Summary

This submission draws on analysis of existing literature and data to set out the current and historical balance in some of the areas of R&D spending raised by the Committee. However, the past balance between different funding streams or types doesn't necessarily set out a blue print for what future balance should be. Rather, a clear vision of the purpose of increasing the R&D intensity of the UK is necessary to make decisions on the desirable balance of spending and interventions.

Similarly, evaluating the effectiveness of research and innovation spending requires a clear view of the purpose and outcomes against which success will be measured and it isn't yet clear what these are. That said, there are some principles and patterns of investment on which the UK's strength in research and innovation is built, and there are lessons to learn from the experience of those in different parts of the research and innovation landscape on what they need to thrive in the UK. Our submission therefore also draws on extensive engagement with CaSE members to begin to answer the questions on the effectiveness of research and innovation spending by considering how to increase UK R&D intensity and what 'spending it well' would look like.

Recommendations

- Set out the long-term budget for the public portion of investment up to 2027 in line with the ambition for R&D investment to reach 2.4% of GDP.
- Create a vision for what reaching the 2.4% target will achieve and a roadmap for delivery with Cabinet level buy-in and accountability across Government
- As part of their delivery plan for 2.4%, Government should set out a transparent, evidence-based plan for total increases in funding at different stages from curiosity driven blue skies research to directed business-led development.
- To support decisions relating to balance of R&D funding across departments Government should assess optimum R&D budgets in departments in line with Departmental, Industrial Strategy and Government's wider aims and research needs.
- Plan and transparently set out the contribution QR will make to the total protecting the unhypothecated nature of mainstream QR.
- Create a digital 'shop window' for UK innovation support to boost effectiveness of research and innovation funding and support
- Implement the recommendations from the Connell Review of SBRI commissioned by Government to maximise its potential
- Allocate sufficient resource within government to administer R&D tax credits, EIS, SEIS and other incentives so they can be most effective
- Review and update definition of eligible activity for R&D tax credit to more effectively capture and incentivize R&D.
- Following a positive pilot, and subject to evaluation, introduce Innovate UK loans to fill the gap in innovation support alongside continuing grant funding.
- Carefully monitor success rates of flexible funds in UKRI to ensure there is sufficient funding to not only fund 'safe bets' but also take appropriate risk to support and drive research and innovation.
- Following a positive pilot, and subject to evaluation, increase the scale of the Innovate UK investment accelerator and increase the number of funds involved.

The rationale needed for making public R&D funding decisions

The Government's target to invest 2.4% of GDP in R&D by 2027 and 3% in the long term is a welcome ambition. We commend the Government for setting out a long-term ambition for increasing investment in science and innovation. It is in line with calls CaSE and others have made so that the UK can meet the economic, health, security and environmental challenges facing society.

The Government has set out the 2.4% target but as yet haven't clearly articulated an accompanying vision and purpose. In theory such a target could be met in different ways. What is increased research intensity to achieve for the UK? What outcomes must it deliver in order to be successful?

Balance and effectiveness of R&D funding

For many years the UK has had a relatively stable system of funding and evaluation. Total budgets have been broadly static with some gradual shifts in public R&D funding in recent decades. Defence R&D spending has reduced and civil has risen. Civil spending is now more concentrated. BIS/BEIS budgets (which includes RCs and HEFCs) accounted for 69% of total public R&D spend in 2010, and increased to 72% in 2016[1]. Static overall budgets have meant that there has not been an opportunity or desire to assess the balance between different types and sources of funding. For many years the battle has been to protect research funding from budget cuts in the 'science budget' and across government departments, preserve the dual support system, and work towards a 'batteries included' approach to capital and resource funding. The primary evaluation tool has been the Research Excellence Framework (and its predecessors) coupled with our academic productivity in papers and citations per pound and our international research standing.

However, research and innovation is now set in a new context. The UK has an industrial strategy which sets out economy-wide ambitions focusing on four grand challenge areas that will require research and innovation input to succeed. The UK now has a target for R&D investment to reach 2.4% of GDP and 3% in the long term that will require a step change in investment (as set out in our model later in this submission). The UK is set to leave the EU, which will include changes to funding streams in terms of volume and type of funding. In this new context, what is the purpose of public research and innovation funding and so how should funding be directed and on what basis should it be deemed 'effective'?

The questions of balance and effectiveness in this inquiry are therefore pertinent but the answer will depend on the purpose of research and innovation. If the purpose UK research and innovation spending is clear, then it is possible to assess the effectiveness of existing funding towards achieving the intended outcomes and decide on the balance of funding accordingly.

Elements of the answer are contained in the Industrial Strategy.

The Industrial Strategy[2] states that it is the strategy that "will inform decisions now, and in the future." That it will help fulfil the Prime Minister's ambition "to make our United Kingdom a country that truly works for everyone". It states that the "central objective of our Industrial Strategy [is] to improve living standards and economic growth across the country" and elsewhere gives an overview saying the industrial strategy "will create an economy that boosts productivity and earning power throughout the UK".

More specifically the vision attached to the 'ideas' pillar containing the 2.4% commitment and other research and innovation focussed plans is "By 2030 we want the UK to be the most innovative

[1] UK Government expenditure on science engineering and technology 2016, ONS, 2018
[2] HMG Industrial Strategy, Building a Britain fit for the future, 2017

country in the world: a home to the most dynamic businesses at the cutting edge of new technologies and processes, and which supports all businesses to adopt new ways of working to help them prosper." There are some more granular ambitions that don't have any measures, or time periods associated with them, such as for the Grand Challenges to "put the UK at the forefront of the artificial intelligence and data revolution; maximise the advantages for UK industry of the global shift to clean growth; become a world leader in shaping the future of mobility; and harness the power of innovation to help meet the needs of an ageing society." There are also a few specific, time bound outcomes mentioned including "The government wants to see fully self-driving cars on the UK roads by 2021".

In the Industrial Strategy Government said that they "will create an independent Industrial Strategy Council that will develop measures to assess and evaluate our Industrial Strategy and make recommendations to the government. The Council will have access to relevant government data and will be funded to commission specific evaluation projects as appropriate."

A year on from that statement the Council and the measures have not been created.

So, the strategy has a collection of ambitions and some more concrete aims but the measures of success or 'effectiveness' for the industrial strategy as a whole, and for the 2.4% target specifically, at a level that can support decision making on research and innovation across government are still needed.

But the next question is whether the industrial strategy is the guiding strategy for all science funding across government?

Historically public research and innovation funding has had three purposes which broadly align with the UKRI strategic prospectus which states that UKRI will work with all the research and innovation communities to:

- push the frontiers of human knowledge and understanding
- deliver economic impact
- create social and cultural impact by supporting our society and others to become enriched, healthier, more resilient and sustainable[3]

Arguably these aims re broader than that of the industrial strategy alone. The Government also has Clean Growth Strategy (2017), a Transport Investment Strategy (2017) and MoD Science and Technology Strategy (2017), a Clean Air Strategy (2018), a Digital Strategy 2018-2020 amongst others that contain different measures and ambitions that involve R&D.

The Government must set out a vision, intended outcomes, budget and a delivery plan for the 2.4% target if we're to achieve it and derive maximum benefit for the UK.

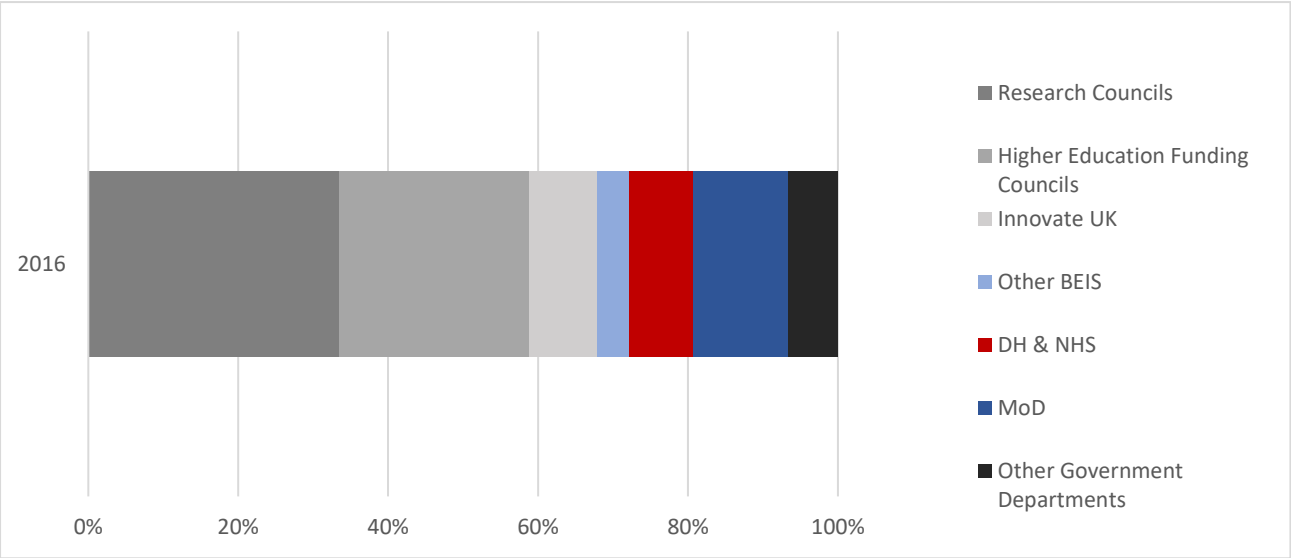
Historic and current balance of public R&D funding

Current UK public investment in R&D

Figure 1 Graph – Public Expenditure on R&D by organisation type[4]

[3] This third strand would have historically had a greater emphasis on national defence

[4] UK Government expenditure on science engineering and technology 2016, ONS, 2018



In 2016 68% of total public R&D funding was through Research Councils, Higher Education Funding Councils and Innovate UK[5]. Movement of Innovate UK and Research England to UKRI will mean that from 2017, alongside budget increases, means UKRI will deliver 70% of public R&D funding[6].

