

Carbon Capture and Storage

Challenges and opportunities - from a UiO perspective

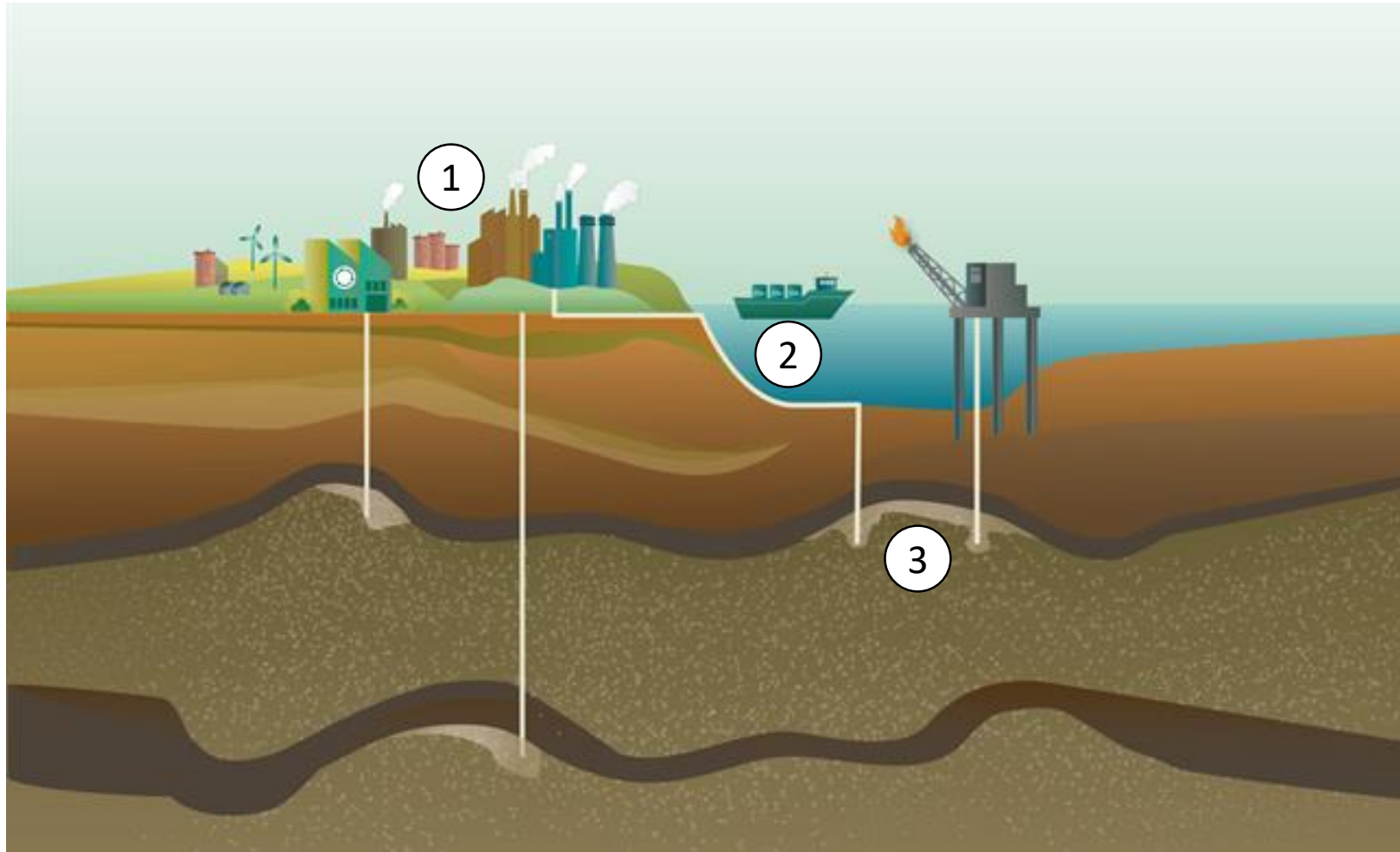
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What is CCS?



- 1 Capture of CO₂ from industry
- 2 Transport to repository
- 3 Storage under ground

