

IFP/ADEME/BRGM seminar:

**“Reduction of Emissions and Geological Storage of CO₂:
Innovation and Industrial Stakes”
Paris 15-16 September 2005.**

Feedback from Industrial CO₂ Storage Projects

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"Feedback from Industrial CO2 Storage Projects"

CONTENT:

- Pre-Existing Experience
- Sleipner & Weyburn – the pioneers
- In Salah, K12B, Frio Brine, Snohvit and ???
- What will Authorities and Public demand?
- Way forward?

Experience with CO₂ and gases underground?

- **CO₂-EOR** –

since decades in West Texas, Hungary, Turkey, Brazil,...?

- **Natural gas storage** –

600 sites, some 60 years, handful of early leaks, 0.013 %

- **Natural Gas Re-injection** –

Norway re-injects 50, and exports 70 BSm³ annually

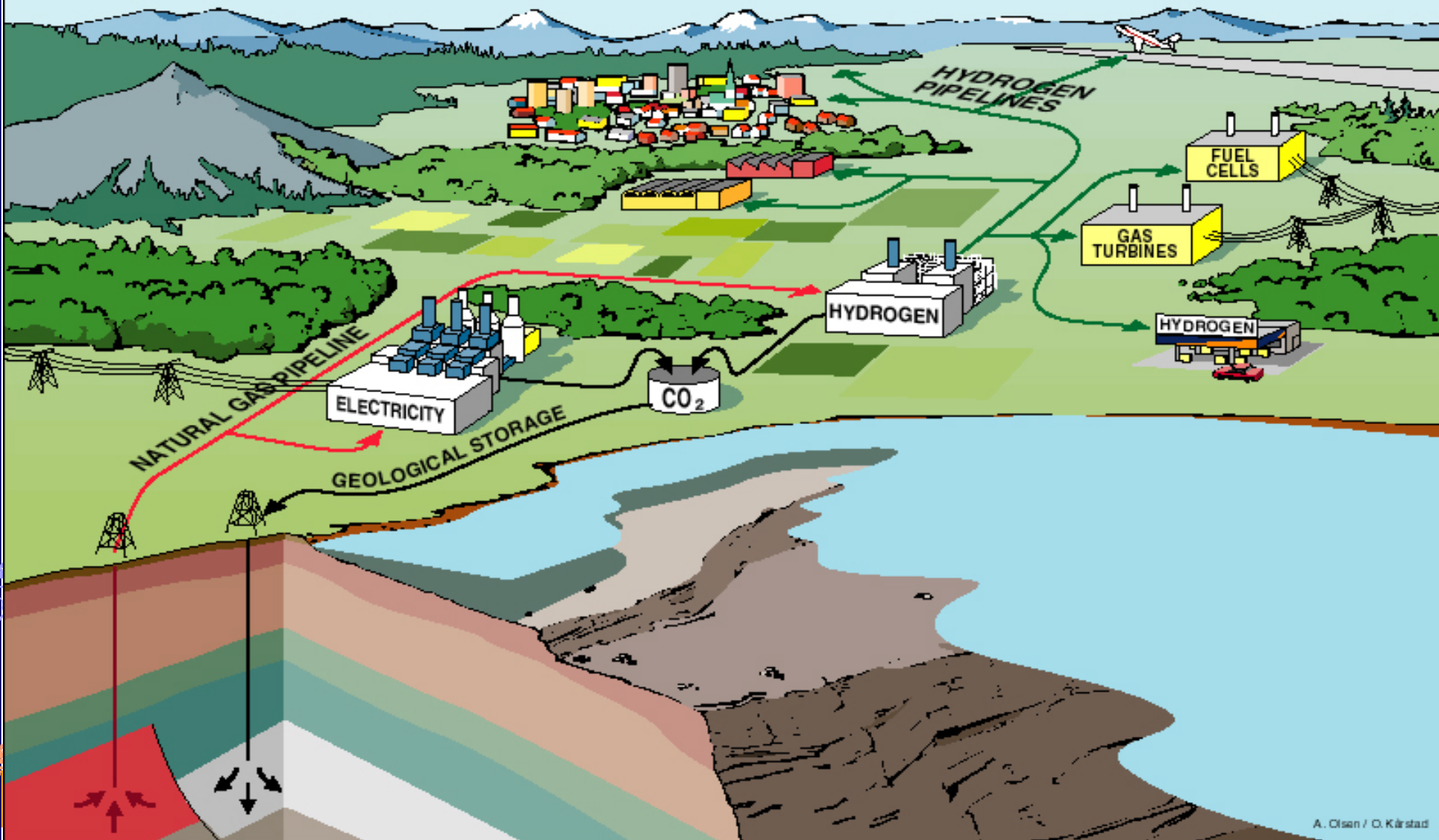
- **Oil & Gas industry** –

quantitative tools and methods

Yara CO₂-tankers, 1500 m³ capacity



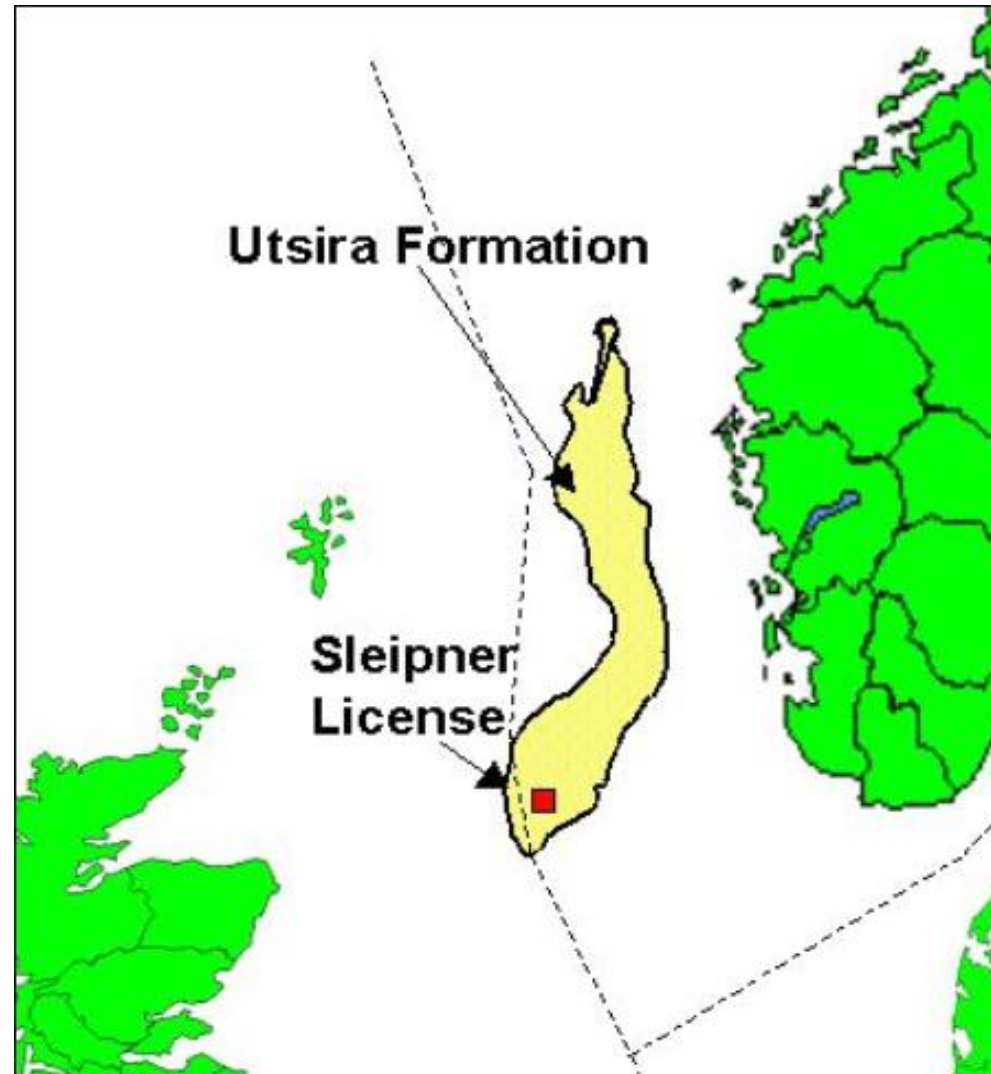
DECARBONISATION OF FOSSIL FUELS TO ELECTRICITY AND HYDROGEN



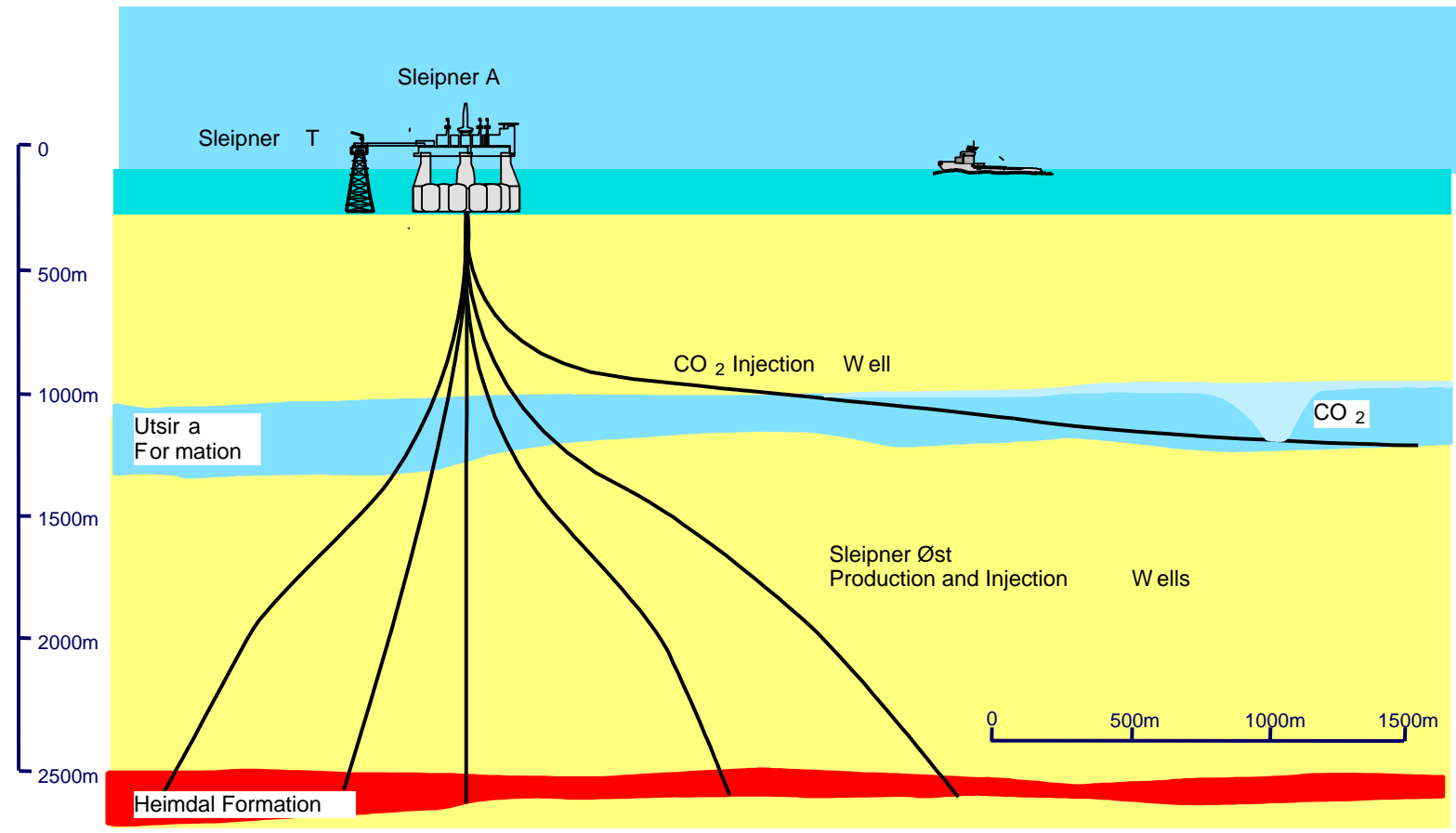
The Sleipner field – CO₂ Treatment and Injection



The Utsira Formation



CO2 Injection Well in "Utsira"



CO₂ Underground Storage Costs

as experienced at **Sleipner**

Yearly costs injecting 1 Mt/year:

• Capex (10% per year)	9.6MUSD/year
• Opex (Natural gas)	<u>7.0 - - “ - - .</u>
Total	<u>16.6 MUSD/year</u>

