



IEA Greenhouse Gas R&D Programme



# Developments on the Implementation of CCS in Europe

**John Gale**

**IEA Greenhouse Gas R&D Programme**

**CCS Workshop**

**19<sup>th</sup> November 2007**

**Tokyo, Japan**



## Introduction

- Recent developments under the International marine environment conventions
  - London Protocol & OSPAR
- European Commission initiatives to support CCS implementation
  - National initiatives and plans
  - National legal and regulatory frameworks
- Broader Issues



## International Marine Conventions

- International marine environmental convention established in 1972
  - London Convention (LC) prevents dumping of wastes at sea
    - London Convention and extended London Protocol
- Below LC there are regional agreements covering specific regions of the ocean
  - Convention for Protection of the Marine Environment of the North East Atlantic (OSPAR)



# London Convention

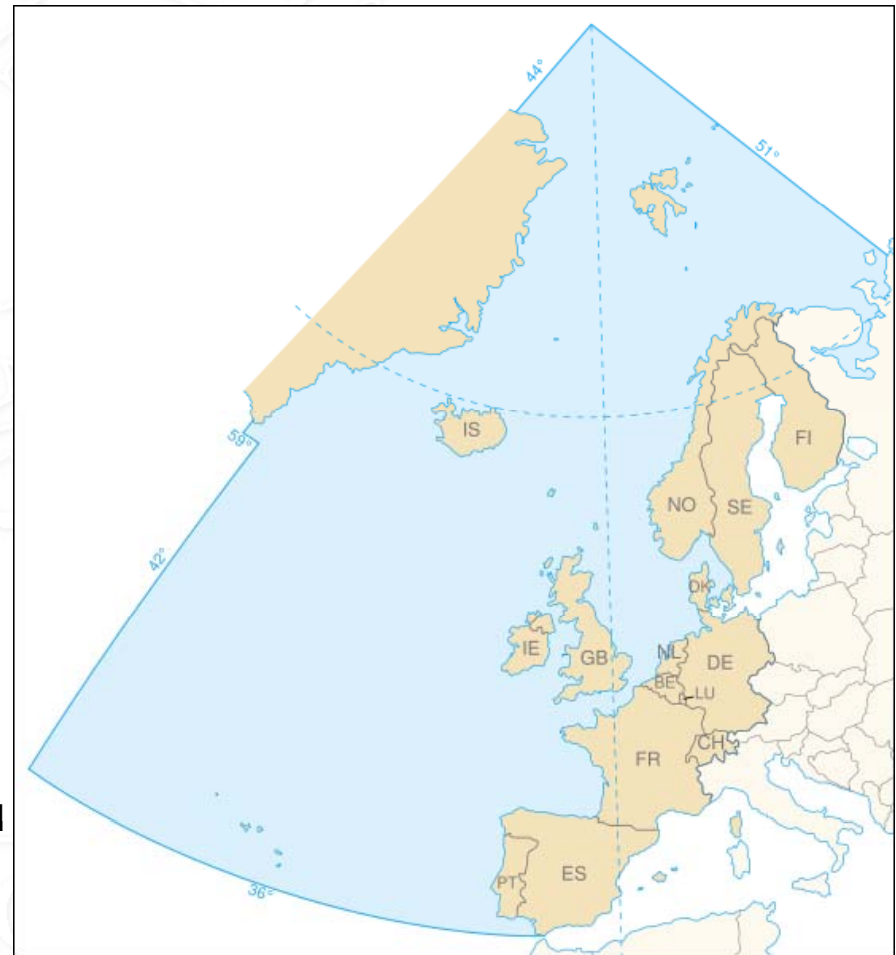
- London Convention introduced in 1975
  - Prevents aims to control all sources of pollution to the marine environment
  - Contracting parties agree to prevent dumping of industrial wastes at sea
    - Those that are liable to cause damage to human health, marine life etc.,
  - Include precautionary approach to ensure preventative measures are taken in the event that anything introduced can cause harm
- London Protocol
- More extensive approach to dumping than LC
- Prevents dumping of all materials not included in a “reverse list”
  - CO<sub>2</sub> not in “reverse list”
- Includes sea, sea bed and sub soil
  - But does not include sub sea bed repositories accessed by land





