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## Brief Overview of Geological Storage of CO<sub>2</sub> –Safety issues

Dr Nick Riley MBE (British Geological Survey, Nottingham, UK; CO<sub>2</sub>GeoNet Co-ordinator)

*njr @bgs.ac.uk*  
*www.co2geonet.com*



European Parliament, 7<sup>th</sup> March 2006



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# CO<sub>2</sub>GeoNet is a “Network of Excellence”

## 13 Research Partners

### Denmark

Geological Survey of Denmark and Greenland –GEUS

### France

Bureau de Recherches Geologiques et Minieres- BRGM  
Institute Francais du Petrole –IFP

### Germany

Federal Institute for Geosciences and Natural Resources –BGR

### Italy

Istituto Nazionale di Oceanografia e di Geofisica Sperimentale-OGS  
Università di Roma “La Sapienza” -URS

### Netherlands

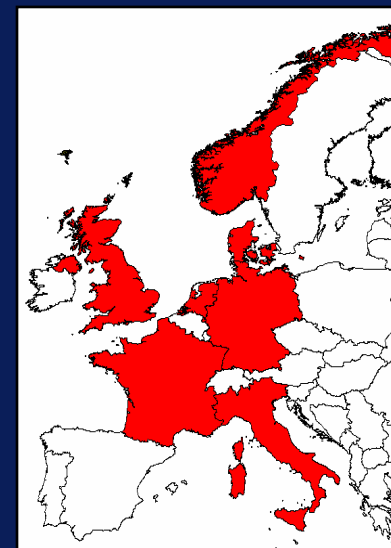
Netherlands Organisation for Applied Scientific Research –TNO

### Norway

Norwegian Institute for Water Research –NIVA  
Stiftelsen Rogalandsforskning-RF  
SINTEF Petroleumsforskning AS –SPR

### UK

Natural Environment Research Council-British Geological Survey-BGS)  
Heriot-Watt University –HWU  
Imperial College of Science, Technology and Medicine-IMPERIAL



**Started April 2004**  
**€9m, 5 years**  
**EC €6m**



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## OUR CHALLENGE

**Without regulatory, industrial and public confidence about CO<sub>2</sub> storage there will be no possibility of decarbonising emissions from fossil fuels.**

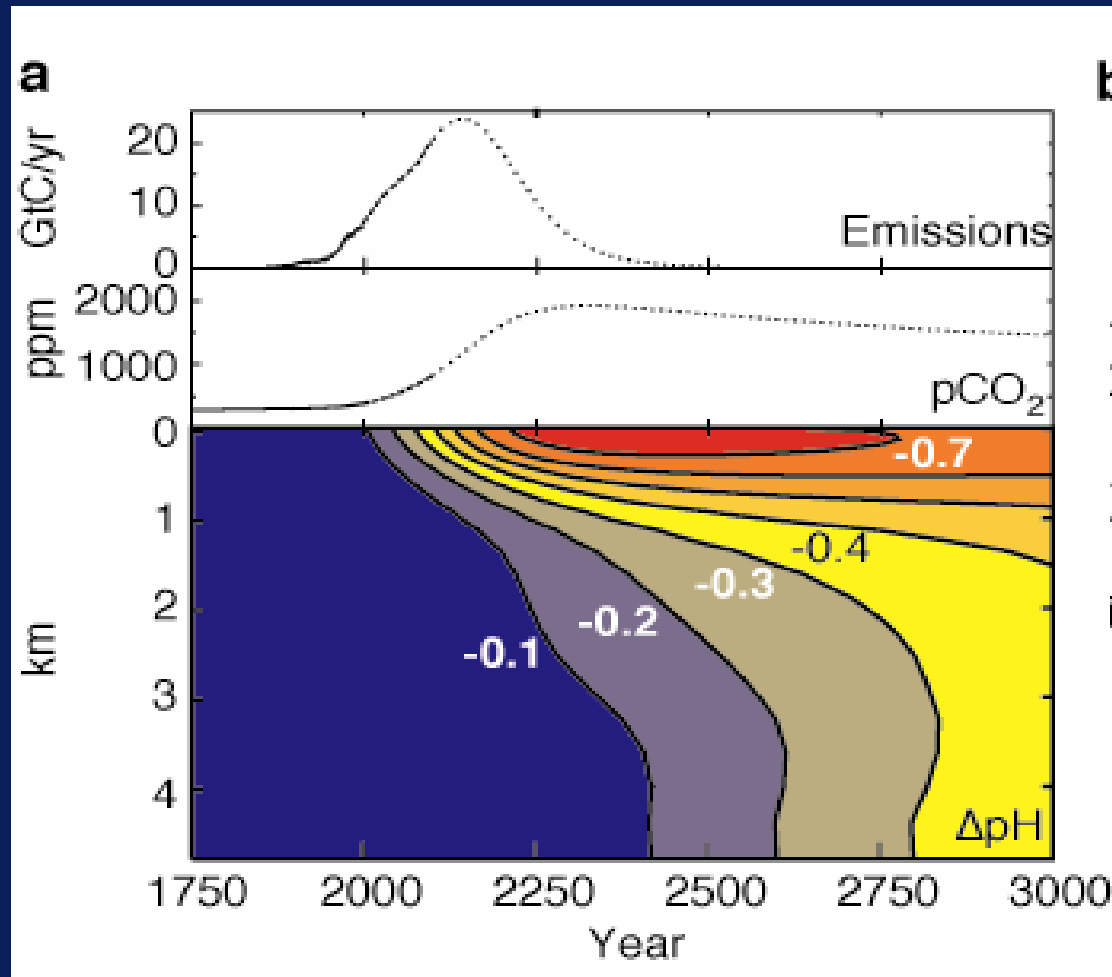
**If this challenge is not met, & quickly – we will not stabilise the CO<sub>2</sub> levels in the atmosphere**