The figures and descriptions in the following section describe current and historic balance across a range of factors raised by the Committee tracking some of the changes over time. Historic balance between modes of funding doesn't necessarily provide a blueprint for optimum future balance and effectiveness but do provide a starting point to learn from. There are also some principles and patterns of investment on which the UK's strength in research and innovation is built and should be central to decision making as a roadmap for R&D increases is developed as part of the ambition to raise UK R&D intensity to 2.4% of GDP.

Individual research disciplines, research councils and cross-disciplinary schemes

Much of the UKRI data in this section is taken from allocations documents – Science Budget Allocation 2015/16[7] and The Allocation of funding for Research and Innovation 2017/18 to 2020/21[8]. Provisional budgets have been set for the next three years, but the full allocations for 2020/21 have yet to be made.

Figure 2 – Public R&D funding announcements coming into effect from 2017/18[9]

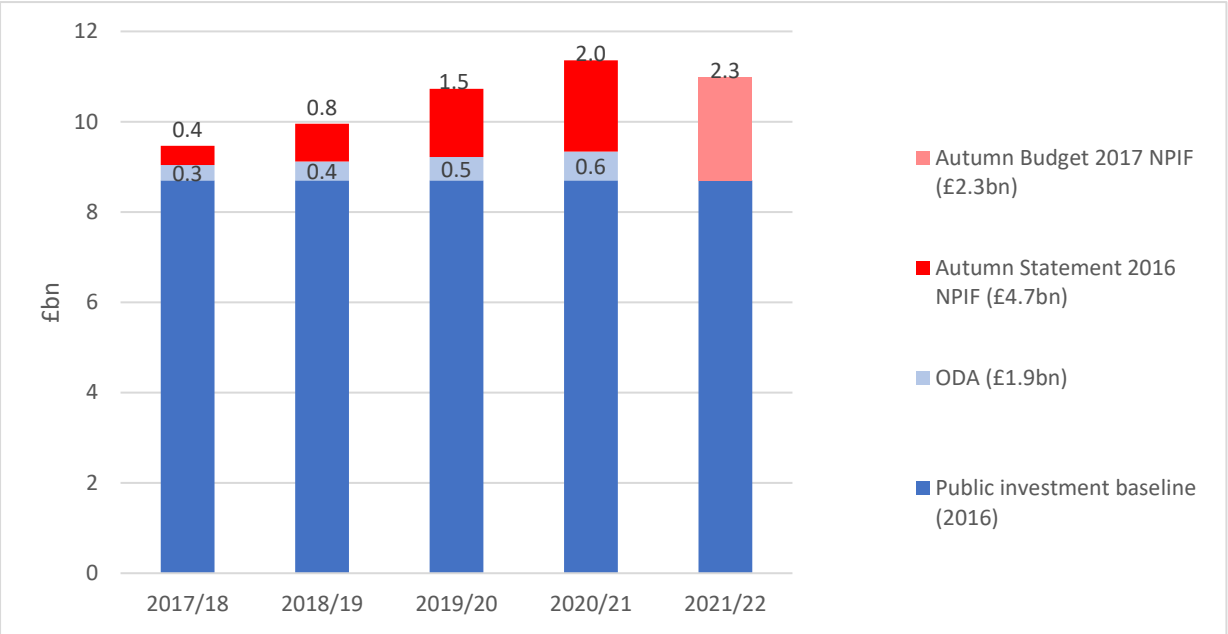
[5] CaSE analysis of ONS GERD (2016) and ONS SET (2016) data

[6] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/731507/research-innovation-funding-allocation-2017-2021.pdf

[7] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/505308/bis-16-160-allocation-science-research-funding-2016-17-2019-20.pdf

[8] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/731507/research-innovation-funding-allocation-2017-2021.pdf

[9] Ibid

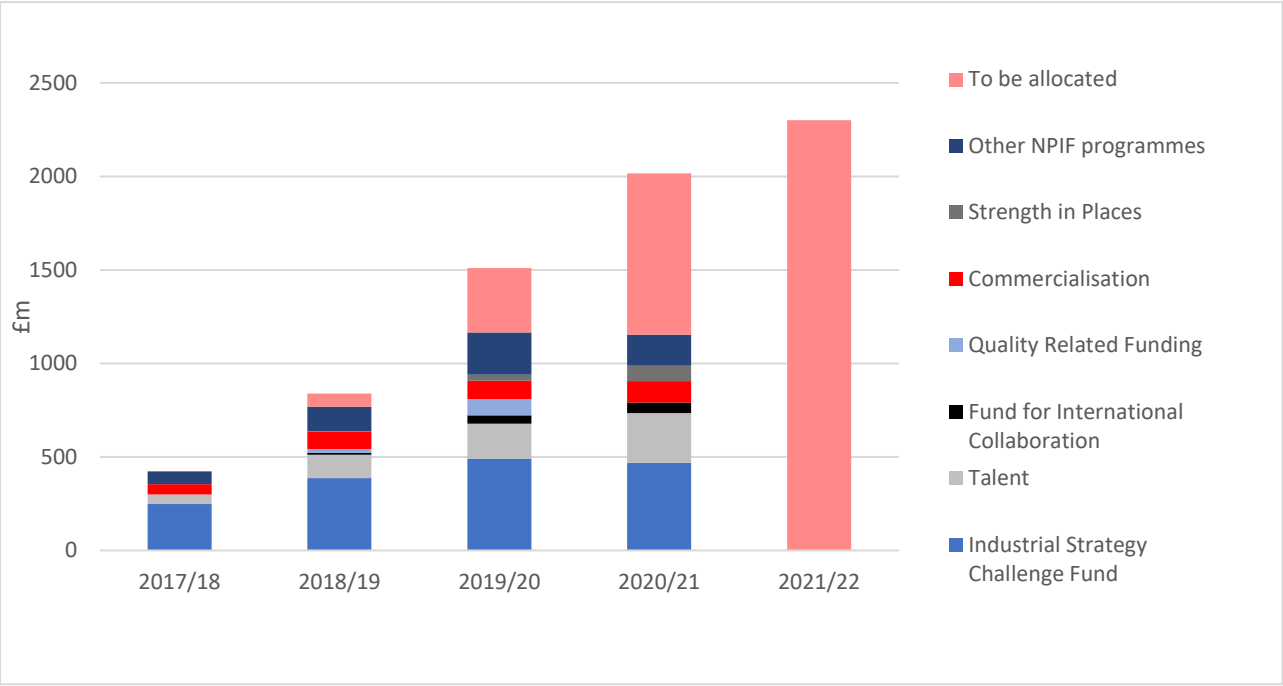


The announced increases are predominantly made up of:

- a growing budget of International Development funding being delivered through UKRI in the Global Challenges Research Fund (GCRF), Newton Fund, and also in QR and Research Council main budgets. This funding for research which must meet Overseas Development Assistance (ODA) criteria will grow by 152% between 2017/18 and 2019/20, from £341m to £518m.
- National Productivity Investment Funding (NPIF) for which UKRI is responsible for delivering £3bn of funding between 2017/18 and 2020/21. The majority (£1.6bn) will support the Industrial Strategy Challenge Fund (ISCF) and a full break down is shown in Figure 3 below.
- The rest of the £4.7bn NPIF allocated for R&D in the 2016 Autumn Statement will fund R&D activity outside UKRI including the space agency and National Academies, listed as other NPIF programmes below.

