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?

	Technology	Learning-by-doing rate: Two-factor curves	Learning-by-doing rate: Single-factor curves
1	Pulverised fuel supercritical coal	3.75%	4.8%
2	Coal conventional technology	13.39%	15.1%
3	Lignite conventional technology	5.67%	7.8%
4	Combined cycle gas turbines (1980–1989)	2.20%	2.8%
	Combined cycle gas turbines (1990–1998)	0.65%	3.3%
5	Large hydro	1.96%	2.9%
6	Combined heat and power	0.23%	2.1%
7	Small hydro	0.48%	2.8%
8	Waste to electricity	41.5%	57.9%
9	Nuclear light water reactor	37.6%	53.2%
10	Wind – onshore	13.1%	15.7%
11	Solar thermal power	2.2%	22.5%
12	Wind – offshore	1.0%	8.3%

NOTE SCALE OF EXISTING CAPACITY

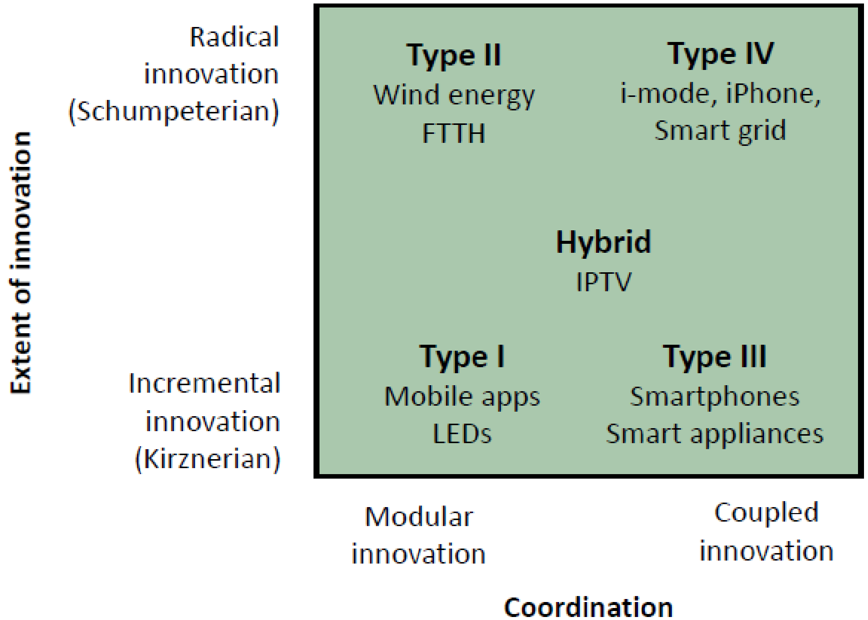
Source: Jamasb and Kohler in Grubb et al., 2008, p. 324, Table 12.1: Learning-by-doing rates using single- and two-factor curves

Directed Technical Change (Acemoglu et al, 2012)

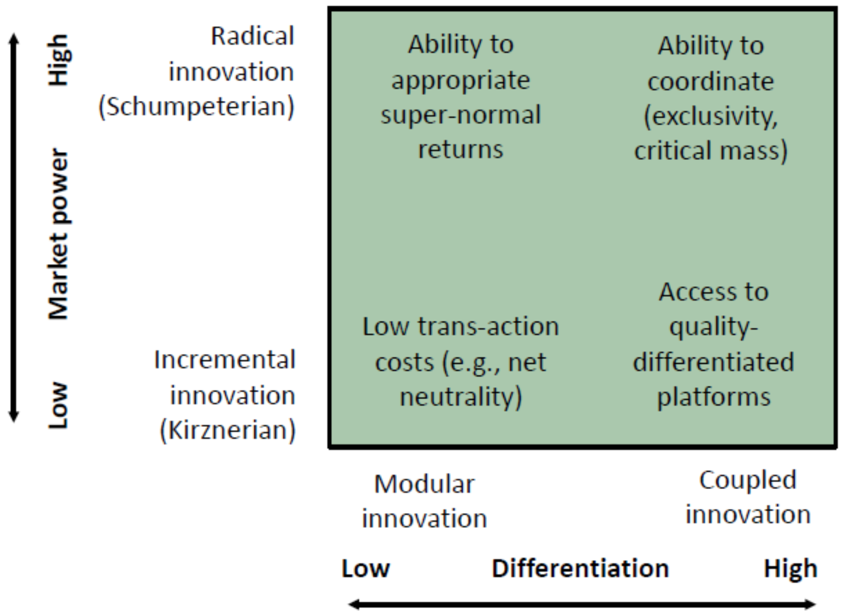
- Path dependency in technological innovation.
- Subsidising ‘clean’ inputs vs ‘dirty’ inputs may shift technical change on to a different pathway.
- This may involve shifting scientists from working on dirty technologies to clean ones.
- This may be cheaper in the long run than directly supporting existing clean technologies.

