IEA Greenhouse Gas R&D Programme

CO_2 Capture and Storage Technology Status

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IEA Greenhouse Gas R&D Programme

Open Hearing on Carbon Capture and Storage

European Parliament

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Introduction

- Briefly discuss the IEA Greenhouse Gas R&D Programme
- Outline role in reducing global CO_2 emissions
- Technology Status
  - International Acceptance
  - Demonstration activities currently underway worldwide
  - New developments
  - Costs
- Barriers to implementation

IEA Greenhouse Gas R&D Programme

- A collaborative research programme which started in 1991.
- Its main role is to evaluate technologies that can reduce greenhouse gas emissions.
- Aim is to:

Provide our members with informed information on the role that technology can play in reducing greenhouse gas emissions

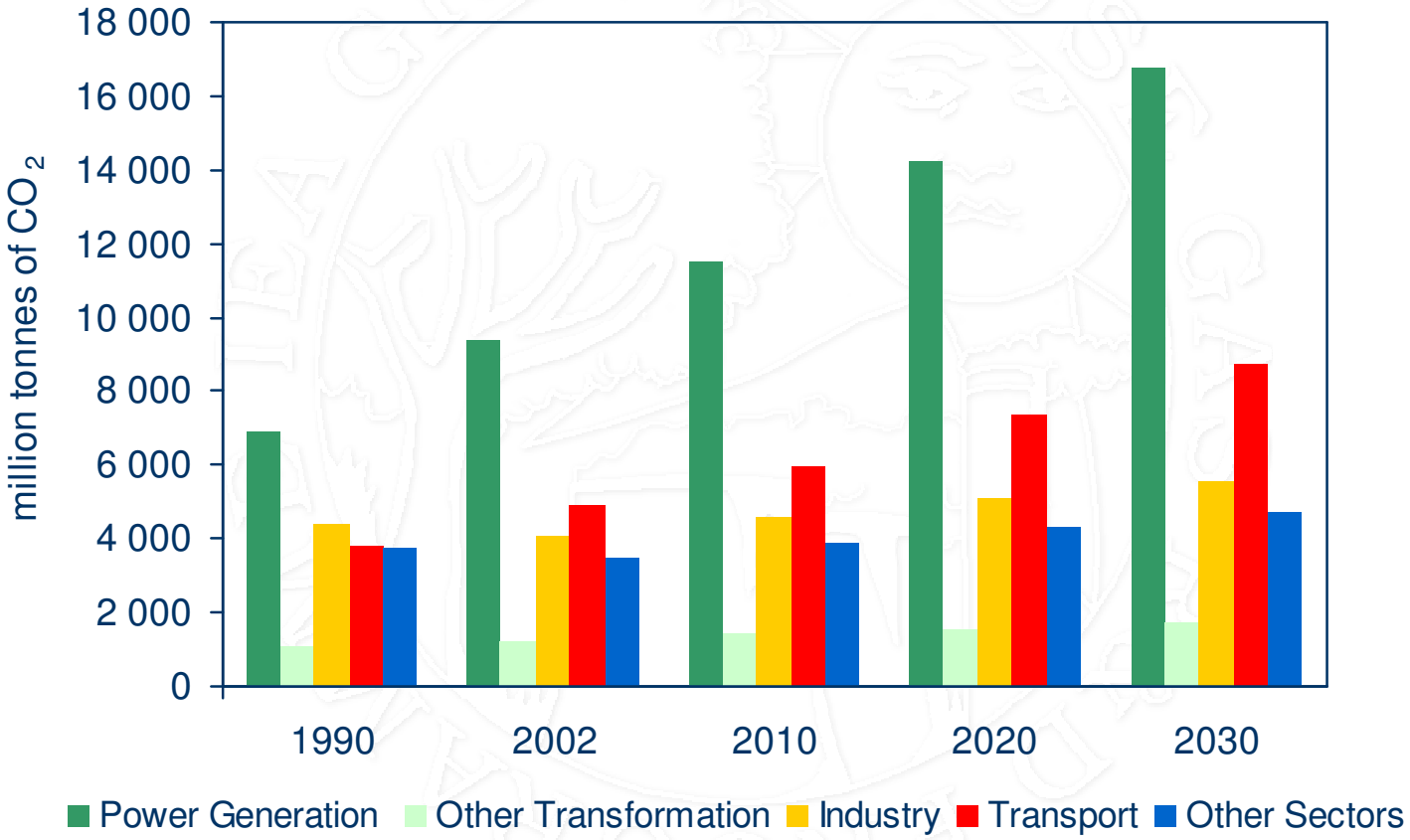
Current Membership

OPEC Organization of the Petroleum Exporting Countries

ALSTOM · B&W · BG GROUP · bp · Chevron · EnTecnologie · e·on · EPRI

ExxonMobil · Repsol YPF · RWE · Schlumberger · Shell · Statoil · Total · Vattenfall