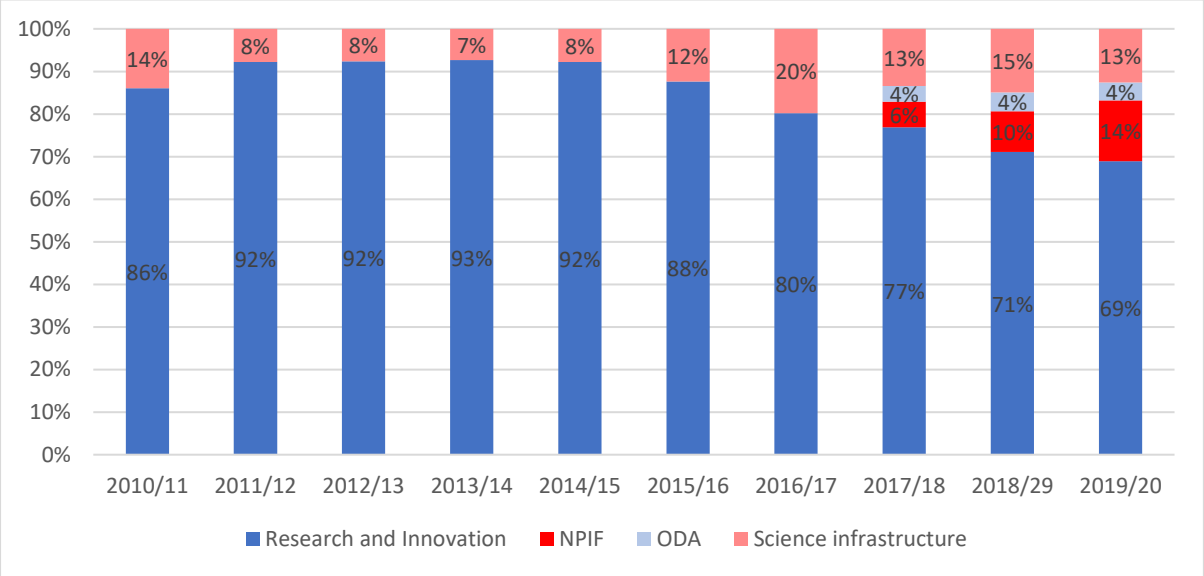
Figure 3 – Breakdown of the National Productivity Investment Fund for R&D[10]

[10] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/731507/research-innovation-funding-allocation-2017-2021.pdf



These changes result in proportional shifts the make-up of the UKRI budget.

Figure 4 –Changing UKRI budgets[11]



- Research and Innovation (R&I) UKRI budgets refer to core resource budgets for Research Councils, Research England and Innovate UK. This is money solely for the purpose of research and does not include funding for administration or staffing.
- In addition to changing proportions due to increases elsewhere, the R&I budget is set to decrease in current terms from £4,916m in 2017/18, to £4,862m in 2018/19 and £4,820m in 2019/20[12] meaning the new funding isn't funding entirely additional activities. Due to the

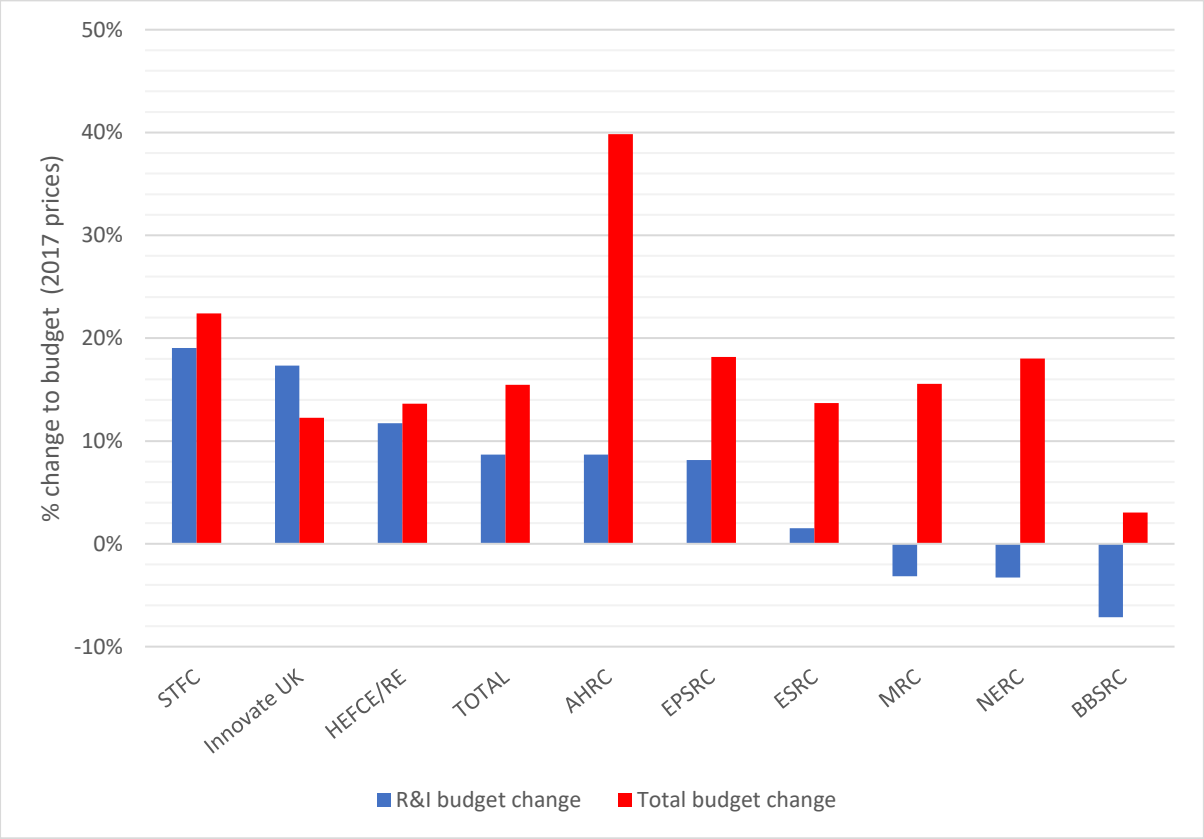
[11] CaSE analysis of science budget allocation documents (2011-2014, 2015-2016 and 2017-2021)

[12] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/731507/research-innovation-funding-allocation-2017-2021.pdf

specific purposes of that ODA and NPIF funding is designed for, this means there will have to be cuts to some of the activities that the research and innovation budget has funded in the past.

The Industrial Strategy stated that UKRI council budgets would increase in real-terms by 20% between 2015/16 and 2019/20[13]. This could be looked at in two different ways. Figure 5 compares the change in R&I budgets for each council and the change in total Research Council budgets over the period.

Figure 5 – Percentage change in UKRI council budgets 2015/16-2019/20[14]



- From allocations to date, only two Councils will see their budgets increase by 20% over this period, with two others close. The average is a 15% increase to total budgets.
- Looking R&I budgets, many are growing at a lower rate to their overall budget and three shrink over the period.

The two research funding streams of the 'dual support' system

The dual support system refers to the principle that public research funding is allocated by two different streams of funding, which have complementary methods of allocation and evaluation. Research Council funding, used responsively to fund research grants, is allocated by prospective assessment of potential, and is confined to the purposes set out in the grant. Quality-Related

13 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/730048/industrial-strategy-white-paper-web-ready-a4-version.pdf, p.68

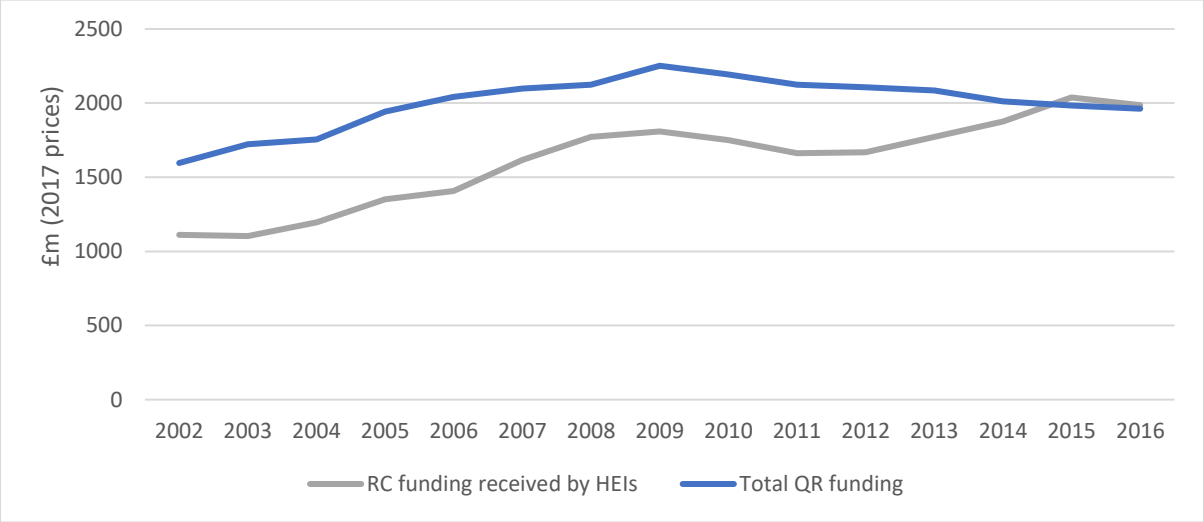
14 CaSE analysis of science budget allocation documents (2015-2016 and 2017-2021)

research funding is used to fund institutions (universities) on a formula basis. It is allocated by retrospective assessment of the quality of past research output and the funds are unhypothecated. It is widely regarded as a unique asset to UK research and innovation strength and resilience.

