



Statoil

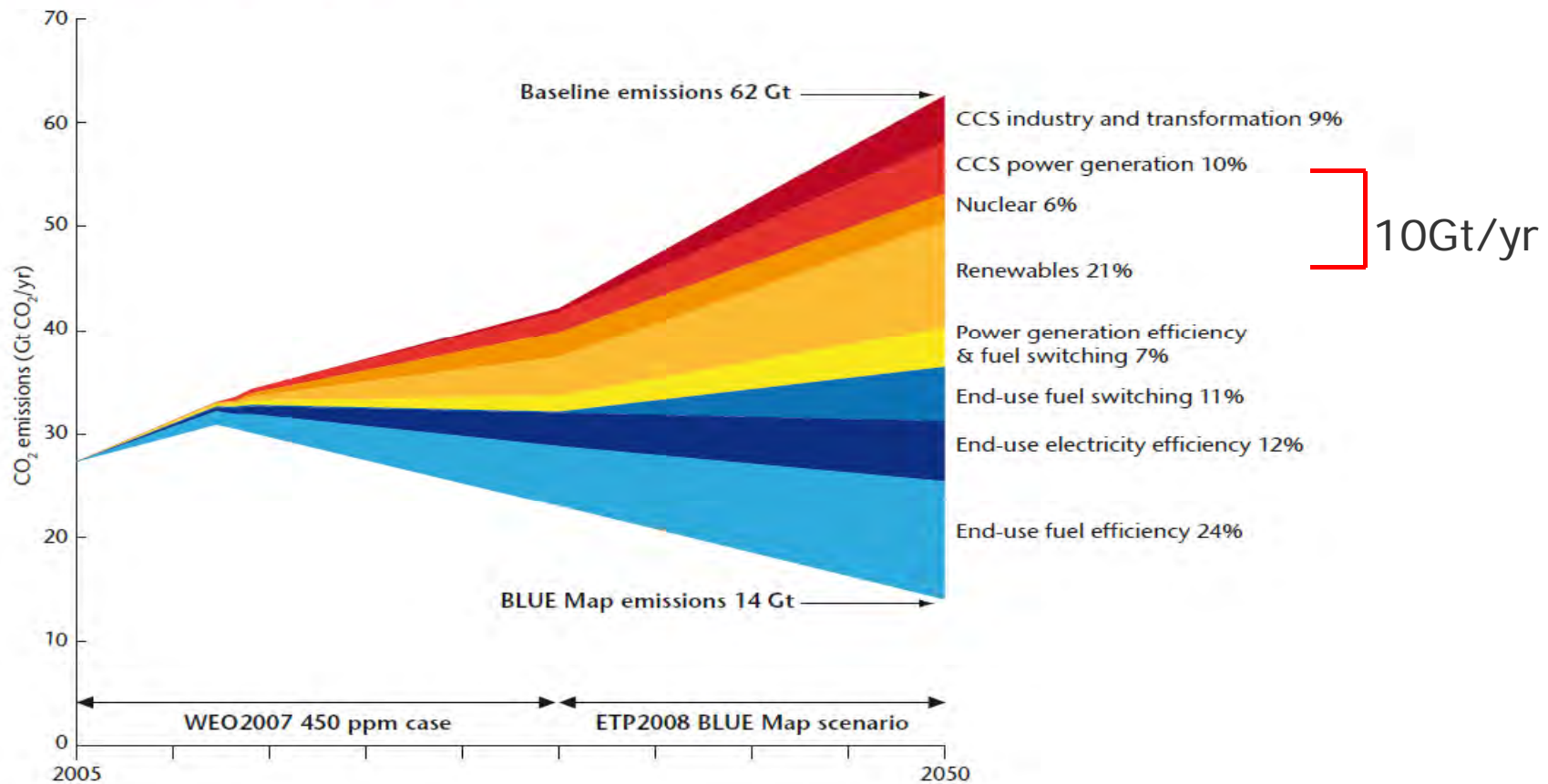
Accelerating the deployment of CO₂ Capture and Storage

EPPM CCS seminar Bangkok 17th of November 2009

Björn Berger, Statoil

Status: Draft

Figure 1: CCS delivers one-fifth of the lowest-cost GHG reduction solution in 2050



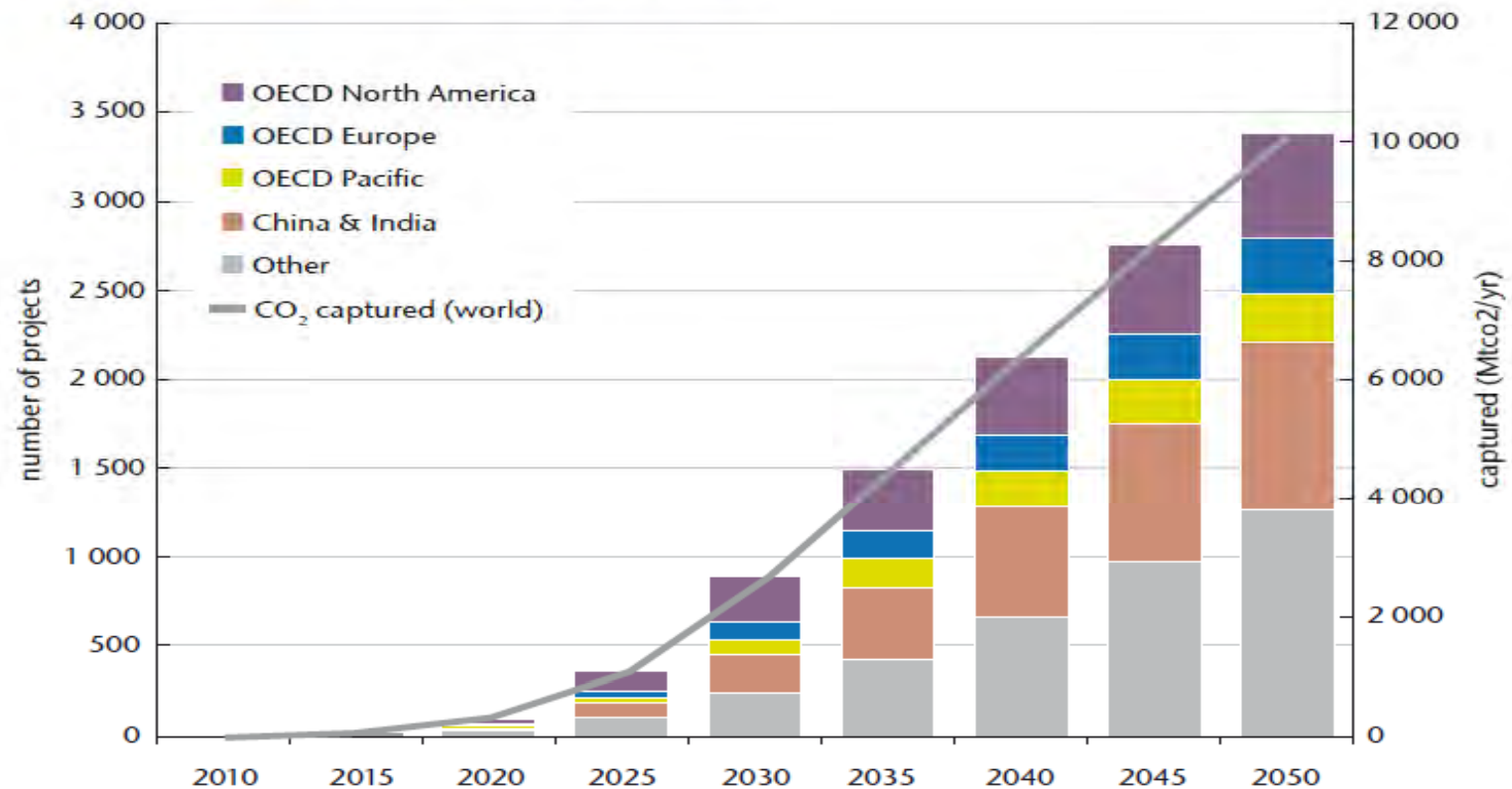
Source: IEA, *Energy Technology Perspectives* (2008a).

