Key priorities and challenges for the science and research budget.

A contribution from the Society of Biology to the Director General,
Knowledge and Innovation at the Department for Business Innovation and Skills

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The Society of Biology is a single unified voice, representing a diverse membership of individuals, learned societies and other organisations. We are committed to ensuring that we provide Government and other policy makers - including funders of biological education and research – with a distinct point of access to authoritative, independent, and evidence-based opinion, representative of the widest range of bioscience disciplines. The Society believes that investing in science and research is essential for the wealth and wellbeing of the nation, and welcomes the opportunity to highlight strategic priorities for forthcoming spending decisions.

Summary

- The UK science research and development sector is one of the most productive in the world and UK innovative capacity creates new products and benefits, and attracts inward investment and international students.

- Public funding is a key driver and motivator of business and charitable investment in science alongside the recognised exceptional productivity of the UK science community.

- Unless action is taken now to stabilise and then grow investment in R&D we cannot reasonably expect to continue the current level of success - this was based on an historic period of strong investment in science.

- Both resource and capital funding are vital, and operate most efficiently when both are assured and predictable. A secure ringfence around these funding streams will reap benefits not just by facilitating research but also by encouraging charitable and international investment.

- The success of the UK science sector relies on a diverse and skilled workforce. Researcher training and skill acquisition take time. Ensuring a healthy skills pipeline in all strategically important research and development areas is challenging, but will reap rewards. The transferable skills of trained scientists are highly valued and have economic impact in the wider economy.

- For sustained success a resilient science base is essential. A diverse funding landscape builds and maintains resilience, being able to both fund centres of excellence and have the capacity to seed areas of promise wherever they arise.

UK Science and Research

The United Kingdom has one of the most vibrant and productive science research environments in the world and despite representing just 1% of world population produces 14% of the world's top cited research articles. This academic measure reflects and underpins our international reputation for innovation and excellence that draws international students contributing almost £8bn[1] to the higher education economy as well as international investment in business and research. Nearly 30% of the UK's GDP is produced by sectors intensive in science, technology, engineering and mathematics.[2] Factors that act upon the science research base have implications across the economy, for national health and wellbeing, and for international prestige. The economic benefits of science research accrue not only through the development of valuable products and processes and associated employment, but also as a result of science advice that leads to avoided costs. Bioscience-based activity alone is worth an estimated €2 trillion to the European economy, in which the UK is a key player.[3] There are social and cultural benefits also as a result of the emotional and motivational satisfaction that many people derive from science knowledge and understanding, and UK science has responded to public interest by supporting enhanced communication and outreach activities. Improved scientific knowledge saves lives and improves the quality of life, not only through improvements in medicine and agriculture, but also through understanding of our natural and built environments (e.g. flood forecasting).

The science funding landscape

There are many factors acting on the science funding environment, including the Research Council settlements; the reduced departmental budgets available for funding of directed and policy-relevant research; the funding position and policies of the Higher Education Funding Councils, and the changing fiscal environment for Higher Education Institutions. Furthermore private investment in science research has been affected by changes and restructuring in the pharmaceutical research and development sector that has long accounted for a significant proportion of the life sciences and indeed national R&D. At the same time, price inflation, which is generally above average in science, has converted the 'flat cash' resource budget allocated in 2010 into a declining asset.

These multiple changes have affected most areas of science, altering planning and development strategies. Aggregate economic evidence of their impact is difficult to obtain as yet given the short time period since the implementation of some of these forces. However, experts across the public and privately funded science sector highlight to us the importance of a stable, predictable and adequate public funding landscape to support development and encourage private investment. We believe that materially encouraging

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[1] Value of education and training exports to the UK economy, 2008/09 Higher Education Sector (£7.87bn) http://www.ukcisa.org.uk/about/impact.php

[2] House of Commons Innovation, Universities, Science and Skills Committee - Engineering: turning ideas into reality (2009).