In 2017, Parliament put the dual support system, or the 'balanced funding principle', into law for the first time[15]. The government must not fall at the first hurdle by failing to invest in one of the two sides of this balanced funding, namely Quality-Related (QR) research funding. As an unhypothecated grant delivered to institutions, QR provides a crucial fund for institutions to invest strategically in line with institutional priorities and needs. A recent report[16] sets out how this funding complements project-based funding and is used by universities to support discovery science, research projects and infrastructure in line strategic priorities, research careers, collaboration and to leverage other funding.

The balance between research council grant funding and QR funding received by HEIs has changed over time[17].

Figure 6 - QR budget v Research Council funding income for HEIs[18]



- Until 2015/16, QR funding was higher than Research Council grant funding to HEIs. It is now slightly lower.
- On average between 2002 and 2008, QR funding was 41% higher than research funding from Research Councils. From 2009 both funding streams declined in real terms, however the increase in Research Council funding from 2012 has not been accompanied by an equivalent increase in QR funding.
- Alongside Research Councils, HEIs have seen proportional increases in other funding streams. In particular, EU Governmental body research funding grew from £369m in 2002 to £745m in 2016[19].

[15] The Higher Education and Research Act 2017
[16] Empowering UK universities: how strategic institutional support helps research thrive, Wellcome Trust, 2018
[17] We have used Research Council funding received by HEIs as reported in HESA so that it is comparable to QR which is only allocated to universities. Research Council funding also funds institutes and other organisations.
[18] HESA – Finances of Higher Education 2002-2016
[19] HESA – Finances of Higher Education 2009 – 2016 (in 2017 prices)

- Due to a combination of real terms and proportional decreases, QR has significantly fallen as a share of total research funding received by HEIs, from a third to a quarter from 2006/07 to 2016/17.
- Research Council grant funding to HEIs has grown from 23% to 25% over the same period.

This has resulted in a change to the types of research funding and the relative level of strategic flexibility HEIs have in making research funding allocation decisions.

The industrial strategy did state that there would be increases to QR. Subsequently, Research England announced an increase to QR funding of £45m from £1,620 in 2017/18 to 1,665m in 2018/19[20], a 4% increase in QR funding.

The primary element of the QR budget, termed 'mainstream QR', is allocated to universities based on the excellence of their research, measured by the Research Excellence Framework exercise conducted every six years. Other elements include funds for universities to support PhD training and engagement with businesses and charities. While there were welcome increases in support for these other elements announced, 'mainstream QR' is in effect being held flat in cash terms[21]. The increase in QR is funded using funding that must meet Official Development Assistance aims meaning that some of mainstream QR will have to demonstrate that it has been used to do so. Prior to this, mainstream QR had been an unhypothecated block of funding. This requirement placed on mainstream QR funding must not be a new direction of travel.

Mainstream QR is the engine of discovery and innovation at universities. It allows ideas to germinate, to succeed and to fail, producing the winners that are taken on for further development. At a time when the Government is investing heavily in the industrial strategy, sufficient support must also be provided for the research that drives discovery. QR is a core element of that alongside responsive mode grants (discussed later).

As part of a roadmap to reach 2.4% and 3% in the long term, UKRI must plan and transparently set out the contribution QR will make to the total. As it does so, the unhypothecated nature of mainstream QR must be protected.

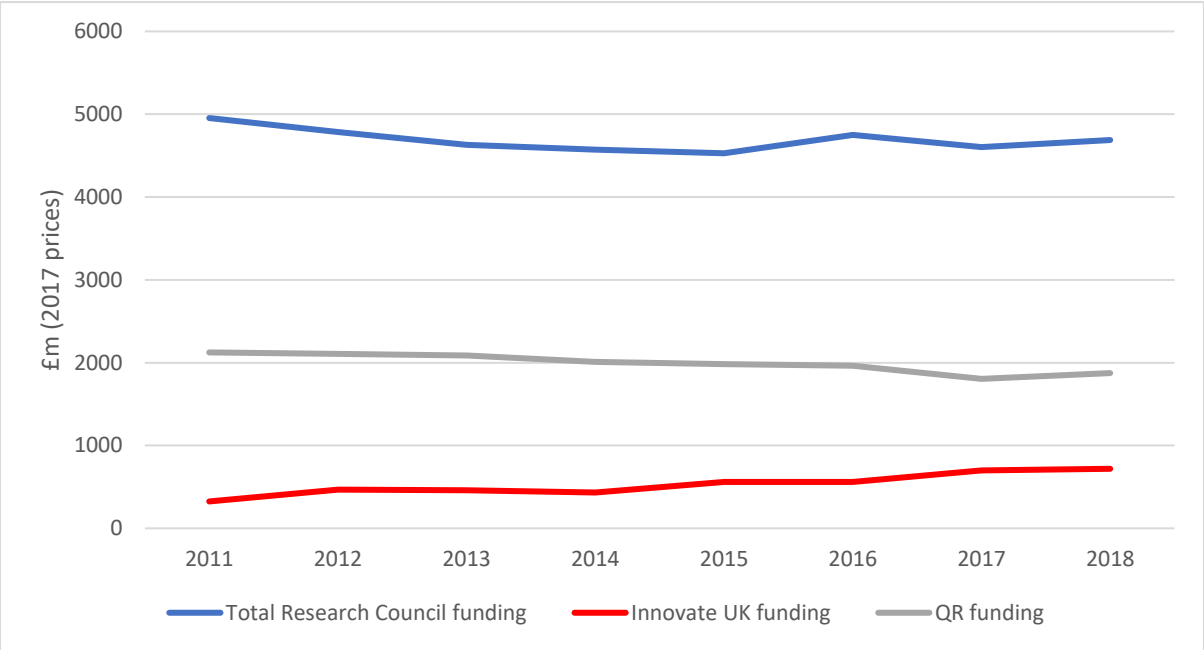
Research and Innovation

Figure 7 – Innovate UK, Research Council, QR funding 2011-2018[22]

[20] https://re.ukri.org/news-events-publications/publications/funding-for-higher-education-institutions-for-2018-19/

[21] https://re.ukri.org/news-events-publications/publications/funding-for-higher-education-institutions-for-2018-19/

[22] CaSE analysis of Innovate UK/TSB annual reports 2011-2017, Science Budget allocation documents (2010-2015, 2015-2016 and 2017-2021), HESA – Finances of Higher Education data (2011-2016) and QR announcements made by Research England.



- The 'core' Innovate UK budget[23] has increased in total and relative to Research Council funding. The budget has grown by 110% between 2011/12 and 2019/20 (£325m to £684m in 2017 constant prices)[24].

In recent years, Innovate UK 'core' budgets have been focused towards innovation challenges and opportunities within chosen sectors[25]. This pattern is changing with the introduction of the Industrial Strategy Challenge Fund.

There has been a relative increase in support for business-led innovation through Innovate UK. This is in line with the view that UK's later stage and business-led innovation support has been underpowered in recent years as shown in Figure 7. The Industrial Strategy loosely sets out the ambition to continue this trajectory saying, "within R&D, the 'D' for development needs a particular boost."

