Written evidence submitted by RCUK Energy Strategy Fellowship (LCI0018)

Executive summary

- The current level of resource allocated to low-carbon innovation is not commensurate with the UK's ambitious energy and climate change goals. It is low both historically and in relation to most other developed counties. This may impose higher costs in the long-term and could lead to missed opportunities for UK business.

- The Government's approach to funding a portfolio of low-carbon RD&D is broadly correct. However, there are some areas, notably energy efficiency, that have been under-resourced in the past. Areas showing unexpectedly slow progress towards large-scale deployment should be critically assessed and the resource re-deployed where necessary.

- The LCICG plays an essential role in the low-carbon innovation sphere. However, expectations concerning its impact need to be managed. The LCICG should set up focused sub-groups in specific areas, with international collaboration being a priority.

- There is strong evidence suggesting greater public for support at the applied research, development and demonstration stage. Later-stage innovation bodies such as the ETI and TSB currently receive about one half of total public funding in low-carbon innovation which appears modest. Although the private sector should be expected to take a greater share of investment at this stage, public sector support is required to minimise the 'valley of death' problem.

- We regard the under-utilisation of existing capital assets due to inadequate operating budgets as being a larger problem than unspent capital budgets. A longer-term view should be taken when investing in infrastructure, for example by taking a life-cycle approach which takes account of future operating costs.

Introduction

The RCUK Energy Strategy Fellowship has recently launched a Prospectus[1] exploring research, skills and training needs across the energy landscape. The Prospectus was commissioned by Research Councils UK (RCUK) who constitute the primary audience for the report. The Prospectus contributes to the evidence base upon which the RCUK Energy Programme can plan research and training activities. However, a number of the findings and recommendations concern the wider UK energy innovation system. The Fellowship Team acted independently in producing the Prospectus, drawing on an extensive series of workshops, stakeholder interviews and literature reviews. The recommendations are grouped according to their main focus:

- how the UK energy innovation system as a whole operates;
- the way the Research Councils conduct their strategic planning and support research and training;
- the RCUK Energy Programme specifically; and
- topic-specific research recommendations (e.g. those relating to wind or PV) across the energy domain.

This evidence draws on both the Prospectus and the judgements of the Fellowship team, focussing on the question posed in the Call for Evidence. We have raised wider issues where we believe these to be relevant to the question being posed.

While there is a very large overlap between *low-carbon* innovation (the subject of this Inquiry) and *energy* innovation (the subject of our work), there are differences. *Low-carbon* innovation could cover land-use change, as well as materials and manufacturing development. *Energy* innovation includes advances in technologies in the fossil fuel industries, which would not typically be viewed as low-carbon.

Question 1: *Will the Government's current approach towards low carbon innovation help to achieve the UK's legally binding targets at the lowest possible cost?*

1. In terms of energy RD&D spend per unit of GDP, the UK spends less on energy innovation than most developed countries, standing at 19th position among the International Energy Agency (IEA) countries and 14th in Europe. The IEA noted in 2012[2] that spending levels in the UK do not match either the UK's ambitious climate policy objectives or the capabilities of the UK research system. The Committee on Climate Change reached the same conclusion in 2010.[3] Further work conducted by the IEA[4] suggests a rise in global energy RD&D spending of between three and six times would be needed to meet a 2 degree target in global temperature rise. The implication of

[1] 'Towards a Brighter Energy Future: Energy Research and Training Prospectus', *RCUK Energy Strategy Fellowship,* 2013, https://workspace.imperial.ac.uk/rcukenergystrategy/Public/reports/Final%20Reports/RCUK%20Brighter%20energy.pdf

[2] International Energy Agency, *Energy Policies of IEA Countries: 2012 Review of the UK,* 2012

[3] Committee on Climate Change, *Building a low-carbon economy – the UK's innovation challenge*. London, 2010

[4] International Energy Agency, *Tracking Clean Energy Progress 2013: IEA Input to the Clean Energy Ministerial,* 2013

analysis in the LCICG Technology Innovation Needs Assessment (TINA) reports is that the current relatively low spend could increase the longer-term costs of hitting decarbonisation targets.

