



Development of a new CO₂ storage facility on Norwegian Continental Shelf CO2GeoNet Workshop – Venice, 11. May 2016 Peter Zweigel, Statoil

Governmental frame and goals



Desired effect:

 «Give an independent and measurable contribution to the development and demonstration of technology for capture and storage of CO₂, with a potential for dissemination»

Additional goals :

- Technology development
- Learning
- Dissemination potential
- Cost reductions

Ambition:

• Minimum 1 full-scale facility for capture and storage within 2020



Time plan - government

- Feasibility studies for capture, transport, storage to be delivered 1. June
 - Tight schedule for feasibility studies
- Coordination and integration of study results until 1. July
- Decision in government as part of annual budget process for 2017 until August/ September.



Three capture facility studies



In total ca. 1.3 Mt CO₂ per year

Norcem, Brevik Cement production Yara, Porsgrunn Ammonium production EGE, Oslo Household waste incineration

Gassnova coordinates



Transport: Studies for transport by ship

- Shuttling ships, assume 3 vessels
- 8000 m³ storage capacity

Gassco coordinates





3 storage site studies



Gassnova coordinates



An industrial-type feasibility project





Offloading concepts (link transport – storage)





Onshore-storage with pipeline to reservoir



Direct injection via STL (Submerged Turret Loading)

Via offshore storage vessel - FSI (floating, storage & injection)

Direct injection via platform (requires STL)







Offloading – an STL example





3 storage cases

- Requirement: 1.3 Mt CO2/ year $\rightarrow \sim 32.5 \text{ Mt CO2}$
 - 200 t/hr in case of batch injection (1.8 days on, 0.5 days off)



Utsira South

- Known reservoir (Sleipner): Utsira Fm.
- Evaluate new location, preferably in non-licensed area
- Site ca. 900 m bsl









Reservoir: Utsira Fm

- Up to 300 m thick. Pinches out towards east.
- Extends 450 km N-S and 70-130 km E-W
- Shallow marine setting
- Homogeneous with few internal clay layers.
- Formation porosity: 30-38%
- Permeability: mostly >1D and up to 3D
- Subtle topography (no tectonic deformation)





Heimdal site

- Depleted gas field
- In operation since 1985
- GIIP: 61.4 GSm3
- Produced gas: c. 45 GSm3
 - \rightarrow c. 150 Mt CO₂
- Only 1 producer left
- Planned shut-down c. 2018
- Stratigraphic license





Heimdal site





Heimdal site

- Site c. 2000 2400 m bsl
- GWC moved from c. 2147 m to c. 2050 m TVDss
- Minor pressure decline (c. 20 bar from initial 214 bar), strong aquifer support
- Proven integrity
- 3 exploration wells
- 10 former producers PP&A'd in 2014-2015
- In operation: 1 produced-water injector A-4, 1 gas producer A-5 A





Smeaheia site

- Statoil: «Smeaheia» 2009-2012 (COSMaP, MOST)
- Gassnova: «Troll Kystnær» 2009-2012
- NPD CO₂ Storage Atlas: «Sognefjord Delta Aquifer East» 2009-2011







From Goldsmith (2000)

Stratigraphy

Seal/caprock

- Optional Thick Cretaceous shales
- Main: Thick U-Jur Draupne Fm shale package
- Thin Heather shale sections in between the sand sections

Reservoir

- Main: Thick (100s of meters) section of intra-Heather sands
 - Sognefjord
 - Fensfjord
 - Krossfjord formations).



Optional Triassic Lunde Fm



Smeaheia structure

- 2 exploration wells
- 3D seismic acquired in Gassnova project
- Fault-bounded block shallower than Troll Field
- Structural traps
- Depth c. 1200 1700 m
- Synrift sediments shed from the close-by Norwegian mainland
- Close to coast: onshore storage?



Line NSR06-31182





Project owner:

The Norwegian Ministry for Petroleum and Energy



Coordinator: Gassnova



Contractor for storage: Statoil ASA

