



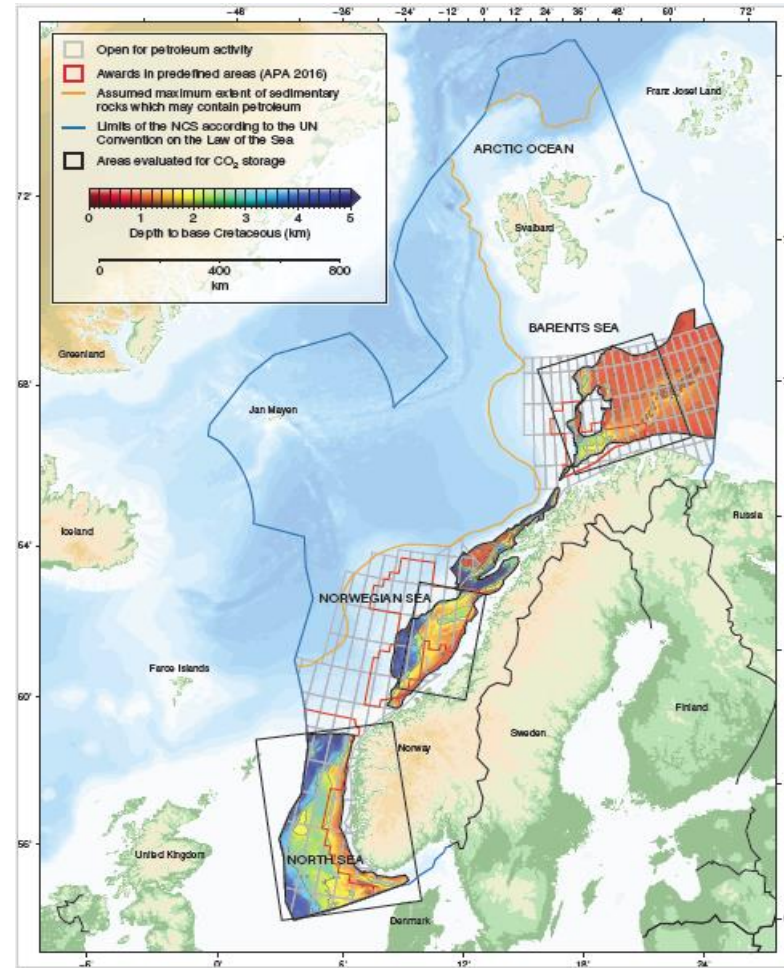
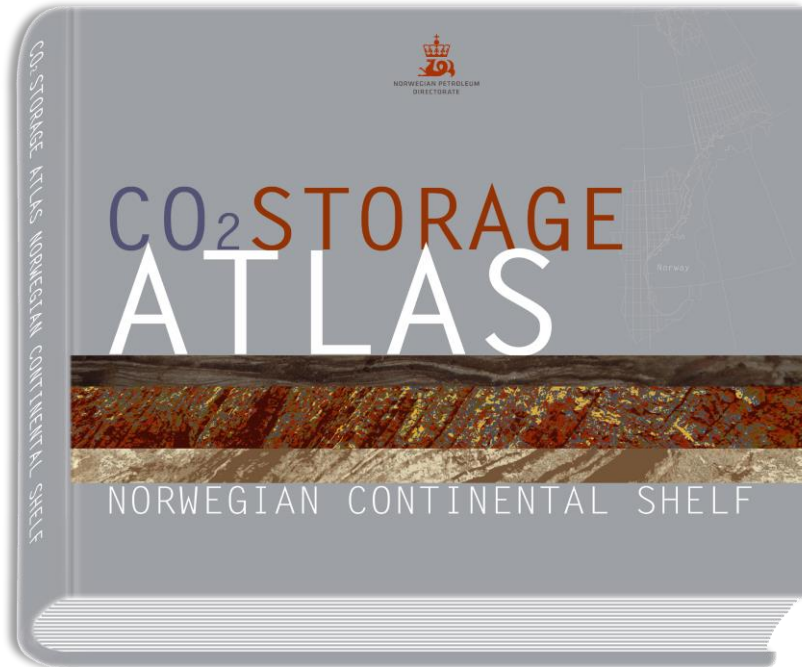
NORWEGIAN PETROLEUM
DIRECTORATE
50 years

Regulations and business models in Norway for CCS

Eva K. Halland and Torhild S. Nilsen,
Norwegian Petroleum Directorate

CCUS conference
SPE / PESGB CCUS 2022 conference 21-24. February 2022.

