

## Scientific Infrastructure

### House of Lords Science & Technology Select Committee Science Council Evidence



#### The Science Council

1. The Science Council was established in 2004. It is an umbrella organisation of learned societies and professional bodies, and currently has 41 member organisations drawn from across science and its applications: a list of member bodies is attached. In addition to providing a mechanism for the sector to work collectively, the Science Council develops and leads collaborative projects working with member bodies and the wider scientific community: examples include the Future Morph website<sup>1</sup> designed to provide young people with information about careers opportunities, and LMI analysis of the UK Science Workforce.<sup>2</sup>
2. The Science Council also works to advance the professional practice of science and since 2004 has awarded the professional qualification of Chartered Scientist (CSci) with 15,000 individuals currently registered. With the aim of raising the profile, aspirations and retention of scientists at graduate and non-graduate levels, professional registration was extended in 2012 to include Registered Scientist and Registered Science Technician.
3. Collectively the Science Council member bodies represent more than 400,000 individual members, including scientists, teachers and senior executives in industry, academia and the public sector.
4. In preparing this submission we have consulted member bodies to identify areas of common interest and the issues they raised form the content of this submission. This includes the importance of developing and nurturing a skills infrastructure to complement investment in physical scientific infrastructure, and the need for the UK to be a strong contributor to international scientific infrastructure programmes. In addition to this response, a number of member bodies will be responding individually to the inquiry.

#### **Current availability and status of UK scientific infrastructure**

5. Maintaining and building on the strength of the UK's research base, world-class facilities and research and science skills will be vital in delivering sustainable economic growth. Continued investment in science infrastructure has a major role to play in both enhancing the capabilities that underpin research and driving advances in sectors critical to the economy. Achieving sustainable economic growth also demands attracting continued investment domestically and from overseas.
6. The contribution of science is essential to finding solutions to the current grand scientific challenges, such as climate change and global food security. Recent reports from the Institute of Physics<sup>3</sup> and the Royal Society of Chemistry<sup>4</sup> also serve to highlight the significant financial contribution that investment in science research makes to the economy. However, unlocking further research opportunities, including finding solutions to the current great scientific challenges such as climate change, global food security and ageing populations, requires continued investment in highly technical and sometimes expensive infrastructure.

<sup>1</sup> <http://www.futuremorph.org/>

<sup>2</sup> *The current and future UK science workforce* TBR, Sept. 2011 <http://www.sciencecouncil.org/content/science-workforce>

<sup>3</sup> [http://www.iop.org/publications/iop/2013/page\\_60319.html](http://www.iop.org/publications/iop/2013/page_60319.html)

<sup>4</sup> [http://www.rsc.org/images/campaign\\_case\\_studies\\_tcm18-232087.pdf](http://www.rsc.org/images/campaign_case_studies_tcm18-232087.pdf)

7. It is critical to the future success of UK economy that Government continues to see science as a priority and maintains the level of investment in our national science and research capacity. It should continue to be an ambition of the UK Government to support high quality researchers in the UK with long-term, stable access to high-quality resources and equipment: this commitment should be to a broadly based multi-disciplinary research capability that can undertake both basic science that will foster future advancements, as well as the delivery of shorter term translational goals. To date the Government has indicated an understanding of the value of basic science and its capacity to deliver over time wide ranging, and often unforeseen advances of great importance, as illustrated by some of the examples in the previously referenced IoP and RSC publications. We understand the difficulties in measuring the returns on investment in large scale facilities, but with sustainable support we believe such facilities provide returns that are often far more substantial and well beyond the original ambitions.
8. The reduction in capital funding announced in the 2010 Comprehensive Spending Review (CSR2010) applied to expenditure in relation to the construction of large facilities, upgrades and maintenance to existing facilities, as well as the funding available for university-based laboratory equipment. Additional capital investment announcements since CSR2010 have been welcomed by the science community. However the ad hoc nature of these allocations creates concern that decisions are often strongly influenced by political considerations and concern for the stability for scientific programmes. There is uncertainty as to the Government's long-term strategy for science and infrastructure. In such a climate long-term planning becomes more difficult and there is a real danger that research capability can be lost as researchers turn to other areas of endeavour or look for opportunities in other countries. An example where the UK has lost research capacity is in nuclear physics, where the quality and level of funding for research in the UK is significantly lower than in competitor countries that have large nuclear industries. This has left the UK without a nuclear research community and thus the capacity to train future nuclear scientists.<sup>5</sup> Germany in particular has lead the way with investment in major new projects such as FAIR in Darmstadt, to which the UK has only recently acquired associate partner status.
9. Investment in scientific infrastructure should not be determined primarily by the size of the existing user community but should also be influenced by the increasing multi-disciplinarity of complex issues and the need for breadth across the UK science base. Future demand must also be an important consideration in investment policy. This is particularly true for fast growing and emerging areas such as the curation of data in solar science and in supercomputing. In these instances Government needs to commit adequate resources to horizon scanning programmes that can identify short and long term infrastructure needs, complemented by adequate investment in the skills infrastructure to maintain and utilise these facilities: such exercises also enable the UK to leverage potential opportunities for incentivising R&D investment from within the UK and from overseas businesses.
10. The demand for small research communities in areas such as Micropalaeontology in terms of numbers is very low, but cover very important areas of research in which the UK is a global leader. It is important therefore that capital funding decisions are not made solely on a research community's visibility or size. Failure to support small research communities could lead to near-total loss of national capacity in the next few years because it send a message to prospective students that their particular research area is not supported.

