NORWEGIAN PETROLEUM DIRECTORATE
50 years

CO2 Atlas Developments and CO2 Storage Achievements

Erik Nilsen Rundell, Norwegian Petroleum Directorate

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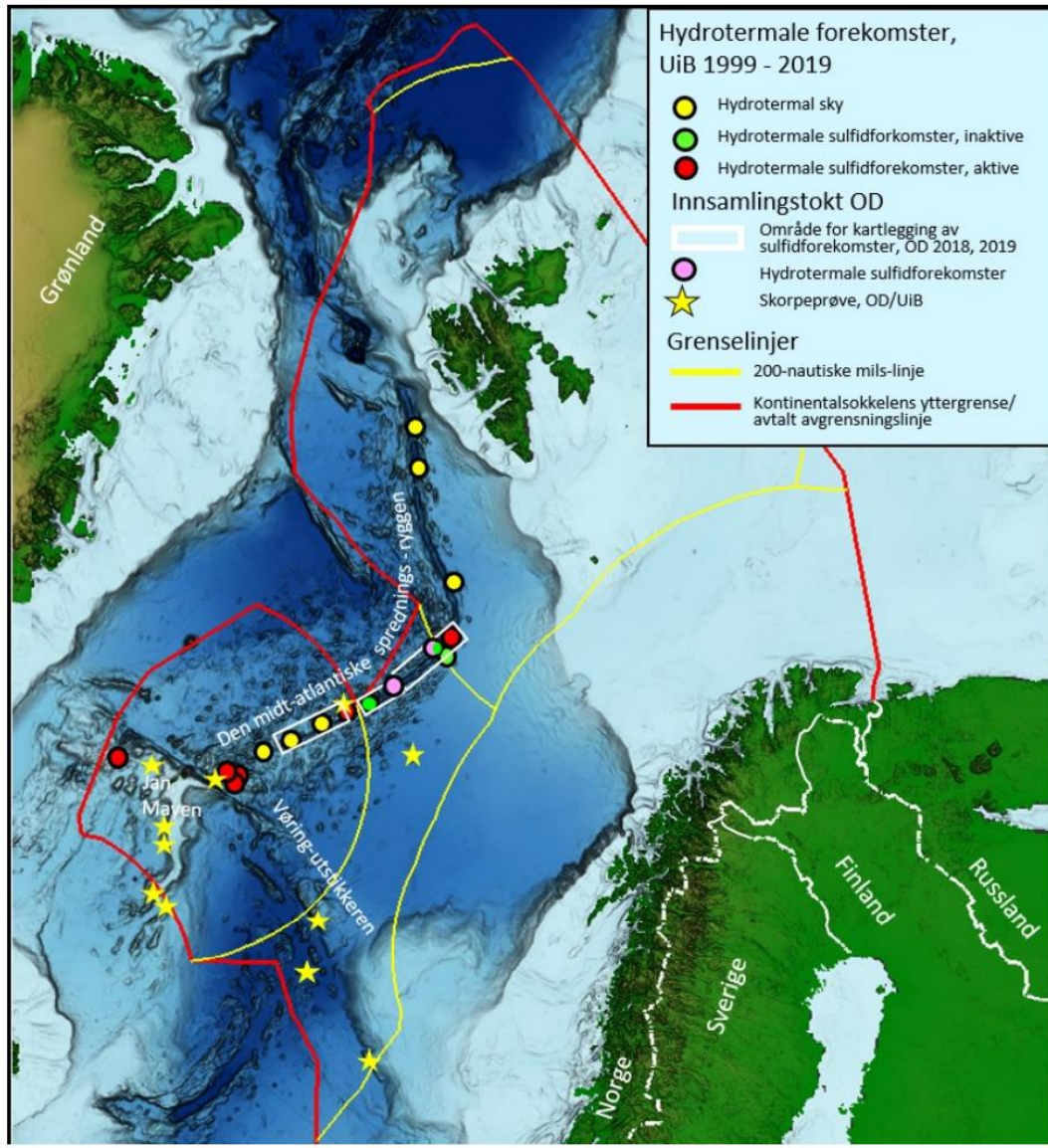
NPDs main objective

Greatest possible value creation for the norwegian society from the petroleum resources, taken into account Health, Safety, Environment and other users of the sea

Seabed minerals



Professional adviser to the Ministry of Petroleum and Energy.

