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 CO_2 storage.
- Closed energy system.
- Competence available in core project areas.
- International attention.

The CO_2 value chain

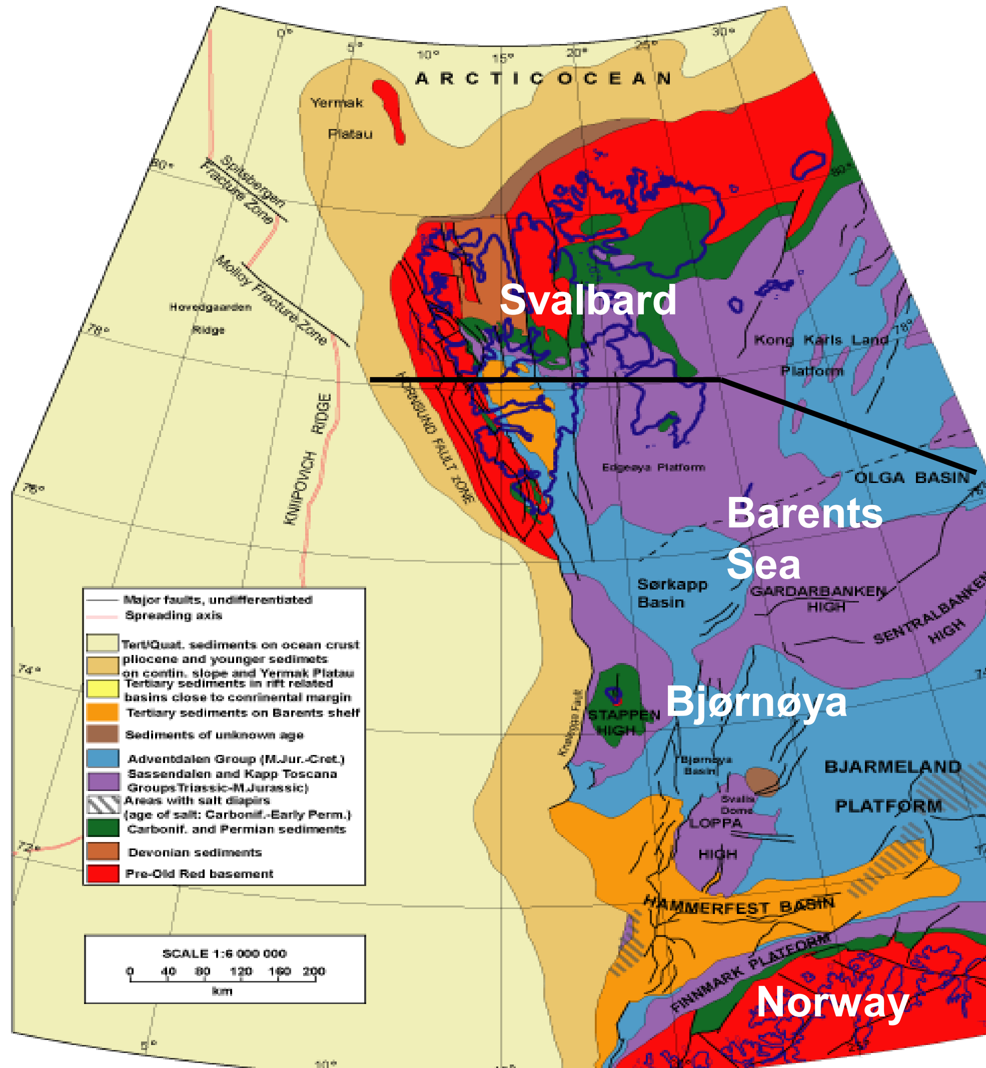
Our vision

- Let’s follow the CO_2 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

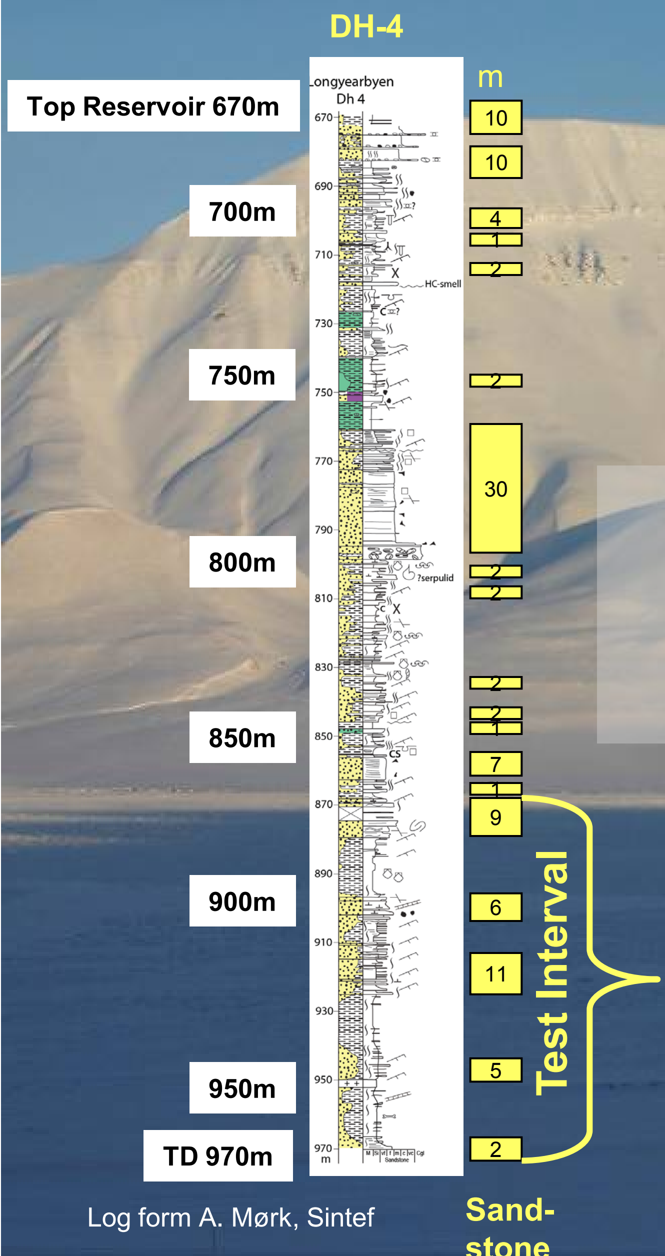
- Most of Svalbard is made up of sedimentary rocks.
- Continuation of the Barents Sea shelf of the Stokhman and Snow White fields.
- They can store CO_2, oil-gas or groundwater.



Project development

- 2006: Vision of CO2 neutral Svalbard (Sand-Braathen).
- 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