Safe and efficient storage of CO₂ on the NCS



The digital CO₂ Atlas published in 2015

Regulations relating to exploitation of subsea reservoirs on the continental shelf for storage of CO₂ and relating to transportation of CO₂ on the continental shelf

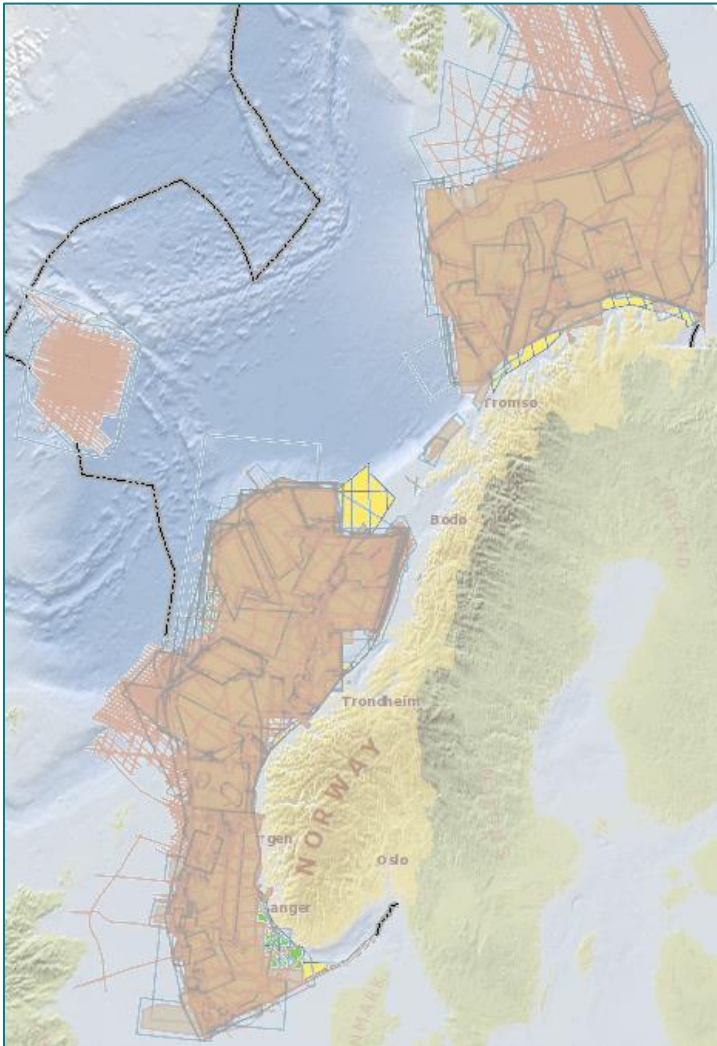