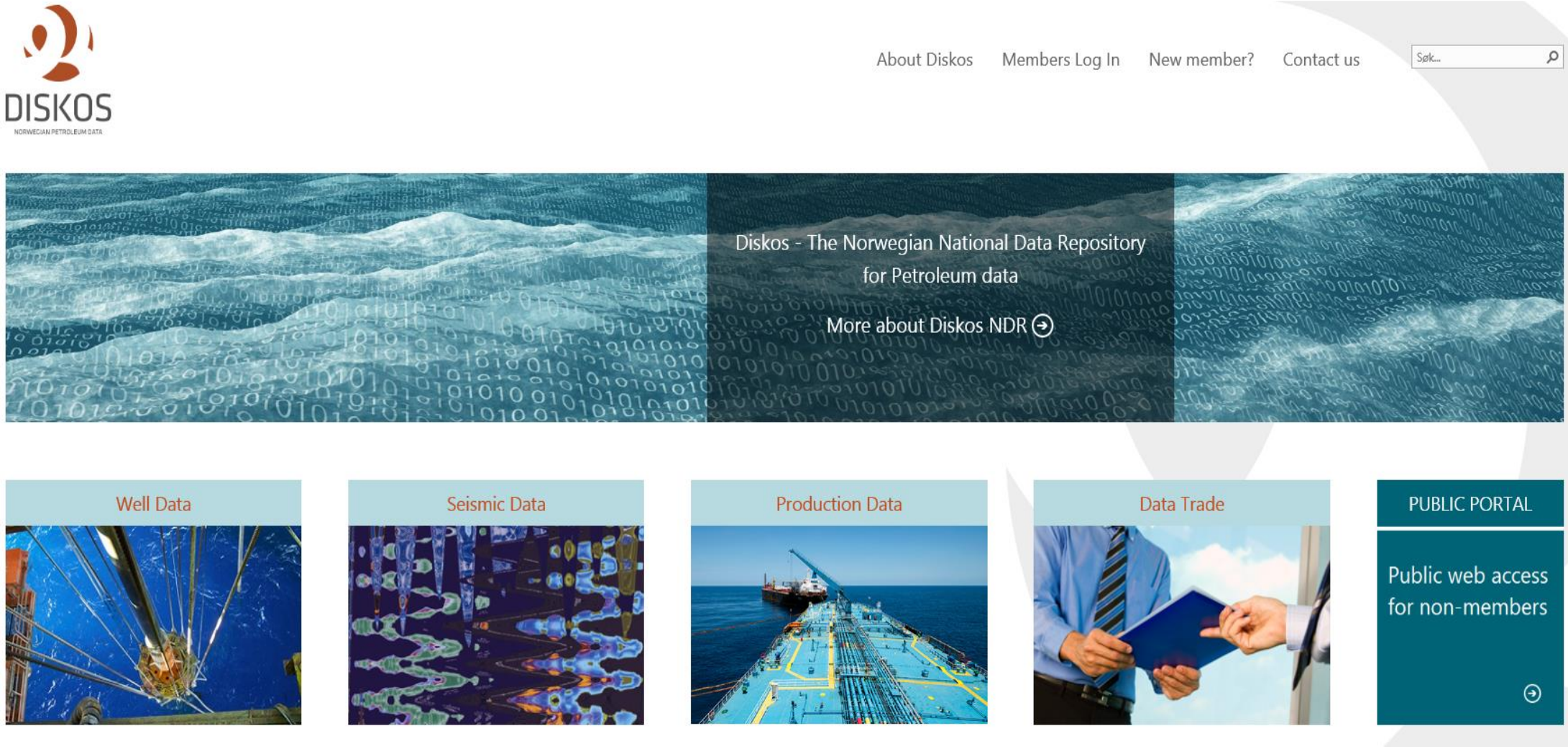
National responsibility for the data from the Norwegian continental shelf.

Follow-up the petroleum activities in cooperation with other authorities.

Driving force for realising the resource potential through a strategic Norwegian continental shelf perspective.

NPD's objective is to contribute to the greatest possible values for Norwegian society from the oil and gas activities through efficient and responsible resource management where health, safety, the environment and other users of the sea are taken into consideration.