KEY POINT: Without CCS, overall costs to halve CO₂ emissions levels by 2050 increase by 70%.

Source: IEA: Technology Roadmap Carbon capture and storage, 20

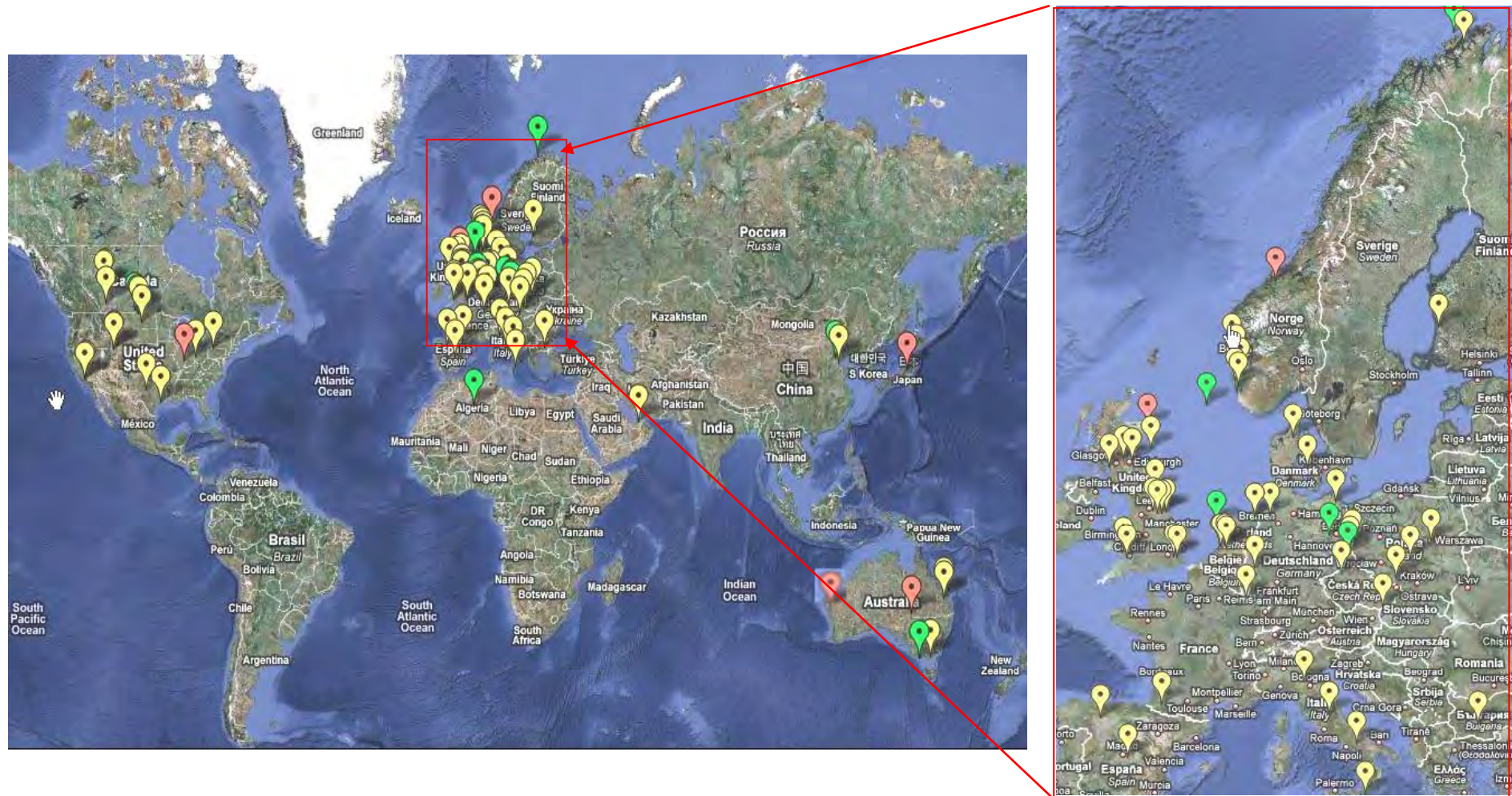
Who has to do what?

Figure 4: Global deployment of CCS 2010–2050
(CO₂ captured and number of projects)



Source: IEA: Technology Roadmap Carbon capture and storage, 2011

Numerous CCS paper projects in the power sector → Capture cost too high to go ahead?