## OSPAR

- Entered into force in 1998
- Ratified by 15 signatory nations and EC
- Most comprehensive and strict legal convention
- Does not distinguish between water column and sub sea bed like the London Protocol
- Activities covered by a framework that considers sources and nature of placement
  - Discharges from land based sources into the sea are NOT PROHIBITED but must be authorised & regulated
  - Placement from a vessel is PROHIBITED
  - Placement of CO<sub>2</sub> from the operation of an offshore platform is NOT PROHIBITED but must be authorised & regulated
  - CO<sub>2</sub> from on shore to an offshore platform can be placed along as it is for enhanced oil recovery





# Recent Amendments to Marine Conventions

- London Protocol
  - Meetings of Scientific Group and Legal Working Group held in April 2006
  - Technical Working Group meeting recommended that:
    - CCS is a waste management option to be considered by Contracting Parties' in their approaches to mitigating greenhouse gas emissions
  - Legal Working Group agreed to amend Annex 1 of Protocol to the Convention to allow CO<sub>2</sub> to be included under wastes that can be disposed of (Paragraph 1.8)
    - Only in sub sea geological structures,
    - The waste is overwhelmingly of carbon dioxide,
    - No wastes or other matter are added.
  - Proposals from Working groups submitted to first Statutory Meeting of the Protocol Parties
    - 30 October – November 3, 2006
  - Amendment to London Protocol accepted
    - CCS in sub sea geological storage structures (CCS\_SSGS) now legal under London Protocol



## Recent Amendments to Marine Conventions

- London Protocol
  - Guidelines adopted in April 2007 for use by national authorities regulating disposal at sea
  - Guidelines indicate that acceptance of CCS does not remove obligation to reduce need for disposal under the Protocol
- Guidelines require:
  - Waste prevention audit/Waste management option review
  - Characterisation of waste stream
  - Site characterisation
  - Impact assessment
  - Permit Issue
  - Compliance monitoring
  - Performance monitoring
  - Mitigation plan



## Recent Amendments to Marine Conventions

- In Spring 2007 OSPAR adopted amendments to the Annexes to the Convention to allow storage of CO<sub>2</sub> in geological formations under the seabed.
  - Follows publication of reports on ocean acidification, which indicated early action was needed to prevent damage to the marine environment from natural uptake of CO<sub>2</sub>.
  - CCS seen as one of a portfolio of measures to reduce emissions
- OSPAR adopted a Decision to ensure environmentally safe storage of carbon dioxide streams in geological formations
- OSPAR adopted guidelines for Risk Assessment and Management of that activity.
- A Decision was also adopted to legally rule out placement of CO<sub>2</sub> into the water-column of the sea and on the seabed.
- Actions considered complimentary to those of London Protocol





## Guidelines on Risk Assessment and Management

- Objective of guidelines

“authorities shall ensure that carbon dioxide streams, which are stored in geological formations, are intended to be retained in these formations permanently and will not lead to significant adverse consequences for the marine environment, human health and other legitimate uses of the maritime area”.



# Guidelines on Risk Assessment and Management

- Storage of CO<sub>2</sub> in geological formations shall not be permitted by Contracting Parties without authorization or regulation by their competent authorities.
- Any authorization or regulation shall be in accordance with the OSPAR Guidelines for Risk Assessment and Management,
  - as updated from time to time.
- A decision to grant a permit or approval shall only be made if a full risk assessment and management process has been completed to the satisfaction of the competent authority
  - “ and that the storage will not lead to significant adverse consequences for the marine environment, human health and other legitimate uses of the maritime area”.
- The provisions of the permit or approval shall ensure the avoidance of significant adverse effects on the marine environment,
  - Bearing in mind that the ultimate objective is permanent containment of CO<sub>2</sub> streams in geological formations.



# Guidelines on Risk Assessment and Management

- Any permit or approval issued shall contain :
  - a description of the operation, including injection rates;
  - the planned types, amounts and sources of the CO<sub>2</sub> streams, including incidental associated substances, to be stored in the geological formation;
  - the location of the injection facility;
  - the characteristics of the geological formations
  - the methods of transport of the CO<sub>2</sub> stream;
- A risk management plan that includes:
  - monitoring and reporting requirements ;
  - mitigation and remediation options including the pre-closure phases;
  - a requirement for a site closure plan, including a description of post-closure monitoring and mitigation and remediation options;
    - Monitoring shall continue until there is confirmation that the probability of any future adverse environmental effects has been reduced to an insignificant level.
- Permits or approvals shall be reviewed at regular intervals, taking into account the results of monitoring programmes and their objectives.



