

# Carbon Capture & Storage: Are Market Mechanisms Enough?

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# Overview

- **The role of CCS in a clean energy future**
- **CCS: Current status**
- **Challenges to wider use of CCS**
  - ◆ **Legal and regulatory frameworks**
  - ◆ **Financing and incentives**
- **Conclusions**



# International Energy Agency

Created in 1973; currently 27 member countries

## Goals:

- energy security
- environmental protection
- economic growth

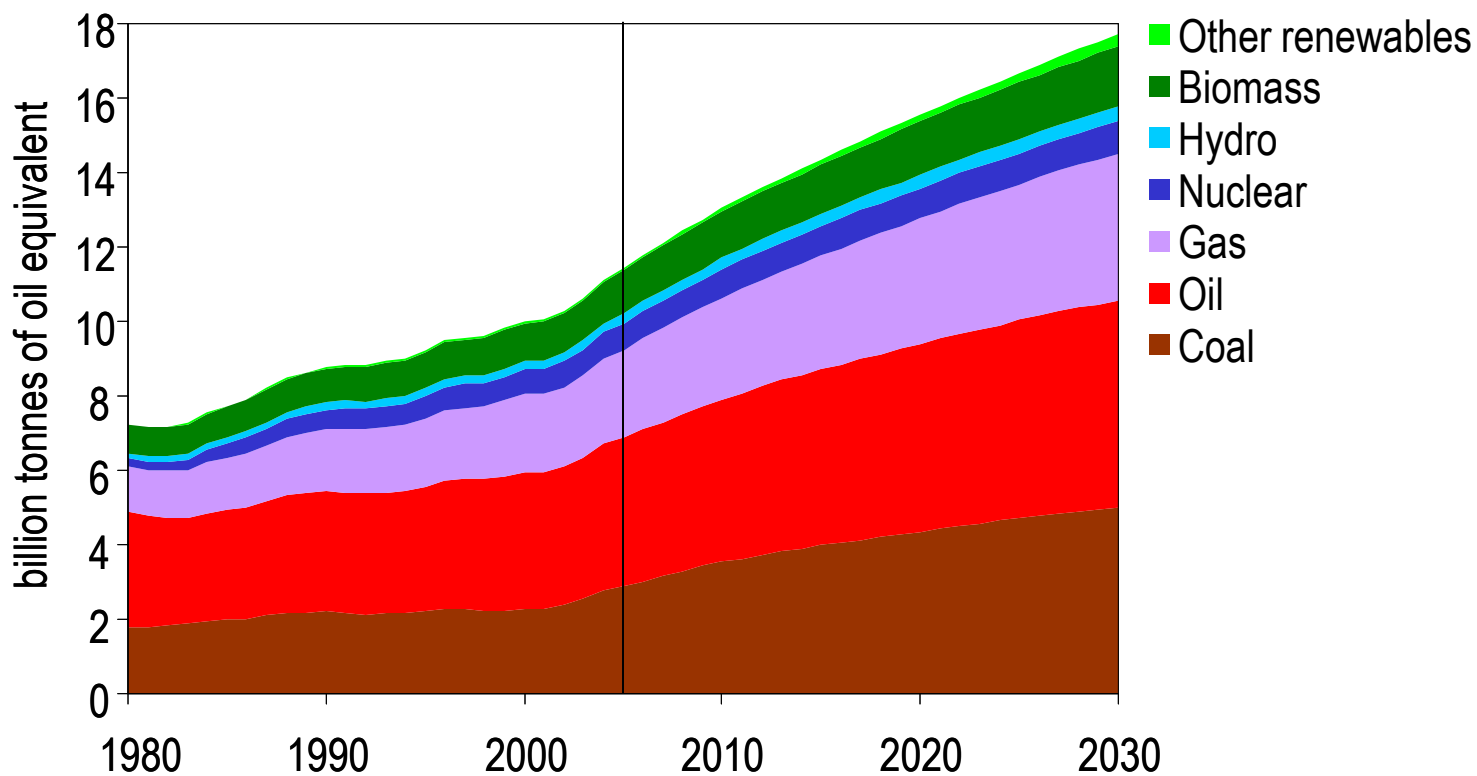


## Activities:

- co-ordinates efforts to ensure energy security
- conducts policy analysis
- compiles energy statistics
- reviews energy policies & programs
- links research activities and governmental directives
- convenes, mobilizes science & technology experts



