POLICY BRIEFING

Science and Engineering Investment

CaSE
Campaign for Science and Engineering

SUMMARY

The UK science base is an integrated ecosystem which encompasses science, engineering, innovation and technology, and a wide range of sectors including higher education, industry, Small and Medium Enterprises (SMEs) and investors. The extraordinary and well-documented success of the UK science base is founded on historic strength, past investment and valued principles for allocation of funding.

CaSE believes the UK should aim to have a healthy and thriving science base in which all parts of this integrated system are well funded and performing optimally. This will generate growth, inward investment and progress. UK government and business investment in the science base is low compared to other leading scientific nations. The UK science base performs well in spite of underfunding, but it is widely agreed that this situation is unsustainable and that investment is required to ensure future strength.

It is critical to the future success of the UK economy that government treats science as a priority and invests in the UK's science and research capacity at a comparable level to our international peers. Research and innovation underpins a strong economy, develops new and existing businesses, improves public policy and services, and attracts foreign direct investment in R&D[1]. A strong science base will be vital for preparing the nation for future challenges, from climate change, food security and future cities, to antimicrobial resistance, national security and meeting the needs of an ageing population. The government's strategic framework and investment levels must therefore reflect the considerable need for, and benefits of, a healthy and thriving science base.

This briefing outlines actions government can take towards this end through public investment and improving the environment and incentives for private investment, collaboration and efficiency.

Priority Actions

A long-term plan that sets an upward trajectory for investment will enable the UK to reap the economic and societal rewards of its strength in science and engineering, driving UK innovation and creating skilled and valued jobs.

ACTION

Commit to an upward trajectory for government investment in science and engineering that exceeds predicted growth as part of a 10 year framework for investment.

[1] http://www.publications.parliament.uk/pa/cm201012/cmselect/cmsctech/writev/valley/valley.pdf

LONG-TERM INVESTMENT FRAMEWORK

Science and engineering have been pivotal in the UK's history and across the political spectrum there is agreement that they are central to the UK's future success. The inherent short-term nature of political cycles still presents a barrier to genuinely long-term planning so investment in science and engineering must be set out on longer time scales than the intervals between elections or spending reviews.

There is political agreement that a long-term framework and investment plan is key to supporting and building on science and engineering success in the UK. We've heard that "if Britain is to become the best place to do science and apply it: we have to give British science the funding it needs for the long term"[2]; and that "Britain needs a long-term vision for science. That means creating certainty through a long-term strategy to unlock investment."[3]

ACTION

Commit to setting out a long-term, cross-government framework for investment in science and engineering.

"If Britain is to become the best place to do science and apply it: we have to give British science the funding it needs for the long-term"

George Osborne, Chancellor of the Exchequer

A long-term and stable government investment framework will help to foster vital partnerships between industry, academia, charities, local councils, LEPs and international partners. These can only develop when there is confidence in the landscape of future investment. These relationships are critical for leverage of investment from outside of government, amplifying the value of the government investment. The long-term investment framework should:

- signal government high-level priorities for science and engineering;
- articulate an investment trajectory for the period; and
- set out the principles and tools for guiding and making funding decisions over the period, outlining a robust and transparent process for making investment decisions in which the research community plays the central role.

