Intro and Rationale

The Chancellor has said that he wants a 'fast-track' spending round that sets departmental budgets for the next financial year 2020/21 before a full spending review next year. We recognise that capital spending for next year, including the science budget, has already been set for 2020/21. However, we believe that this does not preclude further announcements on public investment in research and development alongside the spending round.

Members have told CaSE that leadership and long-term R&D investment from Government enables them to plan and gives industry confidence to keep on investing in R&D. A big announcement on science investment would show that the Government is committed to the target of investing 2.4% of GDP in R&D by 2027. It will also, in a time of uncertainty surrounding the Brexit outcome, signal to multi-national businesses that the UK is still open to international investment in R&D. If the UK doesn't do this, we risk falling further behind our international competitors. For example, Germany has committed to an annual 3% increasing in funding for research institutes until 2023 through its Pact for Research and Innovation[1].

Why R&D?

There are a few areas in which the UK truly leads the world. Research and development (R&D) is one of them. The UK has benefited from its research strength both culturally and economically. It puts the UK in prime position to shape the future direction of new technologies, industries and sectors. But these benefits aren't inevitable and Government action is needed to realise them.

Research and innovation are essential to solving challenges facing Government and citizens. Tackling anti-microbial resistance, cutting transport times, supporting an ageing population to work for longer, securing sustainable energy and more, all require research and innovation.

More broadly, public funding of research, particularly at early stages, develops new knowledge, techniques, and skilled people. This sustains the breadth of excellence that is a unique strength of UK research and that allows the UK to draw on diverse expertise to shape societal and technological changes. It also provides an attractive platform for companies do more high-risk, high-return projects and do them in the UK. It is an essential building block of a competitive environment to anchor business investment and jobs in the UK, with evidence showing that public investment 'crowds in' private investment, attracts overseas investment, and raises private sector productivity growth[2].

At a national level, investment in R&D, along with complementary investment in infrastructure and skills, is linked to core national aims of productivity growth and economic returns across the UK. Concerted and coordinated action from Government is needed to capitalise on the UK's strength in research and innovation and ensure the nation, and indeed the world, benefits from their potential.

The UK cannot rest on its laurels. To counteract uncertainties for research arising from Brexit, historic underinvestment in R&D, and rising international competition the UK must do more in the next five years than in the past to grow confidence in our research base, to actively attract business investment

[1] https://www.research-in-germany.org/en/research-landscape/r-and-d-policy-framework/pact-for-research-and-innovation.html

[2] The Economic Significance of the UK Science Base, Haskel et al for CaSE, 2014

and create good jobs in the UK. The Government must coordinate and deploy all its levers, from funding for R&D, to tax incentives, procurement, and skills policy if the UK is to reap the rewards.

Increasing UK R&D intensity to 2.4% of GDP by 2027

The previous Prime Minister set a target to increase research and development (R&D) investment in the UK to 2.4% of GDP by 2027 as part of its Industrial Strategy. CaSE strongly believes that the new Government should at the very least recommit to this target, if not be more ambitious.

The Government should set out the long-term budget for public investment in R&D up to 2027 in line with the ambition for R&D investment to reach 2.4% of GDP and it should coordinate action and delivery across Government. UKRI and BEIS cannot deliver the transformation of the UK R&D environment alone. This long-term transformation of R&D will require ambitious and coordinated action, including a significant uplift in public investment in R&D.

Why is a long-term plan is needed?

Members have told CaSE that leadership and long-term R&D investment from Government enables them to plan and gives industry confidence to keep on investing in R&D. The long-established principles and mechanisms for funding research have contributed to the UK being a highly efficient research nation. A long-term plan gives confidence for long-term R&D investment decisions by the private sector and for long-term partnerships between the public and private sector. Every country that has successfully raised R&D intensity by a significant margin over the period of a decade has done so through raising both public and private investment[3].