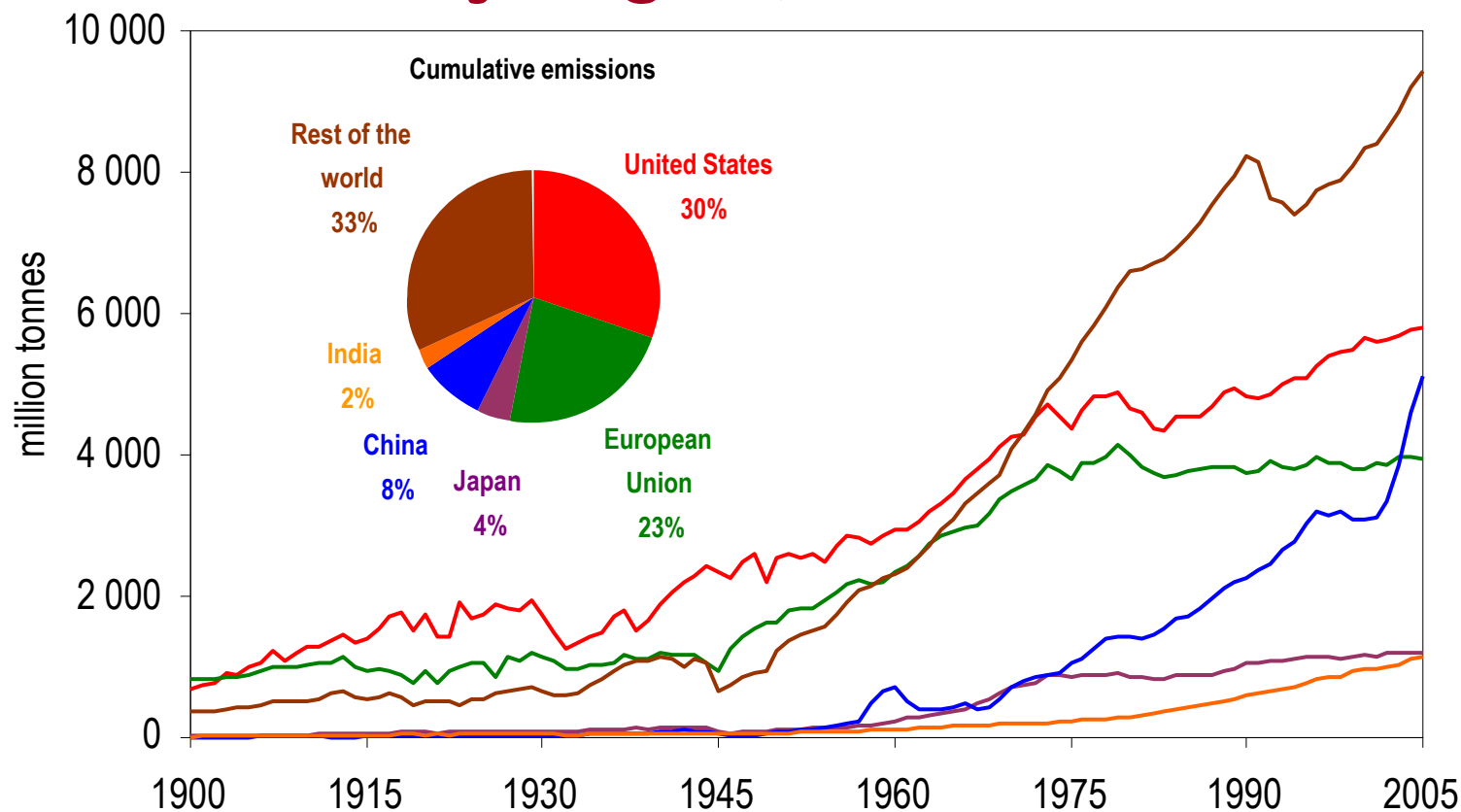
# WEO Reference Scenario: World Primary Energy Demand



Source: IEA/OECD, World Energy Outlook 2007

**Global demand grows by more than half over the next quarter of a century, with coal use rising most in absolute terms**