**Whilst we delay deploying CCS by agonising over the very low risk of possible leakage from geological storage- we continue to emit 100% of fossil fuel CO<sub>2</sub> emissions to the sky.**

**What is unsafe is to fail to deal with fossil fuel emissions effectively and quickly.**



**CO<sub>2</sub> storage is required urgently- not just because of climate change  
Our oceans are acidifying as CO<sub>2</sub> overwhelms them.  
This will have serious consequences not experienced for over 50m years**



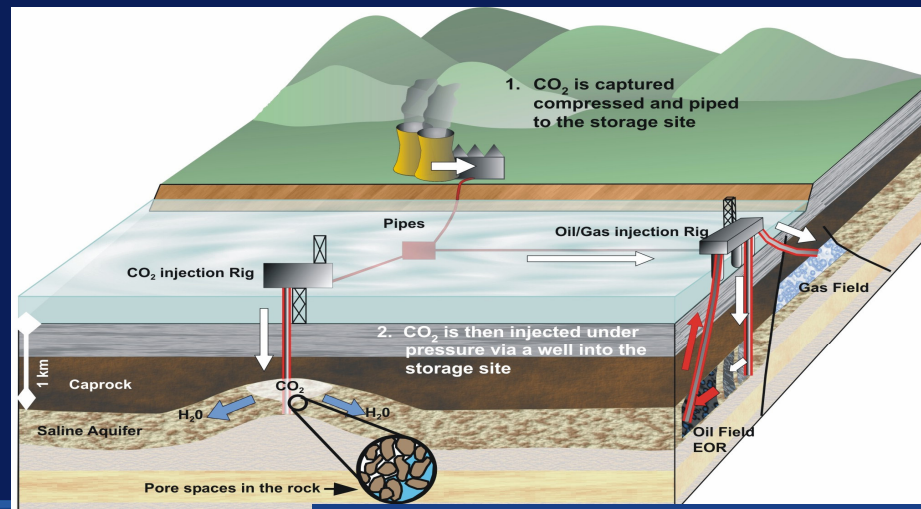
(source Caldiera & Wickett)



European Parliament, 7<sup>th</sup> March 2006

# Overview of Geological Storage

- Storage has to be long term (over 1000 years) and secure. It may be sub-sea bed or onshore. Crucial is understanding a fit for purpose geological model of the site before injecting CO<sub>2</sub>
- Injection rates of at least 1Mt CO<sub>2</sub>/annum over several decades
- Meet safety, environmental protection, carbon credit, public acceptance & regulatory needs- regulation still being formulated
- Avoid sterilising or impacting upon other resources
- Monitor and verify storage to ensure performance matches prediction
- Develop intervention & mitigation strategies for unexpected events