TOTAL INVESTMENT IN SCIENCE AND ENGINEERING

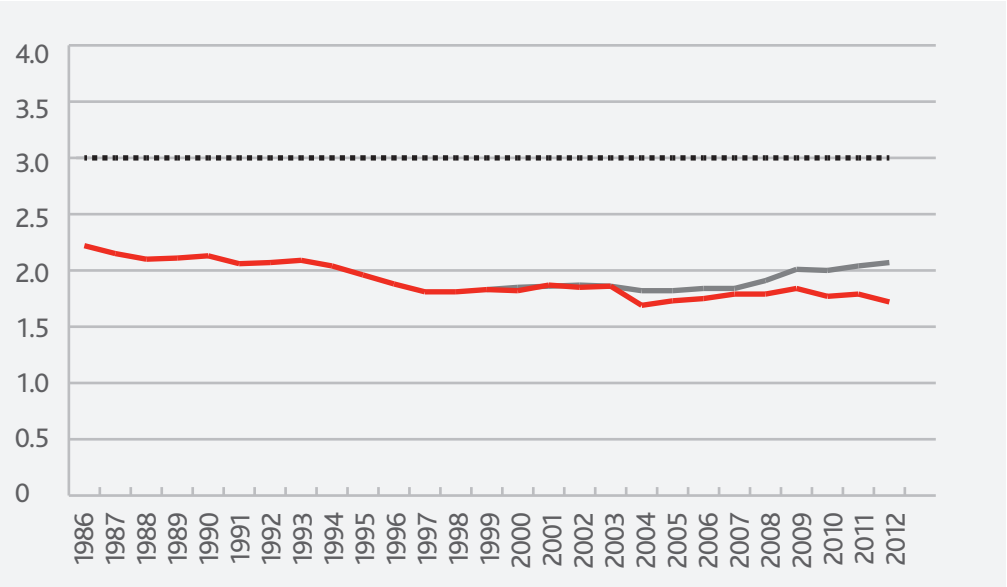
There is a growing evidence base to support advice that government can drive economic growth by investing in science and engineering research[4][5][6]. Public spending on science and engineering is an investment bringing significant returns[7] that can boost economic growth and deliver benefits to society[8]. However, the UK is falling behind other nations through structural underinvestment in R&D with knock-on effects to our skills base and attractiveness as a place for industry to invest[9].

The level of total investment in R&D by government, industry and others, can be comparably measured by looking at a country's investment as a percentage of Gross Domestic Product (GDP). By this measure, the UK's level of investment is internationally low and declining. Since 2004 the UK has invested below the EU average. While the EU28 average is increasing

[2] Chancellor of the Exchequer's speech on science in Cambridge, 25 April 2014
[3] Ed Miliband, Foreword of Labour Science and Innovation green paper, 2014
[4] Estimating the economic benefits of cancer-related research in the UK, Glover et al, 2014
[5] The Economic Significance of the UK Science Base, Haskel et al, 2014
[6] Rates of return to investment in science and innovation, Frontier economics for BIS, 2014
[7] A recent report for CaSE, The Economic Significance of the UK Science Base, found that for every £1 spent by the government on R&D, private sector R&D output rises by 20pence per year in perpetuity, showing that public investment in R&D is an investment that generates economic growth attracting private sector investment from home and overseas.
[8] The Economic Significance of the UK Science Base, Haskel et al, 2014
[9] Insights from International Benchmarking, BIS analysis paper, 2014

(rising from 2.04% in 2011 to 2.07% of GDP in 2012), UK investment is declining (1.78% in 2011 to 1.72% of GDP in 2012)[10].

Figure 1: UK GERD as a % of GDP is low and declining[11]



As figure 1 shows, the UK is becoming less research intensive and continuing this trend will see the UK falling even further behind other nations. This dropping level of R&D investment is a lost opportunity, risking the breadth and depth of UK science excellence with implications for the absorptive capacity of firms and our ability to benefit from global investment in science and innovation[12]. Further, unlike our international peers, the UK does not have a long-term plan for increasing investment in R&D[13]. While comparable economies such as Germany and the United States invest 2.8% of GDP, the UK is sliding backwards, further from the EU target of investing 3% of GDP in R&D by 2020.

Lord Krebs, former Chair of the House of Lords Science and Technology Committee, has voiced his concerns saying "that unless investment in science in the UK keeps pace with that elsewhere in the world, the UK could lose its competitive edge in science and innovation, with consequential impacts on the economy"[14].

"Unless investment in science in the UK keeps pace with that elsewhere in the world, the UK could lose its competitive edge in science and innovation, with consequential impacts on the economy"