Characterising Innovation (Bauer, 2012, p.16, 17)

Typology

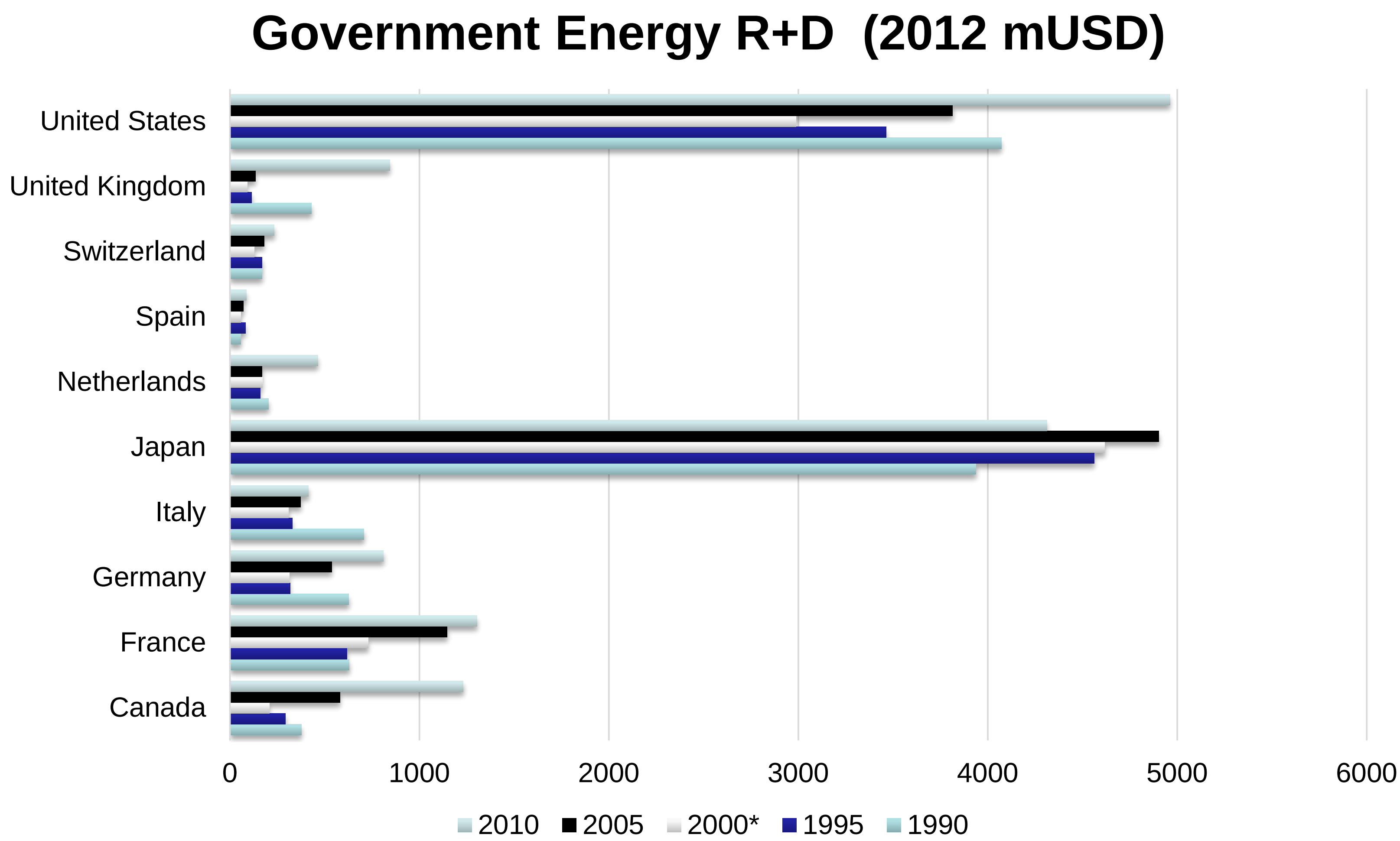


Enabling conditions