A comprehensive regulatory framework for CO₂ storage, published in December 2014

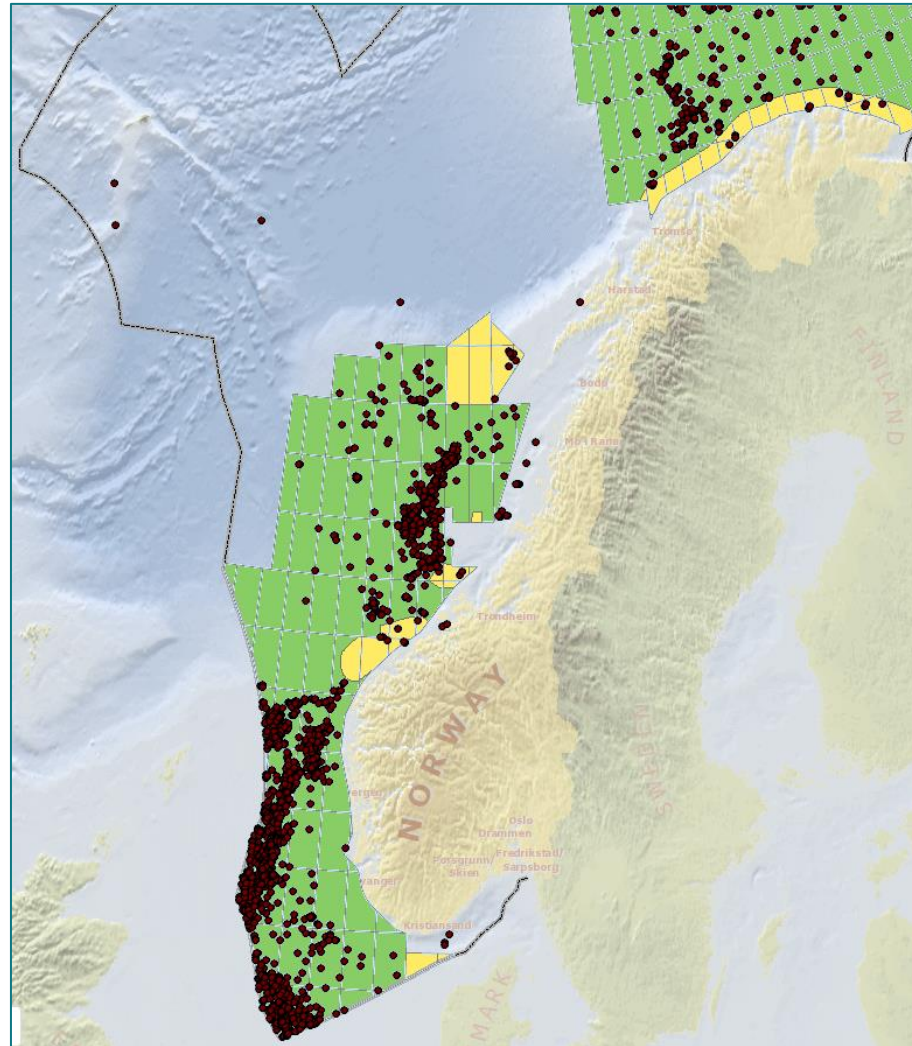


Access to data from the petroleum industry

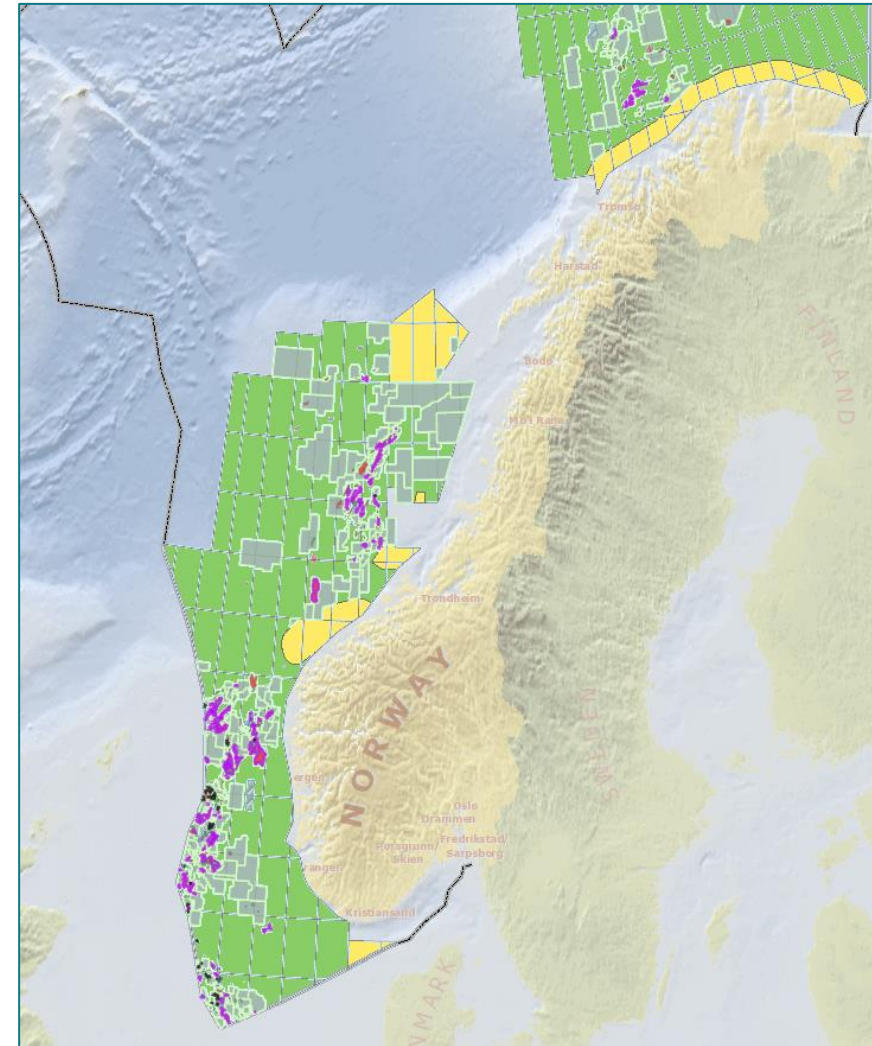
Comprehensive assessments of CO₂ storage sites based on more than 50 years of experience from petroleum activity