[3] BBSRC: A Baseline for economic impact (2012; http://www.bbsrc.ac.uk/web/FILES/Reviews/impact-report-2012.pdf); and businesses in biosciences in 2010 had a turnover of £134bn and GVA (gross value added) of £41bn (TSB).

confidence among researchers and among current and prospective investors must be a prime concern for public policymakers at this time.

Future funding of science

Public funding is a key driver and motivator of business and charitable investment in science alongside the recognised exceptional productivity of the UK science community. This combination, along with some supporting fiscal policies has seen recent private leverage rate estimates of £5 for £1 of additional public investment,[4] and these rates remain achievable in the future so long as we pay prompt attention to retaining our skills base and technical capability through assured maintenance of investment in resources and capital. However, unless action is taken now to stabilise and then grow investment in R&D we cannot reasonably expect to continue the current level of success, which is based on an historic period of science investment. Nor will is be possible to regain lost momentum within a competitive time period.

Recent effective cuts in public spending on science and its infrastructure appear to some extent to have been weathered by the sector but the relative position of the UK as the lowest G8 per-GEP investor in R&D, alongside the expanding public spend allocations in emerging economies sends a worrying message to international and national investors. The UK has one of the world's highest proportions of R&D investment coming from foreign subsidiaries, and therefore it is essential to ensure that this investment does not move abroad. Efficiency and cost cutting measures in the higher education sector, a vital powerhouse of research, have delivered savings above target for many years[5] and improvements to efficiency continue, but this trend cannot continue indefinitely. £7.1 billion of R&D (27%) was carried out by the HE Sector in 2010.[6] The additional pressures working on the HE sector (international competition, higher tuition fees, vulnerability of taught Masters programmes) are an additive source of instability and uncertainty on the R&D landscape. It is essential that we bolster now this important driver of growth at a point when investments are likely to both deliver growth and yield good dividends in an upturn. The Technology Strategy Board already estimates a £7 return in terms of Gross Value Added (GVA) for every £1 that it invests in collaborative R&D.[7] For example an evaluation of cumulative TSB investment over the period 2004-2011 estimated that these projects had generated a total of over 13,000 net additional full-time-equivalent jobs and net additional gross value added of £2.9billion. For each £1 of grant, the equivalent increase in gross value added was approximately £6.70.[8]

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[4] Fuelling prosperity: Research and innovation as drivers of UK growth and competitiveness (2013) Joint statement from the Academy of Medical Sciences, the British Academy, the Royal Academy of Engineering and the Royal Society.

[5] From 2006 to 2011 the UK HE sector has delivered efficiency savings consistently above target http://www.universitiesuk.ac.uk/highereducation/Pages/EfficiencyinHigherEducation.aspx

[6] Enhancing Impact: The Value of Public Sector R&D (CIHE/UKIRC) http://ukirc.ac.uk/knowledgeexchange/reports/article/?objid=8025

[7] TSB Collaborative R&D https://www.innovateuk.org/-/collaborative-r-d

[8] Enhancing Impact: The Value of Public Sector R&D (CIHE/UKIRC) http://ukirc.ac.uk/knowledgeexchange/reports/article/?objid=8025

The period since the 2010 spending review (SR10) affords only a brief glimpse of the impacts of the real-term cuts to the research budget. The Society of Biology championed the protection of the science budget in advance of the SR10 and welcomed the ring-fence on science and research spending with the caveat that we were concerned about the potential effects of inflation over the funding period. In effect the 2010 settlement left the research base budget facing a real-term cumulative shortfall of £1,665m over the spending review period; additional commitments to specific research capital were later announced of £1,354m, and an innovation capital investment of £332m.[9] These extra capital funding allocations were welcome and necessary, but the UK must have a secure, long term funding structure to maximise its return on these and other investments. Additional commitments however welcome rarely provide the predictability that allows for long term planning, something that is vital for continued research and ultimate research uses.

There is a significant lag-time in the research system, both in terms of knowledge generation and use and in skills development, which may have hidden some impacts of recent declining investment, this holds the dual message that it may not be possible to maintain current high levels of productivity for much longer against this trend, but crucially, that investment now may both stave off severe damage and promote strategic growth.