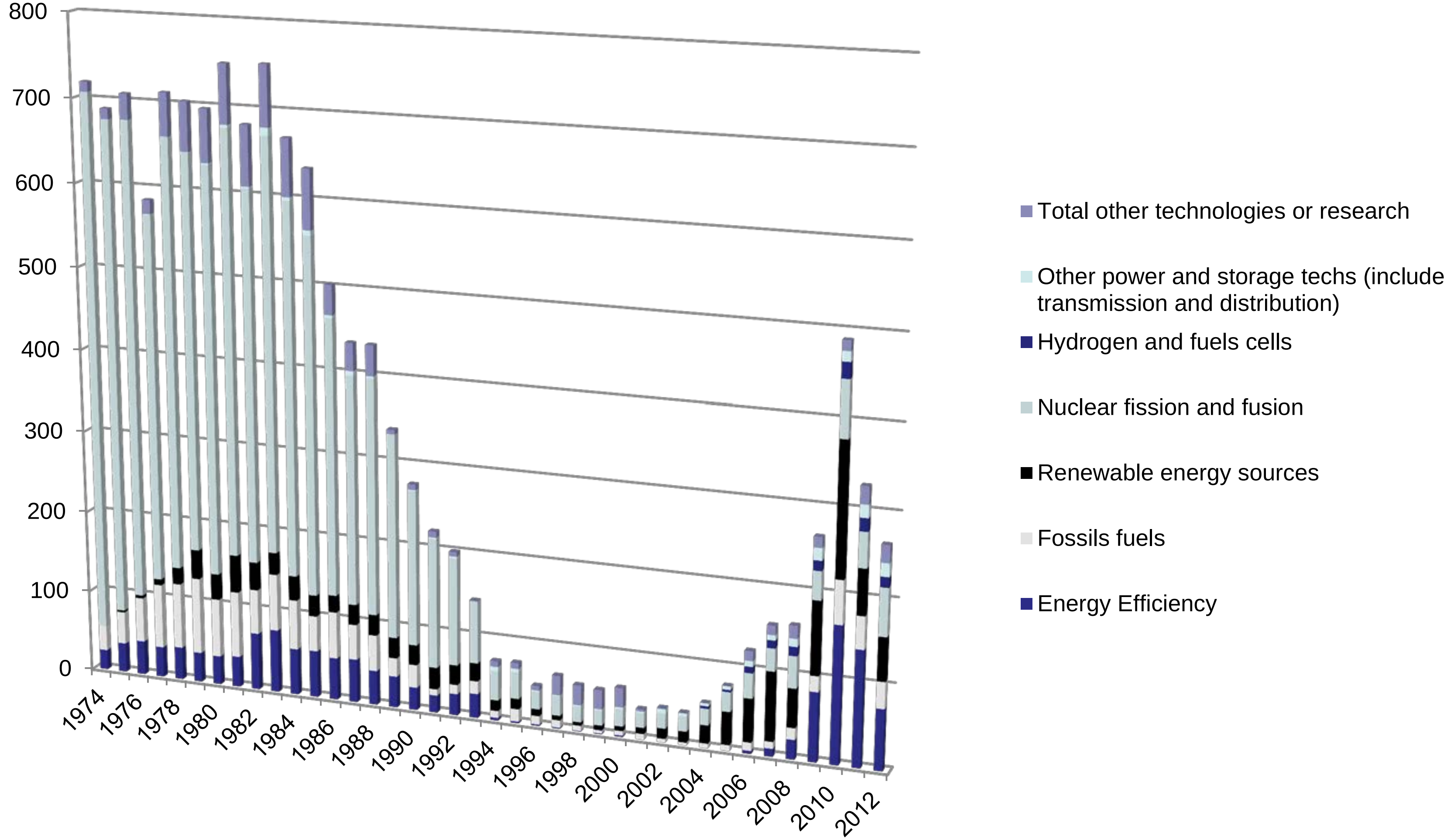
EMPIRICAL EVIDENCE ON R+D AND ENERGY MARKET REFORM

Government R&D Spending



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