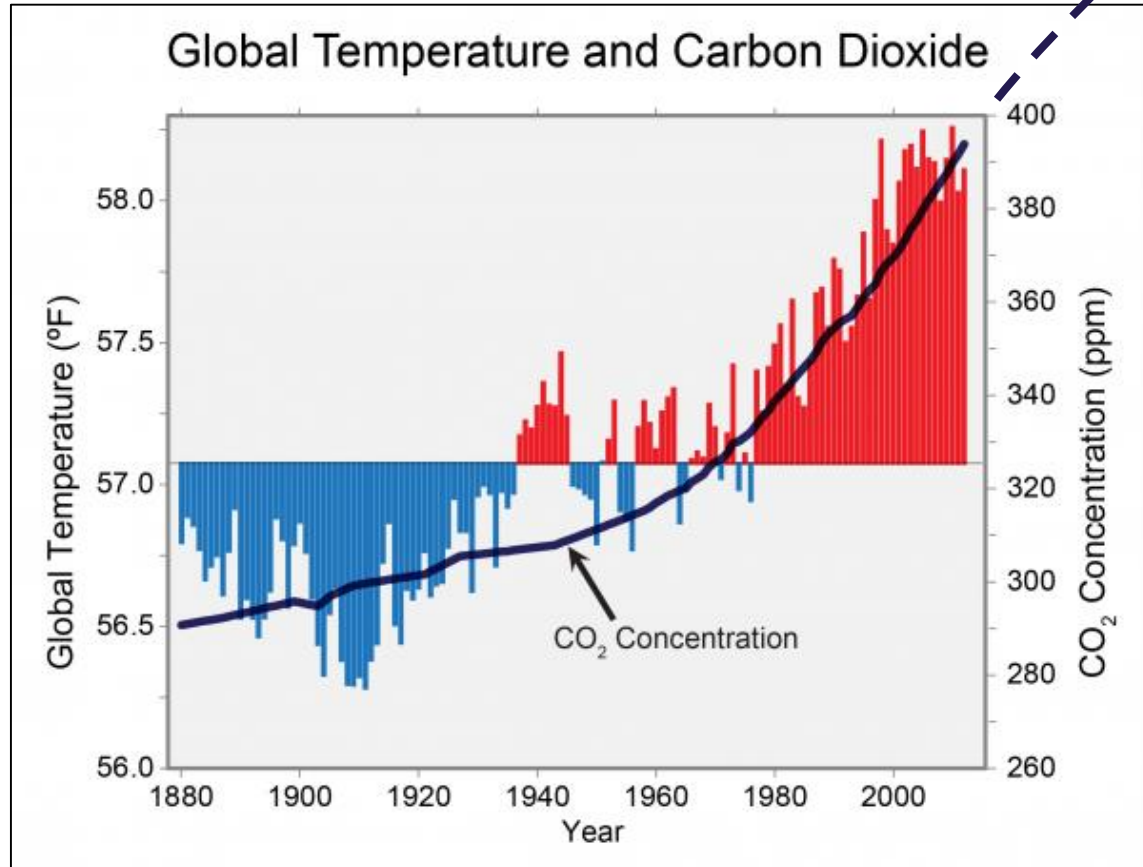
- Simple and uncontroversial principles.
- Has been safely done in Norway for 25 years.

Source: Geoviden 2020, GEUS

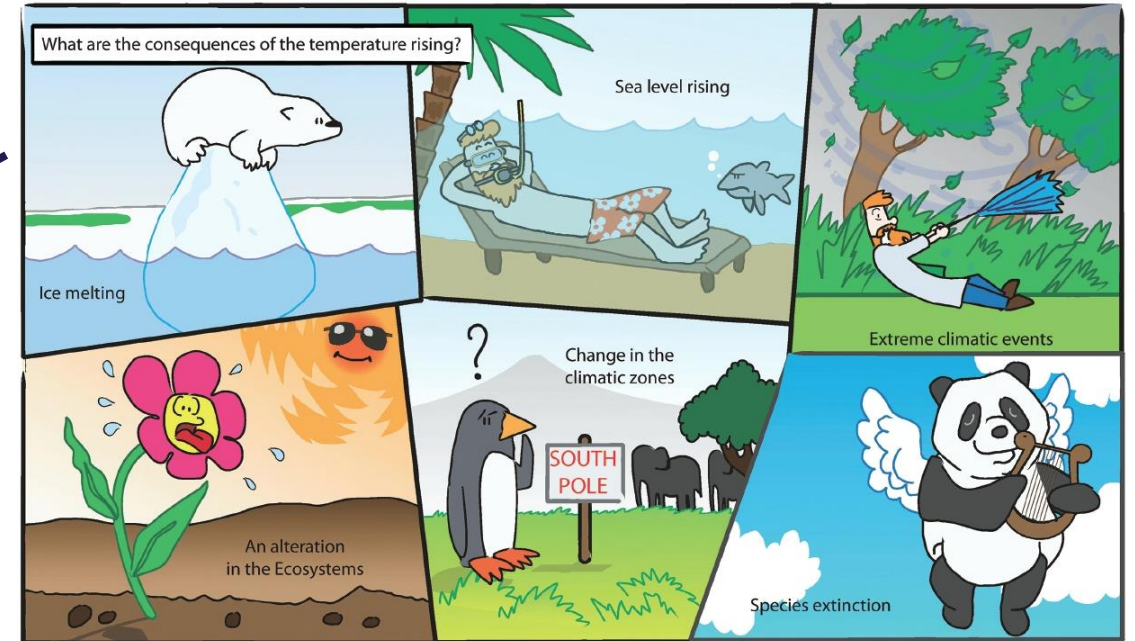


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Why CCS?