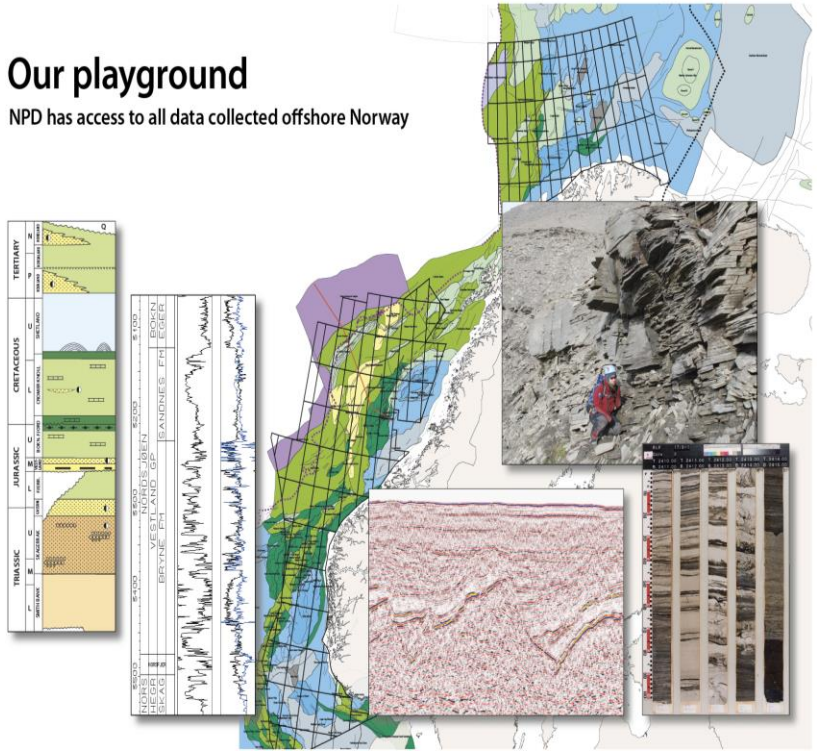
Diskos – the contents



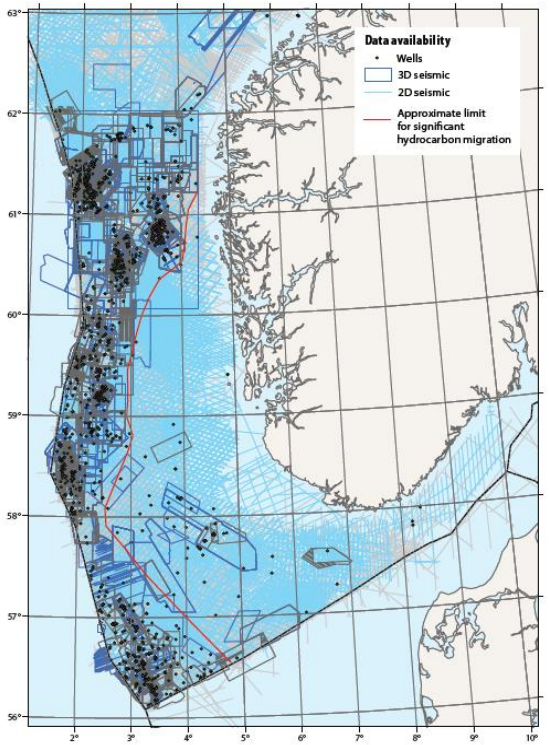
www.diskos.no

Access to data from the petroleum industry

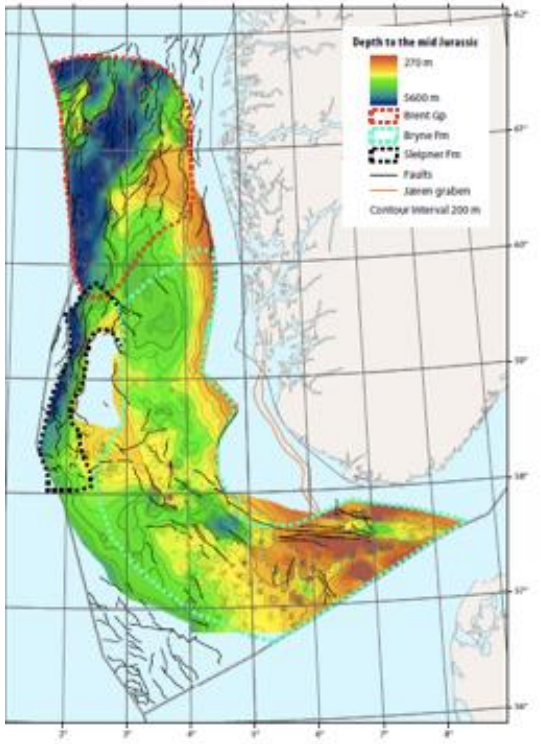
Comprehensive assessments based on 26 years of experience storing CO_2 and more than 50 years of experience with petroleum activity

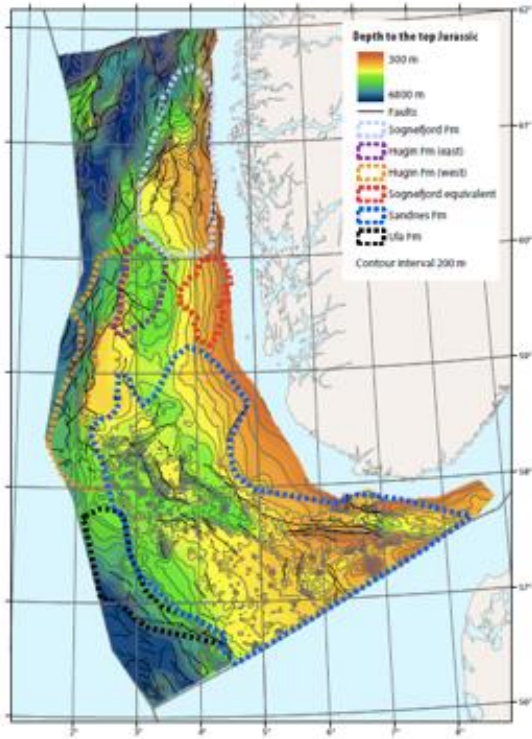


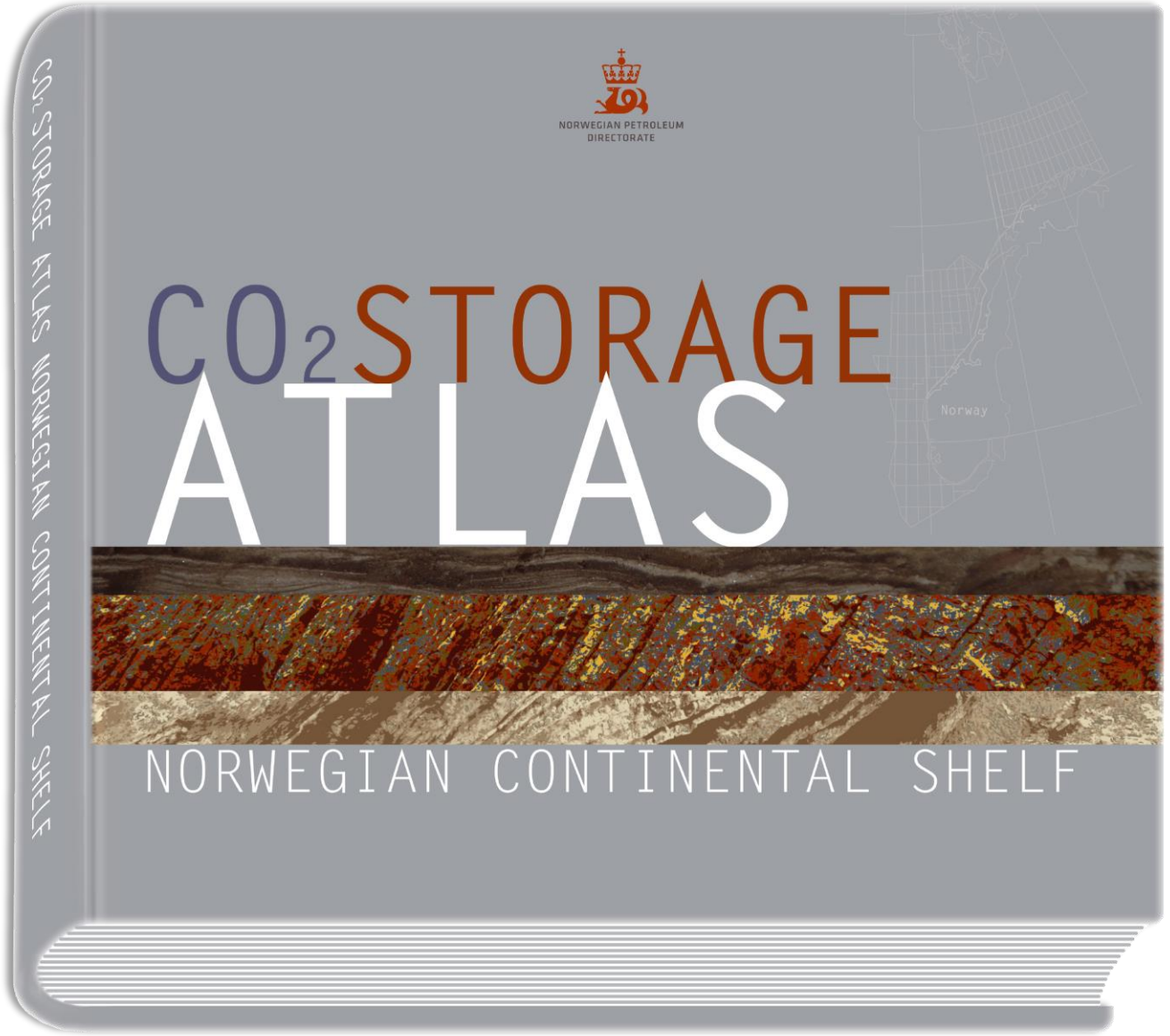
2D and 3D seismic data



The upper and middle Jurassic forms the basis of many of the depth and thickness maps of assessed geological formations







