Longyearbyen CO$_2$-lab
An integrated research and education laboratory
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Location

Svalbard

• Coal mining community at 78° North.
• The world’s northernmost settlement.
• Otherwise known as a research base for monitoring climate change.
The Svalbard scenario

- Coal fuelled community.
- Strict environmental laws and regulations.
- Geological structures suited for CO2 storage.
- Closed energy system.
- Competence available in core project areas.
- International attention.
The CO2 value chain
Our vision

- Let’s follow the CO₂ from the source to the solution.
- Let’s develop high level, field based, university studies along the CCS chain.
The geology is favourable
Uplifted part of the Barents Sea

- Most of Svalbard is made up of sedimentary rocks.
- Continuation of the Barents Sea shelf of the Stokhman and Snow White fields.
- They can store CO₂, oil-gas or groundwater.
Project development

- 2007: Pre-project report submitted to DoJ.
- 2007: Drilling well 1 & 2.
- 2008: Cap rock verified.
- 2009: Drilling well 3 & 4
- 2009: Reservoir identified.
- 2010: Injectivity verified.
- 2011: CCS value chain PhD course introduced.
Reservoir properties

Gross Reservoir Unit 300m
Porosity varies from 2 to 18%
Permeability varies from 0.1 to 2 mD
Highly fractured rock
Low pressure reservoir

First gross test interval (870m-970m) => 100m
Net sandstone of the first test interval => 33m

300m Cored section of the potential reservoir unit (CO2 - storage unit);
Upper Triassic to Middle Jurassic Shallow marine sandstones and shales
Establishing seismic baseline during winter. (Explosives as source - minor harm to nature). Purpose; “Listen” to fracturing during test and for later monitoring.
Both downhole sensors were put in the well and hung off at 855 m the night before this test started. The pressure was 61 bar and 28°C. The injection test lasted for 5 days (120 hours) and the injection rate was stable at 280 – 283 l/min.
Key questions ahead

Learning:
- Tight sandstone reservoir with permeable fracture system
- Unusual pressure gradients

After the pilot study, key questions are:
1) What is needed to map and understand the actual reservoir geometry (sand bodies, intrusions)?
2) Are fractures gradually expanding (not stepwise)
3) Are permeable fractures penetrating the cap rocks? If so is what is the limit of the fracture pressure (LOT)
4) Is the entire reservoir section injective? Only the “worst” part tested
   - Conclusive injection tests this far only on the lower 100 m out of the 300 m section
5) Are shales of the reservoir section fractured and contributing to injectivity?
2011 program

• Activity 1: Testing of reservoir.
  – reducing uncertainty
  – acquire basic understanding
• Activity 2: Investigate rock characteristics at 400 m.
  – Seal properties
  – Fluid flow.
  – Rock fracture, microseismic response.
• Activity 3: Seismic surveillance of reservoir.
2011 program

• Activity 4: Experimental CO$_2$ injection

• Activity 5: Baseline studies - marine geology
  - LIDAR interpretation of the lower and middle part of the reservoir as exposed in a seven kilometer long outcrop at Botneheia.

• Activity 6: Extended reservoir description
  - Detailed mapping of fracture frequencies and characteristics along different levels.
  - Combination of field work and modelling.

• Activity 7: Second generation reservoir models and flow simulations
  - Assess impact of fracture geometries/properties and intrusions on reservoir storage capacity and flow patterns:
  - Perform sensitivity studies of reservoir flow vs. fracture characteristics.
  - Establish size and capacity of the under-pressured segment.
2011 program

• Activity 8: Plan key baseline studies and investments
  – Field lab development planning.
  – Surface monitoring planning.

• Activity 9: Integrating project in national/international networks
  – Develop cooperation with national and international partners/networks

• Activity 10: Outreach program
  – Scientific outreach
  – Public outreach
Educational programs (Master and PhD level)
AG-341: Introduction to CCS

- Following the coal value chain (10 ECTS).
- Global political challenges and agendas.
- Coal - from generation, accumulation to production and energy supplier.
- Carbon capture strategies.
- Carbon storage strategies.
- Safety, HSE in Arctic.
- Field work/ Excursions.
Co-hosting the IEA CCS school
Longyearbyen, 2010
Next step: Carbon capture

- Pilot size capture facility.
- 5-10,000 tons per year
- Demonstrate value chain + acquire CO2 for testing
Isfjorden Fjord with dense network of Statoil, Hydro and Svalex lines

No community conflicts
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<th>Financial partners</th>
<th>Research partners</th>
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<td>GASSNOVA</td>
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The University Centre in Svalbard

The world’s northernmost institution for research and higher education
Thank you for your kind attention!