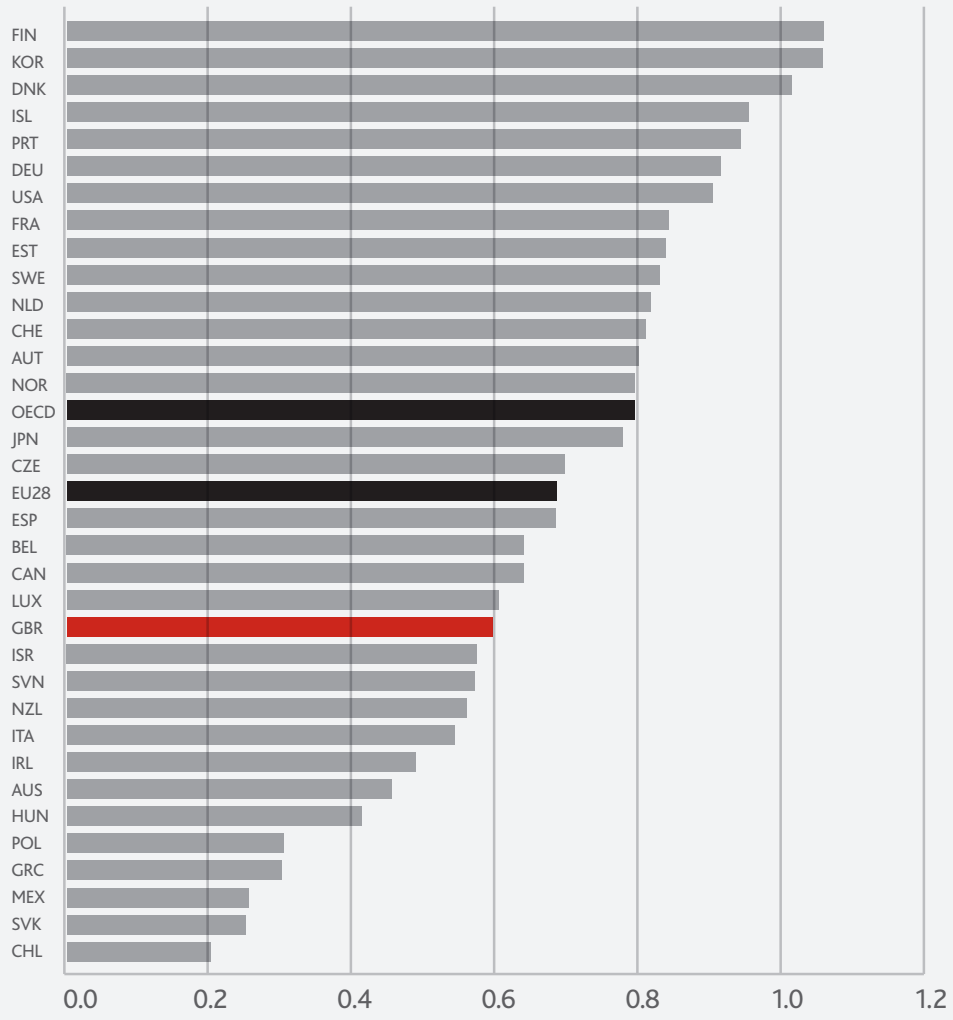
Lord Krebs,
Science and Technology
Select Committee

GOVERNMENT INVESTMENT IN SCIENCE AND ENGINEERING

The total government spend on science, engineering and technology (SET) across all departments dropped by a billion pounds in real terms from £12.7bn to £11.7bn between 2009 and 2012 to its lowest point since 2001. The cumulative drop in government spend on SET over that period is £2.4bn compared to total investment if 2009 levels had been maintained in real terms[15].

[10] Eurostat GERD data, 2011 and 2012
[11] ONS and Eurostat figures for Gross Expenditure on R&D (GERD)
[12] Insights from International Benchmarking, BIS analysis paper, 2014
[13] http://sciencecampaign.org.uk/?p=13867
[14] Lords Committee calls on the Chancellor to increase science budget, June 2013
[15] Science Engineering and Technology Statistics 2012 (released 2014), ONS

Figure 2: Government spend on R&D (GBAORD) as a percentage of GDP[16]



The UK is investing in science at a lower rate than the majority of the EU and the OECD.

As figure 2 shows, this structural underinvestment leaves us in a position where the UK is investing in science at a lower rate than the majority of the EU and the OECD. It is unlikely that the UK will sustain its position as a world-leading research nation on this basis[17]. Action is needed.