Source: US Global Change Research Program modified from Karl et al. 2009

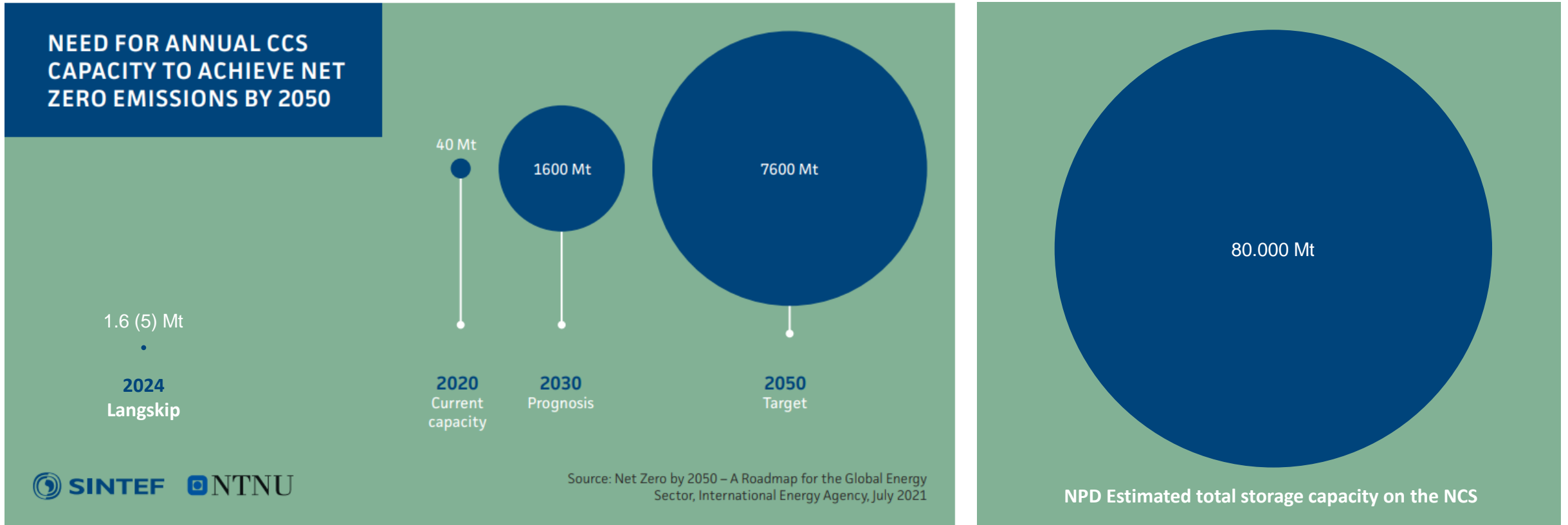


Source: Miljøvernfondet & Longyearbyen CO₂-lab

- Rising global temperature correlate with increasing CO₂ levels in atmosphere.
- Triggering of rapid changes to ecosystems globally.
- Ultimately impacts on 'liveability' for us and our fellow living beings on the planet.
- CCS necessary to reach target in Paris Agreement.



CCS capacity, globally and in Norway

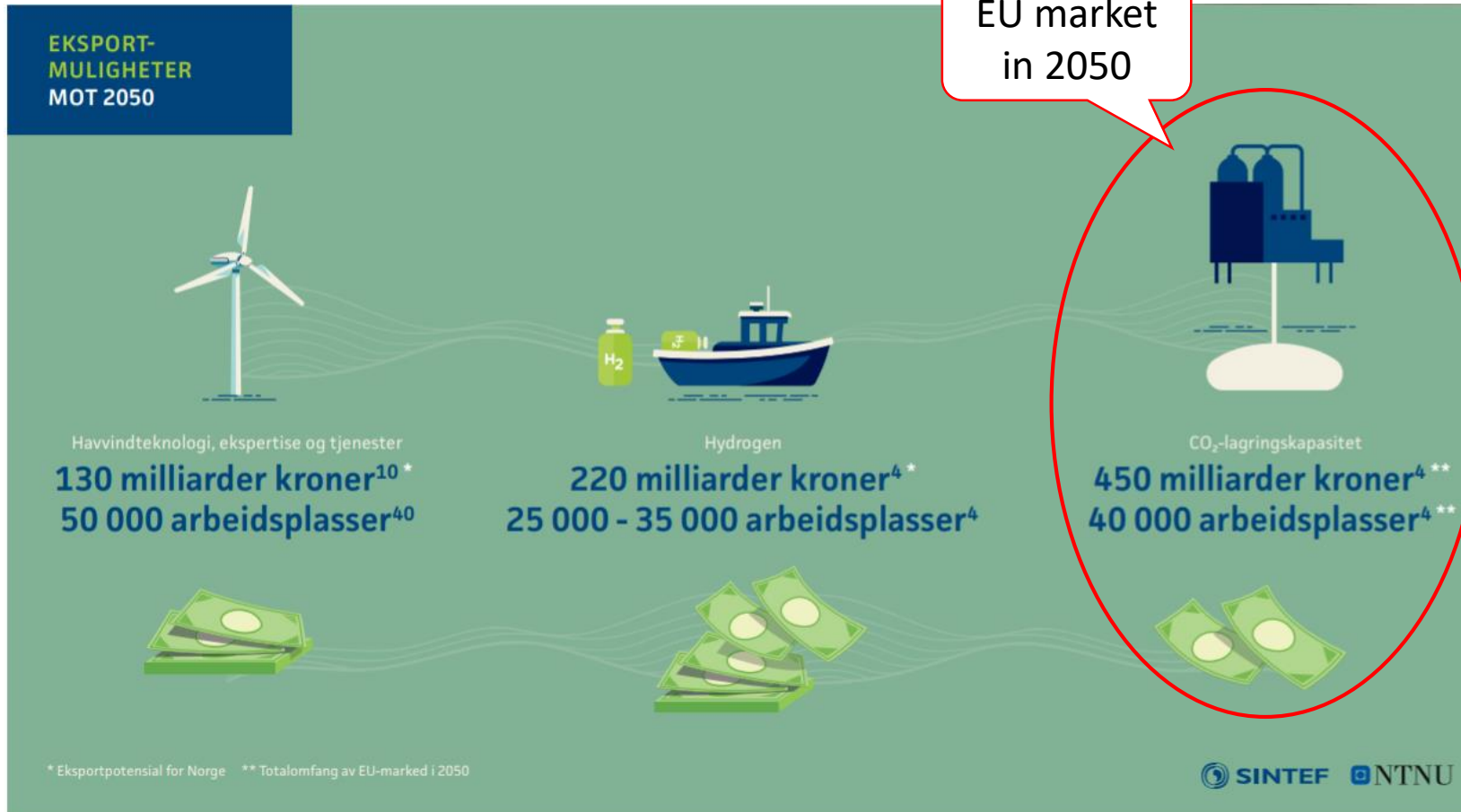


Source: The North Sea as a springboard for the green transition, NTNU & Sintef 2021

- IEA roadmap imply significant global expansion of CCS capacity to reach Net Zero by 2050
- We need hundreds of ‘Langskip’ in the North Sea region
- We have the capacity on the Norwegian Continental Shelf.