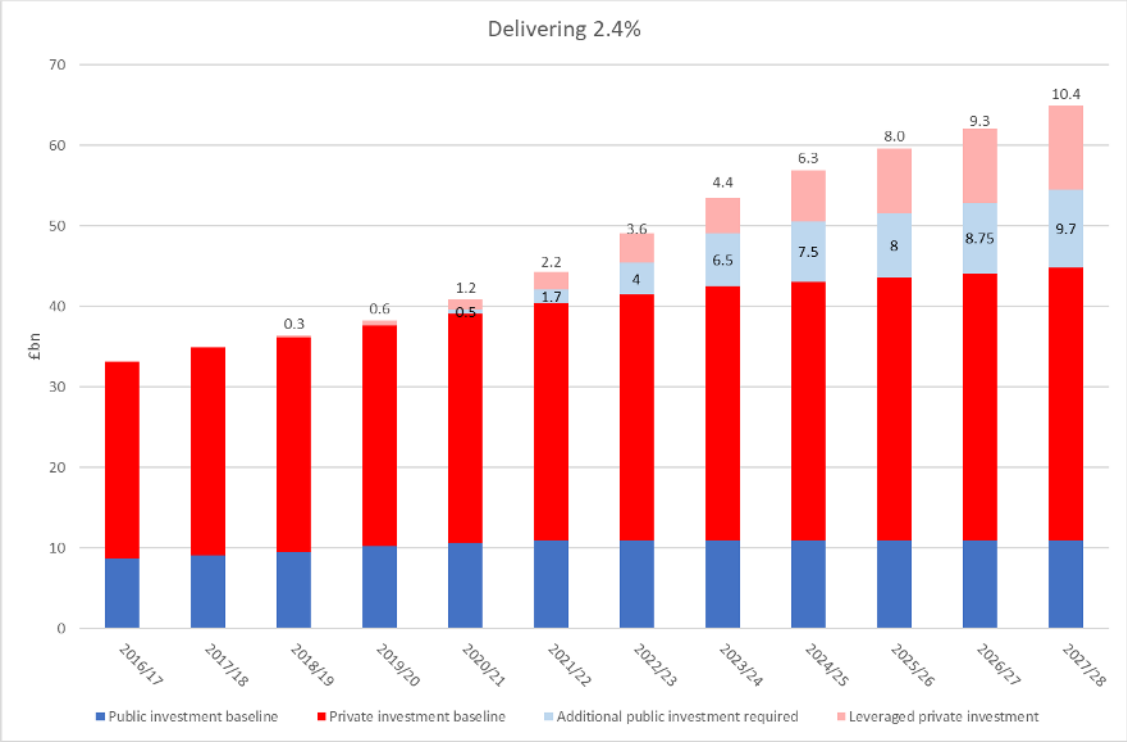
Public investment drives increased private investment, with a time-lag. Government analysis shows that an extra £1 of public spending gives rise to an increase in private funding of £1.36 over a ten-year period[4]. Furthermore, for companies that have previously chosen to invest in R&D elsewhere, a bold, long-term, investment plan, could catch their attention and make the UK a candidate destination for new investment.

The challenge of ensuring public money is spent well is exacerbated by short term budgets with near term aims, as we've seen in recent years[5]. A long-term budget will enable the development of a detailed strategy and delivery plan that will allow for efficient use of the funding, minimizing wastage and maximizing leverage. It would enable Government to consider the appropriate balance of funding and make transparent, evidence-based decisions about how to most effectively use public R&D investment and levers.

Reaching 2.4% of GDP invested in R&D by 2027

CaSE has developed a model for public and private R&D investment to reach an intensity of 2.4% of GDP by 2027 and 3% in the long term (2034/35). The assumptions used in the model are set out below. Broadly speaking the model shows public investment in R&D must double by 2027 to reach the target.

[3] OECD MSTI database, data extracted 4 November 2018
[4] What is the relationship between private and public investment in science, research and innovation? BIS, 2015
[5] Cross-government funding of research and development, NAO, 2017



