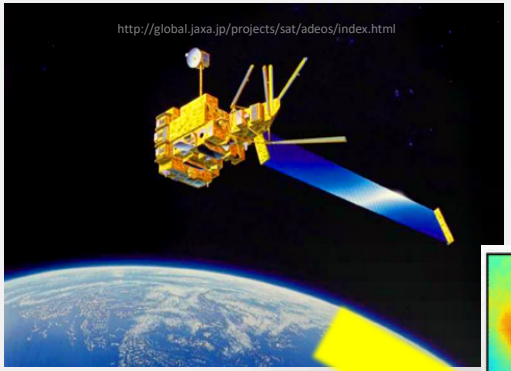


https://www.equinor.com/en/news/20201019-sharing-data-northern-lights.html

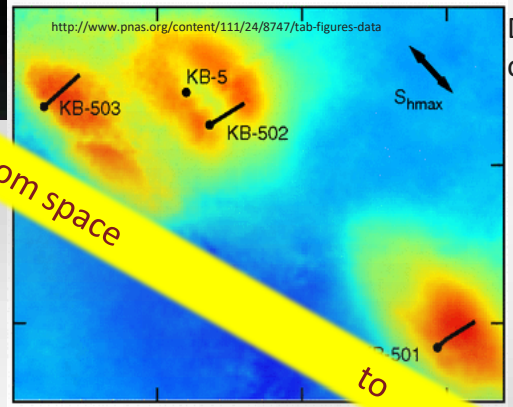
https://sense-act.eu/

Assuring integrity of CO_2 storage sites through ground surface monitoring (SENSE)

SENSE project concept



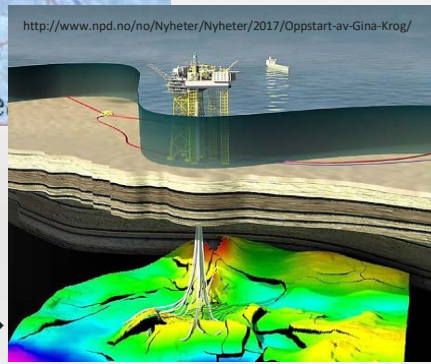
Satellite for monitoring ground motion onshore



Demonstration of concept onshore

Demonstration offshore

From space to the subsurface

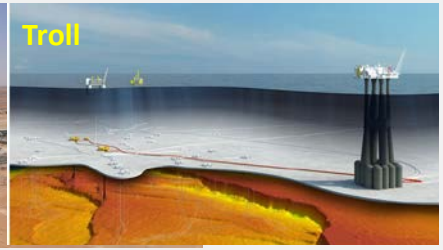


Geomechanical modelling, inversion- history matching → subsurface management & **containment assurance**