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<sup>5</sup> [http://www.iop.org/policy/consultations/research/file\\_41903.pdf](http://www.iop.org/policy/consultations/research/file_41903.pdf)

## **The need for a skills infrastructure**

11. Investment in capital infrastructure alone cannot deliver benefits for the UK economy. To maximise the benefits there is a need to provide for the skills and expertise in the use of the research infrastructure, and contribute to the increasing demand for the high-level technical and research skills arising from the research outputs. Recent research undertaken for the Science Council shows that science skills have become increasingly important across all sectors of the UK economy and society, with 5.8 million people now employed in science-based roles, with a projected increase to 7.1 million people by 2030.<sup>6</sup> As well as helping policy makers understand the landscape for long-term investment in education and skills, it underlines the tremendous demand for high-level STEM qualifications across the entire economy and the increasing capacity for all sectors of the economy to draw on UK science research to maximise the outputs. UK employers have often stated that the UK STEM workforce as a whole lack the practical skills needed for employment in science and technology environments, particularly in relation to laboratory skills. The operation and maintenance of large facilities require large numbers of skilled technicians and other support staff to maximise their outputs: but these staff will also develop the skills and knowledge valuable in other highly technical environments and can therefore contribute to inward investment to the UK.
12. Science Council member bodies indicate high levels of concern that UK post-graduate students do not possess the same level and quality of training that overseas students demonstrate with regard to technical and practical skills. Reduced funding for capital investment in HE combined with reduced funding for UK post-graduate students in areas where there are already skills shortages, is having a negative impact on the resident workforce, often in strategically important research areas. This will have a knock-on impact on the ability of UK business to maximise the use of research outputs and innovation opportunities. The removal of public funding for post-graduate degrees in the UK has increased the competition to recruit from countries such as China and India rather than to invest and train our own UK workforce. The Government has stated its commitment to maintaining a leading role for UK science as a magnet for the world's best researchers and leading science and innovation companies: to ensure that this can happen there is a need to put in place the frameworks to develop and maintain cutting edge technical skills and knowledge. The combination of theoretical knowledge with experimentation is of fundamental importance to the practice of high-quality science in enhancing developmental as well as translational research.
13. Investment in scientific infrastructure can provide this environment. With growing economic demand for a workforce with high-quality technical and practical science skills, the ability to conduct experiments with high-quality apparatus in real laboratory conditions provides scientists with opportunities to develop the necessary skills to meet this demand. There is an opportunity here for Government to significantly increase its investment in the skills pipeline and increase the attractiveness to overseas businesses of investing its R&D activities in the UK. A recent CBI study found that the quality of the UK's scientific research base is one of the most significant factors encouraging international companies to bring high-value investment to the UK<sup>7</sup>. This is borne out by the fact that the largest areas of industry R&D investment in the UK and investment globally are currently focused in areas of intense global competition: pharmaceuticals, biotechnology, aerospace and defence, and software and computer services.<sup>8</sup> If the global perception of the UK's research base can be advanced further it may incentivise overseas investment in a wide range of emerging technologies.