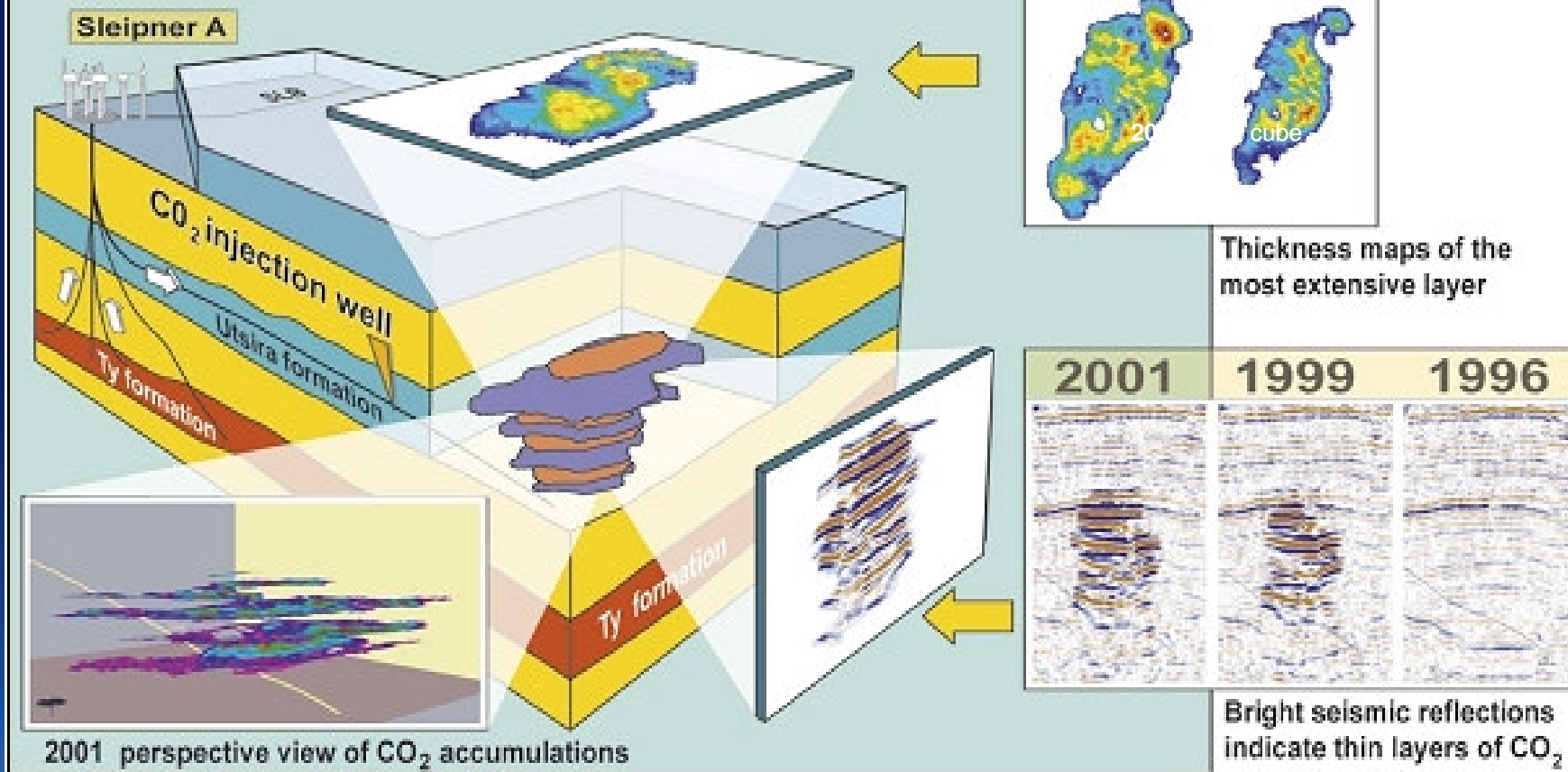
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## Geological formation should have:

- Sufficiently high permeability
- Adequate capacity
- Insignificant internal flow
- Trapping mechanisms
  - ◆ To contain CO<sub>2</sub> for a very long time



