Environmental regulation of subsea geological storage of CO_2 in Norway

Bjørn Christensen, Norwegian Environment Agency

«Headlines»

- Regulatory framework for CO_2 storage in Norway
- Ongoing CO_2 storage at the Norwegian Continental Shelf (Sleipner and Snøhvit)
- “The Longship project” and Northern Lights

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EU-regulations and other international commitments

- The EU-directive 2009/31 EC on geological storage of CO_2 was transposed into Norwegian legislation on Dec 5, 2014
- Norway joined the EU-ETS (Greenhouse Gas Emission Trading System, (EU-directive 2003/87/EC) in 2008
- CCS was included in the EU-ETS system from Jan 1, 2013. The EU-directive 2007/589/EC on monitoring, reporting and verification of emissions applies for CCS
- Norway is a Contracting Party to OSPAR Convention and the London Protocol. Decisions and Recommendations are observed.

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Competent Authorites on CO_2 storage in Norway

- Ministry of Energy (Resource Authority)
- Ministry of Climate and Environment
  - Norwegian Environment Agency

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Permits needed for CO_2 injection and storage i Norway

- The Ministry of Energy
  - Exploration permit including mandatory work program
  - Exploitation permit
  - Approved plan for development and operation
- The Norwegian Environment Agency:
  - Permits for drilling activities (exploration- and injection wells)
  - Permit for injection and storage
  - ETS permit

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Ongoing storage projects in Norway;
Sleipner and Snøhvit

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Sleipner
Offshore gas and condensate field in the North Sea

- Well stream with 5-8 % CO_2 processed offshore
- CO_2 captured and stored in the “Utsira” formation since 1996
- Injection rate reduced from 1 Mt/year to 0,1 MT/year
- 19 Mt CO_2 stored so far
- No leaks or significant problems encountered

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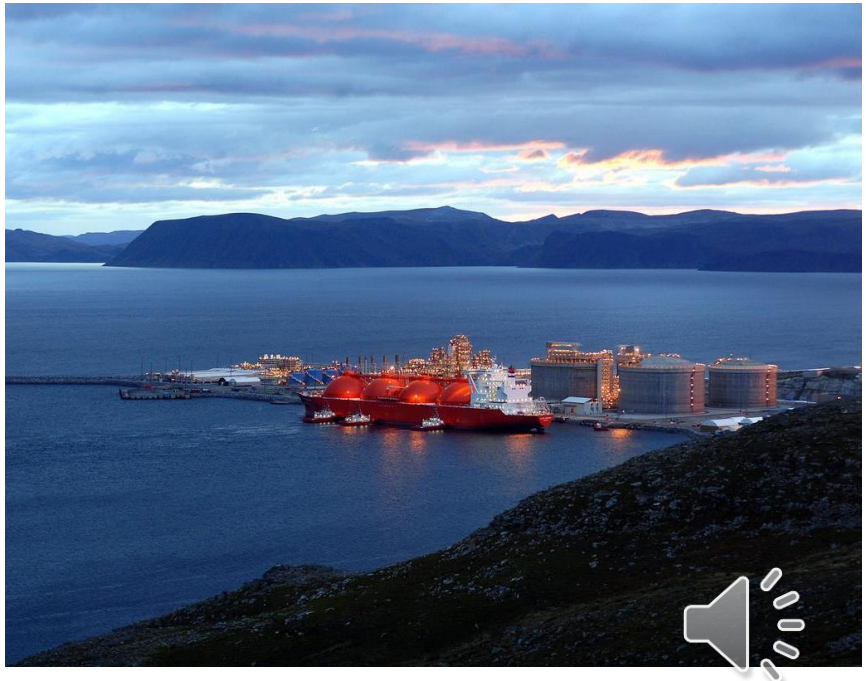
Snøhvit

Offshore gas and condensate field in the Barents Sea

- Well stream with 5-8 % CO_2 transported to onshore LNG plant through av 145 km pipeline
- CO_2 captured and transported back til Snøhvit for subsea storage since 2008
- Injection rate: 0,7 mill. Mt/year
- 8 Mt CO_2 stored so far



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Snøhvit – experiences with CO_2 storage