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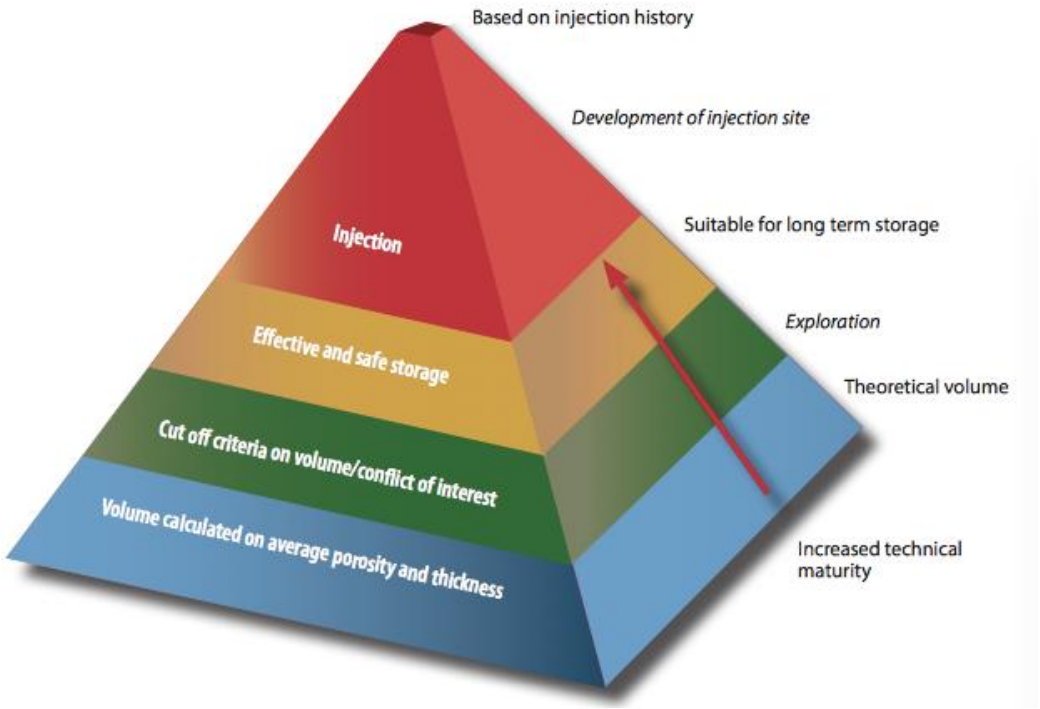
Open link, download for free: https://www.npd.no/fakta/co2-handtering-ccs/

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.

NPD's maturation pyramid



Step 4 is the phase when CO_2 is injected in the reservoir. Throughout the injection period, the injection history is closely evaluated and the experience gained provides further guidance on the reservoirs' ability and capacity to store CO_2.

Step 3 refers to storage volumes where trap, reservoir and seal have been mapped and evaluated in terms of regulatory and technical criteria to ensure safe and effective storage.

Step 2 is the storage volume calculated when areas with possible conflicts of interest with the petroleum industry have been removed. Only aquifers and prospects of reasonable size and quality are evaluated. Evaluation is based on relevant available data.

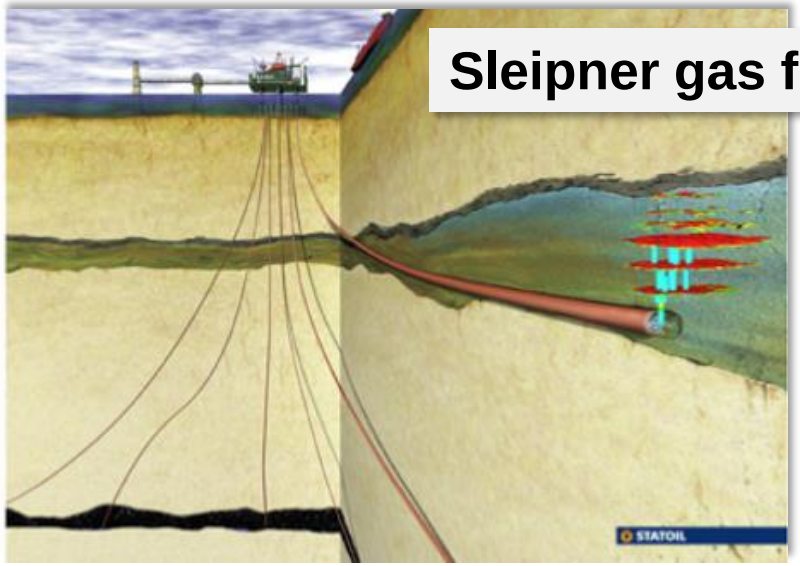
Step 1 is the volume calculated on average porosity and thickness. This is done in a screening phase that identifies possible aquifers suitable for storage of CO_2. The theoretical volume is based on depositional environment, diagenesis, bulk volume from area and thickness, average porosity, permeability and net/gross values.