R+D by generation and transmission declines…

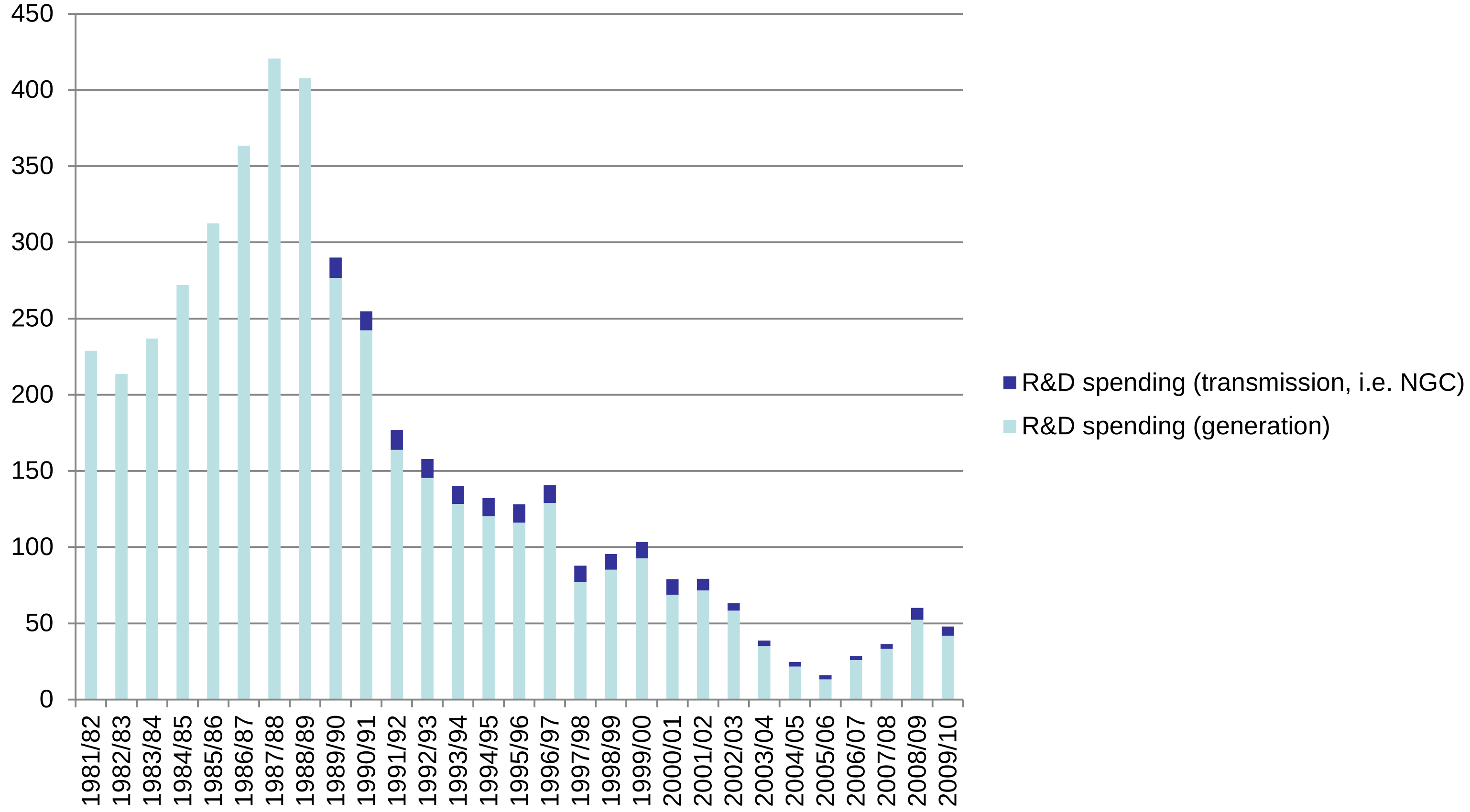
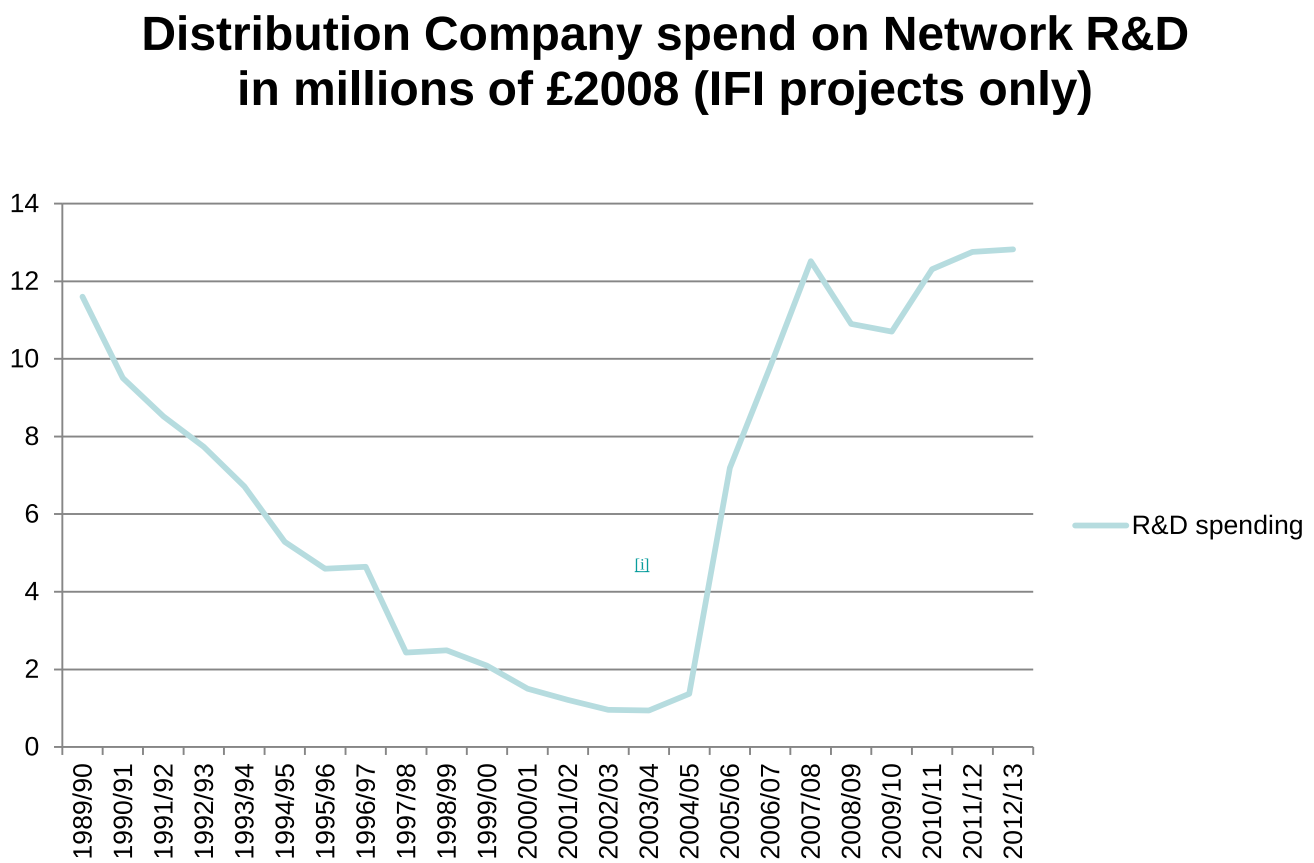