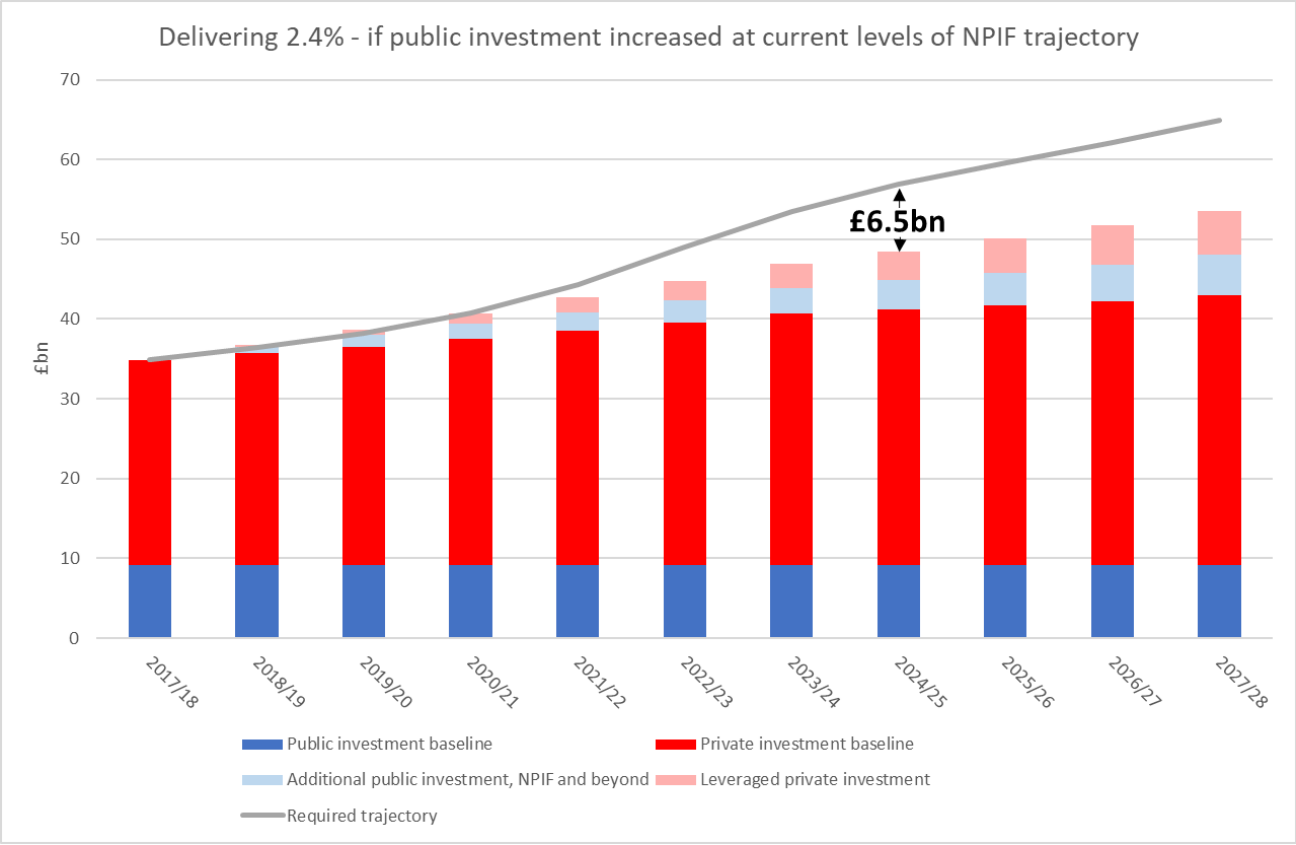
Model assumptions:

- The 1.36 leverage ratio[6] was applied over 10 years to calculate the growth in public investment required to reach the necessary overall uplift in investment, assuming GDP grows according to OBR forecasts.
- The model begins at 2016/17, using the latest year of available data on the Gross Expenditure on R&D (GERD) in the UK,[7] split into public and private spending using GERD categories. The £2.3bn extra announced in Autumn Budget 2017 becomes part of the new baseline level.
- The baseline for public expenditure remains flat in cash terms and the private expenditure baseline increases in line with GDP growth, as per trends in the past decade, using OBR forecasts for GDP growth in the short[8] and medium term[9].