Injection Unit Costs 17 USD per tonne

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

NO, DK, NL, FR & UK Authorities

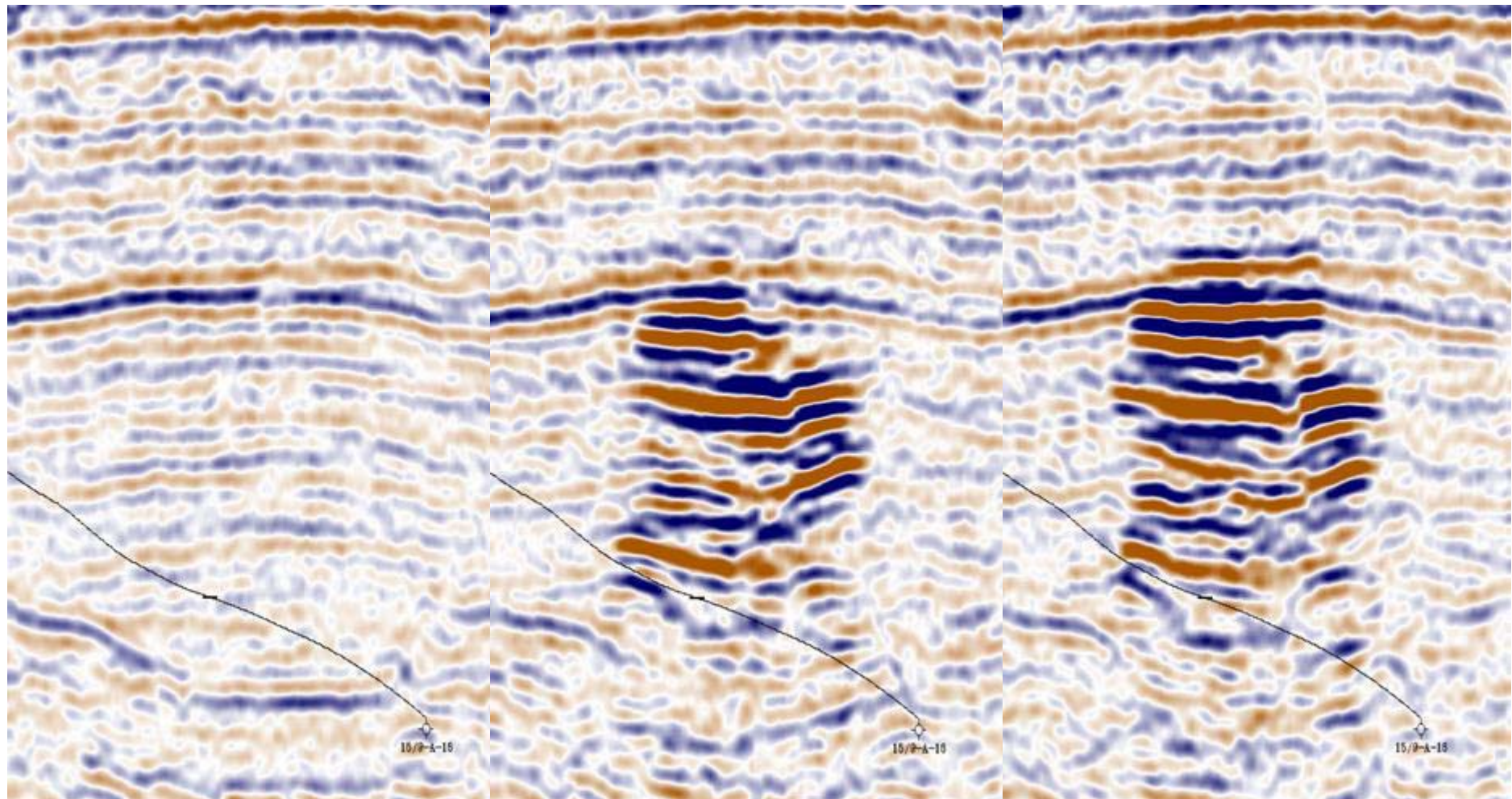


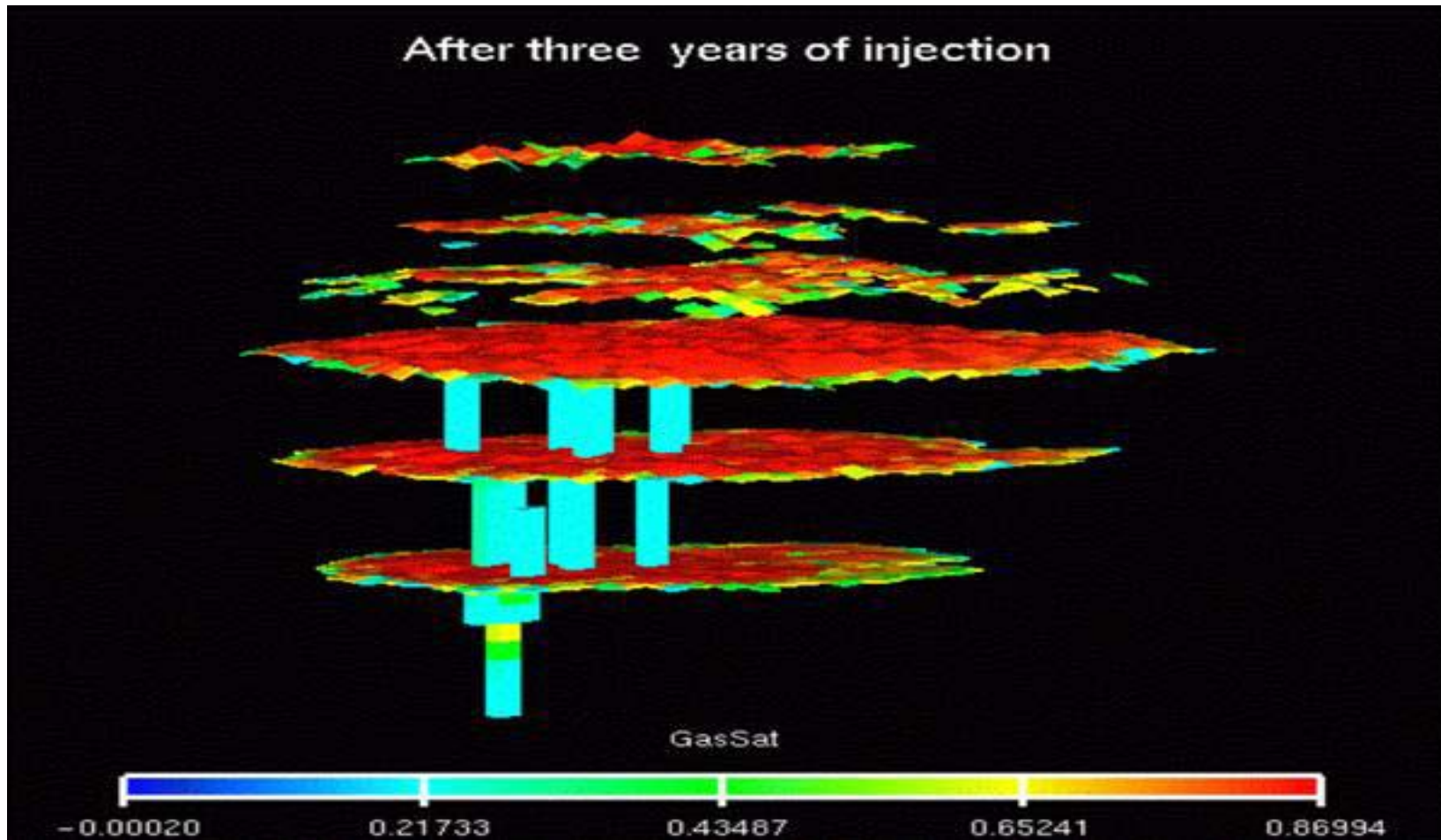
3D Seismic surveys at Sleipner

1996

1999

2001





**Simulated picture of the distribution of CO₂ after three years.
Radius of largest bubble 800 m and the total plume 200 m high.**

Ref: SINTEF Petroleum 2001

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 to stay for thousands of years

DOCUMENTATION

- “SACS Best Practice Manual, 1.version.”
- Download from www.co2store.org, see page “SACS”.