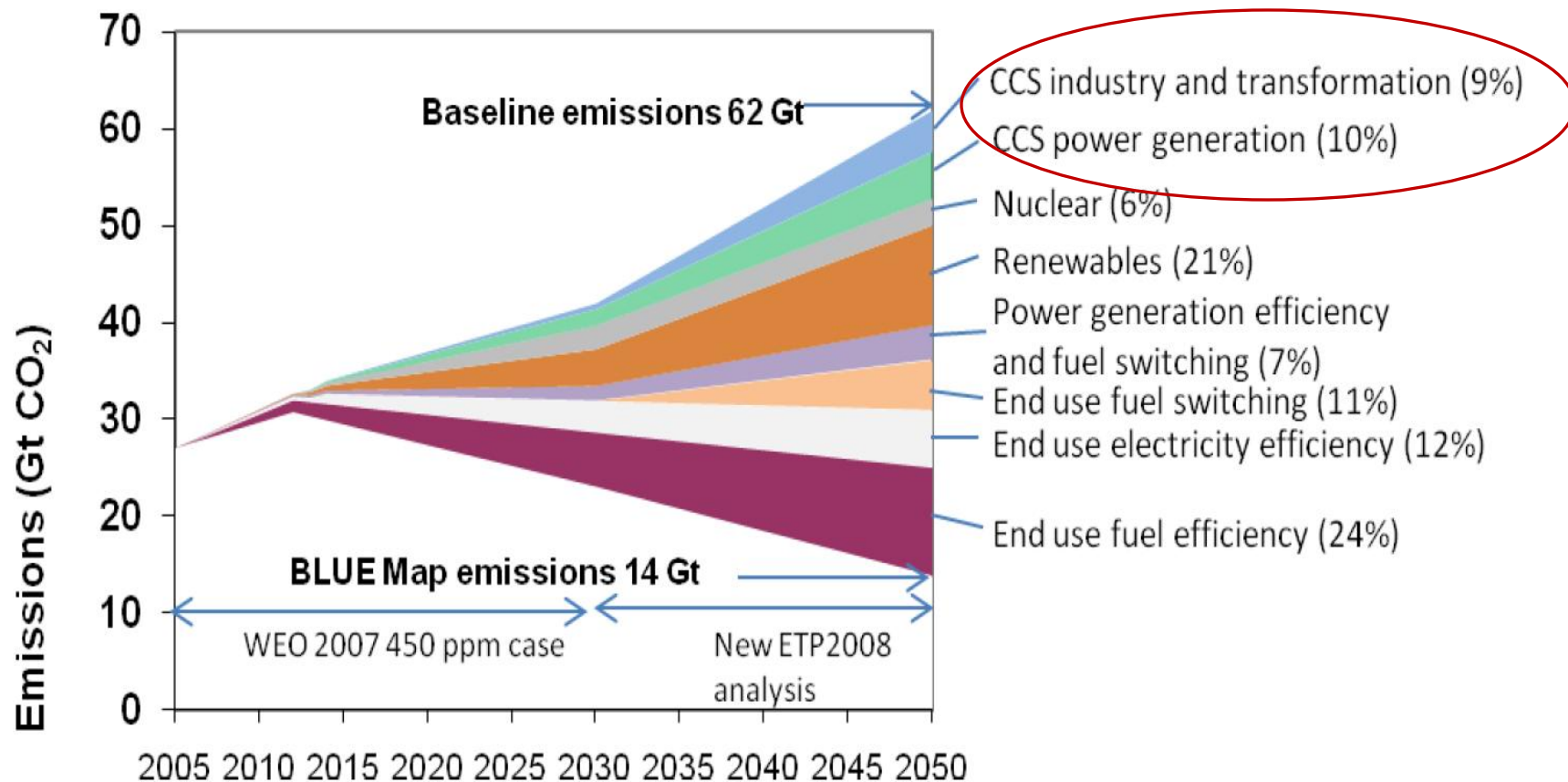
# Energy-Related CO<sub>2</sub> Emissions by Region, 1900-2005