Results

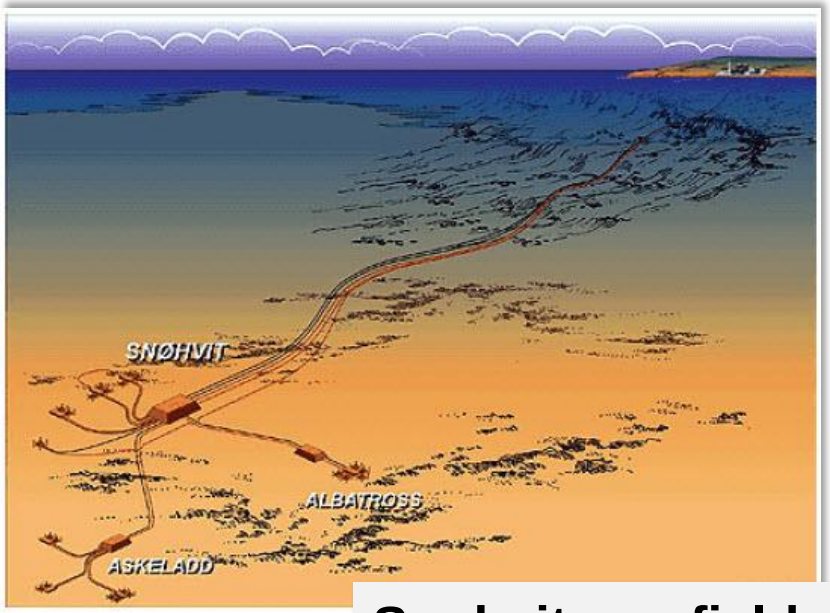
Aquifer	Capacity Gt	Injectivity	Seal	Maturity	Data quality
North Sea aquifers					
Utsira and Skade Formations	15,8	3	2		
Bryne and Sandnes Formations	13,6	2	2/3		
Sognefjord Delta East	4,1	3	2/3		
Statfjord Group East	3,6	2	3		
Gassum Formation	2,9	3	2/3		
Farsund Basin	2,3	2	2/3		
Johansen and Cook Formations	1,8	2	3		
Fiskebank Formation	1	3	3		
Norwegian Sea aquifers					
Garn and Ile Formations	0,4	3	3		
Tilje and Åre Formations	4	2	2/3		
Barents Sea aquifers					
Realgrunnen Subgroup, Bjarmeland Platform	4,8	3	2		
Realgrunnen Subgroup, Hammerfest Basin	2,5	3	2		
Evaluated prospects					
North Sea	0,44				
Norwegian Sea	0,17				
Barents Sea	0,52				
Abandoned fields					
North Sea	3				
Producing Fields_2050					
North Sea 2050	10				
North Sea_Troll aquifer	14				
Norwegian Sea	1,1				
Barents Sea	0,2				

The Norwegian Experience

NPD



Sleipner gas field



Snøhvit gas field

Technology Centre Mongstad (TCM)