We hear from both HE research leaders and private investors that capital equipment provision is considered a high priority for maintaining not just productivity but also for ensuring the attractiveness of institutions to talented technologists and promising innovators, paraphrased as 'good kit attracts the best minds and gives them wings.'[10] This highlights the importance of resource and capital investment in science as twin and interdependent priorities.

In their contribution to the debates in advance of SR10, the Royal Society recognised that a 'flat cash' settlement if accompanied by efficiency savings and rebalancing, could be survivable for the science community in the short term.[11] However, this analysis envisaged the effective end of these constraints with the end of the funding round. The HE sector has delivered the expected efficiency saving.

The exercises underway across the higher education sector to analyse and communicate the impact of research as part of the Research Excellence Framework offer a golden opportunity to showcase the value of the UK research sector and to highlight areas of promise and potential. Indeed the 'impact agenda' is already translating research reputation onto inward investment and has encouraged universities to invest in capital and other projects to maintain productivity during the current funding squeeze. Sustainable and sustained public investment now will therefore reap the rewards of an efficient and primed

[9] Campaign for Science and Engineering- Public Funding of UK Science and Engineering – March 2013 update

[10] NESTA estimate that two-thirds of UK private sector productivity growth between 2000 and 2007 (1.8 percentage points of productivity growth per year) was a result of innovation.

[11] Royal Society (2010) http://royalsociety.org/policy/publications/2010/comprehensive-spending-review/

sector that has invested in retaining skills and capacity to deliver growth. In 2010 Government funded 32% of total R&D.[12]

Maximising the capacity for growth

A diverse funding landscape builds and maintains resilience, and in addition to being in a position to fund centres of excellence and derive benefit from established areas of expertise and development, a resilient science sector needs the capacity to seed areas of promise wherever they arise. There is a pressing need to keep pace with the rate of investment of other nations in order to encourage private investors to choose the UK as the location for their research and development activities. We need to capitalise upon the UK's current productivity and potential for growth in the biomedical sector[13], as well as the high tech and agri-sectors[14], and the potential of synthetic[15] and systems biology. In addition, we remain confronted not only by the grand challenge areas and the 'perfect storm' of expanding global population, potential food, water and energy insecurity and the threat of climate change, but also by the need to address the health needs of a population with greater life expectancy[16] and the perennial challenges of disease and natural disaster.[17]

Our industry members tell us that research and innovation funding (e.g. through the Technology Strategy Board) is very welcome, and should be maintained or increased. They also value the up-skilling of students and post-docs in entrepreneurial skills and commercial sense, for example through research council Doctoral Training Programmes and the Biotechnology Young Entrepreneurs Scheme, and welcome the opportunity for industry to be seen as a stakeholder in strategy and funding reviews. With the abolition of the Department of Business Innovation and Skills R&D Scoreboard, it is becoming more difficult to get an up to date sense of research and investment spending across the sector, and we strongly recommend that this initiative be reinstated. The R&D Scoreboards provided a useful resource to assess the success of policies in leveraging private investment. We have already emphasised the importance of a stable funding environment. Economic stability is

[12] Enhancing Impact: The Value of Public Sector R&D (CIHE/UKIRC) http://ukirc.ac.uk/knowledgeexchange/reports/article/?objid=8025

[13] Approximately one-fifth of the top 100 medicines in use today originate from research conducted in the UK, a record second only to that of the USA.

[14] The John Innes Centre alone contributes £170m annually to the economy; and the gross value-add of yield increase attributable to wheat breeding since 1982 is £373 - £445 million per annum (Plant Breeding in the UK: TSB KTN Economic Impact on Breeding).