## Reporting Requirements

- All plans publicly available
- Reporting plans set out

General basis	Year concerned
Cumulative number of permits issued	
Are <b>guidelines</b> implemented	yes/no <sup>2</sup>
Amount CO <sub>2</sub> stored (tonnes)	
Net amount of CO <sub>2</sub> stored (tonnes)	

Site by Site basis	Year concerned
Chemical composition of the CO <sub>2</sub> stream	
Type of storage formation	
Any observed leakage rates and exposure pathways	
- any expected impacts from this leakage	
Any observed impacts on the marine environment and other legitimate uses of the maritime area	
Any (mitigative) measures taken	



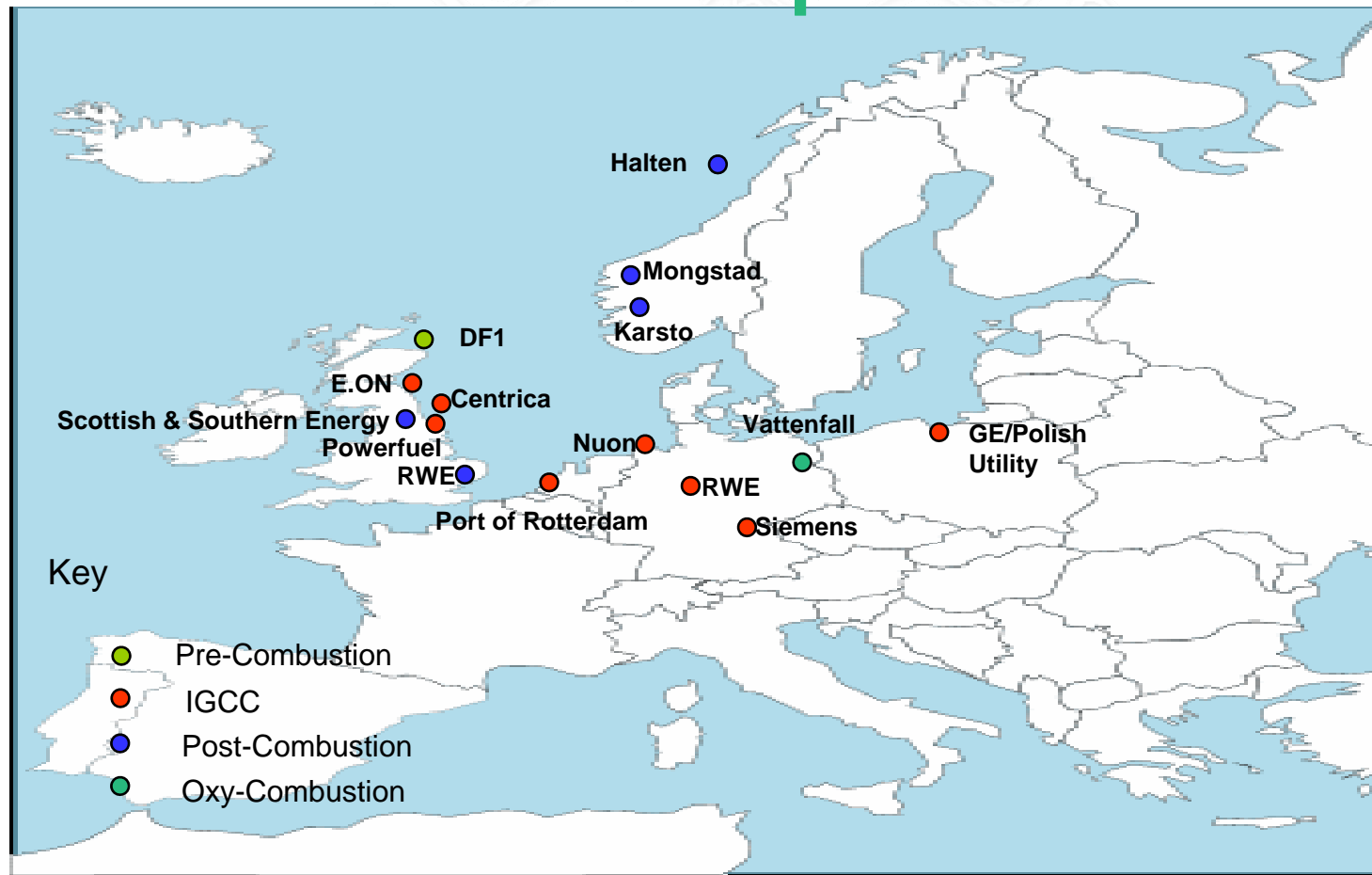


## CO<sub>2</sub> Purity Issue

- Not dealt with Specifically by Marine Conventions
  - “Overwhelmingly” or “Predominately” CO<sub>2</sub>
  - Acceptance that there will be some low level impurities from the capture process
  - Issue of setting " acceptable" CO<sub>2</sub> purity levels will be dealt with by National authorities



