IOP Institute of Physics

The Science Budget

Institute of Physics submission to a Science and Technology Select Committee inquiry

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1 September 2015

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Science and Technology Select Committee
House of Commons
London
SW1A 0AA

Dear Sir/Madam,

Submission to the Science Budget Inquiry

The Institute of Physics is a leading scientific society. We are a charitable organisation with a worldwide membership of more than 50,000, working together to advance physics education, research and application. We engage with policymakers and the general public to develop awareness and understanding of the value of physics and, through IOP Publishing, we are world leaders in professional scientific communications.

The IOP welcomes the opportunity to contribute to the Science and Technology Committee's Inquiry into the Science Budget. Our response to the issues raised in the Terms of Reference is presented below.

Yours faithfully,

Professor Stuart Palmer, FREng CPhys FInstP
Honorary Secretary, Institute of Physics

Institute of Physics submission to the Science and Technology Select Committee – Science Budget Inquiry

- **The extent to which the current ring-fence arrangements, and the separate arrangements for determining 'resource' and 'capital' allocations, have produced coherent UK science and research investment;**

1. UK science is world-leading; from 0.9% of the world's population the UK contributes 15.9% of the world's most highly-cited papers[1], and has maintained this position in the face of growing challenges from emerging economies such as China and Brazil[2]. This overall strength is reflected in UK physics research: a recent study noted that 35% of the top cited papers in astrophysics had a UK author[3] and in the recent Research Excellence Framework 88% of the assessed physics research was ranked as either "internationally excellent" or "world-leading"[4]. This strength has allowed the UK science base to attract the best researchers and to leverage external funding. For example, the UK receives a higher proportion of funding for science projects compared to the level of funding it provides to the EU, winning over 16% of funding from the previous EU Framework Programme compared with its overall contribution of 11.5% of the EU budget[5].

2. The ring fencing of the science budget, currently held within the Department for Business, Innovation and Skills (BIS), has been instrumental in building the strength of the UK science base through enabling the secure funding that is needed for long-term research and the training of highly skilled researchers, allowing the greatest benefit to be gained from increasing investment in science. Since the introduction of the ring-fence there have only been rare occasions when the science budget was 'raided' to provide funding for other departmental commitments[6]. These rare interventions created uncertainly within funding and potentially discouraged long-term investments and international partnerships and commitments. The security of the ring-fence, combined with sustained investment has coincided with significant increases in the strength of the UK science base as measured by research outputs and citation metrics.

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[1] Elsevier - *Performance of the UK research base: International comparison* (2013): https://www.gov.uk/government/publications/performance-of-the-uk-research-base-international-comparison-2013

[2] King's College London and Digital Science - *The nature, scale and beneficiaries of research impact* (2015) - http://www.hefce.ac.uk/media/HEFCE,2014/Content/Pubs/Independentresearch/2015/Analysis,of,REF,impact/Analysis_of_REF_impact.pdf

[3] Thomson Reuters – *The Research and Innovation Performance of the G20* (2014) - http://sciencewatch.com/sites/sw/files/images/basic/research-innovation-g20.pdf

[4] HEFCE - *REF 2014: Unit of assessment summary data – Physics* (2014) - http://www.ref.ac.uk/media/ref/results/AverageProfile_9_Physics.pdf

[5] Russell Group - *Russell Group response to the Government Review of the Balance of Competences between the UK and EU: Research and Development* (2013) - http://www.russellgroup.ac.uk/uploads/Russell-Group-response-to-Balance-of-competences-Research-and-Development-consultation.pdf

[6] BBC News – *Scientists lament raid on research* (2007) - http://news.bbc.co.uk/1/hi/sci/tech/6419261.stm

3. The continued strength of UK science is not guaranteed. It is a product of decades of sustained and secure investment in science from which the UK is now reaping benefits. Over the past five years there has been a real-terms reduction in the science budget which the Research Councils report has already had an impact on the strength of the science base[7]. While the ring-fence has allowed these reductions to be planned for, as much as has been possible, it has also presented an opportunity for 'tucking under' – moving additional expenditures into the science budget – which has had the effect of exacerbating the impact of the reductions. The UK science base has the best chance of building on its current strength if the ring-fence is retained; but with this there must be clear community-informed decisions regarding what it is intended to invest in and what it is not.

