



Norwegian Priorities and Activities Carbon Capture and Storage

Jostein Dahl Karlsen
Advisor

Ministry of Petroleum and Energy
Norway

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Outline of Presentation

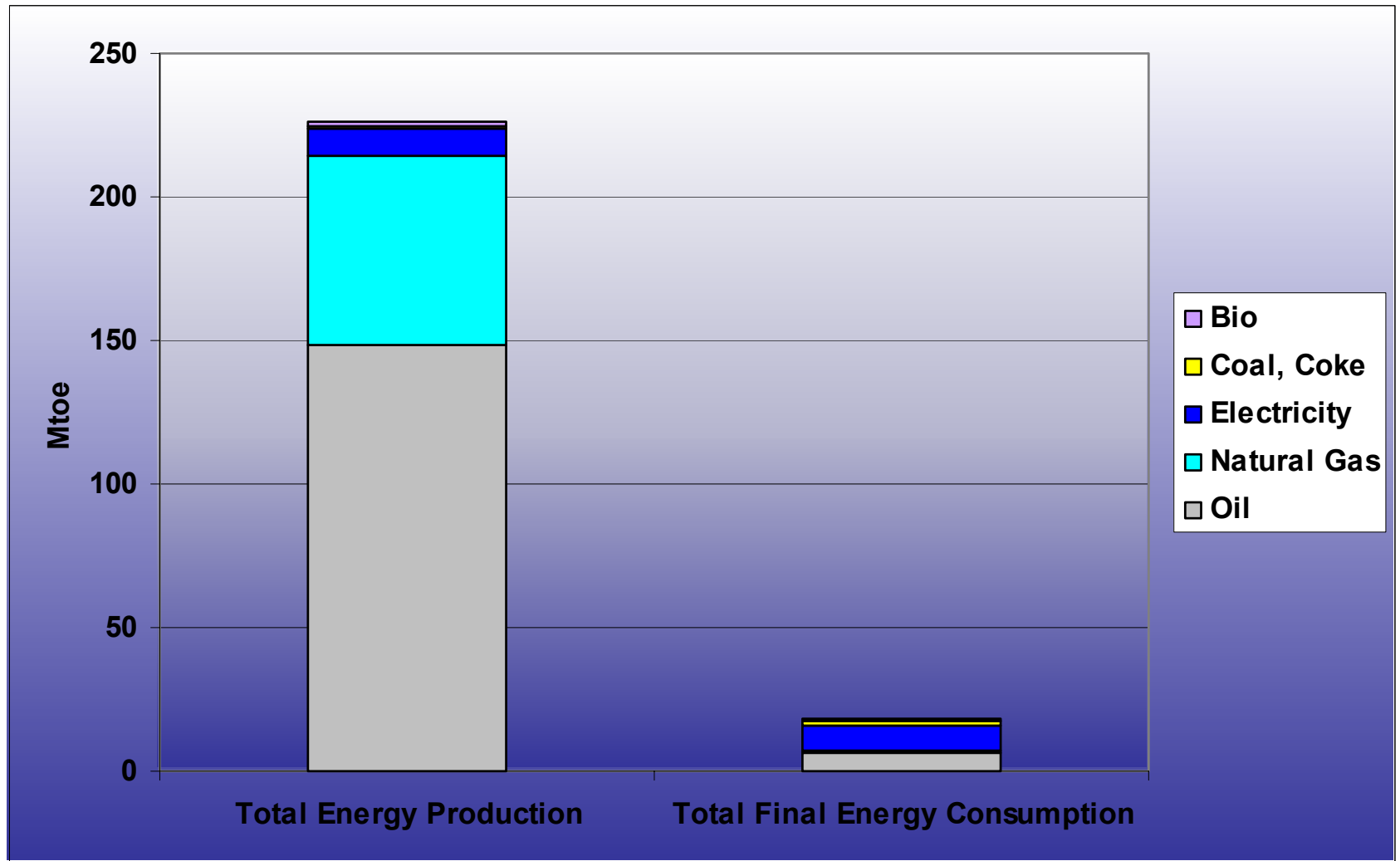
Main Elements;

- Domestic Policy Issues
 - in light of energy situation and emissions
- National Technology Agenda
 - in light of drivers for carbon capture and storage