# Proposed Integrated CCS Projects in Europe





## European Commission Plans

- COM(2006)843, 10.01.07, Sustainable power generation from fossil fuels: aiming for near-zero emissions from coal by 2020
  - Key actions included:
    - Make demonstration of sustainable fossil fuel technologies a priority research topic for 2007-2013
      - Substantial increase in EC R&D funding
      - Member states to make an equal commitment
    - Options to support up to 12 large scale demonstrations
    - All new fossil fuels plants will need to be 'capture ready' by 2020



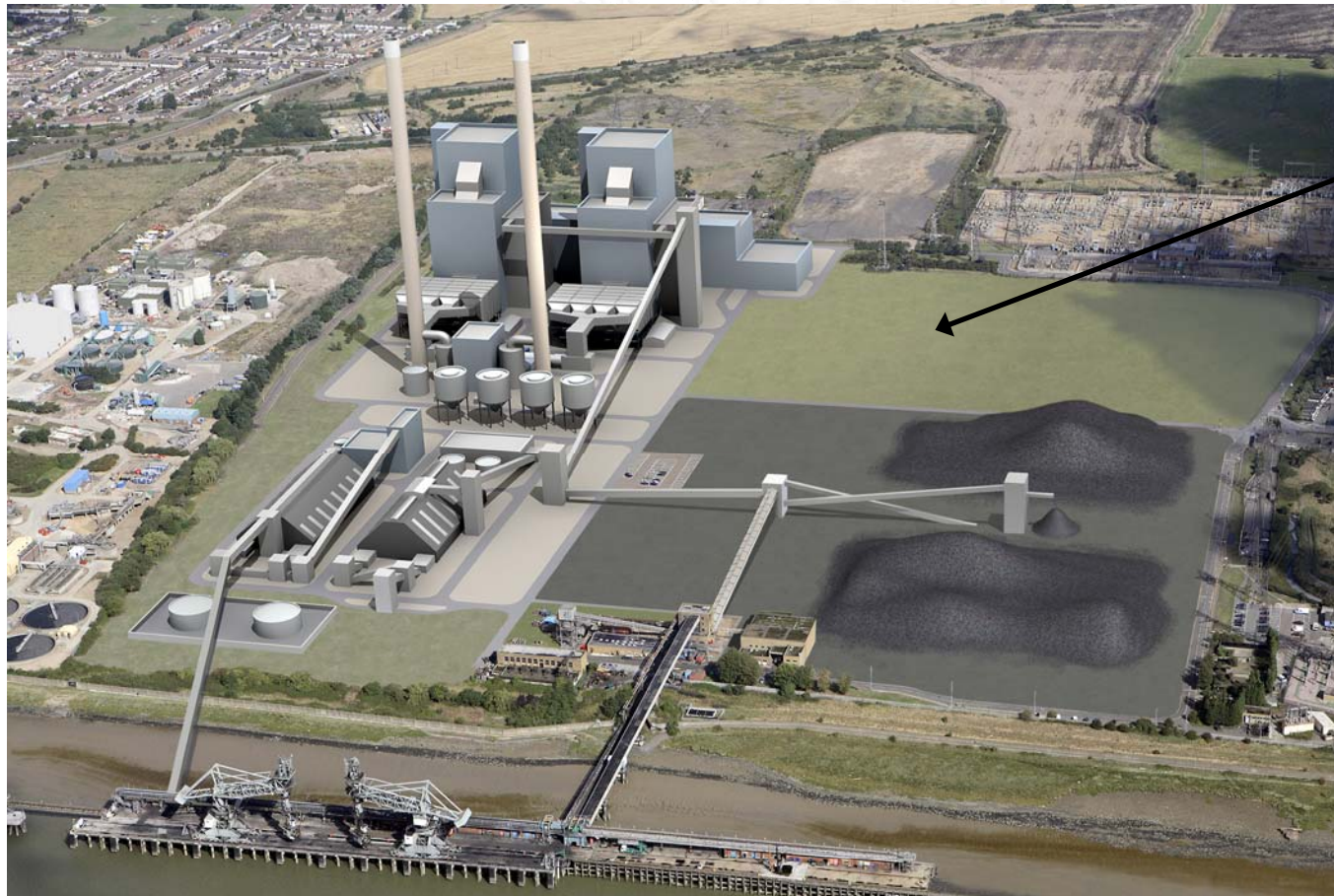
## What is 'Capture Ready'