[15] The value of the global synthetic biology market is expected to grow from $1.6bn in 2011 to $10.8bn by 2016 (UK Synthetic Biology Roadmap Co-ordination Group)

[16] Of total UK health care improvements in cardiovascular medicine, between 10% and 25% could be attributed to UK public and charitably funded research with a central estimate of 17%, and with an estimated time-lag of between 10 and 25 years before the improvements came through. The direct healthcare benefits produced an internal rate of return of 9%, and an estimated overall rate of return to the economy of nearly 40% once wider effects through, for example, the stimulation of private sector research and knowledge spill-overs into other areas were taken into account. (CIHE/UKIRC report Enhancing Impact: The Value of Public Sector R&D). Returns on public and charitable investment in mental health are of the order of 7% (MRC).

[17] NERC's catastrophe weather modelling is being incorporated into reinsurance models which help prevent the unexpected accumulation of risk, bolstering the industry's resilience. A five per cent reduction in average insured losses due to storm damage alone would be worth £62-130m a year to the insurance industry. NERC funding contributes to safeguarding and improving the £7.2 billion insurance sector to the benefit of the UK economy.

of greater importance to industry investors; in this rapidly changing environment, the R&D scoreboards can provide the up to date information necessary to make a case for investment.

Maximising productivity through skill development

The success of the UK science sector relies and rests upon a diverse and skilled workforce. Following the House of Commons Science and Technology Select Committee review of the SR10, we commented that despite some improvements to the environment for skills development within HE; we remained concerned about instability in the skills pipeline.[18] It takes 7 years to train researchers with to PhD level and longer for them to become independent researchers in universities and industry; a lag in production as well as in noticing a shortage is a real hazard and must be borne in mind in planning.

These concerns are still valid, and we will be closely monitoring the outcomes of these changes to the number and diversity of bioscience students. There is also concern that these measures may exacerbate existing skills gaps in areas such as drug discovery, plant sciences and taxonomy, which have been raised by our membership as long term problems confounded by a changing research landscape and uncertainty around future industry investment. The Society of Biology's accreditation scheme is helping to address these issues, accrediting undergraduate degrees that provide a pipeline of skilled graduates into important areas of research.

The arguments in favour of continued investment in science and research have been widely articulated by ourselves and other members of the research and business community before and after the last spending review, and have been reflected in welcome statements of support in principle from Government Ministers, the Chancellor and Prime Minister along with specific fund allocations, especially for capital projects. A buoyant research sector creates jobs, develops and maintains a skilled workforce, garners international prestige and attracts inward investment, generates revenue and enables cost avoidance. Public investment in science research and innovation therefore benefits the public purse in the short and long term, and plays a vital role in economic development, diversification and resilience building.[19]

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[18] Society of Biology (2011) Response to the Spending Review 2010
http://www.societyofbiology.org/policy/consultations/view/46

[19] The Case for Science: Headline figures

- Nearly 30% of the UK's GDP is produced by sectors intensive in science, technology, engineering and mathematics. *House of Commons Innovation, Universities, Science and Skills Committee* - *Engineering: turning ideas into reality, 2009*
- Every pound spent on public/charitable medical research yields additional GDP for the UK that is equivalent to a net return of 30p per year in perpetuity (range 20–67p per year). *Wellcome Trust* - *Medical Research: What's it worth? Estimating the economic benefits from medical research in the UK*
- A 2011 evaluation of TSB funded projects revealed that this investment had generated a total of over 13,000 net additional full-time-equivalent jobs and net additional gross value added of £2.9 billion. For each £1 of grant, the equivalent increase in gross value added was approximately £6.70. *CIHE/UKIRC* - *Enhancing Impact The Value of Public Sector R&D*

Research funding allocations should maintain areas of excellence and ensure that previous investment has a chance to bring all the benefits realistically possible. Areas of promise within curiosity-driven research are vital for long-term development and in the short-term for attracting innovators to the sector as a whole.

Conclusion

The Society urges sustained and enhancing investment in science. The operation of an effective ringfence around capital and resource funding would send a powerful message to the research and investor community that the UK is determined to maintain and capitalise upon its leading position in international science, deriving benefit for the nation and a return on long-standing investments of capital, expertise and innovative capacity.

Member Organisations of the Society of Biology

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