CCS as an opportunity for Norway



EU market
in 2050

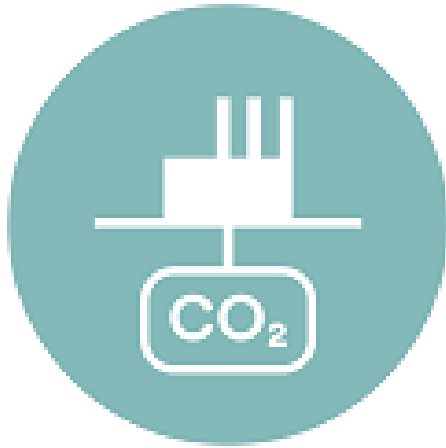
- CCS is a business opportunity for Norway.
- Competitive advantages through central location, industrial capacity and know-how.

Source: Nordsjøen som plattform for grønn omstilling, NTNU & Sintef 2021



UiO at the forefront of CCS research

UiO:Energy



- **Energy Law**
- CO_2 Capture
- CO_2 storage



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CCS law and policy



- UN Framework Convention on Climate Change (UNFCCC), Kyoto Protocol and Paris Agreement
- UN Convention on the Law of the Sea (UNCLOS)
- London Convention and London Protocol
- OSPAR Convention
- Espoo Convention
- International and EU standards (ISO/CEN)

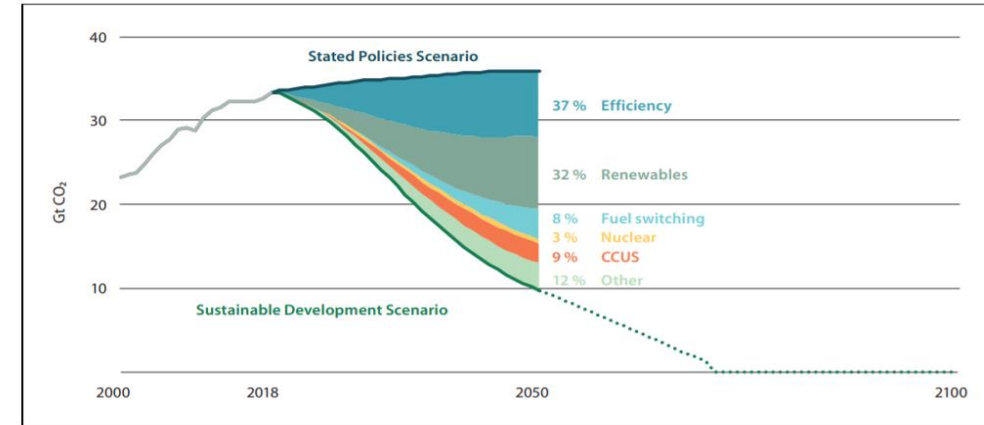


Figure 2.4 Energy-related emission reductions in the IEA's Sustainable Development Scenario 2019 [8]
Source: IEA World Energy Outlook 2019 [8]

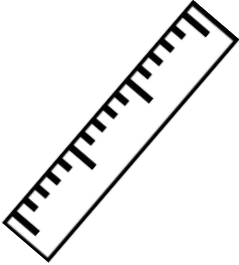


- Directive 2009/31/EC on the geological storage of carbon dioxide: future proof legislation?
- EEA-relevant, incorporated into the EEA Agreement in 2012.
- Financing: state aid regime (General Block Exemption Regulation, state aid guidelines, EU Innovation Fund); Taxonomy Regulation.


- Legislation in place:
 - *Lagringsforskriften, petroleumsforskriften Chap. 4a (storage of CO₂), forurensningsforskriften Chapt. 7A, konsekvensutredningsforskriften vedlegg I og II.*
- Meld. St. 33 (2019–2020) Langskip – fangst og lagring av CO₂
- Meld. St. 36 (2020–2021) - Energi til arbeid – langsiktig verdiskaping fra norske energiresurser



CCS legal research at UiO

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- Throughout the entire **value chain**: capture, transport and storage.
 - Requires **wide competences**: environmental law, energy law, competition law, contract law, administrative law, law of the sea, etc.
 - Under **international, EU and Norwegian law**.

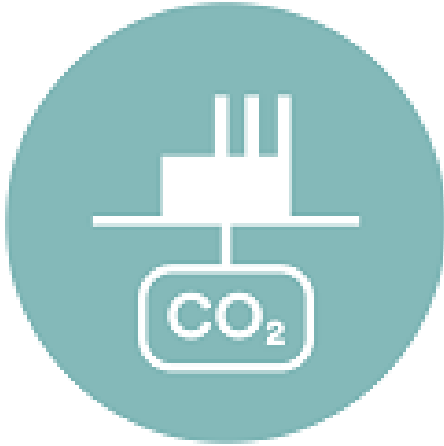
Examples of recent publications:

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- International law framework for **enabling CCS**
 - Long-term **liability for storage** under Norwegian law
 - Liability framework for the **shipping phase** of CO₂
 - **Negative emissions** regulation
 - CCS operations under the **EU Emissions Trading Scheme** and its revision.
 - State financial support to CCS and **state aids** regime
 - Low carbon products and **public procurement** rules
 - **Re-use and re-purposing** of installations in the context of **decommissioning**
 - **CO₂ transport**: regulatory terms, third-party access, permitting rules.
 - **Legal de-risking** in developing **H₂-CCS value chain**: by law and contracts
 - Private financing: coverage under Taxonomy Regulation on sustainable finance



