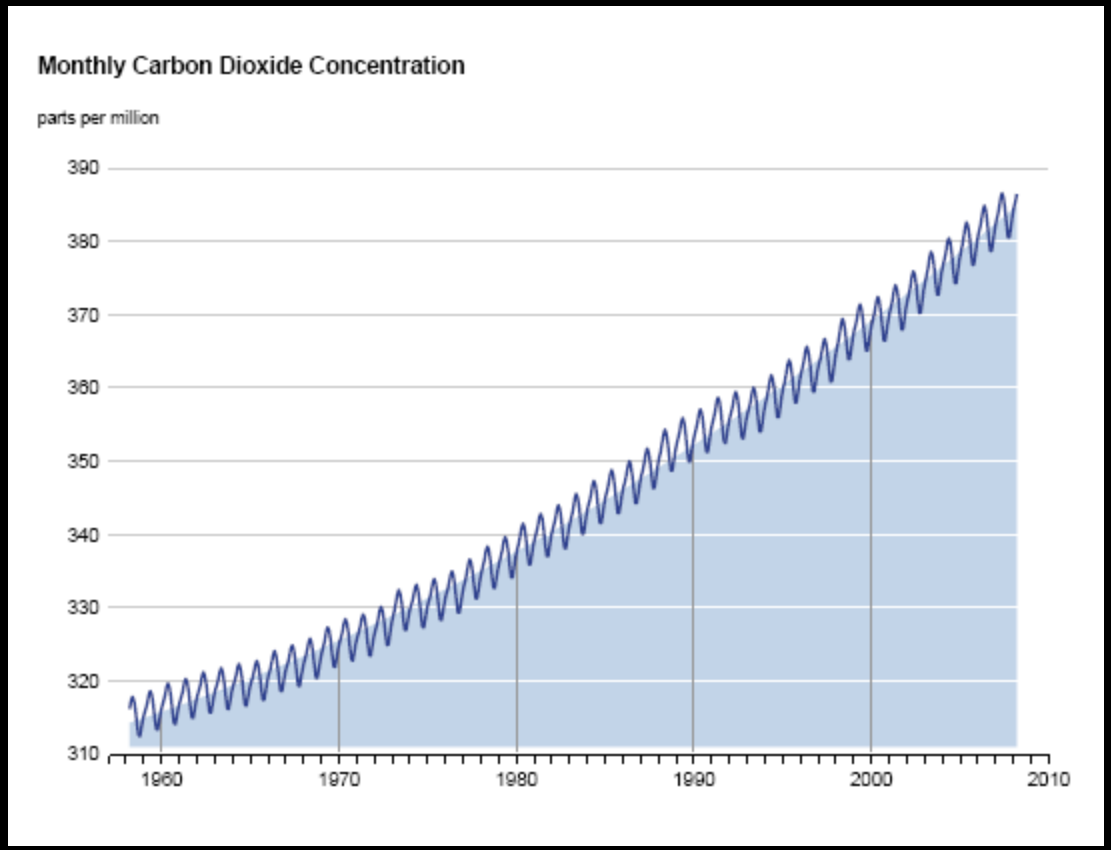
Carbon Capture & Sequestration

Awareness and Capacity Building Programme

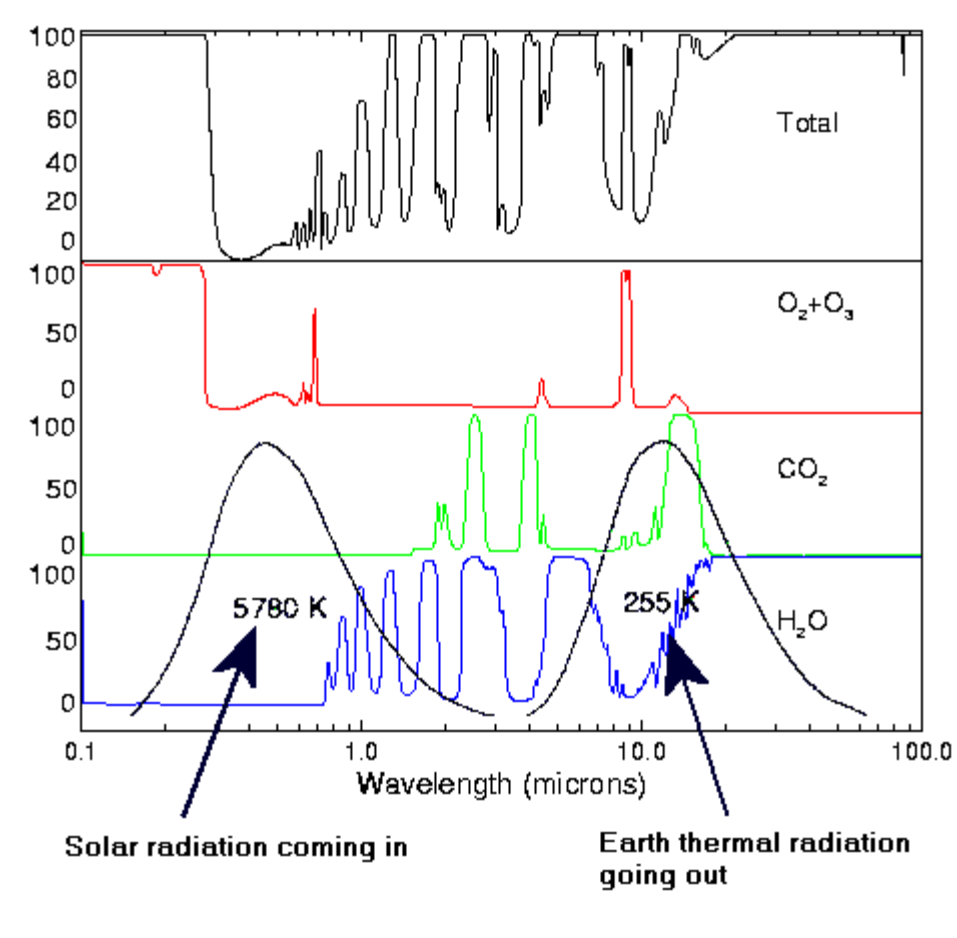
On

Carbon Capture and Storage

Carbon Capture & Sequestration



Absorption Spectra



Carbon Capture & Sequestration

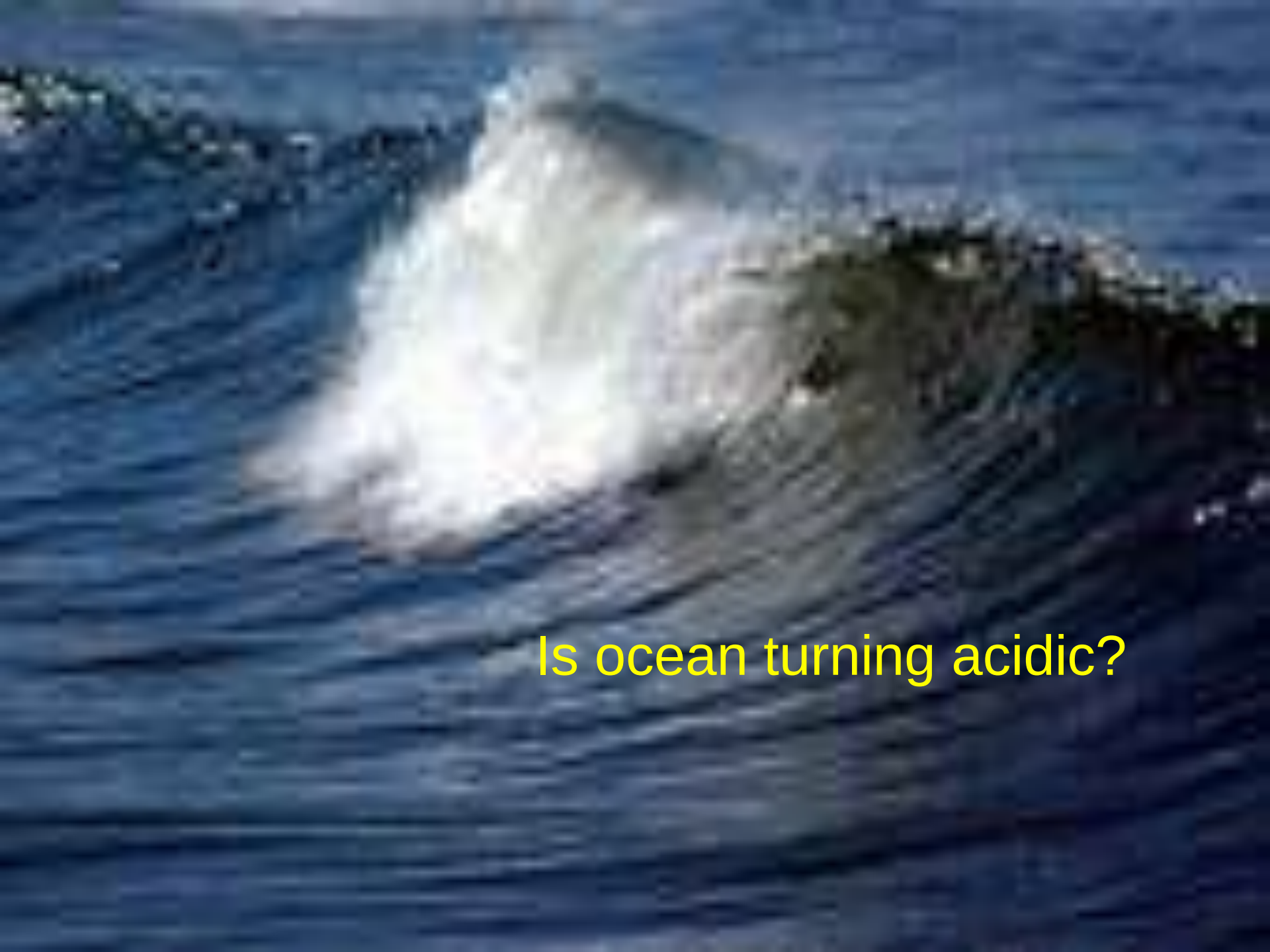
1 ppm is 8.08 billion tons CO_2.

Current CO_2 emission ~ 30billion tons

That amounts to 3.7 ppm

Of which 57% = 2.1ppm

Retained in the atmosphere


Is ocean turning acidic?

Carbon Capture & Sequestration

Power Plants

Transport

Industry

Cement, Iron and Steel

Petrochemicals

Natural Gas, Refinery

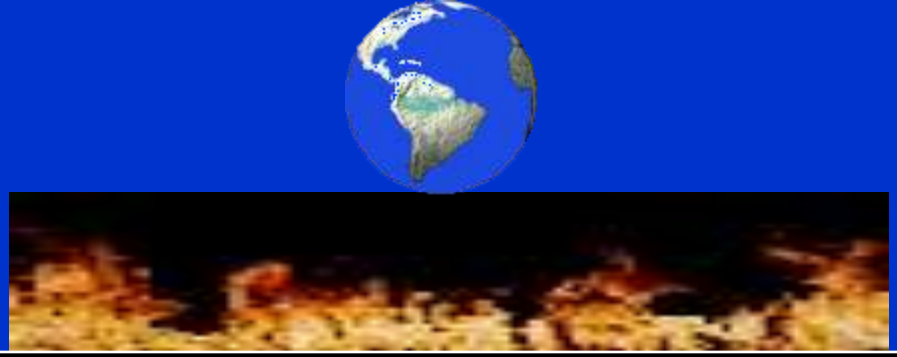
Residential

Carbon Capture & Sequestration

Vehicular pollution

A few Billion of mobile polluters wheezing

All over the place !



Carbon Capture & Sequestration

The current CO_2 emissions ~ 28 Gt

Business as usual projection to 2050

62 Gt

ACT plan 2050 =2005

Reduction by 35 Gt

BLUE plan 2050 =half of 2005