4. The long-term framework for capital investment announced in 2013 will be vital for the future of UK science. The UK is already home to leading large research facilities such as Diamond and the Astronomy Technology Centre (ATC) and for the UK to keep pace with international competitors it must seek to invest in more such centres. However, the removal from the science ring-fence of capital investment, and its consequent separation from project and recurrent funding systems, has created some additional tensions within the science budget which must be addressed. The processes by which capital grants are prioritised and awarded differ from those for other projects and for recurrent expenditure. Often there is less involvement by the broader research community, creating a risk of misalignment between the priorities leading to the capital award and the priorities leading to recurrent funding. In many cases this can lead to capital facilities that are not used effectively because running costs are unavailable. Capital investments involve significant qualities of money and other resources. For them to pay dividends there must be proper consultation with the research community, including tensioning against other projects and priorities before final decisions are made, instead of them being driven by short-term political expediency. Without this, the system has the potential to create scientific white elephants.

- **The extent to which science and research expenditure in Government departments (outside the Science Budget) complements or competes with the Science Budget;**

5. Investment within the science budget has increased over recent decades, however alongside this there has been a coinciding decline in investment, in real terms, through civil and defence departmental R&D funding[8]. This has created a system where the R&D requirements of government departments are increasingly met through research conducted through the Research Councils. This has had the benefit of bringing excellent science into policymaking, but has also had the effect of putting government R&D in direct competition for funding with the science base. There is a case for revisiting this arrangement to ensure effective coordination of departmental funding of R&D and Research Council funded projects. The Government's science

[7] STFC Programmatic Review 2013
[8] Department for Business, Innovation and Skills – *Science, Engineering and Technology Statistics* (2013) - https://www.gov.uk/government/statistics/science-engineering-and-technology-statistics-2013

and innovation strategy made some positive moves in this regard by announcing a review of departmental R&D spending to present a clearer picture of current needs and allocations.

- **The need for and rationale for any adjustment to the trajectory of future Government expenditure on science and research, and what would be gained from an increase (or lost from a reduction) compared with current expenditure levels;**

6. The freezing in cash terms of the science budget in 2010 has had the effect of real-terms cut in funding, amounting to around £1bn over the five year spending period[9]. If this 'flat cash' continues, or if further cuts to science investment are planned in the next spending period, there is a real risk that instead of the UK continuing to be a world-leader and science helping to boost economic growth, it will instead fall behind its competitors, many of which are continuing to ramp up investment in science. The Research Councils are increasingly reporting finding themselves in the position of turning away excellent research due to restricted budgets and limiting access for researchers to leading large facilities. Further reductions to the science budget will exacerbate this. An increase in funding would enable them to fund more research, with no drop in quality, leading to an increase in world-class science, driving economic growth. To gain the full benefit of past investment in research, skills and facilities, the government should commit to increasing the science budget in real terms over the next spending round.

7. There is an increasing evidence base that demonstrates that investment in science drives economic growth and national productivity. For example, research conducted by the UK Innovation Research Centre suggests that for every £1 invested in R&D by the government, private sector R&D output rises by 20 pence per year in perpetuity[10]. Moreover, recent analysis for BIS suggests that current estimations of the effect of public R&D investment in "crowding-in" private investment have been underestimated. Previous projections from BIS had suggested that for every £1 of public investment in R&D there was increased private investment of £0.85p; however, new research suggests this could be as high as £1.36 for every £1 of public investment and an additional 0.29p from investment by Higher Education Institutions (HEIs) alone[11].

8. The real-terms decrease in the science budget has had a corresponding impact on the value of HEFCE's QR funding allocated to the research departments within universities. This funding provides for a broad base of research and is particularly important for sciences such as physics which contain a significant proportion of 'basic' research. A recent study by the Institute of Physics and the Royal Society of

[9] CaSE - *2015 Budget briefing* - http://sciencecampaign.org.uk/CaSE2015BudgetBriefing.pdf
[10] UK Innovation Research Centre – *The Economic Significance of the UK Science Base* (2014) - http://www.uk-irc.org/resources/reports/the-economic-significance-of-the-uk-science-base/
[11] Economic Insight – *What is the relationship between public and private investment in science, research and innovation?* (2015) - https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/438763/bis-15-340-relationship-between-public-and-private-investment-in-R-D.pdf

Chemistry shows that UK university physics and chemistry departments are operating with significant deficits in both teaching and research[12]. In the departments surveyed, there was an overall deficit of 18.8% of income in physics departments and 20.6% in chemistry departments. These deficits were higher for research activities than for teaching activities, but most departments reported deficits in both. These deficits represent a threat to continued high quality provision of teaching at both undergraduate and post-graduate levels. Any further reduction in support for research through the science budget will have an impact on the capability of some departments to provide a highly-skilled, technically able workforce at a time when demand is greater than ever[13].