Europe

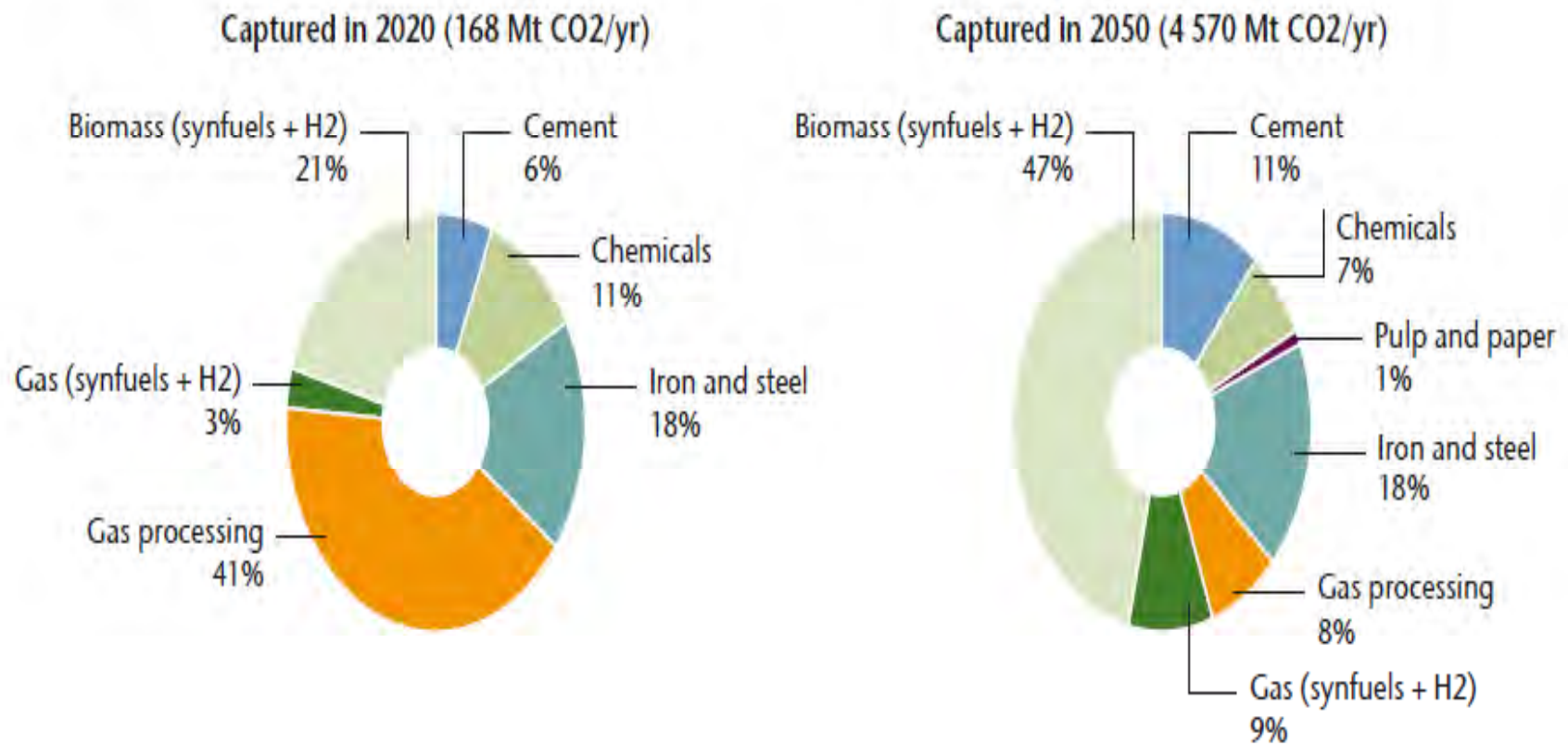
Map credit:
Status: Draft

www.geos.ed.ac.uk/ccsmmap



Early contribution from gas processing is needed

Figure 10: Global deployment of CCS in industry and upstream



Source: IEA: Technology Roadmap Carbon capture and storage, 20

The nature's existing storage sites

Pure CO₂-fields & CO₂-rich natural gas fields



Operating CCS projects

Source: GCCSI: Global status of CCS, 2009

Name	Started	Type	Transport	Storage rate Mt CO ₂ /year
Rangely, USA	1986	NG processing/ EOR Onshore	285km pipeline	1,0
Sleipner, Norway	1996	NG processing Offshore	Direct storage	1,0
Val Verde, USA	1998	NG processing/ EOR Onshore	132km pipeline	1,0
Weyburn, Canada	2000	Synfuel/ EOR Onshore	330km pipeline	2,4
In Salah, Algeria	2004	NG processing Onshore	14km pipeline	1,2
Salt Creek, USA	2006	NG processing/ EOR Onshore	201km pipeline	2,4
Snøhvit, Norway	2008	NG processing	160km pipeline	0,7