2. When setting research priorities in low-carbon innovation, it is important to take account of the 'hype cycle', temporary high levels of interest surrounding a particular technology or set of technologies that may not be warranted by the ultimate potential. The hydrogen economy is a historical example of this. Other technologies that may be caught in the 'hype cycle' could include shale gas extraction, energy storage and wave energy. We would recommend that research areas showing slow progress are critically reviewed to assess their chances of successful deployment, with resources reallocated where necessary.

3. Innovation systems do not have an endless capacity to absorb new resources. Capacity may be constrained by the numbers of skilled professionals and expansion/training lead times. This factor needs to be taken into account in allocating budgets (see Question 2).

Question 2: ***Does the Government have the right balance of focus between energy efficiency, renewable energy and other low carbon technologies?***

4. Given the diversity of the energy landscape, balancing the focus of research and resource levels is an art rather than a science. However, we make the following high-level observations :

    - Research spend on energy efficiency measures has been low historically, only reaching a significant percentage of research spend (28%) in the last few years. There is also very little research being carried out in the UK on non-residential, non-transport energy demand.

    - The UK has significant strengths and has invested substantially in novel and advanced photovoltaic research. However, these investments have not been matched by support further along the innovation chain to support commercial development and the growth of industrial capability. The level of support the UK has given towards innovation in offshore wind technology appears appropriate. Considerable investments have been made in wave energy. However, progress towards commercialisation has been disappointing and the prospects for early deployment at scale are currently weak.

    - There are areas of energy research where private industry is heavily engaged throughout the innovation chain. Research into fossil fuel extraction and utilisation is perhaps the strongest example of this, with transport energy and energy-consuming devices and equipment also areas with heavy industry involvement. The Government should ensure it works to complement these efforts rather than duplicate them.

    - Nuclear fission R&D could currently follow two paths: a) supporting the management of the legacy of the UK's existing nuclear plants and the supply chain for operation and decommissioning; or b) more ambitiously supporting new Generation IV reactor designs and positioning the UK to become a global player in design and manufacturing during the 2030s-40s. The Government should make a long-term decision as to which path to follow in order to minimise the costs of inaction.

5. Energy infrastructure will play an important role in decarbonising the energy system, and Ofgem's initiatives to address issues with the innovation culture and lack of spending in this area

are to be welcomed. The Low Carbon Network Fund and the forthcoming Network Innovation Competition offer very significant extra funds for innovation in this area. However, there is a risk that these resources could be poorly used due to limited capacity and, furthermore, that innovation spending across the energy domain could be distorted. During the process of preparing the Prospectus, we received anecdotal evidence that academics were being drawn away from more fundamental research challenges due to the quantity of resource available under the LCNF programmes.

Question 3: ***What outcomes, if any, are the LCICG likely to achieve? How should its forthcoming strategy drive more investment into low carbon innovation, and how should it measure success?***

6. The LCICG plays an essential role in the low-carbon innovation space, as a coordination function was badly needed. However, expectations regarding what LCICG can achieve in directing, influencing and coordinating innovation will have to be managed. The LCICG membership is wide and contributing organisations have diverse missions relating to low-carbon, energy and economic growth. There is only so much that a high-level umbrella group can do.

7. The establishment of focused sub-groups addressing specific areas, (for example specific technologies or international engagement, see Question 7) would help with coordination at the working level. A sub-group on international co-ordination efforts should be seen as a priority, given the importance of collaboration in this area.

8. Ofgem is currently an associate member of the LCICG. However, given the substantial innovation resource that it now directs, full membership would be more appropriate.