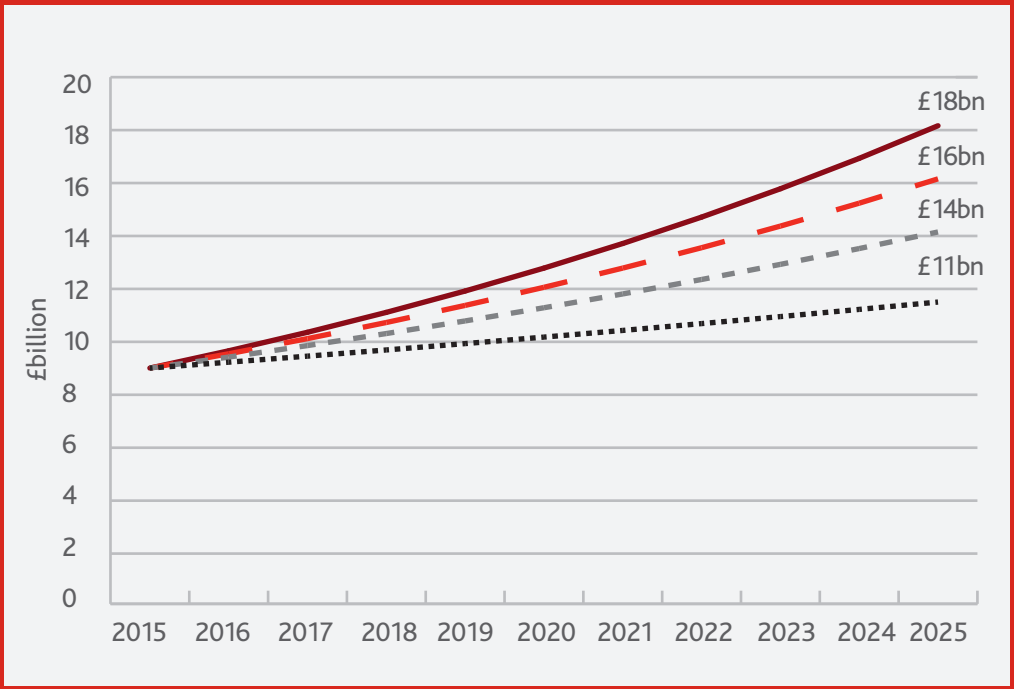
ACTION

Commit to setting an upward trajectory for government investment in science and engineering that exceeds growth.

Committing to matching predicted growth[18] would counteract the negative impact of inflation that has led to the significant real terms cut of over this term of Parliament[19]. This commitment would also halt the downward trend of the UK's rate of total investment in science and maintain spend at 0.6% of GDP, around £11bn in 2025. However, a commitment to match growth would not bring us any nearer to parity with other nations which are investing at a higher rate with ambitious targets for investment.

[16] Government budget appropriations or outlays for R&D (GBAORD), OECD Science, Technology and Industry Scoreboard 2013: Innovation for Growth
[17] International Comparative Performance of the UK Research Base, Elsevier for BIS, 2013
[18] The OBR growth forecast growth of around 2.5% per year, Economic and fiscal outlook, March 2014
[19] Budget briefing, CaSE, 2014

To compete as a world-leader in science and engineering and reap the benefits of global investment, the government must commit to invest in R&D at a rate that exceeds predicted growth. Figure 3 sets out a 10 year plan for the UK to reach Germany's current level of government investment in R&D.



Invest 0.9% of GDP in 2025 – current German rate (Invest at 6.2% above growth p.a.)

Invest 0.8% of GDP in 2025 – current OECD average (Invest at 3.6% above growth p.a.)

Invest 0.7% of GDP in 2025 – EU average (Invest at 2.2% above growth p.a.)

Invest 0.6% of GDP – maintain current UK rate (match OBR growth forecast of 2.5% p.a)

Achieving the rate of German and USA public investment in R&D would transform our place in the global high-skill, innovation economy. We predict that this commitment would attract significant further investment from the private sector[20].

Government support for science and engineering can be split into broad areas: the science budget, capital spend, departmental spending, and innovation support.

To compete as a world-leader in science and engineering and reap the benefits of global investment the government must commit to invest in R&D at a rate that exceeds predicted growth.

SCIENCE BUDGET

The 'science budget' typically refers to the funding set aside by BIS for peer-reviewed research awarded by the Research Councils and Funding Councils (e.g. HEFCE). It includes some other expenditure (such as funding for the UK Space Agency and the Royal Society), and its precise definition changes under different governments. Science and engineering research is a long-term enterprise, and requires sustained support over a period of many years. Along with the absolute levels of investment, the ringfence gives confidence that the UK is a 'safe bet' for individuals and companies looking to invest their time, talent and resources.