UiO at the forefront of CCS research

UiO:Energy

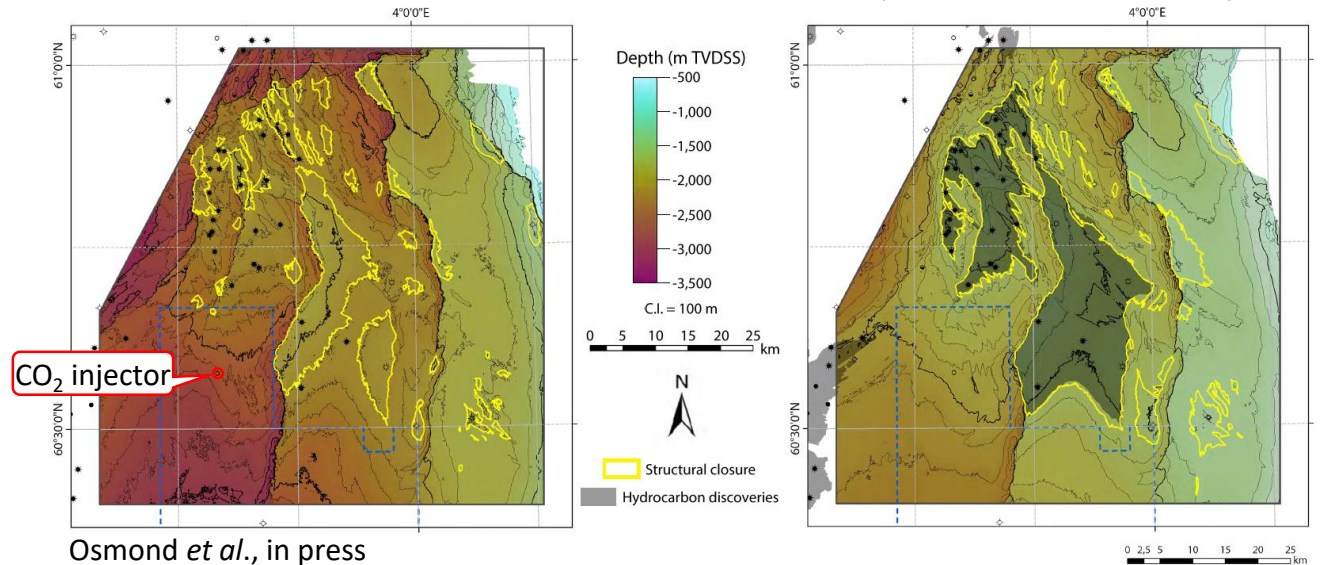
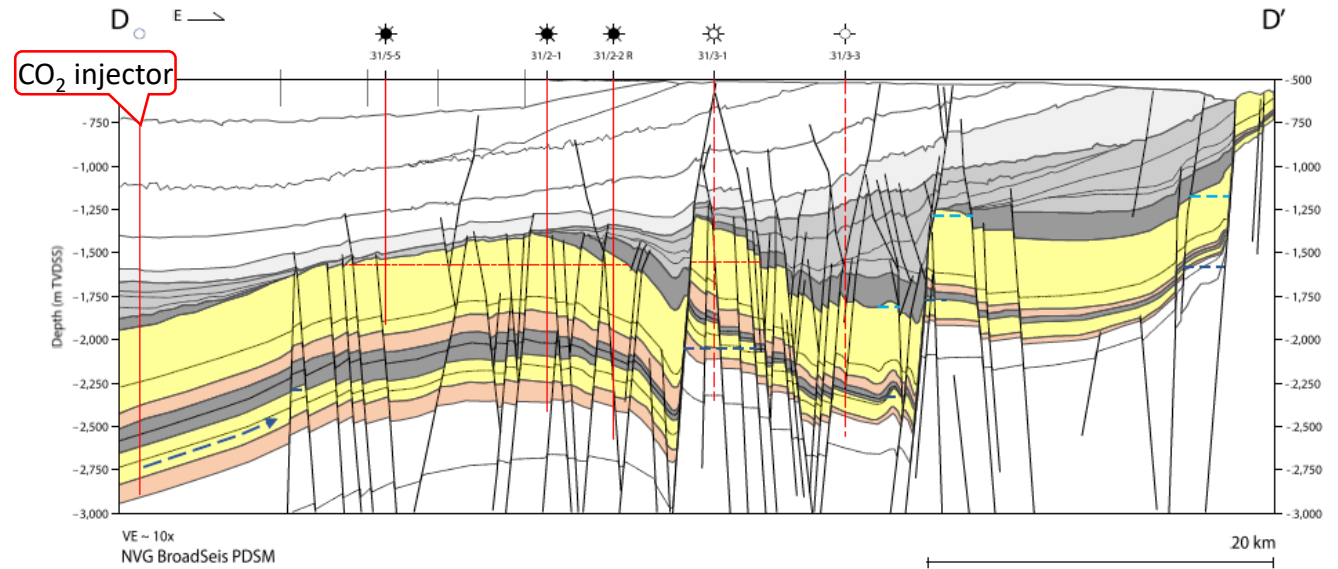
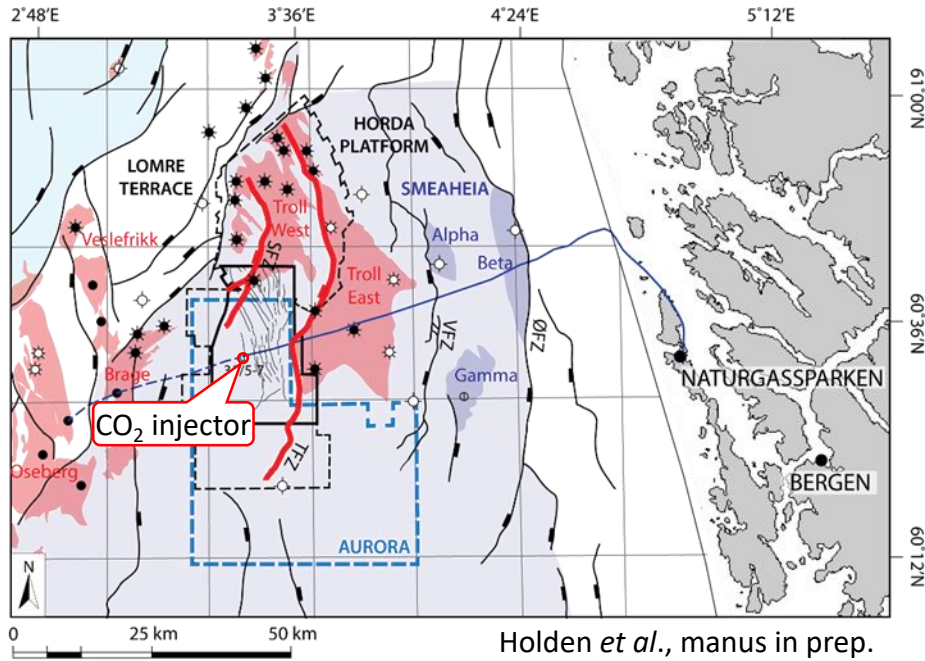