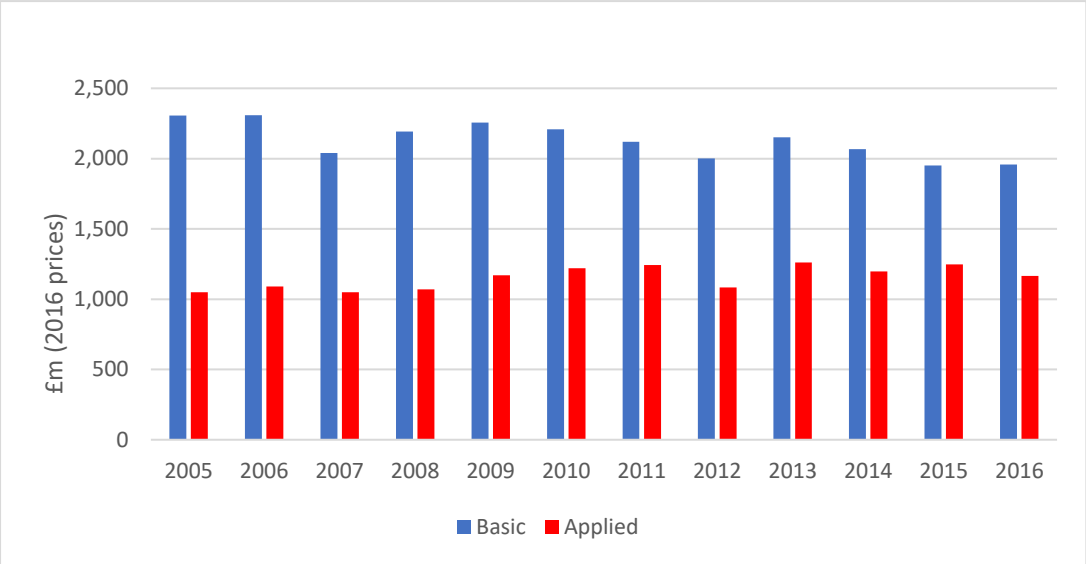
In the past allocations between research and innovation budgets have been set against each other within a flat budget meaning that increases in one result in a decrease in the other. To meet the 2.4% target the government will need to radically increase public R&D funding as a whole. In this new context there is an opportunity to seek out a new, evidence-based approach to deciding relative and total spending across the spectrum of research and innovation funding.

As part of their delivery plan for 2.4%, Government should set out a transparent, evidence-based plan for total increases in funding at different stages from curiosity driven blue skies research to directed business-led development.

Pure and applied research

[23] The 'core' Innovate UK budget refers to grant funding as part of Innovate UK's funding programme. These 'core' budgets exclude all other costs associated with administration and staffing.
[24] CaSE analysis of Innovate UK/TSB data in annual reports
[25] In 2016, these areas were Manufacturing and materials, Infrastructure systems, Health and life sciences, Emerging and Enabling Technologies and an Open programme. This also includes funding for Catapults.

Figure 8 – Total Research Council R&D expenditure by Frascati definition 2005-2016[2627]



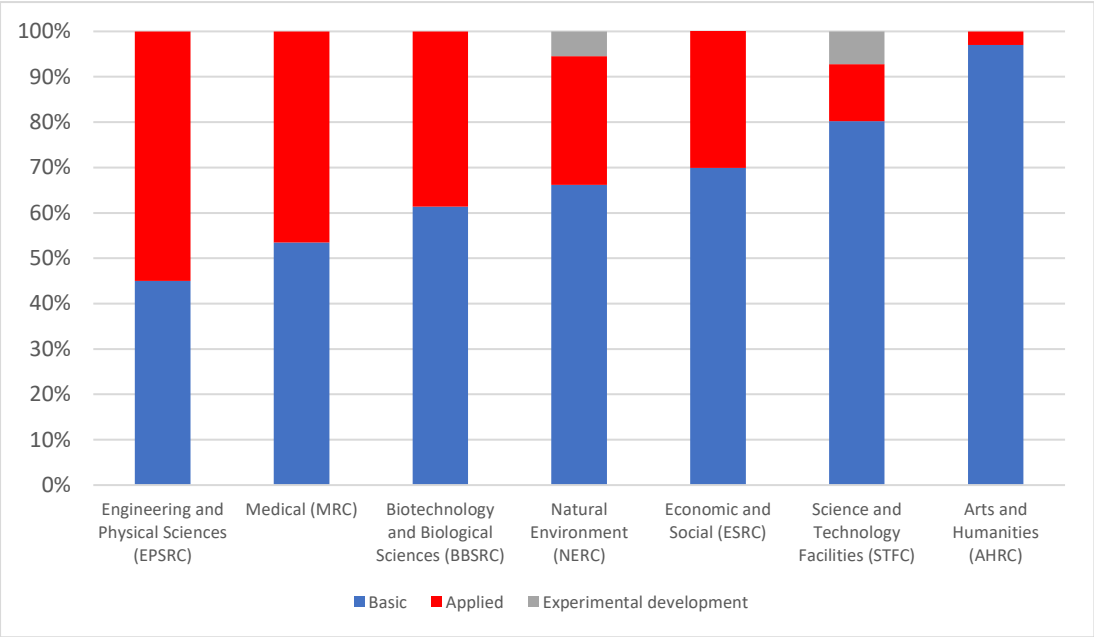
- Within Research Councils, funding for applied research has increased relative to basic research from 31% in 2005 to 37% in 2016.
- The majority of the change is due to decreases in basic research funding rather than increases in applied funding. Applied research saw a real-terms increase of £116m from 2005 to 2016, alongside a £350m reduction in funding for basic research.

Figure 9 - Research Councils' R&D funding by Frascati definition 2016[28]

[26] UK Government expenditure on science engineering and technology 2016, ONS, 2018

[27] Frascati Definitions are internationally recognised by the OECD from its Frascati Manual, Sixth edition, 2012. Definitions of each type of research are as follows: Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view; Applied research is original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective; Experimental development is systematic work, drawing on existing knowledge gained from research and/or practical experience, which is directed to producing new materials, products or devices, to installing new processes, systems and services, or to improving substantially those already produced or installed. R&D covers both formal R&D in R&D units and informal or occasional R&D in other units.

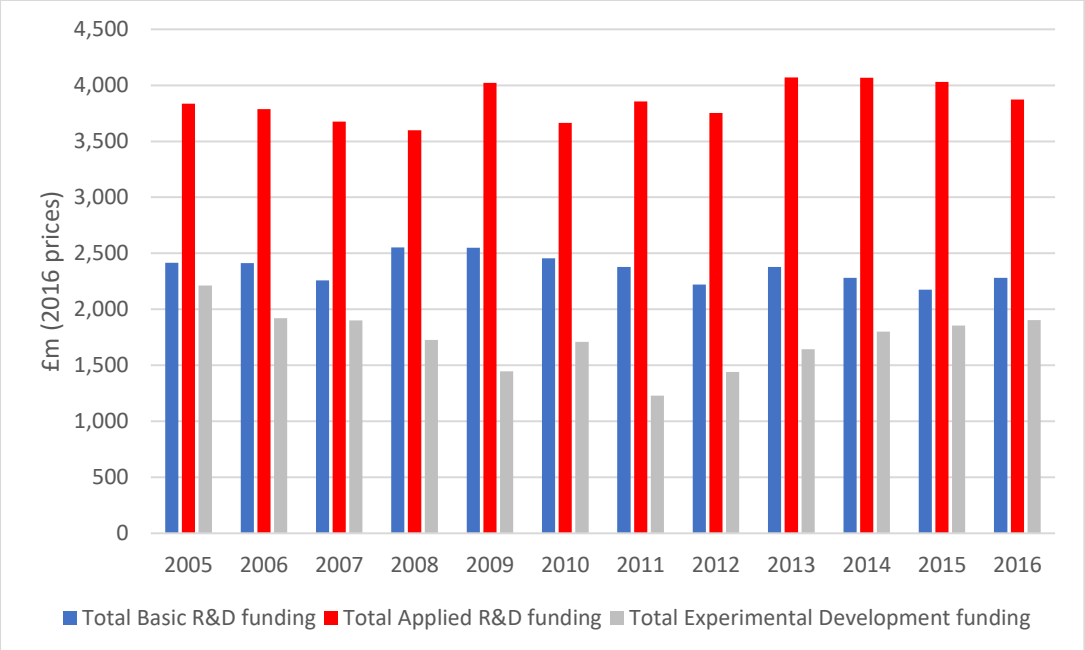
[28] Data received by CaSE from the ONS



Each research council has a different profile in terms of the proportions and spectrum of research they fund. Shifting budgets between research councils then is not necessarily simple shifting the balance between disciplines but could also impact on changes to the balance of stage of research that is supported.

The same is also true of public R&D funding across government departments.