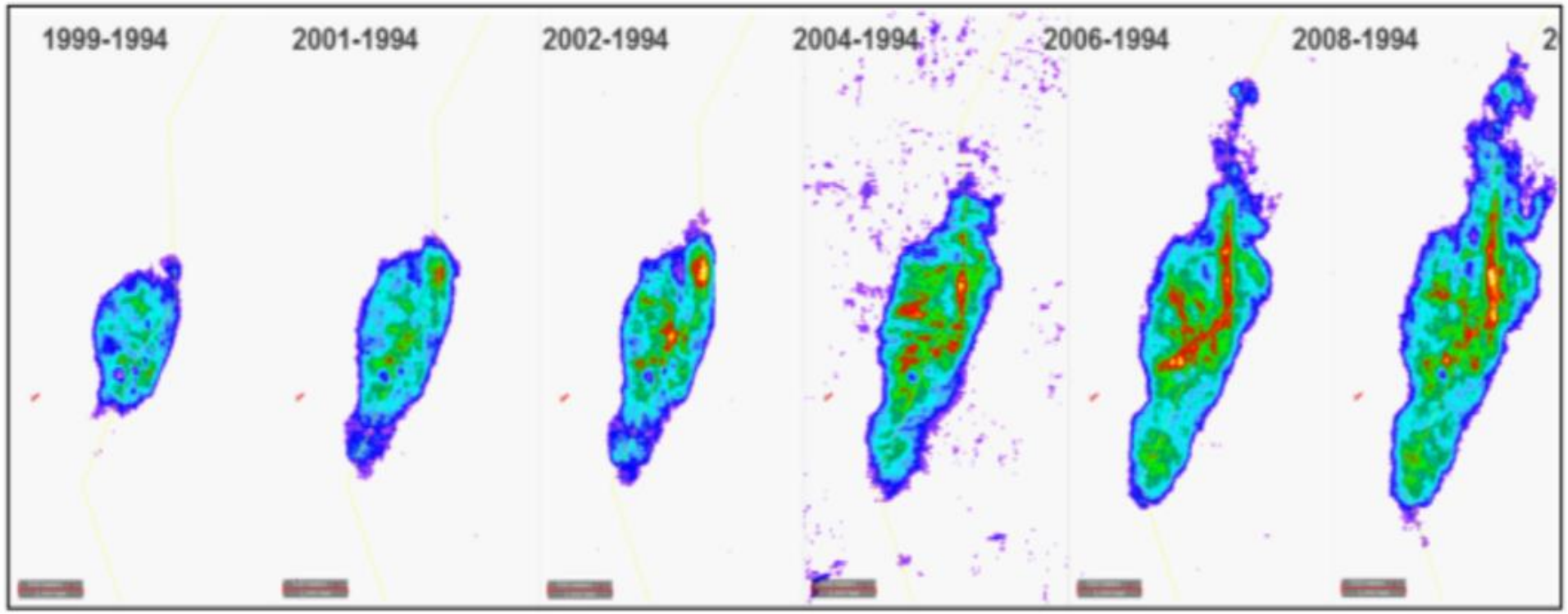
80 Billion tonnes

26 Million tonnes

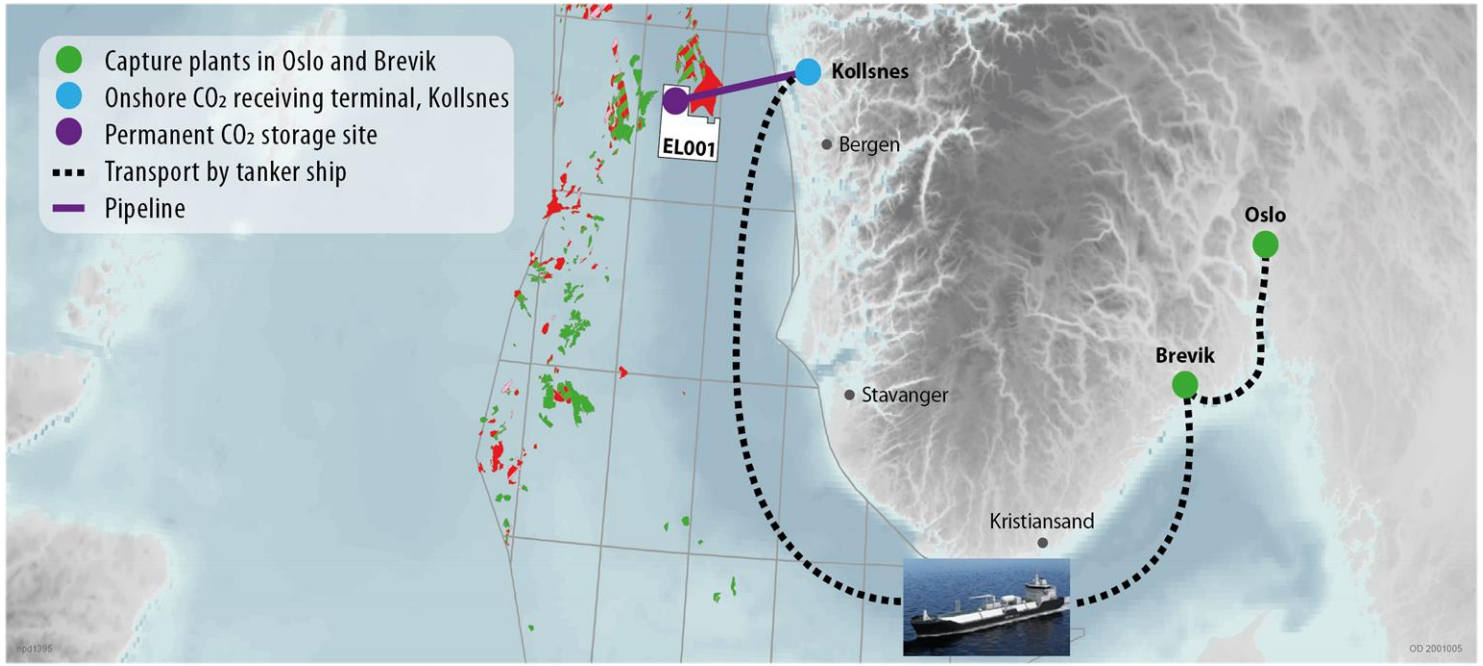
3 Licenses

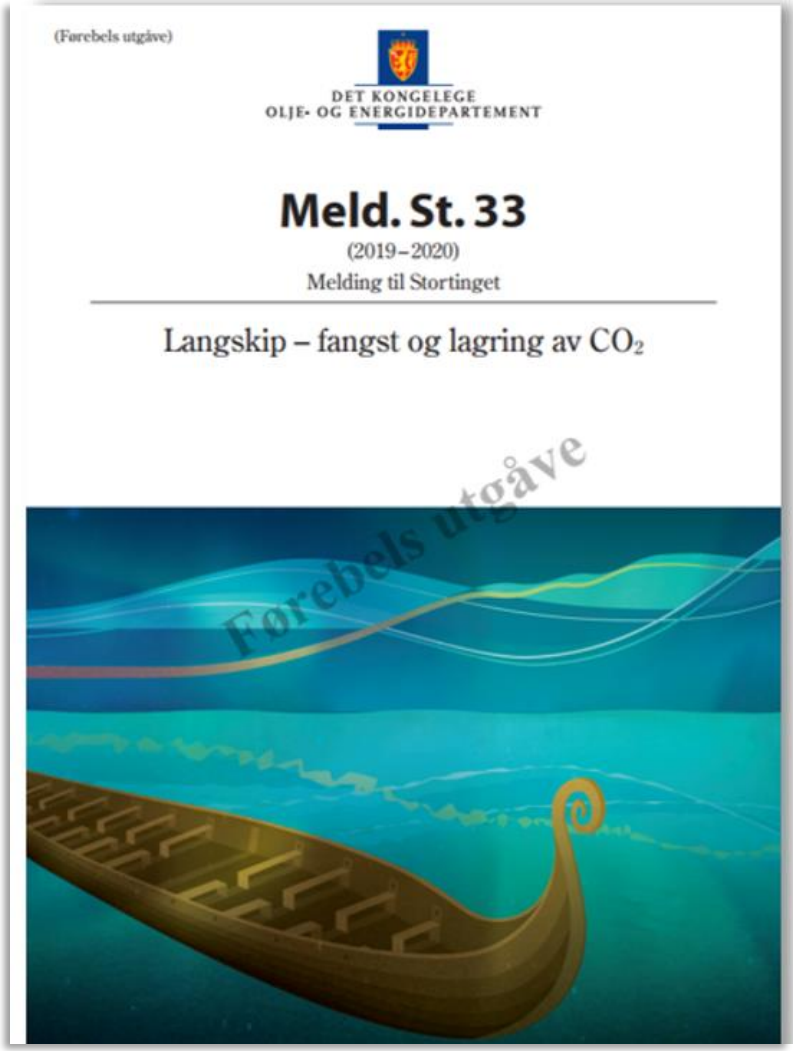
Safe storage - Monitoring

The Operator needs to be able to demonstrate and document that the actual behaviour of the CO2 is in line with the modelled behaviour, and that the Storage Complex is developing “towards eternal stability”, cf. the Storage Regulation section 5-8.