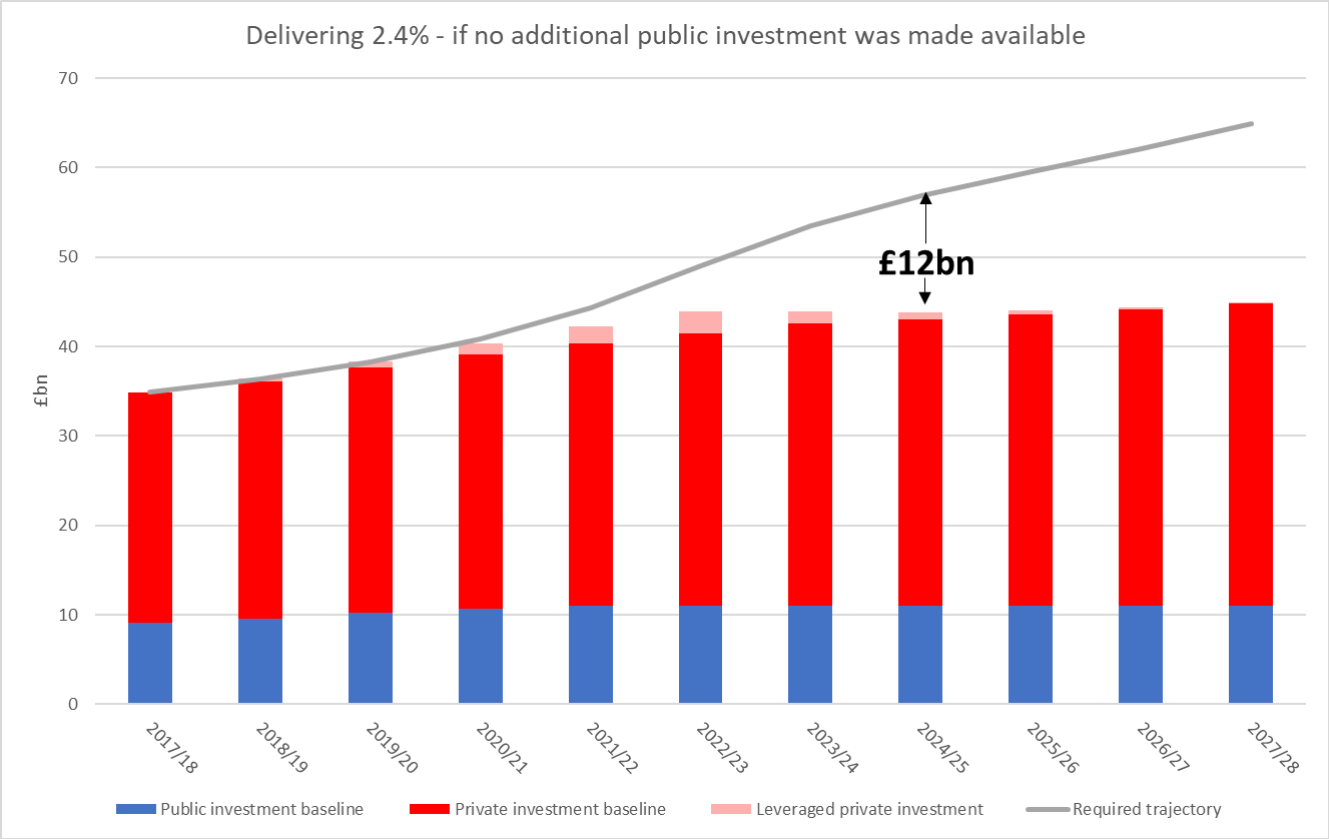
Using the same projection modelling, CaSE also outlined scenarios in which UK Government investment in R&D does not match up that needed to reach the 2.4% target. The first scenario would be for the UK Government to incrementally increase public R&D investment in line with that made over the last few years through the National Productivity Investment Fund (NPIF). The graph below sets out these increases until 2027, along with the recommended trajectory to reach the 2.4% target. In this scenario, UK research intensity would increase its expenditure on R&D to 1.96% of GDP in 2027/28, far below the Government's target. By the end of the period to 2024/25, the UK would be £6.5bn short of where it would need to be to reach the 2.4% target. This scenario would represent progress, but ultimately

[6] What is the relationship between public and private investment in science, research and innovation?, BIS, 2015
[7] UK Government expenditure on science engineering and technology 2016, ONS, 2018
[8] https://www.gov.uk/government/statistics/gdp-deflators-at-market-prices-and-money-gdp-march-2018-spring-statement
[9] http://cdn.obr.uk/FSR-July-2018-1.pdf

would mean the target would not be met and the UK would likely fall further behind its international competitors.



The third scenario, that would likely be damaging for UK science, is if no additional public investment is made in R&D. As the graph shows, the UK would fall substantially behind the Government target, such that the UK's research intensity would decrease to 1.67% of GDP in 2027/28, which would see the UK £12bn behind where it would need to be in 2024/25. This would see the UK make no progress towards the Government's target, and likely fall much further behind competitor countries in the OECD.