Global CO_2 Emissions



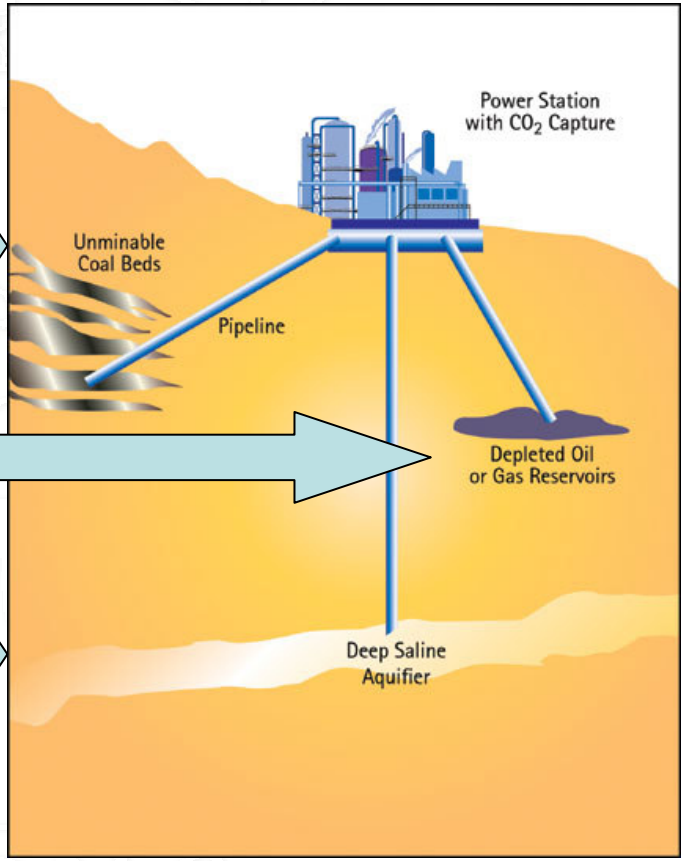
Source: IEA World Energy Outlook 2004

Geological Storage Options

Unminable Coal Seams
30 Gt CO_2
Able to store <2 Years of 2030 Emissions

Depleted Oil & Gas Fields
930 Gt CO_2
Able to Store 50 Years of 2030 Emissions

Deep Saline Aquifers
400-10 000 Gt CO_2
Able to store 20 - 530 Years of 2030 Emissions



Note: CO_2 Storage capacity at cost of 20 US $ per tonne of CO_2

Role for CCS

- Capable of large-scale reductions in CO_2 emissions in the next 20-50 years
  - Without need for major energy infrastructure changes
- CCS should be considered as part of a portfolio of mitigation options
  - Energy efficiency;fuel switching;renewable energy; nuclear power

International Acceptance

- The main international frameworks covering CCS are:
  - The Law of the Sea (UNCLOS)
    - London Convention
    - OSPAR Convention
  - Climate Change Framework
    - Kyoto Protocol

International Acceptance

- Recent developments
  - IPCC Special Report on CCS accepted at IPCC Plenary in September 2006
  - CCS accepted as a mitigation option under Kyoto Protocol in November 2006 at MOP1
    - Committee reviewing issues related to safety
  - London Convention
    - Amendment submitted by Norway in January 2006 to allow CCS in sub sea structures
    - Discussed in April 2006