Longship- a full scale CCS demonstration project

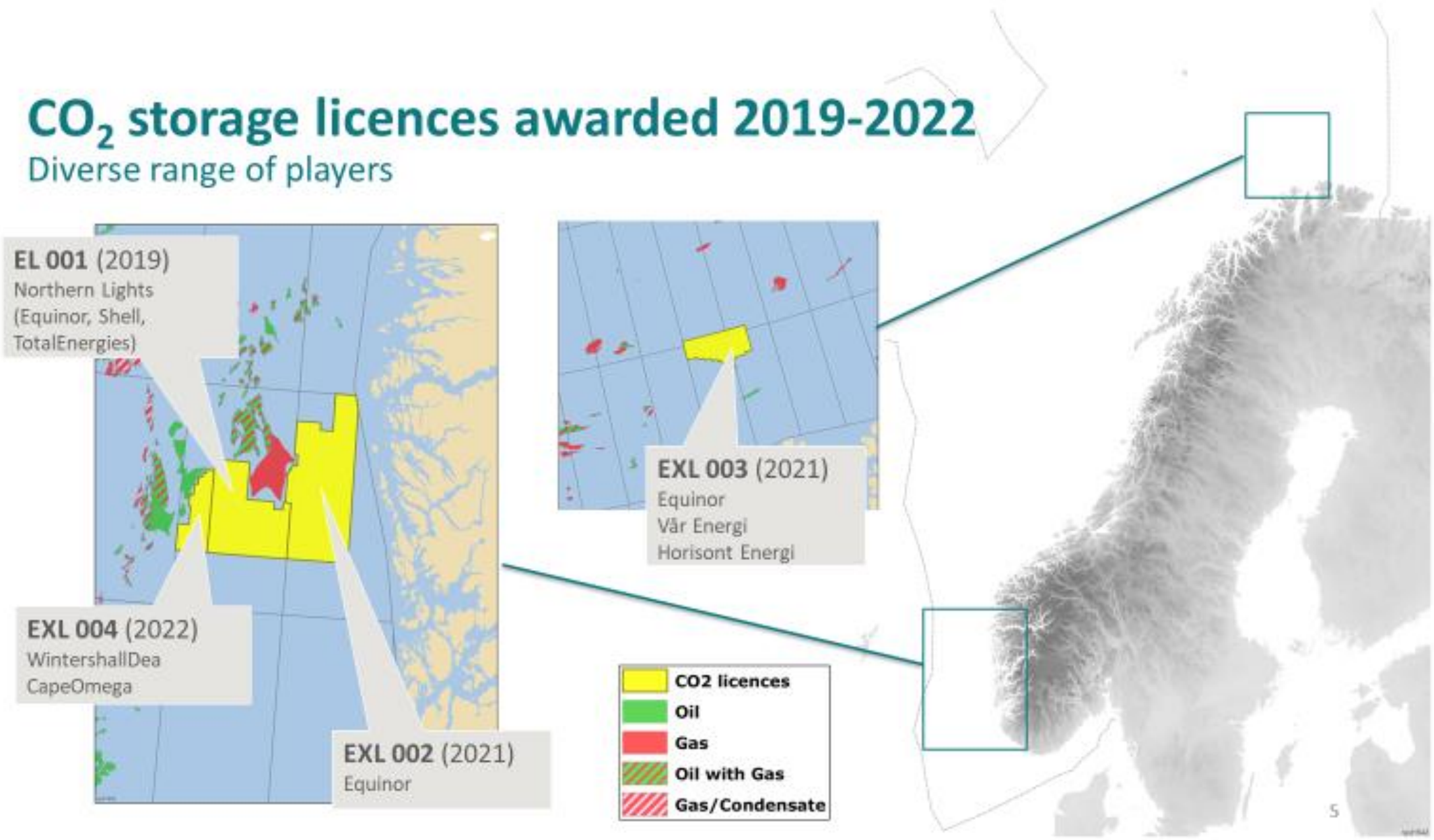


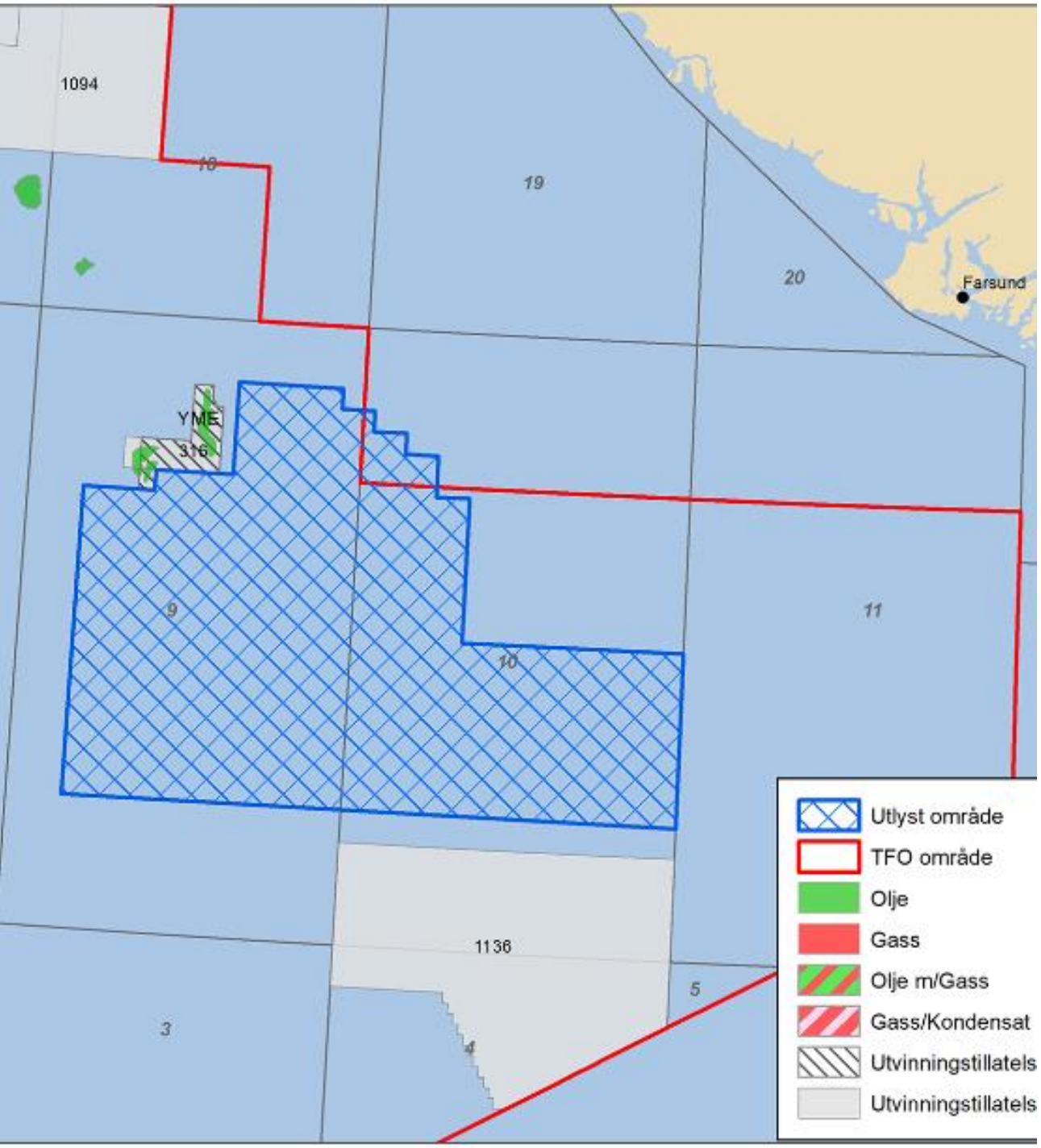


- Accelerate decarbonisation
- Develop a full-scale CCS value chain in Norway by 2024
- Contribute to developing technology for capture, transport and permanent storage of CO_2
- Facilitate a cost-effective solution for full-scale CO_2 management
- Demonstrate that CO2 management are safe and possible
- Facilitate learning and cost reductions
- Facilitate business development
- Demonstrating the potential of this decarbonisation approach to Europe and the world