- Energy Law
- CO_2 Capture
- CO_2 storage



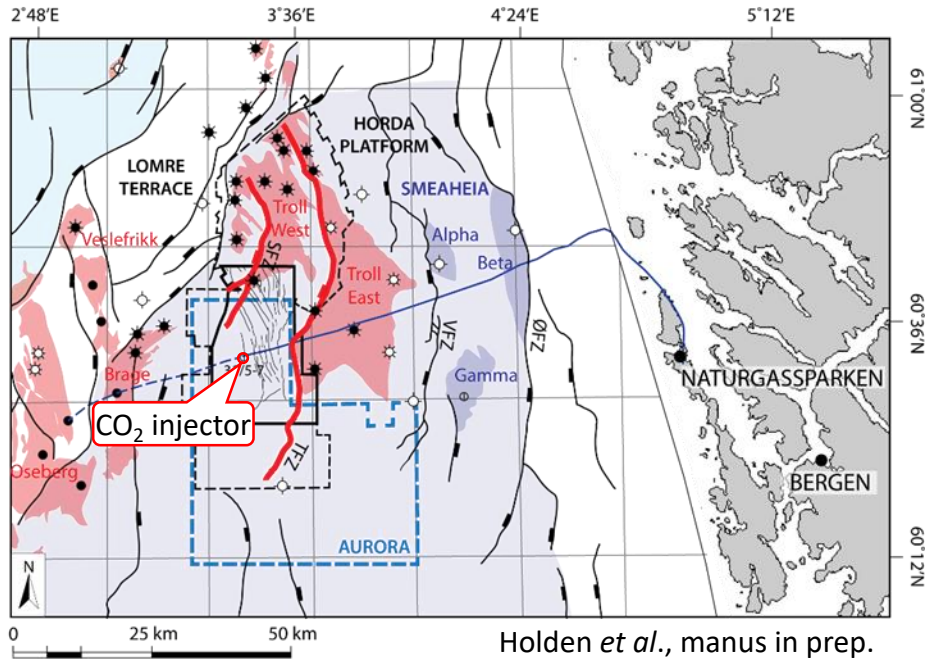
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NCCS and CO₂ Storage research at UiO - Langskip

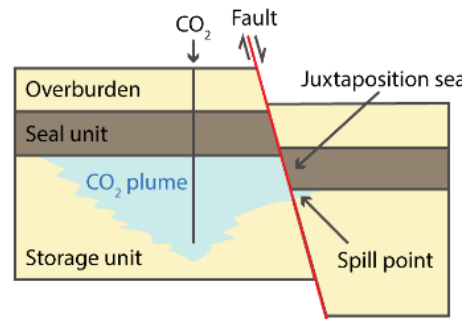


- Storage site quantification.
- Structural analysis.