Recognising the importance of funding the science base, a subset of the government's total spend on science has been ringfenced in the last two terms of parliament. The ringfence has provided relative protection from departmental budget cuts and a degree of stability over the spending review period for the elements of the government spend on science contained within it. This stability enables funders to make medium-term plans and commitments with a greater degree of confidence, provides a stable funding environment that promotes effective collaboration and partnerships that often require long lead-times, and protects a proportion of the government's overall spending on research from being used by departments to cover shorter-term departmental needs.

[20] The Economic Significance of the UK Science Base, Haskel et al, 2014

ACTION

The science budget must continue to be ringfenced and agreed separately from departmental spending.

ACTION

Any additions to the scope of the ringfence must be fully funded, resulting in an expansion of the total ringfenced budget.

On its own, ringfencing the science budget will not be sufficient to foster the healthy and productive science base that the UK needs and that parties have stated they want to build. We are now entering a fifth year of a flat-cash settlement for the science budget at £4.6bn with another flat-cash settlement agreed for 2015-16. The cumulative erosion of the ringfenced science budget will be over £1.1bn from the beginning of 2010 spending review period up to 2015/16. Inflation will continue to affect the research budget every year that flat cash is maintained reducing the capacity and strength of our research base and missing out on the substantial growth opportunities that recent evidence reaffirms investing in science brings[21]. To be most effective, commitment to the ringfence must come alongside commitment to increasing total investment in science.

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CAPITAL SPEND

Capital investment is sometimes viewed as a luxury that can be afforded in years of plenty but safely postponed in times of austerity. However, in science and engineering capital investment underpins progress – the pace of technological change means that equipment has to be regularly renewed. 'Capital' can refer not only to the construction of new facilities, but also the purchase of vital equipment such as DNA sequencing machines or electron microscopes. 'Resource' can refer to the people who use them to test their ideas or the energy to run and service them. In science and engineering, capital and resource spending is entwined, each equally requiring the other; making the financial distinction problematic.

In 2010 science capital spend was removed from the ringfence and subsequently capital commitment for the spending review period was cut by nearly half (46%)[22]. Additional capital commitments have since been announced, reaching £1.1bn in 2015/16. But the erratic nature of these capital announcements has created concern that investment has been determined by political opportunism rather than long-term strategic considerations.

This ad-hoc and short notice funding environment leads to inefficient use of funds and risks unintentionally diverting funds away from areas of national importance. Without sustained underpinning investment, there is a real danger that the UK's research capabilities in important areas will be lost.

The model of short-notice capital funding opportunities strains the relationships that drive the success of the science base. Favours must be called in to assemble consortia across academia, industry and town planning to meet short deadlines. Such uncertainty also affects the development and sustainability of international collaborations and the UK's ability to attract leading international researchers.

The long-term capital commitment to investing £1.1bn per year in real terms up to 2020/21[23] is welcome medium-term stability and recognises the enormous long-term growth potential that comes from investing in scientific infrastructure.

[21] The Economic Significance of the UK Science Base, Haskel et al, 2014
[22] Scientific Infrastructure, House of Lords Select Committee on Science and Technology, 2013
[23] Science and Research funding allocations 2015/16, BIS, 2014

"Value for money can only be gained from capital investment if it is matched by resource and vice versa"

ACTION

Future spending reviews should include both resource and capital allocations within their definition of the 'science budget'.

Not only might this help to ensure that UK research facilities keep pace with those of our international peers, but it also presents a more realistic view of public support for science and engineering research. Further, as clearly set out in the House of Lords Science and Technology Committee report on Scientific Infrastructure, value for money can only be gained from capital investment if it is matched by resource and vice versa[24].

ACTION

Tie capital investment with resource to ensure efficient and effective use of public funds.

The research partnership investment fund (RPIF) has proved to be a popular and effective fund enabling universities to leverage funding from private partners for capital projects. The sector would like to see RPIF continued but also recognise the current model would benefit from some revisions. For instance:

- the timescales on RPIF could be revised so that the bid can come earlier in the process followed by longer lead out times
- predictability would allow institutions to plan for future bids therefore a 5 year commitment with statement of frequency would be welcome
- reducing the current threshold levels would enable a wider pool of businesses and universities with high quality bids to engage.

ACTION

Revise and embed RPIF so that it becomes an increasingly effective fund that leverages private investment and engages a range of businesses with universities.