Some projects in operation

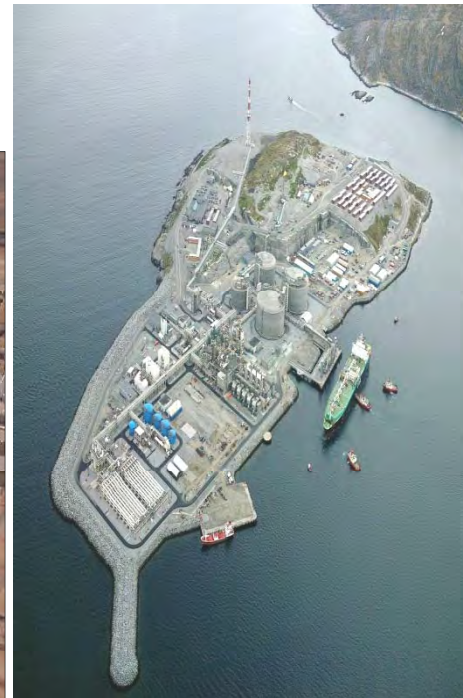
**Sleipner,
Norway**



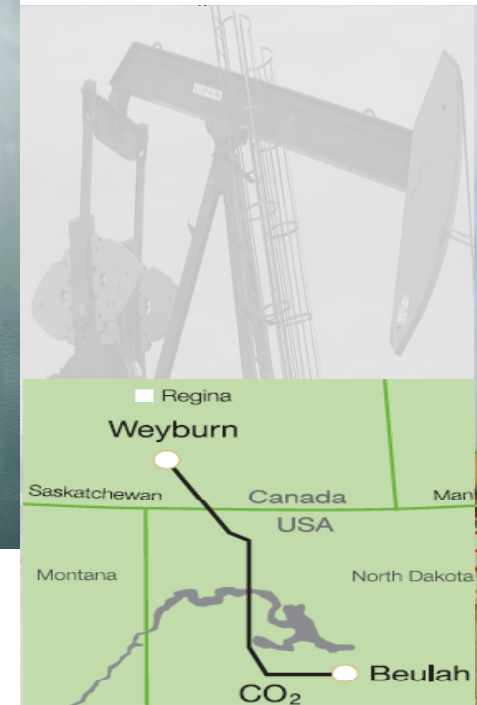
**In Salah,
Algeria**

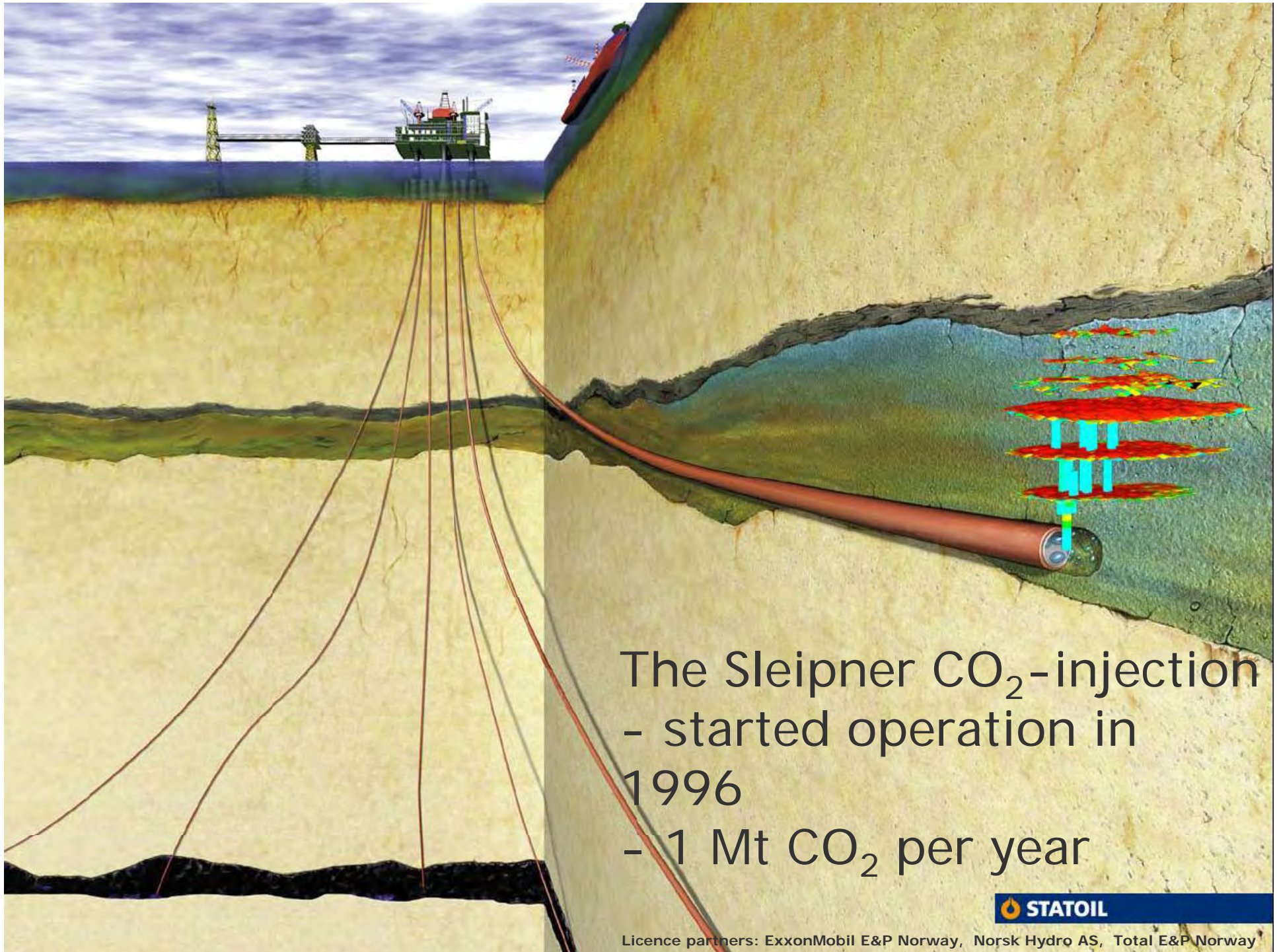


**Snøhvit,
Norway**



**Weyburn,
Canada**



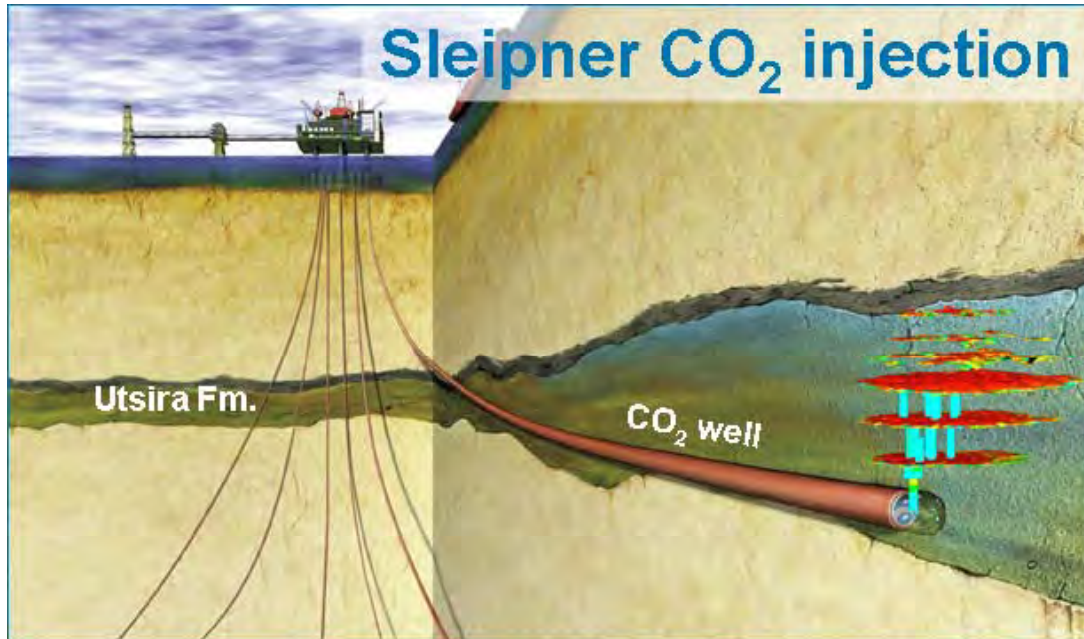


The Sleipner CO₂-injection
- started operation in
1996
- 1 Mt CO₂ per year

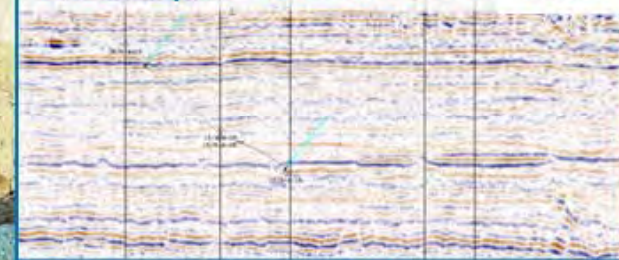


Licence partners: ExxonMobil E&P Norway, Norsk Hydro AS, Total E&P Norway

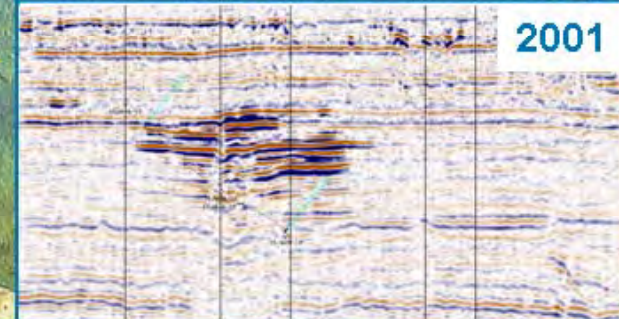