- Injection in the «Tubåen formation» terminated in 2011 due to unpredicted pressure build up
- Injection in the shallower «Stø formation» from 2011
- New injection well put into operation in 2016 to avoid contamination of gas reservoir

- CO_2 plume has since 2016 behaved as predicted
- Declining pressure due to communication with the producing reservoir

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Permits granted by NEA - Sleipner and Snøhvit

- Issued prior til start-up of production in 1996 and 2008, respectively
- Revised in 2017 to ensure compliance with the EU Storage Directive
- Some terms and requirements in the permits:
  - Min. 96 % CO_2 in CO_2 stream
  - Max. injection rate and stored volume defined
  - Reservoir simulation model must be used
  - 4D seismic studies every 3-4 years
  - Monitoring plan must be updated and approved by NEA every five years
  - Parent company guarantees accepted as financial security

- ETS permits: Requirements for monitoring and quantification of CO_2-emissions (ventilation and leakages)

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“The Longship Project” and Northern Lights

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«The Longship Project»

- Supported financially by the Norwegian State for 10 years
- CO_2 capture at:
  - Heidelberg Materials Brevik (cement plant): 400 000 t/year
  - Hafslund Celcio (waste incineration plant): 400 000 t/year
- Transport of liquid CO_2 by ships to a terminal in Western Norway
- Injection and storage of CO_2 in a saline aquifers in the North Sea

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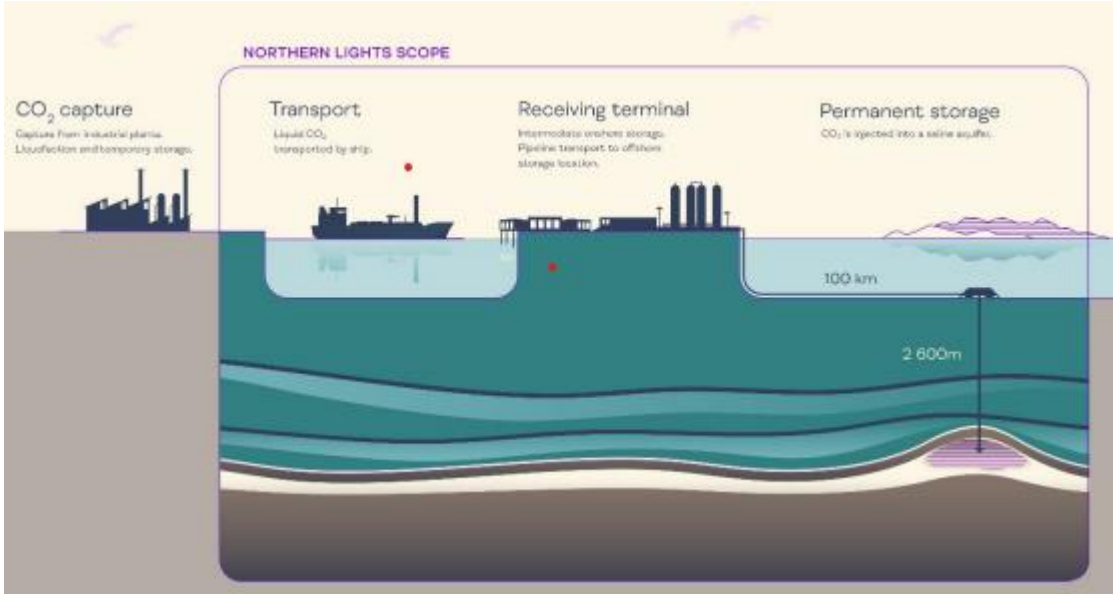
Northern Lights scope within the Longship Project