DEPARTMENTAL R&D

Departmental investment in R&D is an important part of the government spend on science. CaSE has concerns about how publicly funded or commissioned research is valued – particularly within departments where there have been substantial and repeated reductions in spend on R&D. In 2011/12 half of all departments reduced R&D expenditure in excess of 20% compared with the previous year, some by as much as 50%[25]. These reductions were disproportionately large compared to departmental savings of 0-5%. This reduction in spend could be due to cuts or to reduction of internal demand for research. Both are of great concern.

The tension within departments is that every pound spent on research could be seen as a pound less spent on frontline support – whether that be schools, disability support or investment in transport links. However, cutting R&D on this short-term basis could be counterproductive. Departmental spend on R&D is used by departments to invest in research to develop and evaluate new ideas and existing policies. Therefore, relatively small amounts of spend on research can lead to better frontline provision and increased

[24] Scientific Infrastructure, House of Lords Select Committee on Science and Technology, 2013
[25] Government R&D hit by disproportionate cuts, again, CaSE analysis, 2014

cost effectiveness of public spend. For instance, the Department for Transport funded some research into how to design train carriages to facilitate the boarding of a high volume of people before new trains were built. This led to improvements in the design and function of new stock[26]. Departmental R&D is a significant component of government investment in science and needs to be considered alongside the ringfenced science budget and capital spend.

ACTION

Departmental Chief Scientific Advisers should have oversight of the department's R&D strategy and budget.

ACTION

Reductions in a department's R&D spend that are disproportionately large compared to departmental spend should trigger an investigation by the departmental CSA, the results of which should be published.

DUAL FUNDING MODEL

In the UK funding is allocated on the basis of excellence as judged by expert peers. Direct funding for the research base in universities and research institutes is delivered by a dual support system. Block funding through the Higher Education Funding Councils primarily based on measures of prior research quality gives universities and institutes the freedom to make decisions about how the funding should be spent. Research Councils, along with charities, the EU, industry and government departments, provide funding for specific research projects and programmes. Together this model supports the most productive and efficient publicly funded research system in the G8[27]. The general consensus is that it provides a stable and diverse way for institutions to meet the on-going costs of research while also obtaining competitive project-based funding.

ACTION

Continue to support the dual support system of funding research.

Distributing research funding on the basis of specific near-term policy objectives is not consistent with the 'Haldane Principle'. Although no formal definition exists, it refers to the understanding that Government is too far removed from research to be able to set detailed priorities and that the most efficient way to get value for taxpayer money is by allowing researchers to judge which projects should receive state support. The former Science Minister, David Willetts, stated in 2010 that holding to this principle "has been crucial to the international success of British science."[28]

ACTION

Restate a commitment to the Haldane Principle and make funding decisions accordingly.

"The 'Haldane Principle' has been crucial to the international success of British science."

David Willetts, Science Minister

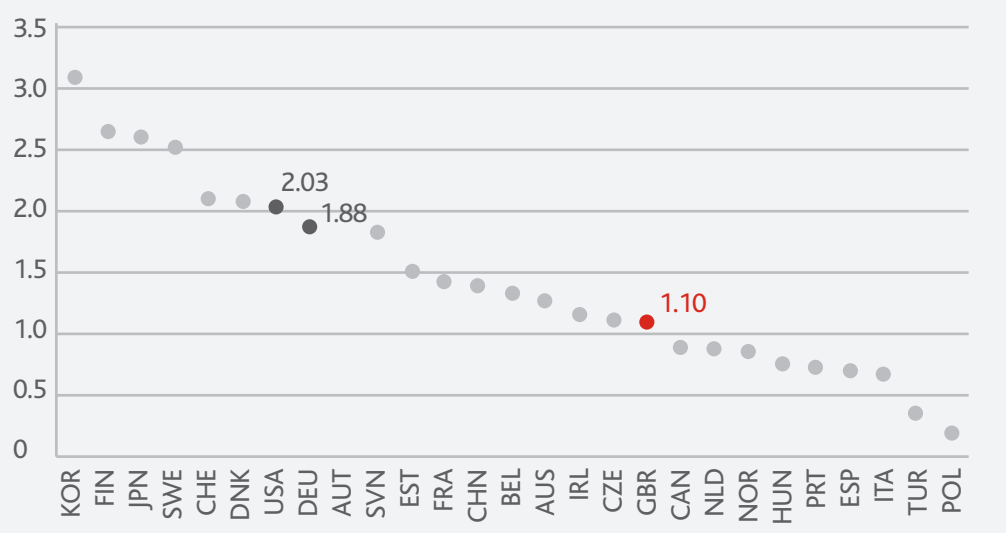
[26] Public procurement as a tool to stimulate innovation evidence, House of Lords S+T Committee, 2011
[27] International Comparative Performance of the UK Research Base, Elsevier for BIS, 2013
[28] Written Ministerial Statement, Hansard, 20 December 2010