CO₂ Underground Storage Costs as experienced at **Weyburn**

Yearly cost analysis (incl. pipeline):

■ Total expenses (USD)	24,582,500
■ Delivery (tonnes)	1,226,400

■ **Unit Storage cost 20 USD/tonne**

Source: Ken Brown, GHGT7

Demonstration

K12-B

Injection of CO₂
In a depleted gas field



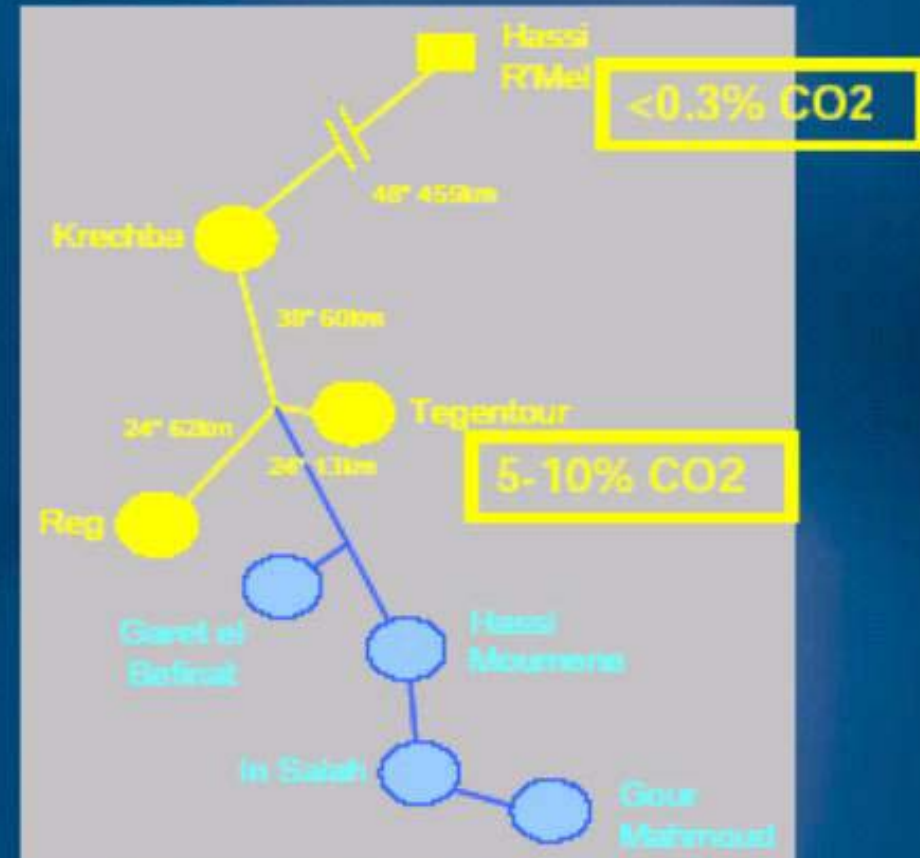
Operator:

Gaz de France PRODUCTION NEDERLAND B.V.