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<sup>6</sup> <http://www.sciencecouncil.org/sites/default/files/ExecSummary2011.pdf>

<sup>7</sup> Making the UK the best place to invest. CBI, April 2011 <http://www.cbi.org.uk/media/934670/making-the-uk-the-best-place-to-invest-report.pdf>

<sup>8</sup> The 2010 R&D Scorecard. Department for Business, Innovation and Skills, November 2010

14. The Science Council welcomes the development of joint regional scientific infrastructure investment ventures between multiple UK universities and considers that there is greater potential to be exploited. This would enable regular access to the best equipment for undergraduates and postgraduates to help them to develop the necessary skills for the UK to be internationally competitive. These facilities would of course need high quality equipment and highly skilled scientists, engineers and technicians.
15. An infrastructure strategy should encompass explicitly translational and developmental research and the associated skills if the UK is to maximise the opportunities to achieve research outcomes.

### **International collaboration**

16. Science is an international activity. The scale and immediacy of the issues the world faces, together with the pace of change in science and technology, demands increasing interaction and cooperation between scientists working in international multi-disciplinary teams. Collaborative partnerships at the European or global level are therefore also beneficial for building and operating large-scale infrastructure facilities and research projects that are beyond the financial capability of most single countries. The recent statement from the G8 Science Ministers summit recognising the need for continued international collaboration on scientific infrastructure projects underpins this point.<sup>9</sup> Scientific collaboration as a tool for advancing diplomatic relations between nations should also not be underestimated.
17. The Science Council appreciates that it will not always be economically viable for international science facilities to be UK-based. Where scientifically optimal and most cost-effective it is rational for large-scale scientific infrastructure to be based overseas. However when this is the case, it is critical that the UK Government and science community are involved at the earliest stages of a project's formulation, design and implementation. Government also needs to ensure that the UK has a science workforce with the appropriate knowledge, skills and experience to enable it to be able to fully collaborate with international partners and lead international research projects. Facilitating this will ensure that UK researchers are able to shape and influence the future of international programmes to suit its interests and have the best possible access to these facilities, thus maximising the research and knowledge exchange opportunities in the UK. If the UK is not a 'first-stage partner', its access and ability to effectively influence a programme's design and strategic direction is significantly diminished.
18. Maintaining UK overseas capabilities is critical to its long-term success in many areas of scientific endeavour. The UK's membership of the International Ocean Drilling Programme (IODP) is one example of a successful international project that has brought together multi-disciplinary teams of researchers, engineers and technicians to explore the Earth's history and structure recorded in seafloor sediments and rocks. Another highly successful international collaboration has been the European Southern Observatory (ESO) project, of which the UK is one of 15 members. Membership of the ESO provides UK-based astronomers and astrophysicists with access to state-of-the-art research facilities thus allowing them to conduct front-line science in the best conditions.
19. Where the UK has been less successful is in the emerging area of synthetic biology, which along with industrial biotechnology has been predicted to contribute between £150bn and

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[http://webarchive.nationalarchives.gov.uk/20101208170217/http://www.innovation.gov.uk/rd\\_scoreboard/downloads/2010\\_RD\\_Scoreboard\\_analysis.pdf](http://webarchive.nationalarchives.gov.uk/20101208170217/http://www.innovation.gov.uk/rd_scoreboard/downloads/2010_RD_Scoreboard_analysis.pdf)

<sup>9</sup> <https://www.gov.uk/government/publications/g8-science-ministers-statement-london-12-june-2013>

£360bn to the global economy by 2025.<sup>10</sup> Additionally the UK does not currently have guaranteed access to a free-electron laser (FEL) facility. It is also understood that in some instances the lack of bilingual and multilingual UK researchers has resulted in the UK being marginalised from international projects. The UK's lack of involvement in these and other collaborative projects puts UK science at a disadvantage against its international competitors and leaves it unable to exploit potential opportunities for attracting overseas investment through research and development (R&D) partnerships.

20. In areas like industrial biotechnology and the geo-sciences no common research database exists. Without common data storage and management systems, information sharing and service provision to the different user communities such as academic, industry, government and the public cannot take place. These and other areas of research require greater investment in e-infrastructure to facilitate the interoperability of data within and across national boundaries.