Seismic



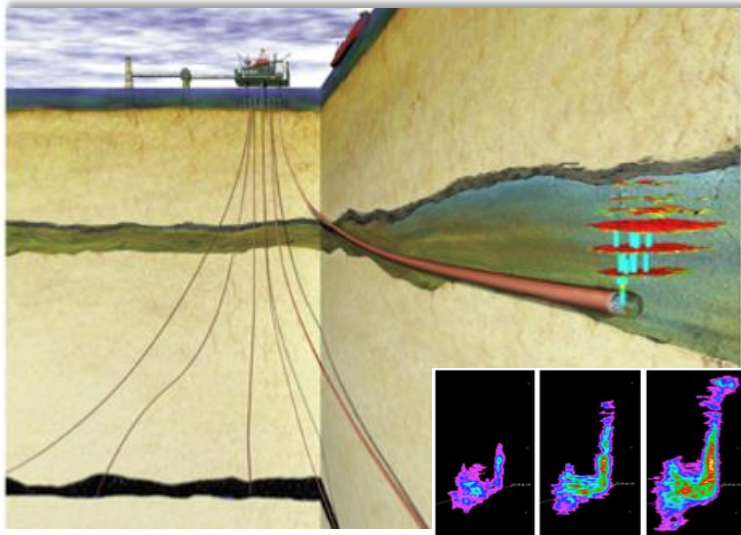
Wells



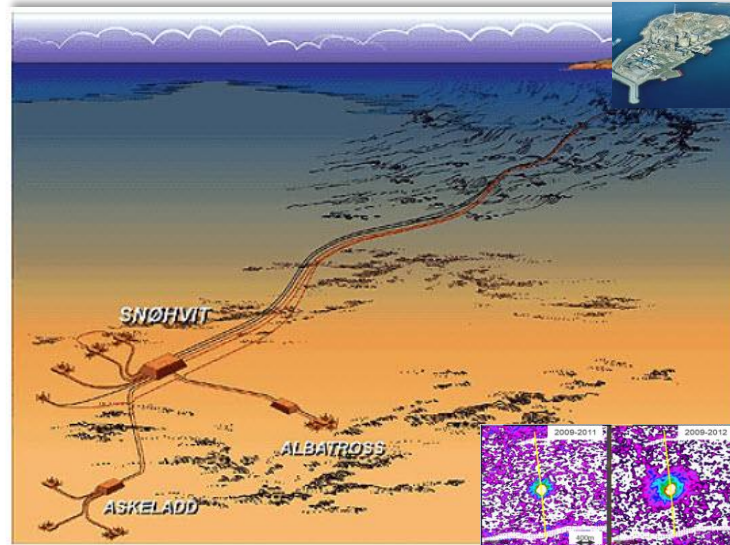
Hydrocarbon fields

25 years experience with CO₂-storage offshore Norway

26 Million tonnes of CO₂ permanently stored deep under the seabed



The Sleipner Vest gas field in the North Sea. This is the world first offshore CCS project. Today, three hydrocarbon fields capture CO₂ through the SleipnerT facility and inject through the same well in the Utsira formation.



The Snøhvit gas field in the Barents Sea. The well stream, with natural gas, CO₂, NGL and condensate, is transported in a 160-kilometre pipeline to the facility onshore. The gas is processed and cooled down to liquid natural gas (LNG). The CO₂ is separated and returned to the field by pipeline for reinjection into a geological formation.



Technology Centre Mongstad (TCM) is the world's largest facility for testing and development of carbon capture technologies.

CO₂ characterization and storage capacity on NCS in potential aquifers and fields