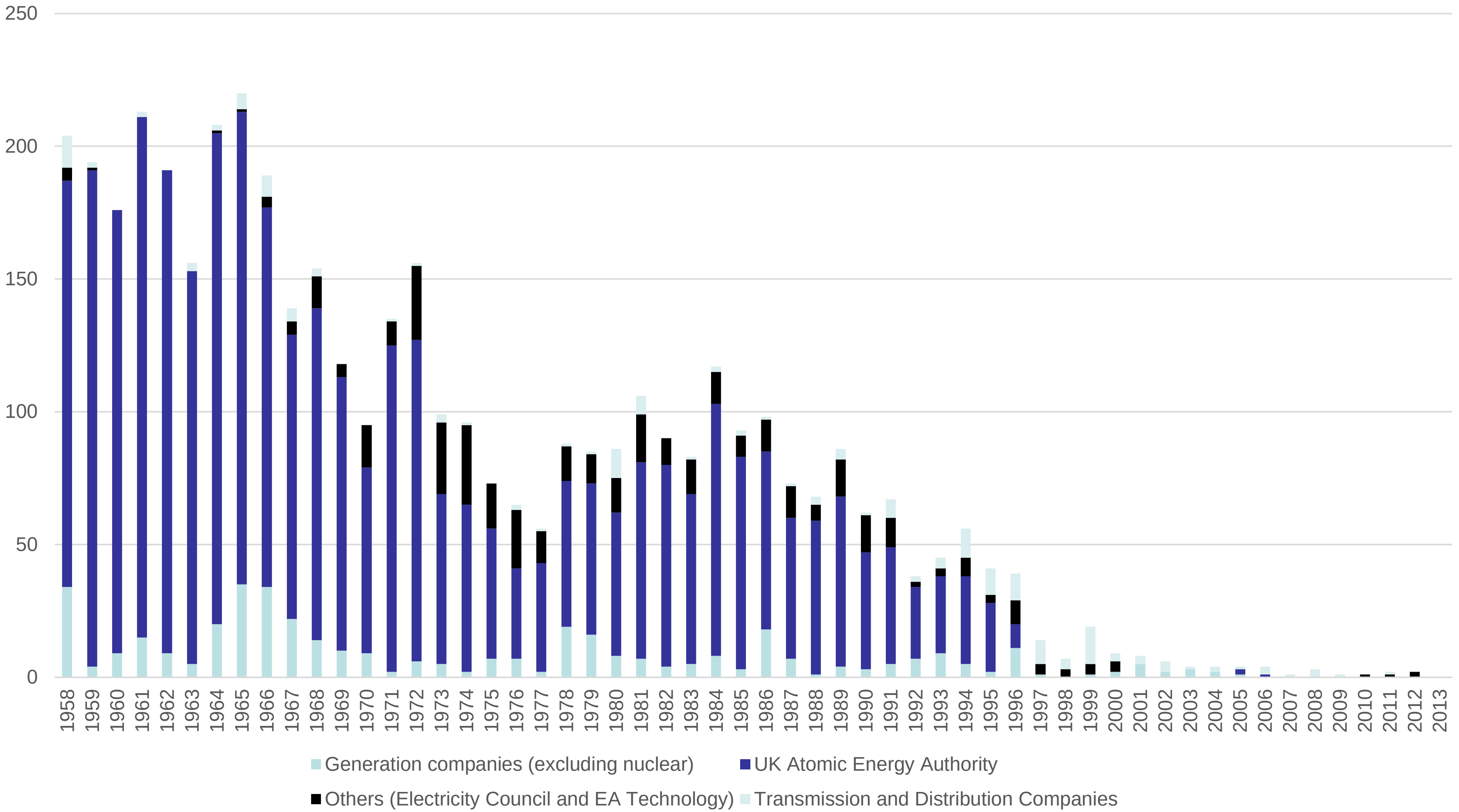
Figure 4: R&D spending in the UK major generation and transmission companies[I]
Source: Surrey (1996), CEGB and NGC Annual Reports and Accounts, BIS R&D Scoreboards, £m 2008 Prices.
From Jamasb and Pollitt, 2011, updated