Question 4: ***Are the Government & LCICG targeting investment towards the most effective stages of the innovation process, including over the long-term?***

9. The patchy quality of data and rapidly shifting patterns of spend associated with changing institutional arrangements makes it difficult to suggest a quantitative answer to this question. However, we note from the recent NAO report[5] and data reported to IEA:

    - The Research Councils accounted for almost 50% of the low carbon innovation spend in FY 2011/12.

    - According to the data reported to IEA, energy spend was £288m in calendar 2012 compared to low carbon spend of approximately £340m in FY 2011/12, pointing to a downward trend.

    - The Energy Technologies Institute (ETI) spend reported by NAO was around £15m in 2011/12. However, ETI's activities have subsequently ramped up. According to the ETI Annual Reports covering calendar years 2011 and 2012,6 ETI's project spend rose to £34.0m in 2011 and £38.4m in 2012.

5 National Audit Office, *Public funding for innovation in low carbon technologies in the UK*, London, October 2013

6 Energy Technologies Institute LLP, *Members' report and financial statements for the year ended 31 December 2012*, March 2013

- The Technology Strategy Board has had a net spend (after co-funding from government and research Councils) of around £20m under its energy theme in each of the last two financial years.[7] However there will be further low carbon spend under the sustainability, built environment and transport themes.

10. The allocation of around one half of public low carbon funds to later stage applied research, development and demonstration via bodies such as ETI and TSB appears modest. On the one hand, the public sector has a unique role to play in early stage basic, applied and strategic research where the risks are highest and the private sector has the least chance of appropriating the benefits. On the other hand, funding needs to rise as technologies move along the innovation chain even though the private sector can be expected to take on a greater share of the cost.

11. The evidence strongly suggests that the greater UK support is needed at the applied research, development and demonstration (mid-TRL) stages given the need to overcome the well-known "valley of death" problem. If low carbon RD&D is to be expanded, increased funding would most usefully be focused on later stage applied research, development and demonstration.

12. Funding support needs to reflect interactions between the research councils and later stage innovation bodies. Innovation is not a linear process whereby discoveries emerging serendipitously from the laboratory are taken up by entrepreneurs. Pilot projects and early demonstrations often identify problems that need to be solved through the application of basic science and engineering. This implies a need for collaboration between the research councils and bodies such as TSB and ETI. Recent collaborations between the research councils and TSB in the low carbon sphere are to be welcomed.

13. Market pull policies, such as feed-in tariffs (FiTs) and the renewables obligation (RO), provide incentives to deploy technologies which are fairly mature but are not ready to compete without market support. The point at which individual technologies are ready for this type of support is a matter of judgment. We would argue that market-pull support for some of the less mature technologies being offered though very high FiTs under Electricity Market Reform (EMR), e.g. wave energy at £305/MWh,[8] may be premature and that any support would be better channelled through 'technology push' mechanisms via the research councils and later stage innovation bodies.

14. There is a risk that current research incentives may lead to an overstatement of the maturity of technologies. Academic researchers are strongly encouraged to demonstrate 'pathways to impact'. While attention to commercialisation prospects is of course desirable, both funding bodies and funding recipients may be encouraged to overstate technological maturity. R&D proposals should be underpinned by a realistic assessment of commercialisation prospects and should be appropriately challenged at the peer review and funding decision stages.

Question 5: ***What is the impact of the short-term funding timelines on private sector investment?***

[7] Technology Strategy Board, Driving Innovation, Annual Report and Accounts 2012-13, HC 567, London: The Stationery Office, July 2013

[8] Department of Energy and Climate Change, *Investing in renewable technologies – CfD contract terms and strike prices*. December 2013

15. There are two possible interpretations of this question. It might refer to the short-time periods that private-sector bodies are afforded to submit R&D funding proposals. It could also refer to the relatively short-term funding cycles and strategic planning horizons adopted by funding bodies. We address the second point here.