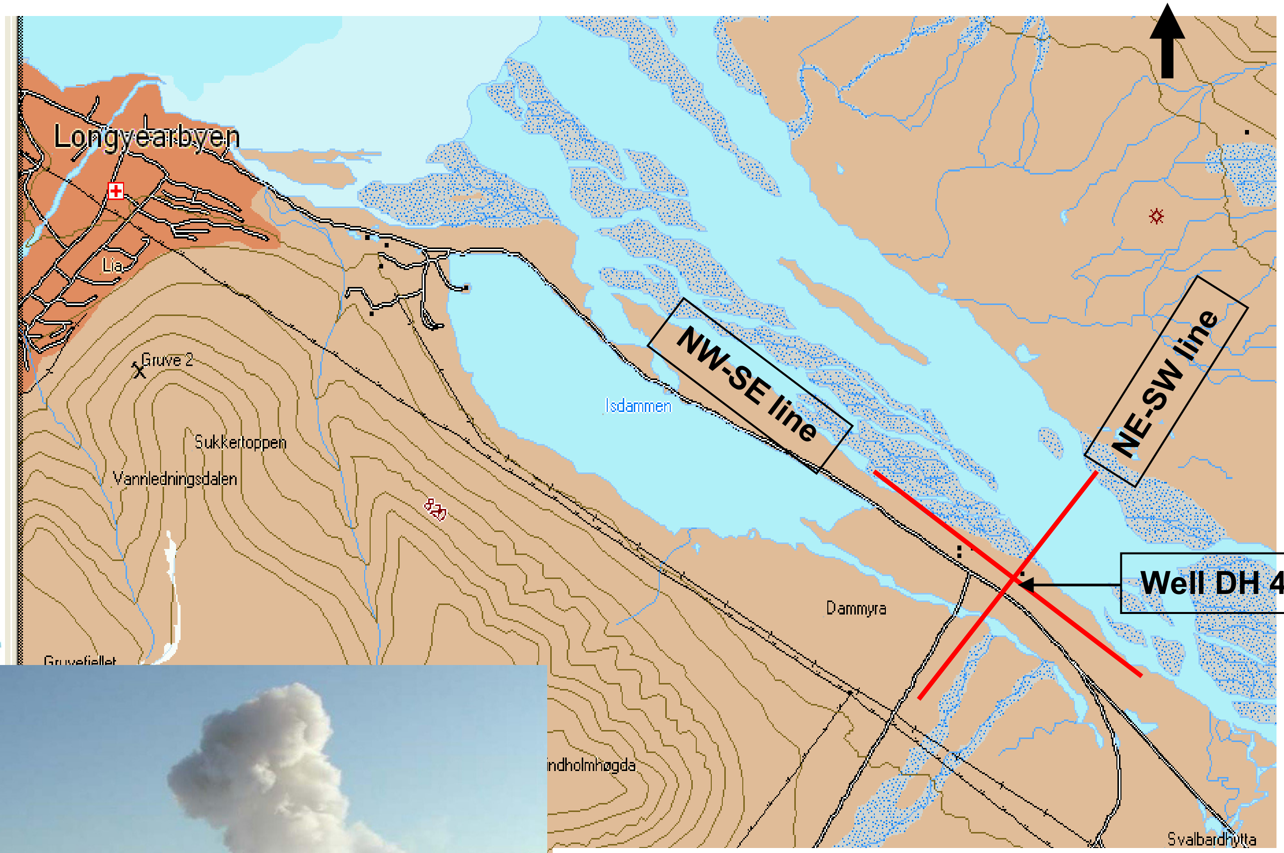
Log form A. Mørk, Sintef

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

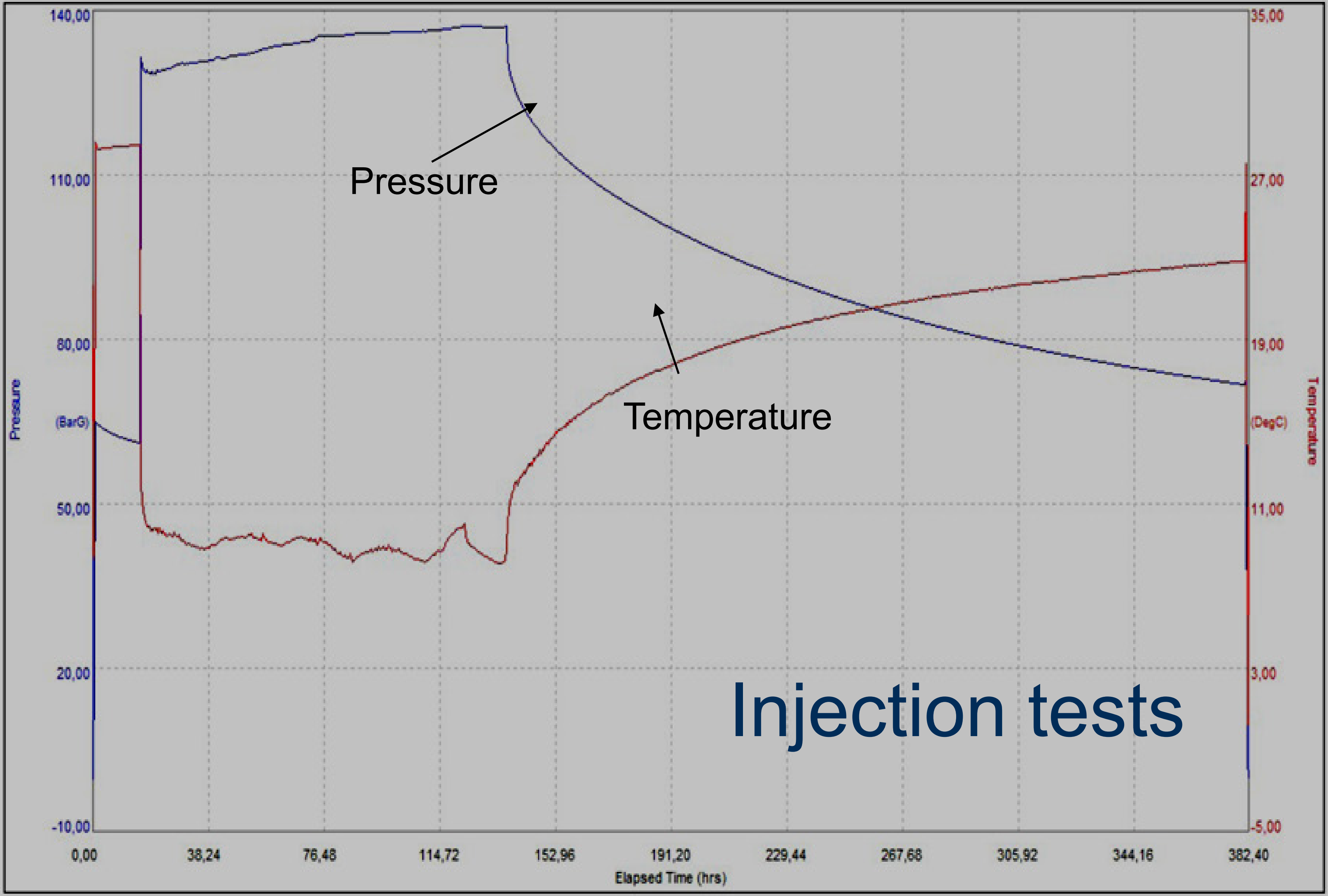
300m Cored section of the potential reservoir unit (CO_2 - storage unit);
Upper Triassic to Middle Jurassic Shallow marine sandstones and shales

