Why and How to subsidise Energy R+D?

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Outline

• R+D, innovation and productivity in theory
• Empirical evidence on R+D and market reform
• What to do about supporting energy R+D?
• Concluding thoughts
R+D, INNOVATION AND PRODUCTIVITY IN THEORY
Energy R+D in context

• Total Global Fossil Fuel subsidies, 2012:
  – $544bn (World Energy Outlook 2013)

• Total Renewable Energy Subsidies, 2012:
  – $100bn (World Energy Outlook 2013)

• Total Industrial Energy R+D, 2012:
  – $15.7bn (Battelle R+D funding forecast 2013)

• Total OECD Government Energy R+D, 2011:
  – $18.6bn (IEA Statistics)
Learning by doing high, but Learning by research significant...

Q: How much do costs fall as capacity doubles?

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<tbody>
<tr>
<td>1. Pulverised fuel supercritical coal</td>
<td>3.75%</td>
<td>4.8%</td>
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<tr>
<td>2. Coal conventional technology</td>
<td>13.39%</td>
<td>15.1%</td>
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<tr>
<td>3. Lignite conventional technology</td>
<td>5.67%</td>
<td>7.8%</td>
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<tr>
<td>4. Combined cycle gas turbines (1980–1989)</td>
<td>2.20%</td>
<td>2.8%</td>
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<tr>
<td>Combined cycle gas turbines (1990–1998)</td>
<td>0.65%</td>
<td>3.3%</td>
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<tr>
<td>5. Large hydro</td>
<td>1.96%</td>
<td>2.9%</td>
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<td>6. Combined heat and power</td>
<td>0.23%</td>
<td>2.1%</td>
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<tr>
<td>7. Small hydro</td>
<td>0.48%</td>
<td>2.8%</td>
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<td>8. Waste to electricity</td>
<td>41.5%</td>
<td>57.9%</td>
</tr>
<tr>
<td>9. Nuclear light water reactor</td>
<td>37.6%</td>
<td>53.2%</td>
</tr>
<tr>
<td>10. Wind – onshore</td>
<td>13.1%</td>
<td>15.7%</td>
</tr>
<tr>
<td>11. Solar thermal power</td>
<td>2.2%</td>
<td>22.5%</td>
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<tr>
<td>12. Wind – offshore</td>
<td>1.0%</td>
<td>8.3%</td>
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NOTE SCALE OF EXISTING CAPACITY

Source: Jamasb and Kohler in Grubb et al., 2008, p. 324, Table 12.1: Learning-by-doing rates using single- and two-factor curves
Directed Technical Change (Acemoglu et al, 2012)

• Path dependency in technological innovation.

• Subsidising ‘clean’ inputs vs ‘dirty’ inputs may shift technical change on to a different pathway.

• This may involve shifting scientists from working on dirty technologies to clean ones.

• This may be cheaper in the long run than directly supporting existing clean technologies.
Characterising Innovation (Bauer, 2012, p.16, 17)

Typology

- **Type II**
  - Wind energy
  - FTTH

- **Type IV**
  - i-mode, iPhone, Smart grid

- **Hybrid**
  - IPTV

- **Type I**
  - Mobile apps
  - LEDs

- **Type III**
  - Smartphones
  - Smart appliances

Enabling conditions

- **Radical innovation (Schumpeterian)**
  - Ability to appropriate super-normal returns
  - Ability to coordinate (exclusivity, critical mass)

- **Incremental innovation (Kirznerian)**
  - Low transaction costs (e.g., net neutrality)
  - Access to quality-differentiated platforms

- **Modular innovation**
  - Low

- **Coupled innovation**
  - High
EMPIRICAL EVIDENCE ON R+D AND ENERGY MARKET REFORM
Government R&D Spending

Government Energy R+D (2012 mUSD)

United States  
United Kingdom  
Switzerland  
Spain  
Netherlands  
Japan  
Italy  
Germany  
France  
Canada

Source: IEA
The tale of liberalisation and R+D in the UK...

