

## Engagement on government commitment to boost R&D spending to 2.4% GDP

On 20 November 2017 the Prime Minister announced the Government's commitment to working with industry to increase the UK's R&D spend to 2.4% of GDP by 2027. This announcement built on the Government's £4.7 billion commitment announced in the 2016 Autumn Statement to capitalise on the UK's status as a world leader in research and development. Reaching this target could increase public and private R&D investment by as much as £80 billion over the next 10 years. Government will start by making an extra investment of £2.3 billion in 2021-22, raising total public investment in R&D to £12.5 billion that year alone.

On behalf of the UKRI Strategy team EPSRC would like to engage with our partner organisations in order to better understand what might be needed in order to achieve the 2.4% GDP target for R&D spend by 2027.

Responses should be sent to [Universityinterface@epsrc.ukri.org](mailto:Universityinterface@epsrc.ukri.org) by **16.00 on Thursday 23 August**, only **one response should be submitted per organisation**.

<b>Organisation name:</b>	UCL
<b>Response submitted by:</b>	Dr Matthew Davis, Director of Research Coordination & Planning – BEAMS, Office of the Vice-Provost (Research)

### 1. What more can UKRI do to maximise the impact of our world leading research base?

We believe it is important for UKRI to:

- advocate an uplift in support for more fundamental and blue-skies research;
- continue to foster closer forms of interdisciplinary research;
- continue to evidence and promote the value of the UK research base;
- advocate the role of the mission-based approach to tackling the world's challenges;
- advocate the UK's continued involvement in international collaborations.

We note that major challenges – social, economic, technological, environmental – do not generally respect disciplinary or sector silos. As such, investment in research that crosses traditional boundaries is more likely to generate impact. New technologies pose environmental, legal, socio-cultural,

and ethical questions, which concern potential users and consumers as well as regulators, and which need to be addressed to make innovation possible and impactful. Therefore, **there continues to be a need to foster closer forms of interdisciplinary research**, which include social scientists as well as natural scientists and engineers. We welcome programmes at the cross-Council and UKRI level, such as the Global Challenges Research Fund (GCRF) and Industrial Strategy Challenge Fund (ISCF), which support this.

We also would note that companies and potential users do not always understand the value of the world-leading knowledge that UK universities and the research-base generates. **Work continues to be needed** – by UKRI and Government, working with universities – **to evidence and promote the value of the UK research-base**, for example, through case studies of successful knowledge exchange and impact. Training of future industrial leaders who understand the value of knowledge, as well as the importance of non-technological (legal, ethical, environmental) aspects of innovation, is also vital.

In order to maximise the impact of our research base, we believe new approaches are also needed at a national level. We **advocate the role of the mission-based approach** (Mazzucato 2018), as developed and championed by Professor Mariana Mazzucato, Director of UCL's Institute for Innovation & Public Purpose (IIPP) and co-chair, with Lord Willetts, of the UCL Commission on Mission-Oriented Innovation & Industrial Strategy (MOIIS). We believe the best way to leverage the UK's research excellence and solve the "wicked" problems that face us today – such as climate change and plastic waste pollution – is through missions that inspire and mobilise the widest set of actors and stakeholders, including universities, funders, policy makers and industry. We believe such missions should be clearly articulated, with measureable targets. By harnessing the directionality of innovation, missions can harness the power of research and innovation to achieve wider social and policy impact as well as meet economic goals. By setting a mission that inspires people around a societal problem, they can provide top-down leadership, at the same time supporting bottom-up innovation by initiating cross-disciplinary projects across related sectors.

We would stress that, in striving for impact, it is also **vital to maintain the UK's world-leading research base**. The UK's research leadership has been built on excellent people and institutions, as well as funding mechanisms that are focussed on excellence irrespective of where it is found, and which provide a careful balance between discovery-led/blue skies and challenge-led/applied research. As we note in our answers to Questions 5 and 6, our world-leading research base – in particular our reputation for fundamental discovery – is a key attractor for both national and overseas commercial investment in R&D. Therefore, although we welcome the implementation of challenge-led programmes at a UKRI level, including ISCF and GCRF, we believe **a proportionate uplift in support for more fundamental and blue-skies research is vital** to ensure a balanced national portfolio. Here, we would

express concern about apparently declining success rates within, for example, the EPSRC Research Base Themes, dropping to as low as 13% in spring 2018. In doing so, work is needed by UKRI and the Research Councils to better articulate the value of – and advocate for – responsive-mode as a vital funding mechanism to Government. This might, for example, include finding new and better terminology to refer to it. We also express concern about the potential loss of access to funding from the European Research Council (ERC), which currently provides a major pillar of support for world-class researchers working across the physical and natural sciences.