Sleipner CO₂ injection



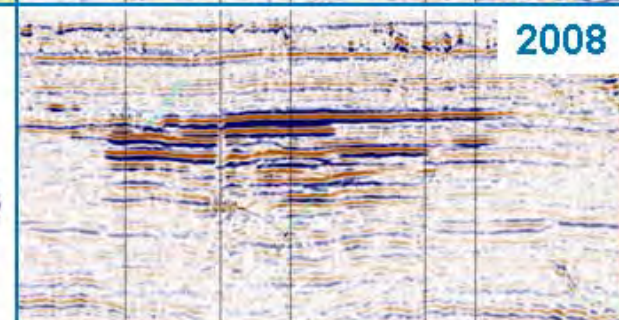
Time-lapse seismic data 1994



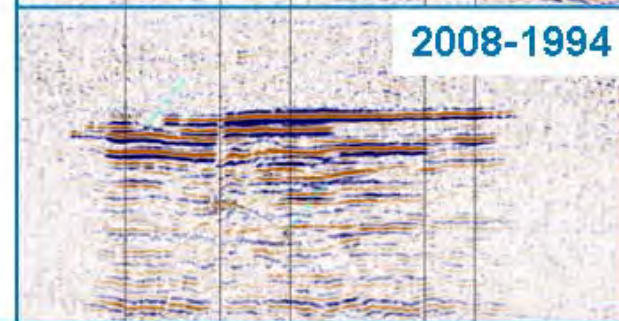
2001



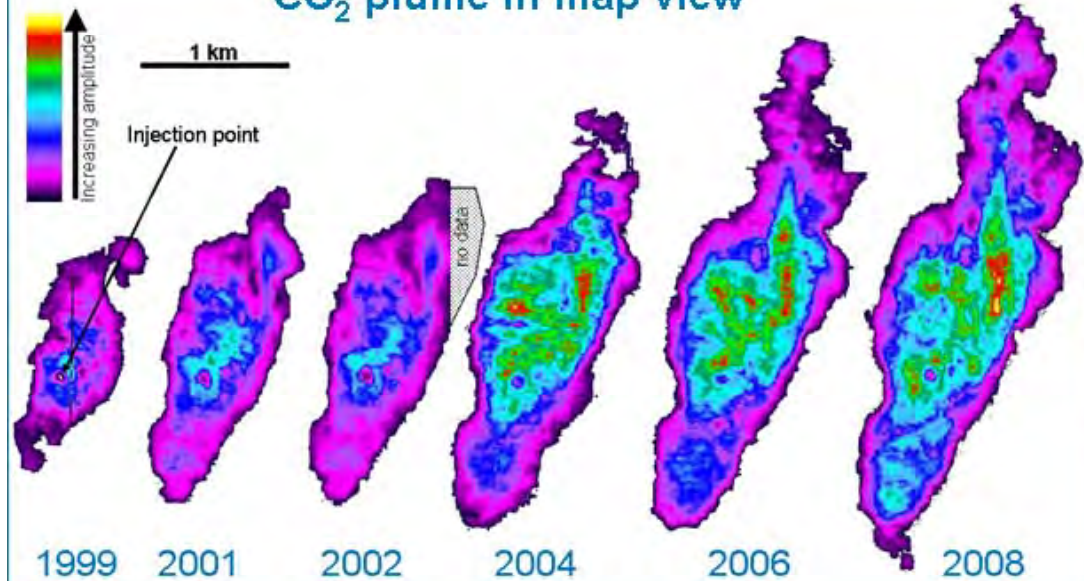
2008



2008-1994



CO₂ plume in map view





The Snøhvit CO₂-injection

- LNG production facility
- captures 0,7 mill tonnes CO₂ per year

Snøhvit

CO₂-capture plant at Melkøya

First CO₂ injected:
22. April 2008



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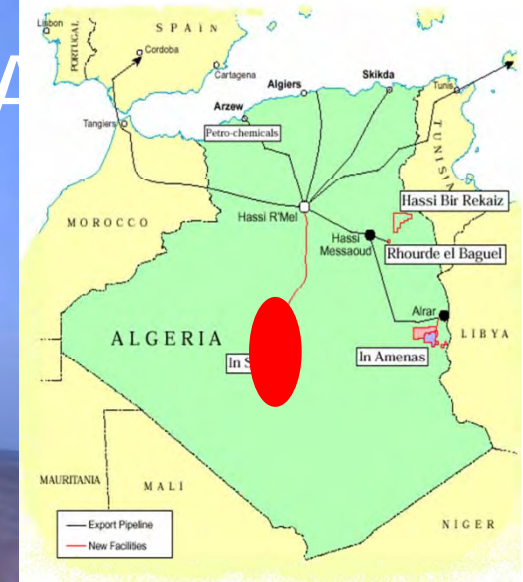


How did Sleipner and Snøhvit happen?