Reduction by 48 Gt

Carbon Capture & Sequestration

Of this about 20% reduction to be achieved by CCS

7 to 10 GT CO_2 to be

Sequestered every year!

Carbon Capture & Sequestration

Enhanced Oil Recovery

Miscible displacement

Minimum Miscibility pressure

Immiscible displacement

Little Incremental Recovery

Active EOR projects in 2004

Country	Number of active EOR projects				Total
	Thermal	Gas	Chemical	Other	
USA	56	83	4	-	**143**
Canada	16	32	-	-	**48**
China	18	-	18	2	**38**
Colombia	2	-	-	-	**2**
France	-	-	1	-	**1**
India	3	1	4	3	**11**
Indonesia	2	-	1	-	**3**
Libya	-	1	-	-	**1**
Mexico	-	1	-	-	**1**
Trinidad	8	5	-	-	**13**
Turkey	-	1	-	-	**1**
UAE	-	1	-	-	**1**
Venezuela	38	9	2	1	**50**
Total	**143**	**134**	**30**	**6**	**313**

Active Gas Injection EOR projects

Country	Number of Projects		
	CO_2	HC	Others
USA	71	8	4
Canada	2	29	1
Libya	-	1	-
India	-	1	-
Mexico	-	-	1
UAE	-	1	-
Trinidad	5	-	-
Turkey	1	-	-
Venezuela	-	8	1
China	-	-	-
Colombia	-	-	-
Indonesia	-	-	-
Total	79	48	7