IEA Greenhouse Gas R&D Programme

CCS Demonstration Projects

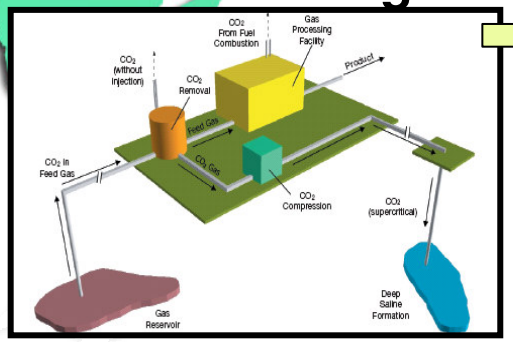
Sleipner

Snøhvit

In-Salah

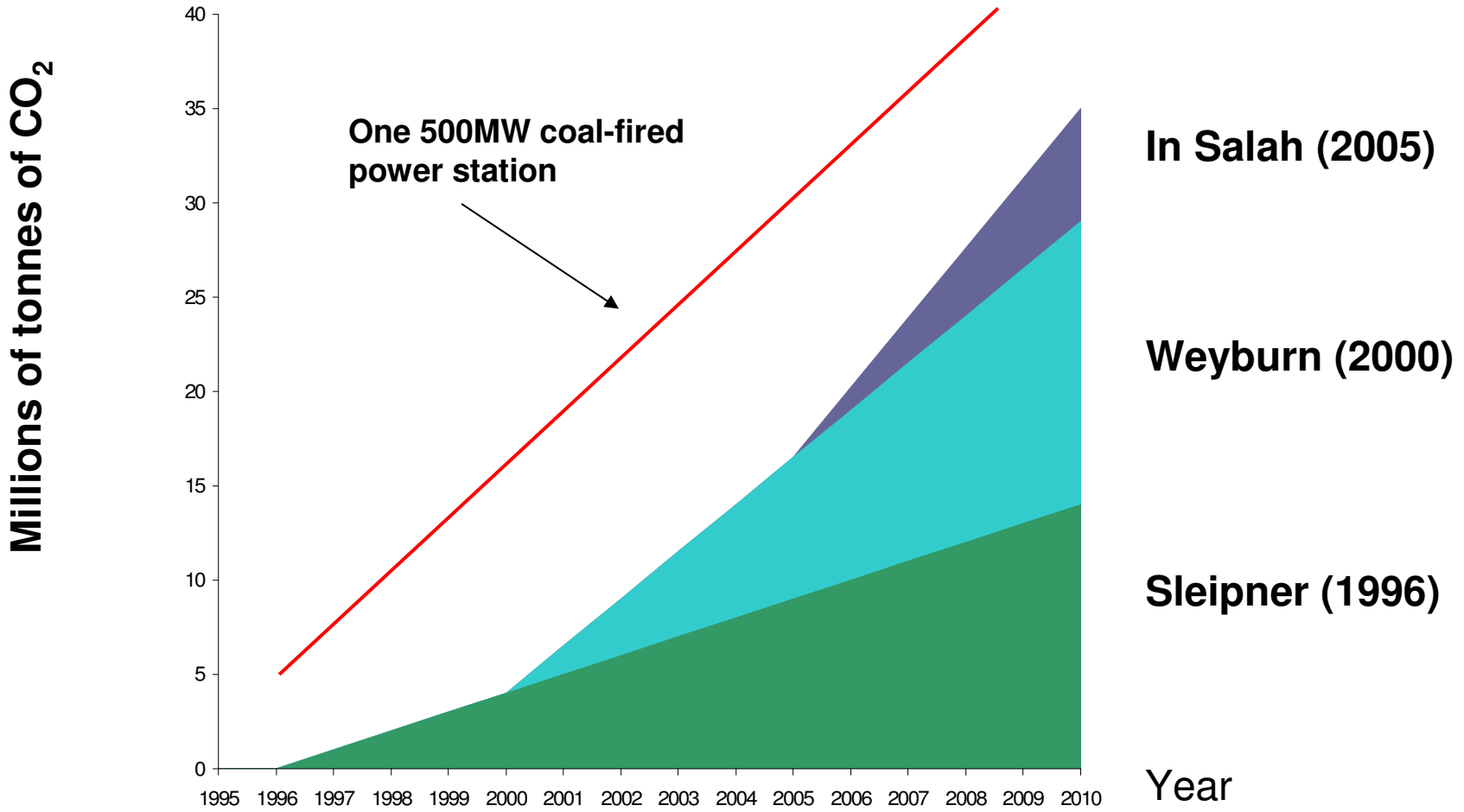
Weyburn

Gorgon



Images Courtesy of BP, Statoil Chevron and PTRC

Monitored CO_2 Stored Underground



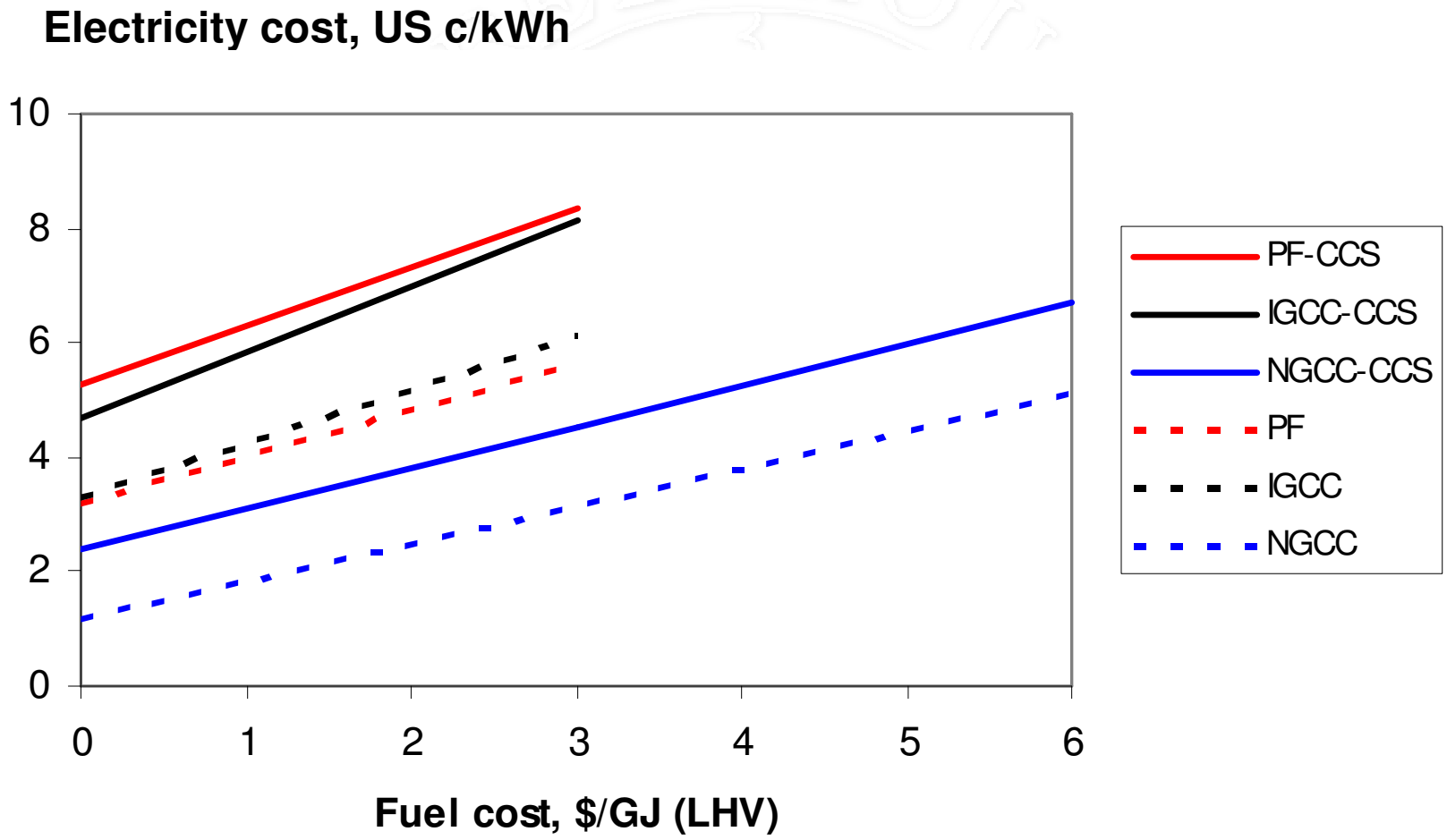
Recently Announced Demonstration Activity

- Integrated system demonstrations in power sector:
  - USA – FutureGen
    - Coal fired IGCC, hydrogen/power & CCS)
  - Europe - HypoGen>Dynamis
    - Coal fired IGCC or PF, hydrogen/power & CCS
  - Canada - Saskatchewan Power
    - Lignite fired PF+CCS
  - Australia - Stanwell Corporation
    - Coal fired IGCC, Power & CCS
  - China - EU nZETS project
    - Clean coal plant and CCS

Recent Announced Demonstration Activity

- Integrated system demonstrations planned in power/oil and gas sector:
  - DF1 – Miller Field/Peterhead power station in Scotland
    - Natural gas plant with power/hydrogen production and CO2-EOR
  - DF2 – California, USA
    - Pet Coke plant with power/hydrogen production and CO2-EOR

Cost of Capture and Storage



CO_2 Capture Cost Reductions

- Costs of new technologies decrease
- "Learning by doing"
  - Incremental improvements in existing technologies
  - Capture costs predicted to decrease by 15-40%,
    - By analogy with other process technologies
- Major technology innovation
  - R&D is being carried out on new capture technologies
  - Further major cost reductions may be achieved