Figure 10 – Public investment in R&D by Frascati definition[29]

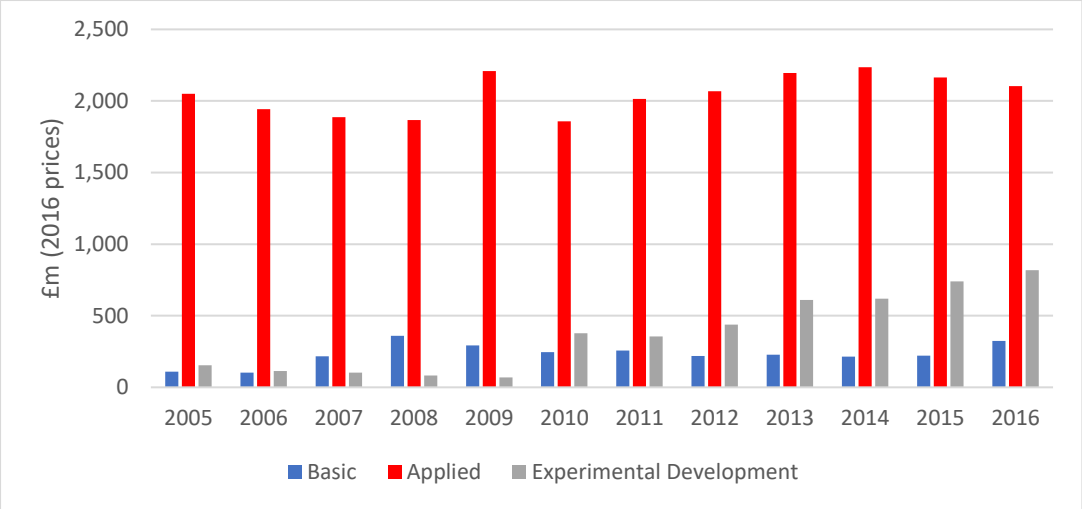


In the last decade the relative proportions have slightly shifted between basic, applied and experimental development funding. The source of experimental development funding has changed,

[29] UK Government expenditure on science engineering and technology 2016, ONS, 2018

with Figure 11 showing increases in civil experimental development funding brought in with the creation of the Technology Strategy Board/Innovate UK in 2007, alongside decreases in defence development spending show in Figure 12.

Figure 11 – Civil departments R&D expenditure by Frascati definition[30] (excl. Research Councils)



- In contrast to Research Councils, civil departments predominantly fund applied research.
- Between 2005 and 2016, experimental development funding from civil departments increased by 428%
- Total Civil department spend on R&D increased by 40% in real terms over the same period of which 23% from was from basic research funding 6% from applied research funding and 71% from experimental development funding.
- However, excluding BEIS or BEIS predecessors[31], civil departmental R&D investment has decreased by 13% between 2005 and 2016[32].
- In 2016, BEIS funding accounted for 93% of the Civil department expenditure on experimental development[33].

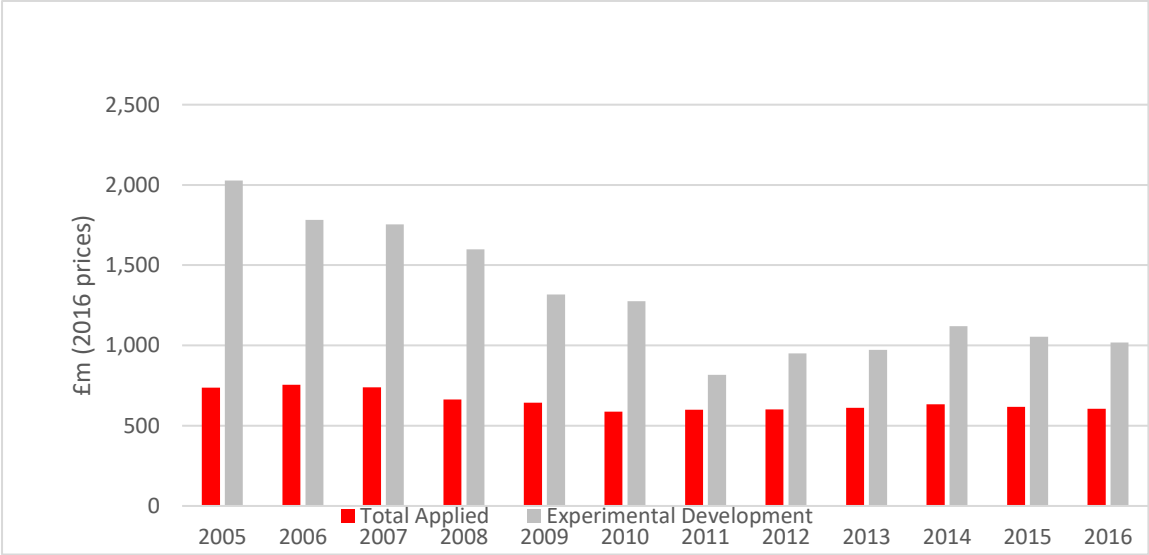
[30] UK Government expenditure on science engineering and technology 2016, ONS, 2018

[31] BEIS (previously known as BIS) was formed in 2009. Previous to this, the equivalent budgets were the Department for Trade and Industry and BIS Science. The R&D spend of these departments prior to 2009 have been used as BEIS predecessors in this instance.

[32] ONS SET 2016, 2018

[33] Ibid

Figure 12 – Ministry of Defence R&D expenditure by Frascati definition[34]



- Defence spending is different again. Applied research has stayed at similar levels with decreases in experimental development.

The varied ways in which different departments invest in R&D helps to support the wide range purposes for which Government spends public money on research and innovation. Maintaining total public R&D but shifting where and how it is delivered within government will result in funding different activities. The balance of funding across government is therefore important to consider and address as the UK makes decisions about public R&D investment to ensure we do not inadvertently lose expertise in the research base or capacity in areas vital to the UK and government activities. Equally, we would not expect all increases in R&D funding to be delivered through BEIS and through UKRI.

To support decisions relating to balance of R&D funding across departments Government should assess optimum R&D budgets in departments in line with Departmental, Industrial Strategy and Government's wider aims and research needs.

2019 Spending Review settlement needed to achieve 2.4% target

Meeting the Government's 2.4%/3.0% of GDP targets

The Government has set out its commitment to raising the R&D intensity of the UK. This could be transformational for the UK economy. So, the first question of 'balance' must be what portion of the spending is to be delivered by government and what is expected to come from other sources.

Balance of public and private contribution to total UK R&D investment

Assessing current balance of contributions is more complex than it first seems. Based on current UK and international norms[35], private, charitable and overseas investment will be expected to make up roughly two thirds of total investment, with Government funding accounting for a third. The ONS GERD statistics[36] provide a breakdown of R&D by sector funding: Research Councils, Higher

[34] UK Government expenditure on science engineering and technology 2016, ONS, 2018
[35] 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
[36] UK Government expenditure on science engineering and technology 2016, ONS, 2018

Education Funding Councils, Government, Business Enterprise, Higher Education, Private Non-Profit, Overseas. The first three are counted as 'public funding' with the rest 'private funding' of R&D.

On this basis the ratio of public to private funding of R&D in 2016 was roughly 1:3.

Sectors funding R&D in the UK[37]	Funding of R&D in 2016 (£bn)	As a % of total R&D funding (2016)
Public sources of funding		
Research Councils and HEFCs (pre-UKRI)*	5.2	16%
Other Government sources	3.5	11%
Private sources of funding		
Business	17.1	52%
Higher Education	0.4	1%
Private Non-profit	1.7	5%
Overseas	5.2	16%

* The balance of public funding is set to change from 2018, as Innovate UK moves to UKRI from inside BEIS. This means that UKRI will become responsible for delivering a larger proportion (70%) of R&D funding than the above table indicates.

Business is the largest investor in UK R&D. In 1997 business funded 50% of UK R&D. This dropped to a low of 42% but has now risen to account for 52% of R&D funding in 2016. Over that period, public funding has stagnated (until the recent injection announced in the Autumn Statement of 2016[38] and the Autumn Budget of 2017[39]) and private funding has grown, accounting for £24.4 billion of expenditure in 2016[40]. The UK is unique internationally in the scale of its research charity sector accounting for 5% of total funding.

Public investment 'crowds in' private investment

Public investment is a reliable driver of private investment in R&D. Research commissioned by CaSE found that public investment 'crowds in' private investment, attracts overseas investment, and every £1 of public investment in R&D raises private sector output by 20p each year in perpetuity[41]. Based upon the evidence presented in the report, a virtuous circle can be proposed in which additional public investment in research leads to increased private sector research, which leads to an increase in absorptive capacity of the private sector to make use of public sector research, hence amplifying economic benefit.

Frontloading of the public portion is necessary to secure the confidence of UK and foreign businesses considering their global R&D investment decisions. In terms of private sectors in 2016 the pharmaceutical industry was the largest business investor at £4.1 billion, the automotive sector was second with £3.4bn and computer programming and information service activities was third at £2.5

[37] ONS GERD 2016. Differences may occur between total percentages and the sum of their independently rounded components.
[38] Reflections on the Autumn Statement, CaSE, 2017
[39] https://www.gov.uk/government/topical-events/autumn-budget-2017
[40] UK Government expenditure on science engineering and technology 2016, ONS, 2018
[41] The Economic Significance of the UK Science Base, Haskel et al for CaSE, 2014

billion and the automotive industry was third at £2.3 billion[42]. These are global industries choosing to invest in the UK.

The UK must do more in the next five years than it has in the past to actively attract investment to counteract major risk factors and uncertainties in the external environment arising from the Brexit process. Increasing public investment is certainly not the only lever the government has to grow private investment, but it is an essential part of the package, without which the Government's 2027 and longer term targets will not be met.