- Licence to operate
- CO₂ had to be removed from natural gas
 - Capture payed by gas customers
- CO₂ tax offshore Norway
 - Pays for the compression and injection

The In Salah CO₂-injection in Algeria

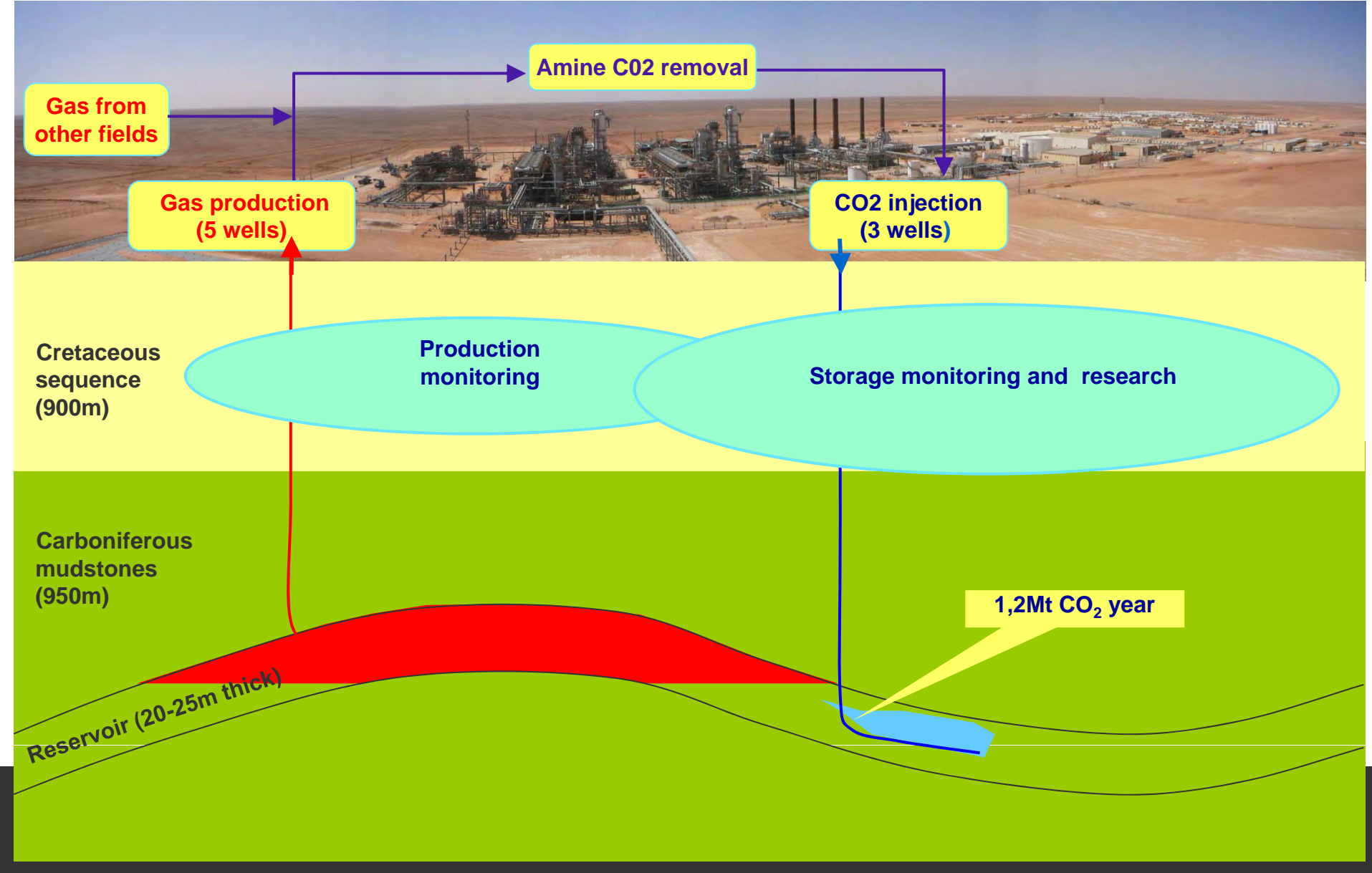
Joint Venture with Sonatrach and BP started 2004



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The In Salah CO₂ storage site at Krechba



The Weyburn-Midale CO₂-EOR and – storage project



The Weyburn-Midale CO₂-EOR Projects in Canada (2)