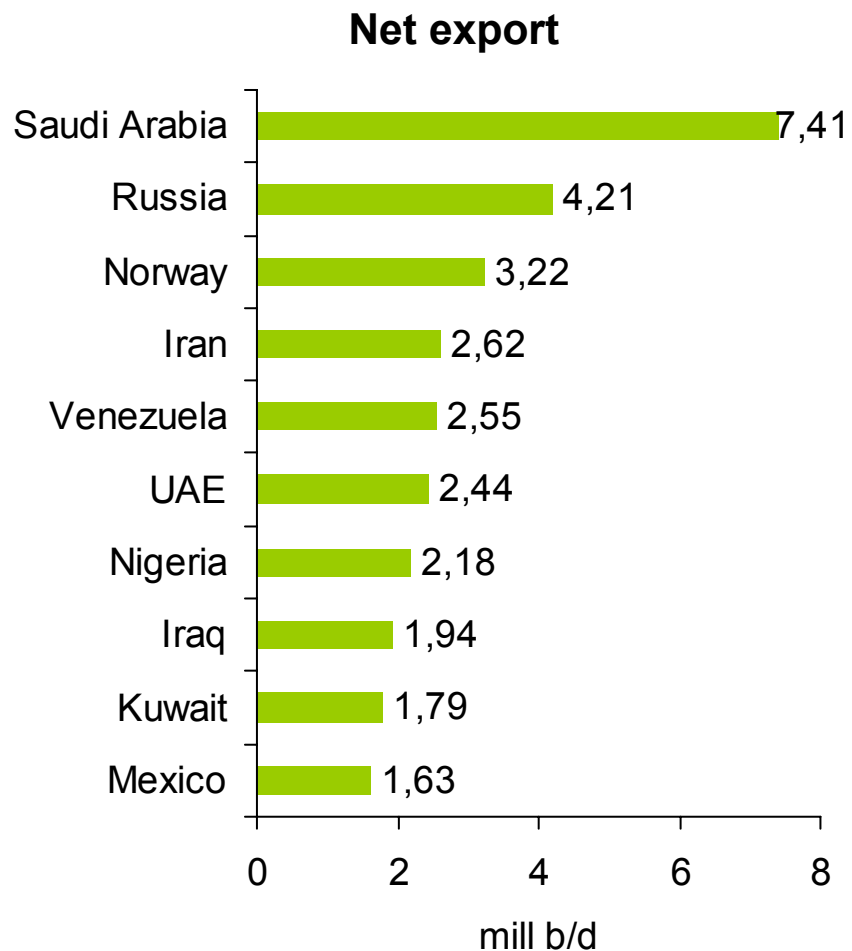
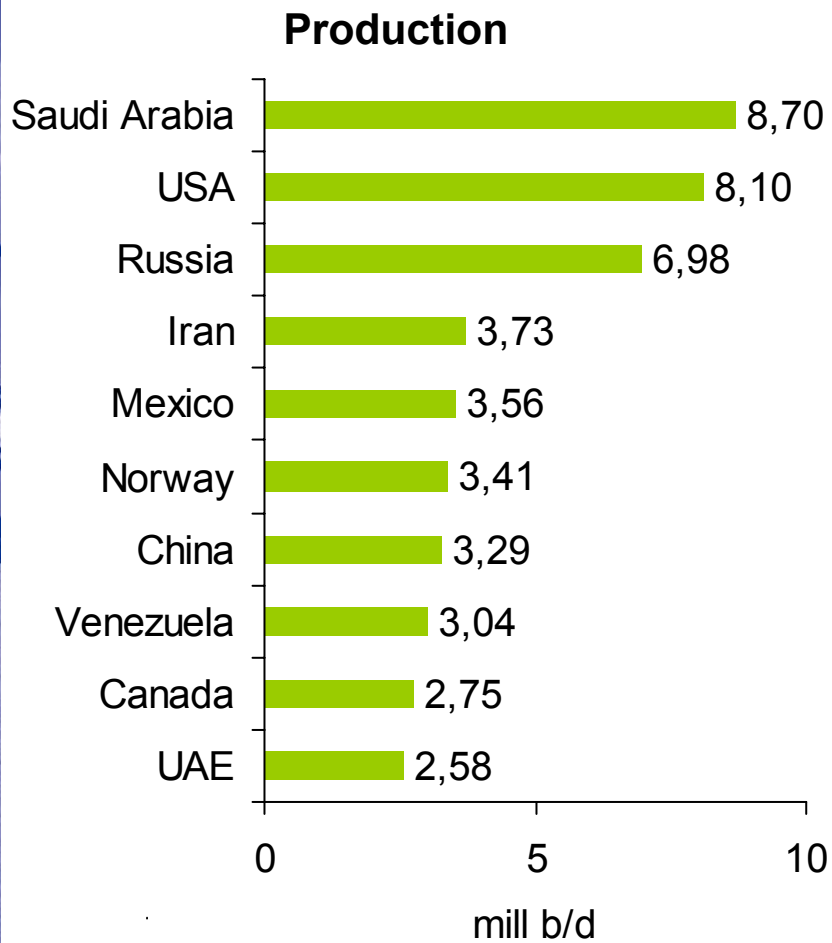