Carbon Capture & Sequestration

3% of total oil production from EOR

10% of that from CO_2

0.3% of total oil production by CO_2

Carbon Capture & Sequestration

Potential for CO2 EOR

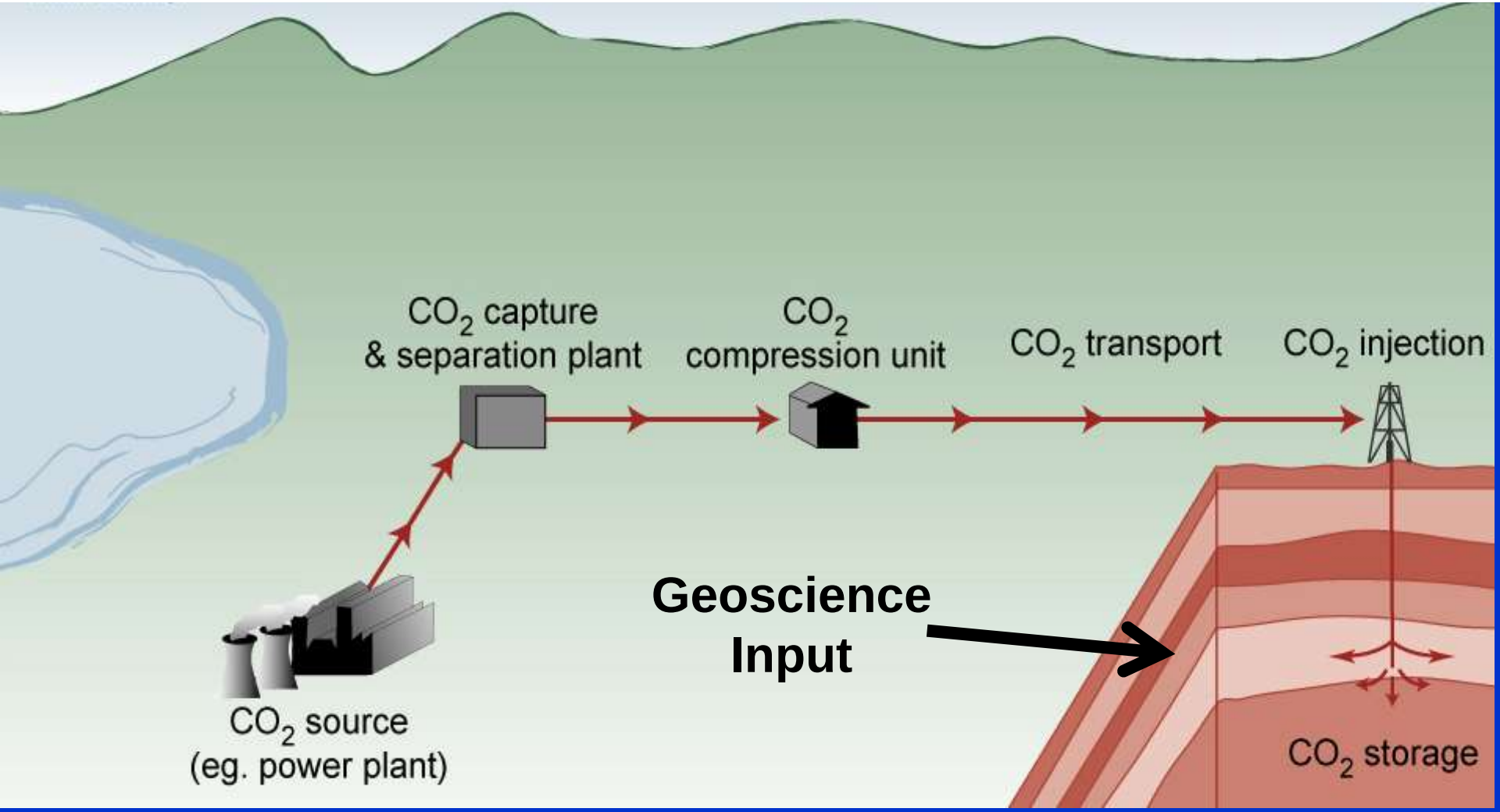
200 billion barrels of extra oil

Will lead to storage of 70 to 100 Gt

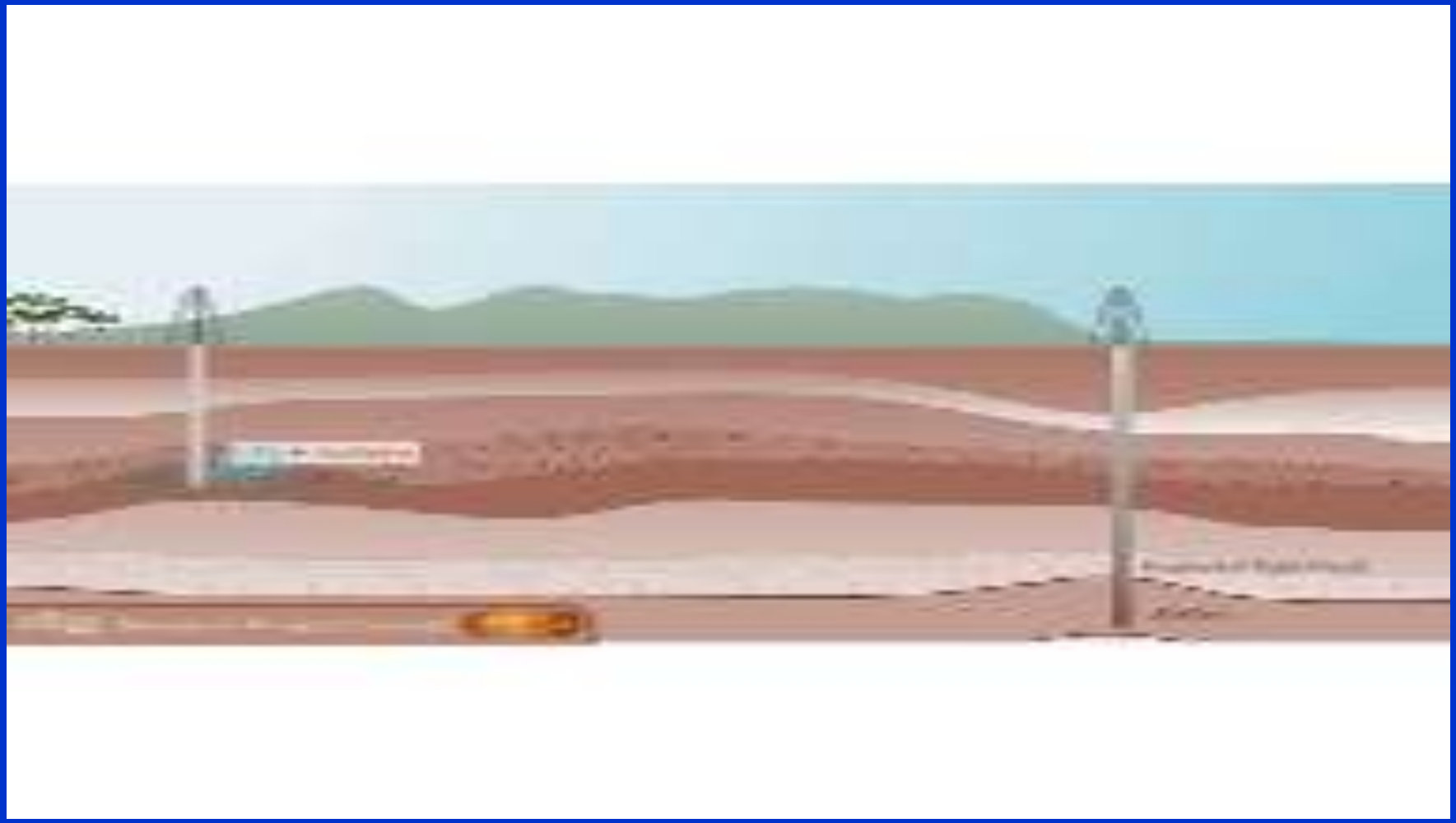
This is about the CO2 emission from this Oil!

Do we do any net good?