Modelling R&D investment reaching 2.4% of GDP by 2027 and 3% in the long-term

The Government's commitment to growing the UK's research intensity to 2.4% of GDP by 2027 and 3% in the long term underpins the ambition of becoming the world's most innovative economy by 2030. This level of investment would be transformational for the UK. Action is needed in the upcoming Budget and Spending Review to ensure this ambition doesn't become just another unmet target. Particularly as the UK leaves the EU, actions speak louder than words and taking bold action will be essential to drive private sector confidence and investment.

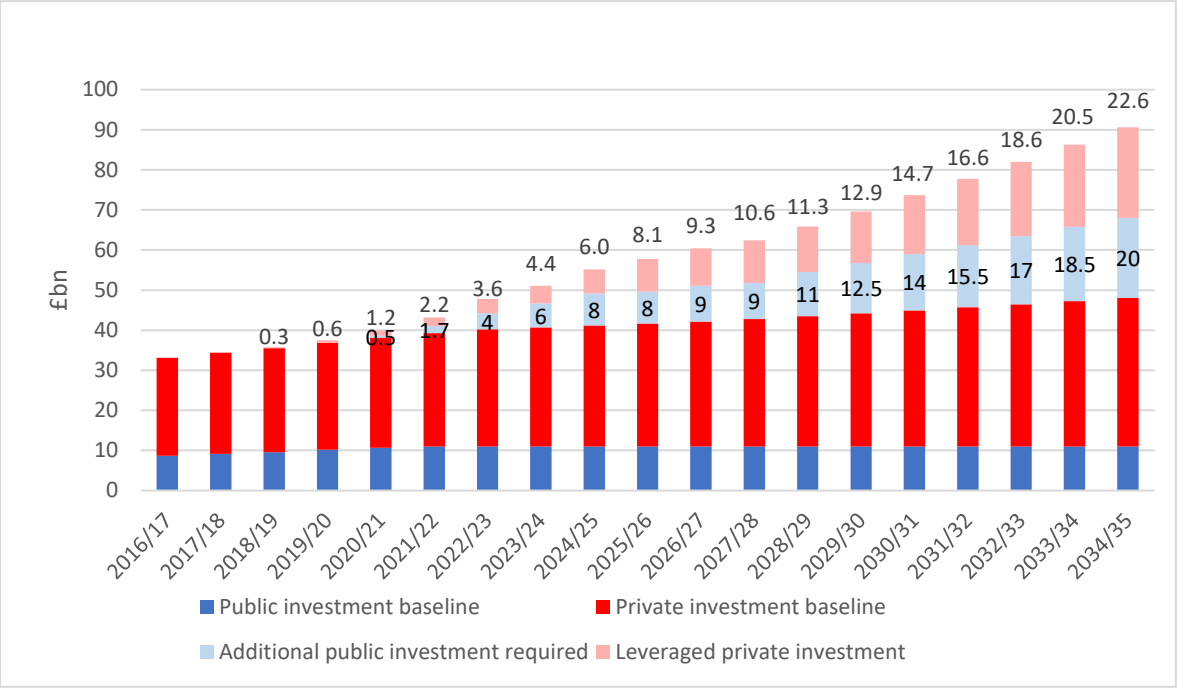
We've developed a model for public and private investment that gets the UK R&D intensity up to 2.4% by 2027 and 3% in the long term (for which we've used 2034/35). The key assumptions we've used in our model are set out below. The assumptions can be tweaked, however, investment broadly of the quantum set out below will be needed from the public and private sectors if the UK is to reap the benefits of realising the Government's ambition for R&D investment to reach 2.4% of GDP and 3% in the long term.

Model assumptions:

- Our model begins at 2016/17, using the latest year of available data on the Gross Expenditure on R&D (GERD) in the UK,[43] split into public and private spending using GERD categories. The £2.3bn announced in Autumn Budget 2017 also becomes part of the new baseline level.
- The baseline for public expenditure remains flat in cash terms and private expenditure increases in line with GDP growth, as per trends in the past decade, using OBR forecasts for GDP growth in the short[44] and medium term[45].
- The additional investment has been calculated using a leverage ratio of 1.36 over ten years for public funding leveraging private investment[46].

Figure 13 - Modelling R&D investment reaching 2.4% of GDP by 2027 and 3% in the long-term

[42] The Economic Significance of the UK Science Base, Haskel et al for CaSE, 2014
[43] UK Government expenditure on science engineering and technology 2016, ONS, 2018
[44] https://www.gov.uk/government/statistics/gdp-deflators-at-market-prices-and-money-gdp-march-2018-spring-statement
[45] http://cdn.obr.uk/FSR-July-2018-1.pdf
[46] Relationship between public and private investment in R&D, Economic Insights report for BIS, 2015



Key points:

- These increases build on funding increases already announced by Government in 2016 and 2017, and equate to an ambitious increase in public investment. Public investment must reach £20bn in 2027, and additional £9bn a year.
- Private must reach £42.4bn in 2027, an additional £9.3bn a year above the private investment baseline. Including the assumed rises in line with inflation that are reflected in the private baseline that is a total private increase of £16.7bn a year.
- This model results in a balance of public:private spending of 1:2 in 2027/28.
- The public investment portion must be frontloaded to achieve sufficient leverage of private investment to achieve the target level of 2.4% by 2027. Additional pledges of public investment are required from 2021/22, in addition to that already pledged in AS16[47] and AB17[48]. Alternatively, there would need to be larger budget increases in later years to achieve sufficient leverage of private investment to reach the target.
- UKRI and BEIS cannot deliver the public investment by itself, cross-Governmental and Devolved Administration R&D spend and levers will be crucial to reach the target.

Recommendations

On the scale of public funding needed to reach 2.4%

Set out the long-term budget for the public portion of investment up to 2027 in line with the ambition for R&D investment to reach 2.4% of GDP.

The scale of public funding increases needs to be similar to that set out in our model (reaching £20bn by 2027) to keep the 2.4% target in sight. It would fuel business confidence in the UK as an ambitious research and innovation nation at a time of major uncertainty.

[47] HMG Autumn Budget 2016
[48] HMG Autumn Budget 2017

Our members tell us that to attract the further R&D investment from companies already in the UK or to anchor the new global investment that will be needed to reach its ambitious R&D target, the UK needs to make a big statement. Even more so due to the uncertainties in the business environment resulting from Brexit. For companies that have previously chosen to invest in R&D elsewhere, a bold, long-term, concrete investment plan, could catch their attention and make the UK a candidate destination for new investment. UK targets for raising national R&D intensity have failed in the past in part due to lack of ambition and long-term commitment of public investment.

A long-term budget will crucially enable the development of a detailed strategy and delivery plan so that the funding can be spent strategically and efficiently in line with Government objectives, deriving maximum leverage and benefit across the UK. It would enable Government as a whole to consider the appropriate balance of funding (across the different measures explored in this submission and also regionally across the UK) and make transparent, evidence-based decisions about how to most effectively use public R&D investment and levers. The alternative of year on year funding announcements, particularly at the level required to meet the Government's 2.4% target by 2027, would miss out on the attracting power of bold signalling and operationally result in reduced benefit and leverage.

As UKRI has responsibility for the majority of the public research spend, clarity on UKRI strategy should then be combined with clarity on UKRI budget for the duration of the 2.4% target period, up to 2027, so that UKRI can deliver a meaningful delivery plan in line with their strategy and enabling the public's money to be spent well.

Create a vision for what reaching the 2.4% target will achieve and a roadmap for delivery with Cabinet level buy-in and accountability across Government

The success of the Industrial Strategy and of the Government's 2.4% target and associated aim of the UK being the most innovate economy in the world by 2030 depends on sustained buy-in from across disparate sectors and geographies, and indeed from across government departments and agencies. However, a year on from the publication of the Industrial Strategy, and the setting out of the 2.4% target, coordination and buy-in across Government Departments is weak. UKRI and BEIS cannot deliver this agenda alone. It will require the full weight of government pulling in the same direction both on public R&D and on leveraging private R&D investment and fostering a vibrant environment for innovation. However, our understanding is that many other spending departments do not own the 2.4% agenda. Indeed, the independent Connell Review of SBRI[49] expressed it in this way: "Spending departments and agencies regard it as BEIS's job to support business R&D, not theirs. And pressure on departmental budgets means that any spending on innovation is often focused on achieving short term imperatives. Stimulating the development of UK SME's is not a priority, even if there are potential long-term cost savings. In terms of SBRI therefore, the congruence between spending department objectives and those of the Industrial Strategy is only partial."