- IEA GHG has produced a headline summary of Capture Ready considerations
  - Carry out a study of capture retrofit options
  - Leave space and access for capture plant
  - Identify a reasonable route to storage of CO<sub>2</sub>
- Major pre-investment is unlikely to be worthwhile unless capture is going to be retrofitted soon after plant start-up





## CO<sub>2</sub> Capture Ready Plant



'Capture Ready' area  
(Site of existing power plant)

Proposed 'capture ready' power plant at Tilbury

Courtesy RWE Npower



## European Commission Plans

- The European Commission has considered how to implement CCS under its existing environmental directives
  - The Waste Directive will not be used
  - A new CCS Directive will be developed
    - Launched for consultation in December 2007
    - Member states will have an initial 3 month consultation period
    - Aim to be adopted by European Parliament by end of 2008



## European Plans

- A revision to the existing directive on use of State aid will be announced in Late 2007.
  - Allow national governments to support demonstration projects directly
- The European Trading system will be modified to allow CCS projects to be included
  - Changes to rules to be announced in late 2007/early 2008
  - Help finance CCS projects in the future





## EU Technology Platform

- Industry/stakeholder group established to support CCS technology demonstration programme in Europe
- Ways of overcoming barriers to technology implementation
- Run the demonstration technology assessment programme
  - Planning stage at present
- Details at:
  - [www.zero-emissionplatform.eu](http://www.zero-emissionplatform.eu)





# United Kingdom

- UK currently has proposals for 8 demonstration projects
- UK Government has announced plans to support one demonstration project
  - Competition to be held in early 2007 with decision by end of 2007
    - Details not announced yet
- Guidelines
  - Project in UK and have a comprehensive engineering design
  - Will cover full CCS chain
  - At least 300MWe
  - Store at least 0.25mT/y CO<sub>2</sub>
  - UK Government will support capture and storage component not full plant
  - Plant to be operational between 2011 and 2017
- UK will announce regulatory framework in Late 2007 for off-shore projects



## Recent Developments in UK

- Government announced in October 2007 that it will support a single post combustion capture demonstration
  - Specific mention of coal
  - Post combustion technology considered to have most potential worldwide
  - Vital for the transition to a low carbon economy in China and India



## Netherlands and Germany

- Dutch Government expressed their intent to host at least 1 CCS demonstration project
  - Mining Act adapted to allow for CCS
  - Initial informal tender to EC was rejected
    - Netherlands expected to build a 400 MW coal fired IGCC project
      - Magnum project supported by NUON
- Two project developers active in Germany
  - RWE planning a 450 MWe coal fired IGCC project with on-shore storage
    - May go it alone
  - Vattenfall have a built a 30 MW Oxy combustion pilot plant
    - Plans to build a 300MW demonstration project in Germany



### Norway

- In July 2006 Statoil announces plan to build the Mongstad CHP plant
  - Gas fired power plant providing 350 MWh heat and 280 MWe
  - Due to be built in 2008 at a cost of \$450M
  - Norwegian Government imposed need for CCS
  - Project pushed out to 2014
  - Norwegian Government will meet \$594M for CCS plant
- It is also planned to create a European CO<sub>2</sub> Test Centre at Mongstad funded by Norwegian Government, DONG Energy, Statoil, Hydro and Vattenfall





## National Legal and Regulatory Frameworks

- Two key goals for Governments;
  - To promote CCS as a climate change option
  - To ensure protection of public health and safety
- Development of a regulatory regime is a key step in developing industry & public confidence
- Several countries regulating CCS under existing laws
  - For many countries it will be quicker to adapt existing legislation than to develop new legal frameworks
  - For countries without existing legislation this might be an issue