R&D expenditure across Government

There is great potential for R&D investment to directly benefit delivery of public services by government, supporting more effective and efficient policymaking and public service delivery, and in assessing policy outcomes against objectives. Departmental R&D budgets can be used to mitigate risk and use resources more efficiently, for example by identifying policy interventions that reduce the severity of road traffic incidents in cities or help prevent and respond to adverse weather conditions and disease outbreaks.

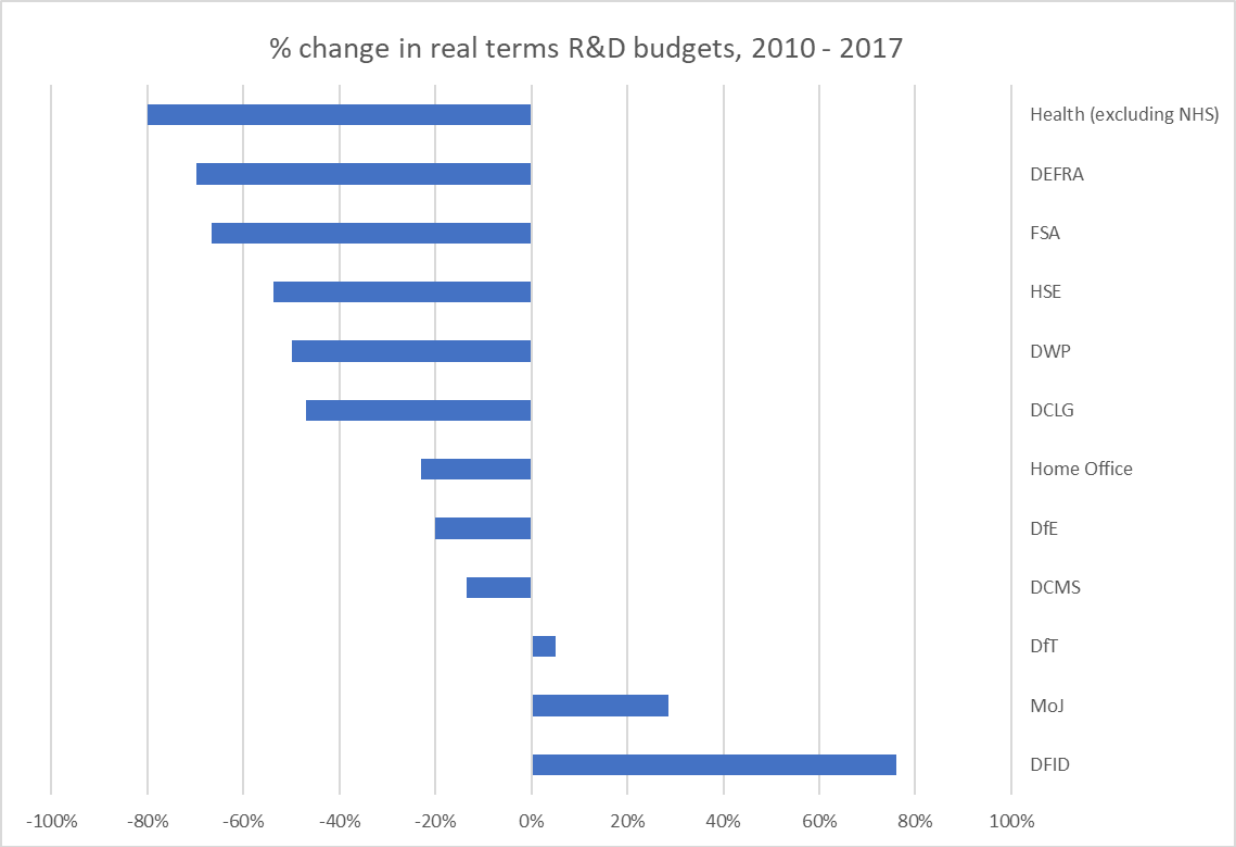
Civil government departments and the Ministry of Defence are all responsible for a research budget, which they may choose to use to help meet their departmental aims or address their areas of research interest[10]. Departmental R&D budgets are responsible for up to 30% of public expenditure on R&D[11], outside of UKRI and other Higher Education Funding Councils, thus clearly have a crucial role in delivering the Government target to increase the UK's research intensity.