The UK plays an active and increasing role in international R&D collaborations, an activity that is associated with increased citation impact (BEIS, Elsevier 2017). It will also be vital for **UKRI to advocate continued involvement in international collaborations**, in particular post-Brexit, in order to maximise the UK's R&D impact and its international standing in research.

*M. Mazzucato (2018), "Mission-oriented research & innovation in the European Union: A problem-solving approach to fuel innovation-led growth", February 2018, European Commission*

*Department for Business, Energy and Industrial Strategy & Elsevier (2017), "International Comparative Performance of the UK Research Base 2016"*

## **2. What's the best way to support and grow emerging technologies and industries?**

In supporting innovation and growth of emerging industries, we believe it is important to **think beyond technologies**, and also to consider the **important role of new and improved services**. We see a number of ways to support the growth of emerging technology and service sectors:

- First of all, as discussed in our response to Question 1, UKRI can accelerate innovation by **supporting research that**, from an early stage, **combines engineering and physical sciences with research tackling social, cultural, environment, ethical and legal aspects** of new and emerging technologies such as Artificial Intelligence (AI) and Big Data.
- Second, we support a **re-evaluation of IP** and its role in innovation. In the context of growing research strengths in countries around the world, including the developing world, generators of knowledge retain an early advantage in being best placed to exploit that knowledge. To do so, such nations must remain agile, dynamic and fast to adapt. We believe efforts in open science and open data can support this.
- Thirdly, to support this agility and the exchange of knowledge, we welcome interventions to encourage and **facilitate mobility of people between universities and industry**, and address the barriers to mobility (for example, related to career progression, salary and pensions).
- Fourthly, as discussed further in Question 3, we see the value of, and

welcome support for, **regional innovation clusters** that bring together local universities, industry and government as a focal point for innovation and regional economic growth.

### **3. What's the best way to support high-potential regions, cities and clusters in the UK to do more R&D and grow their local strengths, without undermining the principle of funding excellence?**

We advocate the following:

- Supporting regional innovation clusters centred on collaborations between local universities and industry, where they are built on research excellence;
- Post-Brexit, the introduction of regional funding schemes that promote local innovation and growth;
- Investment in regions in such a way that provides a national, as well as local, benefit;
- Larger-scale national initiatives that coordinate, bring together, and provide a focus for national research strengths;
- Further support from UKRI for research to inform policy on the geography of innovation.

We see value in **regional innovation clusters centred on collaborations between local universities and industry**, which build on national and global research leadership, and which, through engagement with local leadership (e.g. local authorities), align to local economic growth plans and priorities (e.g. science & innovation audits). **Post-Brexit**, we see the need for **regional funding schemes that promote local innovation and growth**, and which replace for example the European Regional Development Fund (ERDF). However, we believe that **such funding should focus primarily on excellence**, without undermining the principles that have allowed the UK's research base to become world-leading. Successful regions should demonstrate a foundation of research excellence, benchmarked within a national or international context, even in schemes where a regional dimension for importance and impact is introduced. In such interventions, we also warn against too narrow, specific or arbitrary definitions of "local", especially given the UK's relatively compact geography.

In general, we believe that **any such investment should show a national, as well as local, benefit**. UCL is committed to working in partnership with excellent researchers that complement our strength wherever they are, nationally and internationally. We can therefore see opportunities to promote collaborations between larger, more research-intensive universities, and smaller, less research-intensive institutions in other regions. As well as local and regional structures, we also **advocate larger-scale national initiatives that coordinate, bring together, and provide a focus for national research strengths**, such as the UK Collaboratorium for Research in Infrastructure & Cities (UKCRIC).

Finally, we would note that **research to inform policy on the geography of innovation** has been poorly supported by UK Research Councils in recent years. We believe **UKRI should further support appropriate research** in science and technology policy, economic geography and sociology, and the economics of innovation, to better inform research policies focussed on region.

#### **4. What would it take to encourage low-R&D intensive sectors to invest more in R&D?**

We would encourage the following:

- Supporting companies/industries with little historic focus on R&D to invest in R&D, as part of the plan to meet the 2.4% R&D spend target;
- Consulting relevant businesses to identify barriers to investment in R&D, and address regulatory disincentives;
- Provision of evidence (by UKRI and Government) of the value of knowledge generation through R&D, to companies and investors
- Increasing funding for technology demonstrators;
- Focussing investments on smaller companies sitting within larger supply chains;
- Partnership processes that support more proactive procurement by large companies of innovation from SMEs;
- A cross-sectoral and mission-based approach to increasing R&D investment.

