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The case for a new energy research, development and promotion policy for the UK☆

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ABSTRACT

This paper is a critical assessment of the current balance of efforts towards energy research and development (R&D) and the promotion of low-carbon electricity technologies in the UK. We review the UK's main technological options and their estimated cost ranges in the medium term. We contrast the energy R&D spending with the current and expected future cost of renewable promotion policies and point out the high cost of carbon saving through existing renewable promotion arrangements. We also note that liberalisation of the electricity sector has had significant implications for the landscape of energy R&D in the UK. We argue that there is a need for reappraisal of the soundness and balance of the energy R&D and renewable capacity deployment efforts towards new energy technologies. We suggest that the cost-effectiveness of UK deployment policies needs to be more closely analysed as associated costs are non-trivial and expected to rise. We also make a case for considering increasing the current low level of energy R&D expenditure. Much of energy R&D is a public good and we should consider whether the current organisation of R&D effort is fit for purpose. We argue that it is important to build and maintain the research capability in the UK in order to absorb spillovers of technological progress elsewhere in the world. Against this background, the recent signs that an energy R&D renaissance could be underway are therefore positive and welcome.

1. Introduction

This paper is a critical assessment of the current balance of efforts towards research and development (R&D) and the promotion of low-carbon electricity technologies in the UK. We review the main technological options and their estimated cost ranges in the medium term and point out the relatively high cost of carbon saving through existing renewable promotion arrangements. There is a case for revisiting the electricity technology R&D spending in relation to the current and expected future cost of renewable promotion policies. Also, we note a role for induced technical change technology learning analysis. In the light of the above factors, we argue that there is a need for a reappraisal of technology R&D and deployment policy. We suggest that there is a case for increasing R&D expenditure and scrutinising the effectiveness of current low-carbon deployment policies. In addition, there is a need for the development of new models for organising R&D activities suitable for liberalised energy sectors.

☆ While the Government Office for the Science commissioned this review, the views are those of the author(s), are independent of Government, and do not constitute Government policy.

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2. Context of support policies for new technologies

Deregulated electricity markets have worked well for 15 years delivering efficiency improvements and investment in new capacity in the UK. They have achieved more efficient operation of existing equipment. They have also subjected new build to market testing and ensured that 'least cost' versions of available technologies are deployed. Importantly, they have changed the public perception that electricity is special and should not be subject to a fluctuating price driven by supply and demand. Experience around the world shows that properly implemented liberalised markets can handle supply shocks. Sioshansi and Pfaffenberger (2006) note contrasting experiences of supply shocks in Norway, Chile and California. Newbery and Pollitt (1997) showed that one of the main benefits of privatisation of the Central Electricity Generating Board (CEGB) was the elimination of an overly costly nuclear new-build programme. They also showed that the society benefited from the cost reduction and environmental benefits of combined cycle gas turbine (CCGT) deployment in the UK. We believe that this experience demonstrates the need to avoid a return to strategic deployment policies based on old-style industrial policies or expensive public R&D programmes based on poor incentives. Rather, there is a need to design technology policies and organisational models that are

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commensurate with the features of a liberalised electricity sector. We note, however, that failure to innovate combined with increasing pressure from climate change policy could lead to increased government intervention in the sector.

3. Technology options and costs

The much criticised, but still influential, *linear model* of innovation promulgated by Bush (1945) posits that R&D results in technological progress, which in turn leads to diffusion of technology in the market. Clearly, to this must be added the positive feedback loops between the different development phases. Major UK official documents reviewing the energy technology options identify a range of technologies in different stages of development (ICCEPT, 2003; ICCEPT and E4tech Consulting, 2003; House of Lords, 2004; House of Commons, 2005; National Audit Office, 2005). However, in the near and medium term, the range of options is more limited. The main generation technologies with immediate potential for contribution are wind, nuclear and energy efficiency. Further ahead, there is potential in carbon capture and storage and biomass energy. Other technologies are in need of significant progress and their promise lies further in the future (Jamasb et al., 2006).

The estimated costs of renewable sources by 2020 indicated by the Sustainable Development Commission (2005) show that the cost differences between the technological options are expected to become smaller. Moreover, the cost of each technology is, as is often the case, reported in a relatively wide range, as estimates of future costs are uncertain. For example, the cost of on-shore wind power and solar photovoltaics by 2020 is estimated at 1.5–2.5 and 10–16 p/kWh, respectively. The ranges reflect uncertainty with regard to technological progress, discount rates and quality of resources. The unit energy cost of some renewable sources such as wind and biomass can be location specific. Economic efficiency requires that policies should support the development of resources based on the 'least cost' principle. This means that the supply of low-cost or high-quality sites may be more limited than the resource base. Furthermore, many technologies are internationalised and their cost in the UK will depend on their roll-out rates elsewhere. For a typical wind turbine, for example, up to 80% of the cost is represented by the engineered turbine rather than the associated civil works (Department of Trade and Industry, 2001).