Source: IEA/OECD, World Energy Outlook 2007

**Over the last century, China has contributed only 8% of global emissions ; India 2%**

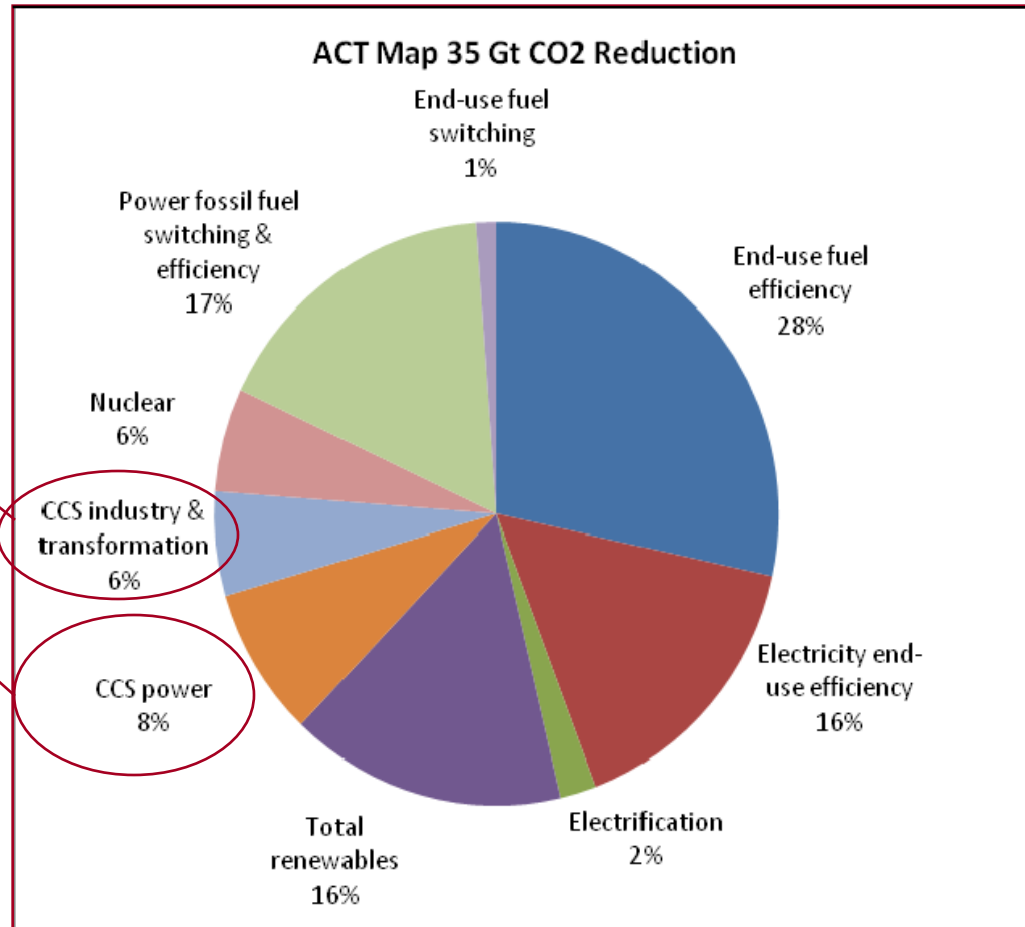
# A Portfolio of Technologies Is Needed



Source: OECD/IEA, *Energy Technology Perspectives* (forthcoming 2008).