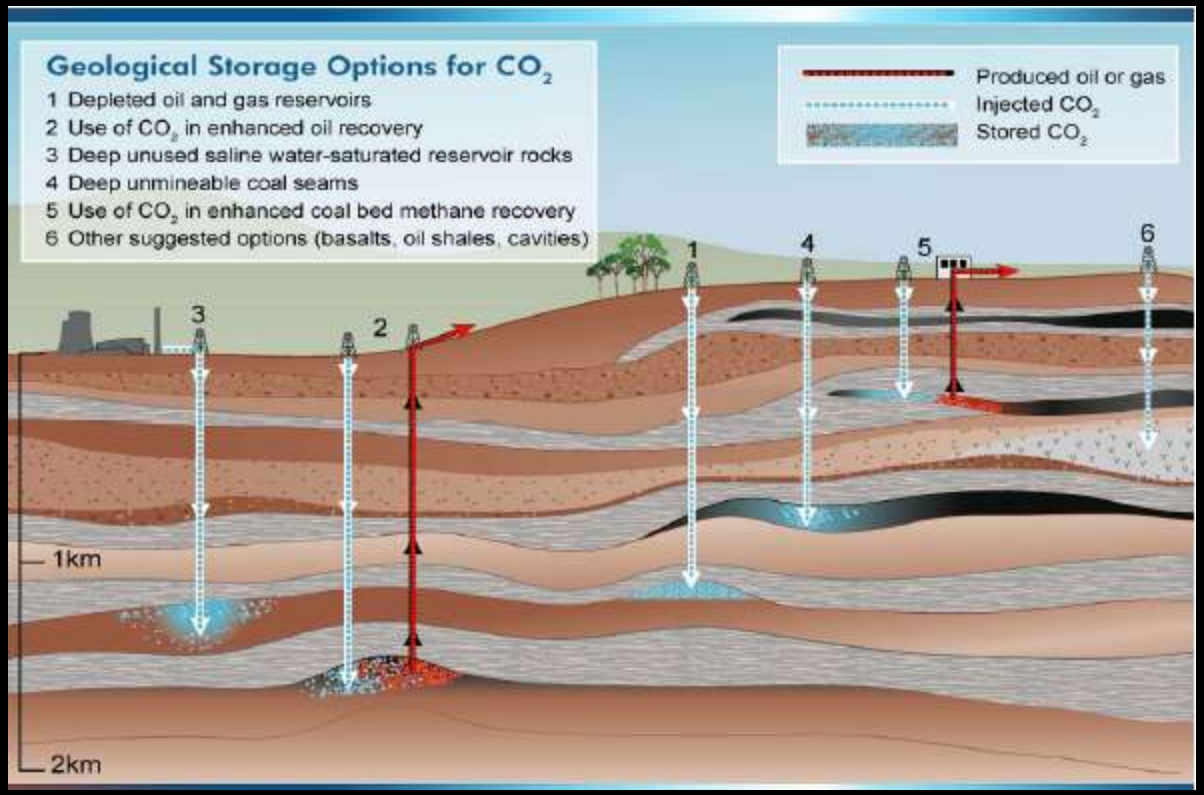
Geosequestration: Carbon Capture and Storage (CCS)