To date, Government has not set out a clear and compelling vision for what achieving the 2.4% target will achieve for the UK at a level that helps Departments outside BEIS, Devolved Administrations, and indeed the public, to see what's in it for them. With the latest increases in budget, UKRI is responsible for around 70% of public R&D funding. At present 30% of public R&D spend and a disproportionate amount of benefit from research and innovation fall outside UKRI and

[49] Leveraging public procurement to grow the innovation economy: an independent review of the Small Business Research Initiative (SBRI), 2017

outside BEIS. From transport and environment to health, security, education and justice, delivering the 2.4% could be transformational. And each department has a role to play in getting there by ensuring Government levers are pushing in the same direction. Many of the levers that will be needed to improve the environment and achieve the R&D target sit in other departments, including Treasury, HMRC, International Trade, Home Office, Health, DCMS amongst others. Members have raised with us their experience of government actions competing against other parts of government creating hinderances and frustrations for businesses and diminishing effectiveness of positive government policies, funding and initiatives. More than removing hinderances, to achieve the 2.4% target and to improve the UK environment, departments across government will have to proactively enact policies and use funds to support this aim if Government's ambition is to be realized. Members raised issues and proposals regarding DWP and pensions, DIT and trade missions, DfE and skills development, Home Office and migration, and procurement and innovation adoption across departments and public bodies.

A clear, shared vision must then fuel and inform the creation of a roadmap for delivery that recognizes the 2.4% target is itself an input rather than outcome measure. The Government acknowledged that the Industrial Strategy, as published, broadly lacked specific outcome measures and milestones for delivery, stating that they "will create an independent Industrial Strategy Council that will develop measures to assess and evaluate our Industrial Strategy and make recommendations to the government. The Council will have access to relevant government data and will be funded to commission specific evaluation projects as appropriate." One year on this Council has not been created and despite significant funds already having been spent, specific outcome measures and milestones are yet to be created and it is unclear where accountability for delivery sits across Government.

We understand a roadmap is under development in BEIS. This must not simply be a BEIS roadmap but must be created with buy-in and input across departments and relevant external stakeholders with targets, measurements, clear accountability, monitoring of progress, and robust evaluation built in from the start. The targets and measures of success should be ambitious and long-term with ownership by the relevant departments at Cabinet level. This will help build, support and drive coordinated effort towards defined aims. Monitoring progress against milestones will enable learning to be fed back to sharpen ongoing policies and programmes. This will help government to track progress and take early steps to change course, scale up support, and to demonstrate progress in light of rigorous evaluation, sharpening the roadmap and ensuring public funds are being responsibly and effectively used.

Any measures or targets should be made carefully to mitigate against driving unhelpful behaviour by measuring an imperfect proxy or by having competing priorities across and within Departments. On this basis, existing targets and performance measures contained in other government strategies such as clean energy, clean air, infrastructure, international development, defence, transport, pensions, digital, should be reviewed across government to ensure they support activity in line with growing the research intensity of the UK economy. Key to success will be having clear ownership and accountability for delivery. History suggests this should be at Cabinet level so that there is support and drive for delivery from the top down and potential competing priorities within departments can be resolved. Some initial suggestions for specific measures drawn from our consultation with members are set out below:

Measure	**Accountability**
A target for inward investment in R&D	Secretary of State for International Trade

A target for productivity growth within each sector with a sector deal	Secretary of State for Business, Energy and Industrial Strategy
A target for the percentage of public procurement from SMEs and start-ups	Each Department (see recommendation below on implementing Connell Review of SBRI)
A target for the number of apprenticeships that will be at level 4 and above, perhaps with a focus on science, technology and engineering	Secretary of State for Education
A target for increasing international student numbers, for instance to maintain a certain percentage of market share	Secretary of State for Education and Home Secretary

On levers to increase private investment to reach 2.4%

Create a digital 'shop window' for UK innovation support to boost effectiveness of research and innovation funding and support

An overarching theme of two roundtables CaSE conducted with small fast-growing companies, large prime companies and other investors or funders of innovation was that there is a lot of good innovation support, infrastructure and incentives in the UK, but the UK does not effectively showcase or communicate the UK offer domestically or internationally. There are a plethora of government websites and portals on different types of support but there was the distinct view that the whole was less than the sum of its parts. CaSE has collated a list[50] of nearly 30 Government backed sites or web pages detailing innovation support. Not all of them are easy to find, they don't all link to each other and none sets out the full picture of funding and support available. This is a missed opportunity. The combination of the Government's ambitions to make the UK the world's most innovative economy and the best place to start and grow a business alongside growing the research intensity of the UK will require significant coordination.

We propose that Government create a digital 'shop window' that showcases in one place the many different incentives, funding, and initiatives for UK research and innovation support, providing sufficient resource for it to be maintained. This one link could then be easily shared to direct people to the array of support available. This is not just a communications challenge, but also should spur functional improvement and join up across different parts of national and local government systems, messages, portals and opportunities. This could be an opportunity to use SBRI to procure an innovative to the solution to the challenge.

This would be part of a wider programme of work to clarify and effectively communicate the UK offer at a top level, using differentiated and targeted communications to reach key audiences, and would be a crucial first step towards the ideal of a 'one stop shop' 'no wrong door' offer for entrepreneurs, investors, businesses looking to start or grow R&D activity in the UK.

Implement the recommendations from the Connell Review of SBRI commissioned by Government to maximise its potential

[50] http://www.sciencecampaign.org.uk/news-media/case-comment/government-support-for-research-and-innovation.html

Procurement is a significant lever government holds at national and local levels to contribute to delivering the 2.4% target that brings benefits to public service delivery, public budgets and private sector innovation environment. As set out in the Connell Review, changes need to be introduced to deliver on SBRI's full potential to boost the UK's innovative capability, support the development and commercialisation of more new technology-based products and services, and give more innovators their "first break" and a route to market.

Allocate sufficient resource within government to administer R&D tax credits, EIS, SEIS and other incentives so they can be most effective

The uptake of R&D tax credits has increased over the last decade with successful claims rising from £970m in 2009/10 to £2.6bn in 2015/16. The £2.6bn in 2015/16 was claimed against £22.9bn of R&D in the UK and the growth in claims has been predominantly driven by large increases in uptake by SMEs[51] in line with Government aims. Administration of this and other schemes such as EIS and SEIS must be allocated sufficient funding to ensure the volume of applications for such schemes can be processed with appropriate support to companies to remove functional disincentives.

Review and update definition of eligible activity for R&D tax credit to more effectively capture and incentivize R&D.

Amongst our members there is also wide agreement that the definition of R&D for the purposes of tax credits needs updating to reflect current and future direction of R&D undertaken by businesses as it is currently too focused on physical products. Suggestions included purchase of data for research purposes and digital infrastructure to support R&D within the definition, as some other countries have done already.

Following a positive pilot, and subject to evaluation, introduce Innovate UK loans to fill the gap in innovation support alongside continuing grant funding.

There was a strong reaction amongst our members against converting grants to loans as there was the view that they supported and incentivized very different activity at different business stages. However, there was praise for the pilot of new loan instruments that are being carefully designed to work in addition to grants in the Innovate UK portfolio. The view was these could fill another support gap in the landscape alongside equity in the lending market.

Carefully monitor success rates of flexible funds in UKRI to ensure there is sufficient funding to not only fund 'safe bets' but also take appropriate risk to support and drive research and innovation.

BBSRC was the only council for which we could find success rates for projects deemed fundable by assessors for their responsive mode grants[52].

BBSRC responsive mode grants	**2016**	**2017**
Projects funded	291	311
Projects deemed fundable that didn't get funding	1025	888
% of eligible projects funded	22%	26%
Average grant size	£426k	£448k
Total BBSRC research funding	£417m	£446m
Responsive mode total (%of BBSRC research total)	£124m (30%)	£139m (31%)

51 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/644599/2017_RD_publication_commentary_final.pdf

52 https://bbsrc.ukri.org/funding/post-application/awarded-grants/

This measure should be recorded consistently and carefully monitored across the breadth of UKRI activities, and responsive mode funding in particular, to inform decisions about where there is capacity for growth and decisions to take about what the optimum level of funding should be.

For instance, looking at BBSRC responsive mode grants, if all of the applications deemed fundable were funded in 2017, the funding pot would have needed to be £537m (assuming the average grant size remained the same). In other words, greater than the total BBSRC research budget. The current situation suggests the size of responsive mode pots are not optimized but are a construct of historical levels in a confined budget.

Following a positive pilot, and subject to evaluation, increase the scale of the Innovate UK investment accelerator and increase the number of funds involved.

The investment accelerator pilot was viewed as successful and a good way of speeding up the route to private and follow on investment effectively leveraging wider investment.

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 thrive. We represent over 110 scientific organisations including businesses, universities, professional bodies, and research charities as well as individual scientists and engineers. Collectively our members employ 380,000 people in the UK, and our industry and charity members invest around £43bn a year globally in R&D.