House of Lords Science and Technology Committee - Call for evidence: Setting science and technology research funding priorities

Response prepared by the Institution of Chemical Engineers

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Introduction
IChemE is the hub for 30,000 chemical, biochemical and process engineering professionals worldwide. We are the heart of the process community, promoting competence and a commitment to sustainable development.

Professional bodies such as IChemE occupy a unique place in society. Our Royal Charter and charitable status confers upon us an obligation to advance the discipline for the benefit of society as a whole and support the professional development of our membership, which spans a wide range of individuals from industry, regulators, academia and consultancies. We can call upon our member's expertise in these fields without bias or favour, in order to reach objective advice based on sound science.

The Institution of Chemical Engineers (IChemE) welcomes the opportunity to submit evidence to this enquiry.

The call for evidence document contains nine questions to which we have allocated numbers one through to nine, inclusive. The institution has responded to each question using this nomenclature.

Call for evidence response:
Question 1: What is the overall objective of publicly-funded science and technology research?

1.1 Science and engineering make a huge contribution to welfare – the health, wealth and happiness of citizens. For example, nearly 30% of the UK's GDP is produced by SET-intensive sectors, according to the 2009 IUSS Select Committee report *Engineering: turning ideas into reality* (para 7). Likewise, research programmes in science and engineering are contributing significantly to advances in healthcare.

1.2 The objective of public funding is thus to support science and technology research that is in the public interest, and for which other sources of funding are not available. Sometimes the provision of public funds enables partnerships to be initiated, where industry or charities, for example, also contribute: encouraging such partnerships is another desirable objective.

1.3 Research in SET topics also contributes to culture – it captures popular attention and generates interest in young people, stimulating the formation of the Science-literate Society commended in the Bodmer Report of 1985 (Royal Society).

1.4 A vital additional purpose of publicly-funded research is the training of highly skilled manpower for the UK workforce.

1.5 For the purposes of this response we distinguish three types of research:

Curiosity-driven: Discoveries in science, including engineering science, which have been made thanks to public funding of research, underpin many of the benefits of modern life. Very often these discoveries were not made with any specific application in view, but were the result of *Curiosity-driven* research. This is thus an essential element of any publicly-funded research programme.

Application-conscious: The second type of research, *Application-conscious,* is that in promising areas of long-term interest, aimed to develop know-how that could be applied. Much engineering research is of this nature. We make a distinction between this and *Mission-driven* research, since

Application-conscious research is speculative in nature, in an area of science/engineering chosen by the researcher. The research is not *Curiosity-driven* though, because it is carried out in a field with potential application in mind.

Mission-driven: The third type of research is that which is designed to yield science-based solutions to particular challenges, generally within a set time-frame. Industrial R&D is mainly of this type.

Question 2: How are public funds for science and technology research allocated? Who is involved at each level and what principles apply? Where appropriate, is the Haldane Principle being upheld?

2.1 The IUSS Select Committee report *Putting Science and Engineering at the Heart of Government Policy (pp50-53)* gives a useful set of flow diagrams summarising public funding streams for research and new technology. Whilst some diversity is inevitable and can be an advantage in enabling targeting of cash to specific needs, the complexity of the overall picture is striking. The downside is evidently the difficulty of ensuring balance, in overlapping programmes, in transparency, and the potential for certain areas to experience shortage of funding. And, perhaps most importantly, in presenting a complex and fragmented support mechanism to the research community, Government has constructed a complex set of channels for feedback into government around science and engineering issues.

2.2 The Haldane Principle, by which we understand "decisions about research funding should be made by scientists and not politicians", is broadly being upheld at the level of individual project submissions to Research Councils. Decisions about these, following peer review, could be fairly said to be based on scientific grounds.

2.3 However, an equally important question is that of allocating funds to the different types of research we distinguished above, and between different technical areas. We do not feel that questions of allocation are best decided solely by scientists, and agree with current practice that an appreciation of societal issues should also inform decision making. But the overall effect of funding allocations on the research community needs to be considered – for example, the effect on the development of trained manpower.

Question 3: Are existing objectives and mechanisms for the allocation of public funds for research appropriate? If not, what changes are necessary?

3.1 IChemE is concerned that pressure on Research Councils to generate science and technology of immediate practical use may jeopardise the *Curiosity-driven* and *Application-conscious* programmes that are a vital part of a healthy research community, and which the Councils have a unique role in funding. We note that the Research Councils have recently introduced a requirement that applicants write an "Impact statement" to explain who will benefit from their research.

