

CaSE submission to HM Treasury

Key points:

- The UK's long-standing strength in science and engineering can cement economic recovery and create prosperity for all. But the economic and societal benefits of research and innovation can only be realised with Government support through long-term strategic planning and investment.
- The Summer Budget and Comprehensive Spending Review provide the Government with the opportunity to back its Science and Innovation Strategy with vital investment, setting out the scale of its ambition for this instrumental part of its long-term economic plan.
- The research community has welcomed the Government's science capital commitments to strengthen the UK's research infrastructure and notes the Government's further commitment in the Science and Innovation Strategy to ensuring the Research Base has appropriate further investment for "staffing, running and maintaining our scientific infrastructure... at the Comprehensive Spending Review".
- Overall Government investment in research and development must increase in real-terms as part of a long-term ambitious and forward-thinking investment plan, with the aim of matching the investment levels of our international peers. This will enable the UK to remain at the forefront of science and innovation:
 - Investment in the Research Base is currently facing real-terms cuts unless the 'Science Budget' flat-cash settlement is improved. Efficiency savings can't compensate for the scale of lost investment.
 - The Research Base requires budget stability; in-year cuts or unexpected drops in investment can have disproportionate impacts on research and must be avoided.
 - Fundamental research is the foundation of innovation in the UK and requires maintained real-terms increases in investment and should not be deprioritised.
 - Departmental R&D budgets make up a significant proportion of total Government investment in science and engineering but are unprotected and have seen large cuts in the previous Parliament which could be damaging the effectiveness of Government.
- For long-term sustainability of the Research Base, the Government needs to determine the right balance of investment to ensure the most efficient and effective use of existing and future research infrastructure.
- The Government is pursuing policies to strengthen regional economies across the UK. Science and engineering have important roles to play in this but excellence, as identified through peer review and in accordance with the Haldane Principle, must remain the guiding principle of funding allocation, with budgets outside of the Research Base budgets being used for the regional agenda.
- Investment in education is an investment in future growth. Cutting education budgets, including Higher and Further Education, will reduce the pipeline of skilled scientists and engineers essential for future economic growth.

5 June 2015

Introduction

CaSE is the UK's leading independent advocacy group for science and engineering, funded by individual and organisational members. We are a non-partisan, united voice for the sector into Government and Parliament bringing together industry, research charities, universities, professional bodies and individual scientists and engineers.

The UK's long-standing strength in science and engineering can cement economic recovery and create prosperity for all. Research and innovation in the public and private sectors yields economic and societal benefits: it generates new products for market, including medicines and life-improving technologies; it boosts productivity through more efficient machinery and processes; creates high-value jobs; and attracts inward investment to the UK¹. But these myriad benefits can only be realised with Government support through strategic long-term planning and investment.

The Government has demonstrated that it understands this through the Science and Innovation Strategy² and by putting science at the heart of the Conservative's long term economic plan³. It has committed to investing £1.1 billion capital in real terms each year up to 2021 to provide much-needed modern research infrastructure for British science.

The Strategy also said:

"Capital investment alone is not sufficient to ensure our research infrastructure is able to continue to deliver world class outputs. We recognise that our science base requires adequate resource funding, and will give full consideration to these requirements when we take a decision at the Spending Review next year."

The Summer Budget and Comprehensive Spending Review provide the Government with the opportunity to back its Science and Innovation Strategy with sufficient resource. This is vital investment if we are to make efficient and effective use of the nation's research infrastructure and ensure there is fuel in the engine for growth.

As a proportion of GDP, government investment in R&D increased from 0.46% in 2012 to 0.49% in 2013 but has been on an overall decline since 2009 and is still lower than in 2003⁴. The Organisation for Economic Co-operation and Development (OECD) average in 2012 was 0.7% of GDP and the EU average was 0.64%. Germany's was 0.84% and America's 0.86%. The UK must set an ambitious upward trajectory for investment at levels equal to our international competitors if we are to remain a scientific, technological, and economic world-leader. Below we set out the major areas of R&D investment that should be increased to achieve this goal, along with some strategic policy priorities to ensure that public funds are spent efficiently and effectively.

¹ For a brief summary of the evidence and references see: <http://sciencecampaign.org.uk/Whychampionscienceandengineering.pdf>

² <https://www.gov.uk/government/publications/our-plan-for-growth-science-and-innovation>

³ <https://www.conservatives.com/Manifesto>

⁴ http://www.ons.gov.uk/ons/dcp171778_398876.pdf

Investment in the Research Base through the Funding Councils must increase

The Funding Councils⁵ are at the heart of the UK research base. Government investment through the Councils in world-leading science, facilities, and people creates the foundations on which the rest of the ecosystem builds.