# Adaptation of Existing Laws

- Many countries in Europe looking at adaptation of existing laws
  - Norway – permitting operations under existing Petroleum and Pollution Control acts
  - Netherlands - Mining Law already adapted for K-12B
    - Covers both on and offshore operations
  - UK - Petroleum Act for North Sea operations
    - New White Paper to be issued in early 2008
    - UK Government will claim rights over all sea bed structures
    - Jurisdictional issues will prevent operations onshore for foreseeable future
  - Poland has advocated it will change its Mining Act
  - Germany can adapt oil and gas exploration laws for offshore operations and Mining Act for on-shore operations
- Most existing laws cover; permitting, construction, operational and abandonment phases but not post closure



## Sleipner Case

- Sleipner is a production operation and is regulated under the Norwegian Petroleum Act
- Act requires:
  - A Plan for Development and Operation (PDO)
    - Approved by the Ministry of Petroleum and Energy
    - Approval requires a impact assessment
  - A Decommissioning plan
    - Monitoring conditions after decommissioning are yet to be set
- Pollution is subject to strict liability under PA



## Sleipner Case

- Also regulated under the Pollution Control Act
  - Main provision is that pollution is prohibited unless permitted by law
  - Sources of pollution, or those that threaten pollution, must be identified
  - Sleipner also requires a permit under the PCA
  - Permit requires:
    - Injection is monitored and reported annually
    - Up to 1 Mt/y CO<sub>2</sub> can be injected
    - Actual volumes injected is reported annually





## Regulatory Components

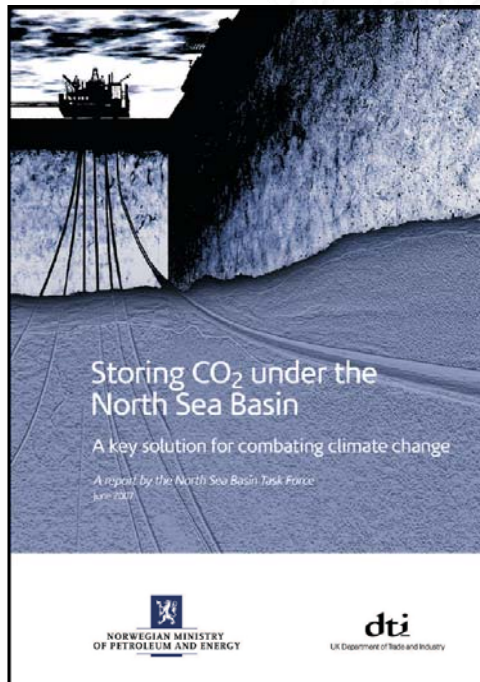
- It is likely than any regulatory regime will include the following:
  - Detailed site characterisation for permitting and operational requirements
  - Monitoring during all phases
    - Pre-operational, operational, post operational and post abandonment
  - Abandonment plan
  - Remediation plan



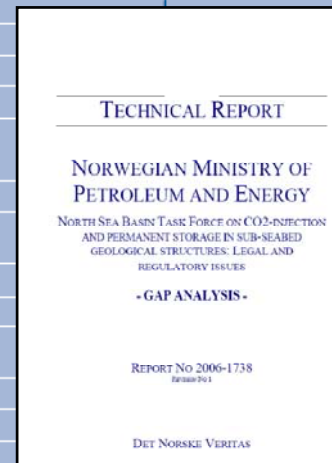
## North Sea Basin Task Force

**Objectives:** In brief, the objectives of the Task Force are to develop broad, common principles that could:

- Form the basis for regulating the transport, injection and storage of CO<sub>2</sub> in the North Sea, and
- Provide a consistent basis for managing the transport, injection and storage of CO<sub>2</sub> in the North Sea.
- Promote the deployment of CO<sub>2</sub> in geological formations beneath the North Sea.



Potential barriers or enablers	International (I), Regional (R), National (N)	Expected time until solved	
		< 2 years	2-5 years
UNFCCC-IPCC National Inventories	N, I	●	●
Kyoto Protocol (CDM and JI)	I	●	●
UNCLOS	I	●	●
London Convention and Protocol	I	●	●
OSPAR	R	●	●
Trans-boundary movement and/or damage	I	●	●
The Aarhus Convention			●
EU ETS			●
EU enabling legal framework			●
UK regulations and CCS			●
Norway regulations and CCS			●
Long-term liability			●
Risk assessment methods			●
Risk acceptance, including site approval criteria			●
Monitoring and verification			●
Public support			●
Accounting and certification of credits			●
Costs and economics			●
Incentives			●
Technology maturity			●





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THANK YOU  
ANY QUESTIONS?



[www.ieagreen.org.uk](http://www.ieagreen.org.uk)