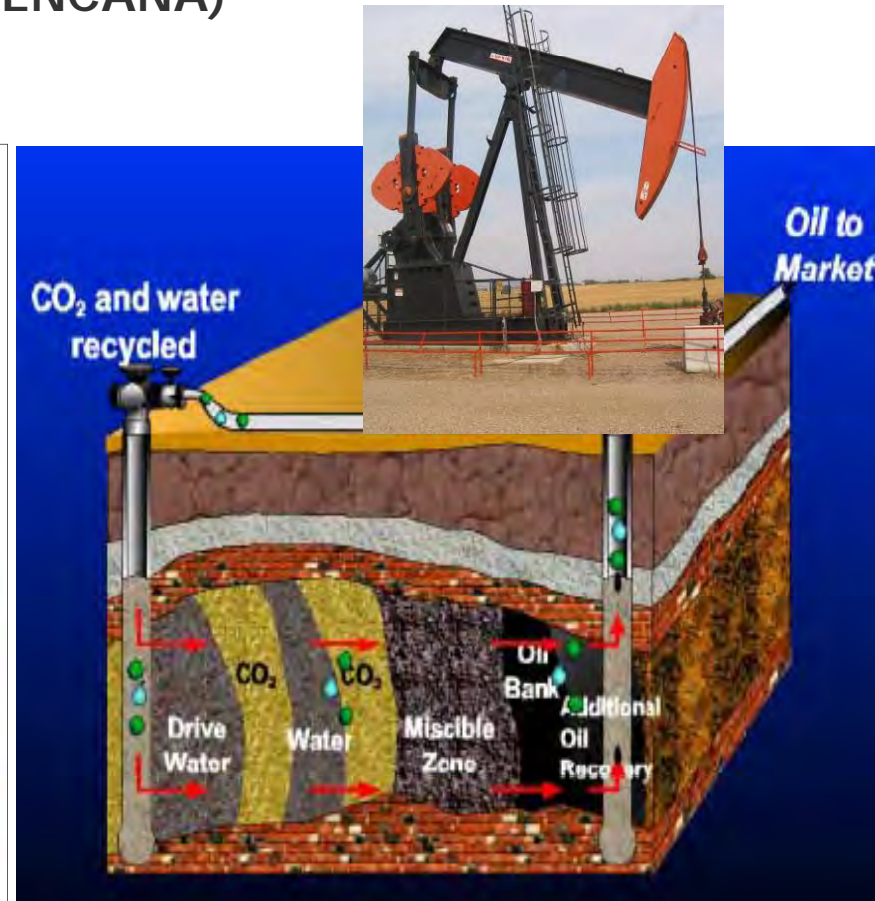
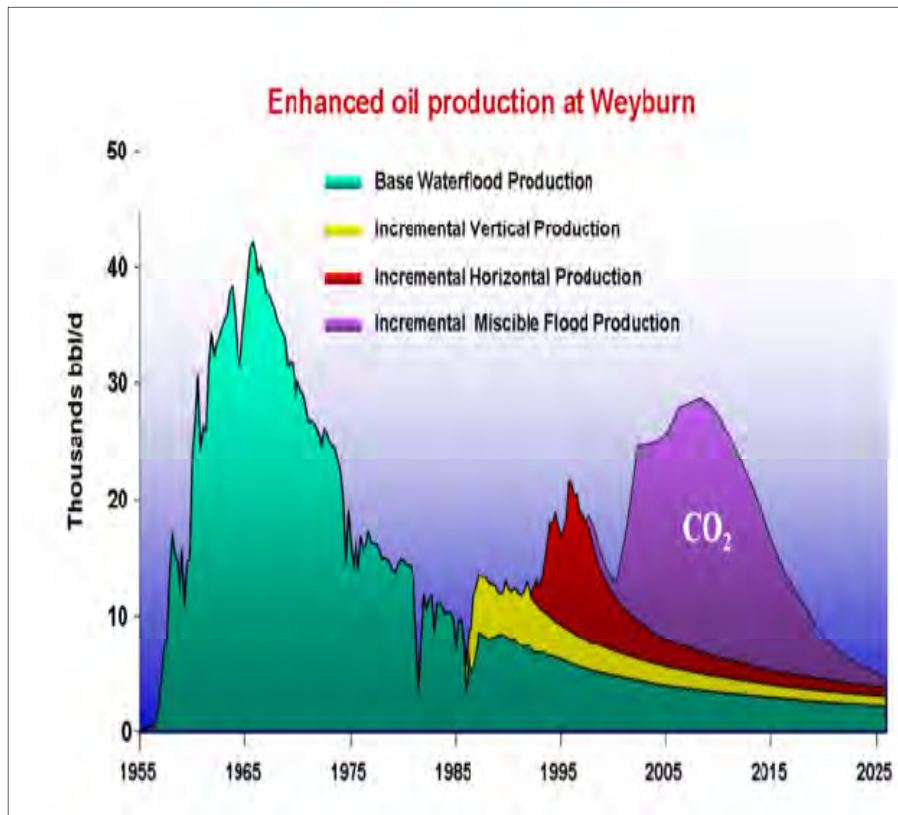
The CO₂- compressor facility



This is where CO₂ arrives after a 320 km pipeline transport from the coal gasification plant with CO₂ capture at Beulah in North Dakota, USA

The Weyburn-Midale CO₂-EOR Projects in Canada (1)

(operator ENCANA)



Challenges and opportunities:

What are the incentives?
...and disincentives?

Roles for government the public & industry How can they work together?



CCS challenges to overcome

Technological



- Technology gaps
- Size
- Capture cost

Financial



- Commercial framework
- Licensing system
- Certification systems

Regulatory



- Global framework:
 - Storage liability
 - Cross-border transport
- Storage site verification

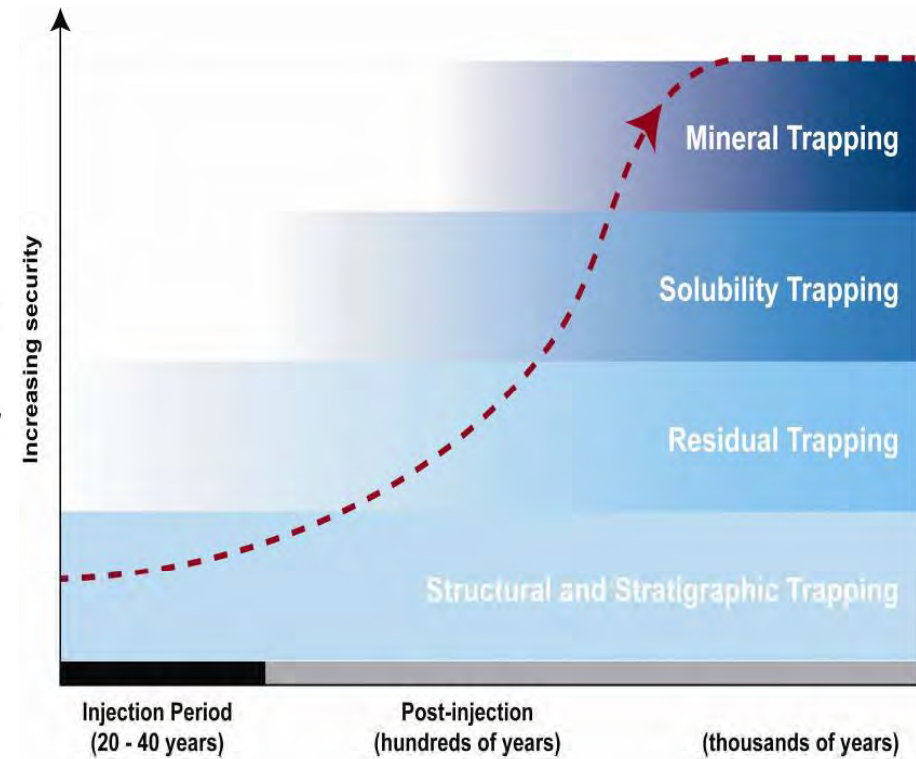
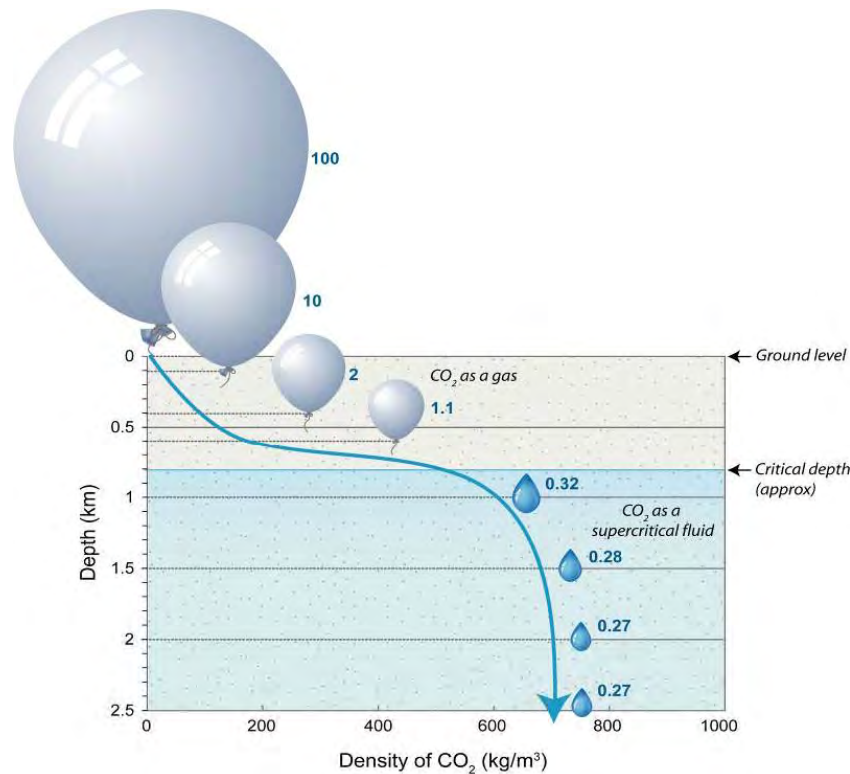
Political