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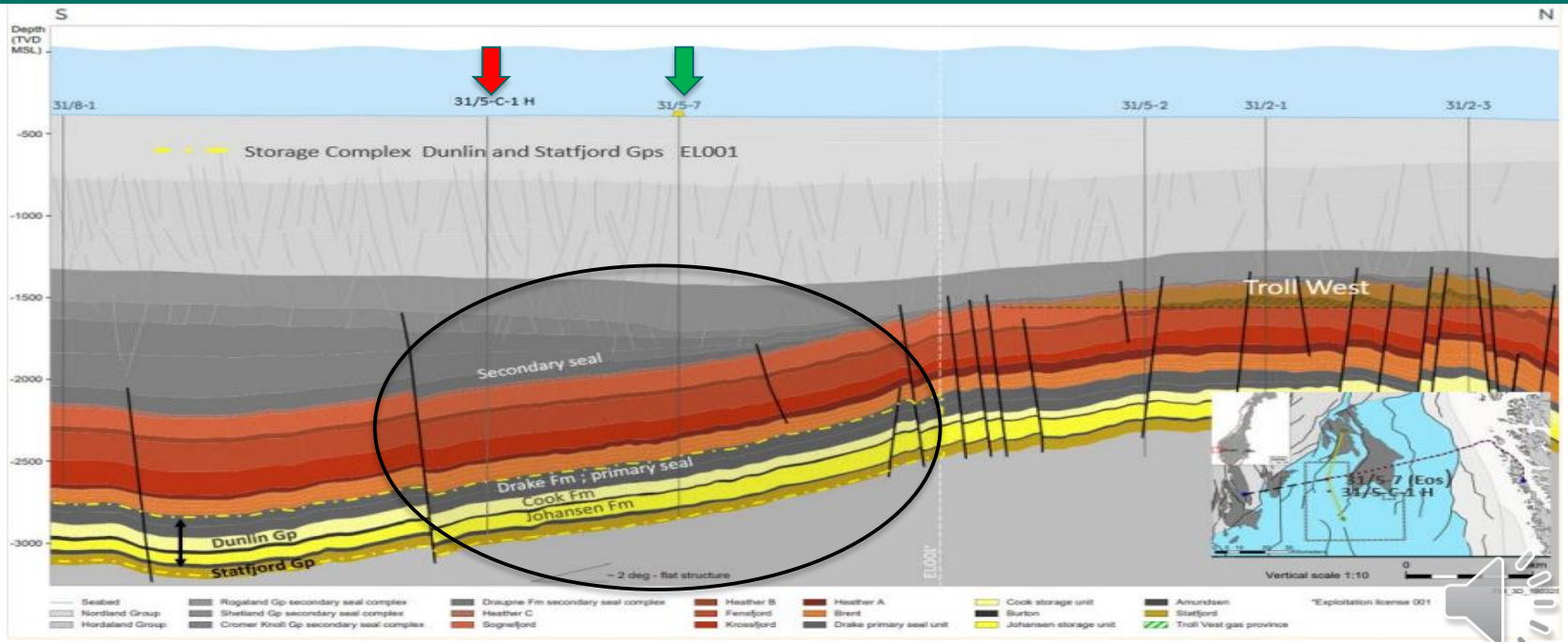
Northern Lights; The storage complex



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Project status – Northern Lights

- Infrastructure for injection and storage built and installed
- Four ships dedicated to CO_2 transport under construction
- Expected to be ready for operation by the end of 2024 – and to receive the first volumes of CO_2 in 2025

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NLs application for an injection and storage permit

- 1,5 mill. Mt CO_2/year for 25 years
- Operational limits based on acceptance criteria for CO_2 stream composition, pressure, temperature etc.
- Proposed plans for approval by NEA:
  - Monitoring plan
  - Plan for corrective measures
  - Preliminary post closure plan
- Proposed financial Security (to be approved by the Ministries)

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NEAs processing of NL's application

- Sent to the EFTA Surveillance Agency (ESA) for «completeness check»
- Public consultation in Norway
- Supplementary information received from Northern Lights
- Draft permit sent to ESA in March 2024 for completeness and compliance check
- Permit will be granted by the end of 2024

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Summary

- CO_2 has been separated from natural gas and stored in geological structures at the Norwegian shelf since 1996
- Permits have granted in accordance with requirements in the EUs storage directive and EU- and LP Guidelines
- No leaks have been observed, but new injection wells had to be drilled at Snøhvit to avoid CO_2 contamination of producing gas reservoir
- Northern Lights will probably be ready to operate by the end of 2024 and receive the first volumes of CO_2 in 2025

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Thank for your attention!

bjorn.christensen@miljodir.no