WIDER INVESTMENT IN SCIENCE AND ENGINEERING

Evidence shows there is a complementary relationship between private and public sector R&D with public investment in research increasing rather than diminishing private sector investment[29]. It is therefore essential that investment in science and innovation is not seen as a zero-sum game in which public and private investment can substitute for each other. Instead, synergy between the public and private sectors is vital to generating economic growth. Therefore one of the most important levers for attracting private investment in R&D is investing public funds in research.

In 2012 the private sector funded 46% of the UK's total R&D spend, equating to £12.3 billion. This was a decrease of 1%, in current prices, from £12.5 billion in 2011. Foreign-owned firms funded an additional 20% of the UK's R&D and 6% came from the not-for-profit sector[30]. As with government spend, when comparing the amount of private sector investment with other countries by examining BERD as a % GDP, the UK performs poorly as shown in figure 4.

Figure 4: BERD as a percentage of GDP across the OECD[31]



One of the most important levers for attracting private investment in R&D is investing public funds in research.

INCENTIVISING BUSINESS INVESTMENT AND INNOVATION

There are a number of reasons why a business might choose to invest in R&D in the UK, and therefore a number of different ways that the government can seek to incentivise business investment. A major attractor for multinational R&D businesses is the quality of a nation's science base. The most compelling evidence of this effect in the UK is that multinational pharmaceutical firms locate their laboratories near to universities with excellent chemistry research[32]. Therefore, actions on increasing investment in the science base articulated elsewhere in the briefing equally apply here. The government also has other levers which can be used to create an attractive environment for private and third sector investment and innovation.

The Government seeks to support and grow innovative businesses through the work of Innovate UK (formerly the TSB). The Innovate UK budget (£440 million in 2013/14 up from £317 million in 2011/12)[33] is spread across a wide program of activity including funding competitions, supporting knowledge transfer partnerships and networks, Smart

[29] The Economic Significance of the UK Science Base, Haskel, Hughes and Bascavusoglu-Moreau, 2014
[30] UK Gross Expenditure on Research and Development 2012, ONS, 2014
[31] OECD Science, Technology and Industry Scoreboard 2013: Innovation for Growth, OECD
[32] The Economic Significance of the UK Science Base, Haskel et al for CaSE, 2014
[33] https://www.gov.uk/government/news/record-440-million-funding-for-innovative-companies

awards, Catapults, and the Small Business Research Initiative (SBRI). Further responsibilities should not be included in the Innovate UK remit without a corresponding increase in budget. Innovate UK has only been operating since 2007 and its effectiveness has not been extensively evaluated. Indications are promising. For instance an independent analysis in 2011 showed that Innovate UK provides a good return on investment, e.g. its collaborative R&D projects (completed by the end of 2009) estimated a gross value added of £6.71 per £1 invested[34].

ACTION

Funding for Innovate UK should be increased to widen the impact of its activities.

ACTION

The performance of Innovate UK and its portfolio of programmes should be evaluated regularly to assess impact and effectiveness of this funding model.

Importantly, businesses recognise the interconnectedness and importance of funding research alongside funding through Innovate UK. Indeed at a recent House of Commons evidence session representatives from Rolls-Royce and GlaxoSmithKline affirmed that they were in favour of more funding for Innovate UK, but not at the expense of the basic funding through research councils[35]. Both are needed.

Businesses are in favour of more funding for Innovate UK, but not at the expense of the basic funding through Research Councils.

The Catapult network is in its early stages with nine centres at different stages of development. By design the centres do not follow a uniform model but could benefit from more coherence across the network. All major political parties have voiced their continuing support for Catapults. To capitalise on this cross-party support, and prior to any expansion of the network, it is essential that the aims of the centres are clear, that the funding model supports these aims and that the network is properly joined up with other structures within the innovation ecosystem, such as universities.