Government energy R&D in the UK - Main categories
Source: IEA Energy R&D statistics database
£m 2008 Prices
Figure 4: R&D spending in the UK major generation and transmission companies

Source: Surrey (1996), CEGB and NGC Annual Reports and Accounts, BIS R&D Scoreboards, £m 2008 Prices.
From Jamasb and Pollitt, 2011, updated
R+D by distribution increases from low base...

Distribution Company spend on Network R&D in millions of £2008 (IFI projects only)

Source: Jamasb and Pollitt, 2011, updated.
LCNF aiming to spend additional £64m per annum.
Patenting by utility companies initially stable...

Number of Patent applications from main UK ESI actors, by type (1958-2012)
From Jamasb and Pollitt, 2011, updated.

www.eprg.group.cam.ac.uk
However, Renewable Technologies do well...

Source: Espacenet Database, search by publication year.
And also total electricity patents relatively unaffected...

Electricity related UK patents publications (UK or EPO or WIPO application with UK priority number) as % of total UK patents publications.
From Jamasb and Pollitt, 2011, updated.
Productivity growth strong through liberalisation...

Productivity Growth in Energy Services

-2.0 0.0 2.0 4.0 6.0 8.0 10.0 12.0

1970-1980

1980-1990

1990-2000

2000-2010

Industrial Power productivity p.a. (kWh / real £)

Lighting Productivity p.a. (Lumens / real £)

WHAT TO DO ABOUT SUPPORTING ENERGY R+D?
Institutions for rapid economic progress
(Nelson, 2008)

- Distinguish ‘physical’ technology and ‘social’ technology
- Example of delivering a recipe as distinct from tools to make food.
- Old social technologies may not be appropriate and need to be replaced by new ones.
- Institutions important to enable new developments.
- The ‘fundamental uncertainty’ of innovation is why it needs to be supported.
- Only a small number of sectors drive productivity in any historical period.
- A mixture of private and public actions required, but public actions can be wrong ones.
- Basically rapid progress is clearly not about the amount money spent on R+D…
Institution for social innovation: Low carbon networks fund

- 2010-2015 price control
- ‘up to £500m to support projects sponsored by the Distribution Network Operators (DNOs) to try out new technology, operating and commercial arrangements’
- ‘The aim of the projects is to help all DNOs understand how they can provide security of supply at value for money as Britain moves to a low carbon economy.’
- First Tier allows DNOs to recover a proportion of expenditure incurred on small scale projects.
- Second Tier annual competition evaluated by panel of experts of up to £64 million to help fund a small number of flagship projects.
- We will be monitoring the learning that emerges from these projects in order to understand its impact on the current regulatory framework.
Who pays for RD+D in Energy?

- IFI/LCNF are customer funded. This is a regressive tax.
- RD+D benefits are uncertain and shared across economy (esp. when projects fail in their own terms).
- Benefits often not lower price of energy (which justifies payment in proportion to use), but in security and environment which are public goods whose individual value is income elastic.
- Benefits often delayed for decades, which means current poor consumers will not benefit.
- IFI/LCNF may have transaction cost savings in collection and monitoring but these are not clear (may be marginally cheaper to collect and monitor using existing systems).
- Overall public RD+D should come out of general taxation.
- But also, collaborative private RD+D is possible, e.g. eFIS EV project in Milton Keynes (Miles, 2014) led by Arup and Mitsui.
CONCLUDING THOUGHTS
Concluding thoughts

• Directed technical change is important but subsidised R+D is *only one* way to achieve this.

• We should *not* close off possibility of radical innovation.

• R+D expenditure in energy did decline, but recovering.

• Innovation and productivity have not declined.

• R+D in energy needs to pay attention to ‘social technology’ given relative innovation in Mbits vs MWhs and path dependency of existing systems.
Innovation in what?

• In governance and payment arrangements in energy? (e.g. SO, LMPs, connection charging)

• In the use of information from smart grids and smart meters? (e.g. in pricing, control)

• In policy making in the face of rising complexity of regulatory decision making. (e.g. in customer engagement, cost benefit assessment)
Bibliography