- **Whether the current distributions of the budget between particular types of expenditure and between different organisations is appropriate for future requirements, and achieves an appropriate balance between pure and applied research;**

9. Current funding arrangements through the research and funding councils are effective in maintaining the essential balance between directed and responsive mode research strength.

10. Both university-led research and non-university sector organisations, such as the Met Office, Atomic Weapons Establishment and the National Physical Laboratory, need to be properly funded. It is essential that the Government maintain the separation in funding that currently exists between these PSREs and the Research Councils to avoid damaging competition for funding between very different kinds of organisation.

- **What level of Government expenditure on science and research is needed to significantly drive the overall level of such expenditure in the economy, through synergies between government and private sector investment (including overseas investment); and to optimally balance its benefits against the opportunity cost of government expenditure foregone on other public services.**

  Science and research are an investment and not a cost to a nation. Recent analysis[14] commissioned by BIS concluded that publically funded R&D has the effect of 'crowding-in' private investment in R&D; estimating that a 1% increase in public expenditure on R&D will lead to a 0.58% increase in private sector expenditure on R&D. At current levels of investment, this is equivalent to a £1 increase in public expenditure leading to a £1.36 increase in private expenditure.

[12] IOP and RSC - *Under-funded and under pressure: the finances of UK university chemistry and physics departments* (2015)
[13] CBI and Pearson – *Inspiring Growth: Education and Skills Survey* (2015) - http://news.cbi.org.uk/business-issues/education-and-skills/gateway-to-growth-cbi-pearson-education-and-skills-survey-2015/
[14] Economic Insight – *What is the relationship between public and private investment in science, research and innovation?* (2015) - https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/438763/bis-15-340-relationship-between-public-and-private-investment-in-R-D.pdf

- **Whether the Government's expenditures on aspects of science and research are consistent with other government policies, including the Industrial Strategies and the Eight Great Technologies and fiscal incentive policies for research investment;**

11. Effective investment in science and research is essential for the Government to achieve its policy priorities, whether these are strategic such as investment in the 'Eight Great Technologies', or reactive such as responding to public health emergencies. Such investment is also vital for any future government to address the longer term policy challenges that we face, such as climate change, ensuring energy security and health issues such as improving cancer survival rates. The IOP and the RSC recently published further examples of where the outputs of UK research have had impacts in key policy areas, including driving efficiencies in health, energy and defence, and generating innovations leading to increased exports and significant financial returns which have contributed to economic growth[15,16]. The roles of the outputs of research and STEM skills in meeting national and policy challenges are acknowledged at the highest levels of government. In this context, it might be said that any government cuts to the science budget and other areas of investment in science and STEM skills would be counter intuitive.

- **The extent to which any increase or reduction in Government expenditure on science and research will have an impact on the UK's relative position among competitor states.**

12. Current UK R&D investment is around 1.7% of GDP, a level which has remained relatively constant for a decade. By contrast, the OECD and G7 averages are 2.3%[17]. The EU has set an overall target of 3% investment by 2020, and Germany, France and the Netherlands are all far ahead of the UK in their efforts towards this, with German R&D investment at around 2.92%[18]. BIS has reported that UK R&D intensity, the proportion of GDP invested in scientific research and development, needs to rise to 2.9% of GDP if the country is to ensure future economic success[19]. Public R&D investment fell below 0.5% of GDP in 2015, whilst the average in the G8 is 0.77%[20].

[15] IOP – *Inspirational physics for a modern economy* (2015) - http://www.iop.org/publications/iop/2015/page_65902.html
[16] RSC – *Inspirational chemistry for a modern economy* (2015) - http://www.rsc.org/globalassets/04-campaigning-outreach/campaigning/campaign-for-government-science-support/inspirational-chemistry-for-a-modern-economy.pdf?id=10935
[17] OECD figures (2013)
[18] UNESCO figures
[19] Department for Business, Innovation and Skills – *Insights from international benchmarking of the UK science and innovation system* (2014) - https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/277090/bis-14-544-insights-from-international-benchmarking-of-the-UK-science-and-innovation-system-bis-analysis-paper-03.pdf
[20] The Guardian – *UK research funding slumps below 0.5% GDP – putting us last in the G8* (2015) - http://www.theguardian.com/science/occams-corner/2015/mar/13/science-vital-uk-spending-research-gdp

13. To keep pace with international competitors the UK should commit to increasing its R&D intensity. From the UK's current position, there is still great potential to leverage economic and societal gains from increased investment in science. Increasing public R&D intensity towards the G8 average of 0.77% and overall R&D intensity towards the EU target of 3% would make use of untapped economic potential compared to international competitors.