- **Public CCS endorsement**
- Incentives
- «Take-off subsidies»

Safe

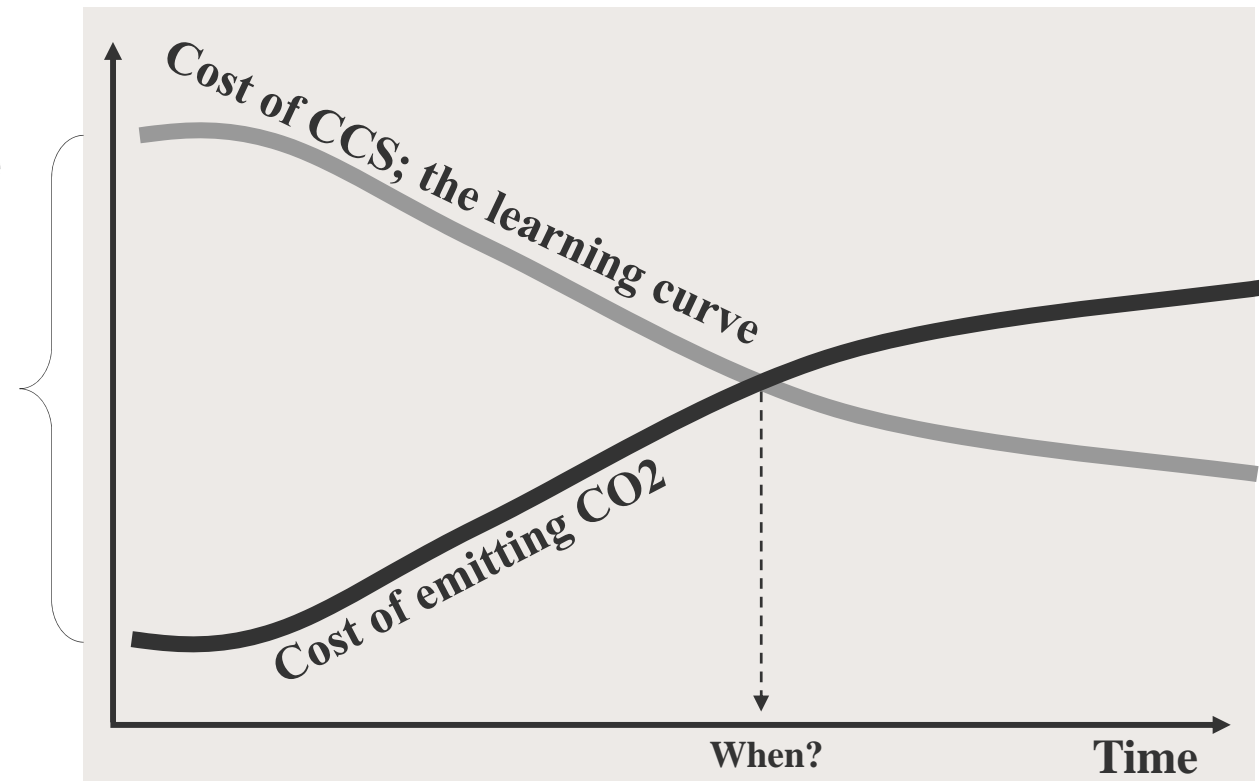
- Left: The density of CO₂ increases greatly with the depth
- Right: The trapping mechanisms make CO₂-storage safer over time



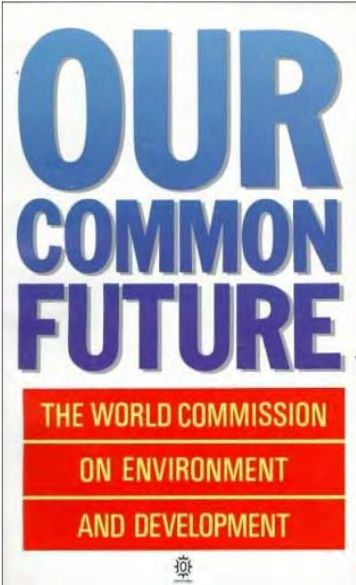
Economics will decide speed and volume of CCS-deployment

Remove cost-gap through:

- Emission Trading Scheme
- CO₂-taxes
- CO₂-EOR income
- CDM
- Direct government subsidies
- Emission limitations



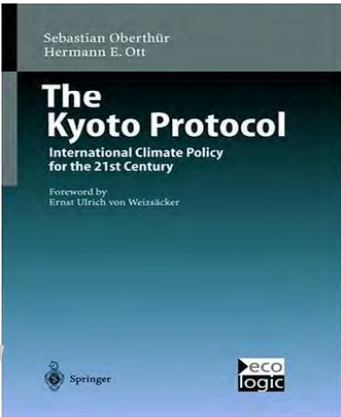
18 years since a CO₂- tax was introduced in Norway



"The Brundtland Report", 1987



Norway's Prime Minister Gro Harlem Brundtland in Rio in 1992 (*)



The Kyoto Protocol, 1997



The Kyoto Protocol ratified, 2005

(*) The Norwegian government introduced a CO₂-tax of about 45 \$/ton offshore Norway in 1991

CO₂-rich natural gas fields



Lowhanging fruits to get started with CCS



Thank you

Presentation title: Accelerating the deployment of CO2 Capture and Storage

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