SENSE consortium

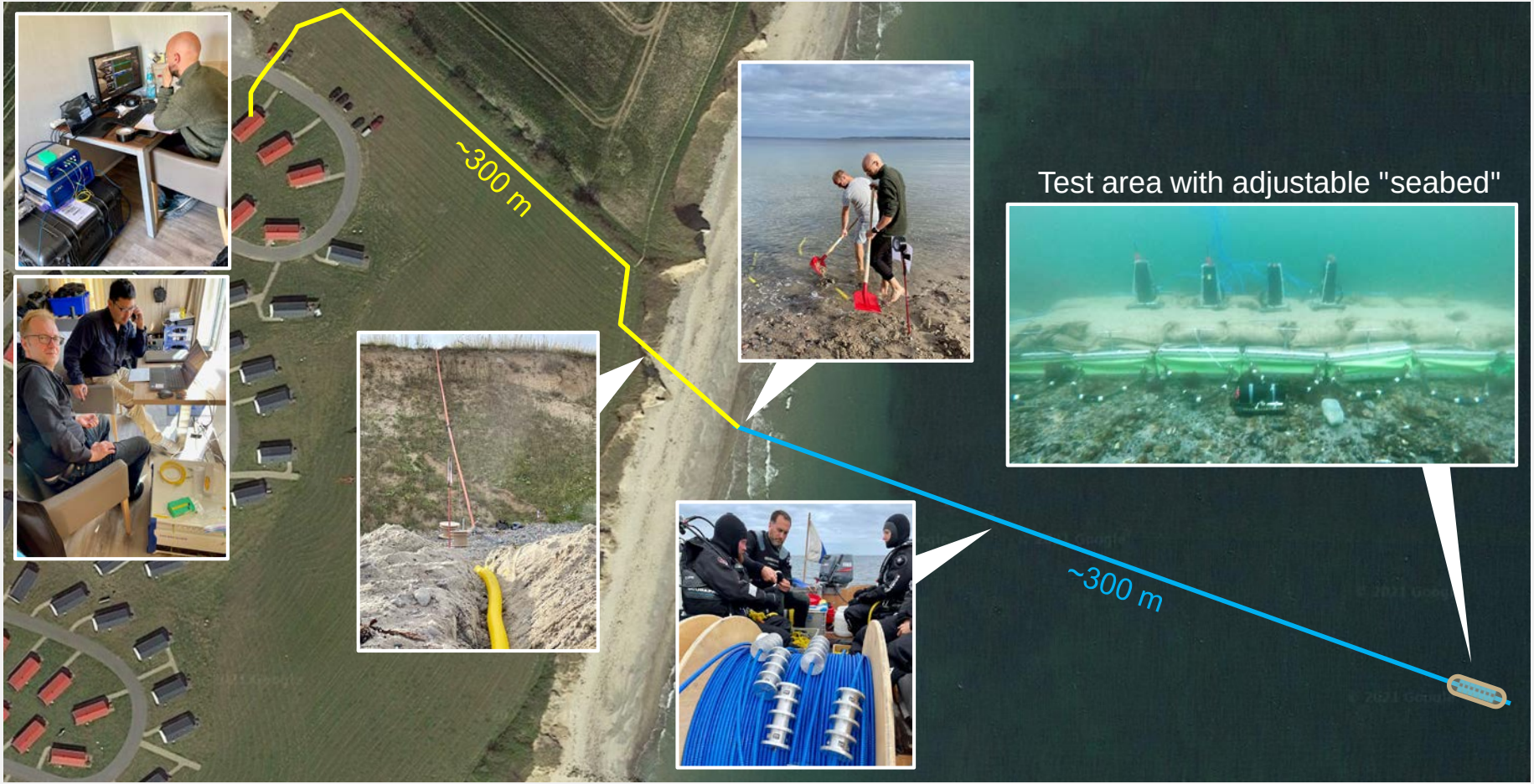
Measurement of ground deformation-case studies