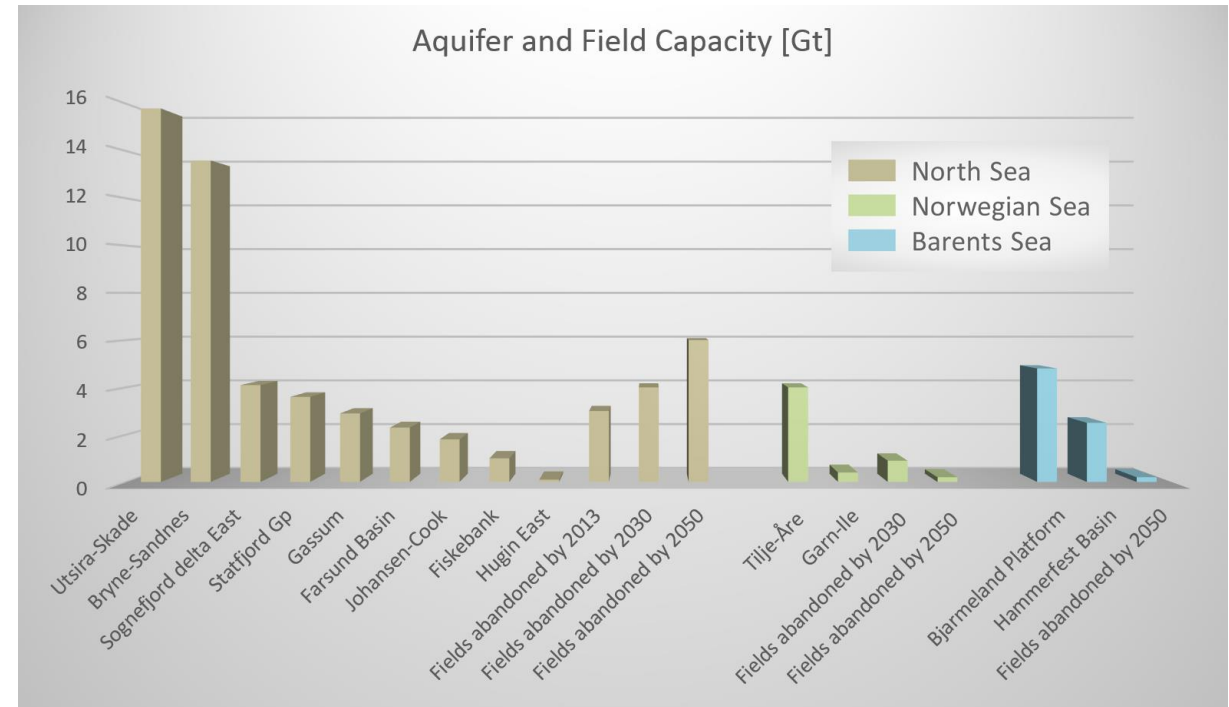
CHARACTERIZATION OF AQUIFERS AND STRUCTURES

Criteria		Definitions, comments	
Reservoir quality	Capacity, communicating volumes	3	Large calculated volume, dominant high scores in checklist
		2	Medium - low estimated volume, or low score in some factors
		1	Dominant low values, or at least one score close to unacceptable
	Injectivity	3	High value for permeability * thickness (k*h)
		2	Medium k*h
		1	Low k*h
Sealing quality	Seal	3	Good sealing shale, dominant high scores in checklist
		2	At least one sealing layer with acceptable properties
		1	Sealing layer with uncertain properties, low scores in checklist
	Fracture of seal	3	Dominant high scores in checklist
		2	Insignificant fractures (natural / wells)
		1	Low scores in checklist
Other leak risk	Wells	3	No previous drilling in the reservoir / safe plugging of wells
		2	Wells penetrating seal, no leakage documented
		1	Possible leaking wells / needs evaluation

Data coverage

Good data coverage Limited data coverage Poor data coverage

Other factors:
How easy / difficult to prepare for monitoring and intervention. The need for pressure relief. Possible support for EOR projects. Potential for conflicts with future petroleum activity.



- Development phase: 1,3 Gt
- Exploitation phase: 47 + 25 Gt
- Exploration phase: 11 Gt

Norwegian Regulation and Organization

International Treaties (UNCLOS, London Protocol, OSPAR)

CCS Regulation in EU- «CCS Directive»

- Ensuring there is no significant risk of leakage or damage to health or the environment
- Preventing any adverse effects on the security of the transport network or storage site

Norwegian Regulation for CO₂ transport and storage

- Based on the EU “CCS Directive” and the existing Norwegian Petroleum legislation
 - Ministry of Petroleum and Energy
 - Ministry of Climate and Environment/ Norwegian Environment Agency
 - (injection permit- amendment to Pollution Control regulations)

State ownership

- The Norwegian State has the proprietary right to subsea reservoirs on the continental shelf for exploitation of said reservoirs for storage of CO₂ and has an exclusive right to management of said reservoirs

Organization and storage of material i Norway

- Materials shall be available in Norway and must be made available, on demand and free of charge to the Ministry.
- Companies - established in concurrence with Norwegian legislation and are registered in the Register of Business Enterprises
- Government bodies shall be able to participate as observers in any cooperative bodies established by the License group

Government bodies involved:

Ministry of Petroleum and Energy
Ministry of Labour and Social Affairs
Norwegian Petroleum Directorate
Petroleum Safety Authority Norway
Ministry of Climate and Environment
Norwegian Environment Agency