4. Policy costs—technology push vs market pull

R&D is the key factor in achieving technological progress. Margolis and Kammen (1999) show a strong relationship between total energy R&D investments and the number of patents granted in the US. They also show that the energy sector is among the least R&D intensive industries. The reasons for this are not obvious. However, this leads us to believe that there may be significant potential for stimulating technological progress by increasing R&D expenditure in the sector.

Public R&D spending on renewables and conservation in the UK has shown a marked decline during the past 15 years (Fig. 1). Much of this decline coincides with and continues in the aftermath of the liberalisation of the electricity sector. The UK energy policy agenda was dominated by the implementation of reforms (privatisation and competition) to the relative neglect of energy R&D and innovation policy. Fig. 2 shows that the UK's average annual R&D spending per capita on renewable technologies and energy efficiency between 1990 and 2005 has been lower than selected comparable countries. There are strong indications that, following liberalisation, major energy companies have reduced their R&D spending and that the new actors (e.g. independent power producers) are not involved extensively in such activities (Eurelectric, 2003). While little is known about R&D spending among the equipment manufacturers, it does not seem likely to have increased (Jamasb and Pollitt, 2008).

The decline in private R&D spending occurred at the same time as a decline in public support for energy R&D. The implicit

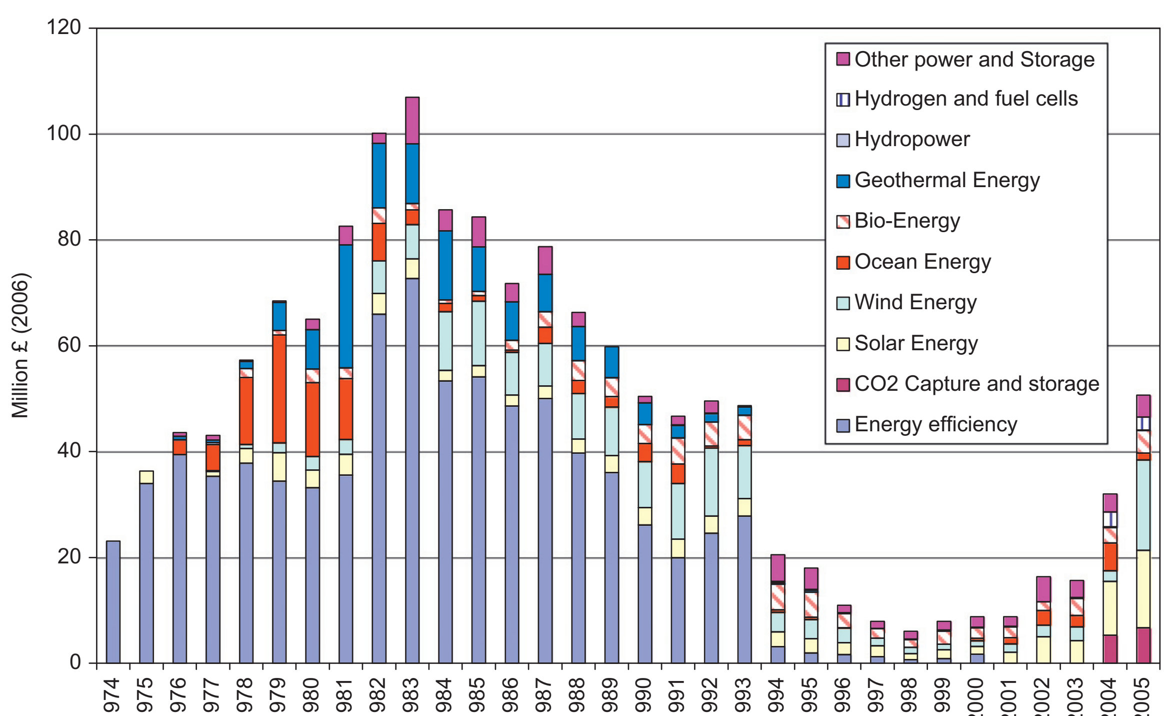

Fig. 1. Public renewable energy R&D spending in the UK (International Energy Agency energy R&D database).