The Choice of Instruments

Economics of Climate Change
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Correcting market failures

• Internalise CO$_2$ costs
  – Align market and welfare maximisation
• Technology policy
  – Compensate R&D and learning spill over
• Address barriers
  – Reduce delays before barriers are swept away
Policy instruments to internalise CO$_2$ costs

- National level
  - Taxes
  - Cap and Trade programs
  - Voluntary commitment
- The key to success
  - *Loud*: Receive management attention
  - *Long*: Commitment to drive investment decisions
  - *Legal*: Enforcement at firm level
Price matters: Energy intensity response

Reduction of national energy intensity vs. Increase in real oil price

- US Energy intensity
- Oil price
- UK Energy intensity

3 year averages are depicted

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Example: Gasoline tax


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Example: EU Emission Trading Scheme

Phase I
2005-07

Phase II
2008-12

Euro/tCO₂

Allocation plans by end of 2006

• Large emitters ~ ½ EU emissions are covered
• Current value 50 billion Euro/year
• EU directive requires 95% free allocation (90% phase II)
Allocation matters

- Production cost
- CO2 Cost
- Uniform updating value

Cost

- Coal
- Improved Coal
- Gas
- Usage efficiency

Efficiency increase
Technology/fuel choice
Substitute output

Auction / Grandfathering
Uniform updating
Fuel specific updating
Emission based updating

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Investment security – challenge for emission trading

Sustained international cost difference would effect energy intensive industry

Phase I
2005-07

Phase II
2008-12

Return on today’s investment

Efficient

Technology
Input choice
Consumption
Trade

Global internalisation

Output based benchmark

Border tax adjustment
International instruments

- Address free rider issue
- Enhance commitment of national governments
- Can also translate to economic instruments
  - Absolute target – Kyoto ‘simple’ and translates
  - Intensity based target on annual basis
    - Implies updating and prevents CO2 internalisation
    - GDP only one of drivers for energy demand
    - Pro-cyclical economic instrument
  - Intensity based long-term targets
    - Only a question of framing?
USA: Historic weak link energy - GDP


Total Final Consumption of Energy calculated in Million tonnes of oil equivalent from total supply by fuel source minus losses and transformations.
UK: Historic weak link energy - GDP

<table>
<thead>
<tr>
<th>Country</th>
<th>CO₂ Emissions</th>
<th>Intensity Level</th>
<th>Intensity (\div) CO₂ Ratio</th>
<th>Intensity Correlation with GDP</th>
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<td>United States</td>
<td>2.42</td>
<td>1.56</td>
<td>0.64</td>
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<td>3.56</td>
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</table>

The Case for Intensity Targets, Pizer, RFF, DP 05-02
Why active technology policy?

- ‘Pure’ market under-invests in technology
  - R&D and learning spill-over not internalised
- Is government action preferable?

Information asymmetry, Incentives?

Grants
Tax breaks
Strategic deployment

Are governments good at picking winners?

R&D
Learning
Application

Patents/secrecy promise returns

Restricts information flow, Monopoly limits competition
Experience curves motivate strategic deployment

Example Solar PV:

Learning rate effects cost
17%  55 billion €
20%  20 billion €
23%  10 billion €

5% discount rate
Why strategic deployment for energy I

- Homogeneous product has (almost) single price
- Regulated markets create risk for high profits
Example: Solar PV production

- Raw Silicon
- Ingot & cut wafer
- Process cell
- Encapsulation

Cost: ~10% ~30% ~30% ~30%

Product innovation: Coating: \( \text{TiO}_2 \) -> \( \text{SiN}_x \)

Process innovation: Wafer: 400um -> 200um
Why strategic deployment in energy II

- Complex product
  - Improvements of many technologies required
  - Inputs from many companies beneficial
- Target and incentivise public R&D support

Source: IEA PV Implementing Agreement, at http://www.oja-services.nl/iea-pvps/isr/index.htm
Internalisation of CO2 benefits new technologies

- Reduces investment: 38 to 20 billion €*
- Increases benefit 150 to 300 billion €
- Increases market confidence

* Break even price moves €40/MWh to €50/MWh, 5% discount, 2005-2040

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Conclusion

- Internalisation of CO₂ externalities
- Technology policy
- Address barriers
- Using only subset of policies is inefficient