R+D by distribution increases from low base…



Source: Jamasb and Pollitt, 2011, updated.
LCNF aiming to spend additional £64m per annum.

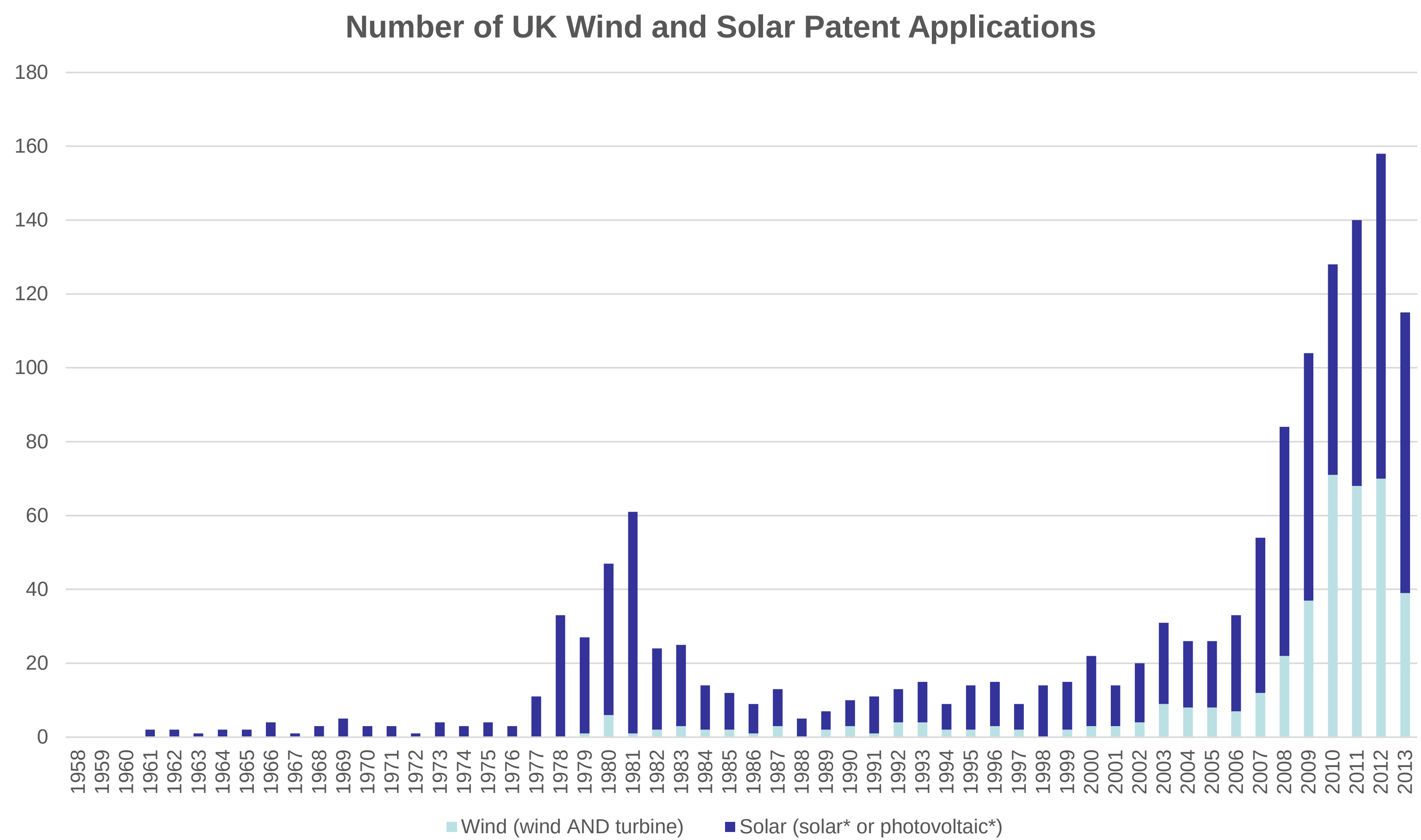
Patenting by utility companies initially stable…