# \$50 USD CO<sub>2</sub> Incentive Scenario

**4.9 Gtpa =  
Equivalent  
to 1,800  
Sleipner  
Projects**

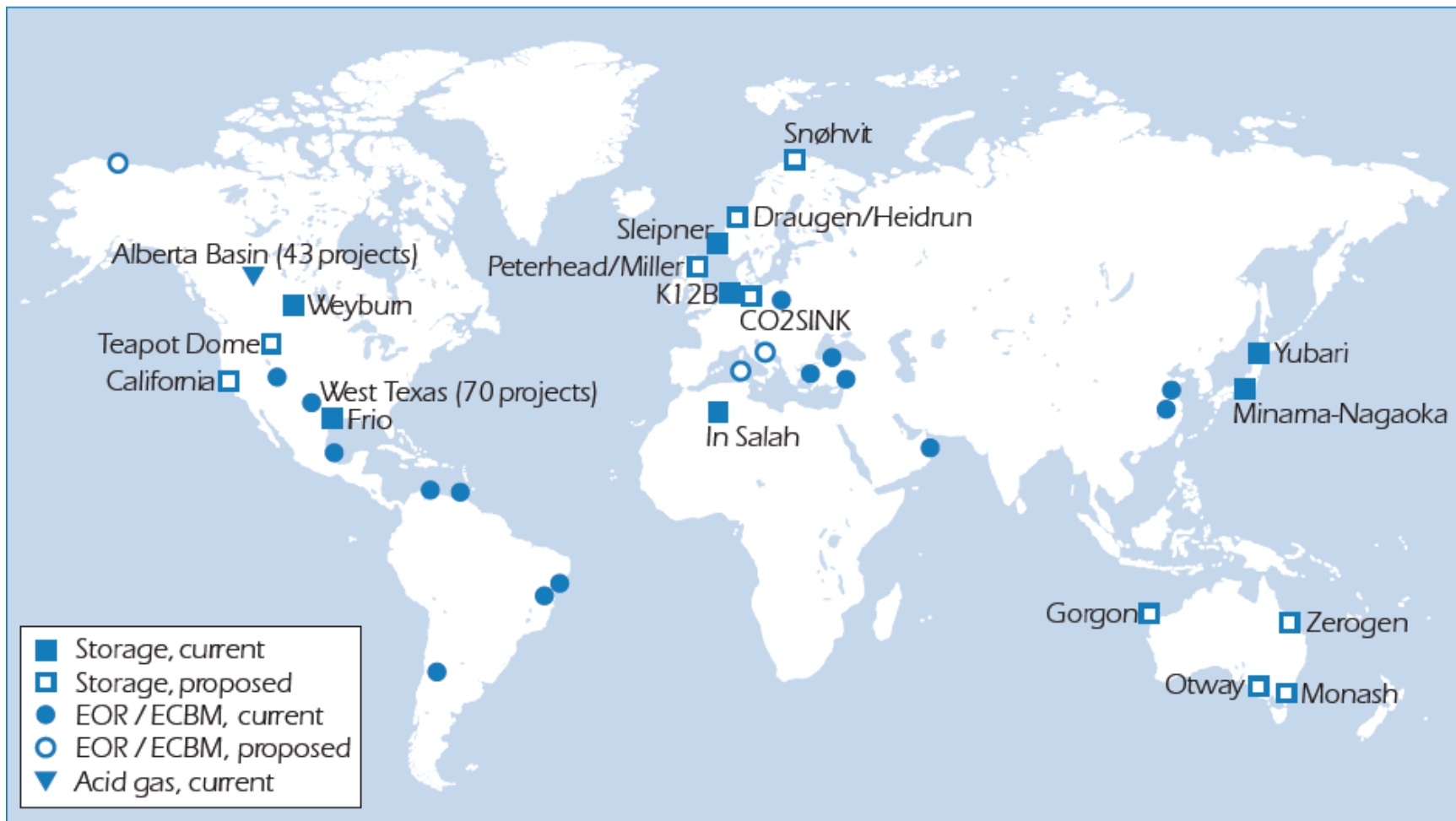


Source: OECD/IEA, *Energy Technology Perspectives* (forthcoming 2008).

# Challenges to CCS Use

- Full-scale demonstration urgently needed
- Public awareness and acceptance
- Legal and regulatory frameworks
  - ◆ National frameworks for capture, transport & storage
  - ◆ International frameworks for offshore storage
- Commercial and financial
  - ◆ Need a firm, long-term price for CO<sub>2</sub>
  - ◆ Need significant government, industry financing

# Current and Proposed CO<sub>2</sub> Storage Projects



# Actual CCS Experience Is Limited

- **4 operational projects**
  - ◆ Sleipner and Snøvit (North Sea), In Salah (Algeria), Weyburn (Canada/US border)
  - ◆ None is full-scale, none involves capture from coal-fired power plants
- **Public-private initiatives**
  - ◆ Regional partnerships:
    - North America Regional Sequestration Partnerships; Canada CCS Technology Network; Germany's R&D programme (COORETEC); Australia's CO2CRC
  - ◆ EU Zero Emissions Technology Platform, Competency networks (CO2NET, CO2GeoNet)
  - ◆ China-related initiatives (Greengen, nZEC, MoveCBM)
  - ◆ Carbon Sequestration Leadership Forum, IEA, others

# Major CCS R&D Initiatives

- **US FutureGen** was to build a USD 1.5 -2 billion 275 MW coal-fired power plant with CCS and hydrogen generation by 2017
  - ◆ Effort in doubt after January 2008 US DOE funding cut
- **EU-funded Hypogen** is a EUR 1.6 billion initiative to build by 2016 a coal-fired pre-combustion power/H<sub>2</sub> plant
- **Queensland (Australia) ZeroGen Project** - IGCC with 100 MW baseload electricity generation by 2012, with capture, pipeline transport and storage in the Northern Denison Trough
- **Stanford's Global Climate & Energy Project**
- **EU Framework Programmes for RD&D (FP5 – FP7):** SACS, CASTOR, GeoCapacity, CO2SINK, CO2ReMoVe, ENCAP