Norwegian Energy Situation

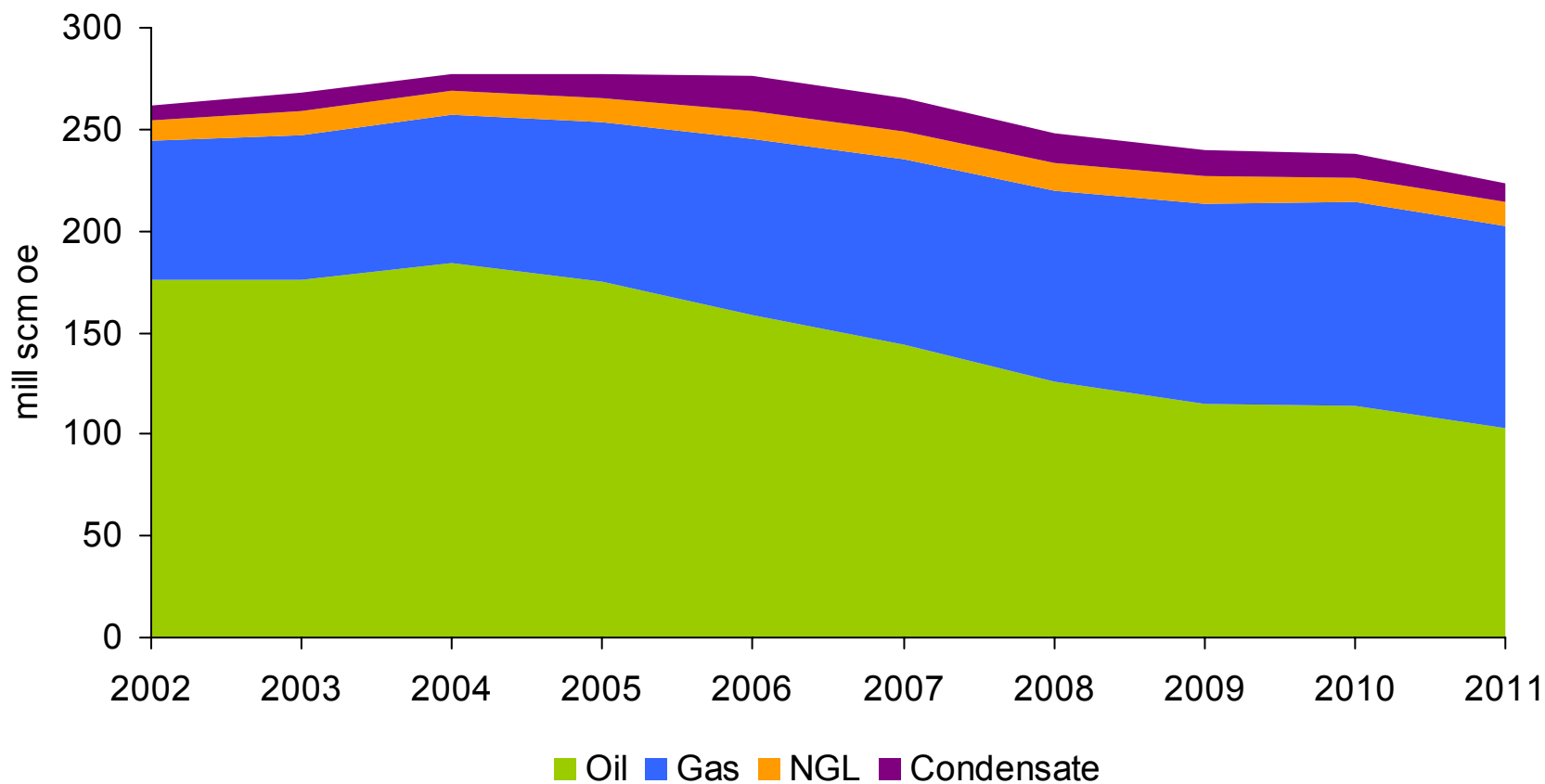
Total Energy Production & Final Consumption