Number of Patent applications from main UK ESI actors, by type (1958-2012)

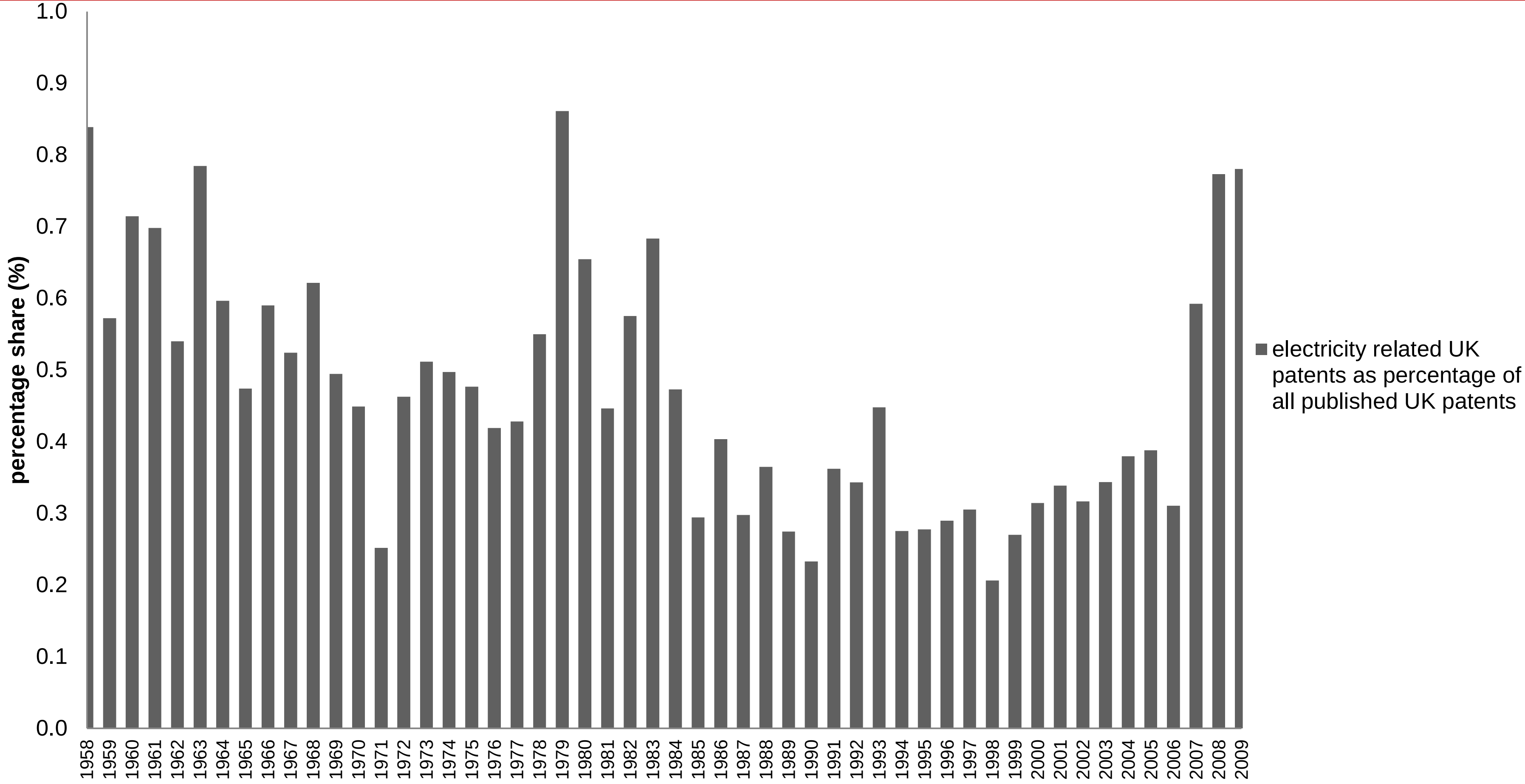
From Jamasb and Pollitt, 2011, updated.