The UK Research Base is the most efficient in the world. With only 3.2% of global expenditure on R&D and 4.1% of global researchers, we produce 15.9% of the most highly cited academic articles⁶. Investment in the Research Base also yields direct benefits for industry: every £1 invested in R&D by the Government raises private sector R&D productivity by 20p each year in perpetuity⁷. The UK Research Base has great capacity to yield significant returns from greater investment by this Government and thus contribute to the long-term health of the UK economy.

And yet investment through the Funding Councils has been declining in real-terms since 2010, when the 'Science Budget' was ring-fenced with a flat-cash settlement and the capital budget cut. This has put the UK research base at risk and reduced the ability of science and engineering to contribute to a strong and sustainable economic recovery for the UK. There is the potential for the UK to support more high-quality science, as judged by peer review, but real-terms reductions to budgets limit capacity meaning research has gone unfunded⁸.

CaSE has compared current investment levels to what could be expected if 2010 budgets were maintained in line with inflation⁹. This analysis found that the UK Research Base, funded through the resource 'Science Budget' and the capital budget, lost over £1 billion of investment in real-terms over the course of the 2010-15 Parliament.

The Coalition government's commitment to invest £1.1 billion in real-terms each year up to 2020/21 through the capital budget is welcome but even taking this into account, the overall shortfall for the research base will continue to rise, reaching £2.3 billion by 2020 unless the flat-cash settlement for the 'Science Budget' is built on with real-terms investment for the long-term.

CaSE recognises the Government's commitment to reduce public spending and national debt and supports efforts to improve efficiency in how the Funding Councils and the wider research base operate. The research community is on track to meet the target of £428 million in efficiency savings to be achieved between 2010 and 2015, set by the Wakeham report^{10,11}. The £1 billion shortfall revealed by CaSE's analysis has therefore not been absorbed through efficiency savings alone. It has instead squeezed the research base and its ability to perform optimally. Furthermore, Universities

⁵ These include the Research Councils, and the Quality-Related funding streams of the Higher Education Funding Councils of England, Wales, Scotland and Northern Ireland.

⁶ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/263729/bis-13-1297-international-comparative-performance-of-the-UK-research-base-2013.pdf

⁷ <http://sciencecampaign.org.uk/UKScienceBase.pdf>

⁸ For instance in 2011-12 the EPSRC was able to award grants to 41% of applicants, this dropped to 34% and 32% in successive years:

<https://www.epsrc.ac.uk/funding/fundingdecisions/fundingdata/>

⁹ <http://sciencecampaign.org.uk/CaSE2015BudgetBriefing.pdf>

¹⁰ <http://www.rcuk.ac.uk/RCUK-prod/assets/documents/reviews/fec/fecReviewReport.pdf>

¹¹ <http://www.universitiesuk.ac.uk/highereducation/Documents/2015/EfficiencyEffectivenessValueForMoney.pdf>

UK members have raised concerns that the long-term sustainability of research could be brought into question should the Wakeham recommendations be rolled forward into future years with similar expectations of savings³.

Real-terms reductions in investment can't be fully compensated for through efficiency savings. They will instead come at the expense of scientific excellence and the volume of research performed in the UK. In-year cuts or unexpected drops in investment can also have a disproportionate impact on research; they may result in the cancellation of funds that have already been factored into a multi-year research project for example, or result in the shutdown of facilities required by many users, including from academia and industry. Short-term savings in government spending will therefore have a counter-productive effect by choking off the innovation needed for economic growth.

Investment through the Funding Councils is also important as it is the primary route through which fundamental research is funded in the UK. This type of research, although not always of obvious immediate application, is the basis for innovation for years to come. For example, it takes over 12 years to develop a drug from the discovery of the active ingredient to the point of licensing for use in patients¹². But even before the discovery of that active ingredient, scientists must elucidate the physiological basis of its action to be able to understand and develop it into a new life-saving medicine. This is also the reason that it is too early to tell what the economic and scientific impacts of the 2010 cuts will be. It is therefore essential to the UK's future success that fundamental research continues to receive significant public investment. Due to the high-risk nature of this type of research private investors will not step in to compensate for reductions in public investment. In fact the opposite is true, public investment in research sends a strong signal to industry and evidence shows it boosts private sector investment in R&D and attracts investment from overseas¹³.

CaSE calls on the Government to commit to real-terms growth in the 'Science Budget' as part of a long-term strategy to provide stability and confidence to investors, with the aim to reach equivalent levels of R&D investment as our international peers within ten years.