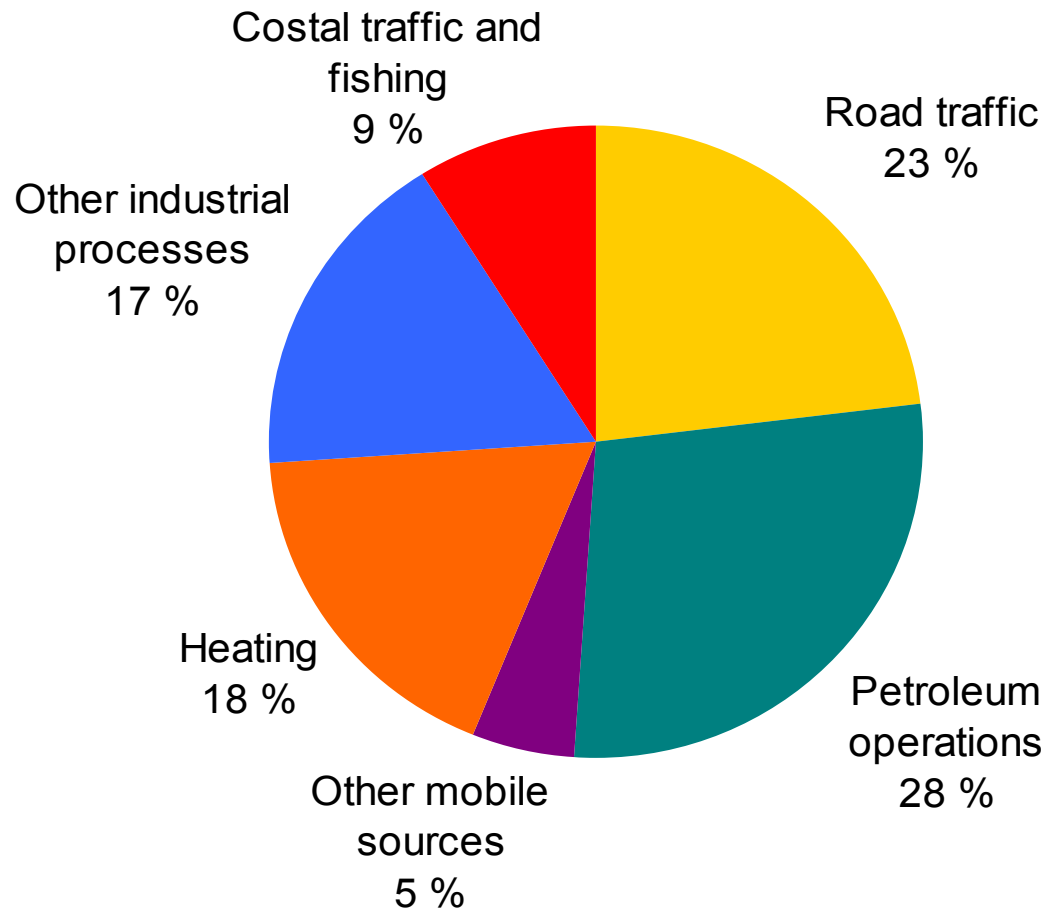
Production and net export of crude oil in 2002 incl. NGL