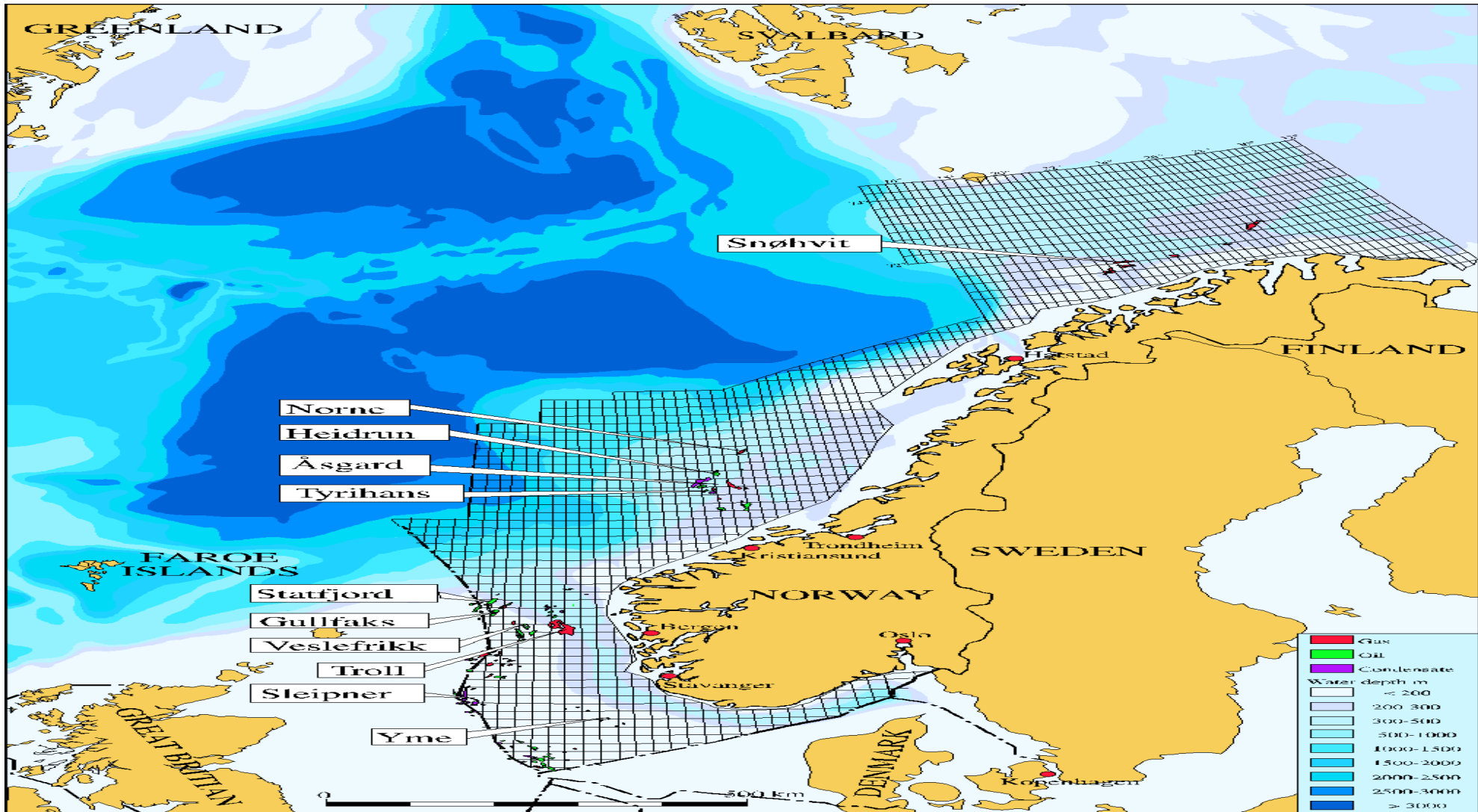
In Salah Gas Project Location, Algeria



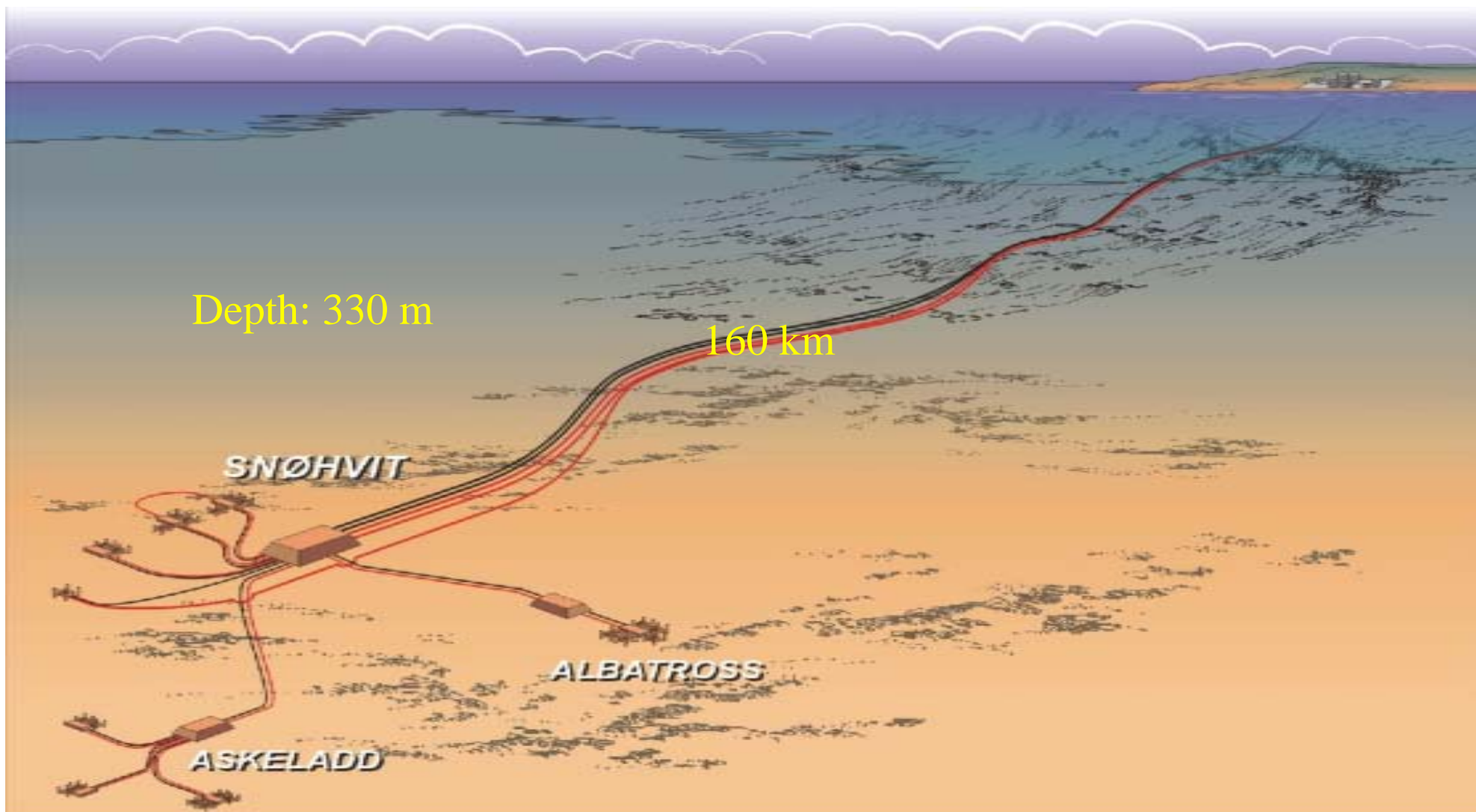
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Snøhvit, the next field to implement CO2 storage