Further cuts to departmental R&D budgets could reduce the effectiveness of Government

Departmental R&D budgets are the intelligence budgets of the Government. They allow ministers and civil servants to stay ahead of rapidly-moving policy and technology, to test ideas, and evaluate them when they have been implemented so that successes and failures can be learned. In some departments, primarily the Department of Health and the Ministry of Defence, research funded from these budgets has a direct impact on frontline staff and their ability to operate effectively.

Research commissioned by departments is often conducted by the academic sector, meaning there is a symbiotic relationship between the UK Research Base and Government.

Departmental R&D spending makes up about 40% of the Government's approximately £10 billion total expenditure on R&D¹⁴. Between 2010/11 and 2011/12, half of all departments reduced R&D expenditure by 20% or more, with some cutting by as much as 50%. These budgets have not

¹² <http://www.abpi.org.uk/industry-info/new-medicines/Pages/default.aspx>

¹³ <http://sciencecampaign.org.uk/CaSEUKScienceBaseReportBriefing.pdf>

¹⁴ http://www.ons.gov.uk/ons/dcp171778_370646.pdf

increased since. This is a continuation of a longer-term trend that could be damaging the Government's ability to respond to new challenges.

As recognised in the Science and Innovation Strategy, departmental R&D spending is currently poorly protected from short-term budget cuts despite its importance to the everyday effectiveness of Government. This is because its allocation and management isn't transparent or consistent across departments. The Government should explore options to protect these crucial budgets and ensure they are sufficient to provide effective intelligence support for departments.

Opportunities created by recent changes to the classification of R&D by the European Commission

The European Commission has reclassified R&D expenditure as Gross Fixed Capital Formation (GFCF), reflecting that it yields benefits in the long-term such as new knowledge, intellectual property, and other useful products. It was previously largely classed as Intermediate Consumption. This change has now been implemented in the UK's National Accounts by the Office for National Statistics¹⁵ and provides the opportunity to take a more strategic long-term view of R&D investment in the Government's own budgeting process.

The reclassification also strengthens the case for investing more in the long term and, if the Government chooses to make use of low interest rates in the capital markets, to use those funds to invest in areas that contribute to sustainable economic growth, such as science and engineering.

Identification and reclassification of R&D as capital investment may aid the development of systems to protect departmental R&D budgets, which have shrunk considerably as discussed above. This was a welcome commitment in the Science and Innovation Strategy.

Conduct an economic review to determine the right balance between resource and capital investment for efficient and effective use of infrastructure

In science and engineering, resource and capital investments are closely entwined, each equally requiring the other. It is vital that resource budgets are sufficient to fully utilise research infrastructure and equipment to gain maximum scientific and economic benefit.

The balance between the 'Science Budget' and the capital budget has changed considerably over the past five years. Resource spending has stayed flat in cash terms (a real terms cut) whilst capital initially dropped early in the last Parliament but has now risen in line with inflation¹⁶.

It appears little is known about what size the UK's resource budget (the 'Science Budget') should be in proportion to the capital budget for optimum efficiency and effectiveness. The Government, supported by the Research Councils and wider research community, should conduct a detailed economic review of the resource required to derive maximum benefit from current research capital, and the resource required to support new equipment and infrastructure investments to keep the UK at the cutting edge of global science and engineering research.

¹⁵ <http://www.ons.gov.uk/ons/guide-method/method-quality/specific/economy/national-accounts/articles/2011-present/measuring-and-capitalising-research---development-in-the-uk-national-accounts.pdf>

¹⁶ <http://sciencecampaign.org.uk/CaSE2015BudgetBriefing.pdf>

Furthermore, within the capital budget, it will be necessary to monitor whether the investment apportioned to ‘world class laboratories’ in the Science and Innovation Strategy is sufficient to meet essential maintenance and upgrade costs of these publicly funded national assets. This information will help maximise the benefit to the UK of historic public investment in scientific infrastructure

Equipped with an evidence base from a resource-capital review, future Government Spending Reviews should include both resource and capital allocations within the definition of the ‘Science Budget’, without an overall loss of budget value, and capital investment should be tied to resource in national budget terms. This will support strategic planning and reflect their interdependency and ensure efficient and effective use of public funds.

Excellence must be the primary driver in Research Base investment decisions

The Research Councils have a long-held and valuable mission to support excellence wherever it exists, as identified by peer review and in accordance with the Haldane Principle¹⁷, through resource and capital investments. The strength and efficiency of the Research Base demonstrates the success of this approach. In recent years, the Government has increasingly looked to address regional economic imbalances with investments in science and engineering research. Both are important missions but the latter should not detract from the proven success of the former by distorting the process of allocation decision making or reducing budgets. Excellence must remain the guiding principle of funding allocation for research projects and large capital investments in the Research Base.