ACTION

Clearly define the purpose and aims of Catapults (individually and collectively) and outline performance indicators to measure success in the short and longer term.

ACTION

Ensure Catapults integrate with, rather than act to duplicate or compete with, the existing science base.

ACTION

Commit to maintaining the funding principles of Catapults, increasing public investment in proportion to the commercial income generated.

[34] Evaluation of the Collaborative Research and Development Programmes. PACEC for the Technology Strategy Board, 2011
[35] Business, Innovation and Skills Committee Evidence Session, Business-University Collaboration, 9 Sept 2014

The sharing of buildings and equipment by universities and businesses or research charities should be fully facilitated and incentivised by the tax system.

If the UK is to be internationally competitive it is crucial that the tax system incentivises R&D activity in the private sector. The aim of the R&D tax credit regime is to modify behaviour by encouraging tax payers to undertake greater levels of R&D, and to locate greater levels of R&D in the UK, than would otherwise be the case. R&D tax credits do not necessarily increase the amount invested in R&D globally but contribute to creating an attractive financial environment for investment. As other nations provide them, the UK must also do so to remain competitive as a location for business to invest in R&D. In order to be a factor in business R&D location decisions, it is vital that the benefit to a business of the R&D tax credit is visible to and focused on those individuals in a business who make the decisions around R&D expenditure and project appraisal. It must also be straightforward for businesses and comparable internationally. There is some concern about the effectiveness of R&D tax credits. Therefore, the return on investment for R&D tax credits should be evaluated and compared with other forms of business incentive.

ACTION

Review the effectiveness of R&D tax credits to monitor their impact on R&D in the UK.

The sharing of buildings and equipment by universities and businesses or research charities should be fully facilitated and incentivised by the tax system. The current VAT exemption for a 'cost sharing group' is too rigid and impedes short term collaboration in specific programmes, which is a common approach in the research sector. Amending the current regulations so that a special purpose vehicle is not required would make the process more flexible, straightforward and remove barriers to collaboration. This would particularly benefit SMEs and public and third sector organisations as they have a high level of demand for use of university facilities and equipment, on which they collectively spend more than large businesses[36].

ACTION

Create a VAT exemption for academia, charities and industry on sharing of equipment, facilities and buildings for the purposes of R&D.

Creating the environment and mechanisms for the science and engineering base to help provide technological solutions to support development across the globe brings simultaneous benefit to the UK economy. This task is broadly shared between UK Trade and Investment, the British Council, and the BIS/FCO's Science and Innovation Network. The new Emerging Powers Research and Innovation Fund provides £375million to develop the scientific capacity of partner nations for their long-term sustainable economic growth. These initiatives are further evidence of the importance of international connectedness in science and engineering research and innovation. Science is an increasingly international endeavour and universities and companies need to be able to recruit top talent and forge mutually beneficial international partnerships.

ACTION

Immigration policy and implementation must complement and support science and innovation policy aims so that industry and academia can attract the brightest and best to the UK science base.

[36] Higher Education – Business and Community Interaction survey 2012-13, June 2014

CaSE
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ABOUT CaSE

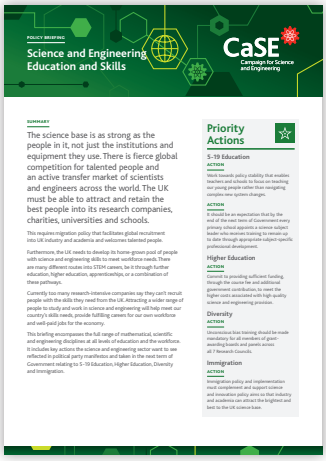
The Campaign for Science & Engineering (CaSE) is the leading independent advocate for science and engineering in the UK.

We speak with the voice of our members from across the science and engineering community, in industry and academia, to raise the political profile of science and engineering and deliver independent, authoritative analysis to convey its economic and societal importance.

FIND OUT MORE

This policy briefing is part of a set of three which can be downloaded at www.sciencecampaign.org.uk

The briefings cover Investment, Education and Skills, and Science and Engineering in Government and were developed in consultation with our members and collaborators from across the science and engineering sector. They set out the actions we want to see reflected in political party commitments and taken in the next term of Parliament.



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