Regulatory framework for CO₂ storage



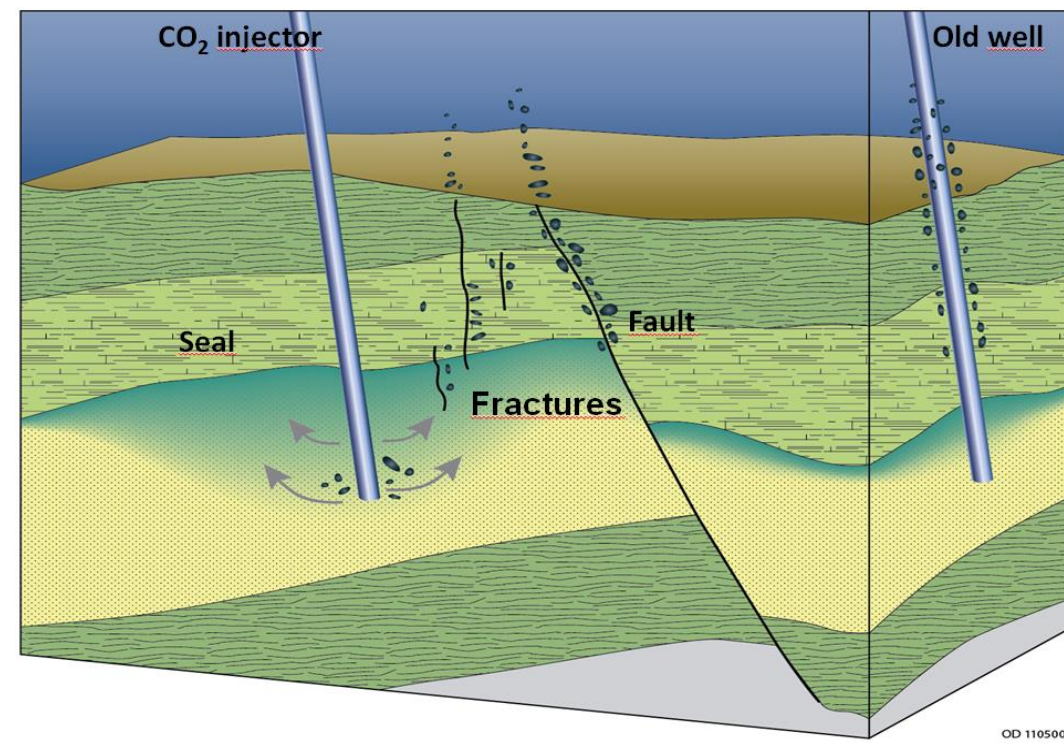
Key elements of the Norwegian CO ₂ regulation	
Survey	gives the right to explore for subsea reservoirs for storage of CO ₂ . Not exclusive, no preferential rights for exploration
Exploration	defined area, exclusive right, work commitment, up to 10 years, granted on objective, published and non-discriminatory criteria, preferred in the granting of an exploitation license
Exploitation	Give an exclusive right to store CO ₂ in the area. Granted on objective, published and non-discriminatory criteria. PDO
Impact assessment is a part of the PDO	Shall account for the effects the development may have for commercial and environmental circumstances, including preventive and mitigating measures. Open announcement.
Injection and storage	Consent from MPE and permission granted from NEA, including a monitoring plan.
Monitoring	Update the plan at least every five years: any changes in the risk assessment linked to leaks for the environment, human health, any new scientific knowledge or technological improvements. Corrective measures.
Shutdown and Post-Operation	Operator responsible for sealing the storage location and removing the injection facilities, monitoring, reporting and implementation of corrective measures. 20 years or upon application.
Hand-over to the state	All available information indicates that the stored CO ₂ will remain entirely and permanently enclosed, all conditions fulfilled.
Financial guarantee	Valid and effective when injection starts. A financial contribution shall, as a minimum, cover anticipated monitoring expenses for a period of 30 years to ensure that the CO ₂ is safely stored after the transfer of responsibility.

Potential challenges for development of CO₂ storage sites

- Access to area – hydrocarbon licenses, windmill parks, fishing and fish farming, CO₂ storage

Norway has long experience of ensuring good coexistence between different users of the sea

- Monitoring – what's expected?
 - Technologies, seabed monitoring, reservoir monitoring, frequencies
- Monitoring after shut down- how often and for how many years?
- Liability- handover to state – define long term monitoring



OD 1105006

Challenges for upscaling CCS deployment

CCUS projects in Europe (IOGP 2021)



Total number of CCS projects: 66 – can contribute with around 60 MtCO₂/yr stored by 2030

Today 4 CCS projects are in operation in Europe

The North Sea basin appears to be a key area for the development of carbon dioxide capture and storage (CCS) in Europe

Why?

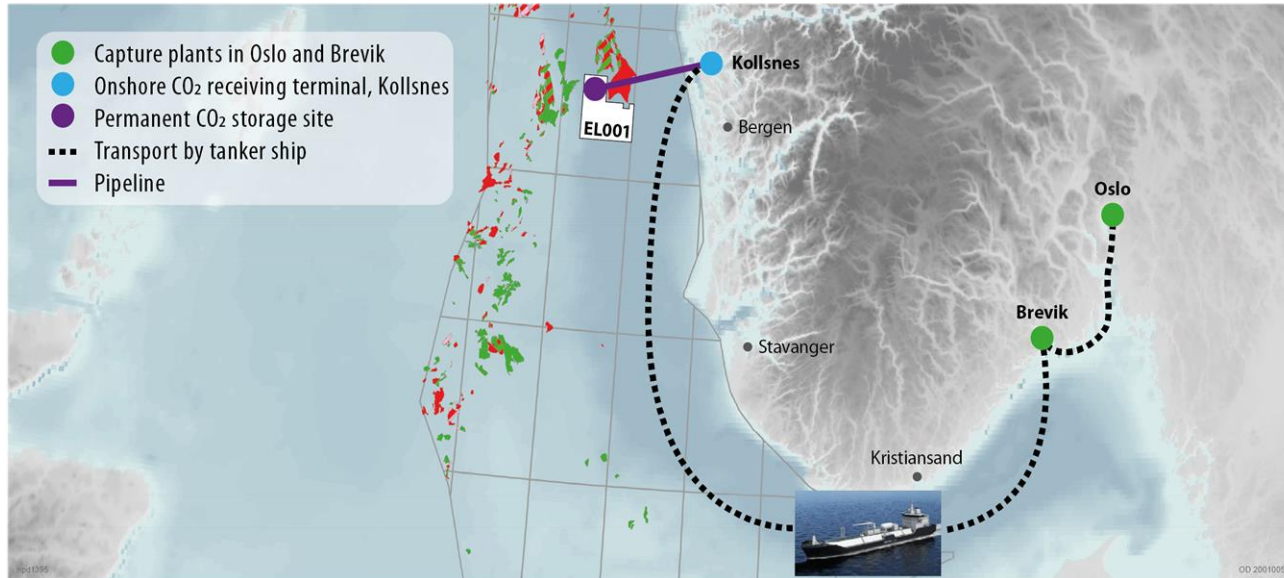
Through years of petroleum activity, the geology is well known and where the potential reservoir rocks suitable for storing CO₂ can be found.