There is an important role for departmental Chief Scientists in decision making about their departments R&D budget and while good progress has been made on publication of Areas of Research Interest for each department more can be done to make the most of these across all departments.

[10] https://www.gov.uk/government/collections/areas-of-research-interest

[11] http://www.sciencecampaign.org.uk/resource/casesubmissionbalanceandeffectivenessofr-d-s-tcommitteeinquirysept18.html

Real terms change in Departmental R&D expenditure; 2010 - 2017[12][13]



Despite the potential of departmental R&D budgets in helping to achieving Government objectives, from 2005 to 2016 overall civil departmental R&D spending fell 30% in real terms, excluding BEIS and its predecessors and the NHS (NIHR)[14]. Over the same time period Ministry of Defence R&D spending fell 40% in real terms[15]. The graph above shows the change in departmental R&D budgets in the period 2010-2017. BEIS (and its predecessor) is excluded because its expenditure in this period includes Innovate UK and this is not direct expenditure by the department. We have also excluded NIHR funding for similar reasons.

It is important to consider R&D budgets in the context of overall departmental budgets over this period, as most have fallen. However, for a significant number of departments, including those that have traditionally been some of the biggest departmental funders of R&D, the departmental R&D budget has fallen more than the departmental day-to-day budgets. Defra, for example, saw its day-to-day budgets cut by 31%, but has seen a much more significant drop of 72% in its R&D investment and the Department for Health and Social Care (excluding NHS) has seen a fall of 80% in R&D investment, while its budget has increased by 11%[16]. For a minority of departments R&D spend has increased while day-

[12] https://www.ons.gov.uk/economy/governmentpublicsectorandtaxes/researchanddevelopmentexpenditure/bulletins/ukgovernmentexpenditureonscienceengineeringandtechnology/2017
[13] https://www.gov.uk/government/collections/public-expenditure-statistical-analyses-pesa
[14] ONS SET statistics 2017, 2019
[15] Ibid
[16] Ibid

to-day budgets have fallen, or have not increased to the same extent. For the Home Office and DCMS the decrease in R&D spend has matched the decrease in overall budget.

Civil departmental R&D spending is much more focused on applied research as opposed to basic research when compared to research council spending on R&D[17]. This helps maintain the breadth of the UK's research base, which is seen as a real strength of the UK. Decreasing the diversity of research funding available may have disproportionate effects on different R&D sectors or organisations. Government departments also give a unique client base for R&D investment by commissioning research activity from outside government.

Horizon Europe Association

UK research and innovation has been greatly supported by EU funding programmes. To date, the UK has secured over €5.9bn of Horizon 2020 funding since the inception of the programme in 2014, the second largest recipient of funding[18], and most universities receive between 15-35% of their competitive funding from Europe[19] . We strongly recommend that the UK Government re-commit to seeking full association with Horizon 2020 and Horizon Europe, which is due to begin in 2021, after Brexit. The Government should make additional funding available in order to participate.

While all parts of the UK are reliant on EU research & development funding to some extent, the areas with the highest dependency overall are South West England, outer London and parts of North England and Scotland[20]. Due to the intertwined nature of UK and EU funding streams in recent years, a situation has developed where some fields of research are more dependent on EU funding than others, both for competitive research funding but also for facilities and networks. Some disciplines such as Archaeology, Chemistry and IT are very reliant on EU funding, while EU grants account for at least 20% of research funding for 15 academic disciplines[21]. Equally large grants for blue skies research funding in the UK are limited and the European Research Council has been an important source of such funding.

Participation in EU Framework Programmes has also provided the UK with a number of 'intangible' benefits. While not directly measurable, these benefits are wide ranging and help to grow research in the UK. A letter from our chair, Professor Graeme Reid, to the previous Science Minister summarised the outcomes of a workshop co-hosted by CaSE and the Wellcome Trust on the intangible benefits of European Collaboration in September 2018[22]. The following were among the intangible benefits identified by the workshop participants.

- Competition for EU funding raises standards and accelerates research progress.
- EU funding increases the diversity of the UK research base by complementing domestic spending.