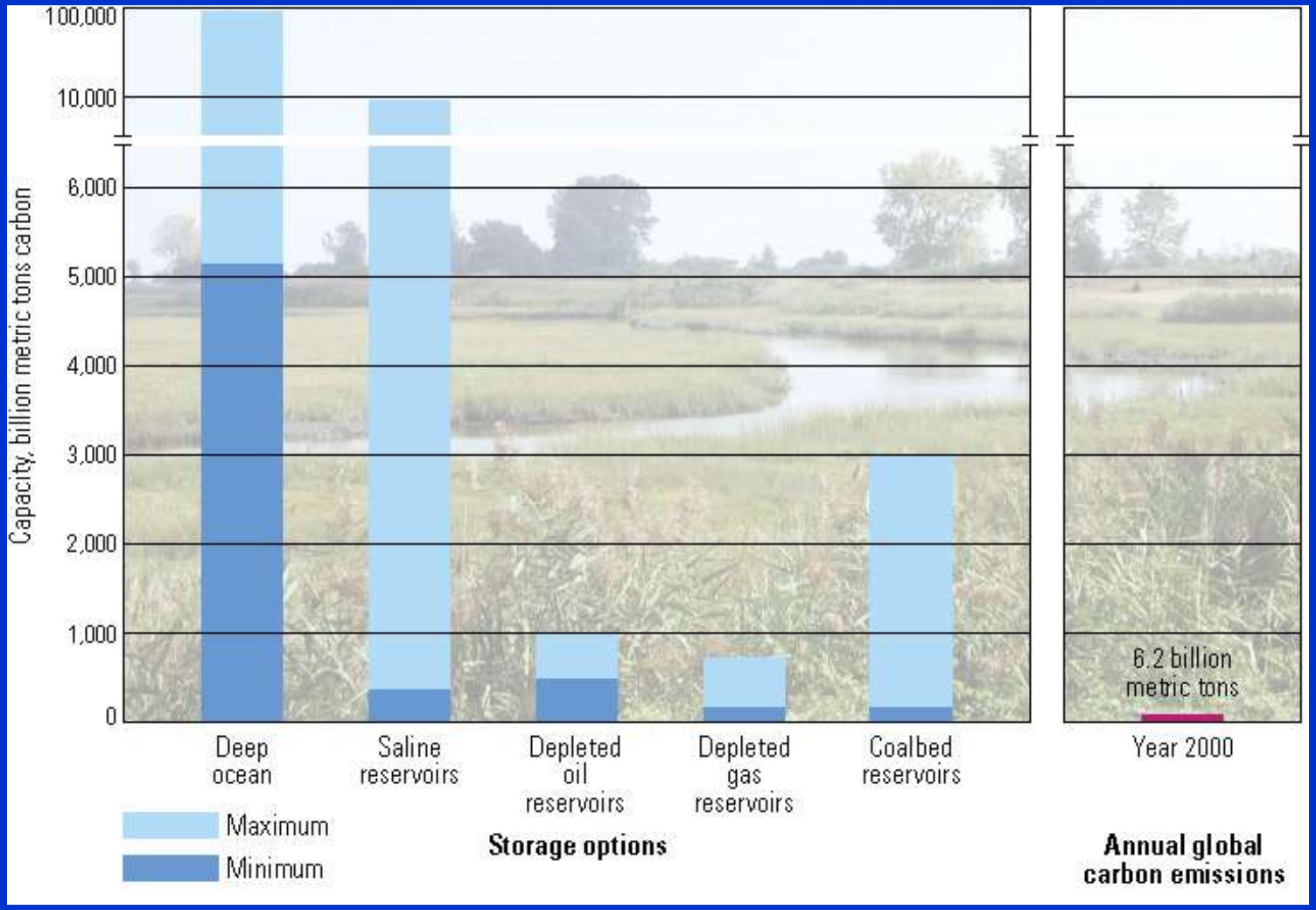
Geo-sequestration Concept



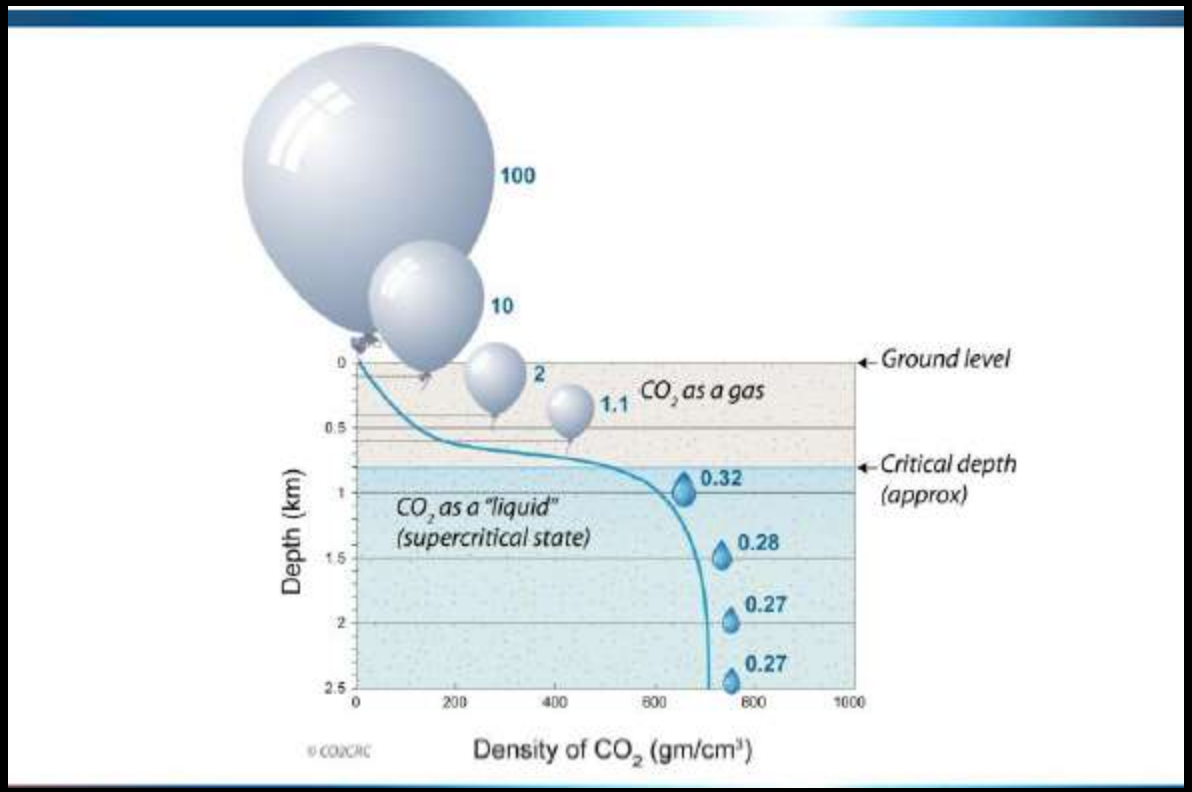
Carbon Capture & Sequestration



Capacity for Carbon Storage

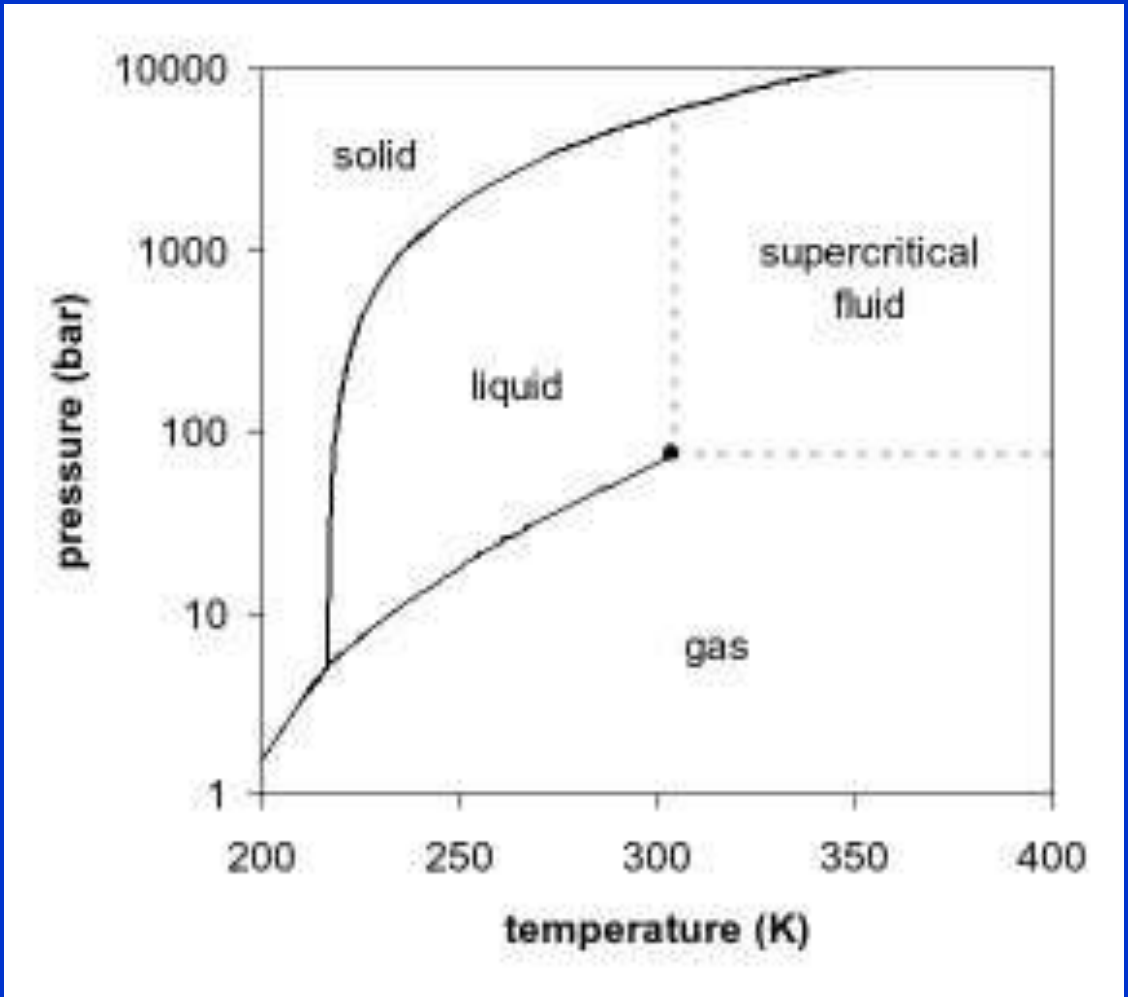


Carbon Capture & Sequestration

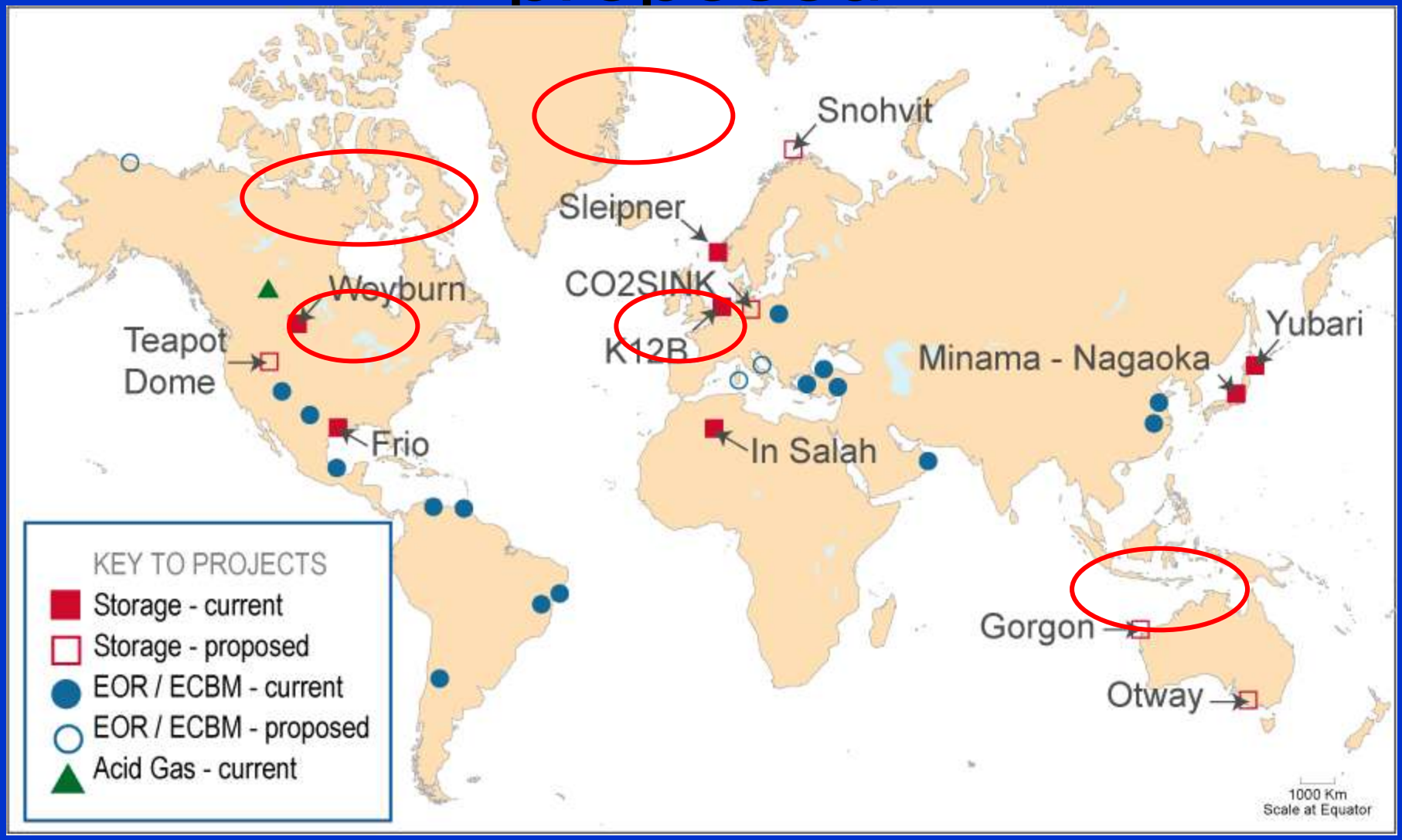


Carbon dioxide pressure-temperature phase diagram

72.9 bar 31 C