16. Longer-term strategic and structural planning by public-sector bodies is needed in this area in order to take full advantage of long-term investments in infrastructure, field trials and experiments. In the Prospectus, we recommended, for example, that the Research Councils should look beyond five-year planning horizons and develop long term strategic plans in areas of energy research where longer time periods are needed to secure scientific and other innovation benefits. However, plans should be regularly reviewed and should not constitute firm budgetary commitments.

17. Longer-term research planning would provide private companies with greater certainty that specific research areas will continue be supported. In turn, this is likely to instil greater confidence amongst investors that it is worthwhile investing in these technologies, given that they will be subject to long-term innovation support.

Question 6: ***How should DECC ensure that its remaining capital allocation for low carbon innovation will be spent wisely, after two years of underspend?***

18. The evidence we gathered during the preparation of our Research and Training Prospectus identified significant problems associated with inadequate operating budgets and the under-utilisation of capital assets in the energy field. These range from the experimental facilities available at STFC's Harwell Site (Diamond light source, ISIS neutron beams) through to the testing facilities needed to support demonstration and early deployment. This issue has been highlighted in a recent report from the House of Lords Science and Technology Committee.[9] Thus, in our view, the problem is how to balance capital and operating spend rather than to spend out available capital.

19. Given the current position, we suggest the following steps:

    - Each potential capital investment needs to be considered on its own merit. There is no point in investing in assets that will remain under-used. If funds remain unspent, this might not be the worst outcome in terms of the public good.

    - Again on a case-by-case basis, the level of resource allocated to operating budgets should be carefully assessed and their adequacy considered. While we appreciate constraints on shifting resources from capital to operating budgets, this might indeed be the best use of unspent resources.

    - We endorse the House of Lords Committee's recommendation that a long-term view be taken when planning infrastructure, whether for scientific experimentation or testing. Capital budget allocations and operating budgets allocations are being taken at different

[9] House of Lords Select Committee on Science and Technology, *Scientific Infrastructure*, 2nd Report of Session 2013–14, HL Paper 76, November 2013

points in time and under different institutional arrangements. A life cycle approach to budgeting for infrastructure, where possible future operating cost streams are identified from the start and communicated to relevant bodies, would seem more appropriate.

Question 7: ***How is the Government maximising opportunities to learn from and partner with international partners within and beyond the EU?***

20. EU support for energy and other low-carbon research will ramp up substantially under Horizon 2020. If the UK were to receive its 'juste retour',[10] approximately £100m per annum might flow back for non-nuclear energy R&D and £40m for nuclear R&D. Given the UK's current energy research budget of £288 million[11] and the potential to leverage research outcomes, this could be an invaluable resource.

21. We have recommended that the UK that should exert greater influence over the development of funding calls under Horizon 2020. Some coordination of bids into the Programme, as is done in some other countries, could also be helpful. The resource allocated to international coordination by DECC and others is limited and greater emphasis on this role and a greater allocation of resource could bring benefits to the UK.

22. The engagement of UK academic energy researchers in the European Energy Research Alliance (EERA) is currently coordinated by the UK Energy Research Centre (UKERC). LCICG could take an expanded role in coordinating wider engagement beyond the academic sphere both with the EU and looking towards the wider international arena, perhaps through a suitably constituted sub-group.

23.

24. The research councils have signed Memoranda of Understanding with several priority countries notably China, India and the US. The resulting collaborations are valuable but, following the 'best-with-best' principle, we would suggest extending collaboration beyond these priority countries on a topic-by-topic basis. For instance, South Korea is a world leader in smart grid technologies and has substantial resource for international collaboration.

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[10] Estimated at just under 15% based on the UK share of EU GDP.

[11] International Energy Agency, *Energy Technology RD&D Budgets Documentation for Beyond 2020 Files*, p.12. Energy Technology Research and Development Database
(Edition: 2013). Mimas, University of Manchester. DOI: http://dx.doi.org/10.5257/iea/et/2013