3.2 It is essential that research that is moving successfully into commercial application is supported, but this is not a task for Research Councils with their ethos of scientific peer review. It is a space in which, since its creation in 2007, the Technology Strategy Board has been active. There is a case for widening the remit of the TSB (or some similar organisation) and increasing its funding. At the same time there should be more clarity about the roles of the Research Councils and their managed programmes, and the interface with TSB and ETI (Energy Technologies Institute). We believe that *Curiosity-driven* and *Application-conscious* research should be the province of Research Councils, but that *Mission-oriented* research should be promoted by other bodies which are tasked also with delivery.

3.3 The UK has a rather poor record at translating scientific discoveries into commercial application, but we do not feel that putting the Research Councils under pressure to fund translation activities is the correct approach. Making relatively small sums of money (all they can afford) available for technology development, which is an expensive business, has been characterised as a policy “guaranteed to fail, but cheaply”. Successful innovation programmes require a different approach to those funding science and technology research.

Question 4: What governs the allocation of funding for Government policy-directed research through Government departmental and agency initiatives? Are existing mechanisms appropriate? What is the role of Departmental Chief Scientific Advisers?

4.1 Our impression is that the allocation of funding for policy-related research from Government Departments and Agencies tends to be inconsistent, as it depends upon the degree to which individual senior managers are informed about, and enthusiastic about, the potential benefits of research. A greater awareness of the importance of sound scientific and engineering evidence across Government, and an appreciation of its value in identifying and developing opportunities as well as governing downside risks, should be inculcated and the Departmental CSAs have a key role in achieving this aim. Sometimes it appears that Government departments would rather fund a consultant, than a scientist.

4.2 We applaud progress made under Professor Sir David King and Professor John Beddington in promoting and enhancing the work of the CSAs but believe that these individuals still have more to do to establish their position at the heart of informing and shaping policy. Furthermore, it is essential either that Departments engage Chief Engineering Advisors in addition to CSAs, or that the CSA explicitly assumes a role which embraces both science and engineering, as indeed Professor Beddington himself has done.

4.3 In support of these aims, we advocate that scientists and engineers in Government should be encouraged to network with professional colleagues through a range of mechanisms including those provided by the professional institutions. They should aim to secure professional registration as both the benchmark of their professional standing and a symbol of the importance attached by Government Departments and Agencies to the contribution of the science and engineering community.

Question 5: How are science and technology research priorities co-ordinated across Government, and between Government and the relevant funding organisations? Who is responsible for ensuring that research gaps to meet policy needs are filled?

5.1 As already commented, we are not confident that the current fragmented research support mechanism can identify gaps, nor fill them.

5.2 As an example of funding gaps, we cite the uncertain funding of biotechnology applications, which involve chemical engineers and biochemical engineers, and which have tended to fall between EPSRC (with its emphasis on physical science) and BBSRC (with its emphasis on bioscience). The Technology Strategy Board has recently announced funding of £2.5 million fund for Industrial Biotechnology, which is very welcome. But assurance of consistent funding of technology development and application in this exciting area, related to topics like pharmaceuticals and healthcare, food and drink, biofuels and the low-carbon economy, is still awaited.

5.3 Another "gap" area of which we are aware is that between social science and engineering where matters of sustainable development are coming forward. The impact of new technology on society, for example in the low-carbon economy, is under study, but this inter-disciplinary research risks failing to attract sufficient support from either community.

Question 6: Is the balance of Government funding for targeted versus response-mode research appropriate? What mechanisms are required to ensure that an appropriate and flexible balance is achieved? Should the funding of science and technology research be protected within the Research Councils or Government departments? How will the current economic climate change the way that funds are allocated in the future?

6.1 In recent years there has been an increasing diversion of Research Council funds from Responsive mode research to "Managed programmes" in specific areas, and to *Mission-driven* research also funded by a variety of other bodies such as the ETI and TSB. Naturally, research funded by Government departments is mostly *Mission-driven*.

6.2 Thus we have seen success rates in Responsive mode fall. By number, the success rates of grant application to EPSRC Responsive mode
was 32% in 2004-5, 30% in 2006-7 and only 23% in 2008-9. These are average figures, and in some areas (e.g. Physical Sciences), Responsive mode success rates are now less than 20%. Researchers thus perceive that support for *Curiosity-driven* and *Application-conscious* research is falling. Low success rates are a challenge for both funders and researchers: they put the peer-review system under strain, and cause the whole process to be regarded by researchers as something of a lottery. A single non-supportive review (sometimes from an inexpert referee) can cause an application to fail, so that applications inevitably tend to avoid potential criticism by being less speculative and imaginative, and thus less risky. This is not to the benefit of the overall programme.