CO_2 Storage Projects - current & proposed



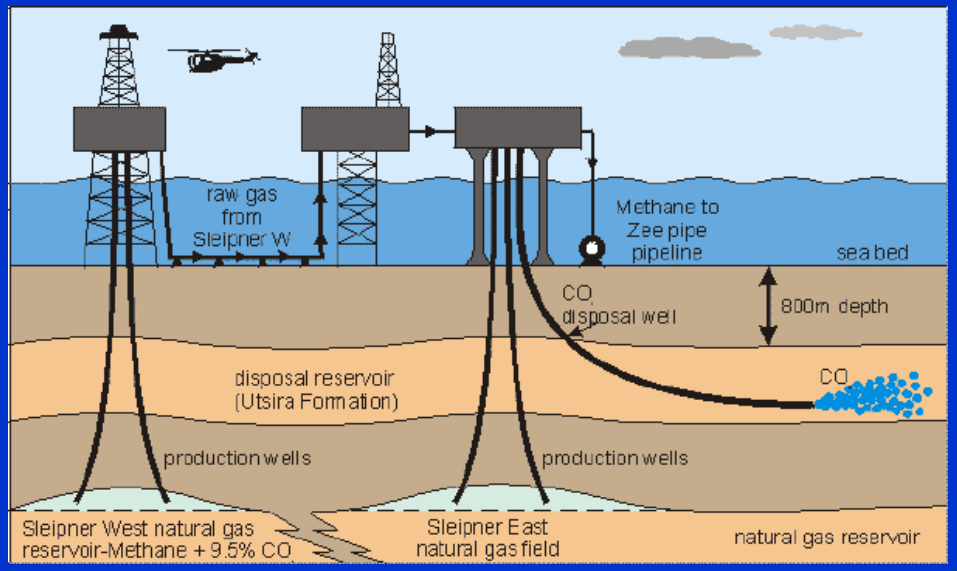
Carbon Capture & Sequestration

Largest project so far sequesters

1 million ton /annum of CO_2

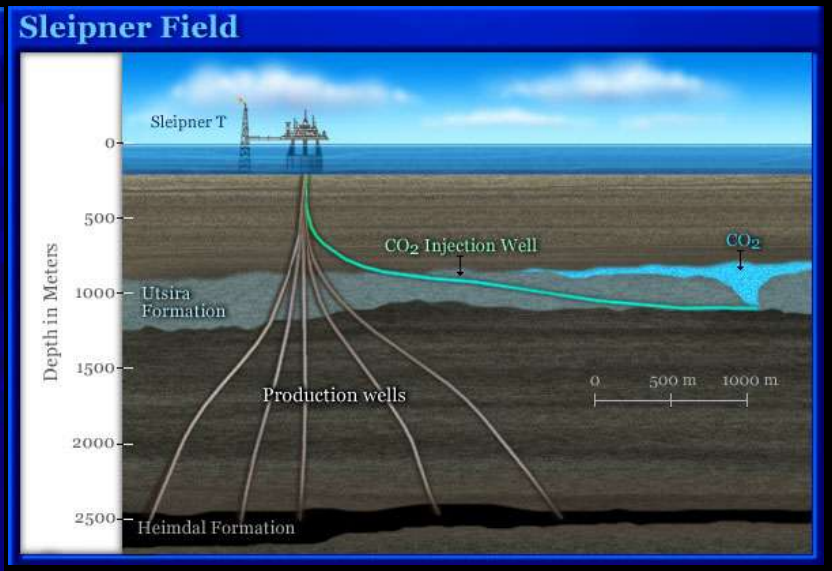
Sleipner

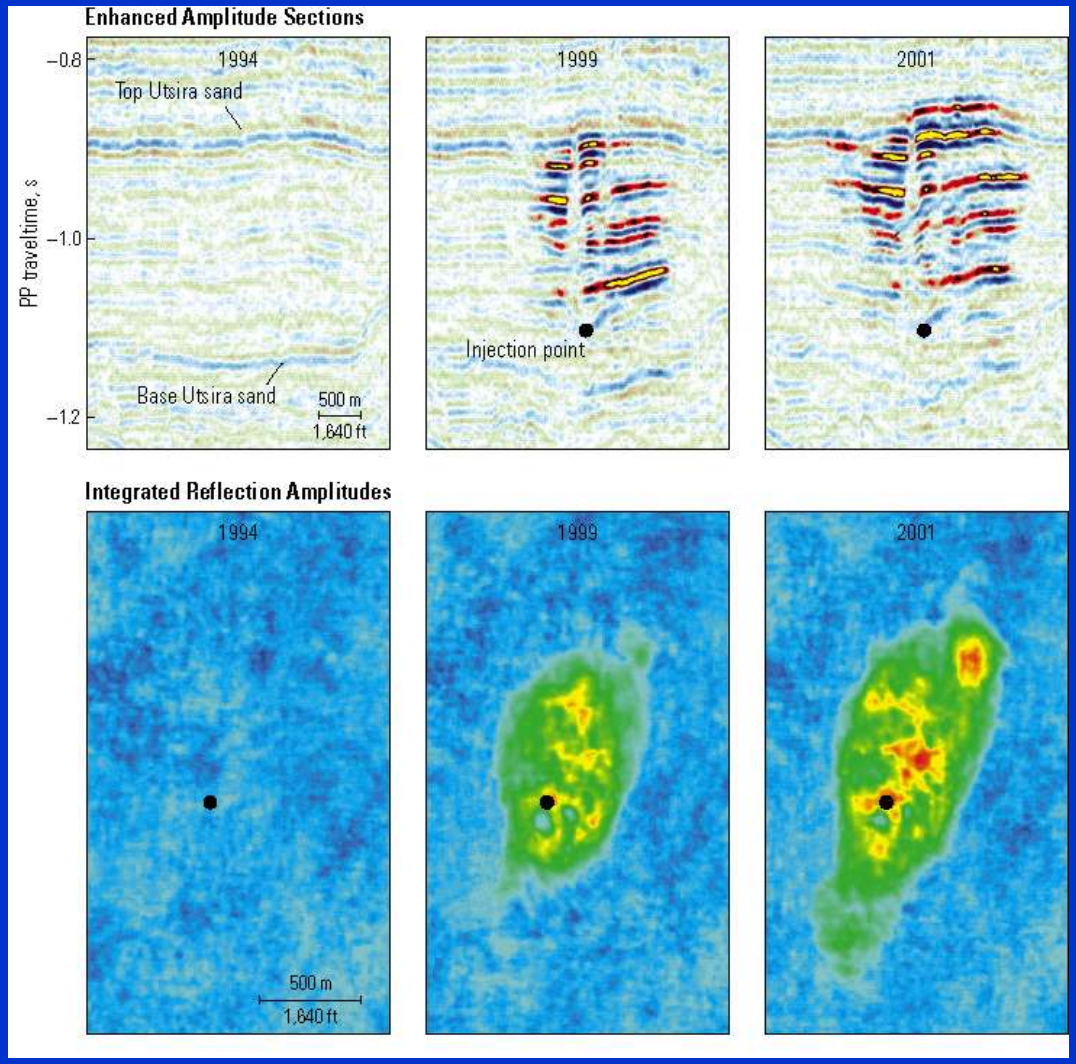
Sleipner (STATOIL)

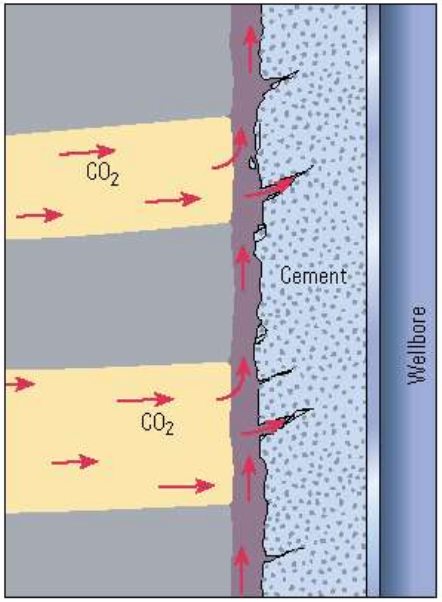


- 250 kilometres west of Norway in the North Sea
- Injection into Utsira Formation, a sandstone.
- 1 million tons CO_2 per year since 1996

Carbon Capture & Sequestration




Enhanced Amplitude Sections
PP traveltime, s
–0.8
–1.0
–1.2
1994
Top Utsira sand
Base Utsira sand
500 m
1,640 ft
1999
Injection point
2001
Integrated Reflection Amplitudes
1994
500 m
1,640 ft
1999
2001