Snøhvit – All subsea



CO2 Storage – Ongoing or near future

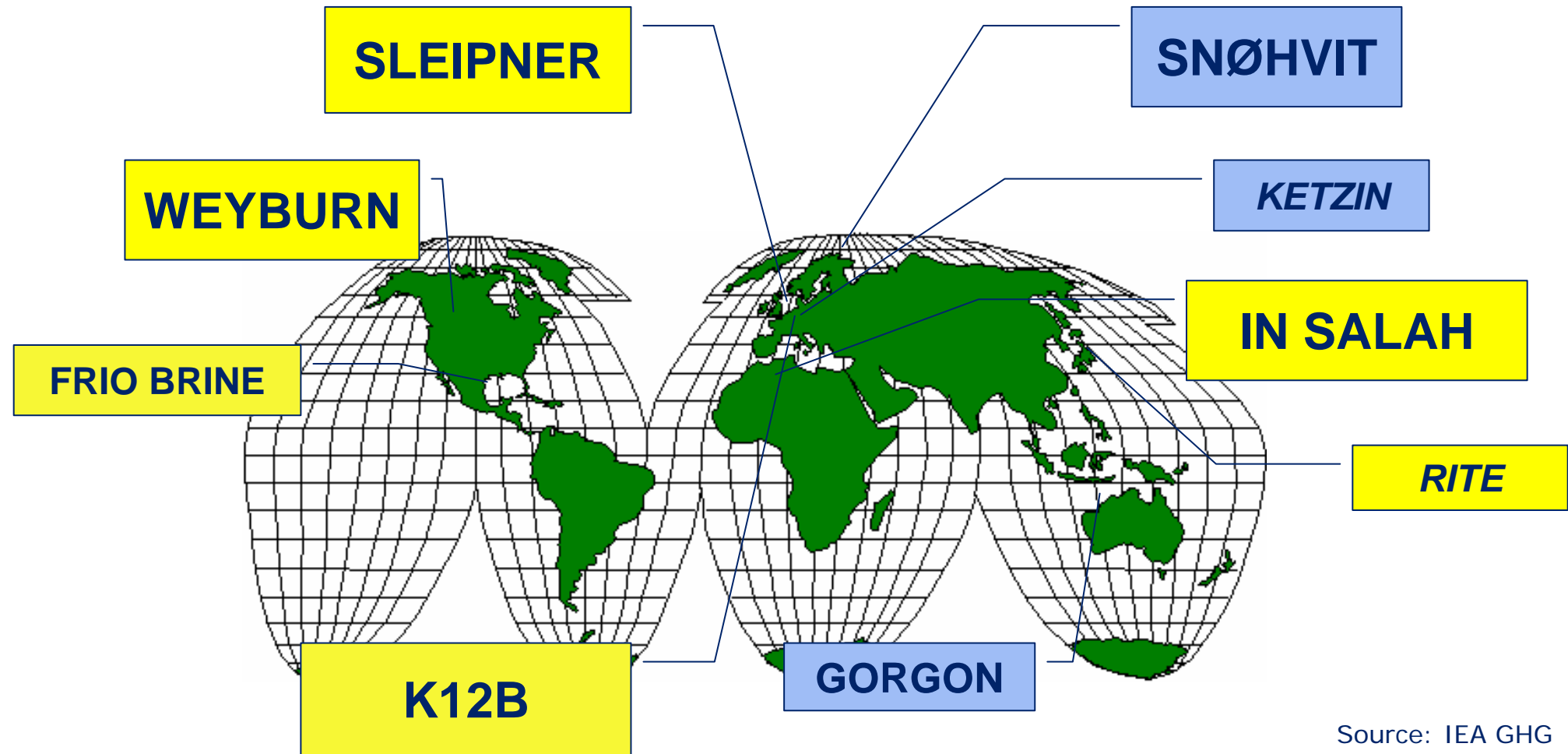
Ongoing or decided

- Sleipner, NO, 1 Mt/y, 1996-
- Weyburn, CA, 1.2 Mt/y, 2000-
- Frio Brine, US, 10^4 t/y, 2004
- K12B, NL, 10^4 t/y, 2004-
- In Salah, 1 Mt/y, 2004-
- Snohvit, 0.75 Mt/y, 2006-

Near future ?

- Ketzin, DE, 10^4 t/y, 2005
- Lindach, AT, 10^4 t/y, 2005
- Casablanca, ES, 10^6 t/y, 2006
- Gorgon, AU, 1 Mt/y, 2008

Demonstrerer CO₂-lagring verden rundt



Source: IEA GHG

What will the Authorities demand?