6.3 IChemE strongly welcomes the growing emphasis on research of commercial and social relevance, but nevertheless remains concerned about the overall picture. With a variety of organisations being responsible for different aspects of public funding, we are not confident that the overall balance of different types of research is being considered or guided.

6.4 The current deterioration in the public finances, as a result of the economic slowdown, will clearly affect the sums of money available for public funding of research. A particular threat is that many leading researchers in engineering in the UK are from overseas and a funding drought could lead to a significant emigration of this talent causing a major long-term setback for UK SET research. Continuity of funding, essential to keep skill-groups in place, is at risk.

6.5 The arrangements for allocating funds should be robust against a wide variety of economic situations, and we feel that the opportunity should be grasped to make the necessary changes, irrespective of the economic climate.

Question 7: How is publicly-funded science and technology research aligned and co-ordinated with non-publicly funded research (for example, industrial and charitable research collaborations)? How can industry be encouraged to participate in research efforts seeking to answer societal needs?

7.1 Ultimately publicly-funded science and technology research must be more strongly aligned with that funded by other sources. Tax and financial measures must play a key part in encouraging a significant enhancement both in the volume of industrial collaborative research and in the willingness of industry to engage in science and engineering R&D. Measures need to be taken to ensure that industry views the UK as a location of choice for collaborative R&D, for example through

- Arrangements for the utilisation and ownership of intellectual property,
- The appropriate funding models, ensuring that "full economic cost" does not simply act as a deterrent to collaboration with the UK,
- The supply of well trained graduates and postgraduates, which is the key factor in determining where companies place their globally mobile R&D investments.

Question 8: To what extent should publicly-funded science and technology research be focused on areas of potential economic importance? How should these areas be identified?

8.1 IChemE thinks that an appreciation of the technology needs of particular industrial sectors is one legitimate consideration in allocating public funds to science and engineering research. The well-established principle that research programmes should be "pre-competitive" is still appropriate. Other leading considerations will be societal needs, and technical potential.

8.2 In 2007 IChemE undertook a consultation with its members worldwide about priorities for the profession in the 21st Century. It identified the following:

- Sustainability and Sustainable Chemical Technology
- Health, Safety, Environment and Public Perception of Risk
- Energy – Securing Reliable and Affordable Supplies in the Near Term
- Food and Drink
- Water
- Bioprocess and Biosystems Engineering

(www.icheme.org/technicalroadmap)

8.3 These topics, many of which feature as priorities in current government policy, give rise to a whole range of issues, some of which need more research.

8.4 Our consultation did not attempt to spot particular winning technologies, and in general we believe that publicly-funded science and technology research also should stop short of trying to spot winners. Consultation with a range of stakeholders is well able to identify needs and opportunities sufficient to inform public funding of research. Bodies such as TSB have a vital role in promoting innovation, but funding ideas through to the market is a task for those companies (and individuals, partnerships etc) who will take on commercial risk, and rewards.

Question 9: How does the UK's science and technology research funding strategy and spend compare with that in other countries and what lessons can be learned? In this regard, how does England compare with the devolved administrations?

9.1 Citation statistics and other evidence show that UK science research punches above its weight in terms of international ranking, which is a splendid result for our scientists, and a testament to the good work of our funding agencies. The IUSS Select Committee report *Putting Science and Engineering at the Heart of Government Policy (p10)* shows though that the UK's Gross domestic expenditure on R&D, at 1.8%% of GDP, is somewhat less than that of our main competitors (Japan 3.4%; USA 2.6%; Germany 2.5%). We also have the impression that competitors are more successful at funding the translation of science through into useful technology.

9.2 In its recent response to the BBSRC consultation on its strategy, IChemE commented that the Research Council needed also to fund engineering research, if its bioscience research was to have the hoped-for impact. Applied science and engineering research are essential steps on the path to realising a successful application (see response, above, to question3), but are too often neglected.

9.3 However we are encouraged by a growing entrepreneurial culture in the UK, and the Government's efforts to stimulate this. We applaud the recently announced creation of the £1 bn UK Innovation Investment Fund, intended to invest in technology-based young businesses. Such support will surely stimulate the science and engineering community and help us to build on the UK's strengths in SET-based research.