DELIVERING COMMERCIAL DEPLOYMENT
FULL SCALE CCS IN NORWAY

CCS: Pathways to Commercialisation, 09.11.2015
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Entire Value Chain

“THE GOVERNMENT’S CCS STRATEGY ENCOMPASSES A WIDE RANGE OF ACTIVITIES ...”

- CO$_2$ capture in industry
- Compression and transport
- EOR/CO$_2$ storage
CLOSING THE GAP. FOCUS ON ...

Technology development
Infrastructure
Legal framework
Government aid
Attractive in terms of practical economics
Public acceptance
NORWAY:
GOVERNMENT: CONTINUED COMMITMENT TO CCS
ACTIVITIES ALONG THE WHOLE VALUE CHAIN

COST-EFFECTIVE CCS
THE NORWEGIAN CLIMIT PROGRAM

• Funding for research, development and demonstration of technology for CO₂ capture, transport and storage

• Support scheme for universities, institutes and industries

• International collaboration
CO$_2$ CAPTURE: PORTFOLIO AND CHALLENGES

- CLIMIT R&D
- CLIMIT Demo
- Cost
- Energy
TCM:
UNIQUE TESTING FLEXIBILITY IN AN INDUSTRIAL SCALE

Three operational areas:

Two feedstreams
- MHPP flue gas (3.5% CO₂)
- Refinery cracker gas (13% CO₂)
• Active business development to secure relevant test activities in the coming years
• Establish support agreements with existing full scale operations
• Share knowledge nationally and globally
• Contribute to scientific research
• Testing at TCM contributes to reducing costs and promoting CCS globally
TCM NEWS:

- CCSL has signed a contract to test its amine technology (from Nov. 2015)

US Funding for TCM Testing:
- NETL has awarded GE, Alstom and University of Kentucky phase 1 funding to advance planning of their CO₂ capture technologies towards large scale pilot testing.
- Phase 2 award for construction and execution of the tests is expected mid. 2016
ENERGY INTENSIVE INDUSTRY

- Commodity market
- Global competition
- Extremely cost effective
- Strong need for R&D
- Large volume production facilities
- High investment costs
- Emissions to air
FEASIBILITY STUDY MAY 2015

POSSIBLE CO₂ SOURCES

- NORCEM BREVIK
- YARA PORSGRUNN
- KLEMETSRUD OSLO

CO₂ STORAGE

- Fields being shut down
- Establishment of a new storage
- CO₂ EOR pilot
- Peterhead (UK)

THE GOVERNMENT'S REQUIREMENTS/
FRAMEWORK CONDITIONS

- The government is responsible for T&L
- Cost and risk sharing between the government and emissions owner
- Time frame for operations 20-25 years
NORCEM - CEMENT INDUSTRY, BREVIK

- Tested four different capture technologies through a CLIMIT-funded project
  - Surplus heat to capture 400 kta CO$_2$
  - Permanent climate measures

Photo: Scanpix
YARA PORSGRUNN

• 3 emission sources (+200 kta sales as "food grade") at full production:
  – 200 kta which are "easy"/reasonable to capture (>95 % CO₂)
  – 350 kta from water flushing process/airing tower (8%)
  – 300 kta from reforms (13%)
• Requirement for participation: "clear governmental leadership, with specific objectives, progress plan and realistic funding schemes"
The Energy Recovery Agency in Oslo Municipality
Klemetsrud Waste Incinerator Facility

- Annual emissions of 300 kta CO₂
- Increase expected
- EU disposal restrictions on degradable waste from 2020
- Expects quota requirement for some of the emissions over time
FULL SCALE:
CO$_2$-STORAGE EXPERIENCE NORWEGIAN CONTINENTAL SHELF

- **Sleipner** – 1 mill t CO$_2$ p.a. since 1996
- **Large storage potential mapped**
- **Several aquifers at high level of technical maturity due to:**
  - «Hands on experience»
  - Sleipner injection since 1996
  - Gassnova evaluation of several injection locations in the North Sea
CONCLUSIONS PERSISTENCE IN CCS:

- Continuous focus on R&D
- Strong Governmental funding
- Smarter incentives for industry
- Importance of demos
- International collaboration
- TCM: Test arena for world wide deployment
Thank you!

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CLIMIT programme
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