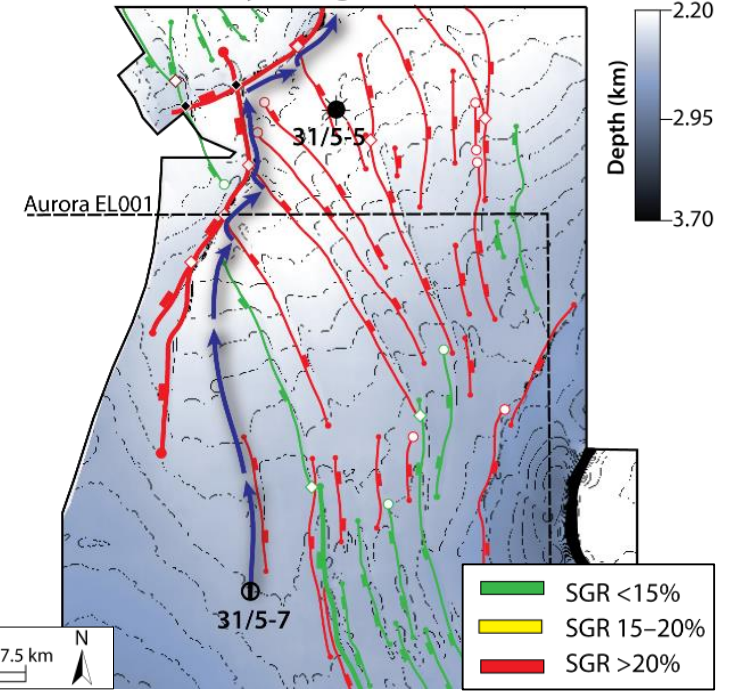
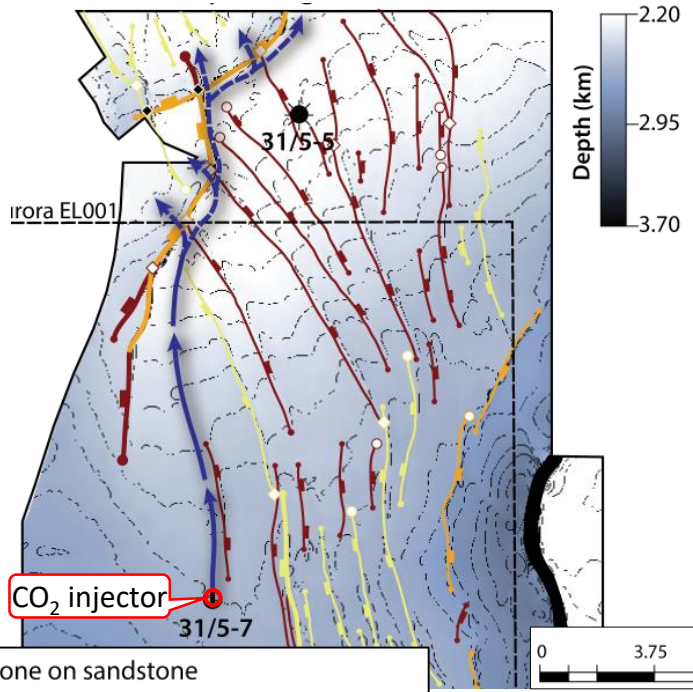
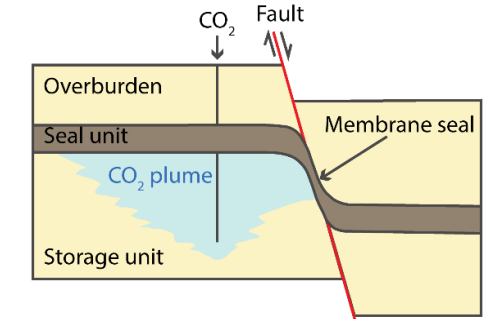
NCCS and CO₂ Storage research at UiO - Langskip



Juxtaposition seal



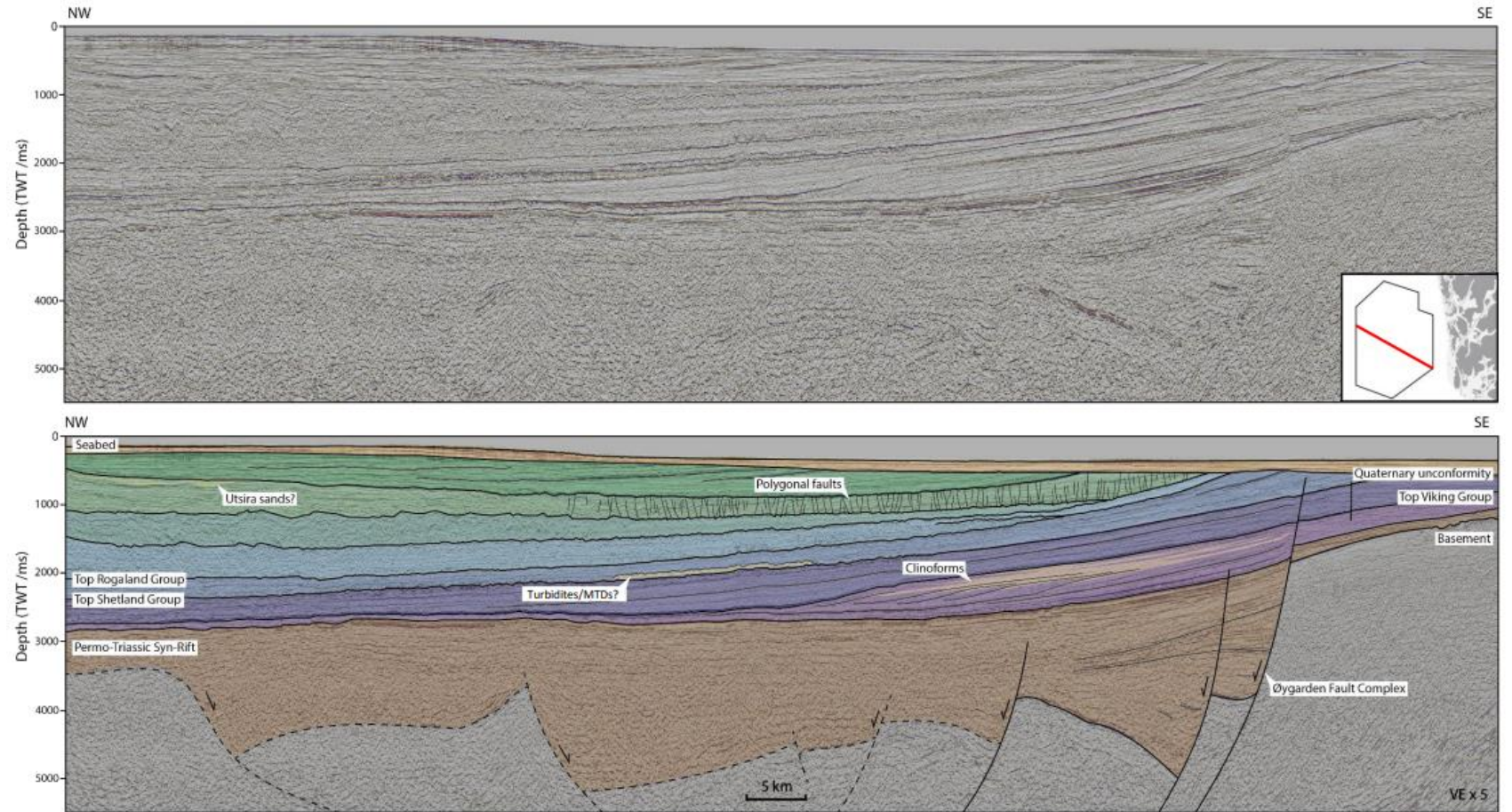
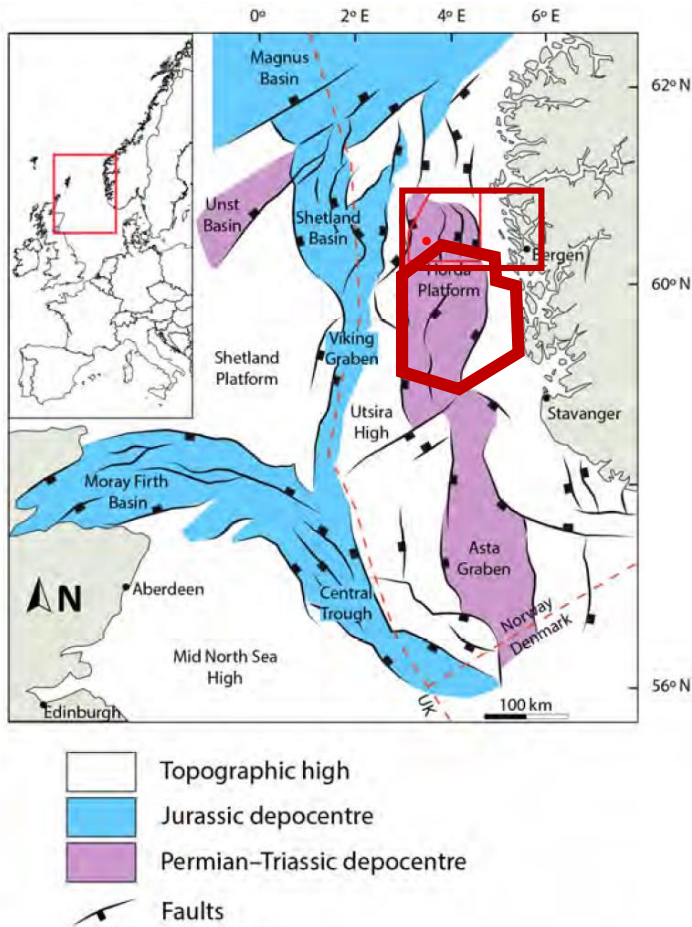
Membrane seal