### **Governance of UK scientific infrastructure facilities**

21. As stated above investment in large scale facilities can be extremely efficient and generate returns often far more substantial than the initial investment alone. This is because it provides a service over a sustained period of time and across a wide range of disciplines, as well as being able to be managed in a more efficient and transparent manner.
22. Evidence from a number of our members has highlighted that the usage of large facilities has recently been impeded by limits placed on the numbers of days of access allowed, thus doing damage to many research programmes. One example of this is the Central Laser Facility (CLF) the development of which has been funded mainly by the Science and Technology and the Biotechnology and Biological Sciences Research Councils. The CLF is a partnership between UK and European universities that use specialised laser equipment to carry out a broad range of experiments in physics, chemistry and biology. Access to the facility is granted by peer-review every 6 months. Currently the facility's two stations, Octopus and Ultra operate significantly below optimum capacity due to the lack of funding for support staff. The current level of support enables operation of only one station at a time, which equates to between 20% and 30% of full operational capacity. Given a relatively small increase in resource funding it would be possible to operate both stations simultaneously, and would provide big gains in capacity. Full capacity could be achieved for both facilities by increasing resource spending by approximately 20%.
23. The key long-term requirement is for a coherent, well-argued and properly adhered to large facility strategy or roadmap. Priorities must be set on the basis of evidence of scientific outputs and societal impact of large facility research. Our members feel that there is scope for a National Science Infrastructure Strategy to outline a long-term timetable of continuous replacement and improvement of capital research facilities, devised and consulted on by input from the Research Councils, higher education, government, professional bodies and other user communities of each of the national facilities.

### **Scottish Independence**

24. Our members are keen to draw the Committee's attention to the impact that Scottish independence might have on science and related infrastructure facilities in Scotland and the rest of the UK. In the event of Scottish independence there will be a clear need for careful

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<sup>10</sup> [https://connect.innovateuk.org/c/document\\_library/get\\_file?p\\_l\\_id=79343&folderId=169208&name=DLFE-1715.pdf](https://connect.innovateuk.org/c/document_library/get_file?p_l_id=79343&folderId=169208&name=DLFE-1715.pdf)

management of any transition of research funding and activity between relevant funding agencies, industry and charities in the short term to cover existing projects. Scotland possesses a number of centres of scientific excellence that are used by research teams from across the UK as well as from overseas. Negotiations between Westminster, Holyrood and other devolved administrations may be required to ensure that the four nations' access to facilities across each others' borders remain readily accessible.

25. Currently RCUK facilitates research with international partners, and research groups in Scotland have excellent access to international science facilities through subscription funding from the UK Research Councils. As such an independent Scottish Government may be required to renegotiate access to international facilities. There are further as yet unknown implications for UK science which require further investigation. These include the impact on students at Scottish universities, immigration, and on science and engineering in business and industry.
26. Overall the Science Council recognises that budgets are very tight in the current spending round. However the Government must develop a more coherent strategy that provides for a stable and long-term funding environment to meet UK scientific infrastructure needs.

Diana Garnham, Chief Executive

June 2013



## Member Bodies of the Science Council June 2013

1. Association for Clinical Biochemistry and Laboratory Medicine\*
2. Association of Neurophysiological Scientists\*
3. Association for Science Education\*\*/ \*\*\*
4. British Academy of Audiology
5. British Association of Sport and Exercise Science
6. British Computer Society\*
7. British Psychological Society\*
8. British Society of Soil Scientists\*
9. Chartered Institution of Water and Environmental Management\*
10. College of Podiatry
11. Energy Institute\*
12. Geological Society of London\*
13. Institute of Biomedical Science\*/ \*\*
14. Institute of Brewing and Distilling\*
15. Institute of Corrosion\*
16. Institute of Food Science and Technology\*/ \*\*
17. Institute of Marine Engineering, Science and Technology\*
18. Institute of Materials, Minerals and Mining\*
19. Institute of Mathematics and its Applications\*
20. Institute of Measurement and Control
21. Institute of Physics and Engineering in Medicine\*/ \*\*
22. Institute of Physics
23. Institute of Science and Technology\*\*
24. Institute of Water\*
25. Institution of Chemical Engineers\*/ \*\*
26. Institution of Environmental Sciences\*
27. London Mathematical Society
28. Mineralogical Society\*
29. Nuclear Institute\*
30. Oil and Colour Chemists' Association\*
31. Operational Research Society
32. Physiological Society
33. Royal Astronomical Society
34. Royal Meteorological Society
35. Royal Society of Chemistry\*/ \*\*
36. Royal Statistical Society\*
37. Society for Cardiological Science and Technology
38. Society for General Microbiology
39. Society of Biology\*/ \*\*
40. Society of Dyers & Colourists
41. The Organisation for Professionals in Regulatory Affairs

\* Licensed to award Chartered Scientist (CSci)

\*\* Licensed to award Registered Scientist (RSci) and Registered Science Technician (RSciTech)

\*\*\* Licensed to award Chartered Science Teacher (CSciTeach)