# Legal & Regulatory Issues

- **Property rights issues for transport and storage**
- **Environmental permitting, risk management**
  - ◆ **M&V frameworks for CO<sub>2</sub> retention**
  - ◆ **Public consultation for proposed projects**
- **Pipeline access, construction regulations**
- **Long-term liability frameworks**
- **Need to develop regulatory models for early projects and adapt as knowledge is gained**

# Offshore CO<sub>2</sub> Storage Legal Issues

- London Protocol, OSPAR limit “dumping” of wastes
- Both had 2007 Amendments on CCS
  - ◆ Allow CO<sub>2</sub> to be placed in offshore storage, but:
    - Disposal must be into a sub-seabed geological formation, *and*
    - Disposed matter must be “overwhelmingly” CO<sub>2</sub>, *and*
    - No wastes or other matter may be added, *and*
    - Disposal must be permitted by national authority.
  - ◆ Require national governments to manage offshore storage via permitting
  - ◆ Developing detailed M&V, site selection guidance
- Japan first country to implement permit scheme in national law
  - ◆ “Overwhelmingly CO<sub>2</sub>” is defined as 99%+

# CCS Financing Issues

- There is no experience with a full-scale, integrated CCS project
  - ◆ CO<sub>2</sub>-EOR allows learning by doing
  - ◆ Government support will be critical for early projects – a Litmus Test?
- CCS investment risks have grown as commodity prices have doubled
- CO<sub>2</sub> transport infrastructure is another important challenge
  - ◆ Governments may need to subsidize first CO<sub>2</sub> pipelines
- Power plants with CCS will require carbon constraints and/or CCS mandates *combined with* technology and liability support

# Market Mechanisms - Options

- **GHG cap-and-trade system**
- **CCS mandates for new (and/or retrofit) plants**
- **Generation performance standard which requires electricity generators to achieve a CO<sub>2</sub>/kWh emissions level**
- **Passing on additional costs to electricity consumers via rate increases**
- **Creation of a dedicated CCS Trust Fund**
- **A combination of these options is likely**

# CCS and GHG Regulation

- UNFCCC does not explicitly reference CCS
- Two accepted methodologies for measuring GHG reductions made by the Parties
  - ◆ National inventories
  - ◆ Reductions made under Kyoto Flexible Mechanisms
- In 2006, the IPCC adopted Guidelines for national inventories which included for the first time CCS methodology
  - ◆ Norway has submitted Sleipner project using these guidelines

# CCS and CDM

- **CDM Executive Board and the COP/MOP have not yet taken a decision on the inclusion of CCS**
- **May 2006 CDM EB Workshop Issues**
  - ◆ **Project boundary issues**
    - **Spanning international boundaries**
    - **Mixing multiple projects in 1 storage reservoir**
  - ◆ **Accounting for leakage resulting from the additional energy required to capture, transport and store CO<sub>2</sub> effectively**
  - ◆ **Ensuring the permanence of stored CO<sub>2</sub>**
  - ◆ **Some concerned that CCS will overwhelm CDM funding**
- **Consultations with Parties, NGOs in 2007; final submissions due in June 2008 at SBSTA**
- **A path forward: approve simplified CCS project first**

## EU ETS and CCS

- ETS is viewed as a key tool to incentivise CCS
- CCS not explicitly referenced in the Directive
- However, CCS can now be opted-in under Article 24
  - ◆ Capture, storage and transport must be opted in together using the “bubble” approach
- January 2008 Energy & Climate package
  - ◆ CCS will be explicitly included under Phase III
  - ◆ Captured and stored CO<sub>2</sub> is recognised as not emitted under the ETS

# IEA CCS Work

- **G8 “Near-Term Opportunities” for CCS**
  - ◆ High-level recommendations for Hokkaido Summit
- **Legal & regulatory frameworks**
  - ◆ *Legal Aspects of CO<sub>2</sub> Storage* publications
  - ◆ May 2008: launch of the IEA International CCS Regulators Network
- **IEA GHG leading work on technical aspects:**
  - ◆ Capture-readiness definition
  - ◆ M&V procedures, technologies
  - ◆ CO<sub>2</sub> storage site selection

# Conclusions

- **CCS is a key part of the climate change solution**
  - ◆ Coal-fired power generation is growing globally
  - ◆ 15-25% of the needed GHG reductions by 2050
- **Government support is critical**
  - ◆ Especially for early projects
  - ◆ Current trends do not bode well
  - ◆ Need 5-10 full-scale demonstrations urgently
- **GHG regulatory schemes and a variety of other incentives need to be tested**

*Thank you!*

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