# CO<sub>2</sub> injection in the Utsira formation



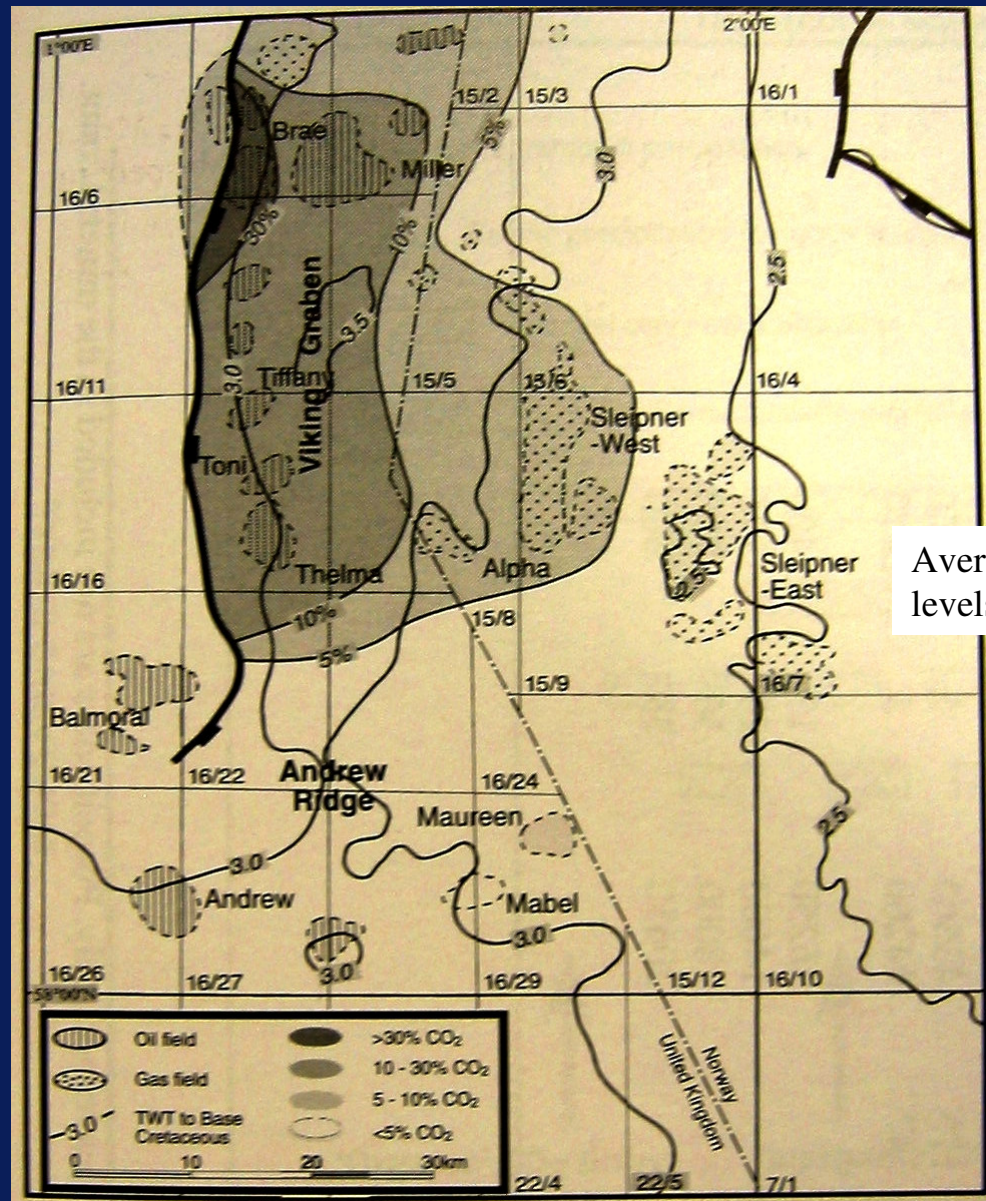
Courtesy of Statoil & SACS/CO<sub>2</sub> Store



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Nature has  
been  
storing CO<sub>2</sub>  
beneath the  
N. Sea for  
over  
50million  
years



Average natural CO<sub>2</sub>  
levels; Jurassic reservoirs

Source Geol Soc Special Volume 2004





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# European Natural Gas Transmission System in 2002