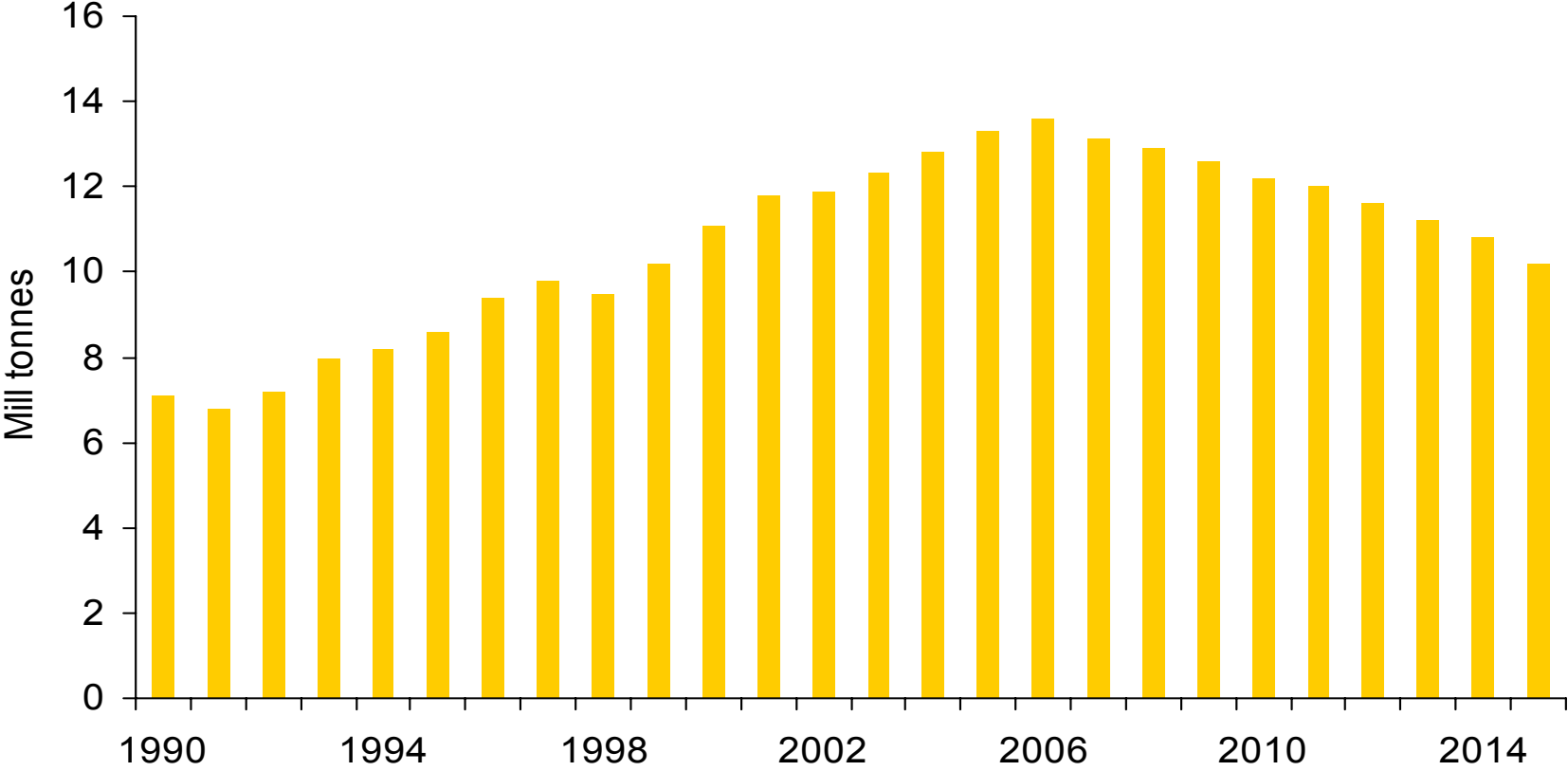
Forecasted Hydrocarbon Production



Sources of Norwegian CO₂ emissions, 2001



Total emissions of CO₂ from the Norwegian petroleum sector



Need for New Generating Capacity

- **Need for improved security of power supply and new generating capacity which is not based on hydro**
- **The Norwegian Government aim to increase the share of natural gas to power generation in an environmentally sound way**
- **Increased efforts to advance gas-fired power plants with CO₂ capture and storage is a main element in the Norwegian Government's energy policy**



National Technology Agenda and Activities

Carbon Capture and Storage Drivers

Main Motivations;

- Control cost, risks and perceptions through:

a)

- Radical Innovation for Carbon Capture
- Optimal Business Models for Linking Sources to Sinks

b)

- Bridging of knowledge gaps related to the sub surface, CO₂ injection and logistics through advanced monitoring and development of codes and standards for "good practice"

KLIMATEK - the Norwegian Climate Technology R&D Programme

Aim;

- stimulate technology for GHG reduction in oil and gas production and processing and energy intensive industries

Priority area:

- new and improved technologies for gas fired power production with CO₂ capture and storage
- co-operation between industry, university and research institutes in Norway and internationally
- Activities during 1997-2006:

Ongoing projects: CO2 Capture

Short term R & D

- Membrane technology development and testing for natural gas power production

Long term R&D:

- New CO2 capture concepts: membrane separation, combustion of enriched fuels, novel absorption/adsorption processes, advanced power cycles etc
- Co-production of power and hydrogen from natural gas with CO2 capture using a metal oxide recycling and fuel-cell