- Storage site quantification.
- **Structural analysis.**

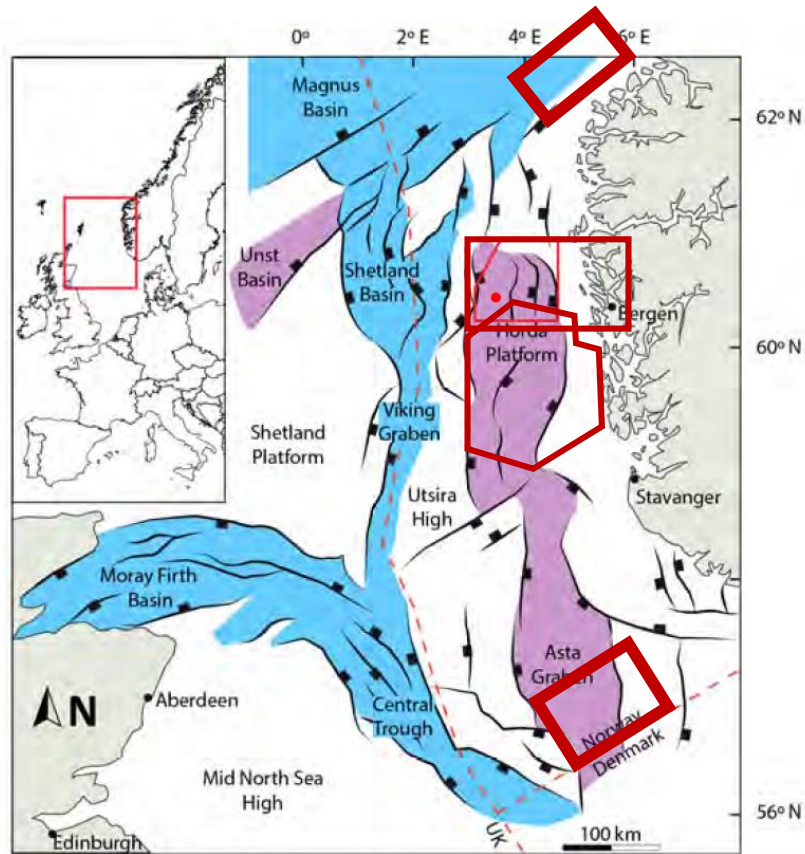
Holden et al., manus in prep.

NCCS and CO₂ Storage research at UiO – Beyond Langskip



Evans, unpublished

CO₂ Storage research at UiO – Beyond Langskip



- Northern North Sea
- Proximity to major onshore infrastructure
- Geologically complex
- Southern North Sea
- Proximity to major onshore infrastructure
- Synergies with Greensand project (DK) and offshore wind projects in DK/NO
- Large storage potential



CCS is an opportunity for Norway

- CCS is a business opportunity for Norway.
- Large storage capacity.
- Competitive advantages through central location, industrial capacity and know-how.
- Know-how, developed largely in synergy between academia and industry, has supported the deployment of Langskip.
- Further research is needed to quantify and de-risk further storage and improve technology to bring down costs.
- Further research is needed to identify and solve present-day obstacles for the upscaling of CCS in the North Sea and opening up a European market.