CO₂ for EOR
Norwegian Continental Shelf
Possibilities and Challenges

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“Carbon Capture and Storage – where are we today?”
Felix Conference Center
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CO2-injection for Enhanced Oil Recovery
and storage of a problematic emission gas

A wonderful vision

that needs more than one party lifting!
Numerous entities and authorities involved in the CO₂ chain - challenges.

These elements exists or can be controlled by the companies on NCS.

How do we make the red elements attractive to commercial entities?
Estimate of recoverable reserves, Jan. 1. 2005

12.9 billion Sm³ o.e.

- Improved recovery from existing fields
  - 180 specific improved recovery projects on fields under assessment,
  - CO₂ possibilities NOT included

- Contingent resources - discoveries: 6%
- Contingent resources - fields: 6%
- Reserves: 31%
- Sold and delivered: 31%
- Undiscovered resources: 26%
Average oil recovery factor (%) - NCS

EOR difficult to justify with 10-15 USD/bbl!

IOR/EOR New goals?

Gas injection, CO₂, Soap, WAG?
NCS - Around 54% (average) of the oil left in the ground with present plans and technology!

Need IOR/EOR to make more oil producible (CO₂ is one of the possibilities)

- Produced
- Reserves
- Recourses remaining in the field after planned shutdown
CO₂ and Enhanced Oil Recovery

- More than 30 years experience onshore. No big offshore fields to learn from.

- Difficult to transfer experience
  - Geology and fluids are different.
  - Fewer wells drilled in offshore fields
  - NCS big fields have already been subjected to advanced methods to increase recovery so less oil is remaining as a CO₂ target

- CO₂-injection may increase recoveries 3-7% on NCS versus a history of 7-15% onshore USA.
NCS potential for added oil using CO\textsubscript{2}
Technical potential

The 20 fields have a potential for 150-300 million Sm$^3$ extra oil

IF enough CO$_2$ could be made available

- at the optimum time in their production life
- at commercial conditions.
CO$_2$ – potentials
Window of opportunity (20 fields NCS)

UK has a similar curve losing potentials earlier!
CO₂ injection and production require extensive modifications in an expensive offshore environment

- New installations may be needed to get all the equipment onboard.

- Modifications for our big fields have estimates between 3 to 6 billion NOK:
  - process upgrades
  - corrosion protection
  - additional wells
  - separation plant to meet sales gas and transportation specifications when justified.

Limited space and weight capacities on ALL offshore installations
Field examples
Gullfaks and Ekofisk with CO₂ from Norway

Break even-prices
for Gullfaks $26-33/bbl

Break even-prices
for Ekofisk, injecting CO₂
after 2020, $23-33/bbl

NB ! Highest recent PDO
less than $18/bbl

(10 €/ton quota price assumed)
Added possibilities and challenges

- Higher quota prices for long term storage of CO₂ could make these projects attractive.

- Huge uncertainties in estimating added oil volumes.

- The field examples do not include hook-up to alternate storage. That will be added costs to avoid emissions, bad press and risks to valuable hydrocarbon resources.
The report concludes that challenges remain

How to make the red elements commercially attractive?

**CO₂ capture**
- From power plants flue gas
- From natural gas processing
- From industrial processes

**CO₂ transport**

**CO₂ storage**
- EOR
- Geological storage
**NPD’s CONCLUSIONS FROM THE STUDY**

*CO₂-injection has a large potential for additional oil recovery on NCS. It is technically feasible to implement, but the projects are not commercially viable for the licensees on NCS today.*

**The reasons are:**

- The costs involved in capturing and transporting CO₂ based on the technologies available makes other methods more attractive to the licensees, even recognizing that CO₂ would provide additional oil.
- EOR/CO₂-projects have large upfront investments. Added income comes after several years and over a long period.
- The risks in these projects are too many for the licensees to lift them alone.
- Decisions on long term risky projects normally require break even prices no higher than $22-25/bbl.
Thank you for your attention