- Access rights and Licence
- Site characterisation and Plan
- Monitoring & Verification
- Reporting to UNFCCC and ETS
- Remediation?
- Decommissioning and "Hand shake"
- Monitoring until "stability"?

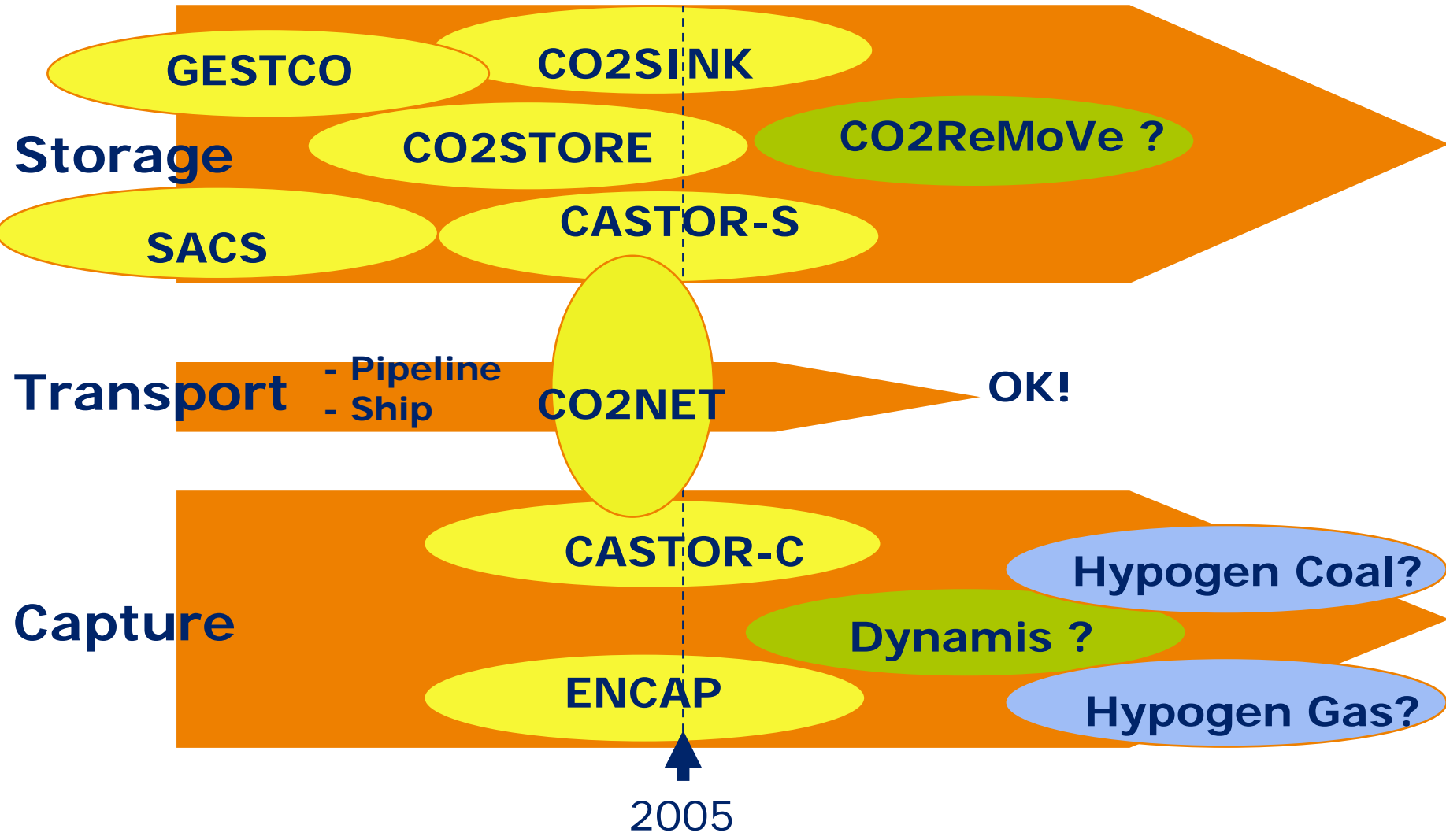
What will the Public demand?

- Safe operation
- No leakage
- Monitoring & Verification in full openness
- Acceptance from UNFCCC and ETS
- Long term stability

Towards Large Scale Implementation?

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Inter-Continental co-operation:

- **IEA GHG - IEA GreenHouse Gas R&D Programme**
- **IPCC – Special Report on CO2 Capture & Storage**
- **CSLF – Carbon Sequestration* Leadership Forum**
- **Bilateral co-op – Several (EU-US, NO-US, NO-CAN,...)**

Need two legs to walk !

Reduce capture COST:

- Technologies exists
- Another chemical factory
- Extra investment and energy consumption
- Costs too high for industry

➔ **NEED NEW TECHNOLOGY**

Build TRUST in storage:

- Is it staying there long enough?
- Experience and large scale demo
- Experience from EOR and storage
- Oil&gas methods and tools works
- Geology varies from site to site

➔ **MORE DEMO SITES**