What's needed?

- Consistent policy support is key to unlocking investment in offshore carbon storage
- Cost - effective technology for injection and monitoring
- Demonstrate the whole value chain
- Develop a sustainable business case
- Rely on professional competence



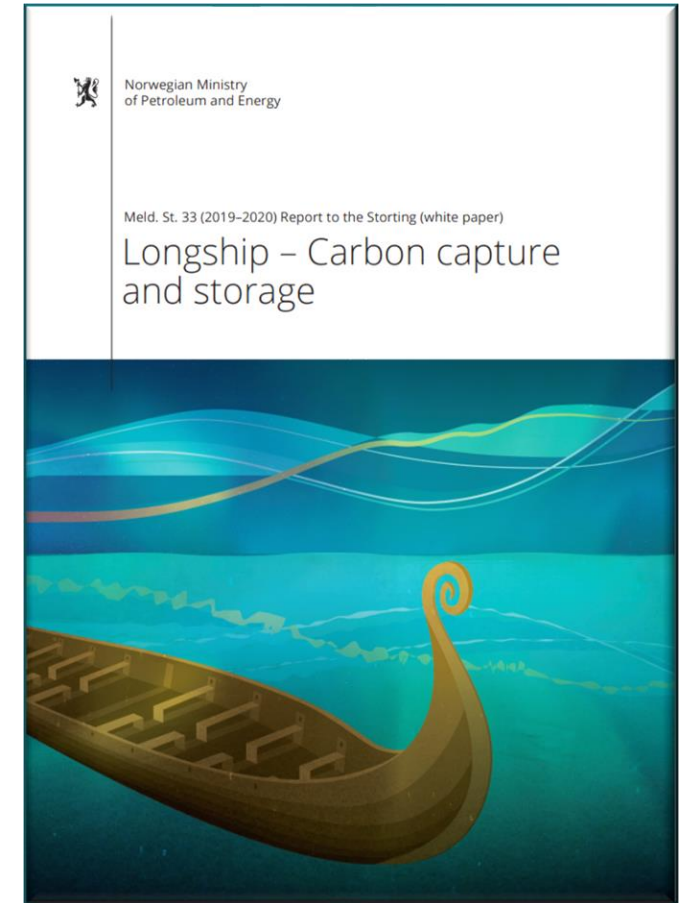
Longship- a full scale CCS demonstration project on the way to large-scale deployment



- Contribute to developing technology for capture, transport and permanent storage of CO₂
- Develop a full-scale CCS value chain in Norway by 2024
- Demonstrate that CO₂ management are safe and possible