Role of Fossil Hydrogen in Carbon Capture

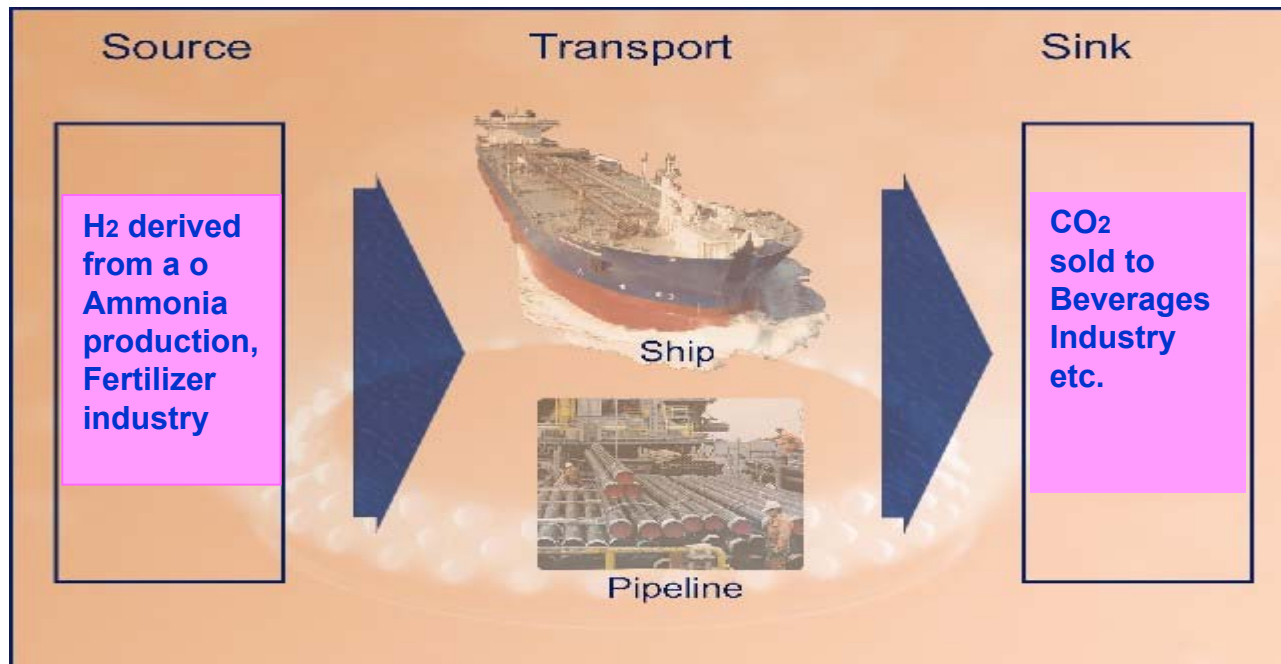


Gain: Virtually free CO_2 source

Existing H₂ – CO₂ Production, Transportation and Use

Norsk Hydro

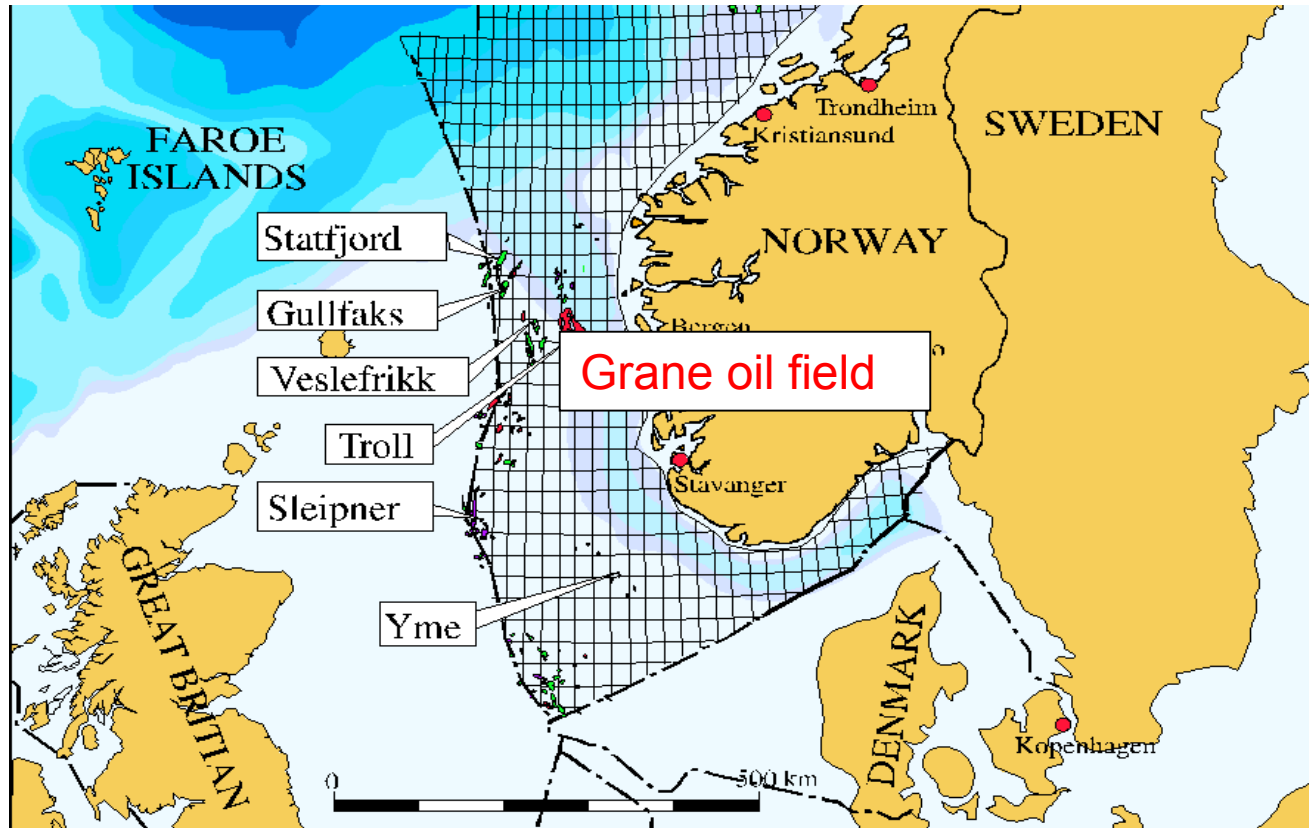
Continental Europe Experience;