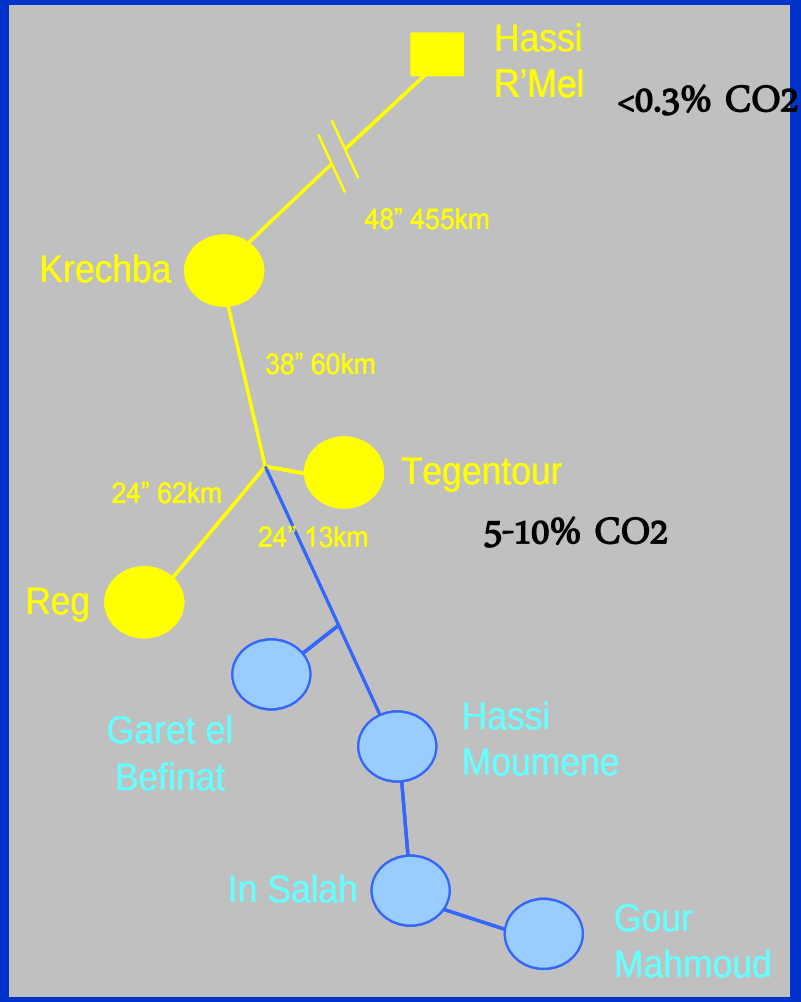

CO_2
Cement
Wellbore
CO_2

Weyburn CO_2 Project

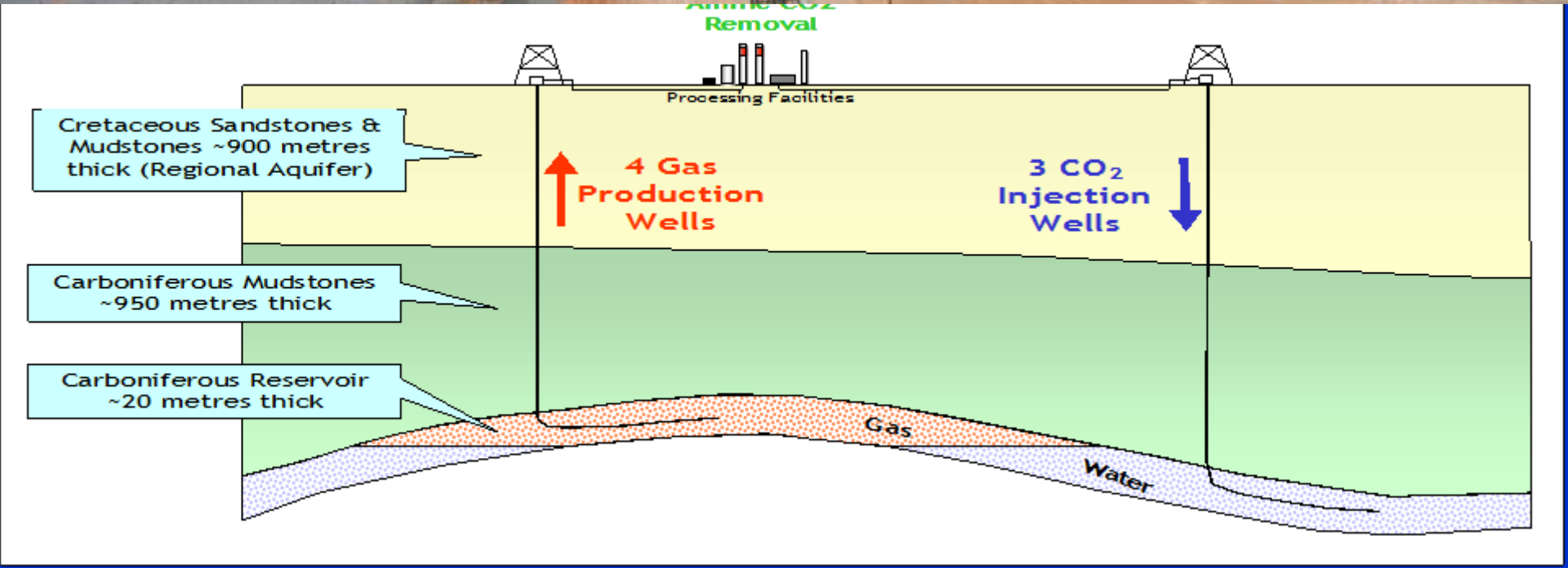
- CO_2 Source: Dakota Gasification Company
- 95 mmscfd (5000 tonnes/day) injection rate
- CO_2 purity 95% (primary feed)
- Currently 26% recycle.

Main CO_2 pipeline enters Weyburn

In Salah Gas Project



In Salah CO_2 Storage Operation

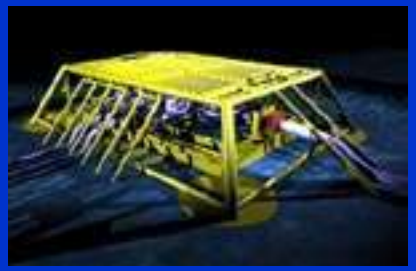


Carbon Capture & Sequestration

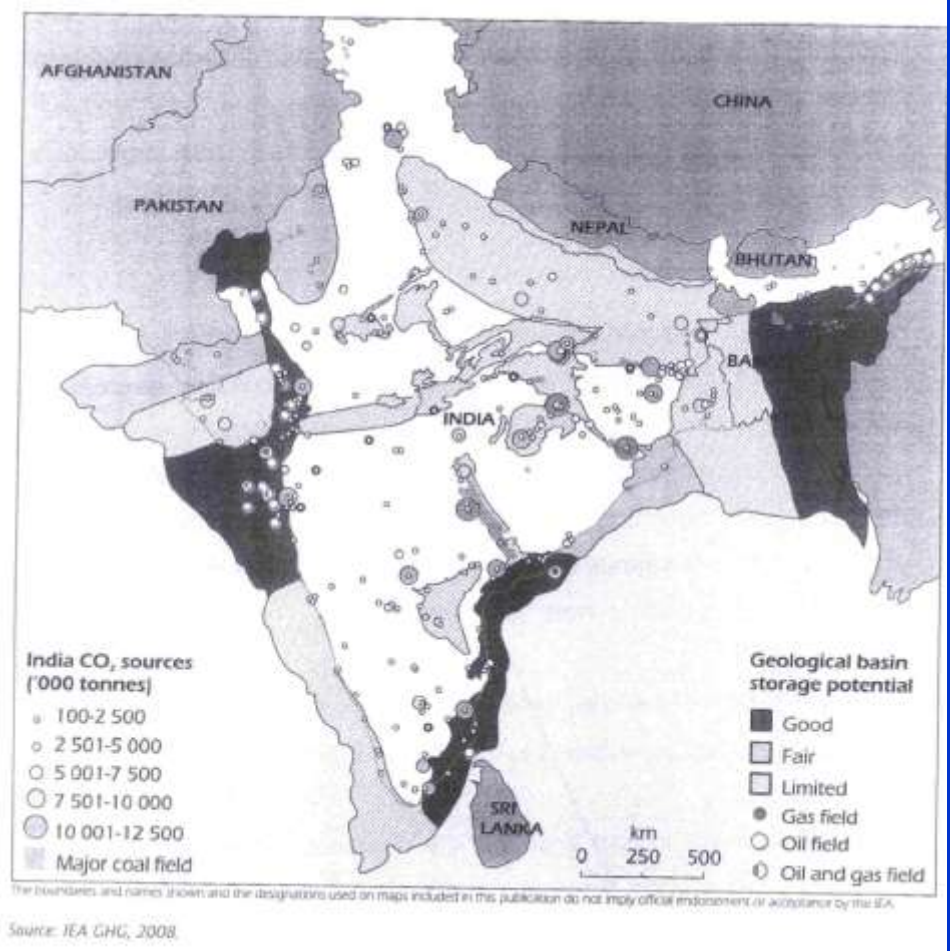
April 2008, Statoil announced carbon storage had started on its Snøhvit field – Statoil is reinjecting Snøhvit's CO2 emissions into the ground beneath the gas-bearing formation on the field. The process will reduce CO2 emissions by 700,000t a year when Snøhvit is at full capacity, it is estimated. This is the equivalent of emissions from 280,000 cars.

Natural gas is first pumped to a carbon capture plan at Melkøya. Here, 5% to 8% of CO2 is removed from the gas and piped back to a 2,600m-deep sandstone formation at Snøhvit, where it sits under the seabed

Snøhvit Project



India CO2 Sources & Storage Potential



Carbon Capture & Sequestration

INDIA

Storage Potential	500 to 1000 Gt
Off shore Deep Saline	300 – 500 Gt
Basalt Traps	200 – 400 Gt
Depleted Oil ,gas fields	5 --10 Gt
Unminable Coal Seams	5 Gt

Carbon Capture & Sequestration

INDIA

No field large enough to store life time emissions from a medium sized Power Plant

Saline Aquifer potential in Assam more than 1000 Km away from CO_2 sources

Carbon Capture & Sequestration

Largest project so far sequesters

1 million ton /annum of CO_2

We generate

30,000 million tons of CO_2 !

A Sleipner a day for 80 years!!!

Carbon Capture & Sequestration

What is left out ?

Costs

Economics

Legal aspects

Regulatory frame work

Monitoring , verification

Politics

Public Acceptance

Risk assessment , mitigation

Long term liability


Surprises…
The Only Certainty


What do you have to lose?