Summary (1)

- Globally CCS can with other measures make a significant impact on reducing CO_2 emissions
- Use existing energy supply infrastructure
- International acceptance is now close
  - CO2-EOR was not an issue anyway
  - Removes a major barrier to implementation
- Technology is mature in certain sectors
  - Several large demonstration projects already in oil and gas sector
  - Development of existing oil and gas technology

Summary (2)

- Power sector projects are now appearing
  - By 2020 we should see several large integrated demonstration projects in power sector
    - But we have some work to do yet
- Costs are high but comparable with other mitigation technologies
  - Capture costs will reduce 15-40% with replication
    - Capture is highest single cost component

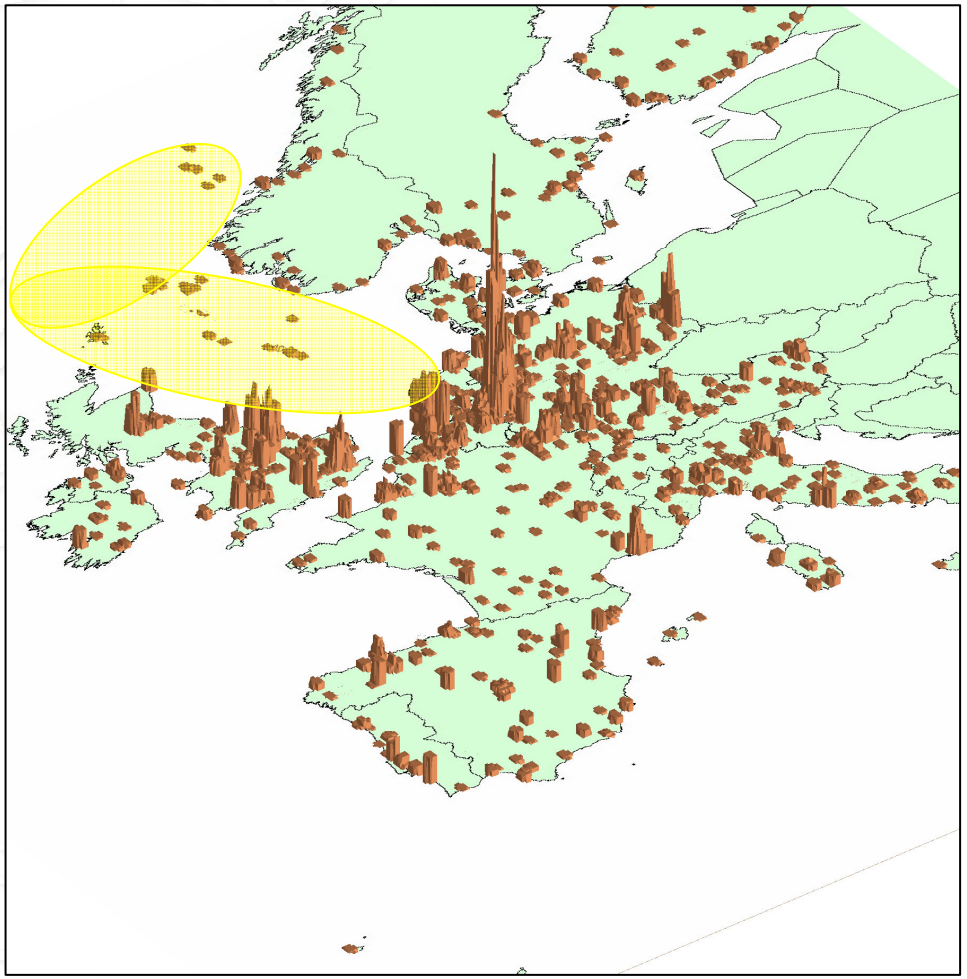
Barriers to Implementation

- The issue of permanence
  - We must be able to demonstrate that the injected CO_2 does not seep back out of the reservoir
    - Health and Safety/global environment
- The absence of regulations
  - No international standards
  - National are being developed in many countries
    - We need to move more rapidly
- Market creation
  - Fiscal or financial incentives needed

Final Thoughts

Europe

- Sources and storage opportunities don't overlie each other
- But can connect 95% of sources
- Emissions of 30.7Gt over 20 years
- Need 150 000 km of pipelines going across national boundaries



Thank You

ANY QUESTIONS?