To support the Government’s regional development agenda, regions and cities budgets could be used, or separate budgets could be created outside of the ‘Science Budget’ ring-fence, for large regional investments to build science and engineering capacity. As with any Government activity, a strong evidence base will help ensure the policy aims are achieved. It would therefore be wise and beneficial to involve the expertise of the Research Councils and wider research community in a transparent when Ministers are deciding if, how, and where to make such investments. The Government should also invest in further research to better understand how science and engineering can best support regional development whilst ensuring the excellence of British science is not adversely affected by regional policy interventions.

Investment in education is an investment in growth

The UK needs to develop its home-grown pipeline of people with science and engineering skills to fulfil workforce needs. There are many different routes into Science Technology Engineering and Maths (STEM) careers, be it through further education, higher education, apprenticeships, or a combination of these pathways.

Currently too many research-intensive companies say they can’t recruit people with the skills they need from the UK¹⁸. Reforming migration policy to allow more skilled workers to come to the UK can help with this and should be a priority for this Government. But attracting a wider range of UK

¹⁷ <http://www.publications.parliament.uk/pa/cm201012/cmhansrd/cm101220/wmstext/101220m0001.htm>

¹⁸ <https://www.gov.uk/government/publications/high-level-stem-skills-supply-and-demand>

nationals to study and work in science and engineering will help meet our country's skills needs in the long term, provide fulfilling careers for our own workforce, and well-paid jobs for the economy.

Research shows the strong impact that primary teachers' knowledge and confidence in science have on students' attitudes towards science and their attainment and progression in it¹⁹. Currently around 5% of teachers in primary education have a science related degree²⁰. This Government could support the increase in primary science expertise by investing in the professional development of existing primary teachers (at a cost of £2 million per annum)²¹ to ensure that every child has access to a high-quality science education.

Across science and engineering there is a need for upwards of 450,000 new STEM based technicians by 2020²². However, there are concerns around the continuing provision of high quality, well-funded vocational STEM courses. There is considerable cost involved in providing some STEM programmes over and above other subjects and data suggest that the current programme weightings for funding science, engineering and IT in FE colleges may not adequately reflect the cost of delivering these practical subjects²³. The Government should look to address the growing Further Education STEM funding gap to ensure that STEM courses are feasible and of high quality. Not doing so would be a disservice to students and a missed opportunity for investing in much needed skills that will be essential for future economic growth.

The provision of science and engineering undergraduate courses comes with additional costs associated with equipping laboratories and providing materials for practical work. Therefore, by nature they cost more to deliver than many others and certainly more than the current cap on undergraduate fees of £9000. Although often invisible to the student, the Government's additional funding for high cost subjects is designed to bridge the funding difference between the student fee and the cost of provision. In the current system, without this extra funding, science and engineering subjects would not be a viable option for universities to offer undergraduates.

The Government, and wider UK, has much to gain from an increased pool of skilled scientists and engineers. Alongside the increased uptake of science and engineering it is therefore absolutely right that Government meets the additional costs that come with teaching these subjects. To do this the Government must commit to providing sufficient funding, through the combination of student fee and additional government contribution, to cover the costs associated with high quality science and engineering undergraduate provision.

Summary

Investment in science and engineering is investment in the future economic prosperity and social wellbeing of the UK. The Summer Budget and Comprehensive Spending Review provide the Government with the opportunity to set out the scale of its ambition for science and engineering as

¹⁹ <http://www.wellcome.ac.uk/About-us/Publications/Reports/Education/Perspectives/index.htm>

²⁰ http://www.psqm.org.uk/docs/PSQmconferenceSEPT2013_primary_focus-LouiseStubberfiledWellcome.pdf

²¹ Estimate from the Wellcome Trust. The current Primary Science Specialist course being offered by National Science Learning Centre has a cost of £3011 which includes 3 x 2 days residential at the NSLC.

²² http://www.engineeringuk.com/Research/Engineering_UK_Report_2015/

²³ <http://www.gatsby.org.uk/uploads/education/reports/pdf/gatsby-challenges-of-stem-fe.pdf>

part of the long term economic plan. Strategic long-term planning and investment in the Research Base will put fuel in the engine for growth.

For further information please contact the CaSE team.

Email: info@sciencecampaign.org.uk

Phone: 020 7679 4994