ruhrigas

## pipelines/LNG receiving terminals

- existing 
- planned or under construction 

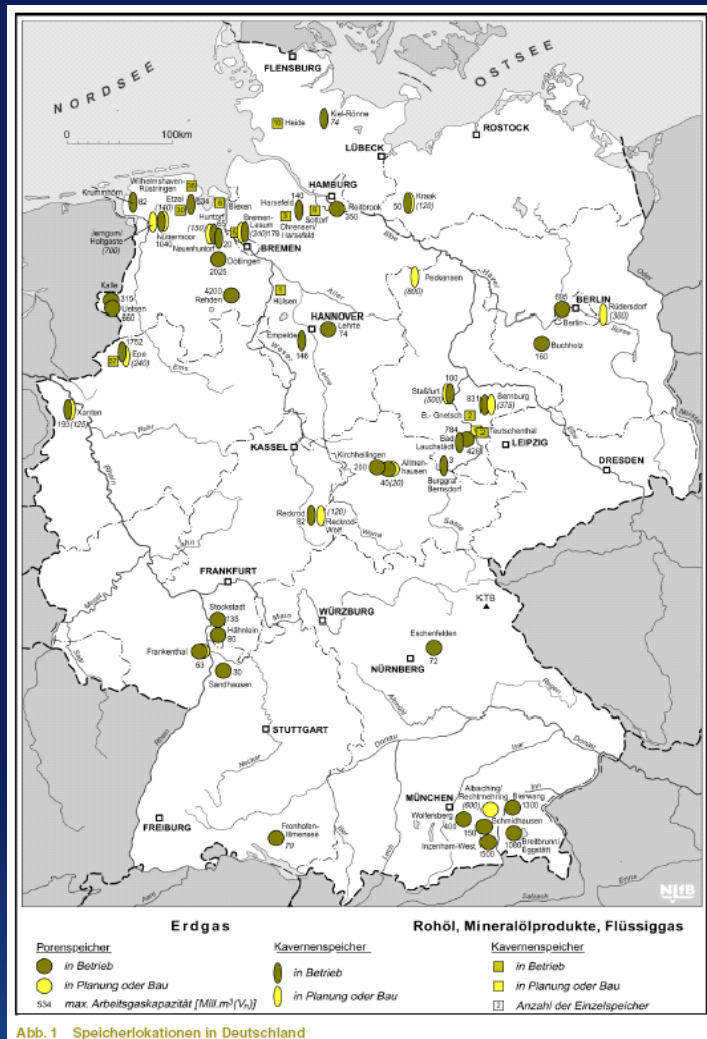
Underground storage & transmission of gas is a mature technology



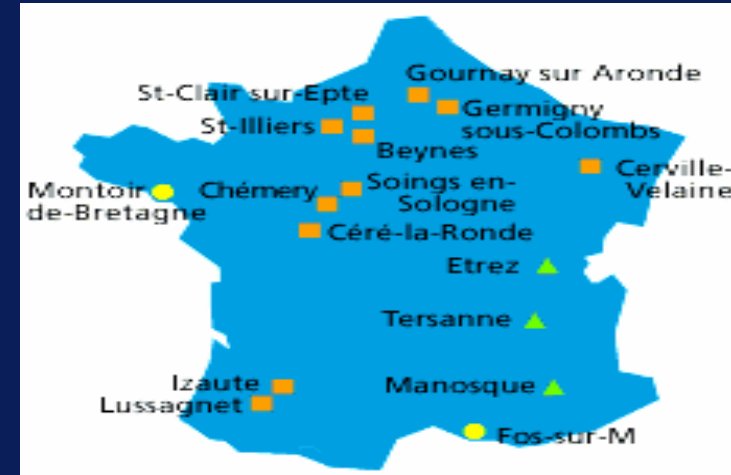
B 1337

2002





(UGS sites in Germany- courtesy of Rhurgas)



(UGS sites in France courtesy of Gaz de France)

UGS technology has an extremely good track record developed over 60 years.

So much so that the public are largely unaware of it and take it for granted- and yet without UGS they would not have reliable or safe gas supplies





The Olympic stadium in Berlin, venue for the 2006 football world cup, is in close proximity to a major underground natural gas storage facility (300m below in an aquifer) which ensures the reliability of Berlin's gas supply. There are numerous underground gas storage facilities in Europe, some store hydrogen too! (photo N. Riley)



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## The issue of permanence

We can have confidence that leakage is less likely over time because:

- Residual gas trapping immobilises a significant amount of CO<sub>2</sub>
  - CO<sub>2</sub> will dissolve in formation waters causing the CO<sub>2</sub> to sink deeper into the earth
  - CO<sub>2</sub> reacts with rock minerals to form solid carbonates immobilising the CO<sub>2</sub>
  - If CO<sub>2</sub> is on the move it gets attenuated by the above mechanisms.
- 
- Provided the appropriate geological criteria are met in choosing a storage site it is very hard to envisage how CO<sub>2</sub> could leak through to the surface via a natural route
  - The consensus amongst the CCS community is that well bores pose a very slight risk of leakage.

The technology to plug leaking wells is a routine oil & gas industry capability.

**Conclusion: If fossil fuels continue to dominate the global energy economy Geological storage is a low risk, no regret strategy which needs widespread and rapid deployment**