CO_2 storage licences awarded 2019-2022

Diverse range of players





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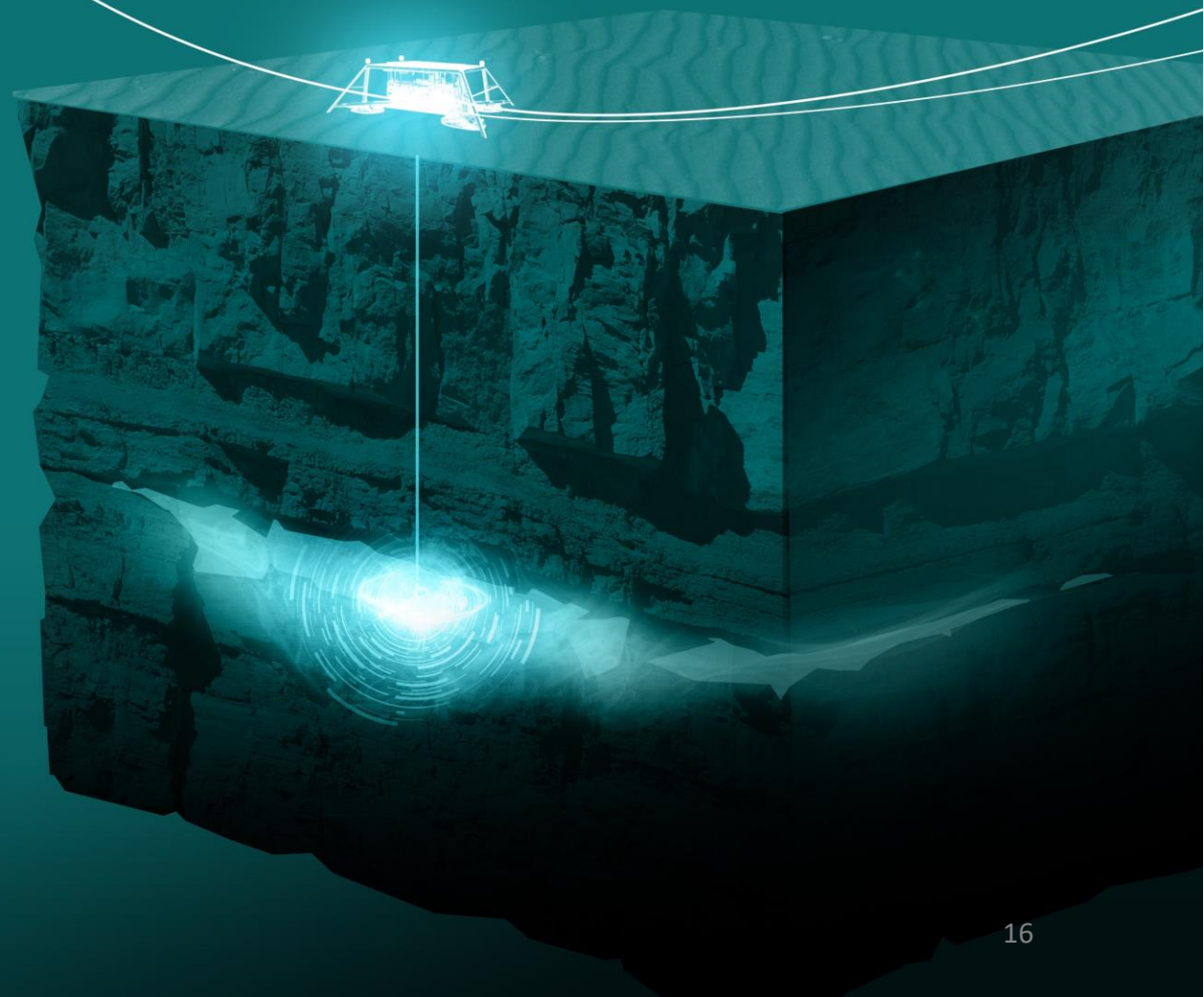
New area announced

The Norwegian Continental Shelf offers

- - Significant CO_2 storage potential
- - Safe storage proven by existing projects
- - An established licensing process for carbon storage

… and we see continued interest for more acreage from a wide range of players



Thank you for your attention!

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