Establishing seismic baseline



Establishing seismic base line 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^{0}C. The injection test lasted for 5 days (120 hours) and the injection rate was stable at 280 – 283 l/min.



Injection tests

Key questions ahead

Learning:

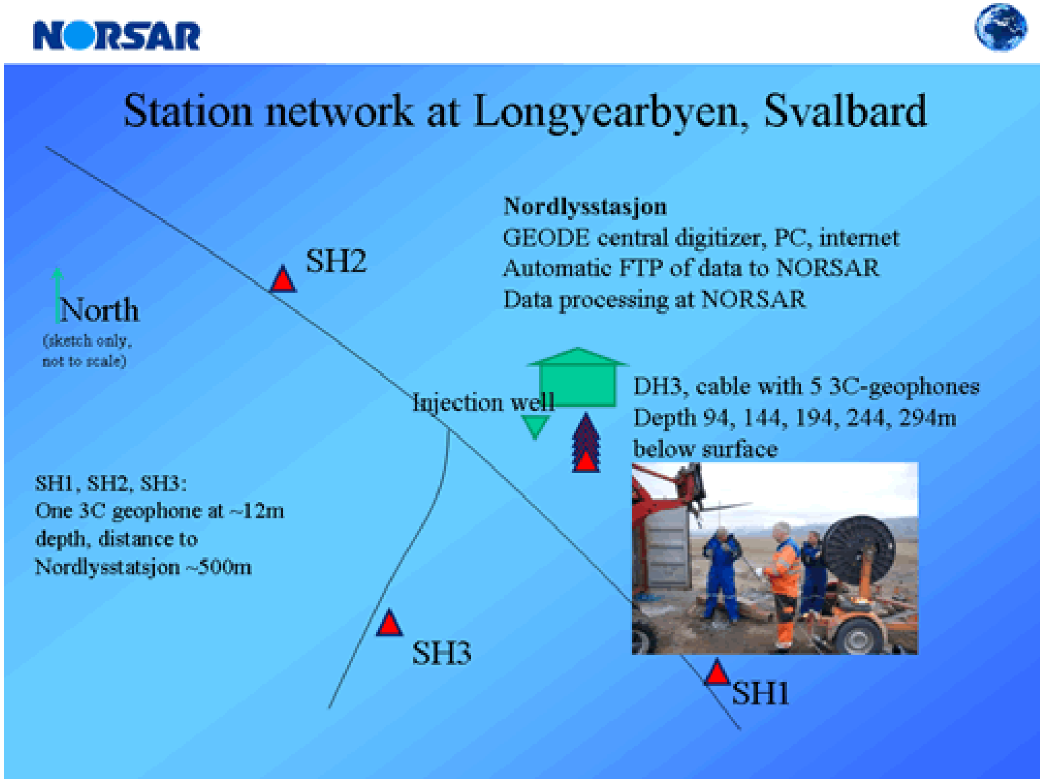
- ✓ Tight sandstone reservoir with permeable fracture system
- ✓ Unusual pressure gradients