[17] http://www.sciencecampaign.org.uk/resource/casesubmissionbalanceandeffectivenessofr-d-s-tcommitteeinquirysept18.html

[18] Horizon 2020 projects and participations statistical database, European Commission

[19] Digital Science, Examining the implications of Brexit for the UK research base, 2016

[20] http://sciencecampaign.org.uk/CaSEVATbriefing2015.pdf

[21] The role of EU funding in UK Research, Royal Society, 2017

[22] http://www.sciencecampaign.org.uk/news-media/press-releases/case-letter-science-minister-intangible-benefits.html

- Participation in EU programmes provides access to advanced facilities and access to large data sets unavailable in the UK alone.
- Participation in EU programmes helps attract talented researchers to the UK. The pool of top quality researchers in the EU is clearly larger than that in the UK alone.
- Many research-intensive businesses operate across several EU member states and are attracted to EU research programmes with similar geographic coverage. Business participation in these collaborative programmes may improve access to markets elsewhere in the EU.
- Participants in EU programmes have opportunities to influence the future shape of EU research and innovation and sometimes have opportunities to influence technical standards that shape future regulation.

No Deal Brexit

A no deal Brexit would result in the UK becoming a third country for participation in Horizon 2020. This would make UK researchers ineligible to apply for European Research Council (ERC) grants and Marie Skłodowska-Curie Actions (MSCA) projects. These are some of the most prestigious awards available through EU programmes and the UK has historically been very successful in being awarded these grants. UK researchers would be able to participate in the collaborative pillars of Horizon 2020 as a third country but would not be eligible for EU funding. The Government has pledged that in the event of a no deal, grant funding already awarded to UK institutions would be underwritten to make up for the loss of EU funding. This is a welcome move to ensure that grant holders will not lose funding for projects they are already delivering. BEIS and UKRI have put significant work into this area and we understand that progress has been made with registering grants held by higher education institutions. There remains a risk that businesses, particularly SMEs, are harder to reach and may be disproportionately affected should the underwrite be required.

A no-deal exit is also likely to affect negotiations for UK participation in Horizon Europe (and other programmes), the successor of Horizon 2020, which will begin in 2021. UK participations in EU science programmes is a stated aim of the UK Government and the European Commission[23]. The provisional budget for Horizon Europe is due to be €100bn, roughly €30bn higher that the Horizon 2020 budget[24]. If a no-deal exit takes place, negotiations could be delayed because of a breakdown in the relationship between the UK and the EU or because the UK Government has other pressing priorities as a result of a no-deal exit.

The Government must consider how it will ensure access to replacement funding in the event of a no-deal Brexit and how it will facilitate access to European collaborations for UK researchers as soon as possible after exit. There is a risk that if this is not dealt with quickly after a no-deal exit then researchers working on European projects will leave the UK and some parts of the science base that are particularly reliant on European funding will wither away in a way that will take many years to reverse. It is important, in the context of the Government's 2.4% of GDP spent on R&D by 2027 target, that funding is

[23] https://www.gov.uk/government/speeches/pm-speech-on-science-and-modern-industrial-strategy-21-may-2018, https://ec.europa.eu/commission/commissioners/2014-2019/moedas/announcements/royal-society-edinburgh-maccormick-lecture-edinburgh_en

[24] EU budget: Commission proposes most ambitious Research and Innovation programme yet

replaced and made available to UK universities, research institutes and businesses alike. The Smith Review of international collaboration could provide options for the Government to quickly put replacement funding in place in the event of a no-deal exit and if there is a delay in associating with Horizon Europe, due to begin in January 2021.

If the UK could not associate with European research programmes in a no deal Brexit or if funding is not made available to participate as a third country, a large hole would be left in the UK's research funding landscape. The potential loss of EU funding and the wider intangible benefits of EU programmes is a real cause for concern for research institutions, higher education and businesses of all sizes in the sector.

About CaSE

The Campaign for Science and Engineering (CaSE) is the UK's leading independent advocate for science and engineering. Our mission is to ensure that the UK has the skills, funding and policies to enable science and engineering to thrive. We represent over 115 scientific organisations including businesses, universities, professional bodies, and research charities as well as individual scientists and engineers. Collectively our members employ over 336,000 people in the UK, and our industry and charity members invest around £32.2bn a year globally in R&D.