We note research that highlights **differences in R&D investment at a sector level** (e.g. Mazzucato & Lazonick 2010). While some industries (e.g. pharma) are R&D focused, others are decreasingly so, and there remains a long tail of smaller companies that invest little or not at all in R&D. Rebalancing the economy, and meeting the 2.4% GDP target for national R&D investment, will entail some focus on this tail (Reid 2018) – although this should not be at the expense of those already successfully investing in R&D.

Clearly, it is important to **ask the relevant businesses what the barriers are to investment in R&D**, and there is an on-going need to **address regulatory disincentives** and to look at fiscal (e.g. tax) incentives. Building on our answer to Question 2, we believe that work is needed – by UKRI and Government, working with universities – to **evidence to these companies the value of knowledge generation through R&D**, and to give confidence to both public and private investors in research. This can be done, for example, through case studies of successful knowledge exchange and impact, and through analyses that demonstrate successful returns on investment. We also see the benefit of **increased funding for technology demonstrators**.

In general, we support the range of instruments already in place to encourage co-investment in collaborative R&D (e.g. KTPs, CASE studentships), including those focussed on small to medium sized enterprises. We see the value of **focussing investments on smaller companies sitting within larger supply chains**, such has been done by the Faraday Challenge in the batteries

and automotive sector, where greater R&D intensity can bring market gains. We also see the value of **partnership processes that support more proactive procurement by large companies of innovation from SMEs**. We note here the piloting work of, e.g., Network Rail and the Transport Systems Catapult.

We also note some **caution about any focus on particular sectors**, given growing problems around classification, and the potential to implement artificial barriers to impact. Many traditional sector classifications are starting to become obsolete, for example, with the notable example of Google moving into the automotive industry. The major challenges affecting the UK, including those highlighted within the Industry Strategy, can only be tackled with a **cross-sectoral approach**. Referring to our answer to Question 1, we champion the **mission-based approach** to innovation and impact, including as a way to inspire and engage smaller, less R&D intensive organisations.

*M. Mazzucato and W. Lazonick (2010), "The limits to the 3% R&D target in Europe 2020: the roles of institutions, industries, and business- government complementarities in achieving equitable and stable growth" (Position Paper), May 2010, FINNOV Consortium [https://www.finnov-fp7.eu/publications/related-publications/finnovpositionpapermay2010.html]*

*G. Reid (2018), "The government has promised more R&D. Where will the money come from?", The Guardian, 4 Jan 2018 [https://www.theguardian.com/science/political-science/2018/jan/04/the-government-has-promised-more-rd-where-will-the-money-come-from]*

## **5. What would it take to support leading R&D-intensive sectors to invest even more?**

We advocate:

- Consulting relevant businesses to identify barriers to investment in R&D, and address regulatory disincentives;
- Visa policy that supports the mobility of overseas researchers and scientists, in particular post-Brexit;
- Setting missions to provide stability for the sector and support the crowding in of private funding as a consequence of Government investment;
- A review of the regulations and fiscal incentives around charitable donations, in order to support the role of philanthropic giving in meeting the 2.4% GDP target.

Clearly it is important to **ask these businesses themselves what the barriers are to investment in R&D**, and there is an on-going need to address regulatory disincentives and to look at fiscal (e.g. tax) incentives. Maintaining investment of these companies in the UK, rather than elsewhere, will require a **supportive regulatory environment**, and a supply of highly trained scientists and researchers. As well as UKRI investments in research training, the latter will need to be supported by **favourable visa rules** for

overseas researchers and scientists, in particular post-Brexit.

Business investment in R&D can be hampered by political and policy instability, with changes in funding structures and incentives creating an unstable business environment. By **setting missions** (Mazzucato 2018), the Government can demonstrate a clear commitment to addressing a major socio-economic challenge, and incrementally develop policy interventions to address this challenge and provide a level of stability to the sector. Furthermore, moving from an environment where governments simply de-risk or remedy market failures, to one where the public sector co-creates markets with a range of different actors, will mean that **Government investment can create further “crowding-in” of private funding**. Missions can provide this degree of additionality, with public investment driving, rather than replacing, business investment in innovation.

Finally, we see a **growing role for philanthropic giving in meeting the 2.4% GDP target, both corporate and private**. We would suggest a **review of the regulations and fiscal incentives around charitable donations**, to ensure that it is attractive as it can be for large firms to donate philanthropically to universities and other research organisations.