Additional H₂ large scale production in world wide refineries

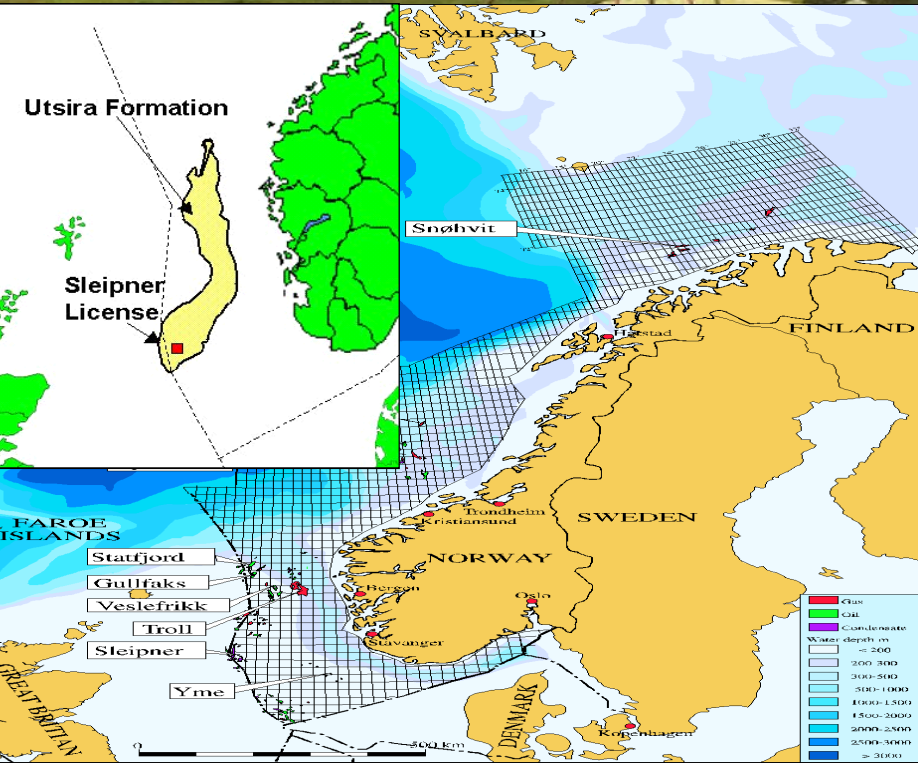
Nat Gas – Hydrogen Power – CO₂ – EOR

The Grane/Hydrokraft Project



Project Grounded due to Prohibitive CO₂ Reservoir Uncertainty

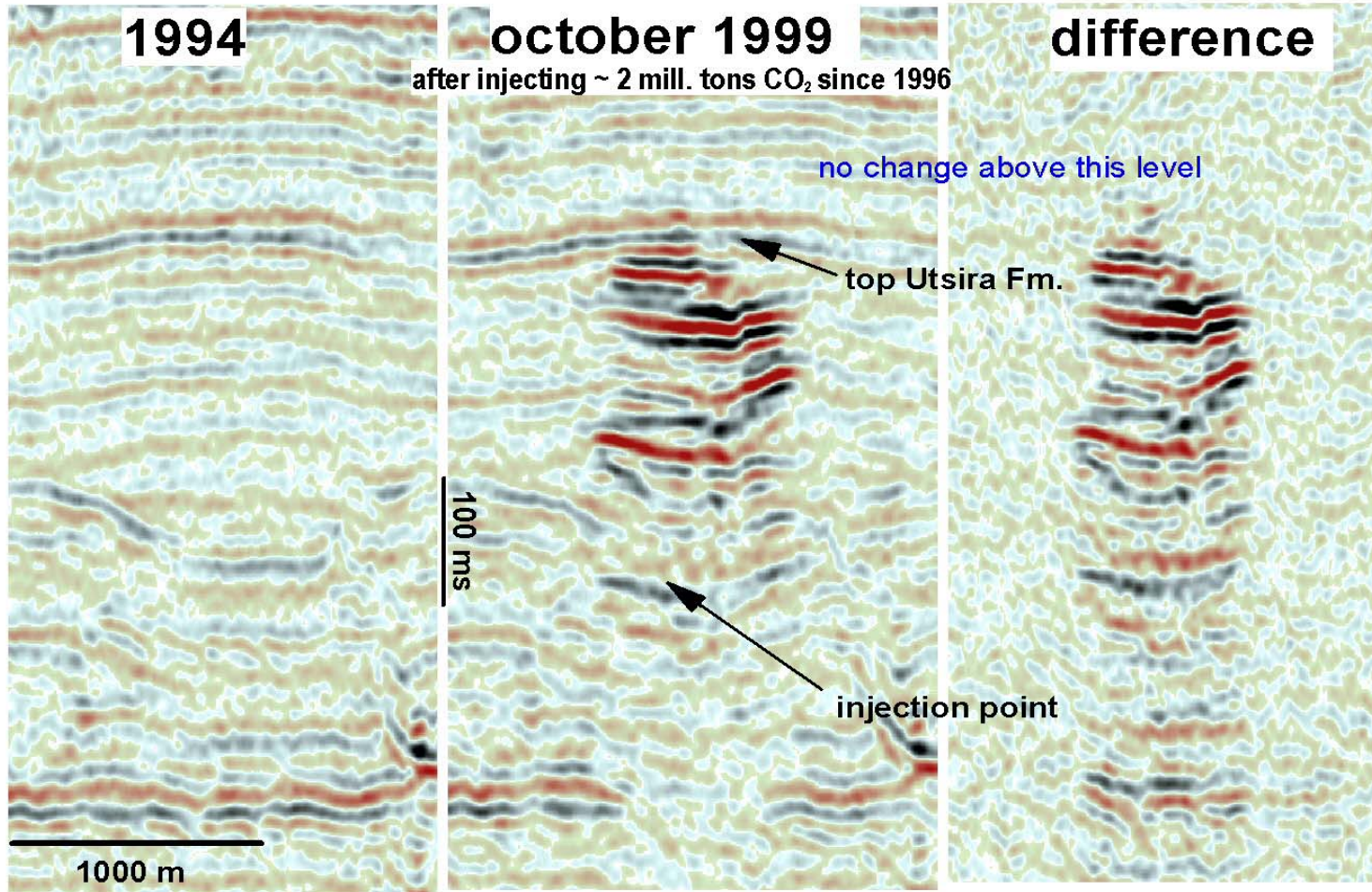
Sleipner; start of injection: 1996
CO2 tax introduced 1992



1 million tons of CO2 injected annually

Sleipner Technology Confidence Build up

Sleipner CO₂ injection seismic monitoring E-W section



Saline Aquifer CO2 Storage project

Statoil
BP
ExxonMobil
TotalFinaElf
Norsk Hydro
Vattenfall



BGS
BRGM
GEUS
IFP
NITG-TNO
SINTEF



IEA Greenhouse Gas R&D Programme
Schlumberger Research
N, Dk, NI, Fr & Uk Authorities, US DOE

SACS goals:

- Verify under what circumstances CO₂ storage in an aquifer is safe and reliable
- Validate models for geology, geochemistry, geophysics and reservoir tools
- Initiate new R&D related to above topics
- Start development of "Manual of Good Practice"

SACS Project 1998-2002

WHAT WE DID ACHIEVE:

- **3D Seismic proven, Gravimetry tested**
- **Reservoir simulation tools partly proven**
- **Geology and Geochemistry of “Utsira” mapped**
- **Reason to expect the CO₂ stay for thousands of years**

WHAT'S NEXT ?

- **“CO₂STORE” 2003 – 2005:**
- **Continued study of CO₂ in “Utsira”**
- **4 Field Cases in DK, DE, UK and NO**

Summary

Points for observation

- Managing CO2 sub surface issues is an ultimate challenge for risk aversion and negative public perception mitigation
- Project owners key stake holders in financing and integration of CSLF carbon storage (and capture) projects
- Contractual party consent to obtain CSLF project listing core

Summary

CSLF

- Identification of suitable collaborative RD & D key to CSLF's progress on technical issues
- Potential CSLF Value Added proposition exist
- Leverage of regional and local resources through information exchange and accumulation of monitoring experience one alternative priority