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?

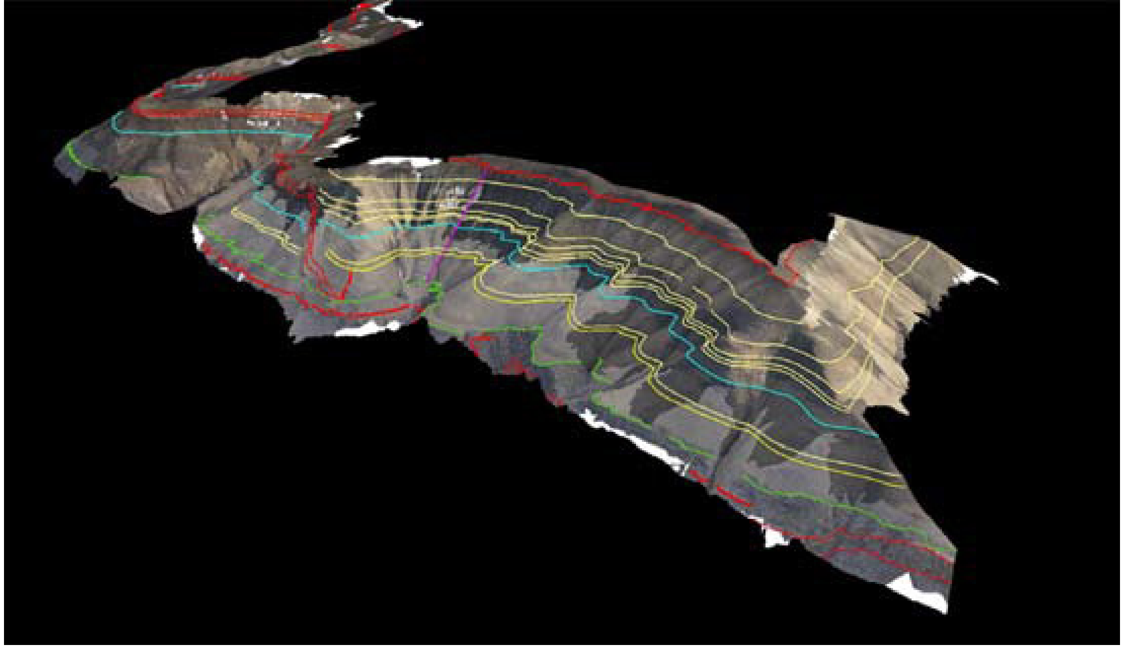
2011 program

- Activity 1: Testing of reservoir.
  - reducing uncertainty
  - acquire basic understanding
- Activity 2: Investigate rock characteristics at 400 m.
  - Seal properties
  - Fluid flow.
  - Rock fracture, micro-seismic 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 CO_2 for testing

No community conflicts

Our partners

UNIS
The University Centre in Svalbard

Financial partners	Research partners
GASSNOVA	Universitas Osloensis MDCCCXI; Universitas Bergensis; CIPR Norwegian Centre of Excellence
ConocoPhillips	NTNU
Store Norske	NGU Norges geologiske undersøkelse
Statoil	SINTEF
LNS Spitsbergen; BJ	NORSAR
Statkraft	IFE Institutt for energiteknikk Forskning for en bedre fremtid
Lundin	
Forskningsrådet	FME; SUCCESS SUbsurface CO2 storage- Critical Elements and Superior Strategy; NGI

The host institution

The University Centre in Svalbard

The world’s northernmost institution for research and higher education

Thank you for your kind attention!