*M. Mazzucato (2018), "Mission-oriented research & innovation in the European Union: A problem-solving approach to fuel innovation-led growth", February 2018, European Commission*

## **6. How do we attract overseas firms to locate more R&D activity in the UK?**

First of all, we believe it is essential to maintain the UK's world-leading research base, where our track record in discovery-led research serves as a magnet for corporate R&D investment from overseas. As discussed in our answer to Question 1, as well as new investments in challenge-led research, this will require **a growth in funding for fundamental, blue skies and responsive-mode research**, where support has dropped in real terms over recent years. We also point strongly to the international reputation of universities and R&D intensive firms in London and the South East as a key attractor of overseas investment. Relating to Question 5 above, we see **a role for universities working with local industry and government to build innovation clusters in key regions**, focussed on the excellence of their research base, and further raise the profile of those clusters to support inward investment.

As per our response to Question 5, overseas investment in R&D will only happen where there is a requisite supply of highly trained scientists and researchers. As well as UKRI investments in research training, the latter will need to be supported by **favourable visa rules** for overseas researchers and scientists, in particular post-Brexit.

In marketing UK's research strengths overseas, beyond existing mechanisms such as trade missions and Science & Innovation Networks (SINs), we also suggest **investment in physical infrastructure overseas, supporting an international presence for UK universities and firms** in key regions (e.g. North America, China). We point, for example, to the example of Innovation Centre Denmark in Silicon Valley (<http://www.icdk.us/>), which serves as a short-term base for Scandinavian firms and research institutions.

## **7. What talent and skills mix will be required over the next 10 years to reach 2.4% of GDP R&D investment in the UK?**

We advocate:

- Greater support from UKRI for postgraduate research training;
- Supporting the development of researchers with an interdisciplinary skillset, as well as collaboration between disciplines;
- The development of novel, non-linear and less study-intensive pathways to support re-education of employees;
- The development of new skills in the public sector, including the ability to manage complex networks.

Clearly, growth in R&D investment will require a proportionate increase in the availability of skilled people. At the high end, technological skills will need to be delivered through research-led education, with **greater support from UKRI for postgraduate research (PGR) training** in key areas (e.g. green materials, sustainable transport, AI). Referring back to our answer to Question 2, we stress again the **need for people with an interdisciplinary skillset**, as well as a pipeline of researchers outside of the sciences and engineering, including researchers in regulatory science and ethics, who are able to tackle the wider challenges of new technologies. Successful and accelerated innovation will require technology leaders who can combine technical skills together with an understanding of the social, cultural, environment, ethical and legal aspects of new and emerging technologies. We would also welcome a review of funding models for research staff looking at ways to **provide longer term support and stability**, to enable better retention of key skills and to allow researchers to tackle larger challenges than can be tackled on shorter term projects and contracts.

To support the growth of commercial R&D required by the 2.4% GDP target, new skills will be required at all levels, including among existing employees. **Professional re-education of the future will need to be built around novel non-linear and less study-intensive pathways.** We note the importance of universities innovating in the delivery of life long learning, including "slow-speed" degree programmes (e.g. MSc programmes taken over 4 or more years) as well as credit-bearing, workplace friendly CPD courses that can build gradually into full qualifications. We note, for example, here the work of UCL's Centre for Engineering Education – joint between the Faculty of Engineering Sciences and the UCL Institute of Education – which, through world-leading research and teaching, is championing new approaches to the



provision of engineering skills. As well as supporting developments in primary and secondary engineering education, the Centre is also looking at how to create better vocational (FE and apprenticeship) and HE routes into engineering, as well as working with companies to address their changing skill needs. Further research funding is required to support this, as well as similar academic centres, to ensure provision of scientific and technological skills in the UK remains world-class.

Finally, **new skills will also be required in the public sector**. One of the key capabilities required by Government and policy makers to manage a missions-based approach to innovation is **ability to manage complex networks**. Missions (Mazzucato 2018) create cross-disciplinary, multi-actor networks to solve societal issues through a diverse range of policy actions. This will require different structures to the ways we currently manage innovation, and managers will have to acknowledge the tension between top-down direction setting and bottom-up explorative approaches. Similarly, a missions-based approach may require a more accepting attitude to risk and project failure than currently exists in the administration of research projects.

*M. Mazzucato (2018), "Mission-oriented research & innovation in the European Union: A problem-solving approach to fuel innovation-led growth", February 2018, European Commission*