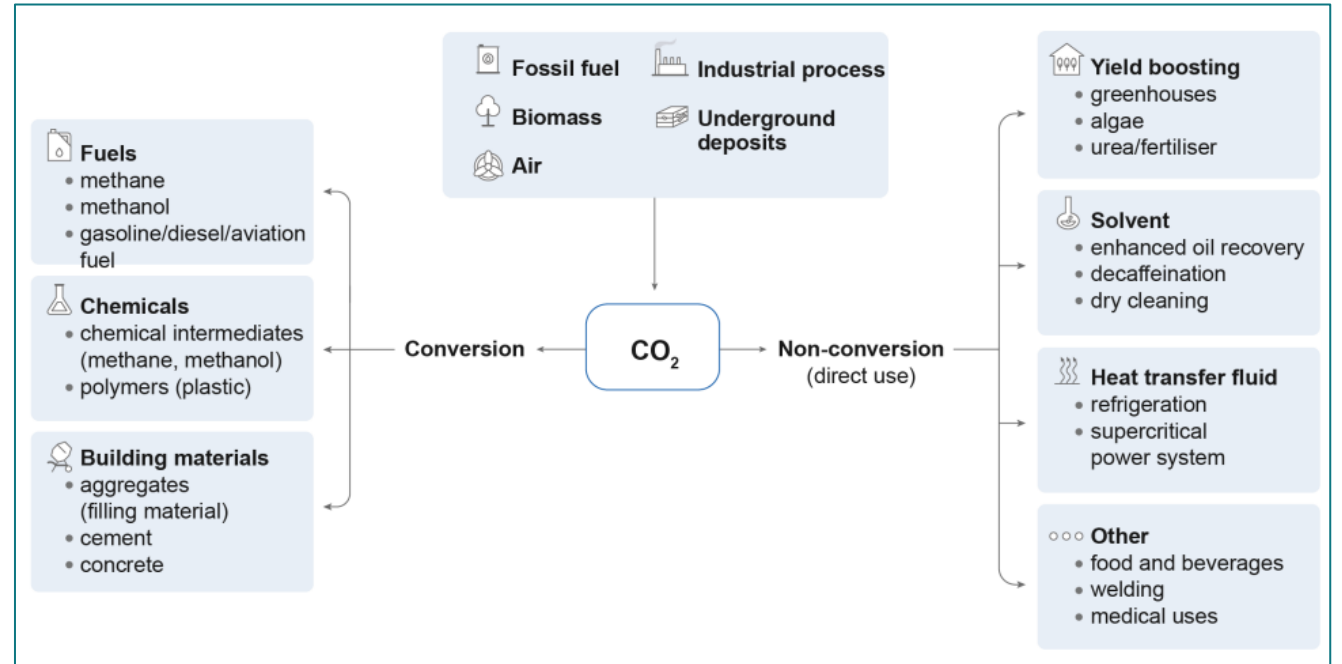
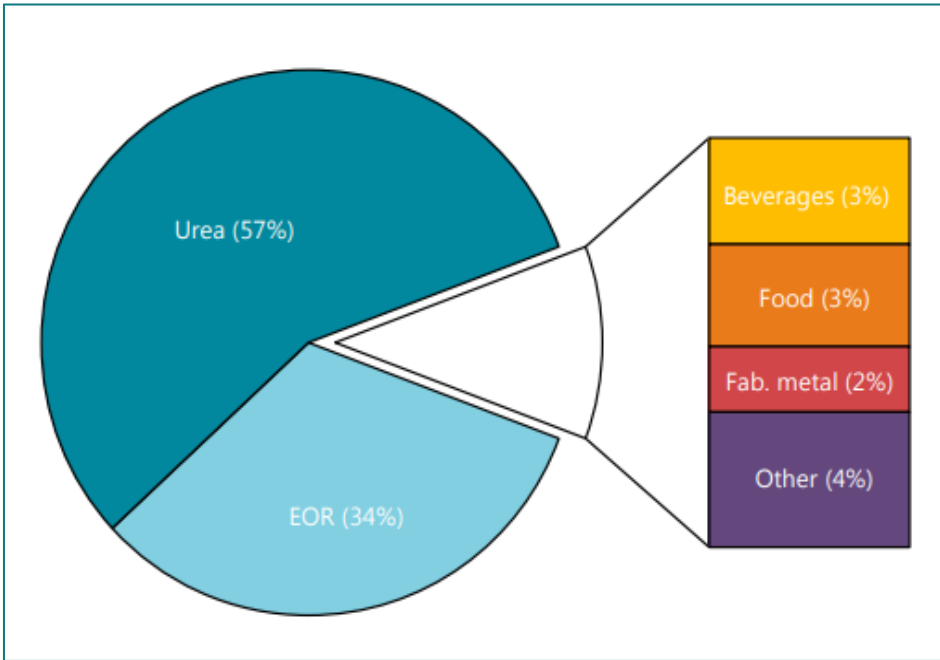
Learning- cost reductions – business development

- CCS can enable negative emissions as part of large-scale deployment



Use of captured CO₂- CCU

Globally, around 230 million tonnes (Mt) of carbon dioxide (CO₂) are used each year but CO₂ used is not the same as CO₂ avoided



IEA: “Putting CO₂ to Use, Creating value from emissions”
September 2019

Safe storage of CO₂ on NCS



We have the experience

CO₂ has been injected and stored for several decades both onshore and offshore. On the Norwegian shelf we have stored CO₂ in deep saline geological formations for 25 years - which we monitor closely

We have the knowledge

Through more than 50 years of oil and gas industry in the North Sea Basin and on the Norwegian continental shelf, we have mapped, collected and interpreted geo- data which gives us a good overview of reservoirs and the sealing rocks that can be used for CO₂ storage.

We have the instruments

We have solid regulations on site characterization and monitoring and we set requirements

We have a huge storage potential

Our mapping and evaluation show that there can be capacity to store as much as 80 billion tonnes of CO₂ offshore Norway.

Its ready now

CCS is a key part for meeting our climate targets by decarbonizing the industry, can enable negative emissions and the technology is ready now.

Thank you for your attention!

npd.no
factpages.npd.no/no
norskpetroleum.no