1. In Salah/Troll Subsidence data
2. Boknis Eck, Offshore Germany
3. Hatfield Moors, onshore UK
4. Gulf of Mexico

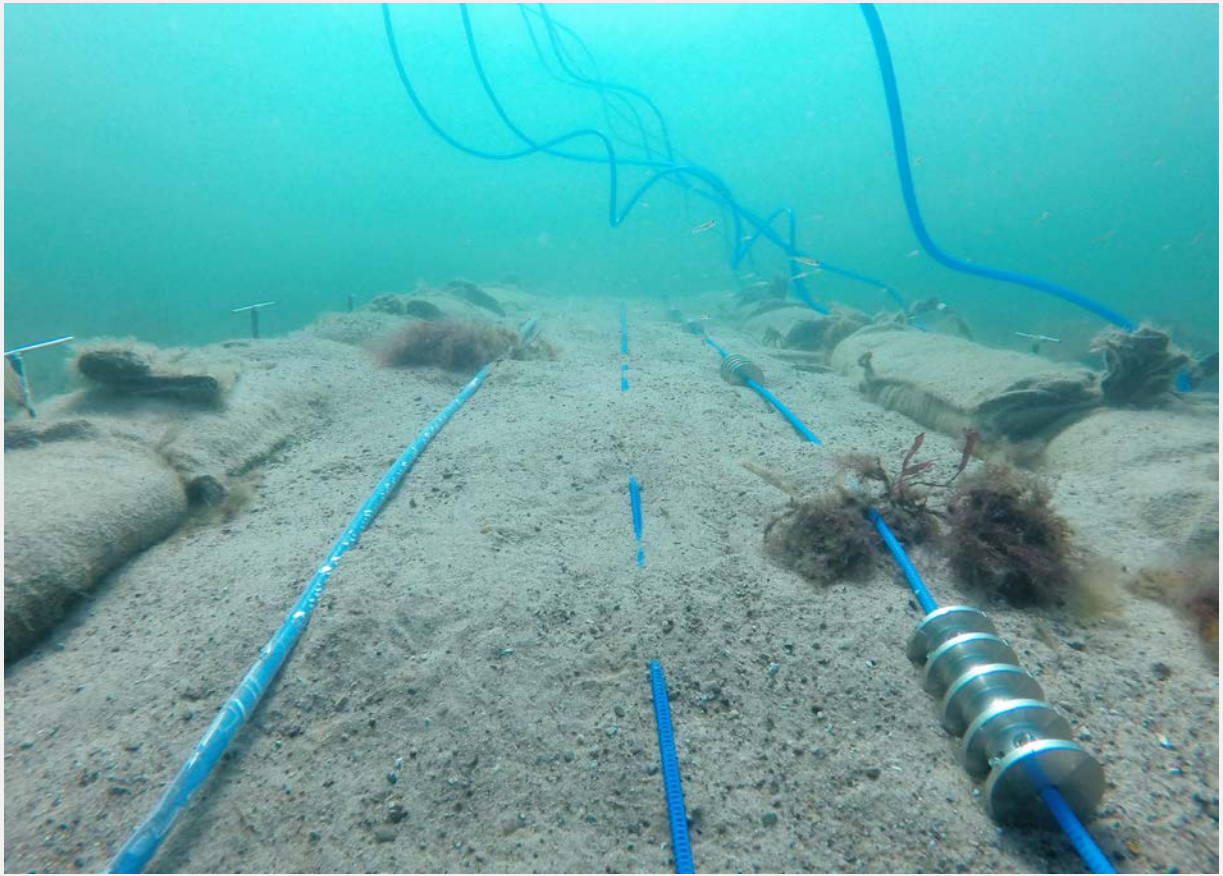


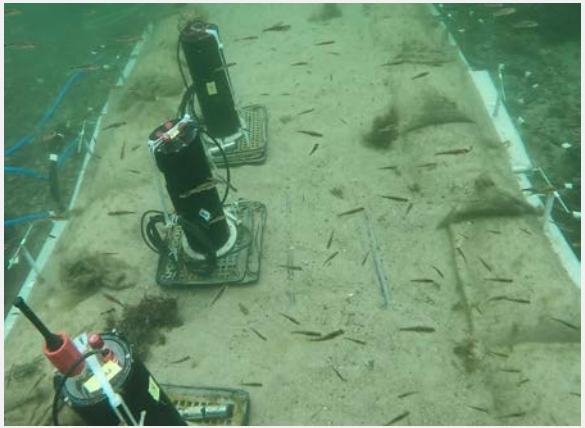
3. Hatfield Moors, natural gas storage, sandstone, 450 m deep

Fiber optics cable test at Boknis Eck



DSS Cable test at Boknis Eck





The nearshore tests were less controlled, but similar ground deformation sensitivity as in NGI's sandbox was demonstrated

Research Opportunities with CCS-ACT program

http://www.act-ccs.eu/

- ACT will address the
  - Technological, environmental, social and economic challenges required to accelerate CCUS.
  - Operational achievements and project economics,
  - Regulatory environment, stakeholder acceptance, technical performance, techno-economic assessments and revenue generation potential, state of the supply chain, pathways to market
- ACT4 call will be announced March 2022
- Annual Research Council calls on CCS are due in February
- Horizon Europe

Summary

- CCS community has gained lots of experience from early-running projects and can assess CO_2 storage sites for safe carbon sequestration.
- There are still some research gaps to increase confidence in successful operation.
- Operators have very good experience with injecting CO2 into reservoirs in a safe way and have done so for > 25 years.
- The missing link is the business case; who should pay for CO2 sequestration?

NGI

Acknowledgement

https://sense-act.eu/

SENSE (Assuring integrity of CO_2 storage sites through ground surface monitoring) project No. 299664, has been subsidized through ACT (EC Project no. 691712) by Gassnova, Norway, United Kingdom Department for Business, Energy and Industrial Strategy, Forschungszentrum Jülich GMBH, Projektträger Jülich, Germany, The French Agency for the Environment and Energy Management, The United States Department of Energy, and State Research Agency, Spain. Additional support from Equinor and Quad Geometrics and permission to use data from the Krechba Field by In Salah Gas JV are appreciated.