Incentives for CCS and Regulatory Requirements

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POLICY & REGULATION: CRUCIAL ROLE

1. Strategic vision and defining the role of CCS
   - Enabling CCS as part of energy portfolio

2. Development of a legal framework
   - Making CCS a legal activity & clarifying responsibilities
   - Ensuring safety and environmental viability of operations

3. Providing incentives for demonstration and deployment
   - Business models & financing of projects

4. Information, education, discussions
   - Contributing to public acceptance
SETTING STRATEGIC POLICY

DRIVERS & DIRECTION

- Making firm decisions to address climate change
- Improving understanding of CCS and its role within the broader technology portfolio
- Recognition of the role of CCS
- Planning for the future
- More attention to industrial CCS applications
LEGAL/REGULATORY FRAMEWORKS

- Many OECD countries have implemented, or are implementing, legal & regulatory frameworks
  - Safety & environmental effectiveness
  - Long-term liability
  - Ensuring public engagement

- Many non-OECD countries are lacking CCS-related regulations

- Dealing with outstanding international legal issues
  - Ratification of the London Protocol and OSPAR amendments
  - Inclusion of CCS in CDM activities under the UNFCCC
IEA Model CCS Regulatory Framework 2010

- Regulatory development process
- Capture, transport and storage
- 29 key issues, including:
  - Property rights; Protecting human health;
  - Authorisation of storage site exploration activities;
  - Regulating site selection and characterisation activities;
  - Monitoring, reporting and verification requirements;
  - Liability, Corrective measures,
  - Authorisation for storage site closure
## Life-cycle of CO\(_2\) storage in Model Framework

<table>
<thead>
<tr>
<th>Project Milestones</th>
<th>Exploration Authorisation</th>
<th>Storage Authorisation</th>
<th>Injection Notification</th>
<th>Cessation of Injection Notification</th>
<th>Closure Authorisation</th>
<th>Transfer of Responsibility*</th>
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### Period

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<tr>
<th>Period</th>
<th>Exploration Period</th>
<th>Operation Period</th>
<th>Closure Period</th>
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### Authorised Activities

- Authorised to Explore
- Authorised to Store
- Authorised to Inject

### Operator Activities

- Exploration
- Construction
- Injection
- Decommissioning

### Monitoring

- Baseline Monitoring
- Monitoring
- Relevant Authority Monitoring* |

### Liability

- Operator Responsibility
- Relevant Authority Responsibility* |

*Where long-term responsibility is transferred to the Relevant Authority*
STATUS OF CCS COSTS

CO₂ Capture from power generation (IEA, 2011)

<table>
<thead>
<tr>
<th>Fuel (capture route)</th>
<th>Coal (similar for all capture routes; relative to a pulverized coal baseline)</th>
<th>Natural gas (post-combustion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital costs</td>
<td>3 800 USD/kW (74% increase)</td>
<td>1 700 USD/kW (82% increase)</td>
</tr>
<tr>
<td>Cost of CO₂ avoided</td>
<td>55 USD/tCO₂</td>
<td>80 USD/tCO₂</td>
</tr>
</tbody>
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Notes: Averages figures for OECD countries shown (costs in China estimated to be about half for most cases), capital costs are overnight costs

CO₂ Capture from industrial application (UNIDO, 2010)

Refining sector 28-96 €/tCO₂
Cement plant 36-107 €/tCO₂
Pulp and paper 30-40 €/tCO₂
Iron & Steel 30-40 €/tCO₂ (Kuramochi, 2011)

CO₂ transport & storage

Very site-specific; likely additional costs of about 20 USD/tCO₂
LONG-TERM INVESTMENT NEEDS

- **Long-term**: mobilising 2500 – 3000 bn USD investment in capture plant, transport and storage between 2010-2050
- **1400 bn USD** investment in non-OECD countries 2010-2050
CREATING INCENTIVES

- Time dimension: R&D → Demonstration → Deployment
- Geographic dimension: OECD vs. non-OECD world

1. Development and infrastructure planning
   - RD&D financing, capital cost support for large-scale demonstration
   - Prototype and demo stage (e.g., fuel cells, 2nd generation biofuels, electric vehicles, CCS)

2. Stable, technology-specific incentives
   - Feed-in tariffs, tax credits, loan guarantees

3. Technology-neutral but declining support
   - Green certificates, GHG trading

4. Accelerate adoption by addressing market barriers
   - Building codes, efficiency standards, information campaigns

Mature technology (Energy efficiency, industrial CHP)

Low cost gap (Onshore wind, biomass power in some markets)

High cost gap (Solar CSP, solar PV, hybrid vehicles)

1. Technology development and demonstration
2. Niche markets
3. Achieving competitiveness
4. Mass market
EXAMPLES OF POLICY TOOLS

- CCS mandate or emission performance standard
- CCS quota obligation with or without trading
- Price-based support schemes (like feed in tariffs)
- Grants or tax breaks
- Carbon price
- International cooperation
# MARKET FAILURES AS RATIONALE FOR POLICY INTERVENTION

## Market failure

<table>
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<th>Market failure</th>
<th>Example policies</th>
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<tr>
<td>Emissions externality</td>
<td>Carbon pricing (carbon tax or emissions trading scheme), emission performance standard</td>
</tr>
<tr>
<td>‘Learning by doing’</td>
<td><em>quantity</em>-based instruments: feed-in tariff, portfolio standards (CCS quota obligations), emission performance standard, international cooperation</td>
</tr>
<tr>
<td>Risk and capital market failure</td>
<td>provision of debt/equity, grants, investment tax credits, insurance, feed-in tariff, international cooperation</td>
</tr>
</tbody>
</table>
POLICY GATEWAYS

- Policy evolution could be mapped on a series of explicit policy gateways
- Provides investors with a greater degree of policy certainty

**Cost/Revenue**

- **Demonstration**
- **Early deployment**
- **Wide-scale deployment**

**First Gateway**
- Technical feasibility proven
- First cost threshold met

**Second Gateway**
- Further cost reductions
- Infrastructure development on track

**Market saturation (revenues)**

**CCS costs**

**Time**
CONCLUSION: KEY NEEDS

- Strategic long-term vision for the energy sector under climate constraints
- Evolving policy incentives
- Legal frameworks
- International cooperation
Thank you!

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