However, Renewable Technologies do well…



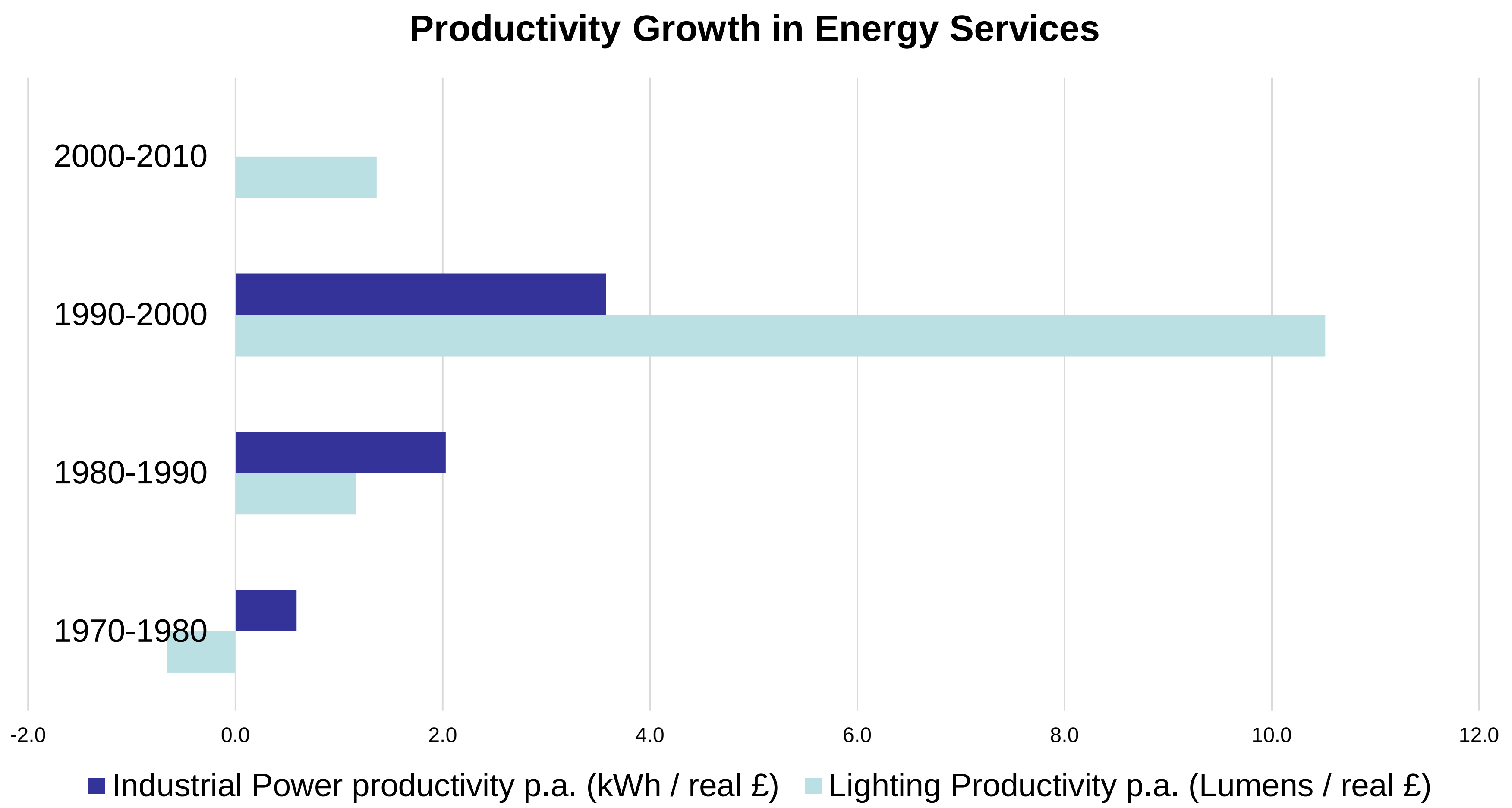
Source: Espacenet Database, search by publication year.

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…



Source: Derived from Fouquet (2008, 2013).

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

- Acemoglu, D., Aghion, P., Bursztyn, L. and Hemous, D. (2012), 'The Environment and Directed Technical Change', *American Economic Review,* 102 (1): 131-166.
- Bauer, J.M. (2012), Designing Regulation to Support Innovation: Experiences and Future Challenges, CRNI Conference November 30, 2012.
- Fouquet, R. (2008) *Heat Power and Light: Revolutions in Energy Services*. Edward Elgar. Cheltenham and Northampton, MA.
- Fouquet, R. (2013), *Long Run Demand for Energy Services: the Role of Economic and Technological Development*, Basque Centre on Climate Change Working Paper.
- Jamasb, T. and Kohler, J. (2008), 'Learning Curves for energy technologies: a critical assessment', in Grubb et al., pp.314-332.
- Jamasb, T.J. and Pollitt, M.G. (2008), 'Liberalisation and R&D in Network Industries: The Case of the Electricity Industry', *Research Policy* 37 (6-7), pp.995-1008.
- Jamasb, T. and Pollitt, M. (2011), 'Electricity Sector Liberalisation and Innovation: An Analysis of the UK Patenting Activities', *Research Policy*, Vol.40, No.2, pp.309-324.
- Miles, J. (2014), *Electric Vehicles: Cleaner, Better,…Cheaper*?, EPRG Seminar 17 February 2014.
- Nelson, R.R. (2008), 'What enables rapid economic progress: What are the needed institutions?', *Research Policy*, 37: 1-11.